6th Annual Meeting of the

# European Society for the study of Human Evolution

14-17 September 2016
**MADRID** / SPAIN

ESHE

# Journal of Human Evolution

ELSEVIER




The *Journal of Human Evolution* concentrates on publishing the highest quality papers covering all aspects of human evolution. The central focus is aimed jointly at palaeoanthropological work, covering human and primate fossils, and at comparative studies of living species, including both morphological and molecular evidence. These include descriptions of new discoveries, interpretative analyses of new and previously described material, and assessments of the phylogeny and palaeobiology of primate species.

**2015 Impact Factor***

**3.767**

*Journal Citation Reports published by Thomson Reuters 2016

**Supports Open Access**

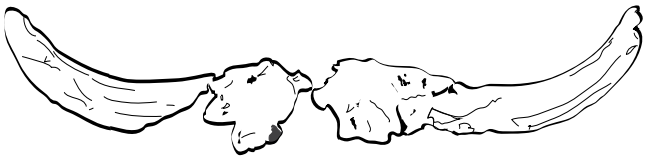
To submit your paper online and for more information, visit:
**elsevier.com/locate/jhevol**

**European Society for the study of Human Evolution**

ESHE

6th Annual Meeting

Madrid, Spain 14 -17 September, 2016



Proceedings of the European Society for the study of Human Evolution 5

Cover image: Bison Horns courtesy of the Museo Arqueológico Regional
Proceedings of the European Society for the study of Human Evolution Vol. 5
Citation: PESHE 5, 2016


PESHE 5 compiled and designed by Mikaela Lui

ISSN 2195-0776 (Print)
ISSN 2195-0784 (Online)

Dear Participants of the 6th Annual meeting of the *European Society for the study of Human Evolution,*

¡Bienvenido a Madrid!

We are delighted to welcome you to the historical city of Alcalá de Henares in the Community of Madrid. Spain has made a tremendous contribution to European palaeoanthropology, beginning with precursors such as Casiano de Prado in the 1860's. It is also the place where palaeolithic rock art was first recognised in 1879, when the nine year old daughter of Marcelino Sanz de Sautuloa cried out *"¡Mira papá, bueyes!" ("look papa, bulls!")* in the Altamira Cave. This discovery was followed by intense debate within the entire European archaeological community, ending only with the memorable *mea culpa* by Émile Cartailhac in 1902. Since then, Spain has continued to be the focus of attention for many prehistorians, most notably including early famous figures, such as Henri Breuil and Hugo Obermaier. In recent decades, Spanish palaeoanthropology has witnessed spectacular development, boosted by the extraordinary discoveries in the Atapuerca area and the pioneering work of Emiliano Aguirre. This has given birth to a new generation of young, prolific researchers.

As we open the 6th Annual ESHE meeting, we celebrate the ongoing success of the society, which I am honoured to have been a part of since its conception. This year, we accepted more abstracts than ever before, and as of August, have over 525 members. The success of the society means that each year we are able to present to you even more exciting and ground-breaking research, which shapes our knowledge of our remote past to help us better understand our present and prepare for the future. Thanks to the kind support of the Museo Arqueológico Regional, we have not only been able to host our conference in a stunning location, but also host special guest Fernando Colmenares as our keynote speaker, as well as visit the rich and historical site of Pinilla del Valle.

As in previous years, we are able to encourage and support our student members to attend and participate in the conferences by providing travel grants to those presenting at this year's meeting. In addition to our yearly student poster prize, we are also able to introduce a Pecha Kucha Prize this year for students thanks to the kind donation by the Journal of Human Evolution, who will also host a workshop over the weekend to help young researchers get their work published.

This meeting would not be possible without the hard work of our local organisers in Madrid. I would firstly like to thank Juan Luis Arsuaga and Enrique Baquedano, director of the Museo Arqueológico, for scouting and providing us with this amazing venue. I would also like to give special thanks to their teams, Belén Marquez Mora and Bárbara Rodriguez Alvarez for taking care of local organisation and making this entire conference possible.

The 6th Annual ESHE meeting is sponsored by the Museo Arqueológico Regional, the Journal of Human Evolution ,Aicon 3D Systems and Nature Ecology and Evolution.

The organisation of this meeting and the preparation of the abstract volume was diligently undertaken by the tireless work of Mikaela Lui and our ESHE Board Members, in particular Phillipp Gunz, Shannon McPherron, Marie Soressi and Thomas Terberger.

We thank you for taking part in making this year's ESHE meeting a success, and we look forward to seeing you all at the 7th Annual meeting in Leiden in the Netherlands in 2017.

With best wishes,

Jean-Jacques Hublin
President, European Society for the study of Human Evolution.

**Board Officers**

Jean-Jacques Hublin, *President*
Wil Roebroeks, *Vice President*
Thomas Terberger, *Teasurer*
Marie Soressi, *Secretary*
Shannon McPherron, *Adjunct Secretary*

**Regular Board Members**

Sabine Gaudzinski
Philipp Gunz
Katerina Harvati
Michelle Langley
Karen Ruebens
Geoff Smith
Gerhard Weber

**Local Organisers**

Juan Luis Arsuaga
Enrique Baquedano
Belén Márquez Mora
Bárbara Rodríguez Álvarez

**Sponsors**

Museo Arqueológico Regional
Journal of Human Evolution / Elsevier
AICON 3D Systems GmbH
Nature Ecology and Evolution

MUSEO ARQUEOLÓGICO REGIONAL

**The Regional Archaeological Museum (M.A.R)** is located in the former Convent de la Madre de Dios, founded in 1624. Construction began after Doña María de Mendoza stated in her will in 1565 her desire to found a Dominican monastery using houses belonging to her in the urban centre of Alcalá de Henares. This act marked the beginning of the building's rich history. Some of the paintings that decorated it are still visible in the church nave, many alluding to the Dominican order.

The building was used as a convent until 2 December 1808, when it was emptied and converted into a barracks for French troops. Many speculate it was then that the high altar in the church was destroyed and many valuable objects were plundered. Although the monks were able to return in 1815, in 1835 the convent was confiscated once again and became the property of the municipality, which converted it into a prison that was used until 1951. In the meantime, the church had also been occupied by the local government, when the façade on Bernardas Square was moved to Santiago Street. In this time, much work was done to modify the structure of the building.

In 1985, following transfer of the various services to other sites, the authorities decided to use the former convent, by then seriously deteriorated, as the headquarters for the Regional Archaeological Museum. Restoration began on the building, located in a privileged position in the World Heritage listed city centre of Alcalá de Henares, in 1987 and the building, on which was re-opened in 1999, after its establishment as an Archaeological Museum by Decree in 1997.

This Institute seeks to present the archaeological finds of the Communidad de Madrid as elements belonging to precise historical contexts that underpin our interpretation and understanding of them. The M.A.R. shows its visitors archaeological remains with the aid of attractive exhibition resources which help in an understanding of their functions as part of the historical moment to which they belong.

# The Museum Collection

The permanent exhibition is designed to explain the historic journey of the Comunidad de Madrid by showcasing every day elements, such as habitat, settlement and housing to track the development of every-day life throughout the course of history.

The exhibition is designed around 9 thematic units. Spread over the Museum´s two levels. After an introduction, the exhibition begins with Unit 2, which provides a glimpse into the Madrid region prior to the arrival of humans. This section gives us an understanding of how the familiar landscape of the Madrid region was formed. Unit 3 introduces us to the first people to inhabit Madrid, their physical characteristics and way of life. This section is based on studies of the emblematic site at Áridos. The transformation of these groups of hunter-gatherers into sedentary producers is explained in Unit 4. Unit 5 then reveals the changes these indigenous groups underwent following the arrival of the Romans and the flourishing of the villas and the cities.

On the upper level, Unit 6 brings us gradually into medieval Madrid, showing the collapse of the previous system following the fall of Rome and the adoption of the feudal order. The arrival of modern society came with the move of the Court to Madrid in the sixteenth century. This also signified the entry of Counter-Reformation ideas into the region and profound changes in the organization and physiognomy of the municipalities.

In Unit 8 visitors see how history is reconstructed through archaeological remains. Here the visitor can use the interactive facilities to become an archaeologist and see what happened in the past. This trip through the history of the Madrid region ends with a visit to the Garden of Antiquities in Unit 9. The entire permanent collection will be available to view throughout the entire conference.

The M.A.R. further fosters public knowledge of the region's rich history through its many carefully curated temporary exhibitions. In these exhibitions, the museum seeks to look into particularly moments and figures of Madrid's history in great detail. The most recent exhibition, The Scipios and the Roman Conquest of Hispania, which ended in September 2016 looked at the journey of the noble military family and their conquest of Spain in the context of the 2nd Punic War. The exhibition included over 2000 pieces from over 30 institutions across Spain and Italy to piece together this chapter of history.

Keynote Speech: Wednesday, 14th September, 19:30-20:30, *Museo Arqueológico Regional*

**Professor Fernando Colmenares**: Human sociality and prosociality in evolutionary context: Of ladders, trees, anthropomorphism, anthropocentrism and evolutionary theory

Human sociality (group-level social bonding) and prosociality (spontaneous and enforced cooperation) have been selected for its fitness-enhancing effects and have themselves selected for the suite of genetic, physiological, anatomical, psychological, behavioural, and social adaptations that provide its necessary scaffolding. Much of what we know about these co-evolutionary processes and niche construction events has been garnered through the comparative study of the social behaviour and cognition of extant humans and nonhuman primates. Lay people and scholars from a variety of behavioural sciences are currently engaged in a heated debate about the extent of continuity (deep similarities) between humans and nonhuman primates with regards to their behaviour and cognition. In my talk I will examine some of the arguments in support of anthropomorphism versus anthropodenial and its grounding in evolutionary theory. I will particularly focus on the link between the anthropomorphizing of nonhumans' behaviour, the model of evolution adopted (e.g., ladder, ladderized tree), and the role of anthropomorphism in the defence of model animals, animal welfare, and conservation. I will conclude that a genuine comparative perspective, whatever the level of the biological hierarchy tackled, should be based on a biological approach, as opposed to an anthropocentric approach, as the latter is at odds with genuinely evolutionary (tree) thinking.

Fernando Colmenares is Professor of Evolutionary and Integrative Psychobiology in the Psychobiology Department at the Complutense University of Madrid (Spain), where he teaches evolutionary and integrative behavioural biology, evo-devo, and comparative psychology. He was born in Madrid and studied at the Complutense University where he obtained a Bachelor degree in Biology (Zoology) in 1978 and a PhD in Ethology in 1986. From 1986 to 1988 Colmenares was a postdoctoral British Council fellow in the Subdepartment of Animal Behaviour at Cambridge University, UK, and from 1988 to 1991 he held a postdoctoral fellowship in the Developmental Psychology Department at the Autonomous University of Madrid. After 1992 he has been a visiting scientist in the Department of Ethology at Zürich University (1992), and in the Developmental and Comparative Psychology Department at the Max-Planck Institute for Evolutionary Anthropology, Leipzig (in 2004, 2007, and 2015). He is author or co-author of over 80 publications. Since 1991 he has held several teaching positions in the Psychobiology Department at the Complutense University of Madrid (assistant professor in 1991, associate professor in 1994 and full professor in 2012).

His research interests focus on the evolutionary and developmental origins of sociality and prosociality from a comparative perspective. He seeks to integrate information on processes that are located in different levels of the biological hierarchy as well as information on the proximate (mechanistic) and ultimate (evolutionary) causes that account for cross-species similarities and differences in social behaviour and cognition. Recently Colmenares and his research team have been carrying out experiments on imitation and other cognitive skills in several species of marine mammals, and on prosociality and punishment in humans and chimpanzees, as well as conducting large-scale surveys of aggression, victimization, prosocial behaviour, and peer status in classrooms of adolescents.

## Excursion Schedule

Coach departure is from the Museo Arqueológico Regional. We will leave the buses in Pinilla del Valle. From there, we will take the path towards the sites; this runs around the edge of the Pinilla Reservoir. The distance there and back is about 4 km. On the way we will be able to see waterfowl characteristic of flooded areas; with a little luck we might see a protected or threatened species such as the black stork. The visit is a low difficulty activity. You should wear comfortable footwear (boots or sports shoes). We recommend you bring binoculars. As it is still relatively warm at this time of year, we recommend you bring sunscreen, hats and sunglasses etc. There are no toilets available.

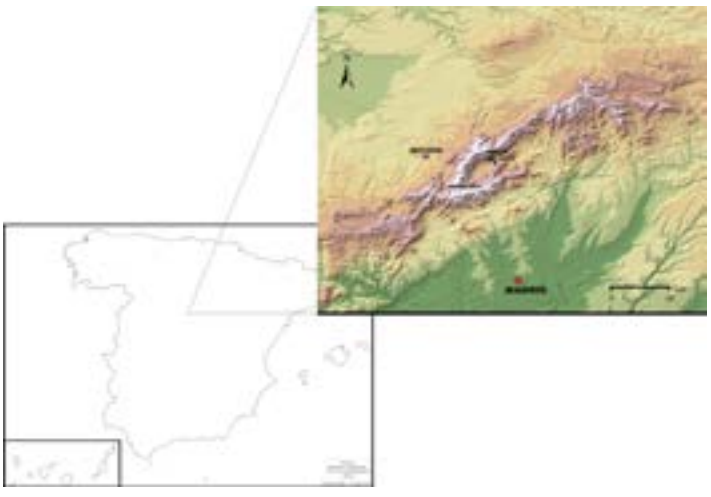
Expected arrival in Alcalá de Henares is 17:30 but there may be delays due to heavy traffic, so please do not rely on this arrival time for onward travel.

| | |
|---|---|
| 9:00 - 10:00 | Travel from Alcalá de Henares to Pinilla del Valle sites |
| 10:00 - 14:00 | Visit of ongoing excavations at the archaeological sites of Pinilla del Valle:<br>Camino Cave, Navalmaíllo Rock Shelter, Buena Pinta Cave and Descubierta Cave |
| 14:00 - 15:30 | Picnic |
| 16:00 | Travel back to Alcalá de Henares |

## **The Archaeological Sites of the Pinilla del Valle:** The Valley of the Neanderthals Project

By: Pinilla del Valle Research Team.

The upper reaches of the Lozoya Valley, close to the village of Pinilla del Valle, ca. 100 km north of Madrid, is home to a number of prehistoric sites of special scientific interest. These sites contain the remains of Neanderthals (*Homo neanderthalensis*). They also contain fossil remnants of vertebrates from the Upper Pleistocene more complete than those of any other site in the Iberian Peninsula. Along with other palaeobotanical and geomorphological information, the findings at these sites are allowing us to reconstruct the past climates and landscapes of the region.



The first site that was found, the Camino Cave, was discovered in 1979 by palaeontologists from the Universidad Complutense de Madrid. Excavations began in the 1980s under the supervision of Prof. F. Alférez. After a break during the 1990s, work was resumed in 2002 by an interdisciplinary group of researchers - archaeologists, palaeontologists, geologists, biologists and restorers - coordinated by the Museo Arqueológico Regional de la Comunidad de Madrid, and soon extended to cover the entire area of the upper Lozoya River valley.

This led to other sites being found at Calvero de la Higuera: Navalmaíllo Rock Shelter, Buena Pinta Cave, and Des-Cubierta Cave. The last of these was only discovered in 2009. There is, however, evidence that other fossil-bearing cavities exist in this same karst system.

The interest that arose in these sites led to the declaration of the area of "Los Calveros" as an Area of Special Cultural Interest by the Madrid Regional Government in 2005.


*Aerial views of the Calvero de la Higuera Hill*

**THE CAMINO CAVE SITE**

The old and largely dismantled cave formed in Cretaceous dolomite that makes up this site is filled with sediments. It has a number of stratigraphic levels dated to between 140.4 ± 11.3 ky (Level 3) and 91.0 ± 7.9 ky (Level 5).

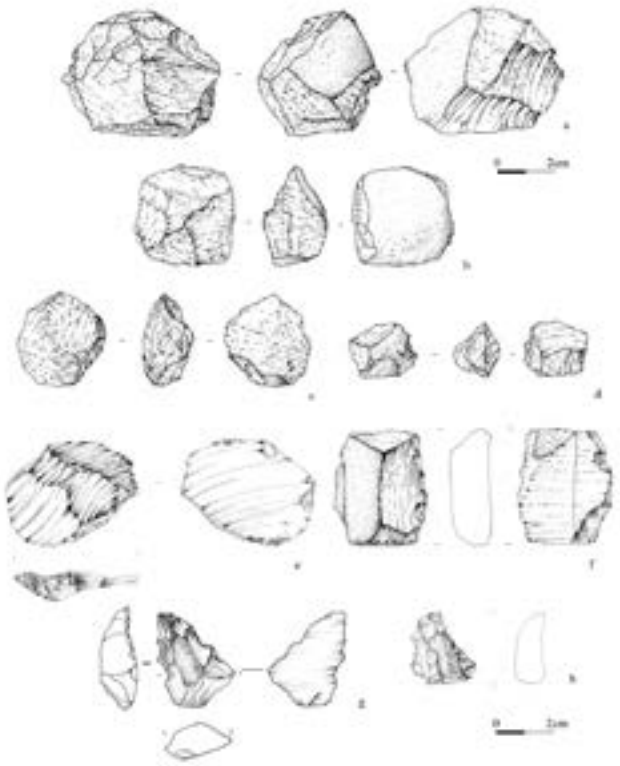
Several thousand vertebrate fossils have been recovered over the many years of excavation at the site. Over 50 individual species have been identified at this site. These, plus the great abundance of carnivore remains, the markings on herbivore bones, and the overall modifications of the latter suggest that the cave was once a hyena den. It was originally thought that *Homo neanderthalensis*, two molars of which have been found at the site, was responsible for this accumulation. However, the virtual absence of any sign of lithic industry or hearths likely means that humans did not use this cave much at all.

The species most represented among the cave's fossils include fallow deer (*Dama dama*), horses (*Equus ferus torralbae*) and red deer (*Cervus elaphus*). Carnivores are represented by many different species, including spotted hyaenas (*Crocuta crocuta*) (pictured), brown bears (*Ursus arctos*), wolves (*Canis lupus*), lynx (*Lynx cf. pardinus*), and even lions (*Panthera leo*). The finding of the remains of a porcupine (*Hystrix cf. brachyura*) along with those of a boar (*Sus scrofa*) and a Hermann's tortoise (*Testudo hermanni*) suggest that some of the sediments in this cave were deposited during warmer periods with conditions similar to those of today.

**NAVALMAILLO ROCK SHELTER**

The Navalmaíllo Rock Shelter site was discovered by the current research team during surveys undertaken in 2002.

This large rock shelter was where a group of Neanderthals settled. The site has several archaeological levels. We have two dates of 71.7 ± 5.1 ky and 77.2± 6.1 ky. In contrast to the above site, evidence has been found of hearths in two levels, and there is abundant evidence of Mousterian lithic industry, mainly involving quartz, the most abundant material in the area. In addition, the site has a rich faunal association, which provides evidence of these people's diet. Herbivores far outnumber carnivores at this site, particularly fallow and red deer, aurochs (giant cattle, now extinct), and rhinoceroses.



*(a) Trifacial quartz core. (b) Centripetal unifacial quartz core (c) Centripetal bifacial quartz core (d) "Micro-core" from Navalmaíllo, level F (e) Levallois flake (f) Sandstone denticulate (g) Chert denticulate point (h). Retouched chert flake (Márquez et al 2013).*

**BUENA PINTA CAVE**

This site was discovered by the current research team during surveys undertaken in 2003. This small cave, the mouth of which has been partially dismantled by erosion, runs into the calcareous rock several tens of metres in the form of a straight gallery.

Like Camino Cave, this cave was used as a hyena den during the Pleistocene. Hyenas brought the bones of large mammals (which show marks left by the carnivores) into the cave. Abundant coprolites (fossilized faeces) and the remains of hyena pups have also been found. However, the discovery of hammerstones and quartz and flint pieces representative of lithic industry indicate a sporadic human presence at the site. Indeed, during the 2007 excavations, three molars belonging to a single member of *Homo neanderthalensis* were unearthed in Level 3. The main fossil-containing levels have been dated to between 61.5 ± 5.0 and 63.4 ± 5.5 ky.

**DES-CUBIERTA CAVE**

Discovered in 2009, this is one of the most recently found sites. It is formed from a series of connected galleries which saw their ceilings collapse as the surface of the *calvero* (hill) in which they lie was eroded. The sedimentary infilling is thus accessible from above.

Given its size, the sediments present are very heterogeneous from the chronological, sedimentological, palaeontological and archaeological viewpoints. Some sectors contain the remains of micromammals characteristic of the Middle Pleistocene (130,000 years BP); they therefore contain the oldest of all the Calvero de la Higuera materials examined. Other sectors contain palaeontological remains and evidence of lithic industry from the Upper Pleistocene.

In 2011, five well preserved Neanderthal teeth were found from an infant just 2-3 years old (now known as The Lozoya Child) plus a fragment of a mandible. Analysis of other remains suggests this child may have been laid in a grave.

**RESEARCH LINES**

The interdisciplinary project underway has the aim of reconstructing the past from the information provided by the above sites. The idea is to understand how the landscape changed, what the climate was at the transition between the Middle and Upper Pleistocene, how the animals, plants and humans of the area evolved, how hyenas and Neanderthals interacted, and to comprehend the activity of the latter animals at the Cuevas del Camino and Buena Pinta sites. Learning more about the behaviour of Neanderthals and understanding the occupation levels they left behind at the Navalmaillo Rock Shelter and Cueva Des-Cubierta sites, are further grand goals.

This project is directed by palaeontologist Juan Luis Arsuaga (UCM-ISCIII), archaeologist Enrique Baquedano (MAR), and geologist Alfredo Pérez-González (CENIEH).

**REFERENCES**

Alvarez Lao, D. J., Arsuaga, J. L., Baquedano, E., Pérez-González, A. Last Interglacial (MIS 5) ungulate assemblage from the Ce tral Iberian Peninsula: The Camino Cave (Pinilla del Valle, Madrid, Spain), 2013, *Palaeogeography, Palaeoclimatology, Palaeoecoogy* 374: 327–337

Arriaza, M.C., Huguet, R., Laplana, C., Pérez González, A., Márquez, B., Arsuaga, J.L., Baquedano, E., 2015, Lagomorph predtion represented in a middle Palaeolithic level of the Navalmaíllo Rock Shelter site (Pinilla del Valle, Spain), as inferred via a new use of classical taphonomic criteria. *Quaternary International*, http://dx.doi.org/10.1016/ j.quaint.2015.03.040.

Arsuaga, J.L., Baquedano, E., Pérez-González, A., Sala, M.T.N., García, N., Álvarez-Lao, D., Laplana, C., Huguet, R., Sevilla, P., Blain, H.-A., Quam, R., Ruiz-Zapata, B., Sala, P., García, M.J.G., Uzquiano, P., Pantoja, A., 2010. El yacimiento arqueopaleontológico del Pleistoceno Superior de la Cueva del Camino en el Calvero de la Higuera (Pinilla del Valle, Madrid). In: Baquedano, E., Rosell, J. (Eds.), *Actas de la 1ª Reunión de científicos sobre cubiles de hiena (y otros grandes carnívoros en los yacimientos arqueológicos de la Península Ibérica). Zona Arqueológica* 13, 422-442.

Arsuaga, J. L., Baquedano, E. Pérez González, A., 2011. Neanderthals and carnivore occupations in Pinilla del Valle sites (Community of Madrid, Spain). Oosterbeek, L. (Ed.), *Proceedings of the XV World Congress of the International Union for Prehistoric and Protohistoric Sciences (Lisbon, 4-9 September 2006). BAR International Series* 2224, 111-119.

Arsuaga J.L., Baquedano, E., Pérez González, A., Sala, N., Quam, R.M., Rodríguez, L., García, R., García, N., Alvarez-Lao, D.J., Laplana, C., Huguet, R., Sevilla, P., Maldonado, E., Blain, H-A., Ruiz Zapata, B., Sala, P., Gil-García M.J., Uzquiano, P., Pantoja, A., Márquez, B., 2012. Understanding the ancient habitats of the last-interglacial (late MIS 5) Neanderthals of central Iberia: Paleoenvironmental and taphonomic evidence from the Cueva del Camino (Spain) site. *Quaternary International* 275, 55-75.

Baquedano, E., Arsuaga, J. L. & Pérez-González, A. 2010. Homínidos y carnívoros: competencia en un mismo nicho ecológico pleistoceno: los yacimientos del Calvero de la Higuera en Pinilla del Valle. In *Actas de las Quintas Jornadas de Patrimonio Arqueológico de la Comunidad de Madrid*. 61-72. Comunidad de Madrid.

Baquedano, E., Márquez., B., Pérez-González, A., Mosquera, M., Huguet, R., Espinosa, J. A., Sánchez Romero, L., Panera, J., Arsuaga, J. L., 2011-2012, Neandertales en el Valle del Lozoya: los yacimientos paleolíticos del Calvero de la Higuera (Pinilla del Valle, Madrid), Neandertales en Iberia: Últimos avances en la investigación del Paleolítico Medio Ibérico. *Mainake*. XXXIII: 83-100.

Blain, H-A., Laplana, C., Sevilla, P., Arsuaga, J. L., Baquedano, E., Pérez-González, A. 2014, MIS 5/4 transition in a mountain environment: herpetofaunal assemblages from Cueva del Camino, central Spain, *Boreas*, 43(1): 107-120.

Hontecillas, D., Houssaye, A., Laplana, C., Sevilla, P., Arsuaga, J. L., Pérez-González, A., Baquedano, E. & Knoll, F. 2015, Reworked marine pythonomorph (Reptilia, Squamata) remains in Late Pleistocene cave deposits in central Spain, C*retaceous Research*, 54: 188-202.

Huguet, R., Arsuaga, J. L., Pérez-González, A., Arriaza, M. C., Sala-Burgos, M. T. N., Laplana, C., Sevilla, P., García, N., Alvarez-Lao, D., Blain, H-A. & Baquedano, E. 2010. Homínidos y hienas en el Calvero de la Higuera (Pinilla del Valle, Madrid) durante el Pleistoceno superior. Resultados preliminares. In: Baquedano, E., Rosell, J. (Eds.), *Actas de la 1ª Reunión de científicos sobre cubiles de hiena (y otros grandes carnívoros en los yacimientos arqueológicos de la Península Ibérica). Zona Arqueológica* 13, 444-458.

Laplana, C., Sevilla, P., Blain, H-A., Arriaza, M.C., Arsuaga, J. L., Pérez-González, A., & Baquedano, E. 2015, Cold-climate rodent indicators for the Late Pleistocene of Central Iberia: New data from the Buena Pinta Cave (Pinilla del Valle, Madrid Region, Spain), *Comptes Rendus Palevol*.

Laplana, C., Sevilla, P., Arsuaga, J. L., Arriaza, M.C., Baquedano, E., Pérez-González, A., & López-Martínez, N. 2015, How Far into Europe Did Pikas (Lagomorpha: Ochotonidae) Go during the Pleistocene? New Evidence from Central Iberia. *PLOSOne,* Nov. 4. DOI:10.1371/journal.pone.0140513

Márquez, B., Baquedano, E., Pérez-González, A., & Arsuaga, J. L., 2015. Microwear analysis of Mousterian quartz tools from the Navalmaíllo Rock Shelter (Pinilla del Valle, Madrid, Spain), *Quaternary International. 425. http://dx.doi.org/10.1016 /j.quaint.2015.08.052*.

Márquez, B., Mosquera, M., Baquedano, E., Pérez-González, A., Arsuaga, J. L., Panera,J. Espinosa, J. A., Gómez, J., 2013. Evidence of a Neanderthal- made quartz-based technology at Navalmaíllo Rockshelter (Pinilla del Valle, Madrid Region, Spain). *Journal of Anthropological Research* 69 (3), 373-395.

Pérez-González, A., Karampaglidis, T., Arsuaga, J.L., Baquedano, E., Bárez, S., Gómez, J.J., Panera, J., Márquez, B., Laplana, C., Mosquera, M., Huguet, R., Sala, P., Arriaza, M.C., Benito, A., Aracil, E., Maldonado, E., 2010. Aproximación geomorfológica a los yacimientos del Pleistoceno Superior del Calvero de la Higuera en el Valle Alto del Lozoya (Sistema Central Español, Madrid). In: Baquedano, E., Rosell, J. (Eds.), *Actas de la 1ª Reunión de científicos sobre cubiles de hiena (y otros grandes carnívoros en los yacimientos arqueológicos de la Península Ibérica). Zona Arqueológica* 13, 404-419.

| Wednesday, 14 September | |
|---|---|
| 13:00 – 17:00 | **Meeting Registration • Main Entrance of the Museo Arqueológico Regional**<br>**Plaza de las Bernardas, s/n**<br>**28801, Alcalá de Henares (Madrid)**<br><br>**Poster drop-off and set-up, Session 1 • First Floor, Museo Arqueológico Regional** |
| 17:00-19:00 | **Poster session 1, Open Bar • First floor, Museo Arqueológico Regional** |
| 19:00-19:20 | **Opening Speech – Jean-Jacques Hublin**<br>**Ground Floor, Museo Arqueológico Regional** |
| 19:20-20:30 | **Keynote Speech: Fernando Colmenares**<br>**Human sociality and prosociality in evolutionary context:** Of ladders, trees, anthropomorphism, anthropocentrism and evolutionary theory |

| Poster Session 1<br>Wednesday, 14 September 17:00 - 19:00 | |
|---|---|
| **Authors of odd-numbered posters are expected to present for the first hour (17:00-18:00). Authors of even-numbered posters are expected to present for th second hour (18:00-19:00). All posters will remain on display for the duration of the conference.** | |
| **1** | **José María Bermúdez de Castro**<br>Teeth: the "black box" |
| **2** | **Beatriz Gamarra**<br>Dental topography and dietary adaptations in European Miocene hominids |
| **3** | **Julia Stuhlträger**<br>Dietary composition and tooth wear in forest chimpanzees (*Pan troglodytes verus*): implications for the dietary reconstruction in fossil hominins |
| **4** | **Federica Landi**<br>Investigating locomotion from cranial base morphology and foramen magnum position in primates and hominins |
| **5** | **Ian Towle**<br>Pitting enamel hypoplasia in *Paranthropus robustu*s |
| **6** | **Thomas Püschel**<br>The Evolution of the Platyrrhine Talus |

| | |
|---|---|
| **7** | **Aroa Casado**<br>Geometric Morphometric analyses of dental crown loss with age in baboons from the Amboseli National Park |
| **8** | **Juan Manuel Becerra**<br>Geometric Morphometric topography and dental crown loss analyses in hominoidea primates |
| **9** | **Priscilla Bayle**<br>Enamel thickness and dental tissue proportions in the Neandertals from the Sima de las Palomas del Cabezo Gordo, Southeastern Spain |
| **10** | **Clément Zanolli**<br>Innovative approaches to quantify and statistically compare tooth enamel thickness distribution |
| **11** | **Annabelle Lockey**<br>Upper molar enamel thickness of Plio-Pleistocene hominins. |
| **12** | **Mario Modesto-Mata**<br>New methodology to reconstruct in 2D the enamel of human lower molars and its application to *Homo antecessor* |
| **13** | **Inga Stolbovaya**<br>Patterns of craniofacial and dental covariation in relation to wisdom teeth impaction |
| **14** | **Lisa Buchegger**<br>Covariation of Upper and Lower Premolars in Modern Humans |
| **15** | **Cecilia García-Campos**<br>Sexual dimorphism of the human permanent mandibular canine tissue proportions |
| **16** | **Diana Badreddin**<br>Cortical Bone Thickness in Modern Human Mandibles Showing Asymmetric Dental Wear |
| **17** | **Jose-Francisco Diez-Pastor**<br>A novel method for semi-automatic count of perikymata |
| **18** | **Daniela Pacheco**<br>A new methodological approach for analyzing dental topographic variability |
| **19** | **Almudena Estalrrich**<br>What shall we eat? The Diet of El Sidrón Group: A molar microwear texture analysis. |
| **20** | **Sireen El Zaatari**<br>The diet of the Middle Pleistocene hominin (Eyasi 1) from Lake Eyasi, Tanzania |
| **21** | **Rebecca Haywood**<br>Exploring the incidence frequencies of non-metric dental traits in Great Apes |
| **22** | **Laura C Fitton**<br>Simulating dental wear and its effect on food breakdown in a hard object feeding primate |
| **23** | **Elisabeth Cuesta-Torralvo**<br>Occlusal dental wear and tooth crown shape: a Geometric Morphometric analysis of a known-age skeletal collection from Portugal using Geomorph in R |
| **24** | **Amélie Vialet**<br>The dentition from Montmaurin-La Niche cave (Haute-Garonne, France). New insights in the *Homo heidelbergensis* debate |

| | |
|---|---|
| **25** | **Karyn** Rehbock<br>Postnatal ontogeny of the hyoid and tongue on human and chimpanzee (*Pan troglodytes*) cadavers - implications for the relationship of the skeletal and muscular components of the hominoid supra-laryngeal vocal tract |
| **26** | **Maria Dobrovolskaya**<br>Vascular system of human compact bone tissue: a tool of the microscopic study for the microevolution processes reconstruction |
| **27** | **Antoine Balzeau**<br>New Data on the Context of the La Ferrassie 8 Neandertal child skeleton (Grand Abri of La Ferrassie, Dordogne, France |
| **28** | **Maria Mednikova**<br>Who was robuster? A comparative study of small tubular bone inner robusticity in Neanderthals and the AMH of the Upper Palaeolithic |
| **29** | **Miguel Prôa**<br>Exploring the microevolutionary processes acting on Primate cranial form using morphometric data and quantitative genetic models |
| **30** | **Davinia Moreno**<br>ESR dating of fluvial deposits from the Middle Tagus Basin (Central Spain): new numerical age results for the Acheulean sites of Pinedo and Cien Fanegas |
| **31** | **Paloma Sevilla**<br>The exceptional microvertebrate record of the Calvero de la Higuera sites (Pinilla del Valle, Spanish Central System): a key to understanding the natural environment of Neanderthals in central Iberia |
| **32** | **Maïlys Richard**<br>Towards a better definition of the chronological framework for Upper Pleistocene prehistoric sites in Western Europe |
| **33** | **M. Frouin**<br>Dating the Middle-Upper Palaeolithic Transition in western Georgia (South Caucasus): a multi-method (OSL, IRSL and 14C) approach. |
| **34** | **Thibaut Deviese**<br>New methodological advances in dating archaeological bones at the Oxford Radiocarbon Accelerator Unit |
| **35** | **Monika Knul**<br>Re-assessing the quality of published radiocarbon dates of the late Middle and Upper Palaeolithic in Europe |
| **36** | **Robert S. Feranec**<br>Paleoecology and paleoenvironment at two late Pleistocene Neanderthal-bearing sites in Pinilla del Valle, Spain |
| **37** | **Lucía Cobo-Sánchez**<br>Spatial simulation and modeling on the early Pleistocene site of DS (Bed I, Olduvai Gorge, Tanzania): a powerful tool for predicting potential archaeological information from unexcavated areas |
| **38** | **M. Patrocinio Espigares**<br>Early Pleistocene hominins in Europe: the sites of Barranco León and Fuente Nueva-3 (Orce, Spain) |
| **39** | **Ana Isabel Ortega Martinez**<br>Galería Complex site: The sequence of Acheulean site of Atapuerca (Burgos, Spain) |
| **40** | **Laura Sánchez-Romero**<br>Accumulation processes assessment in Ambrona site (Soria, Spain) through density and orientation analysis of spatial datasets from 1960 to present“ |
| **41** | **Ruth Blasco**<br>The eaten and the eaters: Human-carnivore interactions at Middle Pleistocene Qesem Cave, Israel |

| | |
|---|---|
| **42** | **Claire Harris**<br>The distribution of early Palaeolithic sites in Britain |
| **43** | **Yoni Parush**<br>Recycling for functional needs: case study from the Late Lower Paleolithic site of Qesem Cave Israel |
| **44** | **Marco Peresani**<br>Human-birds interactions during the Pleistocene in Southern Europe. An updated review. |
| **45** | **Richard Marques**<br>Communicating Human Evolution: The impact of non-formal advanced courses on high school students |
| **46** | **Fulco Scherjon**<br>How (not) to model Neanderthal extinction |
| **47** | **Nikoloz Tushabramishvili**<br>The Oldest Middle Paleolithic Portable Art from the Caves of Georgia |
| **48** | **Geeske Langejans**<br>Middle Paleolithic macro-lithic artifacts from Neumark Nord 2/2 (Germany): Unraveling the Neandertal toolkit |
| **49** | **Fabio Negrino**<br>Colonization dynamics and the diffusion of the Protoaurignacian in Italy and Southern France: The Rhône-Marche corridors and its chrono-cultural implications. |
| **50** | **Regine Stolarczyk**<br>Heat treatment: understanding complexity, innovative impact and implications for the cultural development during the Middle Stone Age |
| **51** | **César Laplana**<br>Buena Pinta Cave: Neanderthals in a mountain environment in central Spain during MIS3 |
| **52** | **Marianne Deschamps**<br>Patterns of long-term change in Middle Paleolithic stone tool technology at Gruta da Oliveira (Almonda karst system, Torres Novas, Portugal) |
| **53** | **Telmo Pereira**<br>New insights on the lithic assemblage of Gruta Nova da Columbeira |
| **54** | **Felipe Cuartero**<br>The Micro-hinge Facetting at the Solutrean Site of Las Delicias (Madrid, Spain): a Special Technique for the Preparation of Platforms in Bifacial Reduction |
| **55** | **Dorothée Drucker**<br>Human diet during the Gravettian in northeastern Spain: insights from stable isotopes |
| **56** | **Sara E. Rhodes**<br>The paleoclimatic and archaeological implications of the micromammalian assemblages from Geißenklösterle Cave in southwestern Germany |
| **57** | **Guido Bataille**<br>Blade and bladelet production sequences of AH IV at Hohle Fels Cave and their implications for technological variability during the Swabian Aurignacian. |
| **58** | **Radka Šmídová**<br>Microbial attack on bones: experimental analogy and its implication in archaeological contexts |
| **59** | **Ana Álvarez-Fernández**<br>Comparison of three microscopy techniques applied to functional analysis of use-wear on experimental stone tools |
| **60** | **Miguel Ángel Maté-González**<br>Implementation of photogrammetry to the three-dimensional reconstruction of cut marks: an alternative to the Scanning Electron Microscopy |

| Thursday, 15 September | |
|---|---|
| **8:00-9:00** | **Meeting Registration: Main Entrance, Museo Arqueológico Regional** |
| **Session 1 • Podium**<br>Ground Floor, MAR | |
| **9:00** | **Tomos Proffitt**<br>Wild monkeys flake stone tools |
| **9:20** | **Jason Lewis**<br>Further context of the 3.3 Ma archaeological assemblage from Lomekwi 3, West Turkana, Kenya |
| **9:40** | **Julio Mercader Florin**<br>Acheulean Ecology, Diet and Technological Behavior: Plant Residues from Olduvai Gorge |
| **10:00** | **Tegenu Gossa Aredo**<br>The Newly Discoverd Early Stone Age site of Melka Wakena, Ethiopia |
| **10:20** | **Sonia Harmand**<br>The Missing Oldowan: New 2.3 - 2.0 Ma Sites from the Nasura Complex, West Turkana, Kenya |
| **10:40** | **Mark J. Sier**<br>Geochronological correlation of Turkana Basin core and outcrop. Paleoclimate and environmental reconstruction in Early-Middle Pleistocene East Africa. |
| **11:00** | **Bienvenido Martínez-Navarro**<br>The Engel Ela-Ramud Basin: a new Plio-Pleistocene archeo-paleontological site in Eritrea |
| **11:20** | **Paula García-Medrano**<br>The mental template: Middle Pleistocene handaxe shaping strategies |
| **11:40-12:00** | **Coffee Break** |
| **Session 2 • Pecha Kucha** | |
| **12:10-12:35** | **Antonio Rodríguez-Hidalgo**<br>Hunting, butchering, carrying and sharing along the Gran dolina sequence: The ancient origin of the modern subsistence dynamics |
| | **Lee Arnold**<br>New bracketing luminescence ages constrain the Sima de los Huesos hominin fossils to MIS 12 |
| | **Eva María Poza Rey**<br>Morphological analysis of variation in the Sima de los Huesos (Atapuerca, Spain) brain endocast collection. |
| | |
| **12:35-13:00** | **Laura Rodríguez**<br>Neandertal remains from Pinilla del Valle (Madrid, Spain) |
| | **Manuel Will**<br>The evolution of body size within the genus Homo: new empirical data and theoretical perspectives |
| | **Stephanie Melillo**<br>Structural effects of human clavicle variation |

| | |
|---|---|
| | |
| 13:00-13:25 | **Fotios Alexandros Karakostis**<br>Three-dimensional Morphometric Analysis of Human Hand Entheses |
| | **Kevin Turley**<br>Ontogenetic Trajectories of Talo-Crural Joint Shape in Extant Ape African Lineages: Insights into the Study of Fossil Hominins. |
| | **Michael B. C. Rivera**<br>Climatic and neutral evolution of the human femur and tibia, both worldwide and in high latitude populations |
| **13:30-14:50** | **Lunch Break** |
| **Session 3 • Podium** | |
| **15:00** | **Yoel Rak**<br>What Do We Really Know about the Origin of Humans? |
| **15:20** | **William Sellers**<br>Lateral stability and footfall sequences in primate locomotion |
| **15:40** | **Pierre Frémondière**<br>Exploring birth process in australopithecines: contribution of birth simulations and discriminant analyses based on an actual modern human obstetrical sample |
| **16:00** | **Philipp Mitteroecker**<br>The “cliff edge model” of obstetric selection in humans |
| **16:20** | **Cinzia Fornai**<br>Virtual reconstruction of *Australopithecus sediba* pelvis and reconsideration of its morphological affinities |
| **16:40** | **Rolf Quam**<br>Early hominin auditory capacities |
| **17:00** | **Alexander Stoessel**<br>Different shapes but similar function of Neandertal and anatomically modern human ear ossicles |
| **17:20** | **Sandra Mathews**<br>The oldest case of polyarticular arthritis in the hominin fossil record: the MH2 skeleton (*Australopithecus sediba*) - a trade-off of bipedalism? |
| **17:40** | **Markus Bastir**<br>A geometric morphometric reconstruction of the thorax of *H. naledi* |
| **18:00-20:00** | **Poster Session 2 • First Floor** |

| Poster Session 2<br>Thursday, 15 September (18:00 - 20:00) | |
|---|---|
| **Authors of odd-numbered posters are expected to present for the first hour (18:00-19:00). Authors of even-numbered posters are expected to present for th second hour (19:00-20:00). All posters will remain on display for the duration of the conference.** | |
| **61** | **Peter Allen**<br>Visualising and Investigating the Effect of Environment on Prey Detection Rates |
| **62** | **Antonio Profico**<br>Digital alignment: an automatized protocol for virtual reconstruction of incomplete fossil specimens |
| **63** | **Martin Friess**<br>Analyzing the shape of fragmentary specimens: a test combining best-fit and Procrustes methods, and the case study of the late Early Pleistocene parietal bone from Gombore II, Melka Kunture, Ethiopia. |
| **64** | **James Hicks**<br>On the Role of Precuneal Expansion in the Evolution of Cognition |
| **65** | **Cedric Boeckx** - From bones to hormones and cognition: understanding the "Self-domestication" of Homo sapiens through archaic genomes |
| **66** | **Frederick L. Coolidge**<br>Evolutionary Implications of the Neuropsychological Functions of the Retrosplenial Cortex |
| **67** | **Leah Levulis**<br>On the Evolutionary Implications of Expanded Olfactory Bulbs in *Homo sapiens* |
| **68** | **Amélie Beaudet**<br>Morphoarchitectural variation in the extant human endocast |
| **69** | **Sofia Pereira-Pedro**<br>The brain and the braincase: fronto-temporal morphology and the orbital space |
| **70** | **Gizéh Rangel de Lázaro**<br>A preliminary automatic procedure for vascular morphometrics and diploic patterns in modern human and fossil crania |
| **71** | **Zachary Cofran**<br>Brain size growth is more plastic in humans than in chimpanzees |
| **72** | **Simon Neubauer**<br>Endocranial shape and taxonomic affinities of KNM-ER 42700 |
| **73** | **Simon J. Maxwell**<br>The completeness of the early hominin fossil record |
| **74** | **Ana Pantoja-Pérez**<br>Virtual assessment for the study of the cranial fractures. Application to the Sima de los Huesos hominin crania |
| **75** | **Marco Vidal-Cordasco**<br>Born to Walk: A wider pelvis reduces the energetic costs of locomotion |
| **76** | **Adrián Pablos**<br>The cuboids from Sima de los Huesos (Atapuerca, Burgos, Spain) |
| **77** | **Michaela Stančíková**<br>Human gnaw marks on bones (Pilot experimental analysis) |
| **78** | **Christopher J. Dunmore**<br>Is there a Relationship between Flake Form and Manual Pressure during Stone Tool Production? An Experimental Test |
| **79** | **Sarah Elton**<br>Ecomorphological patterns in the mammalian humerus: implications for community-based palaeoecological reconstruction |

| | |
|---|---|
| **80** | **Scott Blumenthal**<br>Human evolution and the expansion of grazer-dominated biomes in eastern Africa over the last 5 million years |
| **81** | **Asier Gómez-Olivencia**<br>Evolution of the vertebral formula in hominoids: insights from ancestral state reconstruction approaches |
| **82** | **Tara Chapman**<br>Geometrical parameters of hominin ribs: a comparison between the Kebara 2 Neandertal and modern humans |
| **83** | **Daniel García-Martínez**<br>Positional rib assessment of the adult costal remains from the El Sidrón neandertal site (49000 y/o, Asturias, northern Spain) |
| **84** | **Lucía López-Polín**<br>The preparation of two hominin scapulae from TD6 unit at Gran Dolina site (Sierra de Atapuerca, Spain) |
| **85** | **Luis Rios**<br>Congenital conditions in Neandertal remains from El Sidrón (Asturias, Spain) |
| **86** | **Martin Haeusler**<br>Neanderthal vertebral curvature and spinal motion - the evidence of spinal osteoarthritis in the La Chapelle-aux Saints skeleton |
| **87** | **Ella Been**<br>Knee joint pathology in Ein Qashish 3 (EQH-3) Neanderthal |
| **88** | **Thomas O'Mahoney**<br>A networked approach to the analysis of integration and modularity in the primate shoulder and thoracic skeleton |
| **89** | **Ana Mateos**<br>EVOBREATH®. A new database for Evolutionary Bioenergetics Research on Paleoanthropology |
| **90** | **Olalla Prado-Nóvoa**<br>Energetic efficiency of acorn gathering for the Atapuerca middle Pleistocene populations |
| **91** | **Rebeca García-González**<br>The ontogeny of femoral strength in Middle Pleistocene humans from Sima de los Huesos (Atapuerca, Spain) |
| **92** | **Lumila Menéndez**<br>Altitude is associated with craniofacial shape variation in late Holocene southern South Americans |
| **93** | **Isabelle De Groote**<br>New genetic and morphological evidence suggests a single hoaxer created 'Piltdown Man' |
| **94** | **Isabelle Crevecoeur**<br>Population processes in the Nile Valley at the beginning of the Holocene, the El-Barga clue |
| **95** | **Hila May**<br>Did the agriculture revolution in the Levant improve peoples' nutrition? 40 years of ongoing debate |
| **96** | **Amanda Henry**<br>The costs of fire |
| **97** | **Josephine Joordens**<br>Using fish phylogeography to resolve hominin dispersal opportunies between the Chad Basin and Turkana Basin (Africa) in the past ~ 5 Ma |
| **98** | **Knut Bretzke**<br>The Acheulean site Suhailah 1 extends the occupation history of SE Arabia |
| **99** | **Aviad Agam**<br>Lithic Procurement Strategies in the Lower Paleolithic: A View From Acheulo-Yabrudian Qesem Cave, Israel |
| **100** | **Robert Patalano**<br>Innovations in Isotopes: Plant Biomarkers and the Environmental Context of the Earliest Acheulean, Olduvai Gorge |

| | |
|---|---|
| **101** | **Andreu Ollé**<br>Functional analysis of the Acheulian assemblages from the Áridos elephant butchery sites (Madrid, Spain) |
| **102** | **Makarius Itambu**<br>Phytolith Environments from Olduvai Gorge (Bed II) |
| **103** | **Robert Davis**<br>The Breckland Palaeolithic Project: New Investigations of the First Acheuleans in Britain |
| **104** | **Isidoro Campaña**<br>Automated image analysis of sand particle shape for describing hominin-bearing sediments in an Early and Middle Pleistocene site (Gran Dolina, Sierra de Atapuerca, Spain) |
| **105** | **Mathieu Duval**<br>Direct dating of human remains beyond the radiocarbon time range: what about using ESR? |
| **106** | **Martina Demuro**<br>Extended-range luminescence dating of sedimentary infill sequences of the Atapuerca karst complex: determining access history to the Sima de los Huesos site |
| **107** | **Tobias Lauer**<br>Testing the potential of violet-stimulated luminescence (VSL) on quartz from the Acheulean- to Middle Stone Age sedimentary sequence at Montagu Cave, Western Cape Provence, South Africa |
| **108** | **Magnus M. Haaland**<br>Multi-scale and micro-contextual investigation of the Middle Stone Age sequence in Blombos Cave, South Africa |
| **109** | **Andrzej Wisniewski**<br>New data on the late Middle Palaeolithic in Poland: current discussion on chronological framework and typo-technological variability |
| **110** | **Juan Luis Arsuaga**<br>Neandertals at Atapuerca: the MIS3 Galería de las Estatuas site |
| **111** | **Will Archer**<br>Assessing the behavioural drivers of lithic flake variability through geometric morphometrics |
| **112** | **Marion Prévost**<br>The Nahr Ibrahim technique and side-scraper resharpening at the Unit III of the Middle Paleolithic open-air site of Nesher Ramla (Israel) |
| **113** | **Paloma Vidal-Matutano**<br>The earliest evidence of a smoking hearth? a palaeoeconomical approach from El Salt (Eastern Iberia) |
| **114** | **Phil Glauberman**<br>Technological Divergence at the Crossroads? Comparing the Obsidian Middle Palaeolithic in the Armenian Volcanic Highlands and Central Anatolia |
| **115** | **Marie-Claire Dawson**<br>Testing siliceous raw material homogeneity and its impact on Palaeolithic hunter-gatherer societies: a regional case study from the Dordogne in South-West France |
| **116** | **Robert Power**<br>Dental calculus indicates widespread plant use within the Neanderthal dietary niche |
| **117** | **Philippe Fernandez**<br>Faunal input for evolutive dynamics of Neandertal populations in France |
| **118** | **Paul Goldberg**<br>On the context of the Neanderthal Skeletons at La Ferrassie, France: new evidence on old data |
| **119** | **Susan M Mentzer**<br>Micromorphological analyses of the Middle Stone Age deposits in Bizmoune Cave (Morocco) |
| **120** | **Juan Marín**<br>Ungulate carcass transport strategies at the Middle Palaeolithic site of Abric Romaní (Capellades, Spain) |

| | |
|---|---|
| **121** | **Alessandra Livraghi**<br>Giant deers and large-sized bovids exploited by Quina Neanderthals in the North of Italy |
| **122** | **Mohsen Zeidi**<br>New results from Ghar-e Boof and their implications for the shift from the Middle to the Upper Paleolithic in the Southern Zagros Mountains |
| **123** | **Armando Falcucci**<br>New investigations on the Protoaurignacian lithic technology of Fumane cave |
| **124** | **Yamandu Hilbert**<br>Upper Paleolithic sites in northern Saudi Arabia and the extent of the Levantine UP contextual zone: implications for human movements across the northern Arabian Peninsula during MIS 3 |
| **125** | **Olga Druzhinina**<br>Early human habitation in the south-eastern Baltic Sea region: New archaeological data on the middle to upper Palaeolithic transition |
| **126** | **Andreas Taller**<br>Gravettian origins? Hohle Fels Cave and its significance for the cultural evolution of the Central European Upper Palaeolithic |
| **127** | **Joao Marreiros**<br>Exploring lithic variability during the Gravettian in Iberia: lithic technology, use-wear analysis and raw material sourcing from the Gravettian occupation of L'Arbreda Cave (Catalunya, Spain) |
| **128** | **Elizabeth Velliky**<br>Modified ochre pieces, ochre-related artefacts, and symbolic behaviours at Hohle Fels Cave in southwestern Germany |
| **129** | **Noora Taipale**<br>Domestic tools, hafting, and the evolution of technology: The Upper Palaeolithic of Hohle Fels as a case study |
| **130** | **Juan Luis Fernández-Marchena**<br>Crossing the Pyrenees. Material evidences of symbolic behaviour of LGM human groups in a stop along the way |
| **131** | **Dries Cnuts**<br>A new method for identifying experimental and Palaeolithic hafting adhesives using GC x GC-HRTOFMS |
| **132** | **Samantha Porter**<br>A Portable and Low Cost Open Design Rig for Reflectance Transformation Imaging |
| **133** | **Ariane Burke**<br>Modelling human systems and their response to climate variability during the Last Glacial Maximum |
| **134** | **Célia Gonçalves**<br>Stone age settlement patterns in the Lunho Valley (Niassa, Mozambique): GIS Preliminary Results |
| **135** | **Lucía Bermejo**<br>GPR data to contrains Interpretations in the archaeological karstic test stie of Sierra de Atapuerca (Burgos, Spain) |
| **136** | **Tim Schüler**<br>Prospection between excavations - nondestructive field methods for understanding the old documentation of the Middle to Upper Paleolithic site of Ranis-Ilsenhöhle, Germany |
| **137** | **Christelle Lahaye**<br>Another sequence, same evidence: human presence at the end of the Pleistocene in America. The Toca da Janela da Barra do Antonião, Piauí, Brazil |
| **138** | **Antonio Jesús Sánchez Flores**<br>Faunal bone discrimination for archaeological purposes by laser plasma spectroscopy |
| **139** | **Ella Assaf**<br>Learning to knap in the Lower Palaeolithic: Archaeological evidences for knowledge transmission in Qesem Cave |

| Friday, 16 September | |
|---|---|
| **Session 4 • Podium** | |
| **8:30** | **Emiliano Bruner**<br>Evolving brains between Europe and Asia: from Maba to Atapuerca |
| **8:50** | **Philipp Gunz**<br>The evolution and development of endocranial shape |
| **9:10** | **Rodrigo Lacruz**<br>Biological Bases for Interpreting Hominin Dental Ontogeny and Life History |
| **9:30** | **Gary T. Schwartz**<br>Evolution of hominin tooth size explained through development-based models |
| **9:50** | **Alessio Veneziano**<br>Mandibular and dental reduction in Homo: discarding the functional hypotheses? |
| **10:10** | **Inga Bergmann**<br>Variability and Evolution of Mandible Morphology among ***Homo sapiens*** |
| **10:30** | **Antonio Rosas**<br>Tempo and mode in the neandertal evolutionary lineage: a renewed attention to the mandible |
| **10:50-11:10** | **Coffee Break** |
| **Session 5 •Podium** | |
| **11:10** | **Susanne Haupt**<br>Paleodiet of an infant *Homo erectus* in Early Pleistocene of Sangiran |
| **11:30** | **Josep M. Pares**<br>Extending the chronostratigraphy at Gran Dolina archaeological site, Atapuerca |
| **11:50** | **Zenobia Jacobs**<br>Luminescence chronologies for Denisova and Chagyrskaya Caves, southern Siberia, Russia |
| **12:10** | **Nuno Bicho**<br>Middle Stone Age technologies in Mozambique: preliminary results |
| **12:30** | **Veerle Rots**<br>There is more to life than subsistence: use-wear and residue analyses on pre-Still Bay stone tools at Sibudu |
| **12:50** | **Maria Martinon-Torres**<br>The earliest unequivocal *H. sapiens* in China: the evidence from the early-Late Pleistocene site of Fuyan (Daoxian) cave. |
| **13:10** | **Viviane Slon**<br>Reconstructing past biodiversity by DNA analysis of Middle and Late Pleistocene sediment |
| **13:30-15:00** | **Lunch Break**<br>**Interactive Workshop, Q&A session and clinic with the Editors of the *Journal of Human Evolution* • Prof. Manuel Fernández Miranda Seminar Room** |

| Session 6 • Pecha Kucha | |
|---|---|
| 15:00-15:25 | **José-Manuel Maíllo-Fernández**<br>Loiyangalani: A Middle Stone Age Site in Serengeti National Park, Tanzania |
| | **Alice Leplongeon**<br>Middle Stone Age and early Late Stone Age lithic assemblages at Enkapune Ya Muto (Kenya) |
| | **Sonja Tomasso**<br>What's the difference? Results of a functional study of Aterian and Mousterian tools from the site of Ifri n'Ammar (Morocco) |
| | |
| 15:25-15:50 | **Belén Márquez**<br>The Navalmaíllo Rock Shelter (Pinilla del Valle, Madrid, Spain). A Neanderthal Camp at the Centre of the Iberian Peninsula |
| | **Manuel Alcaraz-Castaño**<br>Neandertal adaptations in Central Iberia: a multi-proxy investigation of the Middle Paleolithic site of Peña Cabra |
| | **Juan I. Morales**<br>A southern snapshot of the Middle-to-Upper Paleolithic transition: Foradada Cave (Calafell, Tarragona, Spain) |
| | |
| 15:50-16:15 | **Andrew W. Kandel**<br>Transport patterns of Armenian obsidian based on pXRF analysis of Upper Paleolithic artifacts from Aghitu-3 Cave |
| | **Helen Fewlass**<br>Size matters: new frontiers in radiocarbon bone dating |
| | **Rachel Hopkins**<br>Did modern humans enter Europe via the Danube corridor? New results from high precision chrono-metric modelling |
| **16:20-16:40** | **Tea Break** |
| **Session 7 • Podium** | |
| **16:40** | **João Zilhão**<br>The Almonda karst system (Torres Novas, Portugal): a window into half a million years of long-term change in climate, settlement, subsistence, technology and culture |
| **17:00** | **Joan Daura**<br>A new Middle Pleistocene cranium in an Acheulian context at Gruta da Aroeira (Almonda karst system, Torres Novas, Protugal) |
| **17:20** | **Fabio Di Vincenzo**<br>The cranium of the Altamura Neanderthal (Puglia, Italy): virtual extraction, digital restoration and morphological notes |
| **17:40** | **Andrea Picin**<br>Short-term occupations at the lakeshore: a technological reassessment of Königsaue open-air site |
| **18:00** | **Francesca Romagnoli**<br>There's no place like home! Investigating Neanderthal socio-economic behaviour in intra-site activity areas and housing space. |
| **18:20** | **Enrique Baquedano**<br>The Des-Cubierta Cave (Pinilla del Valle, Comunidad de Madrid, Spain): A Neanderthal site with a likely funerary/ritualistic connection |
| **18:40** | **Bruno Maureille**<br>Regourdou 1 (Dordogne, France): one of the oldest nearly complete Neandertal skeletons? |
| **19:00 - 20:00** | **General Assembly • Museo Arqueológico Regional** |

| Saturday, 17 September | |
|---|---|
| **Session 8 • Podium** | |
| **8:30** | **Alistair W.G. Pike**<br>Reconstructing Neanderthal mobility and range at Gruta da Oliveira, Portugal, using high resolution laser ablation Sr isotope analysis |
| **8:50** | **Heike Scherf**<br>Functional vs. genetic influence in humeral trabecular bone - a comparison of Neanderthals, Neolithic and extant humans, and great apes |
| **9:10** | **Daniella Bar-Yosef Mayer**<br>Early Upper Palaeolithic Shell beads and shellfish from Manot Cave, Israel |
| **9:30** | **José-Miguel Tejero**<br>Toward complexity in the osseous raw material work at the beginning of the Early Upper Palaeolithic in Eurasia. The Manot Cave (Israel) osseous tools in the Aurignacian emergence and diffusion context |
| **9:50** | **Ine Leonard**<br>Living at the transition. The lithic raw material economy of the Banat (SW-Romania) and its implications for land use strategies across the Carpathian Basin during the early Upper Palaeolithic |
| **10:10** | **Ana B. Marin-Arroyo**<br>Late middle and early upper Palaeolithic Palaeoenvironmental conditions in the Cantabrian region, northern Spain. How did Neanderthals and anatomically modern humans cope with climatic oscillations? |
| **10:30** | **Rebecca Miller**<br>The Middle to Upper Paleolithic transition: A multidisciplinary approach to the chronostratigraphy of climate change and human occupation at Trou Al'Wesse (Belgium) |
| **10:50-11:10** | **Coffee Break** |
| **Session 9 • Podium** | |
| **11:10** | **Tom Higham**<br>Chronology of the European Aurignacian: towards spatio-temporal mapping of the early spread of modern humans |
| **11:30** | **Katerina Harvati**<br>The Romanian early Upper Paleolithic mandibles: Implications for the skeletal manifestation of Neanderthal admixture |
| **11:50** | **Sahra Talamo**<br>Lifting the veil over the 'Neanderthal' mandible from Riparo Mezzena (Monti Lessini, Italy) using direct radiocarbon dating and genetic analyses. |
| **12:10** | **Frido Welker**<br>Palaeoproteomic evidence identifies archaic hominins associated with the Châtelperronian at the Grotte du Renne. |
| **12:30** | **Mateja Hajdinjak**<br>Genetic analyses of five late Neandertals |
| **12:50** | **Qiaomei Fu**<br>Population genetic history of Upper Palaeolithic Europe |
| **13:10** | **Yvonne Tafelmaier**<br>Beyond terms. Proto- & early Aurignacian: two distinct techno-typological phases of the Aurignacian technocomplex? |
| **13:30-15:00** | **Lunch Break** |

| Session 10 • Pecha Kucha | |
|---|---|
| 15:00-15:25 | **Rebecca Ackermann**<br>Of mice and monkeys: quantitative models for the hybrid phenotype |
| | **Nicole Grunstra**<br>What's in a Tooth? Signals of Ecogeography and Phylogeny in the Dentition of Macaques |
| | **Laura Buti**<br>3D enamel thickness in Neandertal and modern human permanent canines |
| | |
| 15:25-15:50 | **Alejandro Pérez-Pérez**<br>Buccal dental microwear patterns in African hominines support greater dietary specialization than previously thought |
| | **Gerhard W. Weber**<br>The Position of the Malar Process in Relation to the Dentition in Recent and Fossil Hominids |
| | **Stefanie Stelzer**<br>Using the covariation of extant hominoid upper and lower jaws to identify group affinity of fossil hominins |
| | |
| 15:50-16:15 | **Shara Bailey**<br>Taxonomic differences in deciduous lower first molar crown outlines of *Homo sapiens* and *Homo neanderthalensis* |
| | **Cristiana Margherita**<br>Dental morphology and morphometrics of Upper Paleolithic human remains from Dzudzuana and Satsurblia caves, western Georgia |
| | **Thomas Sutikna**<br>Modern humans on Flores by ~46 thousand years ago: New evidence from Liang Bua |
| **Session 11 • Podium** | |
| 16:20 | **Nicholas Conard**<br>Fiber technology, rope-making, textiles and the *Lochstäbe* from the Aurignacian of the Swabian Jura |
| 16:40 | **Hélène Rougier**<br>The Troisième caverne of Goyet (Belgium): An exceptional site with both Neandertal and Upper Paleolithic human remains |
| 17:00 | **Mona Le Luyer**<br>Dental reduction in Late Pleistocene and Early Holocene human populations: a reappraisal in a whole crown perspective |
| 17:20 | **Nohemi Sala**<br>Mortuary practices during Magdalenian in the Swabian Jura |
| 17:40 | **Mathilde Samsel**<br>Continuities and discontinuities in human craniofacial morphology from the Final Palaeolithic to the Late Mesolithic in Western Europe |
| 18:00 | **Jeanne Marie Geiling**<br>Assessing the Role of the Northern Iberian Refugium during the Last Glacial. Analysis of Upper Paleolithic Economic Strategies at El Mirón Cave and other Cantabrian sites |
| 18:20 | **Ekaterina Stansfield**<br>Modern humans before the transition to agriculture: What are the implications for the evolution of our species? |
| 20:30-23:00 | **Closing Party • Museo ArqueológicoRegional** |

# Abstracts
# European Society for the study of Human Evolution

Madrid September 2016

Pecha Kucha Presentation: Session 10, Sa (15:00-15:25)

## Of mice and monkeys: quantitative models for the hybrid phenotype

**Rebecca Ackermann[1], Kerryn Warren[1], Robyn Humphreys[1], Lauren Schroeder[1,2], Terrence Ritzman[1], Chris Percival [3], David Katz[4], Sreetharan Kanthaswamy[5], Tim Weaver[1], Jeffrey Rogers[6,], James M. Cheverud[7], Benedikt Hallgrimsson[3]**

1 - Department of Archaeology, University of Cape Town, Rondebosch 7701, South Africa · 2 - Department of Anthropoloy, University of Buffalo, SUNY, Buffalo, NY, USA · 3 - Department of Cell Biology and Anatomy, University of Calgary, Calgary, AB, Canada · 4 - Department of Anthropology, University of California, Davis, California, USA · 5 - School of Mathematical and Natural Sciences, Arizona State University at the West Campus, Arizona, USA · 6 - Human Genome Sequencing Center, Department of Molecular and Human Genetics, Baylor College of Medicine, Houstan, Texas, USA · 7 - Department of Biology, Loyola University Chicago, Chicago, IL, USA

Hybridization is widespread among sexually reproducing groups of organisms, and results in the transfer of genes from one lineage to another. For hominins, a number of recent genetic studies have revealed a complex picture of lineage divergence and reticulation, resulting in the diversity we see among humans today. These studies have primarily focussed on the contact between lineages in Eurasia in the late Pleistocene, although studies of African diversity and ancient DNA from earlier time periods have added to the picture of widespread gene exchange. Although ancient DNA in particular has begun to provide important insight into the dynamics of this gene exchange, sample size and preservation limit its applicability, especially for providing details on precisely where and when gene exchange occurred, and examining gene exchange in the deeper past. Moreover, as studies from other organisms (e.g. bears) indicate, there are multiple scenarios by which we can get to a final product of, say ca. 3% introgressed DNA; only a finer grained temporal record, correlated with a deeper understanding of behavioural and environmental change, can provide us with such information.

Here we present ongoing research into the effects of hybridization on the phenotype of three mammals: mice, baboons, and macaques. This research provides alternative but also complementary means for identifying hybrids in the past, such as Oase 1 & 2, thereby potentially increasing the resolution of our record. Previous studies focussed on understanding and quantifying cranial variation in one of these primates (*Papio* baboons) as well as other mammalian taxa. These studies showed that hybrids are often transgressive, displaying craniofacial traits not present (or present at very low frequency) in unhybridized samples. These traits include atypical dental and sutural variation, and suggest that hybridization results in detectable signatures of breakdown in the coordination of early development. Here, analyses of size and shape (in addition to non-metric) variation in the crania, as well as postcranial variation, are presented. Mouse samples include *Mus musculus* subspecies (N=150), as well as *M. spretus* (N=50), and various first generation (F1), second generation (F2), and backcrossed (B1; B2) hybrids. Baboon samples are drawn from pedigreed baboon crania (N=985) from the Southwest National Primate Research Center in Texas, and primarily represent parental taxa and F1 crosses. Results indicate that both hybrid mice and baboons are generally heterotic, with variation that is outside of the range of the parental taxa. Individual transgressive hybrids are also identified. For the mice, these results hold across the whole phenotype, and not merely the skull, and also include transgressive coat colour/pattern traits. Beyond the F1 generation the hybrids move towards the parental phenotype in shape, however when considered in a multigenerational context the "hybrid swarm" conforms to our expectations for increased variance relative to parental groups. Macaque data, drawn from a sample of multi-generational Indian*Chinese crosses from the California National Primate Research Center, are beginning to provide information on later (e.g. 4th generation and beyond) hybrids. Currently the combined results of metric and non-metric skeletal studies offer a means for determining hybrid status in the fossil record of human evolution.

Financial support: National Research Foundation of South Africa; DST/NRF Centre of Excellence in Palaeosciences (COE-Pal); NSF HOMINID program grant #BCS-0725068; NSF Rapid Grant.

Poster Presentation Number 99, Th (18:00-20:00)

## Lithic Procurement Strategies in the Lower Paleolithic: A View From Acheulo-Yabrudian Qesem Cave, Israel

**Aviad Agam**[1]

1 - Tel-Aviv University

Lithic raw material procurement strategies used by prehistoric societies are often divided into two types: direct procurement, which is the forming of task-specific forays, aimed at the acquisition of lithic materials; and embedded procurement, in which lithic materials acquisition is integrated into other subsistence activities [1]. The current study is part of a larger, on-going research project analyzing patterns of lithic procurement and exploitation at the Acheulo-Yabrudian (Late Lower Paleolithic) site of Qesem Cave, Israel [2]. The study is investigating the strategies of flint procurement applied by the Qesem Cave occupants – Did they procure flint by direct procurement, embedded procurement, or a combination of the two? To achieve this goal 6000 pieces from three well-defined lithic assemblages, with similar chronology ( 300 kya), were studied. Two of the studied assemblages are blade-dominated Amudian, and one is Yabrudian (dominated by Quina scrapers). The studied items were classified into flint types, according to visual traits. Fieldwork around the site was undertaken in order to locate potential flint sources, following the flint-bearing outcrops, using geologic maps. Flint sources were crossed with flint types, using both macroscopic and petrographic data, and types were assigned to potential sources. Flint types were divided into five groups of potential sources: up to 8 km from the site ("local"), 12-13 km, 15 km, 30 km, and unknown. These correlations will be further tested in the future using geochemical analysis. The results suggest that early humans used a combination of strategies for the acquisition of lithic materials: short-distance direct procurement; short-distance embedded procurement; long-distance direct procurement; and long-distance embedded procurement. Availability surely played a significant role in selecting raw materials for tool production. However, it was certainly not a sole consideration. While "local" materials dominate the three assemblages, flint types from more distant sources (12-13 km and 15 km away) also appear in significant proportions, indicating that an effort was invested in bringing specific types of flint from afar as well. Flint pieces from outcrops 30 km away, on the other hand, are found in low proportions, indicating it was not a main source for acquiring flint for the Qesem inhabitants. Complex flint procurement strategies have already been demonstrated at Qesem: 10Be contents in artefacts from the cave were used to distinguish between flints collected from the surface or by shallow mining and flints extracted from quarried or primary sources [3], indicating that both procurement strategies were used by the Qesem inhabitants. A certain degree of selectivity in the pattern of exploitation of certain flint types was detected. For example, the eight most dominant flint types used for the manufacture of scrapers in the Yabrudian assemblage were not used to produce scrapers from the two Amudian assemblages, implying differences in behaviors in the production of Yabrudian and Amudian assemblages. In some cases, a preference towards specific mechanical-related traits (i.e., size of grains, degree of translucency and homogeneity) may be suggested. These considerations may be related to technological aspects. In other cases, differences in pattern of exploitation of certain flint types could not be explained by technological reasoning. As these changes cannot be associated with availability, and as random collection does not seem likely, it is more likely that some other considerations, possibly cultural in nature, affected these choices. To conclude, the results demonstrate the diversity in lithic acquisition strategies applied by the Qesem hominins. They also emphasize the importance of flint in the Qesem inhabitants' lives, and the great efforts and thought put into its procurement.

**References:** [1] Binford, L.R., 1979. Organization and formation processes: looking at curated technologies. J. Anthropol. Res., 255-273. [2] Wilson, L., Agam, A., Barkai, R., Gopher, A., 2016. Raw material choices in Amudian versus Yabrudian lithic assemblages at Qesem Cave: A preliminary evaluation. Quatern. Int. In press. doi:10.1016/j.quaint.2015.02.015. [3]Verri, G., Barkai, R., Bordeanu, C., Gopher, A., Hass, M., Kaufman, A., Kubik, P., Montanari, E., Paul, M., Ronen, A., Weiner, S. Boaretto, E. 2004. Flint mining in Prehistory Recorded by in Situ Produced Cosmogenic 10Be. Proc. Natl. Acad. Sci. 101, 7880–7884.

Pecha Kucha Presentation: Session 6, Fr (15:25-15:50)

## Neandertal adaptations in Central Iberia: a multi-proxy investigation of the Middle Paleolithic site of Peña Cabra, Guadalajara, Spain

**Manuel Alcaraz-Castaño[1], Javier Alcolea-González[2], Gerd-Christian Weniger[1], Javier Baena-Preysler[3], Rodrigo de Balbín-Behrmann[2], Felipe Cuartero[3], Martin Kehl[4], José-Antonio López-Sáez[5] Raquel Piqué[6], José Yravedra[7]**

1 - Neanderthal Museum, Germany · 2 - Área de Prehistoria, Universidad de Alcalá, Spain · 3 - Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid, Spain · 4 - Institute of Geography, University of Cologne, Germany · 5 - Grupo de Investigación Arqueobiología. Instituto de Historia, CCHS CSIC, Spain · 6 - Departament de Prehistòria, Universitat Autònoma de Barcelona, Spain · 7 - Departamento de Prehistoria, Universidad Complutense de Madrid, Spain

The interior lands of the Iberian Peninsula are a key area to investigate important issues on Neandertal settlement patterns and population dynamics. The nature of Neandertal adaptations to the harsh environments of the upland regions of the Spanish plateau, and the long-claimed Mousterian late survival south of the Ebro basin are among the most relevant. However, well-dated sequences bearing environmental data and informative faunal and lithic assemblages have been traditionally scarce in these territories. Although some recently published research have started to call into question previous models and assumptions [1, 2], we are still in need of more robust data. Here we focus on the environs of the Central System Range (central Iberia). This area, together with the Madrid Basin, is where more significant advances have been made in the last years [1-4]. In the framework of a project aimed at investigating human-environment interactions and population dynamics during the Late Pleistocene in central Iberia, we have conducted new geoarcheological fieldworks at the Peña Cabra site. This is a northwest-oriented limestone rock shelter located at 868 m above sea level. It lies within the Upper Tagus basin (Sorbe River valley, Guadalajara) and it hosts a multi-layered fluvial deposit containing Mousterian assemblages. Our objectives and methods have been the following: 1) Study of the site formation processes (micromorphology, sedimentology and taphonomy). 2) Chronometric analysis (14C and OSL). 3) Study of environmental and climatic setting (palynological, anthracological and sedimentological analyses). 4) Study of human-environment interactions and techno-economic and social behaviours (lithic technology, zooarchaeology and integrating all data). Here we present the first results of these analyses, and we discuss them in the context of the current problems of the Neandertal settlement of central Iberia. Micromorphology shows that Mousterian assemblages are preserved in mostly in situ archeological layers, and taphonomic analysis of the bones points to a highly anthropogenic nature of the faunal assemblages, with very few signs of carnivore action. These data suggest that the deposit was not subject to important post-depositional alterations. Presence of fire activity was detected both at the microscopic and macroscopic level, as primarily shown by thermoaltered lithic and bone objects. Palynological and anthracological data show an open and cold environment dominated by Pinus. However, the presence of several thermophilous and mesophilous taxa in the pollen record suggest that the area could have acted as an ecological refuge for arboreal species. Faunal assemblages show that hunting strategies were focused on horse, reed deer, roe deer and goat. All these animals were introduced to the site by humans. Lithic technology shows at least three different *Chaîne Opératoires*: a first one based on discoid knapping methods produced on quartzite and quartz, a second based on Levallois technology on flint and quartzite, and a third one aimed at the production of small tools by means of a micro-Levallois method carried out on flint and fine-grained quartzite. Retouched tools, including sidescrapers and points, are abundant, and some of them exhibit traits of intensive exploitation, such as resharpening and recycling. However, there is no strong evidence of ramification processes, being the micro-Levallois production most probably an intentional strategy, and not a by-product of the necessity of maximizing available lithic resources. This intentional search for small tools, scanty detected in the Iberian interior, suggests that these Neandertal societies had a complex techno-economic organization . These results depict the Peña Cabra rockshelter as one of the few currently known archives bearing different proxies for the study of human-environment interactions and population dynamics during the Middle Paleolithic in inland Iberia.

This research is supported by a Marie Curie Intra European Fellowship within the 7th European Community Framework Programme. It is also benefited from the CRC 806 "Our Way to Europe", funded by the *Deutsche Forschungsgemeinschaft*, and the Spanish Research Projects HAR2013-43701-P and HAR2013-48784-C3-3 of the *Plan Nacional de I+D+i* of the *Ministerio de Economía y Competitividad*. Fieldworks in Peña Cabra were authorized by the *Dirección General de Cultura de la Junta de Comunidades de Castilla – La Mancha* (Spain).

**References**:[1] Kehl, M. et al. 2013. Late Neanderthals at Jarama VI (central Iberia)? Quaternary Research 80, 218-234. [2] Baena, J. et al. 2015. Recycling in abundance: Re-use and recycling processes in the Lower and Middle Paleolithic contexts of the central Iberian Peninsula. Quaternary International 361, 142-154. [3] Márquez, B. et al. in press. Microwear analysis of Mousterian quartz tools from the Navalmaillo Rock Shelter (Pinilla del Valle, Madrid, Spain). Quaternary International [4] Álvarez-Alonso, D. et al. in press. Neanderthal settlement in central Iberia: Geo-archaeological research in the Abrigo del Molino site, MIS 3 (Segovia, Iberian Peninsula). Quaternary International [5] Dibble, H. L., McPherron, S. P. 2006. The Missing Mousterian. Current Anthropology 47 (5), 777-803.

Poster Presentation Number 61, Th (18:00-20:00)

## Visualising and Investigating the Effect of Environment on Prey Detection Rates

**Peter Allen**[1], **John Stewart**[1], **Jan Wiener**[1], **Christos Gatzidis**[1]

1 - Bournemouth University, UK

The opening of the vegetation in the environment of Europe during MIS3 which accompanied the transition from the Aurignacian to the Gravettian industries is likely to have affected hunting styles of those respective populations. Hunting styles in open habitats have been characterised as pursuit hunting versus the encounter hunting utilised in the more closed environments. A missing area of investigation concerns the ability to detect prey visually in a given environment prior to hunting. Our hypothesis is that the degree of vegetation openness is positively correlated with the distance at which prey can be reliably detected.

Our approach to investigate this utilises realistic virtual outdoor environments of varying compositions, each environment containing a red deer as a "target" object. These requirements are based on data about the vegetation found in Southern Europe prior to the Last Glacial Maximum , allowing us to understand changes in prey detection rates experienced by the Aurignacian and Gravettian societies as Europe climate changed during MIS3.

Participants are presented with 32 trial environments, each generated according to parameters such as the size of the area to be represented, foliage species contained, density and the upper and lower bounds for the initial distance to the prey animal. Environments can be either grassland or forest, with foliage densities of 2000, 5000, 8000 or 11000 instances per square km. Participants are instructed to search the environment visually as they are moved forwards at walking pace, their task being to locate the deer. The participant can indicate when the prey is found and its location. Environments are presented via a 3-screen setup giving a more naturalistic field of view than a single screen would allow.

To analyse how prey spotting distance was affected by the environment, we ran an ANOVA with the within factors environment (forest, grassland) and density (2000, 5000, 8000 or 11000 foliage instances per sq Km) which revealed main effects for environment ($F(1,14)=117$; $p<.05$) and density ($F(3,42) = 61$; $p<.05$) but no interaction. We had expected that spotting distance in the grassland environments would remain high even as density increased but instead found that while spotting distance was greater in the grasslands environments as compared to forests of the same density, spotting distance decreased linearly with increasing vegetation density in both environment types.

**References:**[1] Huntley, B., Allen, J., 2004. Glacial Environments III: Palaeo-vegetation Patterns in Last Glacial Europe. In: Andel, T. (Ed.), Neanderthals and modern humans in the European landscape during the last glaciation. McDonald Institute for Archaeological Research, Cambridge, pp. 79-102.

Poster Presentation Number 59, We (17:00-19:00)

## Comparison of three microscopy techniques applied to functional analysis of use-wear on experimental stone tools

**Ana Álvarez-Fernández[1], Rebeca García-González[1], Belén Márquez[2], José Miguel Carretero[1,3], Juan Luis Arsuaga[3,4]**

1 - Laboratorio de Evolución Humana, Dpto. de Historia, Geografía y Comunicación, Universidad de Burgos, Burgos, Spain · 2 - Museo Arqueológico Regiona, Alcalá de Henares, Madrid, Spain · 3 - Centro Mixto UCM-ISCIII de Investigación sobre evolución y comportamiento humanos, Madrid · 4- Departamento de Paleontología, Universidad Complutense de Madrid, Madrid, Spain

Traceology, the archaeological discipline that analyzes and identifies the use-wear on stone tools edges, is one reliable approach to infer the subsistence strategies in prehistoric humans, since provide us direct information about the function and use of stone tools [i.e. 1, 2, 3].

Traditionally, analyses of use-wear have been performed through steromicroscope or Optical Light Microscope (OLM). However, the conclusions of these studies are limited because the magnification of these microscopes. These limitations were solved with the use of Scanning Electronical Microscope (SEM) and, most recently, with Laser Scanning Confocal Microscopy (LSCM). However, although OLM and SEM are proved as good complementary techniques, it is not yet fully understood if the application of these three new methodologies implies a real improve in this field. The aim of this study is to compare the results obtained by OLM, SEM and LSCM in a controlled work.

An experimental sample of 10 flint flakes has been analyzed after their use on antler (five) and bone (five). These two worked materials have been chosen because the difficulties of distinguish the wear traces leave by them in used archaeological stone tools. During the experimentation, beyond worked material, the orientation and work time have been also controlled. The experimental tools were then analyzed by OLM, SEM and LSCM.

Observation of the experimental use-wear through OLM returned the expected results. Work with antler produced a soft and shiny polish displayed in blocks and micro-holes and craquelures can be observed on them. On the other hand, work with bone produced very shiny and compact polish that looks continuous and is located close to the edge. SEM has proven be a good complement to these visualizations thanks to its ability to work with high magnifications, amplifying the depth of field. In this way, images obtained with SEM have allowed us to distinguish successfully between the two different groups of used tools.

LSCM can perform tridimensional measurements and provides a series of statistical parameters. In this study, five topographic variables related to the peak-to-valley amplitude have been selected in order to determine whether the resulting polish can be observed and quantified or not in the surface topography. Two of them parameters display average values: Pa (average of the height) and Pq (standard deviation of the height); and three display absolute parameters: Pp (highest value of the peaks), Pv (deepest value of the valleys) and Pt (addition of the highest value of the peak and the deepest value of the valley). Distinction between worked materials, in this case, antler and bone, is not definitive yet but we can distinguish between active edges and non-active zones. When active edges to non-active zones are compared both, the values of the five parameters are higher on active edges than on non-active zones. We have observed differences between every parameter, but that differences are more obvious between the parameters Pp, Pv and Pt than the parameters Pa and Pq.

Our results show that the integration of different microscopy techniques notably improves the interpretation of use-wear surfaces on lithic tools. Optical microscopes along with the SEM allow us to distinguish between different used surfaces. When these surfaces are analyzed with LSCM, we obtain several metrical parameters which are susceptible of statistical analysis to perform an objective comparison.

The authors received support from the Ministerio de Economía y Competitividad, Spain (project CGL2012-38434-C03-01).

**References:**[1] Semenov, S.A., 1964. Prehistoric Technology: an experimental study of the oldest tools and artefacts from traces of manufactures and wear. Adams & Dart, Bath.[2] Borel, A., Ollé, A., Vergès, J.M., Sala, R. 2013. Scanning Electron and Optical Light Microscopy: two complementary approaches for the understanding and interpretation of usewear and residues on stone tools, J. Archaeol. Sci. 48, 46-59.[3] Evans, A.A., Donahue, R.E. 2008. Laser scanning confocal microscopy: a potential technique for the study of lithic microwear, J. Archaeol. Sci. 35, 2223-2230.

Poster Presentation Number 111, Th (18:00-20:00)

## Assessing the behavioural drivers of lithic flake variability through geometric morphometrics

**Will Archer[1], Stefan Schlager[2], Cornel M. Pop[1], Zeljko Rezek[1], Tamara Dogandžić[1], Dawit Desta[1], Marcel Weiss[1], Sam Lin [1], Shannon McPherron[1]**

1 -Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 2 - Biological Anthropology, Faculty of Medicine, Albert-Ludwigs-University Freiburg, Germany

The archaeological record represents one window onto a complex evolutionary relationship between environment and hominin behaviour. Technological systems in particular reflect a dynamic set of interactions between human cognitive capacity, ecological variables and cultural tendencies. Quantifiable differences in the morphology of flaked stone artefacts - the most abundant remains of past behaviours for much of human evolutionary history - may reflect differences in hominin technological capacity. However, drawing inferences between aspects of technological variability and specific human decision making processes is a complex endeavour. What is needed is a detailed picture of the complex causal relationship between knapping behaviours and artefact morphological variation.

In a controlled experimental setup Dibble and colleagues documented how flake size and shape vary relative to the effects of a host of strictly monitored independent variables. This ongoing work largely established the hierarchical importance of platform dimensions and external platform angle ('EPA') in driving shape variation, relative to the lesser effects of variables that are more closely controlled by the stone artefact knapper [1,3,4]. However, when these experimental results are applied to actual assemblages there remains a significant amount of unexplained variability, particularly when considered on a flake by flake basis [2]. It is still unclear whether this is a result of measurement error on certain key variables (e.g. EPA), whether traditional linear measurements are a limiting factor in general, or whether there are additional flake shape predictors that remain unaccounted for.

Our aim is to build upon Dibble's work by both (a) extending the characterization of variability beyond the linear measurements that are traditionally relied on in lithic analysis, and (b) by exploring causal relationships in an assemblage which more closely resembles the dispersion of shape and size that one expects to see in the archaeological record. Our experimental dataset of flakes was produced by a range of different knappers, on a set of different raw-materials, and via a range of different core reduction strategies. To help address issues of measurement error and unexplained variability, we opted for shape analysis rather than more traditional linear measurements. Thus we develop a new approach to capturing flake variation in this collection by drawing on the powerful statistical shape analysis tools of three-dimensional geometric morphometrics ('3DGM'). Although a number of attempts have been made to develop 3DGM approaches to analysing overall stone artefact morphologies, a method that captures all important flake curves and surfaces in three dimensions has remained elusive. We CT and surface scanned a large collection of complete experimental flakes, and then proceeded to landmark homologous features on these scans. We further applied approaches to slide landmarks along the geometrically correspondent curves and surfaces of flakes in the scanned assemblage. Here we introduce this broader project including our aims and objectives and a discussion of our methodological protocol. Our statistical models, which are developed on a small set of three-dimensional flake platform predictors, estimate artefact shape and size exceptionally well. Preliminary findings indicate that 3DGM provides a useful set of tools to predict the shape and size of resharpened and broken artefacts in the archaeological record. These methods will become increasingly important as advances in the efficiency of scanning technologies make the wider application of 3DGM in stone artefact archaeology even more feasible.

We thank the Max Planck Society for their support of this research.

**References:**[1] Dibble, H. L., & Rezek, Z. (2009). Introducing a new experimental design for controlled studies of flake formation: results for exterior platform angle, platform depth, angle of blow, velocity, and force. Journal of Archaeological Science, 36(9), 1945-1954.[2] Dogandžić, T., Braun, D.R., & McPherron, S.P. (2015). Edge Length and Surface Area of a Blank: Experimental Assessment of Measures, Size Predictions and Utility. PLoS One, 10(9), e0133984.[3] Magnani, M., Rezek, Z., Lin, S. C., Chan, A., & Dibble, H. L. (2014). Flake variation in relation to the application of force. Journal of Archaeological Science, 46, 37-49.[4] Rezek, Z., Lin, S., Iovita, R., & Dibble, H. L. (2011). The relative effects of core surface morphology on flake shape and other attributes. Journal of Archaeological Science, 38(6), 1346-1359.

Pecha Kucha Presentation: Session 2, Th (12:10-12:35)

## New bracketing luminescence ages constrain the Sima de los Huesos hominin fossils to MIS 12

**Lee Arnold**[1], **Martina Demuro**[1], **Arantza Aranburu**[2], **Juan Luis Arsuaga**[3]

1 - University of Adelaide · 2 - Universidad del Pais Vasco · 3 - Universidad Complutense de Madrid

Located within the deep chambers of the Atapuerca karst system (northern Spain), the Sima de los Huesos (SH) site has yielded thousands of hominin fossils from a single stratigraphic level. Nuclear DNA sequencing and cranial morphological analyses of these fossils have firmly placed the SH hominins at the beginning of the Neanderthal lineage [1,2] and have shown a mosaic pattern of evolution, with certain Neanderthal specialisations (teeth, face, temporomandibular joint and occipital bone) arising earlier than other Neanderthal apomorphies. Establishing firm minimum and maximum ages for the SH fossils using numerical dating techniques is equally important for understanding the evolutionary history of these individuals and their temporal relationships with other Early and Middle Pleistocene hominin records from Europe. The minimum age of the SH fossils has recently been constrained to at least 430 ka (onset of Marine Isotope Stage (MIS) 11) via luminescence and U-series dating of closely overlaying sedimentary material [1,3]. However, a bracketing (maximum) age limit still needs to be established in order to firmly constrain the chronology of the SH remains and to confirm the timing for the onset of Neanderthal speciation.

This study aims to resolve this important gap in the SH chronological record and determine an improved precision, bracketing chronology for the hominin remains. To this end, we report on new luminescence dating results obtained for the sediment layer directly underlying the hominin accumulations.

A total of four new luminescence dating samples were obtained in this study. All samples came from red clays that either encased (LU-6) or immediately underlay (LU-5) the hominin fossils. Three samples were collected from LU-6, which is predominantly composed of very fine sandy silt (red clays), high density of hominin and carnivore fossils, and varying amounts of intraclasts. Two of these samples were collected from the main SH chamber and a third one was obtained from the middle section of the Sima ramp. The fourth sample was collected from the lower section of the Sima ramp within LU-5, a unit with the same composition as LU-6 but without fossils. Luminescence ages were obtained using thermally-transferred optically stimulated luminescence (TT-OSL) measurements made on individual quartz grains, following the successful application of this 'extended-range' luminescence dating technique at several independently dated Atapuerca sites [4]. An average of 4,000 grains were measured on each sample. Data was analysed following [3] and ages were calculated using dose rate values obtained from a combination of beta counting and in situ field gamma spectrometry measurements.

The results suggest that the red clays were sufficiently exposed to daylight to ensure adequate bleaching of the TT-OSL signals prior to their deposition in the cave. The resulting four TT-OSL luminescence ages for LU-6 and LU-5 are statistically indistinguishable at $2\sigma$ and are in close agreement with the 430 ka age published for the material overlying the fossils [1]. The integration of these minimum and maximum ages places the accumulation of the SH hominins firmly within MIS 12.

Our new ages confirm that the SH hominins are the earliest known palaeodeme exhibiting clear Neanderthal features. Significantly, several other European Middle Pleistocene fossils of purportedly similar or younger age do not show the same clear Neanderthal features apparent in the SH individuals (at least in the preserved regions). The latest SH dating results therefore point to a complex phylogeographic pattern, with several lineages coexisting in the same continent for perhaps a long period. This is an exciting scenario to be confirmed with future extended-range luminescence dating of other European hominin sites.

**References:**[1] Arsuaga, J.L., Martínez, I., Arnold, L.J., Aranburu, A., Gracia-Téllez, A., et. al (2014) Neandertal roots: cranial and chronological evidence from Sima de los Huesos. Science 344, 1358-1363.[2] Meyer, M., Arsuaga, J.L., de Filippo, C., Nagel, S., Aximu-Petri, A., et.al (2016) Nuclear DNA sequences from the Middle Pleistocene Sima de los Huesos hominins. Nature 531, 504-507.[3] Arnold, L.J., Demuro, M., Parés, J.M., Arsuaga, J.L., Aranburu, A.,et.al. (2014) Luminescence dating and palaeomagnetic age constraint on hominins from Sima de los Huesos, Atapuerca, Spain. J Hum Evol 67, 85-107.[4] Arnold, L.J., Demuro, M., Parés, J.M., Pérez-González, A., Arsuaga, J.L., et.al (2015) Evaluating the suitability of extended-range luminescence dating techniques over Early and Middle Pleistocene timescales: Published datasets and case studies from Atapuerca, Spain. Quat Int 389, 167-190.

Poster Presentation Number 110, Th (18:00-20:00)

## Neandertals at Atapuerca: the MIS3 Galería de las Estatuas site

**Juan Luis Arsuaga[1,2], Asier Gómez-Olivencia[2,3,4,5], Alejandro Bonmatí[2], Adrián Pablos[2,6,7,8], Virginia Martínez-Pillado[6], Jaime Lira [2], Almudena Alcázar de Velasco[2], Ana Pantoja[2], Nohemi Sala[2,7], Ana Isabel Ortega[6], Gloria Cuenca-Bescós[9], Nuria García[1,2], Arantza Aranburu[11],Blanca Ruiz-Zapata[10], María José Gil-García[10], Xosé Pedro Rodríguez-Álvarez[11,12], Andreu Ollé[12,13], Marina Mosquera[12,13]**

1 - Dpto. de Paleontología, Universidad Complutense de Madrid, Spain · 2 - Centro mixto UCM-ISCIII de Investigación sobre Evolución y Comportamiento Humanos, Spain · 3 - Dpto. Estratigrafía-Paleontología, Universidad del País Vasco · 4 - Ikerbasque-Basque Fundation for Science · 5 - Musée de l'Homme · 6 - Centro Nacional de Investigación sobre Evolución Humana, Burgos, Spain · 7 - Paleoanthropology. Eberhard Karls Univ. Tübingen, Germany · 8 - Cc de la Vida. Univ. Alcalá, Spain · 9 - Paleontología, Aragosaurus-IUCA and Facultad Ciencias, Universidad de Zaragoza, Spain · 10 - Departamento Mineralogía y Petrología, Facultad de Ciencia y Tecnología, Euskal Herriko Unibertsitatea, Bilbao, Portugal · 11 - Geo-Q ARANZADI, Leioa (Bizkaia) · 10 - Departamento de Geología, Geografía y Medio Ambiente Ed. Ciencias, Universidad de Alcalá de Henares, Spain · 12 - Àrea de Prehistòria, Dept. d'Història i Història de l'Art, Univ. Rovira i Virgili, Tarragona, Spain · 13 - Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain.

Cave sites with Mousterian occupations in the Iberian Peninsula are mainly limited to the Northern, Eastern and Southern mountain ranges. Thus, the information available for the interior part of the Iberian Peninsula is very limited. Since 2008, we are working on a new cave site in the Sierra de Atapuerca (Burgos, Spain): Galería de las Estatuas (GE). GE is a subhorizontal cavity located at the upper level of the Cueva Mayor-Cueva del Silo karst system [1]. This gallery was an ancient entrance to the cave system which is currently closed and sealed by a stalagmitic crust whose base has been dated in ca. 14 ka BP [2]. Two test pits, GE-I (9m$^2$) and GE-II (6m$^2$) have been excavated. They reveal, below the stalagmitic crust, the presence of a detrital sedimentary sequence of more than 2 m which has been divided into 5 geological levels [3] with a rich assemblage of faunal and lithic remains. The macromammal assemblage (ca. 1100 specimens) is composed by both ungulates and carnivores. The most common prey species are red deer (*Cervus elaphus*) and equids (*Equus* sp.). Mitochondrial analysis on the latter have provided evidence of the presence of, at least, *E. hydruntinus*. Large bovids (in which, *Bison* cf. *priscus* has been identified) are also present, though in a lower proportion. Carnivores, which represent ca. 7% of the macromammal assemblage, are mainly represented by foxes (*V. vulpes*) and hyenas (*C. crocuta*). The taphonomic analysis of the macromammal assemblage reveals both anthropic, and to a lesser extent, carnivore activities. Small carnivores and owls are likely the main responsible for the accumulation of the microfaunal assemblage. 228 specimens have been identified to the species level. The small mammals are dominated by open habitat dwellers, such as humid to dry meadows, such as *Marmota* sp., *Microtus arvalis* and *M. agrestis*. Somewhat warm rodent species, as *Hystrix (Acanthion) vinogradovi* are present, though their presence is definitively small. Beaver (*Castor fiber*) is also present, but poorly represented. The pollen sequence shows two different polinic zones. The lower levels would correspond to an open landscape dominated by Asteraceae; cold conditions were present in this first part of the sequence. The upper part of the sequence corresponds to a warmer-humid moment with greater development of forests, dominated by *Pinus*, though other taxa are present (e.g., *Quercus, Corylus*). A total of 499 lithic objects have been found. Flint is the most common raw material (83.8%). The raw materials are locally available but there is a clear selection towards those that show the best quality. The retouched flakes represent the 8% (n=40) of all the lithic industry and from a typological point of view, the most common elements are side-scrapers (n=18; some of which show the "Quina" type retouch), and denticulates (n=12). The study of the cores and some of the flakes reveals centripetal knapping, some of which shows the characteristic *Levallois débitage*. One quartzite core shows evidence of bipolar-on anvil technique. However, the low amount of cores (n=8) and the fact that 64.3% of the remains have a maximum length <20mm suggest that retouching activities were more common than those of *débitage*. In sum, the lithic industry shows a clear Mousterian affinity. The radiocarbon datings of bone and tooth remains from both test pits locate this archaeo-paleontological assemblage from 43.5 ka uncal BP to older than 46.3 ka uncal BP. This is consistent with the archaeopaleontological evidence and would be roughly contemporaneous with the Neandertal site of Valdegoba [5]. Galeria de las Estatuas would correspond to a site used by Neandertals, and also sporadically by carnivores providing important information regarding Neandertal occupations and landscape changes during MIS3 in the Northern Plateau of the Iberian Peninsula prior to the demise of this species.

We would like to acknowledge to the whole GE excavation team that during the 2008-2015 period: this work has been possible thanks to their effort. Field work at Atapuerca is funded by Junta de Castilla y León and Fundación Atapuerca. The study was supported by the Spanish Ministerio de Ciencia y Tecnología (Projects CGL2012-38434-C03-01, CGL-2015-65387-C3-2-P, (MINECO/FEDER), CGL-2015- 65387-C3- 1-P). AGO is also funded by the Gobierno Vasco/Eusko Jaurlaritza (Research Group IT834-13). AO, XPRA and MM also receive support from the Generalitat de Catalunya (Project 2014SGR899). AA also receives support from the University of Basque Country (Project US-14/16).

**References:**[1] Ortega, A.I., Benito-Calvo, A., Pérez-González, A., Martín-Merino, M.A., Pérez-Martínez, R., et.al. (2013) Evolution of multilevel caves in the Sierra de Atapuerca (Burgos, Spain) and its relation to human occupation. Geomorphology 196, 122-137.[2] Martínez-Pillado, V., Aramburu, A., Arsuaga, J. L., Ruiz Zapata, B., Gil García, M. J., et.al. (2014) Upper Pleistocene and Holocene palaeoenvironmental records in Cueva Mayor karst (Atapuerca, Spain) from different proxies: Speleothem crystal fabrics, Palynology and Archaeology. International Journal of Speleology, 43 (1): 1-14.[3] Aranburu, A., Martínez-Pillado, V., García, F., Arsuaga, J.L., Alcázar de Velasco, A., et.al (2012) La variabilidad de los rellenos endokársticos de la Galería de Estatuas (Atapuerca, Burgos) y su caracterización paleoambiental. In: González-Díez, A., et al.(Eds.), Avances de la Geomorfología en España 2010-2012. Actas de la XII Reunión Nacional de Geomorfología. Santander, 17-20 septiembre de 2012. PUbliCan Ediciones. Universidad de Cantabria, Santander, pp. 397-400.[4] Quam, R.M., Arsuaga, J.L., Bermúdez de Castro, J.M., Díez, C.J., Lorenzo, C.,et.al. (2001) Human remains from Valdegoba Cave (Huérmeces, Burgos, Spain). J. Hum. Evol. 41, 385-435.[5] Dalén, L., Orlando, L., Shapiro, B., Durling, M.B., Quam, R., et.al. (2012) Partial genetic turnover in neandertals: continuity in the east and population replacement in the west. Molecular Biology and Evolution 29, 1893-1897.

Poster Presentation Number 139, Th (18:00-20:00)

## Learning to knap in the Lower Palaeolithic: Archaeological evidences for knowledge transmission in Qesem Cave, Israel

**Ella Assaf**[1]

1 - Tel-Aviv University

The late Lower Palaeolithic Acheulo-Yabrudian Cultural Complex (AYCC) in the Levant is a time of significant changes and innovations, such as the emergence of new lineage of hominins and the development of new technological and social behaviors. Did these changes affect the way prehistoric people transmitted knowledge to their descendants? In recent years, growing numbers of researchers have chosen to explore these issues, with an emphasis on learning processes relating to flint knapping. Different levels of knapping skills were identified in various Palaeolithic, Mesolithic and Neolithic sites around the world. Nevertheless, our knowledge regarding the way prehistoric humans acquired and passed their knowledge is still very limited, and more so when we discuss early prehistory. The site of Qesem Cave (dated to 420-200,000 kya) provides rich, well preserved and thoroughly studied lithic assemblages – an opportunity to address issues of knowledge transmission relating to flint knapping. During the 2009-2011 excavation seasons in "The southern area" of the cave, Amudian assemblages were recovered in which various levels of knapping skills are represented, including skilled and unskilled knappers, or knappers who were in the process of learning. The results of the techno-typological study in the southern area indicate knapping activities focused on the production of "simple" items like flakes, while in other areas of the cave blades and tools were produced more intensively. The analysis of cores indicates that unexperienced knappers trained mainly on medium-low quality flint nodules, and practiced the early stages of the flaking process. Over 50% of the cores were continuously knapped despite obstacles for knapping (i.e. disturbances in the raw material, unsuitable angles between the striking platform and the production surface etc.). In many cases, these cores were abandoned in a relatively early stage. In addition, knappres in this area also used existing cores for practicing; the early knapping cycle on these cores is highly professional and is characterized by a set of successful removals of items without creating hinges or steps while overcoming obstacles related to raw material quality. The second production cycle is characterized by short removals, hinges, steps and crushing signs close to the striking platform and we suggest it was carried out by unexperienced knappres (beginners?). It is likely that knowledge transmission has taken place in other areas of the cave as well and was not restricted to a single area of the cave. Yet, a comparative analysis of the southern area's lithics to other areas of the cave shows that the transmission of knowledge (following the criteria we developed) was more prominent in this area indicating a possible spatial pattern. Qesem Cave is becoming a major contributor to our acquaintances with the AYCC. Lithic innovations (e.g., flint quarrying, the production and use of Quina scrapers, systematic blade production, and flint recycling) is but one of a series of new complex behaviors practiced in the AYCC (e.g., the habitual use of fire, hunting prime-aged game, unique butchering patterns, roasting and sharing meat, the use of bone retouchers, and more) – all of which required new ways of learning and knowledge transmission. Few studies have attempted to identify learning processes related to knapping in Lower Palaeolithic assemblages, but as for today, there are no studies that explore knapping skills in AYCC sites. Thorough analyses of lithic assemblages presented in this study may shed some light on the subject, and expand our understanding of knowledge transmission related to flint knapping in early human societies.

Poster Presentation Number 16, We (17:00-19:00)

## Cortical Bone Thickness in Modern Human Mandibles Showing Asymmetric Dental Wear

**Diana Badreddin[1], Cinzia Fornai[2,3], Dzhuliana Badreddin[1], Rudolf Slavicek[4], Oleh Andrukhov[1], Xiaohui Rausch-Fan[1]**

1 - University Clinic of Dentistry, Medical University of Vienna, Austria · 2 - Department of Anthropology University of Vienna · 3 - Institute of Evolutionary medicine, University of Zurich, Switzerland · 4 - A.E.R.S Dental medicine organizations, Vienna

**Introduction**: Bone is a multifunctional and dynamic tissue that requires mechanical stimulation to preserve its competence. In fact, bone mineral density declines significantly in induced conditions of masticatory hypofunction, as demonstrated, for example, by Sato et al. [1]. A particular condition is shown by individuals who have developed an asymmetric mandible in response to a mastication pattern based on a strongly preferred chewing side. According to Baek et al. [2], these subjects show side shift of mandibular body, differences between bilateral rami height and menton deviated to the shorter side. Moreover, their teeth are usually more worn on the preferential chewing side. There is still lack of thorough quantitative investigation on mandibular cortical bone (CB) distribution and thickness in relation to usage of the mandibular structures. With this study, we aim to perform a quantitative analysis of the CB thickness in relation to occlusal dental wear, using 3D image data from individuals showing a marked asymmetric dental wear, since they offer a unique opportunity to investigate the effect of mastication on bone. **Materials and Methods**: Twenty human mandibles from the Weissbach Anatomical Collection, Natural History Museum, Vienna were used. All mandibles exhibited a difference in the degree of wear between left and right first molars (LM1) of at least 2 Molnar classes [3]. Ten specimens with light occlusal wear (stage 1-2), and ten subjects showing heavy occlusal wear (stage 5 or higher) were used as control groups. Mandibular CB thickness was measured on cone beam computer tomography (CBCT) data. After image segmentation (in Amira 6.0.1), a bony portion was identified by means of oriented planes passing through the most mesial and distal points of the LM1 crown. In order to compensate for individual size differences, the average cortical bone thickness (ACBT = CB volume divided by the area of the contact surface between cortical and trabecular bone) was calculated. A permutation test of ACBT was carried out to check for significant differences between worn and unworn sides of the asymmetric specimens, and of the two control groups. The intra-observer error was tested on three repeated measurements performed on the 10 unworn specimens. **Results**:We found no significant statistical differences between ACBT in the asymmetric group of specimens between worn and unworn side. Similarly, the ACBT of the unworn and worn groups did not reveal any significant differences. The intraobserver error was proved negligible. **Conclusions**: Our data show that there are no significant differences in the cortical bone thickness. These results can be interpreted in several ways. It is possible that even though right and left mandibular corpuses differ in individuals showing marked asymmetric dental wear, the cortical bone thickness does not. However, CB thickness might vary locally, which might be better proved by investigating the differences in CB thickness between lingual and buccal sides. We cannot rule out that CBCT image resolution is not sufficient to detect the differences in CB thickness, and microCT images might be necessary. Further research is needed to explore the outcomes of additional approaches, considering for example the entire corpus rather than a portion of it, higher resolution images or CBCT images of patients for which the asymmetric usage of the dental arches is diagnosed.

The authors are grateful to Stefano Benazzi for valuable advices. This study was supported by A.E.R.S. Dental Medicine Organizations GmbH, Vienna, Austria (project number FA547014), and the Siegfried Ludwig - Rudolf Slavicek Foundation, Vienna, Austria (Project number FA547016).

**References**:[1] Sato H, Kawamura A, Yamaguchi M, Kasai K. Relationship between masticatory function and internal structure of the mandible based on computed tomography findings 2005 American Journal of Orthodontics and Dentofacial Orthopedics, Vol 128, Number 6 [2] Baek C, Paeng JY, Lee JS, Hong J. Morphologic evaluation and classification of facial asymmetry using 3-dimensional computed tomography. J Oral Maxillofac Surg. 2012, May, 70 (5).1161-9 [3] Molnar S. Human tooth wear, tooth function and cultural variability. Am J Phys Anthropol. 1971 Mar; 34(2):175-89

Pecha Kucha Presentation: Session 10, Sa (15:50-16:15)

## Taxonomic differences in deciduous lower first molar crown outlines of *Homo sapiens* and *Homo neanderthalensis*

**Shara Bailey[1], Stefano Benazzi[2], Giuseppe Mancuso[2], Rita Sorrentino[2], Jean-Jacques Hublin[3]**

1 - New York University · 2 - University of Bologna · MPI EVA, Dept. of Human Evolution

We have previously demonstrated that the outline shapes of the upper and lower deciduous second molar and permanent first molar are taxonomically diagnostic – especially in separating *Homo neanderthalensis* from *Homo sapiens* [1,2]. The upper deciduous first molar (udm1) shape also has proven to separate these two groups well [1], but the utility of the lower deciduous first molar (ldm1) shape is yet to be explored. Here we assess crown shape differences of ldm1 in fossil and recent humans. The recent *H. sapiens* sample is geographically diverse including 103 individuals from Africa, Europe, South America, India, and Australia. The fossil sample includes 3 early *H. sapiens*, 8 Upper Paleolithic *H. sapiens* and 13 *H. neanderthalensis* individuals. Images of the occlusal surface were either 1) taken with Canon Rebel XT DSLR camera equipped with a macro lens, or 2) obtained from occlusal screen shots of 3D models derived from microCT scans. In either case, each tooth was oriented so that the cervical border was perpendicular to the camera's optical axis. The images were imported into Adobe Photoshop and rotated with the buccal side towards the x-axis to approximate anatomical position. Backgrounds were removed and each image was scaled to approximately the same size and resolution (300 dpi). When interproximal wear was present, the outline was reconstructed by estimating the original mesial and/or distal borders following standard protocols [2]. The occlusal images were then imported in Rhino 4.0 Beta CAD environment (Robert McNeel & Associates, Seattle, WA) and aligned to the xy-plane of the Cartesian coordinate system. The crown outline was manually digitized for each tooth using the spline function, centered superimposing the centroids of their area and then represented by 24 pseudolandmarks obtained by equiangularly spaced radial vectors emanating from the centroid. The first radius was directed buccally and parallel to the y-axis of the Cartesian coordinate system. Size information from the centered and oriented outlines was removed with a uniform scaling of the pseudolandmark configurations to unit centroid size [1, 3]. A principal components analysis (PCA) of the matrix of shape coordinates was carried out to explore the pattern of morphological variation across the ldm1 sample. Finally, we used a leave-one-out cross-validation quadratic discriminant analysis based on the PCs that account for at least 90% of the total variability to assign the specimen to the group (*H. neanderthalensis* contra Upper Paleolithic and recent *H. sapiens*) with the higher posterior probability. For data processing and analyses, we used software routines written in R software v. 2.15.1 [4]. When only PC1 and PC2 are considered, ldm1s cluster fairly tightly and separately from those of Upper Paleolithic *H. sapiens*. However, the range of shapes in the recent *H. sapiens* sample completely overlaps those of the fossil samples. Consequently, results of the quadratic discriminant analysis based on the first PCs that account for about 90% of variation were mixed. While classification overall was 83.5%, Neanderthals were misclassified 70% of the time (9/13 individuals). *H. sapiens* fared better with ca. 10.5% misclassification (12/114 individuals). Moreover, when recent humans were removed from the analysis, accuracy dropped to 67%, with about one-third of each sample (early, Upper Paleolithic and Neanderthal) misidentified. Our results indicate that unlike the udm1 the crown shape of ldm1 is not taxonomically diagnostic. The developmental implications of these results will be discussed.

We thank the curators of the institutions where fossil and recent human samples were collected. We also thank Caroline Souday who helped photograph some of the fossil and recent human samples (under the supervision of SEB). For scanning assistance we thank Matt Skinner, Heiko Temming and Patrick Schoenfeld. This research was funded by the LSB Leakey foundation and the Max Planck Society.

**References:**[1] Benazzi S, Douka K, Fornai C, Bauer CC, Kullmer O, Svoboda J, Pap I, Mallegni F, Bayle P, Coquerelle M et al.2011. Early dispersal of modern humans in Europe and implications for Neanderthal behaviour. Nature 479:525-528 [2] Bailey SE, Benazzi S, Buti L, and Hublin J-J. 2016. Allometry, merism, and tooth shape of the lower second deciduous molar and first permanent molar. Am J Phys Anthropol 159:93-105[3] Benazzi S, Fornai C, Buti L, Toussaint M, Mallegni F, Ricci S, Gruppioni G, Weber GW, Condemi S, and Ronchitelli A. 2012. Cervical and crown outline analysis of worn Neanderthal and modern human lower second deciduous molars. Am J Phys Anthropol 149(4):537-546.[4] R Development Core Team. 2012. R : a language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing [5] Bailey SE, Benazzi S, and Hublin J-J. 2014. Allometry, merism and tooth shape of the upper deciduous M2 and permanent M1. Am J Phys Anthropol 154:104-114

Poster Presentation Number 27, We (17:00-19:00)

## New Data on the Context of the La Ferrassie 8 Neandertal child skeleton (Grand Abri of La Ferrassie, Dordogne, France)

**Antoine Balzeau[1,2], Vera Aldeias[3,4], Laurent Bruxelles[5,6], Laurent Chiotti[1], Isabelle Crevecoeur[7], Camille Daujeard[1], Harrold L. Dibble[2,8,9], Paul Goldberg[10,11,12], Asier Gómez-Olivencia[13,14,15], Guillaume Guérin[16,17], Stéphane Madeleine[18], Shannon J.P. McPherron[3], Dennis Sandgathe[19], Catherine Schwab[20], Sahra Talamo[3], Jean-Jacques Hublin[3], Alain Turq[7,18]**

1 - Histoire Naturelle de l'Homme Préhistorique, UMR 7194, Sorbonne Universités, MNHN, CNRS, UPMC, UPVD, Paris, France · 2 - Department of African Zoology, Royal Museum for Central Africa, Tervuren, Belgium · 3 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 4 - ICArEHB, Universidade do Algarve, Faro, Portugal · 5 - INRAP, Nîmes, France; University of Toulouse, UMR 5608 CNRS (TRACES), Toulouse, France · 6 - School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, South Africa · 7 - UMR 5199-PACEA, CNRS, Université de Bordeaux, Allée Geoffroy Saint-Hilaire, CS 50023, 33615 Pessac Cedex, France · 8 - Dpt Anthropology, Univ. Pennsylvania, Philadelphia · 9 - Institute of Human Origins, Arizona State University, USA · 10- Centre for Archaeological Sciences, Univ. Wollongong, Australia · 11 - Eberhard Karls Universität Institute for Archaeological Sciences, Tübingen, Germany · 12 - Boston Univ., Department of Archaeology, USA · 13 - Dpto. Estratigrafía-Paleontología. Universidad del País Vasco · 14 - Ikerbasque-Basque Fundation for Science · 15 - Musée de l'Homme and Centro Mixto UCM - ISCIII · 16 - Institut de Recherce sur les Archéomatériaux, UMR 5060 CNRS - Université Bordeaux · 17 - Centre de Recherce en Physique Appliquée à l'Archéologie (CRP2A), Maison de l'archéologie · 18 - Musée national de Préhistoire 24620 Les Eyzies de Tayac · 19 - Dept. of Archaeology, Simon Fraser Univ. Burnaby, Canada · 20 - Musée d'Archéologie nationale et Domaine national de Saint-Germain-en-Laye

The first evidence of the partial infant Neandertal skeleton La Ferrassie 8 (LF 8) (Grand Abri of La Ferrassie, Dordogne, France) was discovered in 1970, although most of the remains were found in 1973 as part of the 1968–1973 work at the site by H. Delporte. This individual and the other Neandertal children from La Ferrassie were published in the early 1980s by J.-L. Heim, and since then LF 8 has been regarded as coming from a poorly documented excavation. Here we provide new information on the LF 8 Neandertal child skeleton based on the revision of the archives of the original finding in 1970 and 1973 and recent fieldwork in 2014. We have: a) identified 47 new human remains recovered during the former excavation [1]; b) studied the associated paleontological remains from taxonomic, taphonomic, and spatial points of view; and c) analysed unpublished observations on the stratigraphy and density of associated objects. In 2014, we performed additional excavations in order a) to see whether there were still human fossil remains that were not recovered in 1973; b) to gather new information on the stratigraphy, object density and spatial distribution in order to cross-check these data with those of the original excavations. Finally, we also report here on attempts to radiocarbon date on faunal remains found in the immediate area and on OSL ages for the stratigraphic section adjacent to the LF8 find area. Our findings add to the anatomical representation of the LF 8 child, although it is still limited to the trunk and head: no limb bones have been found except for a few hand phalanges. Second, we were able to reconstruct a bison horn core from ca. 20 pieces, which was associated with LF 8 and represents the largest single faunal remain from that area. Third, we noted an unexpected distribution of the human and faunal remains that were found together in the layer that was otherwise sterile. This distribution does not appear to be a result of the excavation methods used in 1970 and 1973, since the lack of other objects in the area was also clear from the more recent excavations. Fourth, taphonomic analyses detected a different preservation of the human remains versus the horn core and other faunal remains. Taphonomical alterations highlight different prior-to-burial taphonomic scenarios and time of surface bone exposure for both human and faunal samples. Indeed carnivore marks, cut-marks, green bone fractures and fire alterations are exclusively observed on the faunal associated remains, which are also more affected by climatic alterations. Inversely taphonomical agents specific to burial conditions (sediments, humidity, root etchings) indicate a same sedimentary context for the two series. Our results provide a good example of how complementary and multidisciplinary approaches of all the available information are necessary in assessing the evidence and interpreting it within a solid scientific context.

**References:**[1] Gómez-Olivencia A., Crevecoeur I., Balzeau A. (2015) La Ferrassie 8 Neandertal child reloaded: new remains and re-assesment of the original collection. Journal of Human Evolution 82, 107-126.

Podium Presentation: Session 7, Fr (18:20)

## The Des-Cubierta Cave (Pinilla del Valle, Comunidad de Madrid, Spain): a Neanderthal site with a likely funerary/ritualistic connection

**Enrique Baquedano[1], Juan Luis Arsuaga[2], Alfredo Pérez-Gonzalez[3], Belén Márquez[1], César Laplana[1], María Cruz Ortega[2], Rosa Huguet[4], Eva María Poza-Rey[2], Laura Rodríguez[5], Jose Ignacio Alonso[6], Ana Isabel Ortega[3], Marian Galindo-Pellicena[2], Nuria García[2], Diego Alvarez-Lao[7]**

1 - Museo Arqueológico Regional, Alcalá de Henares, Madrid, Spain · 2 - Centro Mixto UCM-ISCIII de Evolución y Comportamiento Humanos, Madrid, Spain · 3 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain · 4 - Institut de Paleoecologia Humana I Evolució Social (IPHES), Tarragona, Spain · 5 - Laboratorio de Evolución Humana, Edificio I+D+i, Universidad de Burgos, Spain · 6 - Estudios Arqueológicos ARQUEO S.C., Burgos, Spain · 7 - Area de Paleontologia, Departamento de Geologia, Universidad de Oviedo, Spain

The karst dolomite hill of Calvero de la Higuera (Pinilla del Valle, Comunidad de Madrid, Spain) is extraordinarily rich in sites that were occupied by hominids and carnivores. Signs abound that *Homo neanderthalensis* used the area's caves and rockshelters as camps, and that these structures also provided dens for hyaenas (*Crocuta crocuta*) [1]. The present work reports a new site quite unlike any other at Pinilla del Valle - one which increases our knowledge of Neanderthal behaviour. During a survey undertaken in the spring of 2009, the removal of plant cover revealed a large cavity, the roof of which had been eroded away. It was named the Des-Cubierta Cave (a play on the Spanish words for 'discovered' and 'uncovered'). This cave has a main gallery some 87 m long and 1-4.5 m wide. According to the infills, it has at least five old openings. Its sediments, Middle and Late Pleistocene in age, were exposed to the elements but have been largely preserved thanks to the formation of a surface breccia. The Middle and Late Pleistocene layers are clearly separated by a layer of flat stones. The Middle Pleistocene lower layer contains at least one hyaena den. These sedimentary layers include dolomitic blocks and clasts that arrived gravitationally. Very little sandy or silty matrix is present. The novelty of the site resides in its Late Pleistocene levels which have been carbon dated to 38-42 ka BP. In these layers, six dental remains and a jaw have been found, all of which may belong to a single child of *Homo neanderthalensis*. Some of the teeth were found next to a hearth containing a single horn core. Runoff water (probably) washed the rest of these remains away from the hearth area, which would seem to be a grave. The most remarkable finds, however, are those of numerous small hearths in which the horn cores of aurochs (*Bos primigenius*) and bison (*Bison priscus*), and the antlers of red deer (*Cervus elaphus*), were laid (more than 30 specimens). Some of the skull can be seen at the base of the antlers, giving this piece the appearance of a modern hunting trophy. Few other bone or dental remains accompany these horn cores and antlers. Just above the level of the flat stones, where the Late Pleistocene sequence begins, the skull of an adult steppe rhinoceros (*Stephanorhinus hemitoechus*) was found. Its lower and upper jaws have been removed, as indeed have those of the other herbivores mentioned. However, the rhinoceros skull was not placed in a hearth. Neither the discovered remains, nor the Mousterian lithic industry found at the site, are arranged as would be expected if the cave were a dwelling site. It may be that some of these hearths have a funerary purpose; other child graves with hearths containing horn cores are known. However, the majority of those at the Des-Cubierta Cave do not appear to have had such a function, nor indeed any functional meaning. They may therefore have been of ritual or symbolic significance.

Research at the Des-Cubierta Cave is conducted as part of project S2010/BMD-2330 funded by the I+D activities programme for research groups run by the Education Secretariat of the Madrid Regional Government. The study is also partly funded by the Museo Arqueológico Regional de la Comunidad de Madrid, Grupo Mahou and Canal de Isabel II-Gestión. The authors thank the members of the Pinilla del Valle excavation team for their work in the field.

**References:**[1] Baquedano, E., Márquez, B., Laplana, C., Arsuaga, J. L., Pérez-González, A. 2014, The archaeological sites at Pinilla del Valle (Madrid, Spain). In: Sala Ramos, R. (ed.), Pleistocene and Holocene hunter-gatherers in Iberia and the Gibraltar Straits: the current archaeological record. Universidad de Burgos-Fundación Atapuerca: 577-584.

Podium Presentation: Session 8, Sa (9:10)

## Early Upper Palaeolithic Shell beads and shellfish from Manot Cave, Israel

**Daniella Bar-Yosef Mayer**[1], **Omry Barzilai**[2], **Israel Hershkovitz**[1], **Ofer Marder**[3]

1 - Tel Aviv University · 2 - Israel Antiquities Authority · 3 - Ben Gurion University

The Early Upper Palaeolithic sequence at Manot Cave, western Galilee, Israel (46-33 ka Cal BP) contains rich deposits of two techno-complexes: The Ahmarian and the Levantine Aurignacian. The Ahmarian, recovered at the center of the cave, is characterized by long and narrow blade industry. The blade tools consist of retouched items, end scrapers, burins and el-Wad points. The Levantine Aurignacian, currently the dominant techno-complex at the cave, is attested at the entrance center of the cave above the Ahmarian occupation. The Aurignacian is dominated by nosed and carinated items, curved-twisted bladelets ('Dufour'), as well as bi-points made of antler. The malacological faunal assemblages from the two techno-complexes were analyzed (NISP=1180). Ornamental shells (MNI=66), mostly deriving from the Aurignacian assemblages, include perforated *Nassarius gibbosulus*, *Columbella rustica* and *Antalis* spp. as well as two cowrie beads found in association with human bones. The cowries belong to *Zonaria pyrum* and *Erosaria* sp., the latter possibly an extinct species. Few Early Upper Palaeolithic shell assemblages are well-known and well published, yet the ones that are known, especially Ksar Akil, Üçagızlı and a few other sites in Israel such as Kebara Cave and Hayonim Cave will be compared to the Manot assemblage. The comparison reveals Aurignacian trends present in the circum-Mediterranean shell beads. The relatively small number of shells from the Ahmarian levels of Manot requires further research in order to characterize the Ahmarian shell assemblage. Edible molluscs are also present: *Patella caerulea* and *Phorcus turbinatus* were collected on rocky shores of the Mediterranean. While those are represented by just a few shells, hundreds of land snails of the genus *Levantina*, were found as a shell midden. Molluscs were collected from the immediate vicinity of the site and from the nearest Mediterranean shore, about 15 km away. The consumption of shellfish and snails also seems to represent an EUP trend throughout the Mediterranean region.

Podium Presentation: Session 3, Th (17:40)

## A geometric morphometric reconstruction of the thorax of *H. naledi*

**Markus Bastir[1,11], Daniel García-Martínez[1,11], Scott A. Williams[2,11], Marc R. Meyer[3,11], Shahed Nalla[4,11], Peter Schmid [5,11], Alon Barash[6], Motoharu Oishi[7], Naomichi Ogihara[8], Steven E. Churchill[9,11], John Hawks[10,11], Lee R. Berger[11]**

1 - Paleoanthropology Group. Museo Nacional de Ciencias Naturales (CSIC), Madrid, Spain · 2 - Center for the Study of Human Origins, Department of Anthropology, New York University, New York, USA · 3 - Department of Anthropology, Chaffey College, Rancho Cucamonga, California, USA · 4 - Department of Human Anatomy and Physiology, Faculty of Health Sciences, University of Johannesburg, South Africa. · 5 - Anthropological Institute and Museum, University of Zurich, Zurich, Switzerland · 6 - Faculty of Medicine Galilee, Bar Ilan University, Zefat, Israel · 7 - Laboratory of Anatomy 1, School of Veterinary Medicine, Azabu University, Kanagawa, Japan · 8 - Department of Mechanical Engineering, Faculty of Science and Technology, Keio University, Yokohama, Japan · 9 - Department of Evolutionary Anthropology, Duke University, Durham, USA· 10 - Department of Anthropology, University of Wisconsin-Madison, Madison, USA· 11 - Evolutionary Studies Institute and Centre for Excellence in PalaeoSciences, University of the Witwatersrand

*H. naledi* shows a mosaic morphological pattern with several modern features in the skull, hands and feet, and primitive features in the ribs and pelvis . This pattern reflects a morphology that could be expected of a hominin at the evolutionary transition between *Australopithecus* and *Homo*, although the chronological age of these fossils is currently not known [1,2]. Within the lower thorax, two thoracic vertebrae from levels 10 and 11 and the proximal aspect of an 11th rib were found in near anatomical connection, therefore likely belonging to the same individual. In this study we explore this association and report our ongoing work towards a quantitative 3D reconstruction of the thorax of *H. naledi*. We measured 512 3D-(semi)landmarks on human and non-human primate ribcages (N=33) for geometric morphometric analyses. We analyzed shape variation of isolated ribs and ribcages by principal components analysis. Morphometric covariation between the shape of ribs in isolation and the shape of the remaining thorax in articulation was analyzed by partial least squares analysis [3]. The results of the principal components analysis of isolated ribs indicate a reduced curvature of the proximal 11th rib. The partial least squares analysis shows that less curved ribs of the lower thorax are highly correlated ($R=0.87$, $p<0.001$) with ribcages that are much wider caudally than cranially. A relatively small first rib fragment also fits with this thorax model. These findings together suggest that the ribcage of *H. naledi* likely resembled a "funnel shaped" thorax configuration, although the marked declination of the vertebral part of the 11th rib in its costo-vertebral joint does not fit well with such a pattern. Overall, the thorax of *H. naledi* seems to be more similar to non-human primates and *Australopithecus* than to modern humans. This hypothesis is also supported by evidence of a wide and flared upper pelvis [1], which together with the thorax would indicate a primitive trunk (and body) shape. This is consistent with evidence from the shoulder suggesting a primitive, elevated shoulder well adapted for climbing [1]. Functionally, such a body shape is suboptimal for effective bipedalism (particularly endurance running) and contrasts with the derived anatomy observed in the remains of the lower limb of *H. naledi* [4]. On the other hand, a narrow upper thorax allows for increased upper limb mobility that fits with its strongly curved metacarpals suggested to facilitate an arboreal locomotor repertoire . The evidence of the trunk points towards the body shape of a hominin capable of an extended range of locomotion in both arboreal and terrestrial habitats. However, more research is necessary to clarify the significance of the declination of floating ribs for overall thorax shape. Future discoveries of more complete thorax elements from the Rising Star cave system may improve our understanding of the functional and evolutionary morphology of *H. naledi*.

Funding: This research is funded by the Spanish Ministry of Economy and Competitivity (CGL2012-37279 and CGL2015-63648-P) and the Leakey Foundation. A visit to RMCA (Tervuren, Belgium) by DGM was funded by the European Commission's Research Infrastructure Action via the Synthesys Project (BE-TAF-5639).

**References:**[1] Berger, L.R., Hawks, J., de Ruiter, D.J., Churchill, S.E., Schmid, P., et.al. (2015) Homo naledi, a new species of the genus Homo from the Dinaledi Chamber, South Africa. eLife 4.[2] Dirks, P.H.G.M., Berger, L.R., Roberts, E.M., Kramers, J.D., Hawks, J., et.al. (2015) Geological and taphonomic context for the new hominin species Homo naledi from the Dinaledi Chamber, South Africa. eLife 4, e09561.[3] Bastir, M., Garcia-Martinez, D., Estalrrich, A., Garcia-Tabernero, A., Huguet, R., et.al. (2015) The relevance of the first ribs of the El Sidron site (Asturias, Spain) for the understanding of the Neandertal thorax. J. Hum. Evol. 80, 64-73.[4] Harcourt-Smith, W.E.H., Throckmorton, Z., Congdon, K.A., Zipfel, B., Deane, A.S., et.al. (2015) The foot of Homo naledi. Nat Commun 6.[5] Kivell, T.L., Deane, A.S., Tocheri, M.W., Orr, C.M., Schmid, P., et.al. (2015) The hand of Homo naledi. Nat Commun 6

Poster Presentation Number 57, We (17:00-19:00)

## Blade and bladelet production sequences of AH IV at Hohle Fels Cave and their implications for technological variability during the Swabian Aurignacian

**Guido Bataille**[1], **Nicholas John Conard**[1]

1 - University of Tuebingen, Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters, Abteilung für Urgeschichte und Naturwissenschaftliche Archäologie, Tübingen, Germany

The Swabian Jura with its flagship sites in the Ach and the Lone Valleys is of crucial importance for the understanding of the formation and development of the European Aurignacian. The lowest Aurignacian horizons of the region (e.g. Geißenklösterle, AH III and Hohle Fels, AH Vb) are among the oldest known Aurignacian assemblages [1, 2]. Moreover, they exposed early evidences of symbolic artefacts such as organic beads, figurative art objects and bone flutes in the centre of Europe [3, 4, 5]. Hohle Fels in the Ach valley near Schelklingen exhibits a long Pleistocene stratigraphy with Middle Paleolithic, Aurignacian, Gravettian and Magdalenian horizons. Furthermore, a complex Aurignacian stratigraphy of 1 m thickness (AHs IIIa.1, IIIa, IIIb, IV, Va, Vaa & Vb) is embedded within geological horizons GH 6-8. The Hohle Fels Aurignacian reflects the known regional picture, characterized by an occupational hiatus between the lowermost Aurignacian and the uppermost Middle Paleolithic horizon (AH VI). Though severe processes of postdepositional mixing could be excluded, zones of dislocations of sediments in the northern part of the section as a result of an inclination of the sediments (15°) are apparent. Nevertheless, clusters of ashes, charcoal and artefacts indicate *in situ* zones of human activity. Here we present results of a detailed technological study of the lithic assemblage from AH IV (GH 7) which belongs to the upper section of the Aurignacian sequence. This analysis provides a key step toward establishing a regional model of the Swabian Aurignacian in relation to environmental and cultural properties. A special focus lies on the technological variability of the Swabian Aurignacian. Our results indicate that the production of bladelet cores on blades coming from sub-volumetric unidirectional cores plays an important role. Though functionally related, the blade and bladelet production systems of AH IV clearly differ technologically from each other. Moreover, the bulk of lamellar blanks were produced by the application of different varieties of the burin technology. We conclude that, while the blade production system is static, the lamellar production system is characterized by divergent technological methods in order to obtain specific and distinct blank products.

**References:**[1] Conard, N.J, Bolus, M., 2008. Radiocarbon dating the late Middle Paleolithic and the Aurignacian of the Swabian Jura. Journal of Human Evolution 55, 886–897.[2] Higham, T., Basell, L., Jacobi, R., Wood, R., Bronk Ramsey, C., Conard, N.J., 2012. Testing models for the beginnings of the Aurignacian and the advent of figurative art and music: The radiocarbon chronology of Geißenklösterle. Journal of Human Evolution 62, 664–676.[3] Conard, N.J., Malina, M., 2006. Schmuck und vielleicht auch Musik am Vogelherd bei Niederstotzingen-Stetten ob Lontal, Kreis Heidenheim. Archäologische Ausgrabungen Baden-Württemberg 2006, 21–25.[4] Conard, N.J., Malina, M., 2009. New flutes document the earliest musical tradition in southwestern Germany. Nature letter., DOI: 10.1038/nature08169.[5] Conard, N.J. 2009. A female figurine from the basal Aurignacian of Hohle Fels Cave in southwestern Germany. Nature 459/14, 248-252.

Poster Presentation Number 9, We (17:00-19:00)

## Enamel thickness and dental tissue proportions in the Neandertals from the Sima de las Palomas del Cabezo Gordo, Southeastern Spain

**Priscilla Bayle[1], Mona Le Luyer[1], Katherine A Robson Brown[2], Michael J Walker[3]**

1 - UMR 5199 PACEA, University of Bordeaux · 2 - Centre for Human Evolutionary Research, University of Bristol · 3 - Department of Zoology and Physical Anthropology, Biology Faculty, University of Murcia

Enamel thickness and dental tissue proportions have been studied frequently to assess taxonomy, phylogeny, and masticatory biomechanical constraints in fossil and extant hominoids [1]. Many studies have focussed on Neandertals and their comparison with modern humans [2]. By and large, Neandertal deciduous and permanent teeth (mainly molars) have been described as having similar enamel volumes to modern humans, albeit deposited over a topographically more complex enamel-dentine junction surface and with larger dentine volumes. Thereby Neandertal teeth show thinner average and relative enamel thicknesses. However, few complete dentitions have been published, and little quantitative information is available on anterior teeth and premolars. Moreover, our limited knowledge about variation in Neandertal enamel thickness and dental tissue proportions does not permit evaluation of possible existence, or nature, of chrono-geographical trends in these fossil humans. Although sample sizes do not allow a proper evaluation, Olejniczak et al. [2] noticed that variation encompassed by Neandertal molars, spanning a substantial geographical and temporal interval, was less than in recent humans. Here we report on results of microCT-based analysis of enamel thickness and dental tissue proportions in Neandertal teeth from Sima de las Palomas del Cabezo Gordo (SPCG, Torre Pacheco, Murcia, Spain). They are compared to data for Middle, Late Pleistocene and Holocene archaic and modern humans. Besides providing a unique opportunity to study the homogeneity of these parameters in a constrained chrono-spatial context, this report substantially increases the range of Neandertal variation known so far, notably for deciduous and anterior permanent teeth. Dating plausibly from ca. 55-50 ka cal BP (within outermost limits of ca. 64 and 38 ka cal BP), 300 skeletal fragments from SPCG correspond to 9 or more Neandertal individuals, and include articulated parts of 3 adult skeletons [3-4]. 31 SPCG teeth were examined for enamel thickness and tissue proportions. All the teeth chosen were well preserved, free of damage, and unworn to slightly-worn on their occlusal aspect. Teeth were scanned on Skyscan 1172 X-ray equipment transported to the Department of Zoology and Physical Anthropology at the University of Murcia from the Department of Archaeology and Anthropology of the University of Bristol. We used Nrecon v.1.6.6 (Skyscan) to reconstruct the final volumes with an isotropic voxel size ranging from 21 µm for isolated teeth to 36 µm for jaw fragments. After segmentation, 13 linear, surface, and volumetric variables were measured or calculated for describing 3D and 2D tissue proportions and enamel thickness, and 3D maps of topographical enamel thickness distribution were created. On the whole, the SPCG internal tooth structure is in line with the Neandertal range of variation for deciduous and permanent dentition and for all tooth positions. Nevertheless, the deciduous and permanent upper SPCG incisors show a different signal from the rest of the dentition as measured on permanent teeth of other Neandertals [5]. However, for several teeth the SPCG data extend the range of Neandertal variation known hitherto. They also show noteworthy variation within tooth types, suggesting that Neandertal intra- and inter-population variation in internal dental structure is still far from having been documented.

The transportation of the microCT scanner to Murcia was funded by the LabEx des Sciences Archéologiques de Bordeaux (ANR program of prospects investments, ANR-10-LABX-52, DHP project), a Benjamin Meaker Visiting Fellowship, and the University of Bristol Institute for Advanced Studies. Some comparative microCT data used in this study were produced through the microCT facilities of the MRI platform and LabEx CeMEB thanks to a funding from IdEx Bordeaux/CNRS (ANR-10-IDEX-03-02, 3Dent'in project). For help and discussion, we thank Luca Bondioli, Nick Corps, Pauline Colombet, Isabelle Crevecoeur, Christopher Dean, Renaud Lebrun, Mariano López-Martínez, Roberto Macchiarelli, Bruno Maureille, Arnaud Mazurier, Jon Ortega, Laurent Puymerail, Stéphane Rottier, Erik Trinkaus, Clément Zanolli, and Josefina Zapata.

**References:**[1] Pampush, J.D., Duque, A.C., Burrows, B.R., Daegling, D.J., Kenney,W.F., McGraw, W.S., 2013. Homoplasy and thick enamel in primates. J. Hum. Evol. 64, 216-224. [2] Olejniczak, A.J., Smith, T.M., Feeney, R.N.M., Macchiarelli, R., Mazurier, A., Bondioli, L., Rosas, A., Fortea, J., de la Rasilla, M., García-Tabernero, A., Radovcic, J., Skinner, M.M., Toussaint, M., Hublin, J.-J., 2008. Dental tissue proportions and enamel thickness in Neandertal and modern human molars. J. Hum. Evol. 55, 12-23. [3] Walker, M.J., López-Martínez, M.V., Ortega-Rodrigáñez, J., Haber-Uriarte, M., López-Jiménez, A., Avilés-Fernández, A., Polo-Camacho, J.L., Campillo-Boj, M., García-Torres, J., Carríon-García, J.S., San Nicolás-del Toro, M., Rodríguez-Estrella, T., 2012. The excavation of buried articulated Neanderthal skeletons at Sima de las Palomas (Murcia, SE Spain). Quatern. Int. 259, 7-21. [4] Trinkaus, E., Walker, M.J. (Eds.), In press. The People of Palomas: The Neandertals from the Sima de las Palomas del Cabezo Gordo, Southeastern Spain. Texas A&M University Press, College Station, Texas. [5] Smith, T.M., Olejniczak, A.J., Zermeno, J.P., Tafforeau, P., Skinner, M.M., Hoffmann, A., Radovčić, J., Toussaint, M., Kruszynski, R., Menter, C., Moggi-Cecchi, J., Glasmacher, U.A., Kullmer, O., Schrenk, F., Stringer, C., Hublin, J.-J., 2012. Variation in enamel thickness within the genus Homo. J. Hum. Evol. 62, 395-411.

Poster Presentation Number 68, Th (18:00-20:00)

## Morphoarchitectural variation in the extant human endocast

**Amélie Beaudet[1], Jean Dumoncel[2,3], Frikkie De Beer[4], Stanley Durrleman[5], Emmanuel Gillissen[6], Jakobus Hoffman[4], Anna Oettlé[1], Gérard Subsol[7] John Francis Thackeray[8], José Braga[2,8]**

1 - Department of Anatomy, University of Pretoria, South Africa · 2 - UMR 5288 AMIS CNRS-Université Toulouse 3 Paul Sabatier, France · 3 - UMR 5505 IRIT CNRS-Université Toulouse 3 Paul Sabatier, France · 4 - South African Nuclear Energy Corporation, Pelindaba, South Africa · 5 - Aramis Lab, INRIA, Sorbonne Universités, UPMC Université Paris 06, UMR S 1127, Inserm U 1127, CNRS UMR 7225, ICM, Paris, France · 6 - Department of African Zoology, Royal Museum for Central Africa, Tervuren, Belgium · 7 - UMR 5506 LIRMM CNRS-Université de Montpellier II, France · 8 - Evolutionary Studies Institutes, University of the Witwatersrand, South Africa

One of the major issues in paleoneurology concerns the timing and patterning of human brain evolution, notably when and how a derived human-like endocranial morphology emerged within the hominin lineage [1]. Since morphological variation within and between paleodemes constitutes the substrate upon which natural selection acts, assessment of the cerebral variation patterns is critical for the understanding of the tempo and mode of cortical changes that occurred through hominin evolution. In the absence of any direct evidence of past neural conditions, endocasts constitute a valuable proxy for the reconstruction of brain morphology in extinct taxa. Paleoneurology has recently enlarged its traditional investigative toolkit by integrating methods of high-resolution imaging and 3D modelling as well as statistical analyses, to facilitate a higher degree of reliability of the quantitative and qualitative estimates. In this context, our study aims at establishing an extensive reference database on virtual endocranial structural variation in extant humans to be used as a comparative platform for the calibrated analysis and interpretation of the fossil record and the estimation of paleobiodiversity.

The extant human braincases investigated so far (N>90) are from the 'Pretoria Bone Collection' stored at the University of Pretoria and were detailed by X-ray microtomography at a spatial resolution ranging from 94 to 123 μm at the MIXRAD facility located at the South African Nuclear Corporation (Necsa), Pelindaba. Virtual endocasts were automatically extracted via the Endex software [2]. Based on a landmark-free registration method [3], we generated a global mean shape and a set of deformation from the reference shape to individuals that were subsequently used to perform a principal component analysis (PCA). Topological mapping of shape variation was computed along PCA axes by representing the magnitude and orientation of displacements from the global mean shape to one standard deviation as signed distances [4].

Variations recorded along the first component alter the overall endocranial aspect from a laterally broad shape, with respect to the rostro-caudal axis, to a laterally narrow and rostro-caudally elongated morphology. Interestingly, our results based on endocranial bony morphology are consistent with the variation pattern directly observed on the human brain [5], confirming that endocasts represent suitable proxies for the assessment of the time-related changes in brain morphoarchitectural variation. Accordingly, the application of our experimental analytical protocol to the fossil record should offer a unique opportunity to explore paleoneurological diversity and to comparatively model the evolving patterns of shape variation with respect to the extant human condition.

Supported by AESOP+ program. We thank the DST-NRF for sponsoring the Micro-XCT facility at Necsa. We are grateful for access to the HPC resources of CALMIP supercomputing center (2016-P1440); we are also indebted to G. Krüger, curator of the 'Pretoria Bone Collection' at the University of Pretoria.

**References**:[1] Falk, D., Redmond, J.C. Jr., Guyer, J., Conroy, G.C., Recheis, W., Weber, G.W., Seidler, H., 2000. Early hominid brain evolution: a new look at old endocasts. J. Hum. Evol. 38, 695-717.[2] Subsol, G., Gesquière, G., Braga, J., Thackeray, F., 2010. 3D automatic methods to segment "virtual" endocasts: state of the art and future directions. Am. J. Phys. Anthropol. 141, suppl. 50, 226-227 (abstract).[3] Durrleman, S., Pennec, X., Trouvé, A., Ayache, N., Braga, J., 2012. Comparison of the endocranial ontogenies between chimpanzees and bonobos via temporal regression and spatiotemporal registration. J. Hum. Evol. 62, 74-88.[4] Durrleman, S., 2010. Statistical models of currents for measuring the variability of anatomical curves, surfaces and their evolution. Ph.D. Dissertation, University of Nice-Sophia Antipolis.[5] Gómez-Robles, A., Hopkins, W.D., Sherwood, C.C., 2013. Increased morphological asymmetry, evolvability and plasticity in human brain evolution. Proc. R. Soc. B Biol. Sci. 280, 20130575.

Poster Presentation Number 8, We (17:00-19:00)

## Geometric Morphometric topography and dental crown loss analyses in hominoidea primates

**Juan Manuel Becerra[1], Aroa Casado[1], Elisabeth Cuesta-Torralvo[1], Alejandro Pérez-Pérez[1], Daniela Pacheco[2], Alejandro Romero [3], Jordi Galbany[4], Beatriz Gamarra[1]**

1 - Universitat de Barcelona · 2 - Universidade de Coimbra · 3 - Universidad de Alicante · 4 - Washington University

Dental shape is a characteristic trait of a species and unless dental wear is intense and most of the crown has been lost, dental shape variation would be preserve enough to detect phylogenetic signal non-related to dental wear [1]. However, dental crown loss is a major handicap for characterizing occlusal relief and cusp patterns. The rate of dental wear and dentin exposure depends on dietary habits and diet composition. Although diet preferences among hominoidea primates are known, significant differences may appear in relation to geographic distribution and environmental conditions, as has been observed through buccal microwear analyses in gorilla populations from different geographic areas [2]. Chimpanzees and gorillas show thin enamel layers in molar teeth compared to humans and orangutans, which suggests that their diets are softer and less abrasive, whereas orangutans would consume harder foodstuffs, such as seeds, and humans, despite the gracialization of the chewing muscles and reduction of facial prognatism, might have included tough foods throughout the evolution of our lineage. Thus, analyses of dental wear rates in hominoidea primates require the use of large samples with similar sample fragmentation by age groups. However, actual ages of wild specimens in skeletal collections are not usually available and comparisons are seldom possible. We present an analysis of dental wear in several hominoidea primate species in order to make inter-specific comparisons of dental crown loss of specimens of unknown age at death. The main objective was to analyse dental wear rates in relation to dietary habits and ecological conditions and to determine which factors can be shown to affect dental wear without considering actual ages of the analysed specimens. Results show significant correlations between dental crown topography variables. Occlusal crown curvature showed a clear association to morphometric topography in all species studied (gorilla, chimpanzee, orangutan and gibbons). Crown relief and orientation patch count were not significantly correlated with crown curvature or the morphometric principal components. Despite samples sizes varied among species, the regression of crown morphometric topography and crown relief and curvature allowed inter-specific comparisons. Chimpanzees showed smaller regression slopes than gorillas and orangutans, suggesting that dental wear rates were greater in the latest species. However, a significant degree of dispersion of the analyzed variables was observed so significant differences were not detected. Estimates of curvature and crown relief for unworn teeth from occlusal morphometrics of worn out teeth indicate significant differences among species, providing a method for analysing dental crown shape from teeth showing various degrees of occlusal dental wear.

**References:**[1] Beatriz Gamarra, Mónica Nova Delgado, Alejandro Romero, Jordi Galbany, Alejandro Pérez-Pérez (2016) Phylogenetic signal in molar dental shape of extant and fossil catarrhine primates. *Journal of Human Evolution* 94, 13-27.[2] Galbany J, Estebaranz F, Martínez LM, Pérez-Pérez A (2009) Buccal dental microwear variability in extant African Hominoidea: taxonomy versus ecology. *Primates* 50(3), 221-30.

Poster Presentation Number 87, Th (18:00-20:00)

## Knee joint pathology in Ein Qashish 3 (EQH-3) Neanderthal

**Ella Been[1,2], Yoel Rak[2], Lihi Levin[2], Barash Alon[3], Ravid Ekshtain[4], Omry Barzilai [5]**

1 - Department of Physical Therapy, Ono Academic College, Israel · 2 - Department of Anatomy and Anthropology, Sackler Faculty of Medicine, Tel Aviv University · 3 - Faculty of Medicine in the Galilee, Bar Ilan University, Safed · 4 - Institute of Archaeology, The Hebrew University of Jerusalem · 5 - Israel Antiquities Authority

'Ein Qashish is a late Mousterian open-air site from the southern Levant bearing evidence of three discrete human fossil remains. One of the fossils, EQH-3, consisted five lower limb bones of a young adult Neandertal male [1] that is the subject of the current paper. One of the 'unusual' features of this individual was the narrow distal articular surface while Neandertals are usually characterized by large articular surfaces. This morphology is part of some anatomical peculiarities found in the left distal femur and proximal tibia of EQH-3: a very narrow inter condylar notch, small lateral articular facet of the distal femur, and prominent tibial intercondylar eminence between the two tibial plateaus. We assume that the nature of this special morphology could be a result of four possibilities: 1. This morphology is related to interbreeding between Neanderthals and H. sapiens. 2. This is a pleisiomorphic character, which can be found in the femur or tibia of other hominins, 3. It is the result of taphonomy, or 4. The combination of these morphologies represent knee pathology.

In order to test which of the hypothesis is correct we compared the morphology of the distal femur and proximal tibia of EQH-3 with that of H. sapiens (modern and early), H. neanderthalensis, and H. erectus specimens.

Our results show that the unique morphology of the knee joint of EQH-3 is different from the morphology of the knee joints modern humans and other hominin specimens. Thus, the first and second hypotheses should be rejected. The narrow intercondylar notch might indeed be a result of taphonomy- but taphonomy cannot be the cause for the small articular condyles or the protruding intercondylar eminence. Accordingly, the third hypothesis should be also partially rejected. The medial intercondylar eminence is the attachment area for the anterior cruciate ligament (ACL), one of the four major ligaments that stabilize the knee joint. The combination of the narrow intercondylar notch and the narrow lateral femoral condyle together with the high intercondylar eminence is often seen in the knee joint of children that experienced an evulsion fracture of the ACL [2,3]. Therefor the forth hypothesis is the most parsimonious explanation for the unique morphology of EQH-3 knee.

ACL evulsion fracture occur most commonly in skeletally immature individuals between the ages of 8 and 14 years. Patients with ACL avulsion fractures will develop knee hemarthrosis within 12–16 hours, and inability to walk and run in the days/weeks after the injury. In order to survive, EQH-3 had to rely on help from members of his group shortly after the injury occurred. After the acute stage is over, in the month and years after the injury, individual with ACL avulsion fractures can walk and run but might suffer from knee instability to bear weight [2,3]. If such pathology did occur in the knee of EQH-3 he might have suffered from instability of the left knee joint and therefor minimize weight bearing on the left leg. The small articular surface of the distal femur might be the result of that pathology as articular surface area directly related to the amount of axial pressure exerted on the joint.

**References:**[1] Been E, Levin L, Barzilai O, Ekshtain R, Mallinsky-Buller A,Greenbaum N, Agha N, Rak Y, Hovers E. (2015) Human Remains from the Late Middle Paleolithic Open-Air Site of 'Ein Qashish, Yizra'el Valley, Israel. European Society for the study of Human Evolution. [2] Anderson AF, & Anderson CN. (2015). Correlation of meniscal and articular cartilage injuries in children and adolescents with timing of anterior cruciate ligament reconstruction. The American journal of sports medicine, 43(2), 275-281. [3] Perugia D, Basiglini L, Vadala A, & Ferretti A. (2009). Clinical and radiological results of arthroscopically treated tibial spine fractures in childhood. International orthopaedics, 33(1), .243-248

Podium Presentation: Session 4, Fr (10:10)

## Variability and Evolution of Mandible Morphology among Homo sapiens and its ancestors in Europe, Africa and Western Asia

**Inga Bergmann**[1], **Sarah E. Freidline**[1], **Philipp Gunz**[1], **Jean-Jacques Hublin**[1]

1 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

Mandibles represent a large portion of the hominin fossil record. However, at times their morphology can provide ambiguous phylogenetic signals. The difficulty in interpreting mandibular morphology results from limited comparative samples and/or methodological issues regarding the covariance of size and shape. Key to the modern human origins debate are specimens from the African Middle Pleistocene and Levantine Late Pleistocene . These fossils exhibit high morphological variability, displaying a mixture of modern and archaic features. This study compares mandibular morphology through time within Homo sapiens, ranging from the earliest forms to their Late Pleistocene descendants and recent modern humans. It aims at identifying the main mandibular regions that have been driven by evolution during the last 300,000 years. To do so, we apply 3D geometric morphometric methods to compare mandibular shape and form (size and shape) in early modern humans (n=9) to Upper Paleolithic and early Holocene humans (n=64), as well as recent modern humans (n=30). The specimens originate from Europe, Northern Africa, and the Near East. Landmark, curve and surface semilandmark data were obtained from 3D surface models generated from either computed tomography (CT) scans or surface scans. Following Procrustes superimposition, shape and form coordinates were analyzed using multivariate statistical analyses. Principal component analysis plots show a better morphological separation between early modern humans and their Late Pleistocene and Holocene descendants in form space compared to shape space, suggesting that size related shape changes account for the main morphological differences between these two clusters. Allometric shape changes occur in the posterior mandible such that the Late Pleistocene and Holocene humans display a broadening of the gonial region. Nevertheless, different shape patterns between the early modern humans and their descendants are present. The main shape changes include a widening of the mandibular rami combined with a narrowing and shortening of the dental arch in the more recent human groups, corresponding to an overall reduction in facial and mandibular size through time. Evaluating anatomically modern humans from widespread geographical regions that cover a time frame of around 300,000 years provides new opportunities to discuss the place and time of the emergence of our species.

I would like to thank David Plotzki and Heiko Temming (technicians, Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig) for their help in CT data processing.

**References:**[1] Mounier, A., Marchal, F., Condemi, S., 2009. Is Homo heidelbergensis a distinct species? New insights on the Mauer mandible. J. Hum. Evol. 56, 219-246.[2] Rightmire, Ph. G., Deacon, H. J., 1990. Comparative studies of Late Pleistocene human remains from Klasies River Mouth, South Africa. J. Hum. Evol. 20/2, 131-156.[3] Stefan, V. H., Trinkaus, E., 1997. Discrete trait and dental morphometric affinities of the Tabun 2 mandible. J. Hum. Evol. 34/5, 443-468.

Poster Presentation Number 135, Th (18:00-20:00)

## GPR data to constrain ERT interpretations in the archaeological karstic test site of Sierra de Atapuerca (Burgos, Spain)

**Lucía Bermejo[1], Ana Isabel Ortega[1], Salvatore Piro[2], Roger Guérin[3], Lawrence B. Conyers[4], Josep M. Parés [1], Alfonso Benito-Calvo[1], Isidoro Campaña[1], José María Bermudez de Castro[1], Eudald Carbonell[5,6]**

1 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain · 2 - Istituto per le Tecnologie Applicate ai Beni Culturali - Consiglio Nazionale delle Ricerche, Roma, Italy · 3 - Université Pierre et Marie Curie-Paris 6, France · 4 - Department of Anthropology, University of Denver Colorado, USA · 5 - Institut Català de Paleoecología Humana i Evolució Social (IPHES), Tarragona, Spain · 6 - Universitat Rovira i Virgili (URV), Tarragona, Spain

The archaeological karstic sites of Sierra de Atapuerca (Burgos, Spain) have already been the target of several ERT (Electrical Resistivity Tomography) prospections [1,2] that have arose valid interpretations (verified by test pits) about the dimensions and direction of some of its sedimentological infillings. Nevertheless, the complex nature of the karstic landscapes generates a series of problematics referring the interpretation of the ERT pseudosections. These problems are mostly in relation with the presence of high resistive values and void spaces and can be also be determined by the characteristics of the array used during the adquisition of the ERT data. Anyhow, they cannot be filtered, just be bore in mind while interpretating the results.

Thanks to the thorough topographic documentation of the caves, some of these handicaps could be solved by comparing the ERT results with the karstic morphologies already known to present. So, in order to find some answers to the problems that appeared in the interpretations of the profiles displayed over the unexplored nearby locations, GPR (Ground Penetrating Radar) data was collected especially on those places where the ERT method offered worse resolution, and this is mostly where high resistive values are found. In this sense, the integration of the GPR results made it possible to approve or disprove the previous interpretations coming from the ERT results, thanks to the fact that it allowed distinguishing which high resistive anomalies corresponded to void spaces and which to the host rock limestone. The comparison of the ERT and GPR data made it also possible to determine the real depth of the top of the voids. As for the bottom of these anomalies identified as void spaces, it could be established wether, within the profile limits, there was something else underneath them or not. This is due to the fact that in the ERT methodology, when the electrical impulses encounter a high resistive body that is big enough, may not be able of passing through this resistivity, disguising the values of what is laying underneath it. On the contrary, in the GPR method (considering the geological characteristics of this site), the electromagnetic wave is only attenuated by the presence of big homegenous clayey-like sediments.

The biggest limitation of intregrating GPR and ERT data is that the former, with a 270 mHz antenna, can reach a maximum of 12 meters (always considering the characteristics of this site), whereas the ERT method can reach up to 40 meters deep with the same resolution. With this new data we intend indeed to create a "database" of the subsurface of this site so that it can be used in the following geophysical prospections that are previewed in this location for the future, as well as to dispose of a comparative tool for other prehistoric sites located in karstic environments. This work allowed identifying unexplored void spaces, as well as determining the development of the sedimentary infillings of several archaeological localities. It also permitted confirming the existence of an entrance, filled with sediments, to the Galería Complex site.

L. Bermejo is beneficiary of a predoctoral grant of the Junta de Castilla y León (EDU/310/2015). A. I. Ortega is beneficiary of a Fundación Atapuerca Post-doctoral Grant. I. Campaña is the beneficiary of a predoctoral FPI Grant from the Spanish MINECO. Research at the Sierra de Atapuerca sites are supported by the MINECO projects CGL2012-38434-C03-02 and CGL2015-65387-C3-3-P. Archaeological fieldwork is also supported by the Consejería de Cultura y Turismo of the Junta de Castilla y León. Authors are grateful to the multidisciplinary Research Team of the Sierra de Atapuerca (EIA) and the Grupo Espeleológico Edelweiss for its constant scientific and logistic support.

**References:**[1] Bermejo, L., Ortega, A. I., Guérin, R., Benito-Calvo, A., Pérez-González, A., Parés, J. M., Aracil, E., Bermúdez de Castro, J. M., & Carbonell, E. (2016). 2D and 3D ERT imaging for identifying karst morphologies in the archaeological sites of Gran Dolina and Galería Complex (Sierra de Atapuerca, Burgos, Spain). Quaternary International (0). doi:10.1016/j.quaint.2015.12.031 (In Press, Corrected Proof).[2] Ortega, A.I., Benito-Calvo, A., Perez-González, A., Porres, A., Martín, M.A., (2010). Applying electrical resistivity tomography to the identification of endokarst geometries in the Pleistocene sites of the Sierra de Atapuerca (Burgos, Spain). Archaeological Prospection 17, 233-245.

Poster Presentation Number 1, We (17:00-19:00)

## Teeth: the "black box"

**José María Bermúdez de Castro[1,2], María Martinón-Torres[2,3], Laura Martín-Francés[1,2], Marina Martínez de Pinillos[1,2], Mario Modesto-Mata[1,4], Cecilia García-Campos[1]**

1 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain · 2 - Department of Anthropology, University College of London, UK. · 3 - Universidad de Burgos, Laboratorio de Evolución Humana, Área de Paleontología. Departamento de CC. Históricas y Geografía, Spain · 4 - Equipo Primeros Pobladores de Extremadura, Casa de la Cultura Rodríguez Moñino, Cáceres, Spain

Teeth represent the best source of information to address different questions regarding growth, development and hominins' lifestyle, including cultural and behavioural aspects. Moreover, teeth are very useful tools in paleodemographic, paleopathological, and paleoenvironmental studies. They are safe DNA containers and exhibit a suite of key features that can be used to characterize paleodemes. In summary, we can consider that teeth are a true "black box" to ascertain and document the events that happened during our ancestors' and our own life, as well as to establish reliable relationships between past and present populations.

The recent recovering of nuclear DNA sequences from two specimens from the Atapuerca-Sima de los Huesos (SH) Middle Pleistocene site has confirmed the close relationship between these hominins and the Neandertals . All previous morphological studies of the about 6,500 human remains recovered so far in SH reached a similar conclusion. In particular, pioneering morphological and metrical studies of the teeth [1, 2, 3] showed a close phylogenetic relationship between the SH hominins and the Neandertals. Additional studies using larger samples and different methodological approaches confirmed previous results (e.g.4].

Although we are aware that a substantial part of the dental morphology and dimensions are conditioned by environmental factors, it is also true that teeth are the skeletal part carrying the strongest taxonomical signal. Some of the dental derived features we identify in the fossils are highly reliable to characterize paleodemes. Here we illustrate the derived morphology of the permanent lower first premolars of the SH hominins. Among other features, the P3s of these paleodemes are characterized by the presence of a small and swollen lingual cusp. It is usually separated by a fine cleft from the distal marginal ridge. The lower half of the buccal face shows a remarkable swelling, which is slightly more pronounced on the mesial side. This derived form has a more symmetrical occlusal outline than in earlier teeth. There are no signs of a buccal cingulum. We show the morphological similarities of these teeth with those of the lower first premolars of other paleodemes, which have been hypothetically included in the Neandertal genealogy.

This report has been supported by the Dirección General de Investigación of the Spanish Ministerio de Economía y Competitividad (MINECO) grant number: CGL2015-65387-C3-1, 3-P, the Consejería de Cultura y Turismo of the Junta de Castilla y León, and the Fundación Atapuerca. We also acknowledge The Leakey Foundation through the personal support of Gordon Getty and Dub Crook to one of the authors (MM-T). Thanks to the European Social Fund for its monetary support.

**References**: [1] Bermúdez de Castro J.M. 1986. Dental remains from Atapuerca (Spain) I. Metrics. Journal of Human Evolution 15, 265-287 [2] Bermúdez de Castro J.M. 1988. Dental remains from Atapuerca/Ibeas (Spain) II. Morphology. Journal of Human Evolution 17, 279-304.[3] Bermúdez de Castro J.M. 1993. The Atapuerca dental remains. New evidence (1987-1991 excavations) and interpretations. Journal of Human Evolution 24, 339-371[4] Martinón-Torres M., Bermúdez de Castro J.M., Gómez-Robles A., Prado-Simón L., Arsuaga J.L. 2012. Morphological description and comparison of the dental remains from Atapuerca-Sima de los Huesos site (Spain). Journal of Human Evolution 62, 7-58 [5] Meyer, M., Arsuaga, J.L., de Filippo C., Nagel S., Aximu-Petri A., Nickel B., Martínez I., Gracia, A., Bermúdez de Castro, J.M., Carbonell E., Viola, B., Kelso J., Prüfer K., Pääbo, S. 2016. Nuclear DNA sequences from the Middle Pleistocene Sima de los Huesos hominins. Nature Doi: 10.1038/nature17405

Podium Presentation: Session 5, Fr (12:10)

## Middle Stone Age technologies in Mozambique: preliminary results

**Nuno Bicho[1], João Cascalheira[1], Jonathan Haws[2], Célia Gonçalves[1], Mussa Raja[3]**

1 - ICArEHB - Universidade do Algarve · 2 - University of Louisville · 3 - Universidade Eduardo Mondlane

Southeast Africa has become an important region to better understand the development of Middle Stone Age and Anatomically Modern Humans. In the last decade, Mozambique and Malawi have received some attention from various researchers [1-4], probably because they are between the earliest finds of Anatomically Modern Humans in the Omo Kibish formation and those with early evidence for cognitive complexity in coastal South Africa. Thus, this is a key region to evaluate the success of *Homo sapiens* across Africa. Starting in 2011 we carried out a series of field seasons in various regions of Mozambique, that included the lacustrine settings of the Niassa Lake in the north, the fluvial environments of the Elephant and Limpopo Rivers in the Massingir area near the Kruger National Park, and the southern coast of the Maputa lands. Non-systematic survey was carried out by foot, directed to specific areas where geomorphology and geology increased the chances to find open air and cave/rockshelter Stone Age sites [5]. The team was able to locate over 50 new sites with MSA materials. Cores, retouched tools and other diagnostic materials were either collected or studied in the field, during survey. Here, we present the first results of the lithic analyses of Middle Stone Age Assemblages collected during the 2014-2016 field seasons in the Niassa and Massingir regions. Data show that raw material use is radically different in the two areas, as a result of the local rocks available in each environment. While quartz is largely used in the Niassa, quartzite is the preferred raw material in Massingir. Chert and other raw materials including silcrete are very rare in both areas. Technology show a common use of Levallois prepared core technology and simpler discoidal core in both areas, although Levallois is more common in Massingir. Also, while in the latter area, Levallois points as well as the respective cores are frequent, they are basically absent in the northern region. Blade production although not very common, when present in Massingir seems to be associated with the prepared core technology. No blades were found in the Niassa Region. Finally, and while there is no absolute dating for the Massingir area, it seems that technology and typology are much more diverse than in the north, where lithic production seems to be uniform during all of the MSA. In Massingir there are common diagnostic materials, indicating that the sequence is similar, to that known from further south, including Howiesons Poort occupations.

We would like to thank to Fundação para a Ciência e Tecnologia (PTDC/EPH-ARQ/4998/2012) and the Wenner-Gren Foundation for Anthropological Research for funding the research in Mozambique.

**References:**.[1] Gonçalves, C., Raja, M., Madime, O., Cascalheira, J., Haws, J., Matos, D., Bicho, N. (2016) Mapping the Stone Age of Mozambique. African Archaeological Review, 33(1):1-12. doi:10.1007/s10437-016-9212-4 [2] Mercader, J., Asmerom, Y., Bennett, T., Raja, M., & Skinner, A. (2009). Initial excavation and dating of Ngalue Cave: a Middle Stone Age site along the Niassa Rift, Mozambique. Journal of Human Evolution, doi:10.1016/j.jhevol.2009.03.005 [3] Thompson, J., Mackay, A., Wright, D., Welling, M., Greaves, A., Gomani-Chindebvu, E., Simengwa, D. (2012) Renewed investigations into the Middle Stone Age of northern Malawi. Quaternary International 270, 129-139.[4] Thompson, J., Mackay, A., Moor, V., Gomani-Chindebvu, E. (2014) Catchment Survey in the Karonga District: a Landscape-Scale Analysis of Provisioning and Core Reduction Strategies during the Middle Stone Age of Northern Malawi. African Archaeological Review 31, 447-47 [5] Bicho, N., Haws, J., Raja, M., Madime, O., Gonçalves, C., Cascalheira, J., Benedetti, M., Pereira, T., and Aldeias, V. (2015) Middle and Late Stone Age of the Niassa region, northern Mozambique. Preliminary results. Quaternary International. 10.1016/j.quaint.2015.09.059

Poster Presentation Number 41, We (17:00-19:00)

## The eaten and the eaters: Human-carnivore interactions at Middle Pleistocene Qesem Cave, Israel

**Ruth Blasco**[1,2], **Jordi Rosell**[3,4], **Ran Barkai**[2], **Avi Gopher**[2]

1 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain · 2 -Department of Archaeology, Tel-Aviv University, Institute of Archaeology, Tel Aviv, Israel · 3 -Àrea de Prehistòria, Universitat Rovira i Virgili (URV), Tarragona, Spain · 4 -IPHES; Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain

Research on the direct and indirect interactions between hominids and carnivores is clearly important from an evolutionary perspective. These interplays could have taken different paths and lead to mutual pressures. Confrontation, dependency (scavenging), competition concerning the use of caves and/or the acquisition of prey, and domestication (as a last stage) are some of the scenarios emerging on these mutual relationships [1]. Some researchers have pointed out a co-evolutionary pattern between hominids and carnivores [2], but, while appreciating the importance of this relationship is widely accepted, tacit assumptions about how this co-evolution worked vary considerably. Reconstructing some aspects related to such interactions during the Pleistocene is possible by studying different archaeological contexts. In this study, we attempt to contribute to the topic by presenting faunal taphonomical data from the lower sequence of Qesem Cave, Israel. These deposits studied have been dated by the Uranium-Thorium series as well as by TL and ESR to between 420 ka and approximately 300 ka [3]. One of the main characteristics of the faunal record from Qesem is the extremely rare presence of carnivores in relation to the very intensive human presence. The assemblages appear to have been generated solely by humans and primarily modified by their food-processing activities. The most common prey species is the Mesopotamian fallow deer (*Dama* cf. *mesopotamica*), which shows a wide age range and a biased anatomical profile, including mainly long-limb bones indicating the importance of marrow in hominid transport decisions [4]. The testimonial presence of carnivores is only evidenced by 2 hyena teeth, 2 metapodials, 6 rib fragments and 12 tooth-marked bones from Yabrudian layers (0.10% of 22,324 studied specimens), and 1 pelvis fragment and 69 gnawed and digested bones from Amudian layers (0.19% of 37,304 analyzed specimens) associated with the central hearth (including an area to its south). Other alterations, such as licking, pitting and scooping out, were not documented. Pits occurring on cancellous tissues do not exceed 3.5mm in length and 2.6mm in breadth, and those located on dense cortical tissue range from 0.2 to 3.9 mm in length and 0.1 to 3.5 mm in breadth. These measures do not rule out any carnivore, since the size of the pits overlap with the ranges for different species of carnivores. The general taphonomical characteristics, including the significant scarcity of carnivore-induced damage (and carnivore specimens) indicate activities of marauding scavengers visiting the cave once it is abandoned by hominids. But carnivores played another role at Qesem Cave. The presence of cut marks on 3 rib fragments of medium-sized carnivores suggests that these predators were also used as food. Incisions were identified both on the external, internal and lateral surfaces of the rib fragments, indicators of processing activities such as defleshing and evisceration. The latter is especially relevant because the internal organs of the thorax are the first parts to disappear in the consumption sequence of hunting carnivores (e.g. [5]). Thus, if the Qesem hominids eviscerated, the access to the carcass was probably primary and immediate, either accidentally or intentionally. In light of these data, we cannot rule out the possibility that these animals were considered a source of occasional extra food for Acheulo-Yabrudian Cultural Complex hominids between 420-300 ka. Nevertheless, this is at the moment an isolated case within a context where the main prey is the fallow deer. Thus, the use of carnivores at Qesem should be understood as sporadic rather than a repeatedly systematic activity. This preliminary study provides basic data on the role of carnivores in anthropogenic contexts, as a sign on a road map of hominid-carnivore interactions during the Middle Pleistocene in the Levant.

The Qesem Cave excavation project is supported by the Israel Science Foundation, the CARE Archaeological Foundation, the Leakey Foundation, the Wenner- Gren Foundation, the Dan David foundation and the Thyssen Foundation. This work has been developed within the framework of the Spanish MICINN projects CGL2015-68604-P and CGL2015-65387-C3-1-P, the Generalitat de Catalunya-AGAUR projects 2014 SGR 900 and 2014/100573, and the SéNeCa Foundation project 19434/PI/14.

**References**:[1] Rosell, J., Baquedano, E., Blasco, R., Camarós, E. (2012) New insights on Hominid-Carnivore interactions during the Pleistocene. J Taphonomy 3-4(10), 125-128.[2] Brantingham, P. (1998) Hominid-carnivore coevolution and invasion of the Predatory Guild. J. Anthropol. Archaeol. 17, 327-53.[3] Falguères, C., Richard, M., Tombret, O., Shao, Q., Bahain, J.J., et.al. (2016) New ESR/U-series dates in Yabrudian/Amudian layers at Qesem cave, Israel. Quat. Int. 398, 6-12[4] Blasco, R., Rosell, J., Barkai, R., Gopher, A. (2014) Subsistence economy and social life: a zooarchaeological view from the 300 ka central hearth at Qesem Cave, Israel. J. Anthropol. Archaeol. 35, 248-258[5] Domínguez-Rodrigo, M. (1999) Flesh availability and bone modification in carcasses consumed by lions. Palaeogeogr. Palaeoclimatol. Palaeoecol. 149, 373-388.

Poster Presentation Number 80, Th (18:00-20:00)

## Human evolution and the expansion of grazer-dominated biomes in eastern Africa over the last 5 million years

**Scott Blumenthal[1], Laura Bishop[2], Thure Cerling[3], Peter Ditchfield[1], J. Tyler Faith[4], Thomas Plummer[5], Richard Potts[6], Christian Tryon[7]**

1 - University of Oxford · 2 - Liverpool John Moores University · 3 - University of Utah · 4 - University of Queensland · 5 - Queens College, City University of New York · 6 - National Museum of Natural History, Smithsonian Institution · 7 - Harvard University

While a number of hypotheses have been proposed directly linking early hominin evolution with environmental change, long-term ecological dynamics across eastern Africa remain poorly understood. The regional expansion of C4 vegetation over the last 5 million years is well documented by stable carbon isotope records from marine sediment leaf wax biomarkers and terrestrial paleosol carbonates [1]. However, the evolutionary significance of this vegetation shift is unclear, in part due to the lack of long-term, multi-basin records of mammal ecology. Despite the availability of paleodiet data (stable isotopes, mesowear) for fossil mammals from many individual fossil collections, previous studies of faunal evolution across eastern Africa have largely relied on taxonomic abundance [2,3,4], which does not provide a direct record of diet. The carbon isotopic composition of tooth enamel of modern and fossil African herbivores can readily distinguish between C4 grazers (>75% C4 vegetation), C3-C4 mixed feeders, and C3-browsers (<25% C4 vegetation) [5]. African biomes are each characterized by a distinct balance of grazing, mixed feeding, and browsing herbivore diet guilds among Artiodactlya-Perissodactyla-Proboscidea (APP) taxa. Here we use a compilation of new and previously published tooth enamel carbon isotope data from APP taxa to evaluate regional biome change over the past 5 million years using fossil collections in the Lake Victoria, Lake Turkana, and Afar regions of eastern Africa.

We find a long-term increase in the proportion of C4 grazers and a long-term decrease in the proportion of C3-C4 mixed feeders since the Pliocene among APP taxa across eastern Africa. These trends are significant in the Lake Victoria and Lake Turkana regions, but not Afar due to the lack of available data between approximately 3 and 1 million years ago. There is a long-term decrease in the proportion of C3 browsers in Turkana, but in general C3 browsers represent a persistently minor component to Pliocene-Pleistocene biomes. Pliocene ecosystems in the Lake Victoria and Afar regions are dominated by C3-C4 mixed feeders, which have no known modern analog. Pliocene ecosystems in Turkana are either dominated by C3-C4 mixed feeders or mixed, with approximately equal proportions of each dietary guild. Pleistocene ecosystems since ca. 2.3 Ma are uniformly dominated by C4 grazers across eastern Africa, which resemble modern mosaic and open grassland environments. Pure grasslands can be identified by >80% C4 grazing fauna, which characterize some Early Pleistocene ecosystems in the Lake Victoria region from ca. 2 to 1 Ma and Turkana from ca. 1.3 to 1 Ma. There are no C3 browser-dominated ecosystems throughout the Pliocene and Pleistocene.

The abundance of C4 grazers among APP taxa and grass-indicator (Alcelaphin and Antilopini) bovids increase through time coincident with increasing carbon isotope values of paleosol carbonates and leaf wax biomarkers. Therefore, the dominant ecological transformation of the Pliocene-Pleistocene in eastern Africa may not be best characterized as vegetation change alone, but rather as a shift towards C4 grazer-dominated biomes. This transformation is coincident with a long-term increase in C4-resource exploitation among hominins across eastern Africa, indicating that this diet shift was likely linked to broader ecological dynamics. By the Early Pleistocene, C4 grazer-dominated ecosystems included hominins (*Homo*, *Paranthropus*) as well as non-human primates (*Theropithecus*) consuming a significant amount of C4-derived resources, suggesting that competitive interactions and resource partitioning among herbivores and primates may have played an important role in the evolutionary and ecological dynamics of these communities. Additional paleodiet proxies are needed to understand the complex trophic interactions associated with foraging in C4 grazer-dominated biomes.

We thank the Government of Kenya and the National Museums of Kenya (NMK) for permission to conduct this study. Funding was provided by the Leakey Foundation, National Geographic Society, National Science Foundation, and the Wenner-Gren Foundation.

**References:** [1] Levin NE (2015) Environment and Climate of Early Human Evolution. The Annual Review of Earth and Planetary Sciences 43:405–429. [2] Bibi F, Kiessling W (2015) Continuous evolutionary change in Plio-Pleistocene mammals of eastern Africa. Proceedings of the National Academy of Sciences 112:10623–10628. [3] Bobe R, Behrensmeyer AK, Eck GG, Harris JM (2007) Patterns of abundance and diversity in late Cenozoic bovids from the Turkana and Hadar Basins, Kenya and Ethiopia. Hominin Environments in the East African Pliocene: an Assessment of the Faunal Evidence, Vertebrate Paleobiology and Paleoanthropology Series. eds Bobe R, Alemseged Z, Behrensmeyer AK (Springer Netherlands, Dordrecht), pp 129–157. [4] Reed KE (1997) Early hominid evolution and ecological change through the African Plio-Pleistocene. Journal of Human Evolution 32(2-3):289–322. [5] Cerling TE, et al. (2015) Dietary changes of large herbivores in the Turkana Basin, Kenya from 4 to 1 Ma. Proceedings of the National Academy of Sciences 112(37):201513075–6.

Poster Presentation Number 65, Th (18:00-20:00)

## From bones to hormones and cognition: understanding the 'self-domestication' of *Homo sapiens* through archaic genomes

**Cedric Boeckx**[1,2], **Constantina Theofanopoulou**[2]

1 - ICREA· 2 - Universitat de Barcelona

The genomics revolution offers new opportunities to test hypotheses formulated long ago in ways that complement other sources of information. Especially in the domain of cognition, the retrieval of ancient DNA could, with the help of well-articulated linking hypotheses connecting genes, brain and cognition, shed light on the emergence of 'cognitive modernity'. It is in this context that we would like to adduce evidence for an old hypothesis in the context of the evolution of our species, that of self-domestication. The idea of self-domestication in Homo sapiens has been suggested by several authors, either based on our behavior, which very much resembles the tameness encountered in domesticated species, or on our distinctive anatomy, since anatomically modern humans exhibit a suit of characteristics commonly associated with the range of anatomical changes species under domestication display. Here we focus on the possible molecular footprints left by this domestication process by examining the role of genes displaying either fixed non-synonymous mutations in anatomically modern humans vs archaic humans and/or signatures of positive selection in our species. Specifically, we match the lists of genes in [4,5], and with the genes highlighted in the context of domestication in several species (dogs, lab-reared Drosophila melanogaster, and cats [1,2,3]) and place the results in the context of self-domestication in bonobos (versus chimpanzees). For this last line of research, we mostly focused on genes that underlie the hormonal changes attested between bonobos and chimpanzees (e.g. in the levels of testosterone, serotonin, oxytocin and thyroid hormones) which give rise to specific phenotypic outputs well-associated with the concept of self-domestication (e.g. aggression vs. cooperation, patrolling vs. playful behavior, developmental heterochrony). We observe a significant overlap between the genes positively selected in our species and the genes highlighted in the cases of domestication (for example, in dogs compared to wolves) and self-domestication (ie the genetic shifts between bonobos and chimpanzees). This convergence, either for specific genes or common signaling pathways, is implicated in neurogenesis, hormone regulation and metabolism but also in osteogenesis. Based on the fact that these osteogenetic and hormone-regulating genes are strongly associated with mental diseases (both developmental disorders and neurodegenerative diseases), we make a case that these too should be counted among the genes related to brain development and function that were modified in the course of evolution of anatomically modern humans since the separation from the Neanderthals/Denisovans. In other words, we attempt to provide a comprehensive linking thread from bones to cognition, based on genes that encode for the neural, endocrine and osteogenic aspects of (self-) domestication. Lastly, since domestication has been shown in several animals to lead to increased cognitive and communicative complexity (understanding of gestures in dogs and pigs, song complexity in vocal learning birds), we argue that self-domestication brings together biological and cultural evolution to account for the evolution of species-specific complex cognitive systems like language.

**References:**[1] Cagan, A., Blass, T., 2016. Identification of genomic variants putatively targeted by selection during dog domestication. BMC evolutionary biology 16(1), 10.[2] Stanley Jr, C.E.,Kulathinal, R.J., 2016. Genomic signatures of domestication on neurogenetic genes in Drosophila melanogaster. BMC evolutionary biology 16(1), 1-14.[3] Montague, M.J., Li, G., Gandolfi, B., Khan, R., Aken, B.L., Searle, S.M., Minx, P., Hillier, L.W., Koboldt, D.C., Davis, B.W., Driscoll, C.A., 2014. Comparative analysis of the domestic cat genome reveals genetic signatures underlying feline biology and domestication. Proceedings of the National Academy of Sciences 111(48), 17230-17235 [4] Paabo S., 2014 The human condition—a molecular approach. Cell 157,216-226 [5] Racimo, F., Kulhwilm, M. and Slatkin, M. 2014. A test for ancient selective sweeps and an application to candidate sites in modern humans. Mol Biol Evol. 31(12):3344-58

Poster Presentation Number 98, Th (18:00-20:00)

## The Acheulean site Suhailah 1 extends the occupation history of SE Arabia

**Knut Bretzke**[1], **Nicholas J. Conard**[1]

1 - University of Tübingen

Intensified research in SE Arabia over the past decade revealed a deep occupation history of the region and rejects the long standing often prevailing hypothesis that SE Arabia was not inhabited by pre-Holocene peoples due to the Rub' al-Khali desert, which hinders expansions into the region. The discovery of the site FAY-NE 1 at Jebel Faya in the interior of the Emirate of Sharjah, UAE represented a turning point. The site with its well-dated archaeological sequence of seven archaeological layers demonstrated the presence of hominins in the region between the onset of the Late Pleistocene at about 125 ka and the early Holocene. How far back the history of hominin occupation of the region reaches and if there was a window of opportunity to occupy SE Arabia during the Middle Pleistocene is largely unknown. At Jebel Faya, there is currently no evidence of Middle Pleistocene occupations. With regard to surface finds from the region, heavily patinated single finds featuring technological traits potentially pointing to a Middle Pleistocene settlement have been reported. However, the lack of convincing sites, rather than single finds, provides a poor basis for arguing that SE Arabia was occupied during the Middle Pleistocene. Here we report the discovery of site Suhailah 1, located in the interior of the Emirate of Sharjah, UAE. Between 2014 and 2016 systematic surface collection at the site from an area of about 900 $m^2$ and two test excavations recovered an assemblage of 1836 lithic artifacts. Lithic artifacts with two clearly distinct states of preservation are present in the assemblage. While 551 artifacts lack patination, 1285 are heavily patinated. Based on the degree of patination in addition to techno-typological observations, we assign the non-patinated artifacts to a phase of occupation during the early Holocene. We assign the heavily patinated artifacts to a second, potentially much older occupation. The most striking characteristic of the older Suhailah assemblage is the presence of three large handaxes in addition to 19 other larger bifacial tools, including handaxe preforms. The remaining tool assemblage is dominated by sidescrapers and denticulates. The 68 cores of the highly patinated assemblage indicate lithic reduction from Levallois, discoidal, single and double platform cores. Based on the techno-typological characteristics of the older Suhailah assemblage and comparisons with the well-dated assemblages from Jebel Faya, about 50 km south of Suhailah, we hypothesize that these occupations in Suhailah most likely pre-dates the sequence at Jebel Faya. Suhailah thus extends the occupation history of SE Arabia into the Middle Pleistocene. Given its techno-typological diversity, Suhailah has great potential for refining our understanding of the early parts of the occupation history of SE Arabia and related settlement dynamics in southern Arabia.

Podium Presentation: Session 4, Fr (8:30)

## Evolving brains between Europe and Asia: from Maba to Atapuerca

**Emiliano Bruner**[1], **Xiujie Wu**[2]

1 - Centro Nacional de Investigación sobre la Evolución Humana, Burgos (Spain) · 2 - Chinese Academy of Sciences, Beijing (China)

Hypotheses on the evolution of the human genus during Middle Pleistocene are hampered by a reduced and scattered fossil record. The phylogenetic relationships between European and African representatives of *Homo heidelbergensis* are largely debated, because of a noticeable heterogeneity of this taxon. The situation is even more complicated when dealing with the Asian record, yet more diverse and fragmented. In Europe there is evidence of continuity between Middle Pleistocene and Neandertals, although the exact process (i.e. gradual vs. bottleneck, isolation vs. interbreeding) is still uncertain. Neandertal traits are first described in the facial block, and later in the neurocranial morphology. In terms of endocranial features and apart from brain size increase, when compared with archaic human species Neandertals display widening of the prefrontal cortex and enlargement of the upper parietal lobules [1,2]. According to the paleoneurological data, specimens from Sima de los Huesos (Spain) show a plesiomorphic endocranial anatomy [3], while those from Saccopastore (Italy) or Krapina (Croatia) display Neandertal traits in both their face and braincase [4]. In this paper we describe the cranial and endocranial morphology of Maba, a partial skull found in China and dated to the end of the Middle Pleistocene, comparing its morphology with the European specimens [5]. The upper face, frontal, and parietal areas are well preserved, supplying relevant information to evaluate its paleoneurological traits. The facial characters, as well as the spatial relationships between face and braincase, strongly suggest a morphological affinity with the specimens from Saccopastore and Krapina, but the neurocranial form is largely archaic in its proportions. Its endocranial morphology is generally compatible with *Homo heidelbergensis*. The combination of Neandertal traits in the face and an archaic endocranial form parallels the condition described for the specimens from Sima de los Huesos. If this morphological similarity is not due to a remarkable parallelism, the range of the Neandertal lineage should be revised. It remains to be evaluated whether Maba represents a pooled Euro-Asiatic population, or else a distinct Eastern linage undergoing a partial separation from the European later groups.

**References:**[1] Bruner, E. 2004. Geometric morphometrics and paleoneurology: brain shape evolution in the genus Homo. J. Hum. Evo.l 47, 279-303.[2] Bruner, E., Holloway, R. 2010. Bivariate approach to the widening of the frontal lobes in the genus Homo. J. Hum. Evol. 58, 138–146.[3] Bruner, E., Manzi, G., Arsuaga, J.L., 2003. Encephalization and allometric trajectories in the genus Homo: evidence from the Neandertal and modern lineages. Proc. Natl. Acad. Sci. USA 100, 15335–15340.[4] Bruner, E., Manzi, G. 2008. Paleoneurology of an early Neandertal: endocranial size, shape, and features of Saccopastore 1. J. Hum. Evol. 54, 729–742.[5] Wu, X., Bruner, E. 2016. The endocranial anatomy of Maba 1. Am. J. Phys. Anthropol. DOI: 10.1002/ajpa.22974.

Poster Presentation Number 14, We (17:00-19:00)

## Covariation of Upper and Lower Premolars in Modern Humans

**Lisa Buchegger[1], Viktoria A. Krenn[1], Fred L. Bookstein[2,3], Cinzia Fornai[2,4], Gerhard W. Weber[1,2]**

1 - Core Facility for Micro-Computed Tomography, University of Vienna, Austria · 2 - Department of Anthropology, University of Vienna, Austria

Modern human premolars are highly variable both in terms of their gross morphology and in the expression of discrete traits. Upper and lower premolars show different patterns of variation. In particular, lower third and fourth premolars (LP3 and LP4, respectively) differ markedly in the number of cusps they bear and in the number and appearance of marginal ridges (e.g.[1,2]). Upper third and fourth premolars (UP3 and UP4, respectively) are less variable. Premolars form a strong developmental and functional unit, hence should be morphologically correlated in order to maintain efficient occlusion and mastication. However, such covariation has never been quantified. This study examines the covariation between upper and lower premolars from diverse modern human populations based on landmark configurations on the enamel dentine junction. Our sample included upper and lower premolars from 43 individuals belonging to seven modern human populations (Khoesan, Sub-Saharan Africans, central Europeans, Indonesians, Papuans, Aboriginals, and Avars). MicroCT images (voxel size: 20-50 μm) were generated at the Vienna Micro-CT Lab. The image data were segmented in order to produce 3D surface models, then aligned so that the buccal ridge was parallel to the X-axis. For UPs and LP4, twenty-four pseudolandmarks were placed on the cervical outline, and the occlusal aspect was represented by 4 landmarks (buccal and lingual horn tips and mesial and distal fossae) and 20 curve semilandmarks on the marginal ridge. For LP3, only 10 curve semilandmarks along the mesial marginal ridge were sampled, because the distal marginal ridge was too inconsistent in its morphology. All landmark configurations were normalized by General Procrustes Analysis and the correlations of the resultant blocks of Procrustes shape variables were analyzed using 2-block Partial Least Square for the following pairs: LP3-LP4, LP3-UP3, LP3-UP4, LP4-UP3, LP4-UP4 and UP3-UP4. Total squared covariation ranged from 45% (LP4-UP3) to 72% (UP3-UP4) and values for the pairwise correlations from 0.63 (LP4-UP3) to 0.83 (UP3-UP4). All analyses showed that for lower premolars the total crown height covaries with the position of the lingual horn tip, while in upper premolars the total crown height covaries with the mesiodistal expansion of the crown. Lower premolars with a tall crown have a centrally positioned lingual horn, while short premolars show mesially placed lingual horns. In upper premolars, tall teeth are mesiodistal narrow, while a small total crown height covaries with mesiodistal broad teeth. The high correlation observed between premolars might be explained in terms of dental ontogeny and function. Upper and lower premolars might belong to the same morphogenetic field and might be influenced by the same genetic signaling pathways. Developmental factors could explain the high overall variability, whereas the high variability we observed in the lingual aspect of lower premolars can have a functional interpretation, since the lingual cusp does not interact during mastication as much as the buccal cusp [3]. The main feature driving premolar correlation is crown height. We interpret this particularly high covariation as a necessary constraint for a harmonious and functional occlusion.

We thank Martin Dockner (Vienna Micro-CT Lab) for technical support, Gerlinde Gruber (Medical University Vienna) and Eduard Winter (Natural History Museum Vienna) for access to materials, and Katarina Matiasek for background information on collections. We are grateful to Dominika Teplanova for her support. This project was financially supported by the Land-Niederoesterreich (project number FA768001), Oesterreichische Nationalbank, Anniversary Fund (project number 16121), A.E.R.S. Dental Medicine Organisations GmbH, Vienna, Austria (project number FA547014), and the Siegfried Ludwig-Rudolf Slavicek Foundation, Vienna, Austria (project number FA547016).

**References:**[1] Kraus, B.S., Jordan, R.E., Abrams, L., 1969. Dental Anatomy and Occlusion. Williams and Wilkins Company [2] Turner, C.G., Nichol, C.R., Scott, G.R., 1991. Scoring Procedures for Key Morphological Traits of the Permanent Dentition: The Arizona State University Dental Anthropology System, in: Kelley, M.A., Larsen, C.S. (Eds.), Advances in Dental Anthropology. Wiley-Liss, 13–31 [3] Krenn, V.A., Fornai, C., Bookstein, F., Weber, G.W., 2016. Variation of 3D outer and inner crown morphology in modern human mandibular premolars, American Journal of Physical Anthropology (in prep)

Poster Presentation Number 133, Th (18:00-20:00)

## Modelling human systems and their response to climate variability during the Last Glacial Maximum

**Ariane Burke**[1], **Julien Riel-Salvatore**[1], **Michael Barton**[2]

1 - Universite de Montreal · 2 - Arizona State University

This research takes a multi-dimensional approach to the study of the archaeological record of Western Europe during the Last Glacial Maximum (LGM). We combine two distinct components of the human adaptive system (technological decisions and mobility) to test the prediction that Upper Palaeolithic groups would have shifted to a more logistical strategy as a result of climate variability during the LGM [1]. The foundation of this research rests upon a comparison between two models. The first model quantifies the impact of a suite of environmental predictors, with a particular focus on climate variability, on the spatial behaviour of human populations in Western Europe [2]. The model uses novel, high-resolution climate experiments specifically designed to simulate inter-annual climate variability in order to test the impact of short-term environmental risk, and the unpredictable resource distribution that ensues, on the spatial structure of hunting and gathering populations. The result is a model that estimates the probability of human occupation as a function of geographical and climactic predictors. The second model explores the link between patterns of mobility and Upper Palaeolithic technological systems [3]. This model uses technological indices (lithic retouch and technological specialisation) and an index that reflects human hunting decisions (herbivore index) to examine patterns of land-use and highlight distinct mobility strategies (residential versus logistical) in specific environmental contexts. Combining detailed climate and lithic data within the conceptual framework posed by these two models allows us to derive a clearer picture of human adaptation to environmental conditions at different temporal and spatial scales during a particularly rigorous climatic interval in Western Europe. It also allows us to explore the interactions among human social, ecological, and technological systems and their impact on the dynamics of Late Pleistocene human populations.

This research was supported by grants from the Fonds Québecois de Recherche Société et Culture, grant #179537 and the National Science Foundation, grant #DEB-1313727.

**References:**[1] Riel-Salvatore J, and Barton CM. 2004. Late Pleistocene technology, economic behavior, and land-use dynamics in southern Italy. Amer Antiq:257-274 [2] Burke A, Levavasseur G, James PA, Guiducci D, Izquierdo M, Bourgeon L, M K, Ramstein G, and Vrac M. 2014. Exploring the impact of climate variability during the Last Glacial Maximum on the pattern of human occupation of Iberia. J Hum Evol 73:35-46 [3] Barton CM, Villaverde V, Zilhão J, Aura JE, Garcia O, and Badal E. 2013. In glacial environments beyond glacial terrains: Human eco-dynamics in late Pleistocene Mediterranean Iberia. Quaternary International 318:53-68 .

Pecha Kucha Presentation: Session 10, Sa (15:00-15:25)

## 3D enamel thickness in Neandertal and modern human permanent canines

**Laura Buti[1], Adeline Le Cabec[2], Daniele Panetta [3], Maria Tripodi[3], Piero Salvadori [3], Jean-Jacques Hublin [2], Robin N.M. Feeney[4], Stefano Benazzi[1,2]**

1 - Department of Cultural Heritage, University of Bologna, Ravenna, Italy · 2 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 3 - Institute of Clinical Physiology – CNR, Pisa, Italy · 4 - UCD School of Medicine, Health Sciences Centre, University College Dublin, Ireland

Most investigations of enamel thickness in extant and extinct hominoid species for taxonomy, dietary and phylogeny purposes have focused on permanent teeth, particularly the molars, which have recently utilised novel methodologies [1]. By contrast, little attention has been dedicated to the anterior dentition [2]. We apply a recent protocol [3] to investigate the 3D enamel thickness in a sample of Neandertal and modern human unworn to variously worn upper and lower permanent canines to 1) provide new data to discriminate the two groups and 2) build information about enamel thickness distribution in Neandertal and modern human canines. MicroCT data of 113 upper (n=51) and lower (n=62) permanent canines from Neandertal (n=31), early modern human (EMH=11), Upper Palaeolithic (UPMH=13) and recent modern human (RMH=58) at different wear stages (stages 1-5 according to Smith, 1984 [4]) were segmented using Avizo 7 to reconstruct 3D digital models of the teeth. The cervical line was digitized on each 3D model in Rapidform XOR to separate the crown from the root dentine. Volumes of enamel and of crown dentine, and the enamel-dentine junction (EDJ) surface were measured to compute 3D Average Enamel Thickness (3D AET) and 3D Relative Enamel Thickness (3D RET) indices. Among lower canines, although permutation tests for 3D AET values do not differ between Neandertal and modern human (MH =UPMH+RMH) at wear stages 1-2 (P=0.28), mean values for 3D RET (12.7±1.9 and 15.5±2.6, respectively) were significantly lower in Neandertal (P=0.0015). The upper canines at the same wear stages show no difference in 3D AET (P=0.836), but Neandertals have significantly lower 3D RET values than MH (P=0.014). Overall, Neandertal and MH upper canines have significantly higher values than lower canines for both 3D AET (P=0.005 and P<0.001, respectively) and 3D RET (P=0.016 and P=0.039, respectively). Although the size of the sample available for study is small, no differences were observed between EMH and both Neandertal and MH lower canines 3D RET (P>0.05). The 3D AET and 3D RET computed for EMH upper canines are greater than those of the MH sample, mainly due to greater enamel volume and reduced EDJ surface area of the EMH sample. Preliminary results suggest that EMH lower canines align with Neandertals for the components of enamel thickness, but they are between Neandertals and MH for the AET and RET indices. By contrast, the EMH upper canines align with Neandertals for enamel and dentine volume, but not for EDJ surface area, which ultimately contributes to similar AET and RET values between EMH and MH. Tooth wear was found to reduce all dental components, affecting both 3D AET and RET indices in all groups. Both upper and lower Neandertal and MH canines present thick enamel in the cuspal half of the labial side of the crown, with MH showing the thickest enamel. Our results demonstrate that 3D RET is a valuable parameter to discriminate between unworn or slightly worn Neandertal and modern human canines. It is reasonable to assume that the enamel distribution reflects the macrowear pattern of the canines and the crowns are thickly enameled exactly in the areas where wear facets develop, so that the discriminatory power of the 3D RET index decreases with tooth wear. In spite of this, as worn teeth are more frequently found in the fossil record, efforts to explore the discriminatory power of worn teeth, including (but not only) enamel thickness analysis, would assist in dental analyses as recently suggested by other authors [5].

**References:**[1] Olejniczak, A.J., Smith, T.M., Feeney, R.N.M., Macchiarelli, R., Mazurier, A., Bondioli, L., Rosas, A., Fortea ,J., de la Rasilla, M., Garcia-Tabernero, A., Radovčić, J., Skinner, M.M., Toussaint, M., Hublin, J.-J., 2008. Dental tissue proportions and enamel thickness in Neandertal and modern human molars. J Hum Evol 55:12–23.[2] Feeney, R.N.M., Zermeno, J.P., Reid, D.J., Nakashima, S., Sano, H., Bahar, A., Hublin, J-J., Smith, T.S., 2010. Enamel thickness in Asian human canines and premolars. Anthrop. Sci., 118 (3):191-198.[3] Benazzi, S., Panetta, D., Fornai, C., Toussaint, M., Gruppioni, G., Hublin, J-J., 2014. Technical Note: Guidelines for the digital computation of 2D and 3D enamel thickness in hominoid teeth. Am. J. Phys. Anthropol. 153(2): 305-13[4] Smith, B.H., 1984. Patterns of molar wear in hunger-gatherers and agriculturalists. Am. J. Phys. Anthropol. 63:39–56[5] Fornai, C., Benazzi, S., Svoboda, J., Pap, I., Harvati, K., Weber, G.W., 2014. Enamel thickness variation of first and second upper molars in modern humans and Neanderthals. J. Hum. Evol. 76:83-91

Poster Presentation Number 104, Th (18:00-20:00)

## Automated image analysis of sand particle shape for describing hominin-bearing sediments in an Early and Middle Pleistocene site (Gran Dolina, Sierra de Atapuerca, Spain)

**Isidoro Campaña[1], Alfonso Benito-Calvo[1], Alfredo Pérez-González[1], José María Bermúdez de Castro[1,3], Eudald Carbonell[2,4]**

1 - Centro Nacional de Investigación Sobre Evolución Humana (CENIEH), Burgos, Spain · 2 - IPHES, Institut Català de Paleoecología Humana i Evolució Social, Tarragona,Spain · 3 - Department of Anthropology, University College of London, U.K · 4 - Universitat Rovira i Virgili (URV) Tarragona, Spain

Gran Dolina is one of the most important Early and Middle Pleistocene archaeological sites in Europe. New hominid specie was defined in this site, *Homo antecessor*, and more than 30.000 lithic tools and 99.000 fossils have been recovered. This site is a limestone cave infilled by 25 m thick of sediments divide into 11 lithostratigraphic units. They are named from TD1 to TD11 and grouped in 19 sedimentary facies. From these units, two units are remarkable by their archaeological remains: TD6 and TD10. In this work, the shape of the sand particles of 67 samples from Gran Dolina have been analyzed using automated image analysis, taking 13 samples of TD6 and 22 samples of TD10. This method allows characterise the shape, form and size of each sand particle. For this purpose, three sand sizes were analyzed: 500-250 μm, 250-125 μm and 125-63 μm; and three shape parameters were used: aspect ratio, convexity and circularity. The results are compared with sedimentary facies and stratigraphic position, especially in TD6 and TD10 units. They indicate that the sand shape of Gran Dolina site depends on the sedimentary transport, allowing to differentiate the sedimentary facies and environments. Analyzed samples show that TD6 unit shows two clear patterns, one in TD6.3 where the values are similar and trend to increase in the 500-250 size fraction. The other pattern is observed in TD6.2 and TD6.1, where the shape parameters display very disperse values, showing higher and lower values than others samples of Gran Dolina. The lowest shape parameters values are recorded in the top layer of TD6, which is related to weathering process associated with hyena coprolites. In TD10, the samples show similar results, excepting the youngest sub-unit samples, TD10.4, where low shape parameters values are observed. They are interpreted as a weathering layer. The hominin-bearing layers do not show any relevant different values with others layers of Gran Dolina. This work shows that the shape analysis of sand grains is an useful and rapid method for characterising archaeological sites. Sedimentary facies show different values which allow identifying weathered layers. Some weathered layers are explained by the action of acid waters from guano and hyena coprolites present in Gran Dolina. Others weathered layers have not clear explanation, but they could be related to a long time exposition and prolonged hiatus. The hominin-bearing layers do not show any pattern or relationship with weathering layers, indicating that their activity in Gran Dolina site not produce significant changes in the sand grains.

This study was supported by the MINECO project, CGL2012-38434-C03-02. I. Campaña is the beneficiary of a predoctoral FPI Grant from the Spanish MINECO. I. Campaña was also the beneficiary of a predoctoral grant from Fundación Atapuerca. Fieldwork at Atapuerca is supported by the Consejería de Cultura y Turismo of the Junta de Castilla y León. Leticia Miguens Rodríguez and Javier Iglesias Cibanal of the Geology Laboratory of CENIEH performed the laboratory sedimentary analyses. This work has benefited from discussions with Leticia Miguens Rodríguez, Javier Iglesias Cibanal, Mathieu Duval and Silvia Rodríguez Sierra.

Poster Presentation Number 7, We (17:00-19:00)

## Geometric Morphometric analyses of dental crown loss with age in baboons from the Amboseli National Park

**Aroa Casado[1], Juan Manuel Becerra[1], Alejandro Pérez-Pérez[1], Elisabeth Cuesta-Torralvo[1], Daniela Pacheco[2], Alejandro Romero [3], Jordi Galbany[4], Susan Alberts[5]**

1 - Universitat de Barcelona · 2 - Universidade de Coimbra · 3 - Universidad de Alicante · 4 - Washington University · 5 - Duke University

Dental wear rates in primates have been shown to change depending on environmental conditions and feeding ecology. Occlusal dental wear and dentine exposure also show significant correlations with age. Knowledge of age-at-death of specimens is crucial for intergroup comparisons, since different degrees of wear and dentine exposure could be attained at different ages in distinct populations or species. Studies of dental wear base on percent dentin exposure areas with respect to total occlusal area [1, 2] are limited to age groups that indeed show dentine exposure, which is a trait that varies among populations and species depending on diet composition and the amount of abrasive particles incorporated to chewed foodstuffs. We present a preliminary analysis of dental wear rates that is independent from dentine exposure and can be applied to all available teeth. The analysis is based on occlusal topography and geometric morphometric methods. Dental crowns are characterized by a 3D point-cloud mesh set across the whole dental crown with the *digitsurface* command in *Geomorph* Geometric Morphometrics package. Cusp tips are not defined as landmarks since they rapidly wear down and change their position when dental wear proceeds. A total of 4,800 points were used as pseudo-landmarks to build a cloud mesh indicative of crown topography and comparisons of crown shapes among specimens of different ages were made. The main objective this research was to correlate the morphometrics of dental crown loss with age at death to determine the reliability of the GM procedure used to characterized dental wear. The analysis was made on a large sample of yellow baboons (*Papio cynocephalus*) specimens of known age-at-death, both sexes included, from Amboseli National Park, Kenya. The results show a significant correlation between dental crown morphometric topography and age. Dental wear significantly increases with age, as expected. However, a significant correlation was also observed between overall dental crown shape and dental size, measured as the centroid size within the geometric morphometrics test. The pseudo-landmarks surfaces varied, not only depending on dental wear but also on crown morphology. A significant variation in molar crown length with respect to breadth, as well as in cusp size and proportions, were detected. The PCA performed distinguished different components of shape changes that could be analyzed separately. Topographic variables of dental crown relief were measured with MorphoTester. Crown curvature showed significant correlations with occlusal gross loss, whereas crown relief index varied with dental crown size, and inversely with crow topography. Surface patch count decreased in teeth with greatest degrees of dentine exposure and overall dental wear. As a whole, the morphometric method used is a reliable tool to measure occlusal dental wear that can be applied to all available teeth, including those with no dentine exposure areas, thus increasing the sample sizes available. In addition, the method used standardizes the 3D meshes for allowing comparisons among specimens and populations, since topographic analyses greatly depend on the number of mesh triangles of the scanned teeth. The R Geomorph procedure used avoids the substantial mesh preparation involved in other methodological analyses and simplifies the study that may, thus, be applied to larger samples. Moreover, the method retained morphometric variation of the dental crowns irrespective from dental wear, although at maximum degrees of crown loss, when occlusal surfaces were almost flat, the morphometric variation only showed variations in height of the remaining tooth crown. This results can be used as a dental wear model for other dental samples of Cercopitecoidea primates of unknown age at death, and show consistent results with both wear and shape dental variation.

**References:**[1] Galbany J, Romero A, Mayo-Alesón M, Itsoma F, Gamarra B, Pérez-Pérez A, Willaume E, Kappeler PM, Charpentier MJ (2014) Age-related tooth wear differs between forest and savanna primates. *PLoS One* 9(4), e94938.[2] Galbany J, Imanizabayo O, Romero A, Vecellio V, Glowacka H, Cranfield MR, Bromage TG, Mudakikwa A, Stoinski TS, McFarlin SC (2016) Tooth wear and feeding ecology in mountain gorillas from Volcanoes National Park, Rwanda. *Am J Phys Anthropol* 159(3), 457-465.

Poster Presentation Number 82, Th (18:00-20:00)

## Geometrical parameters of hominin ribs: a comparison between the Kebara 2 Neandertal and modern humans

**Tara Chapman[1,2], Benoît Beyer[2,4], Victor Sholukha[2,5], Patrick Semal [3], Veronique Feipel[2,4], Stéphane Louryan[2], Serge Van Sint Jan[2]**

1 - Operational Direction Earth and History of Life, Royal Belgian Institute of Natural Sciences, Belgium · 2 - Faculty of Medicine, Université Libre de Bruxelles, Belgium · 3 - Scientific Service Heritage, Royal Belgian Institute of Natural Sciences, Belgium · 4 - Faculty of Motor Sciences, Université Libre de Bruxelles, Belgium · 5 - Dept. of Applied Mathematics, Peter the Great St. Petersburg Polytechnic University (SPbPU), Russia

Ribs were previously rarely studied in palaeoanthropology as they are rarely found complete due to the fact that they are fragile and have complex curvatures. In recent years, however, there has been a growing interest in Neandertal rib remains. The Kebara 2 skeleton was found in 1983 at the Kebara Cave, Mt Carmel, Israel, with a complete set of ribs. Many of the original ribs are missing medial or sternal ends. Sawyer and Maley [1] reconstructed the ribs as part of a complete Neandertal thorax using mainly Kebara 2 remains. The rib geometric parameters of ribs 3-9 of the reconstructed Kebara 2 ribs were analysed in comparison to individual ribs of 14 modern human subjects (7 males and 7 females). All ribs were CT scanned and three-dimensional (3D) models were created. Each rib vertex cloud was then placed into a local coordinate system. Best fitting ellipses of the external contours of the cross section areas were used to analyse rib clouds. The rib midline was created from a pathway between each slice which was created from the centroid of each ellipse. The rib midline was then used to analyse arc length, rib chord, rib width, rib curvature in the axial plane, rib torsion and anterior-posterior bending (difference in mm between the sternal and head ends of the rib).

Common patterns between rib levels were noted in all rib geometric parameters for modern humans. The same patterns were demonstrated in the reconstructed Kebara 2 ribs. The Kebara 2 ribs were within the 95% confidence interval of the modern human mean for the majority of geometrical parameters. The analysis of all variables in a principal components analysis also placed the Kebara 2 ribs within the modern human range. The study further demonstrated significant differences between male and female ribs. Female ribs were demonstrated to have more rib torsion, rib curvature in the axial plane and rib anterior-posterior bending than males. Males were found to have greater arc and chord length and rib width than females. The reconstructed Kebara 2 ribs were more in the male range.

The research has partially been financed by the Belgian Science Policy Office (BELSPO) in the framework of a PhD thesis being undertaken by Tara Chapman at the Laboratory of Anatomy, Biomechanics and Organogenesis (LABO) at the Faculty of Medicine, ULB in conjunction with the Laboratory of Anthropology and Prehistory at the RBINS. Developments in lhpFusionBox were partially financed by the European Commission through the LDHL project. The authors would like to thank Gary Sawyer for the original reconstruction of the Neandertal thorax based on the Kebara 2 ribs. The authors would also like to thank Hakim Bajou and Sonia Telese Izzi for their technical assistance and the Radiology team at ULB Erasme Hospital for the digitisation of the Kebara 2 material.

**References:**[1] Sawyer, G.J., Maley, B., 2005. Neanderthal reconstructed. Anat Rec B New Anat 283B, 23-31.

Poster Presentation Number 131, Th (18:00-20:00)

## A new method for identifying experimental and Palaeolithic hafting adhesives using GC×GC-HRTOFMS

**Dries Cnuts[1], Katelynn A. Perrault[2], Lena Dubois[2], Pierre-Hugues Stefanuto[2], Jean-François Focant[2], Veerle Rots [1]**

1 - Traceolab/Prehistory, University of Liège, Quai Roosevelt 1B (Bât. A4), 4000 Liège, Belgium · 2 - Organic and Biological Analytical Chemistry Group, Chemistry Department, University of Liège, Allée du 6 Août 11 (Bât B6c), Quartier Agora, 4000 Liège (Sart-Tilman), Belgium

Hafting adhesives can be seen as an indication of the cognitive and technical capabilities of the manufacturers and therefore play a key role in the debate on human evolution [1], [2]. These adhesives are mainly from plant origin (resins, gums or tar) and are often mixed with beeswax and other additives in order to make them less brittle. Archaeological evidence indicates that these adhesives were already in use in the Paleolithic from at least 120.000 years ago [3]. Discoveries for this period are however very rare and only become abundant from the Neolithic onwards [4]. Their longer exposure to biochemical alteration processes limits the chance of survival in the archaeological record. If they are present on Paleolithic stone tools, they appear often in such small quantities that they are challenging to identify by traditional gas chromatography – mass spectrometry (GC-MS) or even to remove them effectively from the stone tool. The destructive nature of traditional GC-MS analysis can damage these rare samples for other analyses. Our study aims to overcome this problem by using headspace solid phase microextraction (HS-SPME) for sample extraction and analysis by comprehensive two-dimensional gas chromatography –high-resolution time-of-flight mass spectrometry (GC×GC-HRTOFMS), which has the benefit of analyzing the volatile organic compound (VOC)s from the substance and it does not destroy the complete matrix of the adhesive.

We present the results of a pilot study intended to examine the potential of this technique for analyzing Palaeolithic adhesives. The study involved: (1) an examination of experimental compound adhesives (containing pine and spruce resin, acacia gum and birch tar; beeswax and additives like charcoal, flax or ochre), (2) a blind test on experimental samples to test the reliability of the method and to determine the minimal quantity necessary for analysis, and (3) the analysis of different Palaeolithic adhesives and of experimental samples of at least 15 years old. The analysis was done on extracted and non-extracted adhesives. A unique chromatographic fingerprint was obtained for all experimental adhesive samples. The VOC profile of these adhesives proved to be extremely complex and therefore benefitted significantly from multidimensional separation techniques. GC×GC-HRTOFMS provided an optimal chromatographic separation of adhesive components. HRTOFMS data was used in order to obtain high-resolution mass spectral data to contribute to compound identification.

Our study demonstrates that GC×GC-HRTOFMS is a well suited method for identifying small quantities of compound adhesives with significant potential for Palaeolithic contexts. The additional sensitivity afforded by this technique in comparison to traditional GC-MS is a substantial benefit for these quantities. Furthermore, by only analyzing the VOCs of the adhesives, these rare archeological samples are not destroyed and can still be used for other types of analysis

Christian Lepers and Justin Coppe for providing the resin and beeswax mixtures. The research of K.P. is supported by Wallonie-Bruxelles International. The research of D.C. and V.R. is supported by the European Research Council under the European Union's Seventh Framework Programme (FP/2007-2013) / ERC Grant Agreement n. 312283.

**References:**[1] Wadley, L., 2010. Compound-Adhesive Manufacture as a Behavioral Proxy for Complex Cognition in the Middle Stone Age. Current Anthropology. 51, 111–119.[2] Barham, L., 2013. From Hand to Handle: The First Industrial Revolution. Oxford University Press, Oxford.[3] Mazza, P.P.A., Martini, F., Sala, B., Magi, M., Colombini, M.P., Giachi, G., Landucci, F., Lemorini, C., Modugno, F., Ribechini, E., 2006. A new Palaeolithic discovery: tar-hafted stone tools in a European Mid-Pleistocene bone-bearing bed. Journal of Archaeological Science. 33, 1310–1318.[4] Regert, M., 2004. Investigating the history of prehistoric glues by gas chromatography-mass spectrometry. Journal of separation science. 27, 244–54.

Poster Presentation Number 37, We (17:00-19:00)

## Spatial simulation and modeling on the early Pleistocene site of DS (Bed I, Olduvai Gorge, Tanzania): a powerful tool for predicting potential archaeological information from unexcavated areas

**Lucía Cobo-Sánchez**[1], **Manuel Domínguez-Rodrigo**[1]

1 - Universidad Complutense Madrid

Most spatial archaeological research is based on subjective appreciations and descriptions of graphics rather than on statistics, which can result in unreliable inferences. We present an example of the utility of combining spatial analyses within a powerful multivariate statistical framework to make solid predictions on still hidden archaeological information. The present study uses different regression models and simulations to detect the potentially densest areas of an unexcavated portion of DS (David's Site), a recently discovered early Pleistocene site at Olduvai Gorge (Tanzania). DS is the first Bed I site discovered after the Leakey's left the gorge, and it is, until now, the biggest excavated window in the African Early Pleistocene. The excavated area of 370 m2 exhibits a dense accumulation of associated fossil bones and stone tools with a highly anthropogenic signature, as evidenced by the presence of both percussion marks and cut marks on mostly green-broken bones, and by abundant impact flakes. A chi-square test indicates that the assemblage is not homogeneously distributed. K and L functions applied to the point pattern of the DS planimetry also show that it is moderately clustered. We ran different types of linear and polinomial regressions, that take the original sample distribution and size into account to make predictions about a broader spatial point pattern trend than that documented within the excavated window, and used Cox-Cluster regression models, as they are simulation processes that consider cluster processes, i.e. point inter-dependence, to project a spatial patterning within a new window of unexcavated terrain. Whereas the linear models suggest an increase of intensity towards the west, polinomial models indicate that intensity is more likely to increase towards the south. Addtionally, a Kolmogorov-Smirnov and a Berman's tests show that the ground topography had a significant effect on the distribution of archaeological materials. Simulations that take the effect of this covariate into consideration reproduce the excavated assemblage relatively accurately. However, the polinomial regression predicts a lower density of materials than documented, which can be interpreted as a sign that the density must also be dependent on hominin behaviour, and not just on the paleosurface topography. In order to test these predictions, our excavation strategy will prioritize intervention in the southern/southwestern sector of the unexcavated window in the following campaign. Statistical approches to archaeological spatial analyses appear to be an extremely useful analytical tool. If their potential is demonstrated, the further application of these powerful tests to the study of post-depositional processes affecting the assemblages, as well as to the study of the behavioral patterns that are ultimately responsible for the configuration of archaeological sites would be paramount.

We thank the Tanzanian Commission for Science and Technology (COSTECH), the Department of Antiquities and Ngorongoro Conservation Area Authority in the Ministry of Natural Resources and Tourism for permission to conduct research at Olduvai Gorge. We also thank the Spanish Ministry of Economy and Competitiveness for funding this research (HAR2013-45246-C3-1-P) and the Ministry of Culture for funding our research through their Archaeology Abroad program. We are very thankful for the help provided by Adrian Baddeley, Ege Rubak and Rolf Turner for some problematic coding. We thank them for creating the "spastat" R library and for their excellent book. For their great work in the on-going field research conducted at DS, we would like to express our appreciation and acknowledgement to: Julius Sulley, Lazaro Sarwatt, Yacob Matle, Yona Thomas, Thomas Madangi, Nicolaus Dohho, Caroli Maole, Francis Fabiano, Sangau Letuma, Nicodemus Burra, Ibrahim Mathias, and Shabany Bakari.

Poster Presentation Number 71, Th (18:00-20:00)

## Brain size growth is more plastic in humans than in chimpanzees

**Zachary Cofran**[1]

1 - Vassar College

It has recently been shown that brain shape has lower heritability in humans than in chimpanzees, implying greater plasticity in human neural development [1]. Greater capacity to respond to environmental stimuli may be a hallmark of human cognitive evolution underlying our cultural niche. Here I test whether humans display more plastic brain development, by assessing intraspecific variation in brain size growth from birth, in cross-sectional samples of humans and chimpanzees of known age. Human data comprise a recent clinical Australian sample (n=152) and an autopsy sample from France (n=101) [2,3]. Chimpanzee data are from a wild population (n=30) and a captive (n=69) colony [4,5]. For each sample, brain growth is modeled with an iterative curve fitting procedure that assumes non-linear growth up to an asymptotic adult size. Bootstrapped confidence intervals are estimated in order to statistically compare samples.

The chimpanzee samples show remarkable similarity in growth, despite such different living conditions. Captives have larger brain sizes at both birth and adulthood than the wild chimpanzees, but the former's 95% confidence intervals for both growth and model parameters encompass wild values. In contrast, the two human samples' 95% confidence intervals for growth and model parameters do not overlap at all, except for asymptotic adult size. The French sample starts with a smaller neonatal brain size and grows at a slower rate for a longer time to reach the same average adult size as the Australian sample. Thus, the chimpanzee samples come from very different environments but have statistically indistinguishable brain size growth, while the human samples follow statistically significantly different patterns.

Although these results are consistent with greater plasticity of human neural development, the present findings contrast with previous wisdom of human brain size growth. First, results highlight intraspecific variation in both the rate and duration of growth. Second, asymptotic adult size is reached by 1.9 and 3.5 years in the the Australian and French samples, respectively, which is earlier than is usually acknowledged for our species. Third, the duration of brain growth is very similar between the Australian and captive chimpanzee samples. Human variation identified here not only has cognitive implications, but also cautions against the pooling of ontogenetic brain size data from different populations.

I am grateful to Dr. Adam Gordon for providing the R code for the iterative curve fitting procedure.

**References:**[1] Gómez-Robles, A., Hopkins, W.D., Schapiro, S.J., Sherwood, C.C., 2015. Relaxed genetic control of cortical organization in human brains compared with chimpanzees. Proc. Nat Acad. Sci. 112, 14799–14804.[2] Abbott A.H., Netherway, D.J., Niemann, D.B., Clark, B., Yamamoto, M., Cole, J., Hanieh, A., Moore, M.H., David, D., 2000. CT-determined intracranial volume for a normal population. J. Craniofac. Surg. 11, 211-223.[3] Coqueugniot, H., Hublin, J.-J., 2012. Age-related changes of digital endocranial volume during human ontogeny: results from an osteological reference collection. Am. J. Phys. Anthropol. 147, 312-318.[4] Neubauer, S., Gunz, P., Schwarz, U., Hublin, J.-J., Boesch, C., 2012. Endocranial volumes in an ontogenetic sample of chimpanzees from the Taï Forest National Park, Ivory Coast. Am. J. Phys. Anthropol. 147, 319-325.[5] Herndon, J.G., Tigges, J., Anderson, D.C., Klumpp, S., McClure, H.M., 1999. Brain weight throughout the life span of the chimpanzee. J. Comp. Neurol. 409, 567-572.

Podium Presentation: Session 11, Sa (16:20)

## Fiber technology, rope-making, textiles and the *Lochstäbe* from the Aurignacian of the Swabian Jura

**Nicholas Conard**[1], **Veerle Rots**[2]

1 - University of Tübingen · 2 - TraceoLab / Prehistory, University of Liège, Liège, Belgium

At the end of the day, we know relatively little about fiber technology and textiles in the Paleolithic. Upper Paleolithic depictions, use wear and residues on tools, evidence of stringing ornaments, occasional impressions in clay, and claims of preserved fibers provide hints about these matters [1,2]. Given that most scholars are not looking for evidence of fiber technology, we can hardly be surprised that so little data on the topic exist. Here we suggest that researchers have known about artifacts for working fibers, string and rope for decades, but have been unable to recognize their importance. While we cannot yet prove it, we hypothesize that a number of perforated ivory artifacts (*Lochstab*, plural *Lochstäbe*) with carefully made spiral engravings inside their holes dating to the Aurignacian, are tools for working fibers and making string and rope. Previous researchers have argued that these objects that are well known from Vogelherd and Geißenklösterle represent decorated objects or mobile artworks [3,4]. In 2015 excavations in the Aurignacian deposits at Hohle Fels in the Ach Valley of the Swabian Jura led to the discovery of a beautifully preserved ivory *Lochstab* with four holes, each containing carefully carved, parallel, spiral engravings [5]. Due to its exceptional preservation, the new *Lochstab* from Hohle Fels opened our eyes to the likelihood, that this object is likely not a work of art, but rather a precisely made high-tech tool. Our paper presents the *Lochstäbe* from the Swabian Jura and similar finds from other contexts in Europe and considers the merits and problems with the artistic versus functional interpretation of these remarkable objects. The high aesthetic quality of these finds is readily apparent, but the most prominent aspect of the finds is the series of perfectly cut, deep, parallel groves inside the holes themselves. These parts of the textitLochstäbe are significantly obscured from view, leading us to think that the carefully placed series of deep spiral cuts were made to achieve a functional goal rather than as a form of artistic expression. In light of the new discovery from Hohle Fels, we replicated these artifacts in different medium to test whether or not they could be used to produce string or rope. We build our functional interpretation on extensive experimental work involving reproduced *Lochstäbe*. Based on these tests, we conclude that the *Lochstäbe* are likely carefully made tools for working plant fibers rather than being works of art.

**References:**[1] Soffer, O., J. M. Adovasio, and D. C. Hyland. 2000. The "Venus"Figurines, Textiles, Basketry, Gender, and Status in the Upper Paleolithic. Current Anthropology 41: 511 – 537 [2] Owen, L. 2005. Distorting the Past: Gender and the Division of Labor in the European Upper Paleolithic. Kerns Verlag: Tübingen [3] Riek, G., 1934. Die Eiszeitjägerstation am Vogelherd im Lonetal I: Die Kulturen. Akademische Buchhandlung Franz F. Heine, Tübingen [4] Hahn, J., 1988. Die Geißenklösterle-Höhle im Achtal bei Blaubeuren I. Fundhorizontbildung und Besiedlung im Mittelpaläolithikum und im Aurignacien. Theiss Verlag, Stuttgart.[5]Conard and Malina 2016. Außergewöhnliche neue Funde aus den aurignacienzeitlichen Schichten vom Hohle Fels bei Schelklingen. Archäologische Ausgrabungen in Baden-Württemberg 2015: 60-66

Poster Presentation Number 66, Th (18:00-20:00)

## Evolutionary Implications of the Neuropsychological Functions of the Retrosplenial Cortex

**Frederick L. Coolidge**[1], **James M. Hicks**[1]

1 - University of Colorado, Colorado Springs

The retrosplenial cortex (RSC), identified in human brains by German neurologist Korbinian Brodmann in 1909 (BA 29 and BA 30), is located in the posterior region of the cingulate cortex, the latter of which is situated above the corpus callosum. The RSC and the precuneus (BA 7; medial superior portion of the parietal lobes) appear to have major synergistic neuropsychological roles in the evolution of hominid cognition, particularly, perhaps, for *Homo erectus*. The term *retrosplenial* refers to fact that the RSC is located posteriorly to the splenium, the caudal part of the corpus callosum, and the RSC has numerous neural connections to the medial temporal lobes, hippocampus, precuneus, and anterior thalamic nuclei. Numerus human and animal studies have shown that the RSC plays a central role in a network of brain regions for navigation, especially *de novo* environments, and in spatial memories [1]. This network may also have a role in episodic and autobiographical memories. However, its most critical function may reside in its translational functions between an egocentric viewpoint, known to be a precuneal or posterior parietal cortex function [2], and an allocentric one, that is, it is viewpoint-independent, which neuronally depends upon the hippocampus and other medial regions of the temporal lobes. According to Vann, Aggleton, and Maguire [3], the place and grid cells of the hippocampus index locations contained within episodic or autobiographical memories then the RSC translates these indexes into egocentric information such that a location in a memory may be viewed from a more specific viewpoint or other points of view. It is suspected that the RSC may also act as a short-term storage buffer as information is being translated. Many human neurophysiological studies have confirmed that the RSC is significantly activated by many kinds of spatial navigational tasks including passive viewing of scenery, virtual-interactive spatial navigation, and active navigation of both new environments and highly familiar environments. The RSC is also highly active when topographical information needs updating or manipulated for ideothetic route planning. Human and animal studies involving brain damage in these regions also confirms the loss or major degradation of the aforementioned spatial abilities. As *Homo erectus* has been labeled a weed species, coming out of Africa many times over a million years or more, and it is known to have expanded its territory at least ten-fold over the australopithecines and habilines [4], the ability of *Homo erectus* to be successful in these endeavors no doubt depended upon the natural selection of a network of brain regions that could reciprocally translate these egocentric (self-centered) and allocentric (world-centered) viewpoints. Finally, it has been proposed [5] that this translational RSC model may be related to imaginative or creative thinking for its basic ability to reconstruct scenes or imagine alternative scenes. The latter model might help to account for the dramatic changes in technology from Mode 1 to Mode 2 stone tools. Thus, rather than the enhanced navigation abilities of *erectus* and their bifacial handaxes being independently evolved behaviors, they may share a common neurological substrate.

**References:**[1] Spiers, H. J., & Maguire, E. A. (2006). Thoughts, behaviour, and brain dynamics during navigation in the real world. *Neuroimage, 31*, 1826-1840.[2] Lou, H. C., Luber, B., Crupain, M., Keenan, J. P., Nowak, M., Kjaer, T. W., ... & Lisanby, S. H. (2004). Parietal cortex and representation of the mental self. *Proceedings of the National Academy of Sciences of the United States of America, 101*, 6827-6832[3] Vann, S. D., Aggleton, J. P., & Maguire, E. A. (2009). What does the retrosplenial cortex do? *Nature Reviews Neuroscience, 10*, 792-802.[4] Cachel, S., & Harris, J. W. K. (2003). The lifeways of *Homo erectus* inferred from archaeology and evolutionary ecology: a perspective from East Africa. *Early human behaviour in global context: the rise and diversity of the lower Palaeolithic record*, 108.[5] Burgess, N., & Becker, S. (2001). Modelling spatial recall, mental imagery and neglect. In *Advances in Neural Information Processing Systems 13: Proceedings of the 2000 Conference* (Vol. 13, p. 96). MIT Press.

Poster Presentation Number 94, Th (18:00-20:00)

## Population processes in the Nile Valley at the beginning of the Holocene, the El-Barga clue

**Isabelle Crevecoeur**[1], **Laure Thimon**[1], **Mona Le Luyer**[1], **Priscilla Bayle**[1], **Yann Heuzé**[1], **Matthieu Honegger** [2]

1 - UMR 5199-PACEA, CNRS, Université de Bordeaux, France · 2 - Chaire archéologie préhistorique, Hauterive, Suisse

The Early Holocene site of El-Barga in Nubia was discovered in 2001 by the Swiss archaeological mission in Sudan and has been excavated over the last decade. Two settlements were identified based on archaeological and radiometric grounds: a Mesolithic assemblage ( 7800 - 6900 BCE) and an Early Neolithic cemetery ( 6000 – 5500 BCE). This location is of the utmost importance in the Nubian Nile Valley because it is the only one documenting, with a substantial number of well-preserved individuals, the transitional period leading to the onset of the Neolithic. Based on the morpho-metrical studies of the El-Barga collections, we will address, through both classical methods and conventional and high resolution tomographic acquisitions, the issue of continuity or replacement of the Late Pleistocene populations of the Nile Valley at the onset of the Holocene. The comparative morphometrical analyses of the dental remains show strong biological affinities between the Mesolithic sample from El-Barga and the Nubian Epipalaeolithic populations from Jebel Sahaba. These characteristics significantly differentiate the Mesolithic and Early Neolithic samples at El-Barga. These phenotypic data were supplemented by the analysis of the dental tissue proportions and the enamel-dentine junction conformation of a sample of incisors and molars from both assemblages. In addition, the most complete cranium from both samples were selected for a comparative geometric morphometric analysis. The results support the hypothesis of a biological differentiation between the two El-Barga populations. In addition, it is unlikely that these differences would be related to dietary changes on such a short timescale and at the onset of pastoralism. Therefore, without excluding the possibility of a certain level of continuity, the integrative and comparative anthropological study of the two El-Barga groups, separated in time by less than a millennium, reveals the complexity of the history of population processes in the Nile Valley during this crucial period, although poorly documented, of cultural transition at the beginning of the Holocene.

This study is supported by l'Université de Bordeaux, the LabEx LaScArBx (LASCARBX-AAP1-2011), and by the ANR project Big Dry (ANR-14-CE31).

Poster Presentation Number 54, We (17:00-19:00)

## The Micro-hinge Facetting at the Solutrean Site of Las Delicias (Madrid, Spain): a Special Technique for the Preparation of Platforms in Bifacial Reduction

**Felipe Cuartero[1], Manuel Alcaraz-Castaño[2], Javier Baena[1], Mario López-Recio[1], Manuel Santonja[3]**

1 - Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid (Spain) · 2 - Neanderthal Museum, Mettmann (Germany) · 3 - Centro Nacional de Investigacióon sobre la Evolución Humana (CENIEH), Burgos (Spain).

The recent re-excavation of the Paleolithic open-air site of Las Delicias (Central Iberia) has shown new lithic assemblages and chronometric dates that demonstrate a Solutrean chronology for this classic site of the Manzanares River valley (Madrid). These assemblages are mostly composed of by-products related to bifacial reduction processes aimed at the production of foliate Solutrean pieces, such as laurel leaf points. A moderate component of blade production is also found, and retouched blanks are limited to a low number of expedient retouched tools [1]. Technological reading of the lithic assemblages showed a significant number of bifacial pieces abandoned in different stages of the reduction process, including preforms. It also showed a high amount of waste by-products obtained during the reduction of those pieces, among which the most characteristic are defined as thinning flakes or bifacial reduction flakes [e.g. 2, 3, 4]. In a high number of both bifacial pieces and thinning flakes we have recorded millimeter-size hinged and stepped scars. These micro-scars appear on both faces of bifacial pieces, and in the case of thinning flakes, on the butts and proximal areas of dorsal faces (overhang of the striking platform). In this work we use experimental knapping to demonstrate how these micro-hinges were not caused by knapping accidents, but they were produced at Las Delicias as intentional preparations of the striking platforms. This type of preparation allows for a better use of elastic percussion (soft hammers), which is a requisite for foliate bifacial knapping. We also show that only one percussion tool (antler hammer) is needed to accomplish the whole reduction process of a laurel leaf point. Its continuous use both for preparation of platforms and knapping of thinning flakes produces all the types of butts and knapping accidents identified in the archaeological assemblages of Las Delicias. Lastly, we show how, compared to other techniques of platform preparation [5], the micro-hinge facetting technique allows for obtaining larger and flatter removals, and it does not require the presence of highly skilled artisans to produce foliate points. Overall, our results show that the micro-hinge facetting special technique identified at Las Delicias, not yet defined in the literature, simplify the complexity of Solutrean bifacial reduction as previously described [4, 5]. Since this technique allows for the use of less tools and lees gestures than previously thought, and it does not require a high level of technical skill, as traditionally assumed, we should open up a discussion on the economic and social implications of this finding.

**References:**[1] Alcaraz-Castaño, M., López-Recio, M., Tapias, F., Cuartero, F., Baena, J., Ruiz-Zapata, B., Morín, J., Pérez-González, A., Santonja, M. (in press). The human settlement of Central Iberia during MIS 2: New technological, chronological and environmental data from the Solutrean workshop of Las Delicias (Manzanares River valley, Spain). Quaternary International (2015). http://dx.doi.org/10.1016/j.quaint.2015.06.069[2] Pelegrin, J., Chauchat, C. (1993). Tecnología y función de las puntas de Paijan: el aporte de la experimentación. Latin American Antiquity 4 (4), 367-382.[3] Callahan, E. (2000): The Basics of Biface Knapping in the Eastern Fluted Point Tradition: A Manual for Flintknappers and Lithic Analysts. Piltdown Productions, Lynchburg, Virginia (4th edition).[4] Aubry, T., Bradley, B., Almeida, M., Walter, B., João-Neves, M., Lenoir, M., Tiffagom, M. (2008). Solutrean laurel leaf production at Maîtreaux: an experimental approach guided by techno-economic analysis. World Archaeology 40, 48-66.[5] Pelegrin, J. (1981). Experiments in bifacial work: about "Laurel Leaves". Flintknappers' Exchange 4 (1), 4-7.

Poster Presentation Number 23, We (17:00-19:00)

## Occlusal dental wear and tooth crown shape: a Geometric Morphometric analysis of a known-age skeletal collection from Portugal using Geomorph in R

**Elisabeth Cuesta-Torralvo[1], Daniela Pacheco [2], Claudia Umbelino [2],Alejandro Pérez-Pérez [1], Alejandro Romero [3], Mert Sarigöcek[4], Aroa Casado [1], Juan Manuel Becerra [1], Jordi Galbany [5]**

1 - Universitat de Barcelona · 2 - Universidade de Coimbra · 3 - Universidad de Alicante · 4 - Ege University · 5 - George Washington University

The rate of occlusal dental wear varies among modern human populations since diet abrasivity depends on economic strategies and food processing techniques. Thus, morphometric analyses of dental shape variability require discarding all teeth affected by dental wear, since homologous landmark configurations, frequently on cusp tips, cannot be set if occlusal enamel loss modifies cusp shape and height. This impose serious limitations to the study of dental samples, especially so because dental wear and dentin exposure are frequent in human populations, both hunter-gatherers and agriculturalists [1]. We have attempted a methods of analysis of dental shape independently of dental wear in a modern skeletal collection (Coimbra, XXth century) including individuals of both sexes and known age-at-death. A representative sample was studied. Six or seven individuals of each sex and age category were selected. Six-year age-group intervals ranged from 6 to 65 years old. Actual age of each individual was also available. A total of 147 individuals were studied. The first and second molars, both upper and lower, were scanned with a 3D white light DAVID scanner at maximum resolution. The 3D models were analyzed with the Geomorph package in R. A template including 4,800 points was built from a configuration of 8 homologous topographic landmarks. The template was used to derive 4,800 surface pseudo-landmarks in all analyzed teeth that were used as homologous landmarks for Geometric Morphometric analysis in Geomorph. This landmark configuration was used as a representation of dental crown topography irrespective of dental cusp tips. At the same time, the topographic variables DNE, RFI and OPCR were computed using MorphoTester [2] upon the 4,800 point mesh of all studied teeth. These variables, along with the Centroid size and discrete variable of dental crown shape were used as covariates for studying the morphometric variability of tooth crowns. Results show various levels of GM variability. Inter-observed error was smaller than inter-specific variability. The PCAs showed that the first two components of dental shape correlated with occlusal shape and wear, especially with the size of the hypocone in upper molars and, although less marked, with the Y5 or +4 crown patterns in the lower ones. Overall dental shape also correlated with dental size (Centroid Size) and dental crown curvature (DNE), indicative that dental crown curvature changes with overall occlusal wear. A joint analysis of all teeth showed significant differences in shape among teeth and the actual age of the individuals significantly correlated with isolated PCs depending on the teeth considered. Separate analyses showed more specific morphometric patterns of molar shape indicative of hypocone size, presence of Carabelli's trait, size of cusps. etc., or dental wear. The overall results show that dental wear and dental shape can be separated in distinct components allowing for shape variability consideration independently of dental wear. The procedure developed proves to be reliable for studying large dental samples of human teeth independently of the degree of dental wear. This might provide a method for studying dental shape variability in human populations with unknown age-at-death. The analysis also shows that dental wear rates can be compared among populations to characterize patterns of wear in relation to ecological and dietary diversity.

This project was funded by the Spanish Grant CGL2104-5261-C2-1-P to APP.

**References**:[1] Romero A, Ramírez-Rozzi FV, De Juan J, Pérez-Pérez A (2013) Diet-related buccal dental microwear patterns in Central African Pygmy foragers and Bantu-speaking farmer and pastoralist populations. *PLoS One* 8(12), e84804. doi: 10.1371/journal.pone.0084804.[2] Winchester JM (2016) MorphoTester: An Open Source Application for Morphological Topographic Analysis. *PLoS One* 11(2), e0147649. doi: 10.1371/journal.pone.0147649.

Podium Presentation: Session 7, Fr (17:00)

## A new Middle Pleistocene cranium in an Acheulian context at Gruta da Aroeira (Almonda karst system, Torres Novas, Portugal)

**Joan Daura[1], Montserrat Sanz[1], Juan Luis Arsuaga[2], Rolf Quam[3], Maria Cruz Ortega[2], Elena Santos [2], Dirk L. Hoffmann[4], Sandra Gómez[5], Angel Rubio[6], Lucia Villaescusa[5], Pedro Souto[7], João Mauricio[7], Filipa Rodrigues[7], Artur Ferreira[7], Paulo Godinho[7], Erik Trinkaus[8], João Zilhão[1,9,10]**

1 - UNIARQ, Centro de Arqueologia. Faculdade de Letras, Universidade de Lisboa, Portugal · 2 - Centro UCM-ISCIII de Investigación sobre la Evolución y Comportamiento Humanos, Madrid, Spain · 3 - Department of Anthropology, Binghamton University (SUNY), USA · 4 - Max Planck Institute for Evolutionary Anthropology, Department of Human Evolution, Leipzig, Germany. · 5- Grup de Recerca del Quaternari (GRQ). Department of History and Archaeology, University of Barcelona, Spain · 6 - Laboratorio de Antropología, Depto de Medicina Legal, Toxicología y Antropología Física, Facultad de Medicina, Universidad de Granada, Granada, Spain· 7 - Crivarque-Estudos de Impacto e Trabalhos Geo-Arqueológicos,Torres Novas, Portugal · 8 - Department of Anthropology, Washington University, Saint Louis, USA · 9 - Department of History and Archaeology, University of Barcelona, Spain · 10 - ICREA (Catalan Institution for Research and Advanced Studies), Barcelona, Spain

Despite the abundant remains from Sima de los Huesos and Arago, human cranial variability in the earlier Middle Pleistocene of Europe is poorly known, which makes it difficult to assess patterns of human diversity and possible regions for ancestral populations associated with the western Eurasian spread of the Acheulian technocomplex. A recently discovered partial cranium from the Gruta da Aroeira may shed some light on this period. U-series dating of stratigraphically overlying flowstone provides a minimum age of 390 ka, placing the fossil in the relevant time period . This cave site was first excavated between 1998 and 2002, revealing a rich collection of Acheulian bifaces in association with large mammals and two human teeth [1-2]. Work resumed in 2013, intent on reaching bedrock and establishing the chronology of the stratigraphic sequence, which, at the back of the cave, spans 4 m and comprises three major stratigraphic units. Unit 1 is a colmatation breccia. Unit 2 is a 2.2 m-thick mud-supported breccia rich in angular and sub-rounded clasts comprising Acheulean layer X. Basal unit 3 is a fluvial cave deposit comprising two layers: XI, with faunal remains but no artefacts; XII, sterile. The layer X lithics include handaxes and other bifacial tools; the Levallois method was not used. The highly fragmented faunal remains are dominated by cervids and equids and include Rhinocerotidae, bear, a large bovid, a caprid, and tortoise. Burnt bone fragments were recovered at the base of layer X. A partial human cranium encased in rock-grade breccia was discovered at the base of layer X. It consists of a large part of the right side of a braincase, lacking the occipital bone, but also preserving a portion of the left side of the frontal squama and supraorbital torus, as well as the interorbital region, including the vertical part of the nasal bones. A fragment of the right maxilla, with two molars partially preserved, was also found attached to the calvarium but not in anatomical position. Based on the degree of synostosis of the right coronal suture, the individual was a mature adult. There is no plastic deformation of the preserved regions although an extensive area of the outer surface of the frontal squama and the supraorbital torus was mechanically eroded (abraded) before final deposition, indicating a certain amount of transportation. As a consequence of the abrasion, the frontal squama was considerably thinned and the midorbital and lateral (trigone) parts of the supraorbital arches are lost. The fossil was mechanically removed from the breccia with great care and accuracy, and then CT-scanned and virtually reconstructed, using the Mimics v.18 software program. Although neither the sagittal suture nor bregma are preserved, there remains enough of the right portion of the frontal bone (including the interior frontal crest) to identify the midline. The preserved portions were mirror-imaged and the main transverse neurocranial diameters were measured. The Aroeira skull shows relatively thick bones, and an angular torus is present on the right parietal bone. This latter feature is a primitive trait found on some Middle Pleistocene fossils from the Sima de los Huesos , Caune de l'Arago and Ceprano, but not found in Neandertals and is consistent with a geological age between 400 ka and 500 ka. When the reconstructed braincase is viewed posteriorly, the parietal walls are fairly vertical but converge slightly towards the top. The general measurements of the Aroeira neurocranium are well within the ranges of the Sima de los Huesos (Atapuerca) collection and other European fossils attributed to the mid Middle Pleistocene, although the thickness of the supraorbital torus and the interorbital breadth are outstanding.

Fieldworks were funded by Câmara Municipal de Torres Novas and Fundação para a Ciência e Tecnologia.

**References:**[1] Marks, A.E., Brugal, J.-P., Chabai, V.P., Monigal, K., Goldberg, P.,et.al. 2002. Le gisement Pléistocène moyen de Galeria Pesada, (Estrémadure, Portugal)⊠: premiers résultats. Paléo. 14, 77–100. [2] Trinkaus, E., Marks, A.E., Brugal, J.-P., Bailey, S.E., Rink, W.J., Richter, D., 2003. Later Middle Pleistocene human remains from the Almonda Karstic system, Torres Novas, Portugal. Journal of Human Evolution. 45, 219–226. [3] Hoffmann, D.L., Pike, A.W.G., Wainer, K., Zilhão, J., 2013. New U-series results for the speleogenesis and the Palaeolithic archaeology of the Almonda karstic system (Torres Novas, Portugal). Quaternary International. 294, 168–182 [4] Arsuaga, J.L., Martínez, I., Arnold, L.J., Aranburu, A., Gracia-Téllez, A., et.al. 2014. Neandertal roots: Cranial and chronological evidence from Sima de los Huesos. Science. 344, 1358–1363.

Poster Presentation Number 103, Th (18:00-20:00)

## The Breckland Palaeolithic Project: New Investigations of the First Acheuleans in Britain

**Robert Davis**[1], **Simon Lewis**[1], **Nick Ashton**[2], **Simon Parfitt**[3,4]

1 - Queen Mary University of London · 2 - British Museum · 3 - University College London · 4 - The Natural History Museum, London

The Breckland Palaeolithic Project, a three year research project funded by the Leverhulme Trust, is using the rich archaeological, geological and environmental records of the Breckland of East Anglia, UK, to examine how human populations, culture and technology adapted to a developing landscape within a single region through deep time. The area's Palaeolithic sites divide into three chronological periods: those associated with the pre-Anglian Bytham River; Hoxnian interglacial sites; and sites in post-Anglian river terraces of modern-day rivers. The Breckland therefore documents Middle Pleistocene human occupation within a changing palaeolandscape.

This poster presents results from ongoing investigations of the Breckland's Bytham River sites. The Bytham was a major west-east flowing Pleistocene river that drained central and eastern England until it was destroyed by the Anglian Glaciation approximately 450 ka. The Breckland contains a number of important sites associated with the Bytham River. These include Warren Hill, Maidscross Hill, Brandon Fields and Rampart Fields, which are associated with the lowest two Bytham terraces, are in close geographic and stratigraphic proximity to each other and have produced Acheulean assemblages [1, 2], and High Lodge with its scraper industry [3]. New fieldwork conducted in collaboration with a dating team from the National Museum of Natural History, Paris, and analysis of existing museum collections and archives are providing a clearer indication of the age of these sites and the character and distribution of the associated archaeology. A pre-Anglian age for the lowest Bytham River terrace is suggested by ESR age estimates of 539 ± 38 ka and 544 ± 53 ka for deposition of fluvial deposits at Warren Hill [4]. Assemblages recovered from the higher terrace deposits at Maidscross Hill and Brandon Fields are older still, potentially a full glacial-interglacial cycle earlier and possibly date to MIS 15. Maidscross Hill and Brandon Fields currently represent some of the earliest evidence for Acheulean populations in northern Europe. Work to provide absolute dates for the higher Bytham terraces using the ESR method is ongoing.

Three distinctive stone tool assemblages can be identified at the Breckland's Bytham River sites: fresh ovate handaxes, rolled crude handaxes and elegant scrapers of the type found at High Lodge. Study of museum collections, archives and historic mapping is enabling the character, distribution and relative chronology of these assemblages to be better understood.

**References:**[1] Bridgland, D.R., Lewis, S.G., Wymer, J.J., 1995. Middle Pleistocene stratigraphy and archaeology around Mildenhall and Icklingham, Suffolk: report on the Geologists' Association Field Meeting, 27th June 1992. Proc. Geol. Assoc. 106, 57–69.[2] Lewis, S.G. 1998. Quaternary stratigraphy and Lower Palaeolithic archaeology of the Lark valley, Suffolk. In Ashton, N., Healy, F. and Pettitt, P. (eds.) Stone Age Archaeology: Essays in honour of John Wymer. Oxbow Books, Oxford.[3] Ashton, N.M., Cook, J., Lewis, S.G., Rose, J. (Eds.), 1992. High Lodge: Excavations by G.de G. Sieveking 1962–68 and J. Cook 1988. British Museum Press, London.[4] Voinchet, P., Moreno, D., Bahain, JJ., Tissoux, H., Tombret, O.,Falguères, C., Moncel, MH., Schreve, D., Candy, I.,Antoine, P., Ashton, N., Beamish, M., Cliquest, D., Despriée, J., Lewis, S., Limondin-Lozouet, N., Locht, JL., Parfitt, S. and Pope, M. 2015. New chronological data (ESR and ESR/U-series) for the earliest Acheulean sites of northwestern Europe. J. Quat. Sci. 30, 610–622.

Poster Presentation Number 115, Th (18:00-20:00)

## Testing siliceous raw material homogeneity and its impact on Palaeolithic hunter-gatherer societies: a regional case study from the Dordogne in South-West France

**Marie-Claire Dawson**[1]

1 - PACEA UMR-5199, Université de Bordeaux

The quality of lithic raw materials is known to have played a role in techno-economic choices made by hominids throughout the Palaeolithic, affecting the morphometric characteristics of the products obtained and influencing procurement strategies. The quality of a specific flint is often described in general terms (e.g. good, mediocre or poor) and applied to a type of flint as a whole, despite variability known to occur within an outcrop or even within a same block. In this sense, it is pivotal to determine the homogeneity of flint nodules from a specific source to better judge their knappability and idiosyncrasies.

Our study region, between the right banks of the Dordogne River valley to the south and the Enéa valley to the north-east, represents an ideal context having yielded long Mousterian sequences, including 3 main reference sites: Pech de l'Aze I, II and IV. We focus on one particular type of flint (Senonian) available in different types of deposits in this geographic area: sub-primary and secondary (alterites, eroded slope and alluvial deposits). While these various sources of Senonian flint all derive from the same geological stage, some variability in quality may occur, tied to local epigenetic alterations.

In order to test and document this flint's homogeneity, we carried out surveys of all the different types of deposits, systematically recording the nodule's morpho-dimensional characteristics, cortex type and thickness, and whether the silification is homogenous throughout its volume, as well as microscopic petrological analyses. Variations were observed in the form of a drier, coarser core in some nodules (resembling a quartzite texture), which contrasts with a finer, better silicified sub-cortical zone. The ratio of homogenous sub-cortical vs. coarse flint was estimated, noting the weight and volume of both types of flint for each nodule.

Our hypothesis is that these non-homogenous nodules may have posed an obstacle to knapping. Focusing on the Middle Palaeolithic as a chronological framework to test this hypothesis, we carried out experiments on this Senonian flint, applying various Mousterian debitage methods (Levallois, Discoid, Quina and bifacial thinning). Accidents (e.g. shattered or hinged flakes) were tallied for each type of debitage.

We conclude that some of these local Senonian flint nodules are of poor quality due to their heterogeneity, which would have impacted procurement strategies and methods of reduction. With this in mind, we are interested in whether Neandertals adapted their techno-economic behaviours in relation to the local raw material available by exploring the local archaeological record.

This work was financed by a doctoral research grant as part of the NEMO Project funded by the LaScArBx research programme supported by the ANR (ANR-10-LABX-52).

Poster Presentation Number 93, Th (18:00-20:00)

## New genetic and morphological evidence suggests a single hoaxer created 'Piltdown Man'

**Isabelle De Groote[1], Linus Flink[2], Rizwaan Abbas[3], Silvia Bell[4], Lucia Borgio[5], Laura Buck[6], Christopher Dean[3], Ali Freyne [4], Thomas Higham[7], Chris G. Jones[4], Robert Kruszynski[4], Adrian Lister[4], Simon Parfitt[4], Matthew M. Skinner[8], Karolyn Shindler[4], Christ Stringer[4]**

1 - Liverpool John Moores University, Byrom Street, Liverpool, U.K. · 2 - Liverpool John Moores University · 3 - University College London · 4 - The Natural History Museum · 5 - Victoria and Albert Museum · 6 - Cambridge University · 7 - Oxford University · 8 - Kent University

In 1912 palaeontologist Arthur Smith Woodward, then Keeper of Geology at the British Museum (Natural History) (now the Natural History Museum), and amateur antiquarian Charles Dawson announced the discovery of a fossil that supposedly provided a link between apes and humans: '*Eoanthropus dawson*' ('Dawson's Dawn Man'). The publication generated huge interest from scientists and the general public. Dawson first wrote a letter to Smith Woodward of his apparent find in of February 1912, in which he describes having found a 'thick portion of a human(?)[sic] skull which will rival *H. heidelbergensis* in solidity' [DF 100/53/220]. The type specimen of *Homo heidelbergensis*) had been discovered in Germany in 1907. The Piltdown find would raise not only the reputation of Dawson and Smith Woodward, but also of Britain as a key nation in the story of human evolution. However, 'Piltdown Man's' initial celebrity has long been overshadowed by its subsequent infamy as one of the most famous scientific frauds in history. Our re-evaluation of the Piltdown fossils using the latest scientific methods (DNA analyses, high-precision measurements, spectroscopy and virtual anthropology) shows that there was a consistent *"modus operandi"* throughout the assemblage (specimens are stained brown, loaded with gravel fragments, and restored using filling materials) linking all specimens from the Piltdown I and Piltdown II sites to a single forger – most probably Charles Dawson. We have also detected hitherto unrecognised modifications and damage to the Piltdown mandible and demonstrate that by meticulous study and the application of new, state of the art scientific techniques it is possible to produce new insights into old paleoanthropological questions. Whether Dawson acted alone is uncertain but his hunger for acclaim may have driven him to risk his reputation and misdirect the course of anthropology for decades. The Piltdown hoax stands as a cautionary tale to scientists not to be led by preconceived ideas but to use scientific integrity and rigour in the face of novel discoveries.

Poster Presentation Number 106, Th (18:00-20:00)

## Extended-range luminescence dating of sedimentary infill sequences of the Atapuerca karst complex: determining access history to the Sima de los Huesos site

**Martina Demuro[1], Lee Arnold[1], Arantza Aranburu[2], Juan Luis Arsuaga[3]**

1 - University of Adelaide · 2 - Universidad del Pais Vasco · 3 - Universidad Complutense de Madrid

The Sima de los Huesos site (SH) in northern Spain has produced the largest accumulation of Middle Pleistocene human fossils worldwide. Thousands of human remains, including quasi-complete skeletons, representing at least 28 individuals have been exhumed from a small chamber located within the third and lowermost level of the Atapuerca karst system. The hominin fossils, which display incipient Neanderthal specialisations and have yielded nuclear DNA sequences supporting this interpretation [1,2], have been chronologically constrained to Marine Isotope Stage (MIS) 12 via extended-range luminescence dating on sediment layers directly bracketing the remains and uranium series dating of pene-contemporaneous calcite rafts . Recent taphonomic, stratigraphic and sedimentological studies have made significant advancements in elucidating site formation processes at SH and have lead to the exclusion of both carnivores and mud flows (catastrophic or otherwise) as potential agents responsible for the fossil accumulations [3,4]. However, an adequate reconstruction of the sequence of events leading to the fossil accumulation is still pending. Resolving this question requires a detailed understanding of the sediment infilling history at various sections of the Atapuerca karst system, and the establishment of a firm chronological framework using numerical dating techniques.

This study reports on luminescence dating results obtained for a sedimentary sequence composed of bedded sands overlain by a debris flow deposit at Sala de los Cíclopes (SCi), a large chamber adjacent to the SH site, which currently blocks a palaeoentrance to the karst system . The aim of this dating work is to determine whether this palaeoentrance was accessible during the SH bone accumulations and to assess whether it served as an entryway for the hominins into the karst.

A total of five luminescence dating samples were analysed: four from the SCi chamber and one from a section located outside the cave. Sampling at SCi included one sample from the well-bedded fine silty sands at the base of the sequence and three samples from the overlying debris flow deposit composed of orange/red silty mud matrix supporting gravels. A fifth sample was collected from a sediment profile situated outside the cave that had been sedimentologically correlated to the capping debris flow deposit blocking the cave entrance at SCi. Extended-range luminescence ages were determined using thermally-transferred optically stimulated luminescence (TT-OSL) measurements made on individual silt-sized quartz grains. Data analysis was performed following published procedures and ages were calculated using dose rate values obtained from a combination of in situ gamma spectrometry and beta counting.

The TT-OSL ages for the basal sands are of Early Pleistocene age while those for the debris flow deposit (located inside and outside the SCi) indicate this particular entrance was effectively sealed by 450 ka, or shortly thereafter if we allow for the presence of a gap, albeit narrow, above the debris flow deposit. After 450 ka it appears that the SH chamber was not directly accessible to humans. Considering the close approximation between the mean age of SCi debris flow and that obtained for the clays containing the hominin fossils in SH (mean ages are in agreement at $2\sigma$), it is possible that both hominins and bears had access to the SCi large chamber (and the SH shaft) in the last moments of the final deposition of the debris flow, before the communication with the outside become completely sealed. Additional samples collected from the upper deposits at Sima del Elefante (150 m away from the SCi entrance) suggest the cave remained accessible to bears via a much more distant palaeoentrance until 250 ka. This reconstruction is consistent with the predominance of bear bones at SH from MIS 12 onwards.

**References:**[1] Arsuaga, J.L., Martínez, I., Arnold, L.J., Aranburu, A., Gracia-Téllez, A., et.al. 2014. Neandertal roots: cranial and chronological evidence from Sima de los Huesos. Science 344, 1358-1363.[2] Meyer, M., Arsuaga, J.L., de Filippo, C., Nagel, S., Aximu-Petri, A., et.al. 2016. Nuclear DNA sequences from the Middle Pleistocene Sima de los Huesos hominins. Nature 531, 504-507.[3] Sala, N., Arsuaga, J.L., Martínez, I., Garcia-Téllez, A., 2014. Carnivore activity in the Sima de los Huesos (Atapuerca, Spain) hominin sample. Quat Sci Rev 97, 71-83.[4] Aranburu, A., Arsuaga, J.L., Sala, N., in press. The stratigraphy of the Sima de los Huesos (Atapuerca, Spain) and implications for the origin of the fossil hominin accumulation. Quat Int doi.org/10.1016/j.quaint.2015.02.044.[5] Arnold, L.J., Demuro, M., Parés, J.M., Arsuaga, J.L., Aranburu, A., et.al. 2014. Luminescence dating and palaeomagnetic age constraint on hominins from Sima de los Huesos, Atapuerca, Spain. J Hum Evol 67, 85-107.

Poster Presentation Number 52, We (17:00-19:00)

## Patterns of long-term change in Middle Paleolithic stone tool technology at Gruta da Oliveira (Almonda karst system, Torres Novas, Portugal)

**Marianne Deschamps**[1,2], **Henrique Matias**[1], **João Zilhão**[1,3,4]

1 - UNIARQ - Centro de Arqueologia da Universidade de Lisboa, Portugal · 2 - UMR 5608-TRACES, Université Toulouse 2, France · 3 - ICREA (Catalan Institution for Research and Advanced Studies), Barcelona, Spain · 4 - Department of History and Archaeology, University of Barcelona, Spain

The geographic and temporal diversity of Middle Paleolithic technological systems remains poorly understood, due to the limited number of sites with long stratigraphic sequences associated with a reliable chronometric framework. Gruta da Oliveira [1-3] is exceptional in this regard, particularly where the early parts of the Upper Pleistocene (MIS 5 and MIS 4) are concerned. Discovered in 1989, the site was excavated until 2012 by J. Zilhão. Its 9 m-thick archeo-stratigraphic sequence is sealed by a thick colmatation breccia and the stone tool assemblages found therein are of Middle Palaeolithic technology from top to bottom. Made on flint, quartz and quartzite, these assemblages are associated with abundant faunal and microfaunal remains. Fragmentary Neandertal fossils were also found in a number of stratigraphic units.

Combined with the results of radiocarbon, TL and U-series dating, stratigraphic constraints suggest that the upper part of the sequence (layers 7-12) is of MIS-3 age, its middle part (layers 13-14) of MIS-4 age, and its lower part (layers 15-27) of MIS-5 age [4-5]. In the interest of documenting diachronic techno-economic change across these phases, we present preliminary results of our ongoing work on the unpublished lithic artefacts from the sequence (>29,000 items catalogued so far, and counting). We will place special emphasis on the lower part of the sequence, for which the TL date obtained on burnt flints recovered in overlying layer 14 (77±8 ka) provides a reliable terminus ante quem. Our conclusions are based on a taphonomical critique of the archaeo-stratigraphy, based on the systematic intra-level and inter-level refitting of all quartzite artefacts (preferred over flint due their higher "phenotypic" diversity, which makes for a higher rate of success in the identification of the original nodule of provenience). The spatial distribution of the refit units (148 so far for layers 15-27, 213 so far for layers 8-13) is then used to (a) evaluate the degree of post-depositional integrity of the stratigraphic units recognized in the field and (b) define layer groupings that are meaningful for the purposes of assessing change through time.

As is common in the Middle Paleolithic of Portugal, the percentage of retouched tools, mostly notches and denticulates, is very low throughout; typological analysis is therefore of little utility for the characterization of the Gruta da Oliveira assemblages. This scarcity remains to be fully understood but can be related to raw-material procurement and the economy of the débitage, ultimately determined by settlement-subsistence systems quite distinct from those documented in the Middle Paleolithic elsewhere in Western Europe. The Levallois method is well represented. Macro-tools — cleavers made on flakes, and hand-axes — are found in low numbers in layers 19-17, but they are entirely missing above and below. This pattern suggests that their production is a temporally discrete phenomenon and, hence, a distinctive feature of the late MIS 5 stone tool assemblages of the region, begging the question of their relationship with the cleaver-yielding assemblages from Northern Spain and Southwestern France, which we will discuss.

This work is supported by a Fyssen Foundation post-doctoral grant.

**References**:[1] Zilhão, J., Angelucci, D., Aubry, T., Badal, E., Brugal, J.-P., Carvalho, R., Gameiro, C., Hoffmann, D., Matias, H., Mauricio, J., Nabais, M., Pike, A., Povoas, L., Richter, D., Souto, P., Trinkaus, E., Wainer, K., Willman, J., 2013. A Gruta da Oliveira (Torres Novas): uma jazida de referência para o paleolítico médio da península ibérica, in: Arnaud, J., Martins, A., Neves, C. (Eds.), Arqueologia em Portugal 150 anos. Associação dos Arqueólogos Portugueses, Lisboa, pp. 259-268.[2] Angelucci, D. E., Zilhão, J., 2009. Stratigraphy and Formation Processes of the Late Pleistocene Deposit at Gruta da Oliveira, Almonda Karstic System, Torres Novas, Portugal. Geoarchaeology, 24 (3), 277-310.[3] Willman, J. C., Maki, J., Bayle, P., Trinkaus, E., Zilhão, J., 2012. Middle Paleolithic Human Remains from the Gruta da Oliveira (Torres Novas), Portugal. American Journal of Physical Anthropology 149, 39-51.[4] Hoffmann, D., Pike, A., Wainer, K., Zilhão, J., 2013. New U-series results for the speleogenesis and the Palaeolithic archaeology of the Almonda karstic system (Torres Novas, Portugal). Quaternary International 294, 168-182.[5] Richter, D., Angelucci, D., Dias, M., Prudêncio, M., Gouveia, M., Cardoso, G., Burbidge, C., Zilhão, J., 2014. Heated flint TL-dating for Gruta da Oliveira (Portugal): dosimetric challenges and comparison of chronometric data. Journal of Archaeological Science 41, 705-715.

Poster Presentation Number 34, We (17:00-19:00)

## New methodological advances in dating archaeological bones at the Oxford Radiocarbon Accelerator Unit

**Thibaut Deviese**[1], **Daniel Comeskey**[1], **James McCullagh**[2], **Thomas Higham**[1]

1 - Oxford Radiocarbon Accelerator Unit, RLAHA, University of Oxford · 2 - Chemistry Research Laboratory, Department of Chemistry, University of Oxford

Reliable dating of archaeological bones is one of the keys to understand the chronology of human and fauna evolution. The efficient removal of carbon-based contaminants from samples prior to AMS dating is crucial for the application of the radiocarbon method. Contamination can originate from a wide range of sources in the post-depositional environment. Acidic, dark-coloured, chemically complex humic acids, derived from the breakdown of plant organic matter, are one such contaminant. These range in size from a few hundred to several thousand Daltons. They may enter the bone matrix after its deposition and become chemically cross-linked with the collagen [1]. Sample contamination may also occur during excavation and post excavation activities (i.e. with the application of conservation materials) or during laboratory handling. Over the last decades, much work has been undertaken at the Oxford Radiocarbon Accelerator Unit (ORAU) to improve collagen purification techniques prior to AMS measurement. In particular, alternative sample pre-treatment using liquid chromatography has been developped since 2006. Using a preparative HPLC system and non-carbon based eluents, this technique enables the separation of underivatised amino acids liberated from the hydrolysis of collagen. A particular focus has been on the isolation of hydroxyproline for single compound AMS dating, since this is recognised as being present almost uniquely at high concentrations in bone collagen. This method is particularly relevant for Palaeolithic samples as any small amount of contamination by carbon-containing compounds can significantly affect radiocarbon dates and prevent establishment of robust chronologies. Our first aqueous-only mobile phase HPLC method involved 2 steps. The first separated essential amino acids (EAAs) on a reversed-phase chromatographic column and the second separated the non-essential amino acids (NEAAs) on a mixed-mode chromatographic column [2-4]. Here, we report significant improvements that have been made recently to the method to enable faster hydrolysis and faster preparative separation of amino acids from bone collagen, making the method suitable for routine radiocarbon dating of contaminated and/or poorly preserved bone samples by AMS. We will describe the new specifications of the method and illustrate its efficiency to eliminate contaminants with newly dated examples from the key sites of Sungir and Kostenki (Russia). We will also describe other case studies which use liquid chromatography for dating bone samples with such low levels of collagen preservation that they could not previously be dated using routine methods.

This research has been supported by the European Research Council (grant 324139 awarded to Prof. T. Higham for the 'PalaeoChron' project).

**References:**[1] van Klinken, G.J., Bowels, A.D., Hedges, R., 1994. Radiocarbon dating of peptides isolated from contaminated fossil bone collagen by collagenase digestion and reverse-phase chromatography. Geochimica et Cosmochimica Acta. 58, 2453-2551. [2] McCullagh, J., Marom, A., Hedges, R., 2010. Radiocarbon dating of individual amino acids from archaeological bone collagen, Radiocarbon. 52(2-3), 620-634. [3] Marom, A., McCullagh, J., Higham, T., Sinitsyn, A., Hedges, R., 2012. Single amino acid radiocarbon dating of Upper Palaeolithic modern humans. PNAS. 109(18), 6878-6881. [4] Nalawade-Chavan, S., McCullagh, J., Hedges, R., 2014. New Hydroxyproline Radiocarbon Dates from Sungir, Russia, Confirm Early Mid Upper Palaeolithic Burials in Eurasia. Plos One. 9(1), e76896.

Poster Presentation Number 17, We (17:00-19:00)

## A novel method for semi-automatic count of perikymata

**Jose-Francisco Diez-Pastor[1], Rebeca García González[2], Sergio Chico Carrancio[3], Mario Modesto-Mata[4,5], Raúl Marticorena Sánchez[1]**

1 - Universidad de Burgos. Departamento de Ingeniería Civil. Área de Lenguajes y Sistemas Informáticos, Burgos, Spain. · 2 - Universidad de Burgos. Laboratorio de Evolución Humana. Area Paleontología. Departamento CC. Históricas y Geografía. Edificio I+D+i. Universidad de Burgos, Burgos, Spain · 3 - Universidad de Burgos. Avda. Cantabria s/n Edificio A. Escuela Politécnica Superior, 09006 Burgos, Spain. · 4 - Centro Nacional de Investigacion sobre la Evolucion Humana (CENIEH), Burgos, Spain · 5 - Equipo Primeros Pobladores de Extremadura, Casa de la Cultura Rodríguez Moñino, Cáceres, Spain

Perikymata are the surface manifestations of Retzius line, which show biological rhythms range from 6 to 12 days in hominoids. Number and distribution of these long-period lines provide insights in taxonomical diagnosis in hominins, as well as allow us to obtain an accurate enough estimation of crown formation time. Perikymata are generally visualized on high-resolution images obtained in different microscopes using a magnification of 50X and counts are typically made manually. This procedure is high time consuming and could be a source of inter-observer error. For this reason, here we present a novel semi-automatic method to obtain, both, the number and the distribution of perikymata.

In general the proposed method can be split in two main stages: the first one consists of reconstructing the image of the tooth from multiple fragments or subimages that are obtained by the microscope and, in the second stage, the system detects and analyzes the distribution of perikymata.

The designed method takes the set of images obtained by the microscope, given the resolution of these devices, a single tooth can be represented by more than a dozen of images, each one showing a small part of it. Panoramic image reconstruction is a problem that is similar to solving puzzles; this problem has been widely addressed in digital photography research. In the first place, the image reconstruction algorithm detects invariant features within image fragments, secondly the spatial relations between image fragments are found through the matching of their invariant features, and finally transformations like scaling, rotations or color compensation are performed to produce the final image. This stage of the method eliminates the need for manual processing using image editing tools, what it is very time consuming.

In the next stage of the method, starting from a full reconstructed image, the researcher should delimit the work area of the image to be processed. This area marks the upper and lower bound of the crown. This work area is automatically divided into deciles (ten equal parts).

Often, the perikymata look blurred, fuzzy or eroded in the image and they are hard to recognize, the researcher must draw lines that cross the perikymata by regions where they can be easily distinguished. Using these lines as guides, it is performed automatically the counting and analysis of perikymata.

Intuitively the perikymata can be defined on an image as lines of lower intensity flanked by lines of greater intensity. Using the intensities of the lines drawn by the researcher an intensity profile is built. The problem boils down to deciding which of the valleys in this intensity profile correspond to perikymata.

To analyze this profile intensities we have tested edge detection algorithms, function approximation using neural networks or combinatorial optimization, to determine which are the most likely points defining perikymata. After that, the researcher can validate these perikymata detected by the tool or can correct some of these detections. After validation by the researcher, calculating the distances between perikymata and distribution in deciles it is done automatically.

In our opinion this semi-automatic method involves a great improvement over the manual procedure performed nowadays, it eliminates errors caused by fatigue or lack of concentration, and therefore, obtaining better results and streamlining the tasks of the researcher.

This research has been funded by Ministerio de Economía y Competitividad, Spain (project CGL2012-38434-C03-01). Thanks to the European Social Fund for its monetary support.

Podium Presentation: Session 7, Fr (17:20)

## The cranium of the Altamura Neanderthal (Puglia, Italy): virtual extraction, digital restoration and morphological notes

**Fabio Di Vincenzo[1], Antonio Profico[1], Mary Anne Tafuri[1], David Caramelli[2], Giorgio Manzi[1]**

1 - Dipartimento di Biologia Ambientale, Sapienza Università di Roma · 2 - Dipartimento di Biologia, Università di Firenze

Discovered in 1993 [1], the so-called "uomo di Altamura" is a rare example of a rather complete non-modern human skeleton and one of the most amazing paleoanthropological specimen ever found in Europe. It represents a massive adult male Neanderthal with some peculiarities in its morphology and a very ancient age, ranging between 128 and 187 ka [2]. The preservation of the skeleton is exceptional, although largely incorporated within calcite concretions. In the last years, we started a thorough monitoring program, paired with a laser scanner acquisition and high-resolution photogrammetry of the cave, as well as of the skeletal elements emerging from the karst. Here we present the digital reconstruction of the cranium of the Altamura skeleton partially covered by concretions, virtually extracted from the whole matrix of our digital data. The superficial morphology of the cranium was digitally acquired in two steps, using different methodologies, given that the anterior components of the cranium are directly visible together with other bones of the skeleton, whereas many posterior and basal components are accessible only by techniques inspired to endoscopic surgery. The anterior components – most of the facial bones, the almost entire frontal bone, part of the right temporal and parietal bones, the labial and occlusal surface of the anterior dentition – were acquired with a high-resolution laser scanner (40 μm). By contrast, the posterior components – the occipital bone, large portions of the right parietal and of both temporal bones, the lower portions of the facial bones, and other elements of the cranial base – were acquired by technique of photogrammetry using HD microcameras. The images were processed using the software Agisoft Photoscan. The two large digital surfaces (halves) have in common the incisal edge of the anterior dentition; this allowed us to combine the two halves and adjust the mid-sagittal profile of the braincase appropriately. By means of Geometric Morphometrics, we have used 38 comparative Mid-to-Late Pleistocene *Homo* specimens (including *Homo heidelbergensis* and *Homo neanderthalensis*) and modern humans. The two halves of the Altamura cranium were aligned on a scaled and symmetrized version of a reference model. Using a landmark-based approach (performed separately for the anterior and posterior components), the best-fitting Neanderthal specimen for this purpose resulted to be Saccopastore 1. We have then warped the morphology of the reference specimen with dedicated software to fulfil the missing portions of the aligned two halves of Altamura. This was done in combination with mirrored part of Altamura itself; particularly, the left zygomatic process of the temporal bone, part of the right zygomatic bone and part of the lateral wall of the right parietal bone were digitally mirrored and repositioned on the corresponding missing portions on the opposite side. The complete and detailed protocol is described by Profico et al [3]. The digital reconstruction of the Altamura cranium is now suitable for morphological observations and some morphometric analyses. Among the visible features there are many traits that detach this specimen from the Neanderthal morphology. For instance, the facial districts display an advanced degree of midfacial prognathism with inflated maxillary sinuses, but the vault appears more plesiomorphic than the face: particularly the parietals are angulated in coronal section, while the mastoids are big and projecting downward. At the same time, while the occipital appears definitely Neanderthal-like in many respects – including a double-arched occipital torus and a well defined suprainiac fossa – the brow-ridges do not seem typical for a Neanderthal, since each supraorbital region (despite largely obscured by concretions) appears massive, with a marked distinction between medial and lateral aspects.

**References:**[1] Pesce Delfino V., Vacca E. 1993. An archaic human skeleton discovered at Altamura (Bari, Italy). Riv. Antropol. 71, 249-257.[2] Lari, M., Di Vincenzo, F., Borsato, A., Ghirotto, S., Micheli, M., Balsamo, C., ... & Manzi G., 2015. The Neanderthal in the karst: First dating, morphometric, and paleogenetic data on the fossil skeleton from Altamura (Italy). J. Hum. Evol. 82, 88-94.[3] Profico A., Di Vincenzo, F., Tafuri, M.A. & Manzi, G., 2016. Digital alignment: an automatized protocol for virtual reconstruction of incomplete fossil specimens. PESHE 5 (This Volume).

Poster Presentation Number 26, We (17:00-19:00)

## Vascular system of human compact bone tissue: a tool of the microscopic study for the microevolution processes reconstruction

**Maria Dobrovolskaya**[1], **Maria Mednikova**[1]

1 - Institute of Archaeology RAS

Starting with 800 thousand years ago, the glaciation and warming alternated in the Eurasia during Quaternary period. Thus, different groups of the genus Homo (the later Homo erectus, Neanderthals, Denisovans) have been developed in the extratropical climatic environment. The idea that peopling was accompanied by new biological adaptation is not new. Cultural adaptations (housing, clothes, the fire using) were not comprehensive, environmental impact has been significant. Physiological adaptation of the part of modern humanity to cold stress and low temperature are well studied. These results can be used for modeling of adaptive processes in the evolutionary past. In general, adaptation to low temperatures was associated with the acceleration of oxidation processes as well as cardiovascular system changes. Activation of blood circulation in the internal organs is the typical adaptive pattern. In our view, it is fully applicable to the skeletal system. We suggest to consider the condition of the vascular system of compact bone as "a mirror" of the development of the vascular system of the whole organism. According to the proposed hypothesis, adaptation to the extratropical temperature conditions manifests itself in the increase of the volume of the blood vessels. The increasing of the vascular system volume of bone is one of the aspects of this process. Non-destructive method of X-ray microscopy has been used to estimate the vascular bone system development. We have used the appliance 3D X-ray microscopy UltraXRM ultra-high resolution to produce three-dimensional images of microscopic size samples. X-ray focusing optics with a high degree of accuracy gives a resolution of about 50 nm. The volume the Haversian and Volkman' channels have been calculated inside of the standard volume of cortical bone (1 mm 3). Vascular volume part (VVP, %) estimated as the percent of the total bone volume. Modern adult aboriginal individuals of the Arctic (Eskimo, Chukotka) and Africa (Ancient Egypt) were presented as contrasting contemporary models. The obtained values of the VVP differ from each other by more than three times. Successful results of the estimation of the vascular system volume in the different adaptive cases offer the prospect to apply this tool for the study of the adaptation among ancient Homo in the Pleistocene of Eurasia.

Poster Presentation Number 55, We (17:00-19:00)

## Human diet during the Gravettian in northeastern Spain: insights from stable isotopes

**Dorothée G. Drucker**[1], **Joaquim Soler**[2], **Narcís Soler**[3]

1 - Department of Geosciences, University of Tübingen, Tübingen, Germany · 2 - IInstitut de Recerca Històrica, Universitat de Girona, Girona, Catalonia, Spain · 3 - Institut de Recerca Històrica, Universitat de Girona, Girona, Catalonia, Spain

Stable isotope ($^{13}C$, $^{15}N$) analysis of bone collagen has proved to be a useful tool in the reconstruction of the environment of diet of human population in prehistoric context. It has been successfully applied on animal and human remains of the Gravettian period across northwestern and central Europe. A significant contrast in the main consumed prey is illustrated between central Europe contexts, where the subsistence is mainly oriented on mammoth exploitation, and southwestern France and northern Italy, where a marine component was detected in the human diet [1]. We examined the trophic web revealed in northeastern Spain during the Gravettian to document the human diet in a Mediterranean context. We have investigated the $^{13}C$ and $^{15}N$ abundances in the faunal and human remains of the Reclau Viver and Mollet III caves. These caves are located in the vicinity of Serinyà (Girona) only a few meters apart from each other. J.M. Corominas supervised the excavation of the most northern site, Reclau Viver, from 1944 to 1948, and of Mollet III in 1972. Most commonly found species included lagomorph (*Oryctolagus cuniculus*), horse (*Equus* sp.), red deer (*Cervus elaphus*) and large bovine (*Bos* or *Bison*) [2]. Some fish remains have been retrieved from the Gravettian occupation of the Arbreda cave in the close neighbouring of Reclau Viver and Mollet III. The unearthed human remains from the Serinyà caves were initially attributed to the Gravettian [3]. A first direct AMS date on the skull of Mollet III has confirmed this chronological position (22,330 ± 90 $^{14}C$ BP in) [4]. Consistent additional radiocarbon dates on human post-cranial remains from Reclau Viver and of Mollet III have been performed that will be discussed in this paper. The isotopic results obtained on four human remains and associated main herbivore species will be presented and interpreted in term of main dietary protein contributors. The Serinyà cave environment offered access to a large range of food resources in a favourable region of the Mediterranean zone. In this context, we aim to specify the relative contribution of the rabbit versus larger preys, such as red deer and horse, as well as terrestrial versus aquatic resources. We will consider to which extent the human diet was dependant on a large spectrum of resources. Such information should shed light on the degree of flexibility in human subsistence and thus the capacity of adaptation displayed by the Gravettian people in a Mediterranean context.

Financial support for this project was provided by the Cultural Department of the Catalan Government, the Leakey Foundation and the Spanish Ministry of Economy and Competitiveness (project HAR2013-48784-C3-2-P). D.G.Drucker was supported by the European Social Fund and the Ministry of Science, Research and Arts of Baden-Württemberg.

**References:**[1] Bocherens, H., Drucker, D.G., Germonpré, M., Lázničková-Galetová, M., Naito, Y.I., Wissing, C., Brůžek, J., Oliva, M., 2015. Reconstruction of the Gravettian food-web at Předmostí I using multi-isotopic tracking ($^{13}C$, $^{15}N$, $^{34}S$) of bone collagen. Quatern. Int. 359, 211-228.[2] Estévez, J., 1979. La fauna del Pleistoceno catalán. Ph.D. Dissertation. Universidad de Barcelona.[3] Corominas, J.M., 1949. El paleolítico superior de la cueva "Reclau Viver" de Seriñá (España), Rivista di Scienze Preistoriche 4(1-2), 43-54.[4] Soler, J., Soler, N., Agustí, B., Bolus, M., 2013. The Gravettian calvaria from Mollet III cave (Serinyà, Northeastern Iberian Peninsula). J. Hum. Evol. 65, 322-329.

Poster Presentation Number 125, Th (18:00-20:00)

## Early human habitation in the South-Eastern Baltic Sea Region: new archaeological data on the Middle to Upper Palaeolithic transition

**Olga Druzhinina**[1], **Anatoly Molodkov**[2]

1 - Vyshtynets Museum of Nature and History · 2 - Research Laboratory for Quaternary Geochronology, Institute of Geology, Tallinn University of Technology

In this paper, we introduce the discovery (in 2006) and excavation (in 2009–2011) results concerning the oldest known evidence for human presence in the south-eastern Baltic Sea region found at the Ryadino-5 archaeological open-air site situated in the lower course of the Šešupė River (55° 01' N, 22° 11' E), Kaliningrad Oblast, Russia. Archaeological investigations carried out on the site were supplemented by chronological studies, including infrared optically stimulated luminescence (IR-OSL) dating of the cultural deposits and the geological environment of the archaeological layer. Luminescence dating was performed at the Research Laboratory for Quaternary Geochronology, Tallinn University of Technology using the multiple-aliquot additive-dose technique, applied to sand-sized potassium feldspar. IR-OSL ages for the archaeological sediments ranged from 52.4 ± 4.0 ka (RLQG 2323-104) to 49.2 ± 3.8 ka (RLQG 2324-104) for the main well-defined culture-bearing layer at a sampling place 1, and 44.0 ± 3.4 ka (RLQG 2112-122) for archaeological sediments at a sampling place 2 situated some distance apart from the main one. These results firmly place the habitation of the site to the period of Middle to Early Upper Palaeolithic (M-EUP) transition. The clear stratigraphic identification of the main cultural layer and the highest concentration of the flint artefacts within the horizon under consideration give grounds to assume that the layer occurs <in situ>. The lithic assemblage of the Ryadino site comprises more than 2000 flints. The raw material for production of tools was high quality grey flint. Finds are covered with a porcelainised patina. There are a large number of flints with signs of erosion, probably thermal in origin. Numerous findings of debris show that knapping and working of the flint was carried out on the settlement itself. Three forms of cores have been identified: cone-shaped one-platform, prismatic and formless. Most of the cores are strongly worked off and small in size what could be due to the shortage or peculiarities of local raw material. Among the products without any traces of secondary processing, flakes form the majority. The Ryadino assemblage includes various kinds of tools: end-scrapers, borers and scrapers, fragments of knife blades, bladelets and unidentified tools. Small-sized and truncated flint products are also present. Thus, the chronology of the site (50–44 ka) and its location (55° 01' N) indicate that Ryadino is the northernmost among the known most ancient sites of the M-EUP transitional period in Europe such as Kostenki-12 (53–42 ka), Khotylevo-1 (55–46 ka), Willendorf-II ( 43.5 ka), Geissenklosterle (43–42 ka), Kent's Cavern (44–41 ka). Further north the only sites with slightly younger artefacts are found on the northern Ural Mountains: Mamontova Kurya (43–40 ka) and Zaozer'e (39–37 ka). Most recent multi-proxy palaeoenvironmental data from different sources give evidence for mild climate conditions in the early part of marine isotope stage (MIS) 3 similar to those of the present. It confirms the possibility of the colonization of the Baltic region by ancient humans during this period, which could be probably related to the climate amelioration after the end of the cold MIS 4 (between roughly 70 and 56 ka). The cultural attribution of the Ryadino flint assemblage has yet to be identified. The comparison with the main cultural traditions of the M-EUP transition can expose certain affinities, which will contextualise this site in the broader framework of the M-EUP transitional period, and make an important contribution to our understanding of Neanderthal and modern humans' interactions in Europe.

Poster Presentation Number 78, Th (18:00-20:00)

## Is there a Relationship between Flake Form and Manual Pressure during Stone Tool Production? An Experimental Test

**Christopher J. Dunmore**[1], **Alastair J.M. Key**[1], **Erin Marie Williams-Hatala** [2], **Tracy L. Kivell**[1,3]

1 - Animal Postcranial Evolution (APE) Lab , Skeletal Biology Research Centre, School of Anthropology and Conservation, University of Kent, UK · 2 - Department of Biology, Chatham University, USA · 3 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

The biomechanical capabilities of Lower Palaeolithic hominins are often inferred from the experimental use and production of stone tools by modern humans. Cognitive complexity has also been inferred from technological and morphological aspects of lithic artefacts. Comparatively little work has examined how the morphometric attributes of lithic artefacts may be utilised to infer the biomechanical capabilities of Palaeolithic populations. Here we investigated the relationship between the form of flake stone tools and the pressures experienced by the digits of the hammerstone-holding hand during hard-hammer percussion. Pressure sensors were attached to the dominant hand of nine skilled knappers as they replicated Oldowan and Acheulean reduction processes. In total 291 and 273 flakes were removed, respectively, during each type of reduction. Eight morphometric aspects of the resultant flakes were recorded and regression analyses were used to directly assess the strength of the relationship between flake form and the forces experienced by the tool producer's hand.

Our results identify the pressures incurred by the hand during detachment of flake forms across Olduwan and Acheulean reduction strategies. Further, we identify how these pressures covary with a number of corollary factors that are present at the point of hammer-stone strike, including the exterior platform angle, platform size and hammer-stone mass, among others. Results indicate that pressure is relatively higher on the thumb and index finger, while lowest on the fifth finger, across flake removal strategies. Quantified pressure thresholds that occurred during the detachment of larger flakes are generally greater than those incurred during the removal of smaller flakes, however there is variation across the different production strategies. We go on to discuss the relative accuracy with which these relationships can be used to infer the pressures experienced during the production of tools found in the Lower Palaeolithic record. Further, we contextualise our results within the range of lithic forms recovered from the Lower Palaeolithic artefact record and the hominin fossil record. In turn we consider the extent to which analysis of flake artefact forms may be a fruitful line of enquiry for future research concerned with the evolution of hominin biomechanical capabilities in the upper limb.

Poster Presentation Number 105, Th (18:00-20:00)

## Direct dating of human remains beyond the radiocarbon time range: what about using ESR?

**Mathieu Duval**[1], **Rainer Grün**[2], **Laura Martín-Francés**[1], **José María Bermúdez de Castro**[1]

1 - Centro Nacional de Investigación Sobre la Evolución Humana (CENIEH), Spain.· 2 - Research Centre of Human Evolution, Environmental Futures Research Institute, Griffith University, Australia

The recent impacting discoveries at Atapuerca Sima de los Huesos (Spain) [1], Fuyan Cave (China) [2] or in the Dinaledi Chamber of the Rising Star cave system (South Africa) [3] have highlighted the importance of developing reliable dating tools to accurately constrain the chronology of fossil remains that lie beyond the Radiocarbon time range. Obviously, one option is to obtain indirect age control by dating deposits or materials associated or correlated with the fossil remains. However, direct dating of those remains may offer the advantage to minimize the uncertainty associated to this correlation, which may sometimes be either unclear, or simply does not enable a tight stratigraphic constrain by providing only minimum or maximum ages.

Among all the chronometric dating methods available to date fossil remains beyond 40 ka, Electron Spin Resonance is probably the candidate showing the highest potential [4]. However, like any chronometric dating methods (even the most established and standardized ones), ESR is limited by a range of intrinsic constraints and based on some implicit assumptions. Because these are very rarely openly stated, expectations regarding numerical dating results from non-geochronologists are sometimes unrealistic. Consequently, the objective of this work is to present a fair overview of the potential and current limitations of the ESR method specifically applied to valuable hominin tooth remains. Several studies published over the last decade have demonstrated that it is actually possible to minimize the destructive aspect of the method, mainly by combining ESR analyses of enamel fragments with Laser Ablation ICP-MS U-series analyses [e.g. 5]. However, it must be known that other factors may strongly limit the reliability and accuracy of the age estimates, such as the systematic CT-scanning of the fossils or the difficulty to precisely identify the origin of the sample, which may add a significant uncertainty to the total dose and dose rate evaluations.

Mathieu Duval is currently the recipient of an International Outgoing Fellowship from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme (FP7/2007-2013) under REA grant agreement PIOF-GA-2013-626474.

**References:** [1] Arsuaga, J. L., Martínez, I., Arnold, L. J., Aranburu, A., Gracia-Téllez, A., Sharp, W. D., Quam, R. M., Falguères, C., Pantoja-Pérez, A., Bischoff, J., Poza-Rey, E., Parés, J. M., Carretero, J. M., Demuro, M., Lorenzo, C., Sala, N., Martinón-Torres, M., García, N., Alcázar de Velasco, A., Cuenca-Bescós, G., Gómez-Olivencia, A., Moreno, D., Pablos, A., Shen, C.-C., Rodríguez, L., Ortega, A. I., García, R., Bonmatí, A., Bermúdez de Castro, J. M. and Carbonell, E. (2014). Neandertal roots: Cranial and chronological evidence from Sima de los Huesos. Science 344(6190): 1358-1363. [2] Liu, W., Martinon-Torres, M., Cai, Y.-j., Xing, S., Tong, H.-w., Pei, S.-w., Sier, M. J., Wu, X.-h., Edwards, R. L., Cheng, H., Li, Y.-y., Yang, X.-x., de Castro, J. M. B. and Wu, X.-j. (2015). The earliest unequivocally modern humans in southern China. Nature 526(7575): 696-699. [3] Berger, L. R., Hawks, J., de Ruiter, D. J., Churchill, S. E., Schmid, P., Delezene, L. K., Kivell, T. L., Garvin, H. M., Williams, S. A., DeSilva, J. M., Skinner, M. M., Musiba, C. M., Cameron, N., Holliday, T. W., Harcourt-Smith, W., Ackermann, R. R., Bastir, M., Bogin, B., Bolter, D., Brophy, J., Cofran, Z. D., Congdon, K. A., Deane, A. S., Dembo, M., Drapeau, M., Elliott, M. C., Feuerriegel, E. M., Garcia-Martinez, D., Green, D. J., Gurtov, A., Irish, J. D., Kruger, A., Laird, M. F., Marchi, D., Meyer, M. R., Nalla, S., Negash, E. W., Orr, C. M., Radovcic, D., Schroeder, L., Scott, J. E., Throckmorton, Z., Tocheri, M. W., VanSickle, C., Walker, C. S., Wei, P. and Zipfel, B. (2015). Homo naledi, a new species of the genus Homo from the Dinaledi Chamber, South Africa. eLife 4: e09560. [4] Grün, R., Aubert, M., Hellstrom, J. and Duval, M. (2010). The challenge of direct dating old human fossils. Quaternary International 223–224(0): 87-93. [5] Grün, R., Maroto, J., Eggins, S., Stringer, C., Robertson, S., Taylor, L., Mortimer, G. and McCulloch, M. (2006). ESR and U-series analyses of enamel and dentine fragments of the Banyoles mandible. Journal of Human Evolution 50(3): 347-358.

Poster Presentation Number 79, Th (18:00-20:00)

## Ecomorphological patterns in the mammalian humerus: implications for community-based palaeoecological reconstruction

**Sarah Elton[1], Carlo Meloro[2], Julien Louys[3], Thomas Plummer[4], Laura C. Bishop[2]**

1 - Anthropology, Durham University · 2 - Liverpool John Moores University · 3 - The Australian National University · 4 - Queen's College, CUNY

Ecomorphological analysis is a mainstay of palaeoecological reconstruction for many Pliocene and Pleistocene hominin sites. Most analyses tend to focus on a single taxonomic group (frequently bovids) but there is great potential for taking a broader approach and considering several mammalian groups in concert. In this poster, we compare the ecomorphological signals present in the humerus of modern bovids (N = 281), suids (N = 50), felids (N = 105) and cercopithecids (N = 193), with the ultimate aim to perform community-based ecomorphic analyses. Each taxonomic group was divided into several habitat categories (open, closed, and one or two intermediate, mixed or alternate categories). Linear measurements reflecting functionally informative bone dimensions were included in discriminant function analyses, run separately for each taxonomic group. The cercopithecid data were also included in phylogenetic functional discriminant analysis (pFDA). Bovids were classified most successfully (88% correctly classified [cross-validated]), followed by felids (79% [cross-validated]), suids (72% correctly classified [cross-validated]), and cercopithecids (70% correctly classified [cross-validated]). We observed some common trends between taxa. The humeral trochlea emerged as a key discriminating structure in all the mammalian groups. Trochlea morphology determines the relative ability to flex and extend the elbow, as well as stabilise the joint. Underlining the predictive importance of elbow function, bicipital groove morphology (reflecting the elbow flexor biceps brachii) also emerged as informative in the cercopithecid, bovid and felid analyses. Open and forest samples separated on discriminant function (DF)1 in all four taxonomic groups. This is not unexpected as the greatest ecomorphological distinction is likely to be between the open and closed (forest) habitat categories, but the consistent pattern across taxa underlines the strength of ecomorphological signals in the mammalian postcranium at the extremes of the adaptive spectrum. The intermediate/mixed groups were less straightforwardly distributed, although there were some common trends, such as intermediate groups of bovids and felids lying between the open and forest samples, and bovid, felid and suid intermediate/mixed samples occupying some distinct space on DF2. The cercopithecid open mixed category also grouped on DF2, but occupied very little distinct canonical space. The considerable overlap between the specimens assigned to each cercopithecid habitat group, in contrast to the much smaller degree of overlap evident in bovids, suids and felids, probably reflects primate ecological dependence on trees, even in predominantly terrestrial species, as well as the multiple functions of the primate forelimb. The use of phylogenetic correction (via pFDA on the cercopithecid sample) reduced the discriminatory power of the models, suggesting that, like allometry, phylogeny contains important ecomorphological information, and should not necessarily be factored out of analyses. Our results indicated that although all the taxa we studied had functional morphological adaptations that correlated with their habitat preferences and locomotor behaviours, there was a stronger and more consistent relationship between morphology and habitat preference in bovids than in other groups, including monkeys (which, like bovids, are relatively abundant in the Plio-Pleistocene fossil record). This reinforces the utility of bovids in ecomorphically-based palaeoecological reconstruction. However, because sympatric taxa exploit the same general environment in varying ways, and because understanding the ecomorphology of multiple members of a community will yield different perspectives on palaeoecology, there is considerable scope to extend research beyond single mammalian families to examine extinct community morphospaces.

The research was funded by Leverhulme Trust grants F/00754/C and F/00128/T, the Wellcome Trust, and the Nuffield Foundation.

Poster Presentation Number 19, We (17:00-19:00)

## The diet of the Middle Pleistocene hominin (Eyasi 1) from Lake Eyasi, Tanzania

**Sireen El Zaatari**[1], **Katerina Harvati**[1]

1 - Paleoanthropology, Senckenberg Center for Human Evolution and Paleoenvironment, Eberhard Karls Universität Tübingen, Tübingen, Germany

Between 1935 and 1938, Dr. Ludwig Kohl-Larsen undertook archaeological and anthropological expeditions to East Africa. These expeditions yielded hominin remains including those of Eyasi 1 found on the northeastern shore of Lake Eyasi, close to the Mumba Hills in northern Tanzania. Eyasi 1 consists of a partial cranium, a canine, a premolar, and one molar. It is a surface find believed to be associated with Middle Stone Age Industry and to date to the Middle Pleistocene [1]. Due to the fragmentary nature of these remains and to the lack of more accurate stratigraphic position and date, they have not received much attention in paleoanthropological studies. Yet, the Eyasi 1 cranium seems to exhibit an interesting mix of morphological features with both primitive and derived traits, including some that are generally regarded as uniquely derived for Neandertals [2]. This renders Eyasi 1 highly important in understanding the diversity and evolution of Pleistocene hominins. Here we analyze the dental microwear signature of Eyasi 1 to shed light on the diet of an African Middle Pleistocene hominin for the first time. The Eyasi 1 molar (left M2) was the subject of this study. Scans of a total area of 255 x 191 μm of the crushing, grinding facet 9 of the occlusal surface of this specimen were taken at 100x magnification (with 0.17 μm lateral sampling interval and <0.002 μm vertical resolution) using the Sensofar Plu Neox confocal imaging profiler of the Paleoanthropology Imaging Laboratory, University of Tuebingen, following established scanning protocols for microwear texture analysis technique [3]. The surface textures were characterized by 30 ISO-25178-2 texture parameters generated using SensoMap software. Following the same procedure, microwear data for samples of five recent human groups with diverse, yet known diets were collected for comparative and interpretive purposes. These samples comprised: 1) Chumash (Santa Cruz, California), whose diet consisted predominantly of marine animal meat supplemented by terrestrial plant and animal resources, 2) Fuegians (Yamana Tribe, Tierra del Fuego), who consumed almost exclusively terrestrial animal meat, 3) Arikara (Mobridge Site, South Dakota), whose diet consisted predominantly of large game supplemented by a mix of wild and cultivated plants, 4) Khoesan (Oakhurst Shelter, South Africa), who had a mixed diet comprising mostly of terrestrial animal and plant resources in addition to marine resources, 5) Andaman Islanders (Port Blair, South Andaman), who also had a mixed diet similar to that of the Khoesan (see [4] and references therein for additional details on these samples). Principal component analysis was used to compare the microwear textures of the studied samples. The results of this study show a clear separation of the comparative groups analyzed. The Chumash specimens clustered away from those of the Fuegians and Arikara, whereas the Khoesan and Andamanese occupied the middle region of the plot. Thus, these results confirm the effectiveness of the ISO parameters in differentiating human groups by diet. Eyasi 1 fell outside the clusters of all the groups considered, yet it was closest to the Chumash. The implications of these results in terms of the diet of the Eyasi 1 specimen will be discussed in the context of other Middle and Upper Pleistocene remains from western Eurasia whose microwear texture has previously been analyzed [5].

**References:**[1] Mehlman, M.J., 1984. Archaic Homo sapiens at Lake Eyasi, Tanzania: recent misinterpretations. J. Hum. Evol. 13, 487-501.[2] Trinkaus, E., 2004. Eyasi 1 and the suprainiac fossa. Am. J. Phys. Anthropol. 124, 28-32.[3] Scott, R.S., Ungar, P.S., Bergstrom, T.S., Brown, C.A., Childs, B.E., Teaford, M.F., Walker, A., 2006. Dental microwear texture analysis: technical considerations. J. Hum. Evol. 51, 339-349.[4] El Zaatari, S., 2010. Occlusal microwear texture analysis and the diets of historical/prehistoric hunter-gatherers. Int. J. Osteoarchaeol. 20, 67-87.[5] El Zaatari, S., Grine, F.E., Ungar, P.S., Hublin, J.J., 2016. Neandertal versus modern human dietary responses to climatic fluctuations. PLoS ONE, 11, e0153277

Poster Presentation Number 38, We (17:00-19:00)

## Early Pleistocene hominins in Europe: the sites of Barranco León and Fuente Nueva-3 (Orce, Spain)

**M. Patrocinio Espigares[1], Paul Palmqvist[1], Sergio Ros-Montoya[1], Juan Manuel Jiménez-Arenas[2], Leticia Menéndez[3], Robert Sala [3], Bienvenido Martínez-Navarro[3,4]**

1 - Universidad de Malaga · 2 - Universidad de Granada · 3 - Institut Català de Paleoecologia Humana i Evolució Social-IPHES. · 4 - ICREA, Barcelona, Spain

The Early Pleistocene (Late Villafranchian) sites of Orce, placed in the northeastern sector of the Guadix-Baza Basin (Granada, southeastern Spain), are key to the study of the first human settlements in the European subcontinent.

Evidence of human presence and anthropic activity has been found at two sites, Barranco Leon and Fuente Nueva-3.

In this sedimentary basin, the hominins inhabited a mild environment rich in vegetation, which provided all resources necessary for their living, including the presence of a lake with a permanent water sheet fed by thermal springs and abundant ungulate carcasses. However, these animal resources were also focus of attention for scavenging carnivores.

In Barranco León, with a chronology of 1.4 Ma, and slightly older than Fuente Nueva-3, 1.3 Ma, a deciduous tooth of *Homo* sp. has been unearthed in 2002 [1] and a huge assemblage of Oldowan (i. e. Mode 1) tools, made in flint and limestones, have been recovered in both localities. In addition, evidences of human modification are frequents on the bone surfaces, as cut-marks, resulting from disarticulation, defleshing and evisceration activities, and percussion marks that evidence bone fracturing for accessing marrow contents.

Cut marks are mostly present on large ungulates limb bones, although a number of axial elements, as rib and vertebrae fragments, show cut marked surfaces. Percussion evidences are located almost exclusively in appendicular elements.

Carnivores activities are present too, and are focused, as cut marks, on limb bones. These modifications were mostly originated by the giant, short-faced hyena of African origin *Pachycrocuta brevirostris*, althought the study of the fossil bones from the last four dig seasons evidence the presence of tooth marks from other carnivores of smaller body size.

In any case, anthropic activity predominates in both, Barranco León and Fuente Nueva-3, which suggest a secondary access of carnivores to these areas.

However, the upper archaeological level of Fuente Nueva-3, which has provided 150 coprolites and several tooth remains of *P. brevirostris*, is an exception to the pattern of competitive exclusion depicted above for hominins and scavenging carnivores. Taphonomic analysis of ungulate postcranial remains preserved in this level has shown increased carnivoran activity, thus evidencing a possible competition for ungulate carcasses between *Homo* and *Pachycrocuta*

This work has been done in the framework of the contract Exp. B090678SV18BC funded and authorized by Consejería de Cultura de la Junta de Andalucía, and the project P11-HUM-7248 by Junta de Andalucía

**References:**[1] Toro-Moyano, I, Martínez-Navarro, B., Agustí, J., Souday, C., Bermúdez De Castro, J.M., Martinón-Torres, M., Fajardo, B., Duval, M., Falguères, C., Oms, O., Parés, J.M., Anadón, P., Julià, R., García-Aguilar, J.M., Moigne, A.-M., Espigares, M.P., Ros-Montoya, S., Palmqvist, P., 2013. The oldest human fossil in Europe, from Orce (Spain). Journal of Human Evolution, 65, 1-9.[2] Espigares, M.P., Martínez-Navarro, B., Palmqvist, P., Ros-Montoya, S., Toro, I., Agustí, J. Sala, R., 2013. Homo vs. Pachycrocuta: Earliest evidence of competition for an elephant carcass between scavengers at Fuente Nueva-3 (Orce, Spain). Quaternary International. 295, 113 -125.

Poster Presentation Number 19, We (17:00-19:00)

## What shall we eat? The Diet of El Sidrón Group: a molar microwear texture analysis

**Almudena Estalrrich**[1], **Sireen El Zaatari**[2], **Antonio Rosas**[1]

1 - Paleoanthropology Group MNCN-CSIC. Department of Paleobiology, Museo Nacional de Ciencias Naturales (CSIC), Spain · 2 - Paleoanthropology, Senckenberg Center for Human Evolution and Paleoecology, Eberhard Karls University Tübingen, Tübingen, Germany.

El Sidrón Cave yielded a total of 13 Neandertal individuals all coming from a single archaeological deposit dated to 49 kya [1-3]. This sample allows for unique opportunities of investigating different patterns of Neandertal behavior. In this study, we use occlusal molar microwear texture analysis [4] to explore the diets of eight out of the 13 individuals from this group with the aims of: 1) documenting sex, age, and maternal lineage related differences in diet within this Neandertal familial group, and 2) placing the diets of El Sidrón individuals in the context of those of other Neandertals whose microwear signatures, and thus diet, have been previously documented [5].

The intra-group examinations of the microwear signatures show that El Sidrón females had a more abrasive diet (as shown by their higher *Asfc* or Complexity values) compared to the males. This could be a reflection of the former's inclusion of greater amounts of hard vegetable foods in their diets or the greater use of their dentition in para-masticatory activities. Regarding age, the microwear signatures of sub-adults appear to be indistinguishable from those of adults suggesting that children in this group had the same diet as their adult counterparts. Similarly, no significant mt-DNA lineage related differences in microwear signatures are detected suggesting that food was equally distributed and shared among group members regardless of their lineage.

In the context of other Neandertals, El Sidrón group has microwear signature similar to those of Neandertals from wooded habitats, and clearly distinct from those of groups from open and mixed habitats. This is expected since paleoenvironmental reconstruction from the El Sidrón deposits yielding the Neandertal remains suggest a temperate phase of Marine Isotope Stage 3, with temperate Atlantic conditions similar to those of the present, and supporting a mix of coniferous and deciduous forests. The diet of the El Sidrón group, just like their Neandertal counterparts from similar wooded habitats is reconstructed as being mixed, consisting of substantial amounts of both meat and vegetable foods.

We are grateful to Prof. Peter S. Ungar for providing access to the microscope facilities at the Department of Anthropology from the University of Arkansas. The Paleoanthropology group (MNCN-CSIC). This research was founded by the local Government of the Principado de Asturias, the Spanish Government (Project CGL2012-36682), and the European Community Research Infrastructure Action (SYNTHESYS Project).

**References:**[1] Rosas, A., Estalrrich, A., García-Vargas, S., García-Tabernero, A., Huguet, R., Lalueza-Fox, C., de la Rasilla, M., 2013. Identification of Neandertal individuals in fragmentary fossil assemblages by means of tooth associations: The case of El Sidrón (Asturias, Spain). C. R. Palevol. 12, 279-291.[2] Fortea, J., de la Rasilla, M., Martínez-Maza, C., Sánchez-Moral, S., Cañaveras, J. C., Cuezva, S., Rosas, A., Soler, V., Castro, J., Torres, T., Ortiz, J. E., Julià, R., Badal, E., Altuna, J., Alonso, J., 2003. La cueva de El Sidrón (Borines, Piloña, Asturias): primeros resultados. Estud. Geol. 59, 159–179.[3] Lalueza-Fox, C., Rosas, A., Estalrrich, A., Gigli, E., García-Tabernero, A., García-Vargas, S., Sánchez-Quinto, F., Ramírez, O., Civit, S., Bastir, M., Huguet, R., Santamaría, D., de la Rasilla, M., 2011. Genetic evidence for patrilocal mating behaviour among Neandertal groups. Proc. Nat. Acad. Sci. 108: 250-253.[4] Scott, R. S., Ungar, P. S., Bergstrom, T. S., Brown, C. A., Grine, F. E., Teaford, M. F., Walker, A., 2005. Dental microwear texture analysis shows within-species diet variability in fossil hominins. Nature. 436, 693–695.[5] El Zaatari, S., Grine, F. E., Ungar, P. S., Hublin, J. J., 2011. Ecogeographic variation in Neandertal dietary habits: Evidence from occlusal microwear texture analysis. J. Hum. Evol. 61, 411-424.

Poster Presentation Number 123, Th (18:00-20:00)

## New investigations on the Protoaurignacian lithic technology of Fumane cave

**Armando Falcucci**[1], **Marco Peresani**[2]

1 - Eberhard Karls Universität Tübingen · 2 - Università di Ferrara

The Aurignacian has always been considered an unquestionable cultural proxy for the spread of modern humans from the Levantine corridor to Europe, both for the innovations leading to the increased variety of material culture and modern human remains, especially teeth, found in several Aurignacian layers [1]. Even if in southwestern France the Protoaurignacian is always stratigraphically placed below the Early Aurignacian, new evidence from Central Europe indicates a chronological overlapping between the two assumed consecutive stages [2]. From a techno-typological point of view the Protoaurignacian is a blade-bladelet dominated industry. Both products are often described to be obtained from the same cores, through a continual reduction sequence [3]. Among tools, retouched bladelets are the most attested type, followed by end-scrapers, burins and retouched blades. The Early Aurignacian is instead known for the use of two distinct core reduction sequences that result in the production of blades and bladelets. This difference, proposed in order to offer a more appropriate separation between the two techno-complexes, has blurred the variability of methods and technical expedients that were available to those human groups. In this poster we will present the first results of an accurate analysis of the lithic industry found in the Protoaurignacian layers of a key site for the understanding of the Early Upper Paleolithic: Fumane cave. In layers A2-A1, dwelling structures, lithic assemblages, bone and antler tools, painted stones, and ornamental objects mark the arrival of the first Aurignacians at 41.2 – 40.4 ky cal BP [4]. The present study considers several thousands of blanks, by-products, retouched tools and cores: this latter category is composed of around 200 artifacts. To describe the material, a combination of two main methods is used: attribute analysis and reduction sequence approach. Cores received special attention in the first part of our research project. Each core was described individually to reconstruct the last steps (position, chronology and direction) of the reduction sequence prior to discard, following Roussel et al. [5]. Preliminary observations were then tested on the material using the body of data obtained through the attribute analysis. Protoaurignacian lithic production at Fumane cave is specialized to the manufacture of bladelets with lateral retouch and bladelets with convergent retouch (around 80% of the retouched tools). Cores appear highly exhausted. The last scars show that the main target of the blank production are convergent and slightly curved bladelets. The almost absence of blade cores (only 3 specimens), the dimension of complete blades and the original dimension of raw material nodules, suggest that the production of blade and bladelets are in most cases integrated. Long and large blades come from the first stage of core structure preparation (e.g. cortical and semi-cortical blades, lateral blades and overshot blades). After this stage, small blades and bladelets were produced in the same reduction phase, during an alternate process. Furthermore, an exclusive bladelet production is well attested. Bladelet cores are produced on small blocks, slabs and sometimes thick flakes. They display semi-turning flaking surfaces, but also two or more distinct surfaces, used in succession and often from different platforms to optimize the production.The ongoing analyses at Fumane cave reveal that the concept of the Protoaurignacian is not well stated from a technological point of view. The vast geographic area covered by this techno-complex is characterized by a certain variability, which in our opinion has been minimized to easily track the spread of modern humans across Western Eurasia at the threshold of the Upper Paleolithic.

Research at Fumane is coordinated by the Ferrara University in the framework of a project supported by the Ministry of Culture and Veneto Archaeological Superintendency, public institutions (Lessinia Mountain Community e Regional Natural Park, Fumane Municipality, Veneto Region e Department for Cultural Heritage), Foundations (Foundation Fyssen; Leakey Foundation 2015/2016 General Grant), associations and companies. Armando Falcucci thanks LGFG and the University of Tuebingen for funding his research project and Prof. Nicholas Conard for the supervision.

**References:**[1] Benazzi, S., Slon, V., Talamo, S., Negrino, F., Peresani, M., Bailey, S.E., Sawyer, S., Panetta, D., Vicino, G., Starnini, E., Mannino, M.A., Salvadori, P.A., Meyer, M., Paabo, S., Hublin, J.-J., 2015. The makers of the Protoaurignacian and implications for Neandertal extinction. Science 348, 793-796.[2] Nigst, P.R., Haesaerts, P., Damblon, F., Frank-Fellner, C., Mallol, C., Viola, B.,Götzinger, M., Niven, L., Trnka, G., Hublin, J.-J., 2014. Early modern human settlement of Europe north of the Alps occurred 43,500 years ago in a cold steppe-type environment. Proc. Natl. Acad. Sci. 111, 14394-14399.[3] Bon, F., 2002. L'Aurignacien entre mer et Océan. Réflexion sur l'unité des phases anciennes de l'Aurignacien dans le sud de la France. Société Préhistorique Française, Paris.[4] Higham, T.F.G., Brock, F., Peresani, M., Broglio, A., Wood, R., Douka, K., 2009. Problems with radiocarbon dating the Middle to Upper Palaeolithic transition in Italy. Quaternary Sci. Rev. 28, 1257-1267.[5] Roussel, M., Soressi, M., Hublin, J.-J., 2016. The Chatelperronian conundrum: Blade and bladelet lithic technologies from Quinçay, France. J. Hum. Evol. 95, 13-32.

Poster Presentation Number 36, We (17:00-19:00)

## Paleoecology and paleoenvironment at two late Pleistocene Neanderthal-bearing sites in Pinilla del Valle, Spain

**Robert S. Feranec[1], Nuria Garcia[2,3], Juan-Luis Arsuaga[2,3], Enrique Baquedano[4], Belen Marquez[4], Laplana Cesar [4], Diego J. Álvarez-Lao[5]**

1 - New York State Museum, Research and Collections, Albany, NY· 2 - Departamento de Paleontologia, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Madrid, Spain · 3 - Centro Mixto UCM-ISCIII de Evolución Comportamiento Humanos, Madrid, Spain · 4 - Museo Arqueológico Regional de la Comunidad de Madrid, Plaza de las Bernardas, Alcalá de Henares, Madrid, Spain · 5 - Área de Paleontología, Departamento de Geología, Universidad de Oviedo, Oviedo, Spain

Determining the environmental and ecological conditions in which Neanderthals typically lived and ultimately those in which they went extinct are important for understanding what factors caused their demise, including the role of humans (*Homo sapiens*). Fossil-bearing sites in the Calvero de la Higuera (Pinilla del Valle, Madrid, Spain) contain abundant faunal remains from at least four distinct localities of late Pleistocene age. Nearly all localities bear Neanderthal remains, and the time span represented by the localities permits examination of the ecological settings in which these ancient hominins lived. Here we analyze stable carbon and oxygen isotope values (δ13C and δ18O) from the tooth enamel of large mammalian herbivores and carnivores from two of the Calvero de la Higuera localities, Camino (Level V) and Cueva de la Buena Pinta (CBP; Level III). Camino Level V has been dated to about 94 Ka, while CBP Level III has been dated to about 63 Ka [1]. Climatically, based on the ages obtained for the sites, the CBP Level III specimens are suspected to be from a colder environment than those from Camino Level V. Both localities were hyena dens and contain similar, although not exactly the same, mammalian fauna. One notable difference is the discovery of the Steppe pika (*Ochotona pusilla*) at CBP, which supports the interpretation of a colder climate at CBP Level III. The δ13C values from both localities (N = 82) imply that the ancient ecosystems were dominated by C3 plants. The average δ13C values from CBP are 1.7‰ higher than those found at Camino, indicating a more open environment during the time represented at CBP. Significant differences in δ13C values among taxa within both localities shows resource partitioning, which reduces competition among taxa. For herbivores, *Bos primigenius* shows the highest values and *Stephanorhinus hemitoechus* the lowest, suggesting inhabiting more open and more closed environments for these species, respectively. Carnivore species typically displayed similar δ13C values, except hyena (*Crocuta crocuta*), which have lower values, and may support consumption of bone. Comparing herbivores to carnivores, carnivores displayed lower δ13C values than herbivores from the same site, as expected. For δ18O values, the only observed difference was between wolf (*Canis lupus*) and hyena at Camino Level V. The higher δ18O values in wolf may suggest this species inhabiting more open environments or ingestion of water from a different source than the hyena. The isotopic space occupied by a species, that is, the pattern of δ13C and δ18O values observed among all taxa within a locality, was similar when comparing Camino Level V to CBP Level III. This isotopic pattern among taxa between sites supports the idea of niche conservatism. Continued examination of the typical paleoecological and paleoenvironmental conditions in which Neanderthals lived provides a baseline for evaluating the conditions under which they went extinct.

**References:**[1] Baquedano, E., Marquez, B., Laplana, C., Arsuaga, J.L., Perez Gonzalez, A., 2014. The archaeological sites at Pinilla del Valle (Madrid, Spain). In: Sala, R., (Ed.), Pleistocene and Holocene hunter-gatherers in Iberia and the Gibraltar Strait : the current archaeological record. Burgos: Universidad de Burgos, Servicio de Publicaciones Fundación Atapuerca, pp. 577-584.

Poster Presentation Number 117, Th (18:00-20:00)

## Faunal input for evolutive dynamics of Neandertal populations in France

**Philippe Fernandez**[1], **Jean Philip Brugal**[1,2], **Pierre Magniez**[1], **Sandrine Cabut**[1], **Silvana Condemi**[3], **Anna Degioanni**[1]

1 - Aix Marseille Univ, CNRS, Minist Culture & Com, LAMPEA, Aix-en-Provence, France · 2 - USR 3336, IFRA, Nairobi, Kenya · 3 - Aix Marseille Univ, CNRS, EFS, ADES, Marseille, France

The disappearance of Neandertal in Western Europe is a main issue that has been debated for decades in many studies with no clear resolution until now. Three years ago we started the project NeDeMo (Neandertal Demise Modelisation) in a pluridisciplinary research group with the explicit goal of identifying crucial demographic parameters that resulted in Neandertal demise. We used classical ecological models to test different values of vital statistics and we verified [1, 2, 3] that very small changes in fertility and/or survival rates were sufficient to account for the disappearance of the Neandertal population. In order to improve our models the group NeMoMo (Neandertal Mobility Modelisation) was created to take into account the different bioclimatic context and mammalian associations during the Upper Pleistocene. Thus a preliminary palaeoecological analysis was undertaken starting from the NeMoMo faunal database of available archaeological and natural French sites. This database includes more than 100 stratigraphic sequences/levels containing approximatively 90 large and 50 small mammals from OIS 5 to OIS 2. Our study is founded on their basic trophic preferences regarding habitat (waterside; mountain; meadow-parkland-forest; meadow-steppe-tundra), diet (browsers; grazers; mixed-feeders; frugivorous-granivorous-insectivorous which concern most of the small mammals; carnivores; omnivores) and body-weight (from <1 to >850 kg); all variables being inferred on the basis of modern species. From a methodological point of view, we combined evolution of weight-classes, prey/predator ratio, index of Sorensen, species richness and relative diversity to test the similarity between faunal associations through time and space. Factorial analysis is used to detect underlying structures from these associations in order to identify the dynamics and the main ecological trends for each temporal unit during Upper Pleistocene (OIS 5 to 2). In this poster we address two key questions: is there clear pattern of mammalian distribution through time? Are changes in taxonomical composition related to taphonomic biases, environmental conditions and/or human or carnivore impact?

**References:**[1] Degioanni, A., Bonnenfant, C., Condemi, S., 2013 The disappearance of the Neaderthals: an analysis through demographic parameters modeling. PESHE 2: 73[2] Degioanni, A., Bonnenfant, C., Condemi, S., 2014 Modeling Population Dynamics of the Late Neanderthal Subgroups. PESHE, 3:57[3] Degioanni, A., Bonnenfant, Cabut,S., Condemi, S., 2015 Neandertal demise through modeling: the viewpoint of population dynamics, PESHE, 4:73

Poster Presentation Number 130, Th (18:00-20:00)

## Crossing the Pyrenees. Material evidences of symbolic behaviour of LGM human groups in a stop along the way

**Juan Luis Fernández-Marchena[1], Gala García-Argudo[2], Xavier Mangado[3], Marta Sánchez de la Torre[4], Bàrbara Mas[3], Josep Maria Fullola [3]**

1 - SERP / IPHES · 2 - URV / IPHES · 3 - SERP · 4 - IRAMAT-CRP2A

The open air site of Montlleó (Prats i Sansor, Catalonia), located in the Coll de Saig at 1134 m.o.s.l., is in one of the most propitious mountain passage to cross the Pyrenees. This passage communicates the Ebro basin to the gulf of Lyon through the valleys of Segre and Têt rivers. This situation makes it a strategic location for controlling the circulation of wildlife, as well as a large node of communication between human groups. The archaeological site has a chronocultural sequence belonging to the early Magdalenian, with a series of absolute datings of 18650±50 Cal BP, 18710±80 Cal BP and 20320±120 Cal BP, characterized by the presence of reverse backet microbladelets and some scalene triangles on the top of the sequence. Thus becoming one of the oldest evidence of Magdalenian occupation in the eastern Pyrenees. While the presence of a wide variety of lithic raw materials from both sides of the Pyrenees is of great importance, the site is especially notable for the number and variety of material culture capable of being related to the symbolic world. These evidences may be divided into three groups: traditional personal ornaments, unusual minerals and ochre of diverse colorations. The traditional ornaments group would be comprised of those elements that recurrently appear considered and formally accepted as such in the literature. In the present case of study they would be represented by marine malacofauna anthropically modified -from both coasts, Atlantic and Mediterranean-, perforated deer canines and a discoid lignite bead. Regarding the unusual minerals, we should highlight a set of small rock crystal prisms (4-10 mm), some of which appear with reddish pigment spots at the base. From microscopic analysis we have identified a resinous substance mixed with ochre, which could be inferred as the mount technique used to adhere these prisms. On the other hand, we have recovered a ferruginous quartz prism that, because of its prismatic morphology, reddish colour and by the fact of being an allochthonous material, could be evidence of the symbolic world of these groups. These considerations could also apply to other mineral fragment found at the site, amber-like; which, despite having no evidence of modification to facilitate the suspension, has a residue similar to the rock crystal prisms, suggesting a similar use. The last group of symbolic elements studied in this research corresponds to the pigments. We have seen fit to add these evidences to the investigation due to the wide chromatic range, as well as the high amount of recovered fragments. We must to add violet ochre to the traditional varieties of red hematite and yellow goethite. The methodology followed in this research focuses on technological and functional analysis. On the one hand, we have conducted a study on perforation technology of beads by a 3D digital microscope. In this way we have documented technical features and suspension evidences, as polished areas. The unusual minerals and ochres have been analysed using an optical light microscope (OLM). In the first we use OLM to locate residues susceptible of being adhesive elements. Once detected, a component analysis was carried out with an environmental scanning electron microscope (ESEM) with the aim to characterize their elemental composition. The presence of all these evidences in the same archaeological site, with such remarkable strategic location, suggest that the site should serve as an aggregation site between diverse human groups from the Last Glacial Maximum in the inter-pyrenaical passage dominated by the site of Montlleó. In the Iberian Peninsula, the appearance of the lignite bead and the ferruginous quartz only have parallels in some cantabrian cornice sites material culture. All these features turns Montlleó into a unique and relevant archaeological site to understand the symbolic behaviour of magdalenian human groups.

Pecha Kucha Presentation: Session 6, Fr (15:50-16:15)

## Size matters: new frontiers in radiocarbon bone dating

**Helen Fewlass[1], Sahra Talamo[1], Thibaut Tuna[2], Yoann Fagault[2], Bernd Kromer[1,3], Helene Hoffmann[3], Caterina Pangrazzi[4], Jean-Jacques Hublin[1], Edouard Bard[2]**

1 - Department of Human Evolution, Max Planck Society for Evolutionary Anthropology, Leipzig, Germany · 2 - CEREGE, Aix-Marseille University, CNRS, IRD, Collège de France, Aix-en-Provence, France · 3 - Institut für Umweltphysik, University of Heidelberg, Heidelberg, Germany · 4 - Dipartimento di Lettere e Filosofia, Università degli studi di Trento, Italy

Radiocarbon dating is a vital tool for establishing chronologies back to 50,000 cal BP (Before Present). The method plays a central role in questions relating to the Middle-Upper Palaeolithic transition in Europe. For bone samples, pre-treatment protocols of collagen extraction, ultrafiltration and graphitisation require a 500 mg bone sample at a minimum of 1% collagen preservation to produce enough high-quality collagen for AMS dating with graphite targets. However some rare archaeological samples, particularly from towards the limit of the method, are much too precious for the destruction of even 500 mg, and are therefore unavailable for dating using current methods. As such, for many significant archaeological finds of this time period it has only been possible to obtain indirect dates from associated materials such as faunal remains, ornaments or shells [1,2]. The inherent problems with this strategy have led to controversies over the reliability of some resulting chronologies at key sites spanning the Middle-Upper Palaeolithic transition [1,3].

Utilising the latest improvements in AMS technology, we present here the results of a methodological experiment aimed to address this issue. The improved gas ion source of the MICADAS (MIni CArbon DAting System) [4] developed at ETH Zurich offers a way to measure gaseous samples of <100 μg carbon, which at the upper limit corresponds to ca. 25 mg bone material (at the lowest acceptable limit of 1% collagen preservation). The direct coupling of an elemental analyser to the gas-interface system of the MICADAS cuts out the graphitisation step, reducing the risk of contamination and speeding up the dating procedure. We present the results of the first comparison between 'routine' graphite dates (5 mg bone collagen) and dates of gaseous samples of ca. 30-100 μg carbon (<0.3 mg bone collagen), undertaken with the highest possible precision in mind. The experiment demonstrates the performance of the AixMICADAS [5] in achieving reliable radiocarbon measurements from ca. 0.3 mg collagen samples from the early Medieval to the Middle Palaeolithic. The direct AMS dating of highly precious archaeological bone samples across the breadth of the radiocarbon method without the destruction of 500 mg of bone is now achievable. As such, the technique has great implications for resolving chronological questions relating to the Middle-Upper Palaeolithic transition in Europe [1-3].

This research was funded by the Max Planck Society, by Equipex ASTER-CEREGE and by Collège de France. Many thanks to Lysann Klausnitzer and Sven Steinbrenner for technical assistance.

**References**:[1] Benazzi, S., Douka, K., Fornai, C., Bauer, C.C., Kullmer, O., Svoboda, J., Pap, I., Mallegni, F., Bayle, P., Coquerelle, M., Condemi, S., Ronchitelli, A., Harvati, K., Weber, G.W., 2011. Early dispersal of modern humans in Europe and implications for Neanderthal behaviour. Nature 479, 525-528.[2] Hublin, J.J., Talamo, S., Julien, M., David, F., Connet, N., Bodu, P., Vandermeersch, B., Richards, M.P., 2012. Radiocarbon dates from the Grotte du Renne and Saint-Cesaire support a Neandertal origin for the Chatelperronian. Proceedings of the National Academy of Sciences of the United States of America 109, 18743-18748.[3] Higham, T., Compton, T., Stringer, C., Jacobi, R., Shapiro, B., Trinkaus, E., Chandler, B., Groening, F., Collins, C., Hillson, S., O'Higgins, P., FitzGerald, C., Fagan, M., 2011. The earliest evidence for anatomically modern humans in northwestern Europe. Nature 479, 521-524.[4] Fahrni, S.M., Wacker, L., Synal, H.A., Szidat, S., 2013. Improving a gas ion source for 14C AMS. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 294, 320-327.[5] Bard, E., Tuna, T., Fagault, Y., Bonvalot, L., Wacker, L., Fahrni, S., Synal, H.-A., 2015. AixMICADAS, the accelerator mass spectrometer dedicated to 14C recently installed in Aix-en-Provence, France. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 361, 80-86.

Poster Presentation Number 22, We (17:00-19:00)

## Simulating dental wear and its effect on food breakdown in a hard object feeding primate

**Laura C Fitton**[1], **Karen R Swan**[2], **Samuel N Cobb**[1]

1 - Centre for Anatomical and Human Sciences, Department of Archaeology and Hull York Medical School, University of York · 2 - Centre for Anatomical and Human Sciences, Hull York Medical School

One of the major morphological changes during hominin evolution is in the masticatory apparatus, in particular dental morphology. Tooth occlusal morphology is important in food breakdown as it typically forms the initial point of contact between forces generated by the masticatory muscles and a food item. Differences in topography have previously been associated with differences in mechanical performance and diet.

The robust australopiths possess large crowned molars and can exhibit significant amounts of dental wear. These species have also been associated with tough and stress resistant diets, yet how changes in dental wear effects masticatory performance has yet to be considered. The functional significance of changes in dental occlusal morphology over a lifetime due to wear is of key interest.

*Cercocebus atys* a specialist hard object feeding primate, erupts molar teeth with high sharp cusps that wear down to form an enamel ridge surrounding a dentine pool. Individuals of all ages have been observed feeding habitually on the stress resistant seed casing of *Sacoglottis gabonensis*, as such *C. atys* provides a useful extant model to investigate the relationship between dental wear and hard object feeding. Given this species consumes the same food item during its lifetime it is predicted that differences in dental topography due to tooth wear are functionally neutral. In order to test this, stainless steel M1 dental models representing hypothetical wear stages in *C. atys* were compressed onto 3D printed hard brittle hemispheres (hollow and solid domes, representing a seed case and seed respectively) using a universal tester, and force required to initiate fracture was recorded. For the hollow dome force at initial fracture was comparable across all dental wear stages, with the exception of a decrease in force in the intermediate wear stages. For the solid dome the results were similar to the hollow but the enamel ridge model had an increase in force required (thus a decreased performance).

Results suggest the effect of extreme wear on adult *C. atys* teeth is functionally neutral for feeding on hollow hard food items. Interestingly results also suggest that with their enhance performance the dental topography at intermediate wear stages may compensate for reduced overall muscle capabilities of younger *C. atys* by decreasing the force required to initiate failure.

Podium Presentation: Session 3, Th (16:20)

## Virtual reconstruction of *Australopithecus sediba* pelvis and reconsideration of its morphological affinities

**Cinzia Fornai**[1,2], **Martin Haeusler**[1,3]

1 - Institute of Evolutionary Medicine, University of Zurich, Switzerland · 2 - Department of Anthropology, University of Vienna · 3 - Institute of Anatomy, University of Zurich, Switzerland

Australopithecines and humans show fundamental differences in the pelvic morphology, indicating that the mode of bipedalism and birth process differed substantially between them. However, a mosaic of australopithecine-like and derived features, the latter including vertically oriented ilia, anteriorly deflected anterior superior iliac spines and a superiorly rotated pubis, were described for *Australopithecus sediba*, suggesting that pelvic reorganization preceded the emergence of large-brained babies and modern form of bipedalism [1]. The pelvis of *A. sebida* is represented by two incomplete and broken, yet undistorted specimens: MH1, a juvenile male, and MH2, an elderly female. The MH2 pelvis is the most complete and consists of a right ilium lacking the anterior superior and inferior iliac spines, a fragment of the right pubic base and the right pubic body, a partial left pubis and a sacrum missing the right ala and most of the left side. We performed a virtual reconstruction of the MH2 pelvis based on high-resolution 3D surface models (using Amira 6.0.1, Geomagic, and Viewbox 4). First, we reduced a large fracture in the antero-inferior region of the ilium using pseudolandmarks on curves located on the broken area. As this fracture extends longitudinally through all three fragments of the right hipbone, we used it to confidently realign them. The advanced age of MH2 probably led to a reduced thickness of the symphyseal fibrocartilage, since the symphyseal surfaces of the right and left pubic fragments matched without play. A best-fit plane of the symphyseal articular surface was used as the mid-sagittal plane for the entire pelvis. The missing parts of the hipbone were reconstructed by morphing the A.L. 288-1 *A. afarensis* hipbone [2] using a large set of landmarks and semilandmarks. The right hemi-sacrum was aligned with its midsagittal plane coinciding with the pubic symphyseal plane. Further adjustments in the orientation and vertical position of the sacrum were performed with respect to the preserved area of the sacroiliac joint until the profile of the greater sciatic notch, the wall of the pelvic inlet and the arcuate line were continuous and harmonious. The iliac auricular surface was taken as the best approximation for the missing sacral auricular surface. Therefore, it was cropped and translated to match the sacrum. This left a 2 mm gap at the sacroiliac joint, which we considered as physiological. Afterwards, the StW 431 (*A. africanus*) sacrum was morphed in order to reconstruct the missing ala of the MH2 sacrum, as this is the most complete undistorted early hominin sacrum. Finally, we reconstructed the missing parts of the MH2 hipbone and sacrum by morphing a female modern human pelvis. This did not change our outcome, but helped repairing small defects of the meshes. We constantly double-checked our virtual reconstruction against real models that we reconstructed manually using 3D prints of the MH2 pelvic fragments and their mirror images. Both our virtual and manual reconstructions of the MH2 pelvis showed the marked flaring of the ilium and wide sacrum typical of australopithecines, which has significant implications for the lever arm of the hip abductors, while the superior pubic ramus was found to be slightly more cranially deflected than in *A. afarensis* and *A. africanus* and thus intermediate to the human condition. In contrast to previous observations [1, 3], the MH2 pelvic incidence as a measure for sacral orientation was within the range of australopithecines and modern humans. This confirms a well-developed lumbar lordosis in *A. sediba*. We therefore conclude that *A. sediba* possessed a pelvic morphology conforming to that of other australopithecines. We found no evidence for pelvic reorganization connected to a more derived birth process and mode of bipedal locomotion.

We are grateful to Peter Schmid for useful discussion and Stefano Benazzi for technical advice. This research was financially supported by the Swiss National Science Foundation (31003A-156299/1), A.E.R.S. Dental Medicine Organisations GmbH, Vienna, Austria (project number FA547014), the Siegfried Ludwig-Rudolf Slavicek Foundation, Vienna, Austria (project number FA547016), and the Mäxi Foundation.

**References**:[1] Kibii, J. M., Churchill, S.E., Schmid, P., Carlson, K.J., Reed, N.D., de Ruiter, D.J., Berger, L.R., 2011. A partial pelvis of *Australopithecus sediba*. Science 333, 1407–1411.[2] Häusler, M., Schmid, P., 1995. Comparison of the pelves of Sts 14 and AL 288-1: implications for birth and sexual dimorphism in australopithecines. J Hum Evol 29:363-383.[3] Been, E., Gómez-Olivencia, A., Kramer, P.A., 2014. Lumbar lordosis in extinct hominins: Implications of the pelvic incidence. Am J Phys Anthropol 154:307-314.

Podium Presentation: Session 3, Th (15:40)

## Exploring birth process in australopithecines: contribution of birth simulations and discriminant analyses based on an actual modern human obstetrical sample

**Pierre Frémondière[1], Lionel Thollon[2], François Marchal[1], Nakita Frater[3], Sandra Mathews[3], Cinzia Fornai[3,4], Martin Haeusler[3,5]**

1 - UMR 7268 ADES, CNRS, Aix-Marseille Université, EFS, Marseille, France · 2 - Laboratory of Biomechanics and Application, Aix-Marseille Université, Marseille, France · 3 - Institute of Evolutionary Medicine, University of Zuerich, Switzerland · 4 - Department of Anthropology, University of Vienna, Austria. · 5 - Anatomical Institute, University of Zuerich, Switzerland

Understanding birth mechanism during hominin evolution is crucial in exploring the co-adaptation of bipedalism and encephalization. Some authors argue that the emergence of *Homo erectus* represents a step towards modern human birth process that typically is complex and rotational [1,2]. It thus differs from that of australopithecines and non-human primates that are often said to have a non-rotational and relatively easy birth process [2,3]. In this way, exploration of the *Australopithecus sediba* birth process is extremely relevant given that this species displays a mosaic of *Australopithecus*- and *Homo* -like characteristics. Palaeoanthropological reconstruction of childbirth is, however, hampered by the lack of complete pelves and neonate crania in the fossil record. To partly compensate for this, we propose to assess hypothetical mother-newborn dyads from multiple combinations of different pelvic and neonate cranial reconstructions. The *A. sediba* pelvis was reconstructed virtually based on the MH2 specimen [4]. We then compared the shape of the MH2 pelvic canal to the reconstructions by Haeusler & Schmid of the A.L. 288-1 (*A. afarensis*) and Sts -14 (*A. africanus*) pelves [5]. 3D-models of the pelvic canal of other published reconstructions of these fossils were obtained by kriging a modern human pelvic mesh on digitalized casts and using published measurements and pictures [2]. Neonatal cranial dimensions of australopithecines were estimated based on chimpanzee cranial growth curves that we reversely applied to the Taung and Dikika infants. Using kriging, a 3D model of a modern human neonate cranium was reshaped to the thus predicted australopithecine neonatal head dimensions. Finally, we compared these neonatal head models with all available reconstructions of australopithecine pelves, including two reconstructions of MH2, two of Sts 14, and three of A.L. 288-1. This yielded 13 possible combinations and provided an initial assessment of foetal-pelvic constraints. Our actual exploration of the australopithecine birth process is based on two methods: first, we used a finite-element simulation of the birth process by performing several simulations with restriction of head flexion to a physiological degree and 4 different degrees of sacro-iliac joint laxity, as well as two foetal head orientations: left occipital anterior and occipital posterior presentations, i.e., the most eutocic and the most dystocic head presentation. The majority of our birth simulations showed eutocic deliveries, suggesting that the foetal-pelvic constraint was smaller in australopithecines than in extant humans. Secondly, we performed a partial least square discriminant analysis (PLSDA) of delivery outcomes based on a modern obstetrical sample of 131 births with known pelvis and neonatal dimensions. Of these, we used a total of 61 foetal and pelvic variables for the PLSDA. This enabled us to determine the association of a given foetal-pelvic configuration with caesarean section, operative vaginal, spontaneous vaginal delivery, and rotational and non-rotational birth. When the hypothetical fossil mother-infant dyads were added to the PLSDA, MH2 and all others australopithecines were found to belong to the eutocic group. Rotational birth was not clearly identified because australopithecine dyads either fell in the rotational or the non-rotational group according to the specific PLSDA model. This might suggest that australopithecines had a non-rotational birth with a sagittal head orientation due to their small foetal-pelvic constraint, but a rotational birth with an oblique left occipital anterior presentation would have well been possible if foetal head size was larger than average. We also found no difference in the obstetric mechanism between MH2, Sts 14 and A.L. 288-1, suggesting that A. sediba was not more derived in this trait compared to other australopithecines.

**References:**[1] Abitbol, M., 1996. Birth and Human Evolution, Anatomical and Obstetrical Mechanics in Primates. Bargin and Garvey : Westport, Connecticut-London.[2] Frémondière, P., 2015. L'évolution de l'accouchement dans la lignée humaine.Estimation de la contrainte foeto-pelvienne par deux méthodes complémentaires : la simulation numérique de l'accouchement et l'analyse discriminante des modalités d'accouchement au sein d'un échantillon obstétrical. Ph.D. Dissertation, Aix-Marseille University.[3] Rosenberg, K., Trevathan, W., 2002. Birth, obstetrics and human evolution. British Journal of Obstetrics and Gynaecology 109:1199-1206.[4] Haeusler, M., Frémondière, P., Fornai, C., Frater, N., Mathews, S., Thollon, L., Marchal, F. Virtual reconstruction of the MH2 pelvis (*Australopithecus sediba*) and obstetrical implications. American Journal of Physical Anthropology Suppl 62:165.[5] Häusler, M., Schmid, P., 1995. Comparison of the pelves of Sts 14 and AL 288-1: implications for birth and sexual dimorphism in australopithecines. Journal of Human Evolution 29:363-383.

Poster Presentation Number 63, Th (18:00-20:00)

## Analyzing the shape of fragmentary specimens: a test combining best-fit and Procrustes methods, and the case study of the late Early Pleistocene parietal bone from Gombore II, Melka Kunture, Ethiopia

**Martin Friess[1], Metasebia Endalamaw[2], Clément Zanolli[3], Roberto Macchiarelli[4,5]**

1 - Dépt. Hommes, Natures, Sociétés & UMR 7206 CNRS, Muséum national d'Histoire naturelle, Musée de l'Homme, Paris, France. · 2 - Authority for Research and Conservation of Cultural Heritage, National Museum of Ethiopia, Addis Ababa, Ethiopia · 3 - UMR 5288 CNRS, Université Toulouse Paul Sabatier, Toulouse, France · 4 - UMR 7194 CNRS, Muséum national d'Histoire naturelle, Paris · 5 - Unité de Formation Géosciences, Université de Poitiers, Poitiers, France

The Early to early Middle Pleistocene (Calabrian) site of Gombore, part of the Melka Kunture archaeological complex, on the Ethiopian highlands, has yielded three hominin remains that have been assigned to *H. erectus s.l.* [1]. Associated with a middle Acheulean industry from a level at Gombore II constrained between 0.875 and 0.709 Ma [2], is a left parietal fragment labelled MK 73 GOM II 576 (hereafter GOM II), which had been originally noted for its remarkable thickness [3], but whose morphometric assessment has been hampered by its state of preservation. More recently, a geometric morphometric (GMM) analysis of its midsagittal profile has led to the suggestion that this specimen shows an intermediate morphology between *H. ergaster* and *H. heidelbergensis* [4]. The purpose of our study is to explore means to morphometrically assess incomplete but potentially relevant specimens such GOM II, which are usually excluded from GMM studies for lack of a sufficient number of "true" landmarks. The use of landmark-based approaches is now common place. Further advances of the last decade, namely the introduction of semilandmarks, now allow for analyses of anatomical structures that are largely void of conventional landmarks. In addition, when used within the geometric morphometric framework, missing data can be estimated by warping complete configurations onto incomplete specimens. However, the reliability of this procedure depends on the proportion of present/missing landmarks, and its application was not advisable in the present case. In order to make this specimen available for GMM analysis, we tested constrained mesh alignment techniques, such as iterative closest point matching [5]. A total of 40 hominin parietals, representing taxa from early *Homo* to anatomically modern humans, were included. The geometry of all specimens was rescaled, reduced and iteratively aligned to match the preserved portion of the fragment from Melka Kunture. This protocol enabled the placement of semilandmarks that represent corresponding portions of the parietal bone, which were then submitted to standard multivariate analysis. Our preliminary results suggest for GOM II a more derived parietal shape than an assignment to *H. erectus s.l.* would lead one to expect. More generally, the results offer the perspective of a renewed assessment of specimens previously discarded from quantitative analyses on the basis of their preservation. By definition, such assessments based on fragmentary material remain limited because of both biological and methodological constraints, but may prove useful in cases where they are the only diagnostic option.

Access to the collections and authorization for performing the CT record of the fossil assemblage from Melka Kunture provided by the ARCCH, Federal Democratic Republic of Ethiopia. Research supported by the French CNRS in coll. with the Italian Archaeological Mission at Melka Kunture and Balchit.

**References:**[1] Coppens Y. 2004. The hominids of Melka Kunture. Some general reflections. In: Chavaillon J, Piperno M, editors. Studies on the Early Paleolithic site of Melka Kunture, Ethiopia. Florence: Istituto Italiano di Preistoria e Protostoria, 685-686.[2] Morgan LE, Renne PR, Kieffer G, Piperno M, Gallotti R, Raynal J-P. 2012. A chronological framework for a long and persistent archaeological record: Melka Kunture, Ethiopia. J Hum Evol 62:104-115.[3] Chavaillon J, Brahimi C, Coppens Y. 1974. Première découverte d'Hominidé dans l'un des sites acheuléens de Melka Kunturé (Ethiopie). CR Acad Sc Paris 278:3299-3302.[4] Profico A, Di Vincenzo F, Gagliardi L, Piperno M, Manzi G. 2016. Filling the gap. Human cranial remains from Gombore II (Melka Kunture, Ethiopia, ca. 850 ka) and the origin of Homo heidelbergensis. J Anthropol Sci 94:1-24.[5] Besl PJ, McKay ND. 1992. A Method for Registration of 3-D Shapes. IEEE Trans. Pattern Anal. Mach. Intell., 14(2): 239-256.

Poster Presentation Number 33, We (17:00-19:00)

## Dating the Middle-Upper Palaeolithic Transition in western Georgia (South Caucasus): a multi-method (OSL, IRSL and 14C) approach

**M. Frouin[1], T. Higham[1], J.-L. Schwenninger[1], M. Nioradze[2], T Meshveliani[2], A Belfer-Cohen [3], Ron Pinhasi[4]**

1 - RLAHA, University of Oxford · 2 - Georgian State Museum, Department of Archaeology, Tbilisi, Republic of Georgia · 3 - Institute of Archaeology, Hebrew University, Jerusalem, Israel · 4 - School of Archaeology, University College Dublin, Ireland

The Caucasus region, at the crossroads of Asia and Europe, was an important dispersal route of modern humans following their emergence out of Africa. Between Marine Isotope Stages (MIS) 5 and 3 (125 – 30 ka) the Great Caucasus Range was a biogeographic barrier constrained hominin mobility between the southern and northern Caucasus regions. It is believed that during glacial periods Middle Palaeolithic Neanderthal populations at each region were biogeographically isolated. This is based on the typological assessment of Middle Palaeolithic assemblages from sites in the northern vs southern Caucasus regions. The northern Caucasus Middle Palaeolithic assemblages share some techno-typological similarities with those from eastern Europe and Crimea, while the southern Caucasus assemblages share traits with those from the Levant and the Zagros regions. The Upper Palaeolithic (UP) occupational phases are associated with Anatomically Modern Humans (AMH) in both regions of the Caucasus although most of these did not yield any human remains and as such the authorship of many of these assemblages cannot be attributed with absolute certainty to AMH or Neanderthals. Since no "transitional lithic industries" have been recognized in these regions, it is possible that Neanderthal and AMHs did not interact to any significant degree. In the last 20 years new fieldwork in both regions indicates a time gap between the Middle and Upper Palaeolithic occupations and favours a model of a quick LMP-UP transition between 38 and 34 ka, thus supporting the replacement scenario of Neanderthals by AMH in the southern Caucasus. However, absolute dating of key archaeological sequences is still needed for testing the validity of this scenario. Our investigations aim to provide a revised and refined chronological framework for several major archaeological sites in Georgia (Sakajia, Ortvale, Satsurblia), using luminescence dating methods on different minerals contained in the sediments. Quartz coarse grains were dated using classical Optically Stimulated Luminescence (OSL) techniques, and feldspars using a signal stimulated by infrared (IRSL). Luminescence ages will be presented along with available radiocarbon dates for these sequences. This approach allows us to compare the results from two independent techniques. The combination of OSL/IRSL and 14C results using a Bayesian modelling approach produces a more precise chronology for the LMP and Early UP phases. The different periods of human occupation placed within an improved chronological framework help to understand the process of replacement or ascertain the temporal extent of possible interactions between Neanderthals and AMH in the Caucasus region.

Podium Presentation: Session 9, Sa (12:50)

## Population genetic history of Upper Palaeolithic Europe

**Qiaomei Fu[1], Cosimo Posth[2], Mateja Hajdinjak[3], Martin Petr[3], Janet Kelso[3], Nick Patterson[4], Johannes Krause[2], Svante Pääbo[3], David Reich [5]**

1 - Key Laboratory of Vertebrate Evolution and Human Origins of Chinese Academy of Sciences, IVPP, CAS, Beijing, China · 2 - Max Planck Institute for the Science of Human History, Jena, Germany · 3 - Department of Evolutionary Genetics, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 4 - Broad Institute of MIT and Harvard, Cambridge Massachusetts, USA · 5 - Department of Genetics, Harvard Medical School, Boston, Massachusetts, USA

Even though modern humans arrived in Europe 45,000 years ago, not much is known about their genetic history before the start of agriculture 8,500 years ago. One of the major questions is how climatic fluctuations influenced the population history of Eurasia and to what extent changes in material cultures correspond to movements of people.

We have analyzed genome-wide data from 51 Upper Palaeolithic and Mesolithic modern human remains that span around 40,000 years of Eurasian pre-history. Over this period of time the proportion of Neandertal ancestry in Eurasians decreased from 3-6% to around 2%. The decrease is more marked near genes than in less conserved regions of the genome, suggesting natural selection against Neandertal variants in modern humans.

Whereas some of the earliest modern humans in Europe, such as the 40,000- to 45,000-year-old Ust'-Ishim and Oase 1, did not contribute substantially to present-day Europeans, all individuals between 37,000 and 14,000 years ago descended from a single founder population which forms part of the ancestry of present-day Europeans. A 35,000-year-old individual from northwest Europe represents an early branch of this founder population which was then displaced across a broad region, before reappearing in southwest Europe at the height of the last ice age 19,000 years ago. A new genetic component related to present-day Near Easterners appears in Europe during the first major warming period around 14,000 years ago, which may reflect migrations or population shifts within Europe at the end of the last ice age, an observation that is consistent with the evidence of turnover of mitochondrial genomes at this time.

Overall, our results document how population turnover and migration have been recurring themes in European pre-history. An important direction of future work will be to generate genetic data from ancient individuals from southeastern Europe and the Near East, which will provide further insights into Upper Palaeolithic population history of Eurasia.

Poster Presentation Number 2, We (17:00-19:00)

## Dental topography and dietary adaptations in European Miocene hominids

**Beatriz Gamarra**[1], **Alejandro Romero**[2], **Mercedes Mayo-Alesón**[3], **Alejandro Pérez-Pérez**[4], **Jordi Galbany**[5], B. Gamarra, A[4,6]. Romero, M[6]. Mayo-Alesón[4,6], A. Pérez-Pérez[6], J. Galbany[4,6]

1 - School of Archaeology and Earth Institute, Belfield, University College Dublin, Dublin, Ireland · 2 - Departamento de Biotecnología, Facultad de Ciencias, Universidad de Alicante, Alicante, Spain · 3 - Departament de Psicología Clínica y Psicobiología, Facultat de Psicologia, Universitat de Barcelona.Barcelona, Spain · 4 - Secc. Antropologia, Departament de Biologia Animal, Universitat de Barcelona. Barcelona, Spain · 5 - Center for the Advanced Study of Human Paleobiology. Department of Anthropology. The George Washington University. Washington DC , USA · 6 - Grup d'Estudi de l'Evolució dels Homínids i altres Primats (GRC), Generalitat de Catalunya, Barcelona, Spain

Primate molar shape and occlusal surface topography show a strong relation with feeding habits and mechanical properties of ingested food . Recently, three-dimensional (3D) methods allow quantifying whole-surface dental topographic traits and to analyse molar form-function relationship with regard feeding behaviour despite wear. Molar shape descriptor metrics indicate that folivorous primates present higher complexity and relief values than frugivores and hard-object feeders which present less fibrous diets [1, 2]. The European Miocene hominid dietary adaptations are a key factor to understand great ape evolutionary radiation and genera diversity. Here we apply a novel approach for studying three-dimensional (3D) dental topography metrics to extinct Miocene hominids to determine dental-dietary patterns. Unworn or lightly worn second lower molars (M2) were selected of both European Miocene fossil (≈12-7 Ma) and extant hominid species. The Miocene hominid sample included specimens of *Dryopithecus fontani* (n=1), *Hispanopithecus crusafonti* (n=1), *Hispanopithecus laietanus* (n=4), *Rudapithecus hungaricus* (n=3) and *Oreopithecus bambolii* (n=2).We used extant Hominidae species as a comparative dental topographic sample, covering a wide range of dental-dietary adaptations including folivores (*Gorilla beringei beringei*, n = 4; *Gorilla beringei graueri*, n = 5), frugivores (*Gorilla gorilla gorilla*, n = 5; *Pan troglodytes schweirfurthii*, n = 8) and hard-object feeders (*Pongo pygmaeus*, n = 10). High-resolution dental replicas were scanned with a PIX-4 Pizca (Roland DG Corporation) and processed in Geomagic Studio 2012 (Geomagic, Inc. USA) to obtain isolated tooth crowns. We then obtained 3D-topographic metrics from mesh files for each tooth using MorphoTester . Data metrics included: (i) the surface complexity from polygon meshes (3D-OPCR), corresponding to 3D implementation of orientation patch count rotated based on finer resolution triangulated meshes; (ii) the measure of occlusal relief (RFI; relief index); and (iii) occlusal topographic bending (DNE, dirichlet normal energy). In comparison with extant Hominidae taxa, European Miocene hominids show significant differences for all ranked topographic variables (ANOVA $P<0.001$) suggesting high-level of interspecific variation in topographical metrics. European Miocene hominids presented lower topographic values than extant great apes, compatible with a lower fibrous diet [2,3]. However, pairwise comparisons (Tukey´s HSD; $P<0.05$) indicated only significant topographic differences of *Rudapithecus hungaricus* and *Oreopithecus bambolii* with the hard-object feeder *Pongo pygmaeus*, in agreement with a more folivore/frugivore diet molar adaptation. Contrary, *Hispanopithecus laietanus* exhibit significant differences with great apes' molar topographic metrics suggesting a lack of analogy with the living taxa. Overall, molar topography in European Miocene hominids indicate that these fossils were probably adapted to a feeding strategy different to those found in living representatives. This dietary specialization has been suggested as the cause of their gradual extinction in Europe when dramatic climatic changes occurred during the Late Miocene (11.6-5.3 Ma) .

**References:**[1] Boyer, D.M., Evans, A.R., Jernvall, J., 2010. Evidence of dietary differentiation among late Paleocene-early Eocene plesiadapids (Mammalia, primates). American journal of physical anthropology. 142, 194–210.[2] Berthaume, M.A., 2016. On the relationship between tooth shape and masticatory efficiency: A finite element study. Anat. Rec. 299 (5), 679–687. [3] Lucas, P., 2004. Dental functional morphology: how teeth work. Cambridge University Press, Cambdrige.[4] Winchester, J.M., 2016. MorphoTester: An Open Source Application for Morphological Topographic Analysis. Plos One. 11, e0147649.[5] DeMiguel, D., Alba, D.M., Moyà-Solà, S., 2014. Dietary specialization during the evolution of Western Eurasian hominoids and the extinction of European Great Apes. PloS one. 9, e97442.

Poster Presentation Number 15, We (17:00-19:00)

## Sexual dimorphism of the human permanent mandibular canine tissue proportions

**Cecilia García-Campos[1], María Martinón-Torres[2,3], Laura Martín-Francés[1,2], Marina Martínez de Pinillos[1,2], Mario Modesto-Mata[1,4], Bernardo Perea [5], Elena Labajo[5], José Antonio Sánchez[5], Elena Ruiz[5], Clément Zanolli[6], José María Bermúdez de Castro[1,2]**

1 - Centro Nacional de Investigación sobre la Evolución Humana. Burgos, Spain · 2 - Anthropology Department, University College London. London, UK · 3 - Laboratorio de Evolución Humana Departamento de Historia, Geografía y Comunicación, Burgos, Spain · 4 - Equipo Primeros Pobladores de Extremadura, Casa de la Cultura Rodríguez Moñino, Cáceres, Spain · 5 - Escuela de Medicina Legal y Forense. Universidad Complutense de Madrid, Spain · 6 - UMR 5288 CNRS, University Toulouse III - Paul Sabatier, France

Accurate sex estimation is one of the most important steps for the reconstruction of the biological profile of an individual both in a forensic and a paleoanthopologycal context. Previous works have highlighted that elements of the human permanent dentition are sexually dimorphic [1]. Traditional studies of enamel thickness based on two-dimensional measurements from buccolingual sections of teeth showed that the amount of enamel and dentine can differ significantly between males and females [2,3]. Among the different dental classes, canines show the highest degree of sexual dimorphism [2]. However, the available data on enamel thickness in anterior teeth is very scarce. Thus, the mechanisms underlying the variability are currently not well understood. Indeed, the same pattern of dental tissue distribution that is used for distinguishing modern humans from Neanderthals (relatively smaller amount of dentine and thicker enamel) is used to distinguish males and females in a forensic context [4,5]. Thus, to better understand the biological meaning of these histological patterns, it is necessary to go into detail about how sex influences the dental tissue proportions in modern human populations.

The purpose of the present study is to identify the sexual variability of the dental tissues proportions of modern human permanent mandibular canines, using two-dimensional and volumetric measurements of the enamel, dentine and pulp. We also aim to estimate the accuracy of these features for the sex estimation of isolated remains in a forensic context. The analytical sample consisted of a total of 22 mandibular permanent canines of known sex and age at death from the exhumation of two Spanish cemeteries from the Anthropological Collection of Escuela de Medicina Legal de Madrid. The teeth were scanned by X-ray microtomography (microCT). Following reconstruction, each virtual record was reoriented to obtain crown buccolingual sections and 3D reconstructions were generated after the segmentation process. Then, 2D and 3D variables and ratios described by Olejniczak [4] and Bayle et al. [5] were measured and statistically compared.

Our results support previous studies that suggest that males have larger mandibular canines than females . We show that sexual dimorphism is principally due to the presence of larger dentine proportions and enamel-dentine (EDJ) surface in males, whereas the amount of enamel does not differ significantly between sexes. Our study also reveals that 3D variables are more discriminative than 2D variables. Future studies will explore the full potential of these variables for sex estimation of isolated dental remains in modern and fossil human populations.

This report has been supported by the Dirección General de Investigación of the Spanish Ministerio de Economía y Competitividad (MINECO) grant number: CGL2015-65387-C3-1, 3-P, the Consejería de Educación of the Junta de Castilla y León, The European Social Fund and the Fundación Atapuerca. We also acknowledge The Leakey Foundation through the personal support of Gordon Getty and Dub Crook to one of the authors (MM-T). The dental sample was scanned at the microCT laboratory of CENIEH and in the microCT located in the Multidisciplinary Laboratory of the International Centre for Theoretical (ICTP) of Trieste with the collaboration of Federico Bernardini and Claudio Tuniz. Thanks to the European Social Fund for its monetary support.

**References:** [1] Feeney, R.N., Zermeno, J.P., Reid, D.J., Nakashima, S., Sano, H., Bahar, A., Hirosh, S., Armasastra, B., Hublin, J.J., Smith, T.M., 2010. Enamel thickness in Asian human canines and premolars. Anthropol Sci. 118, 191–198. [2] Schwartz, G.T., Dean, M.C., 2005. Sexual dimorphism in modern human permanent teeth. American journal of physical anthropology. 128, 312–317.[3] Saunders, S.R., Chan, A.H.W., Kahlon, B., Kluge, H.F., FitzGerald, C.M., 2007. Sexual dimorphism of the dental tissues in human permanent mandibular canines and third premolars. American journal of physical anthropology. 133, 735–740.[4] Olejniczak, A.J., Smith, T.M., Feeney, R.N.M., Macchiarelli, R., Mazurier, A., Bondioli, L., Rosas, A., Fortea, J., de la Rasilla, M., Garcia-Tabernero, A., Radovcić, J., Skinner, M.M., Toussaint, M., Hublin, J.-J., 2008. Dental tissue proportions and enamel thickness in Neandertal and modern human molars. Journal of human evolution. 55, 12–23. [5] Bayle, P., Braga, J., Mazurier, A., Macchiarelli, R., 2009. Brief communication: High-resolution assessment of the dental developmental pattern and characterization of tooth tissue proportions in the late Upper Paleolithic child from La Madeleine, France. American Journal of Physical Anthropology. 138, 493–498.

Poster Presentation Number 91, Th (18:00-20:00)

## The ontogeny of femoral strength in Middle Pleistocene humans from Sima de los Huesos (Atapuerca, Spain)

**Rebeca García-González[1], Laura Rodríguez[1], José Miguel Carretero[1], Juan Luis Arsuaga[2,3]**

1 - Laboratorio de Evolución Humana. Dpto. Historia, Geografía y Comunicación. Universidad de Burgos · 2 - Centro UCM-ISCIII de Investigación sobre la Evolución y Comportamiento Humanos, Avda. Monforte de Lemos, 5, 28029 Madrid, Spain · 3 - Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Ciudad Universitariam Madrid, Spain

Numerous studies have focused on the differences in the activity patterns among different human groups based on the cross-sectional properties of adult long bones. However, the conclusions of this kind of approaches have to be taken with caution because the bones, although still adapt to loading forces during adulthood (remodelling), are most susceptible to change from external stimuli during the growth period. Therefore, to correctly understand the relationship between cross-sectional properties of long bones and the mechanical loadings, it is necessary to evaluate the development of these properties over the course of growth. Although the research exploring the ontogeny of cross-sectional properties of fossil humans has undergone a notable increase in the last years, frequently the size of the samples is very small, and even in some cases is limited to a single individual. Moreover, both the geographic and the chronological sample ranges are wider than desirable. In this work we contribute to the present knowledge of this problem with the ontogenetic analysis of femoral strength of the humans from Sima de los Huesos (SH) Middle Pleistocene site (Sierra de Atapuerca, Burgos, Spain) . SH is an exceptional site which has yielded a large collection of human fossils considered early members of the Neandertal clade and dated to around 430 thousand years ago [1,2]. Within the sample, 90 specimens belong to juvenile femora, representing a minimum of 14 individuals in different growth stages. From the juveniles, five complete femora are the main objective of the present study and in addition, five adult specimens can be also analysed. Thus, this sample represents a valuable source of evidence for evaluating the ontogenetic trajectory of femoral cross-sectional properties in a past human species.

We focus here on the growth trajectory of two variables, the polar section modulus (Zj) and the relative cortical thickness (%CA). The Zj is an appropriate parameter for assessing bone strength changes and the %CA is able to yield insights in the dynamics nature of the modeling and remodeling process [3].

Zj and %CA were collected in SH femora at midshaft level. Cross-section slices at midshaft were obtained through CT scan. For comparative purposes we collected the same two variables in a large archaeological sample composed by 27 immature (dental aged from zero to fifteen years old) and 26 adults individuals.

To standardize comparisons between younger and older individuals, femoral strength was evaluated relative to body weight by times femoral length and the %CA relative to femoral length as a surrogate of age. The relative growth trajectories were determined using log-log RMA regression. A different line was fitted to fossil and recent femora testing if these two groups share the same growth trajectory.

Our results show that standardized Zj and %CA for SH femora are well above the mean of our recent human sample. These differences increases along the growth period due to the relative higher growth rate in SH individuals than in recent humans. These findings support the idea that differences between SH and recent humans in cross-sectional properties are not only due to different activity patterns, but also to differences in the relative growth rate.

**References:**[1] Arsuaga, J., Martínez, I., Arnold, L., Aranburu, A., Gracia-Téllez, A., Sharp, W., Quam, R., Falguères, C., Pantoja-Pérez, A., Bischoff, J., Poza-Rey, E., Parés, J.M., Carretero, J.M., Demuro, M., Lorenzo, C., Sala, N., Martinón-Torres, M., García, N., Alcázar de Velasco, A., Cuenca-Bescós, G., Góme-Olivencia, A., Moreno, D., Pablos, A., Shen, C.-C., Rodríguez, L., Ortega, A.I., García, R., Bonmatí, A., Bermúdez de Castro, J.M., Carbonell, E., 2014. Neandertal roots: Cranial and chronological evidence from Sima de los Huesos. Science 344, 1358-1363.[2] Arsuaga, J.L., Carretero, J.-M., Lorenzo, C., Gómez-Olivencia, A., Pablos, A., Rodríguez, L., García-González, R., Bonmatí, A., Quam, R.M., Pantoja-Pérez, A., Martínez, I., Aranburu, A., Gracia-Téllez, A., Poza-Rey, E., Sala, N., García, N., Alcázar de Velasco, A., Cuenca-Bescós, G., Bermúdez de Castro, J.M, Eudald, C. 2015. Postcranial morphology of the middle Pleistocene humans from Sima de los Huesos, Spain. Proceedings of the National Academy of Sciences 112, 11524-11529.[3] Ruff, C.B., Garofalo, E., Holmes, M.A., 2013. Interpreting Skeletal Growth in the Past From a Functional and Physiological Perspective. American Journal of Physical Anthropology 150, 29-37.

Poster Presentation Number 83, Th (18:00-20:00)

## Positional rib assessment of the adult costal remains from the El Sidrón Neandertal site (49000 y/o, Asturias, northern Spain)

**Daniel García-Martínez[1,2], Markus Bastir[1], Rosa Huguet[3,4], Almudena Estalrrich[1], Antonio García-Tabernero[1], Eugenia Cunha [5], Marco de la Rasilla[6], Antonio Rosas[1] et al.**

1 - Paleoanthropology Group, Museo Nacional de Ciencias Naturales (CSIC), Madrid, Spain · 2 - Biology Dept., Faculty of Sciences, Universidad Autónoma de Madrid. , Madrid · 3 - Institut Catalá de Paleoecologia Humana i Evolució Social (IPHES), Tarragona, Spain. Unidad Asociada al CSIC. · 4 - Area de Prehistoria, Universitat Rovira i Virgili (URV) · 5 - Departamento de Ciências da Vida (Antropologia), Universidade de Coimbra, Coimbra, Portugal. · 6 - Departmento de Historia, University of Oviedo, Campus del Milán, Oviedo, Spain

Introduction: The El Sidrón site represents one of the most complete neandertal fossil assemblages of the Iberian Peninsula, where every part of the skeleton is represented [1, 2]. The site has yielded more than 2500 skeletal remains, from which 268 are costal remains. Despite the fragmentary nature of these ribs, 168 remains could be attributed to adults, based both on size and on the fusion of the epiphyses. The aim of this study is to assess the side and the anatomical position of the El Sidrón ribs, and to present a new method for the rib assessment in mixed costal samples when the rib head is preserved. Material and Methods: For diagnosis of the rib anatomical position, we used specific features such as muscle attachments and presence/absence of the articular tubercle in the so-called atypical ribs (1st-2nd and 11th-12th). For the typical ribs (3rd-10th) we used comparative anatomy to evaluate a possible positional range for ribs when the proximal part is missing, something usual in the fossil record. In order to assess remains in which the rib head was preserved (five specimens in the sample), we calculated an index of rib head height by rib head width (HCCD according to [3] and HW defined by this work as the maximum length in medio-lateral direction of the articular surface of the head) along the rib sequence (1st-10th) in a comparative sample of modern humans (N=200 ribs) belonging to the Santarem Collection (Coimbra, Portugal). Then we used neandertal rib heads with known anatomical position (1st and 2nd from Kebara 2; 3rd and 8th of the El Sidrón site, this latter found in anatomical connection within a partial thorax) in order to validate the *H. sapiens* index as a proxy for positioning neandertal ribs. Results: assessment of anatomical position and side was possible in 94 costal remains. The analyses of atypical ribs allowed for determination of five 1st rib remains (2 Left/3 Right), three 2nd rib remains (Left), seven 11th rib remains (4 Left/3 Right) and six 12th rib remains (3 Left/3 Right). Additionally, 16 remains were attributed to 2nd-4th ribs (8 Left/8 Right), 35 remains to ribs 4th-8th (20 Left/15 Right) and 22 remains to ribs 8th-12th (11 Left/10 Right). Results of HCCD/HW displayed that there is an increase of this value along the sequence from 1st to 10th and that the neandertal ribs of known position fall into their correspondent ranges of modern humans. So, this allowed us to use modern humans' index for anatomically locating the El Sidrón rib heads. Following this method, SDR-161+SDR-196 was assessed as a 4th rib, SD-695a and SD-448 were assessed as 5th ribs and SDR-788 and SD-666 were assessed as 6th-7th ribs. Side and position was not possible to assess in 74 remains. Discussion and conclusions: Our results show that the studied assemblage comprises remains belonging to the complete thorax, ranging from upper (1st ribs) to the lower thorax (12th ribs), although the degree of preservation is very variable. Moreover, we propose a method based on rib head measurements that could be useful for the assessment of rib position in mix bone assemblages of modern humans and neandertals. Previous work dealing with the morphology of the El Sidrón 1st ribs [4], proposed that neandertal upper thorax was more antero-posteriorly expanded compared with modern humans, whereas the lower thorax was more medio-laterally expanded than in modern humans. Once the side and anatomical position of a large percentage of the costal sample is established, future work can be focused on a detailed 3D morphological study of the best preserved remains (from upper to lower), in order to validate the aforementioned model and contribute to the knowledge of the neandertal thorax morphology.

Acknowledgements: We thank the El Sidrón Excavation team. This project is funded by the Leakey Foundation, the ERASMUS Program of the Universidad Autónoma de Madrid – Universidade de Coimbra (Spain Portugal), and the Spanish Ministry of Economy and Competitivity: CGL2012 37279 and CGL2012 36682. El Sidrón Field work is supported by Gobierno del Principado de Asturias.

**References:**[1] Rosas, A., Martínez-Maza, C., Bastir, M., García-Tabernero, A., Lalueza-Fox, C., et.al. 2006. Paleobiology and comparative morphology of a late Neandertal sample from El Sidrón, Asturias, Spain. – Proc. Natl. Acad. Sci. 103(51), 19266-19271.[2] Rosas, A., Estalrrich, A., García-Vargas, S., García-Tabernero, A., Huguet, R., Lalueza-Fox, C., & de la Rasilla, M. (2013). Identification of Neandertal individuals in fragmentary fossil assemblages by means of tooth associations: the case of El Sidrón (Asturias, Spain). Comptes Rendus Palevol, 12(5), 279-291.[3] Gómez-Olivencia, A., Carretero, J. M., Lorenzo, C., Arsuaga, J. L., de Castro, J. M. B., & Carbonell, E. (2010). The costal skeleton of Homo antecessor: preliminary results. Journal of human evolution, 59(6), 620-640.[4] Bastir, M., García-Martínez, D., Estalrrich, A., García-Tabernero, A., Huguet, R., et.al. 2015. The relevance of the first ribs of the El Sidrón site (Asturias, Spain) for the understanding of the Neandertal thorax. J. Hum. Evol. 80, 64-73.

Podium Presentation: Session 1, Th (11:20)

## The mental template: Middle Pleistocene handaxe shaping strategies

**Paula García-Medrano**[1], **Andreu Ollé**[1,2], **Nicholas Ashton**[3], **Mark B. Roberts**[4]

1 - Institut Català de Paleoecologia Humana i Evolució Social (IPHES) Zona educacional 4, Campus Sescelades URV (EdificiW3), 43007 Tarragona, Spain · 2 - Àrea de Prehistòria, Universitat Rovira i Virgili (URV), av. Catalunya, 35, 43002 Tarragona, Spain · 3 - Depart. of Prehistory & Europe, British Museum, Franks House, 56 Orsman Road, London N1 5QJ, UK · 4- Institute of Archaeology, University College London, 31-34 Gordon Square, London WC1H 0PY, UK

The morphological variability of Large Cutting Tools during the Middle Pleistocene has been traditionally associated with two main variables: the raw material constraints and the reduction intensity [1,2]. Boxgrove –c.500ka– represents one of the richest and more interesting sites at which to analyse shaping strategies and morphological variability in European Middle Pleistocene handaxes, due to the huge quantity of finished handaxes and also to the presence of complete operative chains [3]. For this paper, we have focused on the entire handaxe sample from the excavations at Quarry 1/B [4].

The aim of this work was to assess the role of raw material characteristics, size, form, and homogeneity of the flint nodules, in the shaping process, and to ascertain if they represent real constraints in the production of a handaxe. In addition, because of the large numbers of handaxes and the intensity of the thinning process at Boxgrove, we also aimed to determine if reduction intensity affected the final shape as much as some authors have postulated previously.

In conjunction with the detailed technological analysis of the sample, we classified the handaxes according to their shaping stage: Test, Rough-out, Shaped and Finished. Each piece was systematically measured, and the data subjected to statistical analyses. The morphological variability was analysed using a geometric morphometrics methodology and PCA [5]. In addition, we have developed an experimental programme that attempts to replicate the Boxgrove shaping strategies, and was especially focused on assessing the raw material role within these processes.

The results show that the knapping strategies were flexible and adapted to the blank's physical characteristics and attributes. These variables affect the reduction strategy but there is no clear relationship between a determinate initial morphology of the blank and a specific final handaxe shape. Throughout the experimental programme, the team explored the knapper's capacity to solve problems arising from reduction accidents and mistakes, which led to re-configuring the knapping strategy to achieve the "mental template". In summary, no substantial morphological differences related to reduction intensity have been noticed within the Boxgrove Q1/B-handaxes. Only the most invasive distal shaping, usually through tranchet removals, generates minor variations in shapes. Thus, systematic re-sharpening as the cause of shape variation seems highly unlikely, this could be related to the short use-life of the Boxgrove handaxes.

We are deeply grateful to the Boxgrove team ant to the British Museum for giving us access to the archaeological material. Besides one of the authors (AO), the knappers were J.M. Vergès, M. Guardiola and J. Guiu. P. García-Medrano benefited from a pre-doctoral research grant from the Fundación Siglo para las Artes en Castilla y León. The experiment was founded by the Catalan AGAUR project 2008-PBR-00033. This work was developed within the frame of the projects SGR 2014-899 (AGAUR) and CGL2015-65387-C3-1-P (MINECO/FEDER).

**References:** [1] Ashton, N. and McNabb, J., (1994) Bifaces in perspective, in: Ashton, N., David, A. (Eds.). Stories in Stone, Lithic Studies Society, London, pp. 182-191. [2] Iovita, R. and McPherron, S., (2011). The handaxe reloaded: A morphometric reassessment of Acheulian and Middle Paleolithic handaxes. Journal of Human Evolution 61: 61-74. [3] Roberts, M.B., Parfitt, S.A., (1999) Boxgrove: a Middle Pleistocene Hominin Site at Eartham Quarry, Boxgrove, West Sussex. English Heritage Archaeological Report. 17. [4] García-Medrano, P. 2011. Los sistemas técnicos del Pleistoceno Medio en el Oeste de Europa. Cadenas operativas y procesos de configuración en los conjuntos líticos de Galería y Gran Dolina-TD10-1 (Sierra de Atapuerca, Burgos, España) y Boxgrove (Sussex, Inglaterra). Doctoral Thesis. University of Burgos. Spain. 495p.p. [5] McPherron, S. P., (1999) Ovate and pointed handaxe assemblages: two points make a line. Préhistoire Européenne 14: 9-32.

Podium Presentation: Session 11, Sa (18:00)

## Assessing the Role of the Northern Iberian Refugium during the Last Glacial. Analysis of Upper Paleolithic Economic Strategies at El Mirón Cave and other Cantabrian sites

**Jeanne Marie Geiling[1], Ana Belén Marín-Arroyo[1], Manuel Ramón González Morales[1], Lawrence Guy Straus[2]**

1 - IIIPC, Universidad de Cantabria · 2 - Department of Anthropology, University of New Mexico; IIIPC, Universidad de Cantabria

During the Last Glacial Maximum advancing ice-sheets and polar deserts substantially reduced hunting territories across much of Central and Northwestern Europe. In this respect, northern Iberia acted as an European refugium for many species. Evidence in favor of this hypothesis is presented by the increase of archaeological sites, especially during the Solutrean [1], in this area, indicating a gradual influx of migrants or concentration of surviving groups in Southern Europe, which resulted in a population expansion scenario across northern Iberia; additional evidence is also provided by aDNA studies. The Northern Iberian region with milder climate and a diverse, high-relief topography and coastal ecotone location acted as an ecological refugium for plants, animals and human populations [2-4]. The origin of late NW European repopulation was likely located in this region. Demographic modeling based on genetic data provides evidence of a major human population turnover in Europe around 14,5 kya during the Late Glacial [5]. The rich and well-preserved Northern Iberian archaeological record and succeeding published data provide an excellent opportunity for studying how human behavior developed within this significant episode of climatic changes and permit analyses of the developments in human subsistence strategies. We analyze economic strategies based on the animal remains recovered from Gravettian, Solutrean and Magdalenian sites of the Cantabrian region in order to identify the implications for human behavioral change. The degree of hunting specialization, the age of the consumed individuals, the types of carcass transport, the extent of logistic mobility and the nature of butchering process are reconstructed and compared among these Upper Paleolithic cultural periods. Our results show that groups tended to have wider diets within the context of increased human presence during the Last Glacial Maximum, with higher pressure on natural resources, which developed to a more specialized economy during the post-LGM Magdalenian. The paleoeconomic choices reflect strategies that were more intensified. This scenario progressively shifted towards a greater specialization on hunted species (in this case red deer and ibex) during the Magdalenian. The Lower Magdalenian was thus a key period in human behavioral change in this region. El Mirón Cave located in eastern Cantabria provides rich series of Lower Magdalenian deposits (16-14.5 uncal kya) with specific cultural characteristics. Within the above-mentioned general framework, relevant results of the unpublished Lower Magdalenian faunal studies from El Mirón are presented, which helped understand human behaviors in context of changing environments. These new data allow us to identify the significant economic changes that took place at the end of the Pleistocene in this refugium, while we consider the important role of the northern Iberian region in European human evolution.

**References:**[1] Straus, L. G. Iberia before the Iberians: the Stone Age prehistory of Cantabrian Spain. (University of New Mexico Press, 1992). [2] Achilli, A. et al. The molecular dissection of mtDNA haplogroup H confirms that the Franco-Cantabrian glacial refuge was a major source for the European gene pool. Am. J. Hum. Genet. 75, 910–918 (2004). [3] Sommer, R. S. et al. Late Quaternary distribution dynamics and phylogeography of the red deer (Cervus elaphus) in Europe. Quat. Sci. Rev. 27, 714–733 (2008).[4] Meiri, M. et al. Late-glacial recolonization and phylogeography of European red deer (Cervus elaphus L.). Mol. Ecol. 22, 4711–4722 (2013). [5] Posth, C. et al. Pleistocene Mitochondrial Genomes Suggest a Single Major Dispersal of Non-Africans and a Late Glacial Population Turnover in Europe. Curr. Biol. 26, 827–833 (2016).

Poster Presentation Number 114, Th (18:00-20:00)

## Technological Divergence at the Crossroads? Comparing the Obsidian Middle Palaeolithic in the Armenian Volcanic Highlands and Central Anatolia

**Phil Glauberman[1], Boris Gasparyan[2], Steven Kuhn[3], Keith Wilkinson[4], Ellery Frahm[5], Yannick Raczynski-Henk [6], Hayk Haydosyan[2], Samvel Nahapetyan[7], Dmitri Arakelyan[8], Daniel Adler[9]**

1 - Middle East Technical University · 2 - Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia · 3 - University of Arizona · 4 - University of Winchester · 5 - University of Minnesota · 6 - University of Leiden · 7 - Yerevan State University · 8 - Institute of Geological Sciences, National Academy of Sciences of the Republic of Armenia · 9 - University of Connecticut

At the intersection of Africa and Eurasia, the Armenian volcanic highlands and Anatolia are crucial locations for investigating Upper Pleistocene hominin behavior and population dynamics. Recent fieldwork is expanding the Middle Palaeolithic (MP) database in the region, bringing to light technological patterning [1, 2]. Utilizing regionally conscribed lithic technological signatures to elucidate MP hominin population dynamics has invigorated discussion of the reliability of such a record for that endeavor and raises the issues of multi-regional technological convergence and divergence. Results of excavation and artifact analysis at the open-air site of Barozh 12 in Armenia provide data on MP lithic technology and mobility [3]. These data form a basis for comparison of core reduction technology observed in the central Anatolian volcanic province (CAVP) at Göllü Dağ. Barozh 12 is an open-air site on a plateau at the foot of the obsidian-rich Mt. Arteni volcanic complex overlooking the Ararat (paleo-lake) Depression. There, obsidian MP artifacts densely cover a surface of c. 6000 $m^2$. Excavation of 4.85 $m^3$ of stratified sediments yielded 12,594 artifacts from a c. 1 m thick sequence, or 2579 artifacts/$m^3$. Consistent with MP assemblages documented in Armenia within an age range of c. 100 – 30 kya, lithic technology is dominated by unidirectional-convergent Levallois core reduction and the production of points. Retouched and un-retouched Levallois points with basal modifications are the most common tool types. pXRF analysis on a sample of 306 artifacts indicates artifact transports from nearby (1–2 km) and distant (outcrop-derived) primary obsidian sources at a maximum linear distance of c. 190 km. Combined with obsidian sourcing data from other Armenian MP sites, raw material transport patterns suggest a diachronic range of hominin mobility situated in the Armenian highlands and northeastern Turkey. Survey in the CAVP has documented numerous MP sites in a geomorphologically similar, obsidian-rich setting at Göllü Dağ . Comparison of obsidian MP assemblages from Barozh 12 with those from Göllü Dağ shows significant differences in Levallois core reduction techniques. Unidirectional-convergent Levallois point production predominates at Barozh 12 and in the MP of the Armenian volcanic highlands, but is not observed in the Göllü Dağ assemblages [4]. Comparison of obsidian assemblages negates the influence of raw material properties on reduction, instead emphasizing variation in learned, transmitted, and persistent knapping behaviors. Separated by topography and distance, the CAVP appears 'isolated' from the emergent pattern of MP technological similarity observed among the Armenian volcanic highlands, the southern flanks of the greater Caucasus mountains in Georgia, the Iranian Plateau, and the northern Levant. While ongoing work seeks to establish better chronological control and expand the lithic database, this comparison suggests a pattern of regionalized, broadly contemporaneous MP technological divergence based on a shared Levallois foundation. At this southwest Asian crossroads of hominin dispersals, MP technological data are starting to reveal a complex multi-regional picture where technological divergence likely occurred and persisted due to physiographic isolation of small populations, probably a commonplace dynamic within the greater Eurasian MP hominin metapopulation.

**Acknowledgements:** This research is supported by an EC 7th Framework Marie Curie International Incoming Fellowship, the Gfoeller Fund of America Corporation, and the Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia.

**References:**[1] Adler, D.S., Wilkinson, K.N., Blockley, S., Mark, D.F., Pinhasi, R., Schmidt-Magee, B.A., Nahapetyan, S., Mallol, C., Berna, F., Glauberman, P.J., Raczynski-Henk, Y., Wales, N., Frahm, E., Jöris, O., MacLeod, A., Smith, V.C., Cullen, V.L., Gasparian, B., 2014. Early Levallois Technology and the Lower to Middle Palaeolithic Transition in the Southern Caucasus. Science 345, 1609-1613.[2] Gasparyan, B., Egeland, C.P., Adler, D.S., Pinhasi, R., Glauberman, P., Haydosyan, H., 2014. The Middle Paleolithic Occupation of Armenia: Summarizing Old and New Data. In Gasparyan, B., Arimura, M. (Eds.) The Stone Age of Armenia. Center for Cultural Resource Studies, Kanazawa University, Kanazawa, pp. 65-106.[3] Glauberman, P.J., Gasparyan, B., Wilkinson, K., Frahm, E., Raczynski-Henk, Y., Haydosyan, H., Arakelyan, D., Nahapetyan, S., Adler, D.S., In press. (2016) Introducing Barozh 12: A Middle Palaeolithic Open-Air Site on the Edge of the Ararat Depression, Armenia. ARAMAZD-Armen. J. Near East. Stud.[4] Kuhn, S. L., Dinçer, B., Balkan-Atlı, N., Erturaç, M. K., 2015. Paleolithic Occupations of the Göllü Dağ, Central Anatolia, Turkey. J. Field Archaeol. 40, 581-602.

Poster Presentation Number 118, Th (18:00-20:00)

## On the context of the Neanderthal Skeletons at La Ferrassie, France: new evidence on old data

**Paul Goldberg[1,2], Vera Aldeias [3,4], Antoine Balzeau[5], Laurent Bruxelles[6], Laurent Chiotti[7], Isabelle Crevecoeur[8], Harold L. Dibble [3,9,10], Asier Gómez-Olivencia[11,12,13,14], Guillaume Guérin[15], Jean-Jacques Hublin[3], Bruno Maureille[8], Shannon J. P. McPherron[3], Stéphane Madeleine[15], Dennis M. Sandgathe[16], Teresa E. Steele [17], Sahra Talamo[3], Alain Turq[15,18]**

1 - Centre for Archaeological Sciences, University of Wollongong, Australia · 2 - Eberhard Karls Universität Tübingen, Institute for Archaeological Sciences, Germany · 3 - Department of Human Evolution, MPI EVA Leipzig, Germany · 4 - Interdisciplinary Center for Archaeology and Evolution of Human Behavior, Universidade do Algarve, Faro, Portugal · 5 - « Histoire Naturelle de l'Homme Préhistorique » (HNHP, UMR 7194), Sorbonne Universités, MNHN, CNRS, UPMC, UPVD, Paris, France and Department of African Zoology, Royal Museum for Central Africa, Tervuren, Belgium · 6 - Laboratoire TRACES, UMR 5608 CNRS-Université de Toulouse (Le Mirail), Maison de la recherche, Toulouse, France · 7 - Département de Préhistoire, Muséum national d'histoire naturelle, UMR 7194 CNRS, Les Eyzies-de-Tayac, France · 8 - UMR 5199-PACEA, CNRS, Université de Bordeaux, France · 9 -Department of Anthropology, University of Pennsylvania, Philadelphia, USA · 10 - Institute of Human Origins, Arizona State University, USA · 11 Dpto. Estratigrafia-Paleontologia. Universidad del Pais Vasco. · 12 - Ikerbasque-Basque Fundation for Science. · 13 - Musee de l'Homme. · 14 - Centro Mixto UCM-ISCIII12 Institut de Recherche sur les Archéomatériaux, UMR 5060 CNRS -Université Bordeaux Montaigne, Centre de Recherche en Physique Appliquée à l'Archéologie (CRP2A), Maison de l'archéologie, France · 15 - Musée national de Préhistoire, Les Eyzies-de-Tayac, France. · 16 - Dept. of Archaeology & Human Evolution Studies Program, Simon Fraser University, Burnaby, BC, Canada · 17 - Dept. of Anthropology, University of California, Davis, CA, USA · 18 - CNRS, Univ. Bordeaux, MCC, PACEA, UMR 5199, Talence, France.

The site of La Ferrassie (France) is well known for the presence of several (N=7) Neandertal individuals, and here we focus on two adults (LF1 and LF2) discovered by Peyrony and Capitan in the early 20thc , and LF8, a child excavated by Delporte in the 1970s. In spite when the LF1 and LF2 discoveries were made, we know that they were found very close to each other and there is some general information on their location within the larger site of La Ferrassie. Nonetheless, the context of these finds is incomplete, with many ambiguities about their archaeological association and exact stratigraphic position. The LF8 skeleton was uncovered about 8-10m further into the cave, in an area that is stratigraphically disconnected from LF1 and 2 near the entrance. Here we present sedimentological, stratigraphic, and chronological data of the deposits from recent excavations (2010-2014) that shed new light on the context of these Neanderthals. LF1 and LF2 were found close to our western excavation section. Field and micromorphological observations of sediments associated with the Middle Paleolithic revealed a sequence of basal fluvial sands (Layer 1) overlain successively by frost-affected, cryoturbated chalky deposits (Layer 2) and finely bedded silty sand anthropogenic deposits, rich in burned bone and flint (Layers 3, 4, and 5). Macroscopic comparisons of the sediments attached to the LF2 foot show a strong affinity to our Layer 4 and/or Layer 5, showing that the specimen clearly postdates Layer 3 ; a similar attempt to assign a layer to loose sediments found near LF1 was inconclusive. Although LF1 and LF2 cannot be positioned stratigraphically with certainty, our microstratigraphic results and comparisons show inconsistencies with Peyrony's 'yellow' and 'red' attributions to the deposits associated with them. Radiocarbon and luminescence (14C, OSL, IRSL) ages attribute the Layer 4/5 deposits to MIS 3: Layer 5b was dated to between 44 and 47 ka cal BP based on radiocarbon, while luminescence ages for Layers 4 and 5 range between 40 ± 2 ka and 54 ± 4 ka [1,2,3]. Although the LF8 skeleton and much of the associated objects were removed during the 1970s excavation, the deposits in the area where LF8 was found are very different from those of the western section, being much stonier and generally consisting of yellow, brown silty clays with generally platy éboulis. We excavated this area of the site and recognized several layers: Layer A (base) through Layer D (top). Evaluation of Delporte's records showed that the LF8 child was most probably at the same elevation as our Layer B. The underlying Layer A, along with the base of Layer B, were deformed by the formation of several cryogenic patterned ground hummock formations. Similar features (called "monticules") were recorded during Peyrony's excavations. This deformation likely occurred at the same time as the deposition of Layer 2 in the western section. Therefore, from a stratigraphic standpoint, Layer B appears to be the temporal equivalent of Layer 2 in the western area. A preliminary OSL age for sediments from the same altitude as LF8 suggests that it dates to MIS 4 ( 66 ka). OSL ages obtained for Layer 2 in the western area [3, 4] are consistent with this preliminary age and support the link between these two Layers. In the remaining deposits, there were no indications for a distinct infill in this area, neither in the profile nor in the artifact plots. Fauna associated with LF8 are currently being radiocarbon dated. There are also clear differences in artifact density in these different loci of the site, with LF8 associated with archaeologically poor Middle Paleolithic sediments as compared with the artifact-rich deposits further toward the western section where LF1 and LF2 were uncovered. Thus, when considered in their totality, all of the data clearly show that LF1 and LF2 are stratigraphically above the sediments that were at the same level as LF8.

**References:**[1] Guérin, G., Frouin, M., Talamo, S., Aldeias, V., Bruxelles, L., et.al. 2015. A multi-method luminescence dating of the Palaeolithic sequence of La Ferrassie based on new excavations adjacent to the La Ferrassie 1 and 2 skeletons. Journal of Archaeological Science 58, 147-166.[2] Frouin, M., Guérin, G., Lahaye, C., Mercier, N., Huot, S., et.al. submitted. New luminescence dating results based on polymineral fine grains from the Middle and Upper Palaeolithic site of La Ferrassie (Dordogne, SW France). Quaternary Geochronology.[3] G. Guérin, M. Frouin, C. Lahaye, N. Mercier, P. Goldberg, V. Aldeias, et.al. 2015 First chronometric ages for La Ferrassie Neanderthals LF1 and LF8 and a comparison with the age of LF2. ESHE,Proceedings of the European Society for the study of Human Evolution 4, London, P.105 [4] Peyrony, D., 1934. La Ferrassie. Moustérien, Périgordien, Aurignacien. Editions Leroux, Paris. [5] Delporte, H., Delibrias, G., Delpech, F., Donard, E., Heim, J.L., et.al. 1984. Le grand abri de La Ferrassie. Fouilles 1968-1973, Paris

Poster Presentation Number 81, Th (18:00-20:00)

## Evolution of the vertebral formula in hominoids: insights from ancestral state reconstruction approaches

**Asier Gómez-Olivencia**[1,2,3,4], **Aida Gómez-Robles**[5]

1 - Dpto. Estratigrafía-Paleontología. Universidad del País Vasco. · 2 - Ikerbasque-Basque Fundation for Science. · 3-Musée de l'Homme. · 4-Centro Mixto UCM-ISCIII · 5 - Department of Anthropology and Center for the Advanced Study of Human Paleobiology, The George Washington University, Washington DC, USA.

The vertebral formula of an individual or species, specifies the number of vertebrae of each anatomical region of the spine. *Hox* genes are (in part) responsible for the specification of segmental identity (i.e., cervical, thoracic, etc.) and their anterior expression boundaries are related with morphological boundaries [1]. Thus, the assessment of the variation and evolution of the morphological boundaries is likely to reflect genetic changes occurred during hominoid axial evolution. When compared to cercopithecoids, which represent the primitive vertebral formula for primates, extant hominoids are characterized by having a reduced thoraco-lumbar region (sum of thoracic and lumbar vertebrae) and a transitional vertebra (the vertebra in which the orientation of the facets changes from transversal to para-sagittal) located more caudally. Despite these common characteristics, variation in vertebral formulae is observed within and among hominoid species. Moreover, the evolution of this variation has not been fully resolved yet and the vertebral formula of the last common ancestor (LCA) of panins and hominins is a matter of intense debate, with two opposing views: the "long-backed scenario" and the "short-backed scenario" [2]. Unlikely previous studies addressing these issues, we have used a formal quantitative approach to reconstruct the most likely ancestral states at different nodes of the primate phylogeny for the absolute position of the thoraco-lumbar border, the lumbo-sacral border and the sacro-coccygeal/caudal border and the absolute position of the transitional vertebra. Character states in different hominoid and cercopithecoid species were assessed based on direct observations of 575 individuals and were complemented with data from the relevant literature [3]. We used a consensus primate phylogeny obtained from molecular data [4] and different approaches to reconstruct ancestral states under three major frameworks: parsimony, maximum likelihood and Bayesian stochastic character mapping. The use of these different approaches allowed us to assess the robustness of our ancestral estimates. For the three approaches, we considered vertebral limits as discrete traits and used an ordered model in which transitions are allowed from one vertebra to the adjacent ones, but not to the others. All three methodologies consistently reconstruct the lumbo-sacral limit at the 24th vertebra, which favors a short-backed scenario for the LCA (contra [5]). This inferred ancestral state implies a lower degree of homoplasy in the evolution of the vertebral formula in panins and hominins. Our results consistently indicate that the sacro-coccygeal border of *Pan paniscus* does not represent the primitive condition as proposed by McCollum et al [5]. This would imply that even in the presence of selective trends towards reduction of the body axis, increases could happen in certain taxa, such as *Pan paniscus* or *Nomascus*. We have assessed Williams et al.'s [3] proposal that the transitional vertebra of the chimpanzee-human LCA was located at the 13th thoracic vertebra (T13). However, the reconstruction of the position of the transitional vertebra of this LCA is not unequivocal: different approaches yield results favoring either a T12 or T13 position. The future inclusion of fossil species in our analyses may help clarify this result. Finally, the ancestral state reconstruction for the thoraco-lumbar limit (i.e., whether having 12 or 13 pairs of ribs is the ancestral state) also remains unsolved. However, the presence of 14 thoracic vertebrae in *Nomascus* and its high percentage in *Pan paniscus* would be derived in all scenarios. These and other formal quantitative methods of ancestral state reconstruction, together with observations from extant primates and from the fossil record, will help us advance in our understanding of the evolution of the primate spine and its implications for posture and locomotion.

The study was supported by the Spanish Ministerio de Economía y competitividad (Projects CGL2012-38434-C03-01, CGL-2015-65387-C3-2-P-MINECO/FEDER-). AGO is also funded by the Gobierno Vasco/Eusko Jaurlaritza (Research Group IT834-13). This research was supported by the European Community Research Infrastructure Action (SYNTHESYS Project; http://www.synthesys.info/; FP6 "Structuring the European Research Area" Programme) (Projects GB-TAF-3674 and BE-TAF-4132).

**References**:[1] Burke, A.C., Nelson, C.E., Morgan, B.A., Tabin, C., 1995. Hox genes and the evolution of the vertebrate axial morphology. Development 121, 333-346 [2] Williams, S.A., Russo, G.A., 2015. Evolution of the hominoid vertebral column: The long and the short of it. Evol. Anthrop. 24, 15-32 [3] Williams, S.A., Middleton, E.R., Villamil, C.I., Shattuck, M.R., 2016. Vertebral numbers and human evolution. Am. J. Phys. Anthrop. 159, 19-36 [4] Arnold, Christian, Luke J. Matthews, and Charles Lindsay Nunn. 2010. The 10kTrees website: A new online resource for primate phylogeny. Evol. Anthrop. 19: 114-118 [5] McCollum, M., Rosenman, B.A., Suwa, G., Meindl, R.S., Lovejoy, C.O., 2010. The vertebral formula of the last common ancestor of african apes and humans. J. Exp. Zool. (Mol Dev Evol) 314B, 123-134

Poster Presentation Number 134, Th (18:00-20:00)

## Stone Age settlement patterns in the Lunho valley (Niassa, Mozambique): GIS preliminary results

**Célia Gonçalves[1], João Cascalheira[1], Jonathan Haws[2], Brandon Zinsious[2], Mussa Raja[3], Nuno Bicho [1]**

1 - ICArEHB, Universidade do Algarve · 2 - University of Louisville · 3 - Universidade Eduardo Mondlane

The central question of this poster focus on the identification of settlement patterns by communities that inhabited the Lunho valley region from c. 300 to c. 20 thousand years ago. Specifically, we tried to identify and characterize the settlement dynamics of each cultural phase (MSA and LSA), in order to verify the existence of resilience or rupture factors in the selection of site location with respect to natural/landscape-related factors, visual prominence in the landscape, among others. Geographically, the Lunho Valley, is located in the Niassa province, and has a route that develops for c. 50km from east to west, flowing into the shores of the lake that gives the name the province (internationally known as Lake Malawi), in northwestern Mozambique. Both valley margins are marked by the presence of terraces and other fluvial deposits with irregular extensions of gravel floors. The importance of the Lake Malawi area in the broader context of African Pleistocene prehistory, particularly in the movement of people along the Great African Rift, has long been recognized [1]. Research conducted so far show that the region has a high archaeological potential, with the identification of numerous open-air sites and rockshelters [2], some of which were already excavated by Mercader´s team [3,4] . Using data collected during archaeological field survey conducted in the Lunho valley in 2014 [2] and GIS techniques we explore a series of simple but important issues in relation to visibility and patterning of archaeological data [5]. The GIS analysis were conducted using ESRI´s ArcGIS 10.3 software leveraging a variety of standard geoprocessing tools and custom geoprocessing models. The topographic variables were extracted and/or obtained from the Digital Elevation Model (DEM) Advance Spaceborne Thermal Emission Reflection Radiometer Global DEM (ASTER, 30m resolution). Of the variables derived from basic terrain analysis, 6 were used in this study: slope, aspect, hillshade, plan curvature, profile curvature and convergence index. In addition, three different scales of topographic position index were calculate: slope position classification, landform classification and Beer´s aspect (i.e. heat load index). In total, 10 variables including pre-processed elevation derived from DEM were used to understand the Stone Age settlement patterns of the Lunho valley. Topographic variables were extracted for 84 archaeological sites and for 445 locations that were randomly assigned. The preliminary results of the spatial and statistical analyses (PCA, HCA, K-S, Kruskal-Wallis) reveals: 1) three of the variables explain more the 77,5% of diversity of the Stone Age settlement: elevation, aspect and Beer´s aspect; 2) different patterns between MSA and LSA occupations; and 3) differential patterns of occupation between the northern and southern banks of the valley . Spatial analysis of the archaeological sites identified in the Lunho valley demonstrates that the sites are not randomly distributed across landscape. Close proximity to water, relatively low elevation and slope, north (MSA sites) or south aspect (LSA sites), moderate (MSA sites) or warmest (LSA sites) heat load, are among the environmental factors which influence site location.

Field work was conducted by permission of the Governmental Authority for Cultural Heritage of Mozambique, Direcção Nacional do Património Cultural. Major funding was provided by the Fundação para a Ciência e Tecnologia (PTDC/EPH-ARQ/4998/2012), with additional funding from the Wenner-Gren Foundation for Anthropological Research.

**References:**[1] Bromage, T., Schrenk, F., Juwayeyi, Y., 1995. Paleobiogeography of the Malawi Rift: Age and vertebrate paleontology of the Chiwondo Beds, northern Malawi. Journal of Human Evolution 28(1), 37-57.[2] Bicho, N., Haws, J., Raja, M., Madime, O., Gonçalves, C., Cascalheira, J., Benedetti, M., Pereira, T., Adeias, V., In press. Middle and Late Stone Age of the Niassa region, northern Mozambique. Preliminary results. Quaternary International. DOI: 10.1016/j.quaint.2015.09.059.[3] Mercader, J., Bennett, T., Raja, M., 2008. Middle Stone Age starch acquisition in the Niassa Rift, Mozambique. Quaternary Research, 70(2), 283-300.[4] Mercader, J., Gosse, J., Bennett, T., Hidy, A., Rood, D., 2012. Cosmogenic nuclide age constraints on Middle Stone Age lithics from Niassa, Mozambique. Quaternary Science Reviews, 47, 116-130.[5] Conolly, J., Lake, M., 2006. Geographical Information Systems in Archaeology. Cambridge Manuals, Cambridge.

Podium Presentation: Session 1, Th (10:00)

## The Newly Discoverd Early Stone Age site of Melka Wakena, Ethiopia

**Tegenu Gossa Aredo[1], Asfawossen Asrat[2], Bienvenido Martinze-Navarro[3], Ravid Ekshtain[1], Erella Hovers[1,4]**

1 - The Institute of archaeology, The Hebrew University of Jerusalem · 2 - School of Earth Sciences, Addis Ababa University · 3 - CREA, Institut Català de Paleoecologia Humana i Evolució Social –IPHES, Tarragona · 4 - International Research Affiliate, Institute of Human Origins, Arizona State University

The earliest Acheulian in eastern Africa appears 1.7 Ma within the Rift Valley (West Turkana, Konso, Gona). These early assemblages present a mosaic of lithic technological characteristics that bridge the Oldowan and Acheulian technological systems. Two sites in central Ethiopia, Melka Kunture (geologically and topographically within the Rift) and the presently-inundated Gadeb sites, present arguably similar sequences from the Oldowan to the Acheulian. The newly discovered site complex of Melka Wakena (MW) contains a series of assemblages that pertain to questions of the evolution, situational contexts and chronology of Early Pleistocene lithic technological variability. Situated at an elevation of >2300 m above sea level, 8 km south of the Gadeb site, MW is among the earliest hominin occupations outside the Rift Valley. Ten localities were found along a 2 km stretch along the Wabe River. The site is stratigraphically placed in the Early Pleistocene (>1Ma) Dino Formation that covers extensive parts of the SE rift shoulders. Surveys and test excavations in 2014-2016 revealed paleontological and archaeological (Early Stone Age) assemblages. These occur in fluvio-lacustrine overbank conglomerates, silts and sands interbedded within a sequence of pyroclastic and volcaniclastic deposits and volcano-lacustrine sediments. The ubiquitous tephra layers in the sequence allow constraining of the age of deposition of the artifact-bearing horizons through paleomagnetic and geochronological analyses, both currently underway. The small faunal collection, derives from *‚in situ* archaeological localities and stratigraphically-coeval exposures on the landscape, represents a mixture of water and terrestrial environments. The assemblage is characterized by high abundance of two water dependent species, the mega-herbivore *Hippopotamus gorgops* and the giant reptile *Crocodylus cf. niloticus*. It also includes some ungulates suggestive of open landscapes: a small to medium size *Equus* sp., Giraffidae indet., *Aepiceros* sp., *Gazella* sp., and Antilopini indet. The rodent *Hystrix* sp. also occurs. This faunal list is coherent with a late Early or earliest Middle Pleistocene age. Two stratified localities were test-excavated. In locality MW1, at least three archaeological horizons are present as distinct levels, two of which were tested. Each contained abundant handaxes, flakes, cores and hammerstones; cleavers were founds only in the lower level. No faunal remains were found in the locality. In locality MW2, the two lowermost out of four archaeological horizons were tested. The lower layer 4, embedded in a coarse-grained sand, contained faunal elements (mainly hippo), a few bearing marks of anthropogenic percussion, associated with few large lithic artifacts. The overlying layer 3 is a dense horizon of hammerstones, large and small flakes, few biface preforms but no bifaces, and a few large and giant cores, all intercalated with large cobbles. This assemblage is found in a fine-grained sand matrix. Patterns of raw material exploitation are similar for all tested horizons. Ignimbrite from locally-available flows was commonly used as raw material, whereas hammerstones were typically made of basalt cobbles obtained from channels. Otherwise, assemblage compositions and lithic technology are variable across the paleo-landscape and through the stratigraphic sequence. Geoarchaeological, taphonomic, faunal and technological analyses are used to address the roles of taphonomic mechanisms and hominin decision-making in the formation of these assemblages. The richness of the MW assemblages and their variability, as well as their geographic proximity to the Gadeb sites, provide a comparative framework for developing hypotheses about causes and processes of technological evolution and ecological adaptations of Early Pleistocene hominins within and outside the Rift Valley.

TGA is supported by a Wadsworth Fellowship grant from the Wenner-Gren Foundation for Anthropological Research. Fieldwork is supported by grants from PAST and from the Ruth Amiran Fund for archaeological research, and a National Geographic Society (grant 9801-15) and by Institute of archaeology HUJ.

Pecha Kucha Presentation: Session 10, Sa (15:00-15:25)

## What's in a Tooth? Signals of Ecogeography and Phylogeny in the Dentition of Macaques

**Nicole Grunstra**[1,2], **Philipp Mitteroecker**[2], **Robert Foley**[1]

1 - Leverhulme Centre for Human Evolutionary Studies, Department of Archaeology and Anthropology, University of Cambridge, UK · 2 - Department of Theoretical Biology, University of Vienna, Austria

Teeth are key for dietary reconstruction of fossil forms. They also serve as a model for phenotypes under selection, the study of which can yield valuable information about what dietary and other (socio)ecological conditions have been relevant in the evolution of phenotypic variation. Here, we investigate the extent to which dental morphology reflects diet and other aspects of geography and ecology in an environmentally and morphologically generalised Old World monkey taxon, the macaques (Cercopithecidae: *Macaca*). Although they have been described as generic monkeys, macaques are well known for their wide geographical distribution and their diversity in resource ecology. Some macaques exhibit a diverse ecogeography even on an intraspecific level (e.g., *M. mulatta*), and therefore this genus lends itself well for studies of between- as well as within-species variation. Using a dataset detailing macaque geography, climate, habitat and dietary ecology, and life history and reproductive biology (henceforth ecogeography), we use a multivariate approach to explore patterns of association between the environment and the macaque dentition. 63 Linear measurements of tooth size as well as certain aspects of the skull and mandible were taken for a total of 12 species. We employed phylogenetic two-block partial least squares (2B-PLS) analysis to explore the patterns of covariation between macaque ecogeography and (cranio)dental morphology, both with and without phylogenetic correction to assess the effect of phylogeny. In addition to the expected main effect of allometry, we hypothesised that any variation in tooth size relates to differences in diet, particularly the degree of frugivory vs. folivory, in keeping with previous work on relative anterior tooth and postcanine tooth size. We also investigated whether within-species variation shows a similar dental pattern to that between species. Our phylogenetically uncorrected results indicate that allometry indeed dominates the first axis of shared covariance between macaque ecogeography and craniodental size. This is strongly associated with temperature and geographical range size, and moderately with latitude and habitat. The second axis shows an antero-posterior tooth size contrast: a large and wide anterior dental arcade concomitant with a longer muzzle, enlarged canines, and smaller postcanine tooth size is strongly associated with tropical climates found at lower latitudes, a large proportion of fruit in the diet, and increased sexual size dimorphism. Conversely, a larger postcanine dentition (and smaller anterior dentition) is associated with shorter faces, but longer skulls, in macaques at northerly and seasonal latitudes, with decidedly less fruit in the diet and strong breeding seasonality. Following phylogenetic correction, however, only the allometric factor remains significant, whereas the second axis explains a negligible amount of the covariance between the environment and morphology. Finally, within-species analyses show a lack of craniodental variation in relation to the environment, suggesting local adaptation may be constrained by stabilising selection. This detailed ecogeographical study demonstrates that in a generalised primate taxon such as macaques, body size differences have evolved in response to environmental differences, but that seemingly adaptive signals in the dentition in relation to diet are in fact dominated by phylogenetic effects. Moreover, microevolutionary processes operating within species are likely to be different from those responsible for macaque diversification. The ecological flexibility of macaques and the taxonomic level at which we observe their variation make the findings of this research relevant to the study of extinct hominins.

Podium Presentation: Session 4, Fr (8:50)

## The evolution and development of endocranial shape

**Philipp Gunz[1], Barbara Drews[1,2], Simon Neubauer[1], Nadia A. Scott[1], Thomas Hildebrandt[3], Jean-Jacques Hublin[1]**

1 - Department of Human Evolution, MPI EVA Leipzig · 2 - Institute of Agricultural Sciences, ETH Zurich · 3 - Department Reproduction Management, Leibniz Institute for Zoo and Wildlife Research (IZW), Berlin

The characteristic globular neurocranial shape of recent modern humans develops in the first months after birth [1,2]. Between birth and the eruption of the deciduous dentition, modern human braincases change from an elongated to a more globular shape owing to both a relative expansion of the posterior cranial fossa and parietal bulging. Neither chimpanzees nor Neanderthals have a postnatal globularization phase [2]. However, given the altriciality of modern humans, it is conceivable that a globularization phase occurs prenatally in other hominids.

Here we explore (1) whether bonobos, as our closest living relatives, have a prenatal globularization phase, and (2) the link between brain shape and brain growth rates. To this end we collected in vivo ultrasound images of prenatal brain development in *Pan paniscus*. Animals were not sedated but rather trained to volunteer for the examination by positive reinforcement. Measurements digitized from longitudinal series of seven bonobo individuals were compared to published modern human growth standards, as well as postnatal CT scans of humans and chimpanzees.

We were particularly interested in determining whether our closest living relatives have a globularization phase just before birth, as this would suggest a heterochronic shift rather than a uniquely modern human trajectory of brain development. We found that bonobos do not have a globularization phase just before birth. In contrast to modern humans, the endocranial shape of *Pan paniscus* does not change much between the last trimester of pregnancy and the early postnatal period. Indeed, the shape of the midsagittal profile does not change at all between gestational week 22 and infancy. This indicates that the difference in postnatal developmental trajectories between *Pan* and modern humans is therefore not simple heterochrony.

Our results suggest that endocranial shape changes in bonobos and humans are linked to the growth rate of the brain, as the overall shape of the brain becomes more globular during periods of rapid brain growth. In contrast to *Pan paniscus*, human brains start becoming more globular around gestational week 27. This coincides with the onset of a cerebellar growth spurt in humans [3] that continues until the first three postnatal months [4].

The rapid prenatal and postnatal enlargement of the cerebellum is a key growth process underlying the modern human globularization phase. The cerebellar expansion is linked to developmental and evolutionary shape changes of the posterior cranial fossa, and may also contribute to the characteristic parietal bulging that sets modern humans apart from our closest living and extinct relatives. Our data suggest that endocranial shape changes throughout development are potentially informative about the growth rate and timing of early brain development in extant and fossil groups.

We are grateful to the Milwaukee County Zoo and the Wilhelma Zoo Stuttgart for making the ultrasound examinations possible, in particular to Barbara Bell, Bruce Beehler, Christina Geiger, Nicole Schauerte, Tobias Knauf-Witzens, and Carsten Knoth. This research was funded by the Max Planck Society; the IZW Berlin provided the ultrasound equipment. The training and ultrasonographic examination of the bonobos in this study were approved by Milwaukee County Zoo and Frankfurt Zoo as well as the scientific committee of the EEP and SSP.

**References:**[1] Neubauer, Simon, Philipp Gunz, and Jean-Jacques Hublin. 2009. The pattern of endocranial ontogenetic shape changes in humans. J Anat 215 (3): 240-255[2] Gunz, Philipp, Simon Neubauer, Lubov Golovanova, Vladimir Doronichev, Bruno Maureille, and Jean-Jacques Hublin. 2012. A uniquely modern human pattern of endocranial development. Insights from a new cranial reconstruction of the Neandertal newborn from Mezmaiskaya. J Hum Evol 62 (2): 300-313[3] Hatab, Mustapha R, Salwa W Kamourieh, and Diane M Twickler. 2008. MR volume of the fetal cerebellum in relation to growth. J Magn Reson Imaging 27 (4): 840-5[4] Holland, Dominic, Linda Chang, Thomas M Ernst, Megan Curran, Steven D Buchthal, Daniel Alicata, Jon Skranes, et al. 2014. Structural growth trajectories and rates of change in the first 3 months of infant brain development. JAMA Neurol 71 (10): 1266-74

Poster Presentation Number 108, Th (18:00-20:00)

## Multi-scale and micro-contextual investigation of the Middle Stone Age sequence in Blombos Cave, South Africa

**Magnus M. Haaland**[1], **Christopher E. Miller**[2,3], **Christopher S. Henshilwood**[1,4]

1 - Institute for Archaeology, History, Culture and Religious Studies, University of Bergen, Bergen, Norway · 2 - Institute for Archaeological Sciences, University of Tübingen, Tübingen, Germany · 3 - Senckenberg Centre for Human Evolution and Paleoenvironment, University of Tübingen, Tübingen, Germany · 4 - Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg, South Africa

The archaeological assemblage recovered from Blombos Cave (BBC), South Africa, has become central to our current understanding of the behavioural and cultural development of early humans in southern Africa during the Late Pleistocene. The most informative archaeological material found has been recovered from the Middle Stone Age (MSA; ca. 101–70 ka) sequence and include worked and engraved ochre, ochre processing kits, engraved bone, marine shell beads, polished bone tools, and bifacially worked stone tools [1-4]. Although these artefacts have been thoroughly studied and have attracted attention for their cultural and behavioural implications, to date little work has focused in detail on the sedimentary context in which they were recovered.

The Blombos Cave sequence is more than 3 meters deep and characterized by well-stratified, unconsolidated sandy deposits, consisting of numerous cm- to mm-thick lenses and laminations. Intermixed within this sandy matrix are the remains of marine and terrestrial fauna, large combustion features, small basin-shaped hearths as well as humified and organic rich horizons. A simple yet important question is: How do we relate the micro-scale, human-made deposits with the archaeological artefacts found within and around them? From a chrono-cultural point of view, this question is fundamental, because it is within the sedimentary matrix that artefacts are recovered, dating samples are taken and where site structure is physically defined. It is the spatial and stratigraphic relationships within the site's deposits that define the spatio-contextual and chronological framework in which most archaeological assemblage are classified, compared and interpreted. In order to reconstruct the spatio-contextual relationship between the archaeological assemblage and its surrounding depositional context, an investigation of the depositional and post-depositional processes responsible for the transportation, accumulation and erosion of the archaeological sediments is necessary. Here we present methods and results of an ongoing geo-archaeological and micro-contextual investigation of the BBC deposits, including a micromorphological study of the complete sedimentary sequence of the cave site.

Micromorphology represents one of the most effective micro-analytical techniques to study undisturbed sedimentary relationships within archaeological deposits . It involves the collection of structurally intact blocks of sediment in the field, and the subsequent preparation and study of these blocks through petrographic thin section analysis in a laboratory; thereby facilitating the identification of sedimentary constituents, post-depositional features and stratigraphic relationships on a microscopic level. During multiple excavation seasons (2000, 2010 and 2013) more than 50 micromorphological block samples were collected across the cave site and throughout the entire stratigraphic sequence, resulting in a dataset with great lateral and horizontal representability.

To better relate our micro-contextual observations to the macroscopic observations carried out in the field, we combine accurate 3D reconstruction of the cave's morphology and section profiles with geo-referenced, high-resolution thin sections scans. Within a GIS framework, all macroscopic field documentation, micromorphological observations and archaeological data is combined and effortlessly explored, visualised and analysed on multiple spatial scales. This improved spatial framework allows for a more robust and multifaceted evaluation of the site formation processes responsible for the accumulation of deposit within Blombos Cave. Furthermore, it enables us to investigate human aspects of the BBC context that hitherto has been overlooked: overall site structure, intra-site spatial variability, prehistoric pyrogenic activity, site modification and maintenance as well as artefact preservation and material provenance.

Acknowledgements: Blombos Cave Excavation team w/Christopher Henshilwood & Karen van Niekerk, University of Bergen, The geoarchaeological working group, Tübingen, Germany. University of Bergen, Humanities Faculty, AHKR Research Abroad Funding, The Meltzer Foundation

**References:**[1] d'Errico F, Henshilwood CS, Vanhaeren M, van Niekerk K (2005) Nassarius kraussianus shell beads from Blombos Cave: evidence for symbolic behaviour in the Middle Stone Age. Journal of Human Evolution 48(1):3-24[2] Henshilwood CS, d'Errico F, Yates R, Jacobs Z, Tribolo C, et.al. (2002) Emergence of Modern Human Behavior: Middle Stone Age Engravings from South Africa. Science 295(5558):1278-1280 [3] Henshilwood CS, d'Errico F, van Niekerk KL, Coquinot Y, Jacobs Z, et.al. (2011) A 100,000-Year-Old Ochre-Processing Workshop at Blombos Cave, South Africa. Science 334(6053):219-222 [4] Mourre V, Villa P, Henshilwood CS (2010) Early Use of Pressure Flaking on Lithic Artifacts at Blombos Cave, South Africa. Science 330(6004):659-662[5] Courty MA, Goldberg P, Macphail R (1989) Soils and micromorphology in archaeology. Cambridge University Press, Cambridge ; New York

Poster Presentation Number 86, Th (18:00-20:00)

## Neanderthal vertebral curvature and spinal motion – the evidence of spinal osteoarthritis in the La Chapelle-aux Saints skeleton

**Martin Haeusler[1], Cinzia Fornai[1], Nakita Frater[1], Ella Been[3], Noémie Bonneau[4]**

1 - Institute of Evolutionary Medicine, University of Zurich, Switzerland · 2 - Department of Anthropology, University of Vienna, Austria · 3 - Physical Therapy Department, Faculty of Health Professions, Ono Academic College, Kiryat Ono, Israel · 4 - Institut de Formation en Masso-Kinésithérapie - CHU de Rouen, France

The reconstruction of the La Chapelle-aux-Saints skeleton by Marcellin Boule in 1912 [1] shaped the popular notion of Neanderthals as brutish creatures at the beginning of the last century. Based on an analysis of the sacrum and right hipbone, he concluded that the spine lacked a lumbar lordosis, and while he reconstructed the thoracic spine with a hyperkyphosis, he depicted the neck as straight, implying a primitive, forward thrust head position. While Boule [1] only superficially commented on the extensive arthritic changes in La Chapelle-aux-Saints, Straus & Cave suggested in 1957 [2] that the distinct spinal curvature of this specimen resulted entirely from his severe facet joint osteoarthritis, but that a healthy Neanderthal would not have differed in posture from modern humans. Trinkaus [3], on the other hand, argued that Boule's interpretation of the spinal curvature cannot be attributed to pathology as the shape of the vertebrae is not affected; rather, Boule might have failed to take into account normal range of variation in vertebral morphology among modern humans. This would imply that the actual vertebral curvature of La Chapelle-aux-Saints did not differ from modern humans. Recently, however, Been and colleagues inferred [4] a hypolordotic angle (32°–34°) for La Chapelle-aux-Saints based on the relationship between the orientation of the inferior articular processes and the lordotic curvature, which is commensurate with other Neanderthal fossils, but lower than in modern humans (51° ± 11°). Here, we propose that the distribution and degree of the osteoarthritic changes throughout the La Chapelle-aux-Saints vertebral column could provide an alternative means to deduce spinal curvature and that they might reflect, how the spine was used during life. Generally, damage to the facet joints is most pronounced at locations where the highest biomechanical stress occurs such as at the peak of spinal curves [5]. The arthritic changes of the facet joints of La Chapelle-aux-Saints are most marked in the lower cervical and upper thoracic and lower thoracic spine, but moderate in the upper cervical, mid-thoracic and lumbar vertebrae. This would imply habitual hyperextension and thus the presence of a lordotic curve at the cervico-thoracic junction as well in the lower thoracic spine. This is supported by marked imbrication of the facet joints in these regions. Remodeling of the facet joints with imbrication can also be observed in the mid-thoracic vertebrae, which opposes a severe thoracic hyperkyphosis. Unfortunately, the ventral margin is damaged in nearly all vertebral bodies, so that the presence or absence of spondylophytes cannot be verified. Remarkably, the lumbar spine shows only moderate arthritic alterations of the facet joints. This contrasts to modern humans, which often demonstrate the most severe changes in the caudalmost motion segments . Nevertheless, marked Baastrup disease ("kissing spines") can be observed at L4-S1, which results from increased lordosis. We supplement our analysis with a reconstruction of the La Chapelle-aux-Saints spine by articulating the preserved vertebrae both in silico and in vitro. Further evidence for the degree of the spinal curvature comes from a new reconstruction of the pelvis of La Chapelle-aux-Saints and the determination of the pelvic incidence. This is a measure for sacral orientation that is highly correlated with lumbar lordosis. In conclusion, our findings suggest that the analysis of osteoarthritic changes of the facets joints is a valuable tool to reconstruct posture and spinal motion in Neanderthals that supplements other methods including inferences of articular process angles and pelvic incidence.

We thank Aurélie Fort, Véronique Laborde, Liliana Huet and the Muséum Nationale d'Histoire Naturelle de Paris for access to the La Chapelle-aux-Saints skeleton. Financial supported was provided by the Swiss National Science Foundation (31003A-156299/1) and the Mäxi Foundation.

**References:** [1] Boule, M., 1912. L'homme fossile de La Chapelle-aux-Saints. Annales de Paléontologie 7:85-192 [2] Straus, W.L., Cave, A.J.E., 1957. Pathology and the posture of Neanderthal Man. Quart Rev Biol 32:348-363 [3] Trinkaus, E., 1985. Pathology and the posture of the La Chapelle-aux-Saints Neandertal. Am J Phys Anthropol 67:19-41 [4] Been, E., Gómez-Olivencia, A., Kramer, P.A., 2012. Lumbar lordosis of extinct hominins. Am J Phys Anthropol 147:64-77 [5] Tischer, T., Aktas, T., Milz, S., Putz, R.V., 2006. Detailed pathological changes of human lumbar facet joints L1-L5 in elderly individuals. Eur Spine J 15:308-315

Podium Presentation: Session 9, Sa (12:30)

## Genetic analyses of five late Neandertals

**Mateja Hajdinjak[1], Martin Petr[1], Udo Stenzel[1], Hélène Rougier[2], Isabelle Crevecoeur[3], Patrick Semal [4], Marie Soressi[5], Sahra Talamo[6], Jean-Jacques Hublin[6], Ivan Gušić[7], Željko Kućan[7], Rudan Pavao[7], Liubov V. Golovanova[8], Vladimir B. Doronichev[8], Cosimo Posth[9], Johannes Krause[9], Petra Korlević[1], Sarah Nagel[1], Birgit Nickel[1], Kay Prüfer[1], Janet Kelso[1], Qiaomei Fu[10], Matthias Meyer[1], Svante Pääbo[1]**

1 - Department of Evolutionary Genetics, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 2 - Department of Anthropology, California State University Northridge, Northridge, California, USA · 3 - Université de Bordeaux, CNRS, UMR 5199-PACEA, Pessac Cedex, France · 4 - Royal Belgian Institute of Natural Sciences, Brussels, Belgium · 5 - Faculty of Archaeology, Leiden University, Leiden, The Netherlands · 6 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 7 - Croatian Academy of Sciences and Arts, Zagreb, Croatia · 8 - ANO Laboratory of Prehistory, St. Petersburg, Russia · 9 - Max Planck Institute for the Science of Human History, Jena, Germany · 10 - Key Laboratory of Vertebrate Evolution and Human Origins of Chinese Academy of Sciences, IVPP, CAS, Beijing, China

Comparisons of the Neandertal genome to present-day human genomes have revealed that 1-2% of present-day human genomes outside of Africa come from Neandertals and it has been suggested that a major part of the admixture took place in the Levant between 47-65 kya [1, 2]. However, it has also been shown that a 42,000-year-old modern human from Romania had a Neandertal ancestor four to six generations back in his family tree, indicating that the admixture between modern humans and Neandertals was not restricted to a single event in the Near East . To better understand late Neandertal populations and the interactions between Neandertals and modern humans we are investigating the genomes of European Neandertals from the time when they or their immediate ancestors could have met modern humans.

We identified five late Neandertal specimens – from the Troisième caverne of Goyet and Spy in Belgium, Les Cottés in France, Vindija Cave in Croatia and Mezmaiskaya Cave in Russia – where the fraction of endogenous sequences are between 6% and 64% after depleting microbial contamination through hypochlorite treatment. We have sequenced the nuclear genomes of these individuals to an average coverage between 1- and 2.7-fold. Several methods were used to estimate the proportion of present-day human DNA contamination in the generated data. Based on the set of diagnostic positions where Neandertal mitochondrial genomes differ from those of present-day humans, modern human contamination of mitochondrial DNA sequences ranges between 0.5% and 4.1%. Nuclear DNA contamination, as determined using a maximum likelihood approach [1, 2], varies between 0.18% and 1.75%.

Based on the number of DNA fragments recovered from the X chromosome and the autosomes, we determined that the specimens from Goyet, Les Cottés and Vindija were females, whereas the Spy and Mezmaiskaya 2 specimens were males. We further use these genomes to determine population structure among late Neandertals and their relationships to the Neandertals that contributed DNA to present-day humans, as well as to determine whether there was gene flow from early modern humans into these late Neandertals.

**References:**[1] Green, R. E., Krause, J., Briggs, A. W., Maricic, T., Stenzel, U., et al., 2010. A draft sequence of the Neandertal genome. Science 328, 710-722.[2] Prüfer, K., Racimo, F., Patterson, N., Jay, F., Sankararaman, S., et.al. 2014. The complete genome sequence of a Neanderthal from the Altai Mountains. Nature 505, 43-49.[3] Fu, Q., Hajdinjak, M., Moldovan, O. T., Constantin, S., Mallick, S., et.al. 2015. An early modern human from Romania with a recent Neanderthal ancestor. Nature 524, 216-219.

Podium Presentation: Session 1, Th (10:20)

## The Missing Oldowan: New 2.3 - 2.0 Ma Sites from the Nasura Complex, West Turkana, Kenya

**Sonia Harmand**[1], **Sandrine Prat**[2], **Xavier Boes**[3], **Jason Lewis**[4], **Craig Feibel**[5], **Helene Roche**[6]

1 - Stony Brook University, Dept of Anthropology · 2 - CNRS/MNHN, UMR 7194 · 3 - INRAP · 4 - Turkana Basin Institute · 5 - Rutgers University · 6 - CNRS, UMR 7055

More than eighty years after Louis Leakey first used the term 'Oldowan' [1], our knowledge of this early lithic technology and its makers is still based on a scant record of sites, especially the earliest record found before 2 million years ago (Ma) in East Africa. The paucity and lack of continuity in the Late Pliocene archaeological record is probably linked to insufficient field research and depositional hiatuses, rather than artifact preservation. The 2.3-2.0 Ma time range saw an evolutionary shift from more primitive hominin forms and sporadic stone tool sites before 2.3 Ma to the multiple advanced forms creating numerous and widespread stone tool sites after 2.0 Ma [2]. It is only after 2.0-1.9 Ma that the archaeological record is distributed across much of Africa with greater numbers of Oldowan sites. Similar increases in archaeological "visibility" are apparent in South Africa and North Africa. The archaeological record becomes then more continuous and high-density which could imply that the making of stone tools becomes more "habitual". Most discussion of early Oldowan hominin behavior and ecology between 2.3 and 2.0 Ma is therefore based on materials from a limited number of sites. The past years, exploratory fieldwork in the Kalochoro Member of the Nachukui formation in the West Turkana area of Northern Kenya by the West Turkana Archaeological Project resulted in the discovery of three new Oldowan sites at Nasura dating to the little-known 2.3 - 2.0 Ma time range. These in situ sites already nearly double the number of archaeological occurrences from 2.3 - 2.0 Ma. They are in close geographic and chronological relation to one another and to high-resolution paleoenvironmental and paleoclimatic records that allow for the testing of hypotheses about hominin morphological and behavioral evolution during this critical interval. We also discovered a hominin maxillary fragment in what appears to be the exact same sedimentary horizon as the in situ artifacts from the site of Nasura 3. If confirmed, this will be one of the only direct associations between hominin remains and a >2.0 Ma archaeological site. We present our preliminary results from the excavation of the Nasura sites and ongoing technological, paleontological and geological work focusing on understanding the mode and tempo of change in the climate, environment, technology, and foraging practices at Nasura across this critical period.

We thank the office of the President of Kenya, the Ministry of Education, Science and Technology, the National Council for Science and Technology (NCST/RCD/12B/012/25) and the National Museums of Kenya for permission to conduct research, and the Turkana Basin Institute and Total Kenya Limited for logistical support in the field. Funding was provided by the French Ministry of Foreign Affairs (Nu681/DGM/ATT/RECH, Nu986/DGM/DPR/PRG), the French National Research Agency (ANR-12-CULT-0006) and INTM Indigo Group France.

**References:**[1] Leakey L.S.B. (1934): Adam's ancestors. London: Methuen & Co.[2] Antón, S., Potts, R., Aiello, L.C., 2014. Evolution of early Homo: An integrated biological perspective. Science 345, 1236828.

Poster Presentation Number 41, We (17:00-19:00)

## The distribution of early Palaeolithic sites in Britain

**Claire Harris**[1], **Nick Ashton**[1], **Simon Lewis**[2]

1 - British Museum · 2 - Queen Mary University of London

The British Lower and Middle Palaeolithic archaeological record is unique, both in terms of the nature of the (re-)occupations that it represents and in the quality of the documentation that supports the vast collections of archaeological finds. The Leverhulme-funded 'Mapping Palaeolithic Britain' project is undertaking analysis of this record at a scale not previously attempted. It draws together information for artefacts from almost 4000 sites and finds locations to explore the route-ways, dispersals and landscape use of different colonising populations over the last 800,000 years. At the core of the project is the British Museum's own collections but data has also been gathered from regional museums and integrated with digital data from Historic Environment Records [1], the Portable Antiquities Scheme [2] and other projects (eg The English Rivers Palaeolithic Survey [3]).

A fundamental problem for any research based around museum collections is in understanding the inevitable biases inherent in the way they were collected and curated. Identifying the collection biases introduced by the differential survival of and access to Pleistocene deposits and variation in the recovery practices of different collectors has provided a solid foundation for answering three primary research questions: i) What were the route-ways into and across Britain, ii) How sustained was occupation at different times and iii) How did landscape use change through time? To answer these questions the project uses the chronological framework developed by the Ancient Human Occupation Britain (AHOB) project and, for the first time on such a wide scale, explores the spatial dimension of changing distributions of artefact types (Lower Palaeolithic handaxes, early Middle Palaeolithic Levallois, and late Middle Palaeolithic 'bout coupés'). The distinctive nature of the Lower and Middle Palaeolithic industries allows them to be used as chronological proxies that enable sites to be mapped on to the changing Palaeolithic landscape. Previous regional studies have been criticised for using handaxes and Levallois pieces as equivalent artefact type and it has been suggested that positive feedback would encourage disproportionate collecting at known handaxe sites [4,5]. Mapping sites, rather than focusing on artefact numbers, helps to avoid the potential problems of 'super-sites' dominating the record.

Early stage analysis has shown clear differences in the number and the distribution of handaxe and Levallois sites. There are two immediately obvious aspects; the much higher number of sites containing handaxes compared to those containing Levallois material and the preponderance of Levallois sites in areas of Kent and London compared to the broader spread of handaxe sites. Having confirmed that this distribution reflects regional land-use patterns and distribution of past human populations rather than differences in regional collection histories or in the distribution of Pleistocene sediments and their exploitation we suggest that the observed pattern, at least in part, relates to the changing palaeogeography of Britain from MIS 13 through to MIS 7 with changing access routes from mainland Europe. After the Anglian glaciation the Strait of Dover and Channel became significant barriers and it seems probable that the easiest routes into Britain would have been across the southern North Sea Basin or via the Rhine and Scheldt into the Thames valley. Mapping handaxe sites dated to MIS 11 and 9 shows, however, that populations were also clearly established in the Solent River system. This would have entailed either a more difficult Channel or Channel River crossing, or a westwards migration, perhaps via the coast from the Thames, or a route from the Thames via the Kennet valley into the Solent. Differences in the number of handaxe and Levallois sites hints at a more sustained occupation during MIS 13 to MIS 9, with a shorter occupation in late MIS 8 and early MIS 7.

**References:**[1] http://www.heritage.norfolk.gov.uk/ Accessed 29/04/16.[2] https://finds.org.uk/ Accessed 29/04/16.[3] http://archaeologydataservice.ac.uk/archives/view/terps_eh_2009/ Accessed 29/04/16.[4] White, M.J., Scott, B. & Ashton, N.M., 2006. The Early Middle Palaeolithic in Britain: archaeology, settlement history and human behaviour. Journal of Quaternary Science 21(5), 525-541.[5] McNabb, J. 2007. The British Lower Palaeolithic: Stones in Contention. Routledge: London.

Podium Presentation: Session 9, Sa (11:30)

## The Romanian early Upper Paleolithic mandibles: Implications for the skeletal manifestation of Neanderthal admixture

**Katerina Harvati**[1], **Mirjana Roksandic**[2]

1 - Paleoanthropology, Senckenberg Centre for Human Evolution and Paleoenvironments, Eberhard Karls Universität Tübingen · 2 - Department of Anthropology, University of Winnipeg

The hominin fossil record of Romania comprises some of the earliest and best preserved early modern human remains in Europe. These Upper Paleolithic samples have all been proposed to show a mixture of archaic and modern features and to possibly represent Neanderthal-modern human hybrids. A recent genomic analysis of Oase 1 confirmed that this individual had a recent Neanderthal ancestry [1]. In light of these findings, we conducted 3-D geometric morphometric and non-metric comparative analyses of the Oase 1 and Muierii 1 mandibles, in order to explore their documented (Oase 1) or potential (Muieri 1) hybrid status and its manifestations in their morphology. The specimens were digitized by KH at the Institute of Speleology, Cluj, and the Academy of Sciences, Bucharest, respectively. The comparative sample comprised 25 fossil and 155 recent human mandibles from around the world, digitized by Elisabeth Nicholson Lopez and KH [2]. 28 landmarks were registered as three-dimensional coordinates using a Microscribe 3DX digitizer, chosen to represent overall mandibular shape [2]. The data were processed with Generalized Procrustes Analysis and analyzed using multivariate statistical approaches. Additionally, an array of discrete traits (Oase 1: 29; Muierii 1: 22) were scored by MR following Mounier et al. [3], whose data served as the basis for the comparative sample. Scoring was conducted on 3D reconstructions obtained from Computed Tomography (CT) scans using VG Studio software. A similarity matrix was used to construct a Principal Coordinate Analysis (PCoA).

In the comparative 3-D analysis Oase 1 clustered with Upper Paleolithic modern humans and was clearly classified as such. Its only remarkable feature was its very large centroid size. On the other hand, Muierii 1 was intermediate in shape between Neanderthals and modern humans and was classified as Neanderthal with low probability. In the non-metric trait analysis Oase 1 also plotted near modern humans in the PCoA 1 which clearly separates modern from Neanderthal samples, falling just outside the convex hull of recent and early (combined Upper Paleolithic and early anatomically modern samples) modern humans. The results for Muierii 1 were less clear, with more overlap between groups. Muierii 1 fell well within the modern human convex hull, near the region of overlap with the Neanderthal and Middle Pleistocene samples. Our analyses did not reveal the recent Neanderthal ancestry for Oase 1 revealed by paleogenomic work. The latter is only suggested by its large size and by non-metric details of its anatomy. This result may be due to the limited phylogenetic signal preserved in the mandible, but also highlights the difficulties of evaluating admixture from skeletal remains, especially in cases where interbreeding occurred several generations previously. The more fragmentary Muierii 1 presents an intermediate overall shape in the morphometric, but not in the non-metric analysis. These results might be consistent with hybrid status, but could also reflect primitive retentions. Potential recent Neanderthal ancestry for Muierii 1 should be further evaluated.

We thank O. Moldovan and A. Soficaru for facilitating access to the specimens. CT scans for the Oase 1 and Muierii 1 mandibles were kindly provided by Prof. E. Trinkaus. E. Nicholson Lopez collected the data for part of the comparative sample of the geometric morphometric analysis. This research was supported by the Max Planck Gesellschaft, the Natural Sciences and Engineering Research Council of Canada (371077-2010), and the European Research Council (ERC STG 283503 'PaGE').

**References:**[1] Fu, Q., Hajdinjak, M., Moldovan, O. T., Constantin, S., Mallick, S., Skoglund, P., et al. 2015. An early modern human from Romania with a recent Neanderthal ancestor. Nature 524, 216-219.[2] Nicholson, E., & Harvati, K. 2006. Quantitative Analysis of Human Mandibular Shape Using 3-D Geometric Morphometrics. American Journal of Physical Anthropology 131, 368-383. [3] Mounier, A., Marchal, F., & Condemi, S. 2009. Is Homo heidelbergensis a distinct species? New insight on the Mauer mandible. Journal of Human Evolution 56, 219-246.

Podium Presentation: Session 5, Fr (11:10)

## Paleodiet of an infant *Homo erectus* in Early Pleistocene of Sangiran

**Susanne Haupt**[1,2], **Tina Lüdecke**[3], **Christine Hertler**[1,2], **Angela Bruch**[1,2], **Andreas Mulch**[3], **Friedemann Schrenk** [4]

1 - Research Centre 'The role of culture in early expansions of humans' (ROCEEH), Senckenberg Research Institute, Frankfurt, Germany · 2 - ROCEEH Research Centre, Heidelberg Academy of Sciences and Humanities, Heidelberg, Germany · 3 - Senckenberg Biodiversity and Climate Research Centre, Frankfurt, Germany · 4 - Department of Palaeoanthropology and Messel Research, Senckenberg Research Institute, Frankfurt, Germany

The Sangiran dome (Java, Indonesia) is one of the richest hominid localities outside of Africa. There are three successive hominid fossil bearing layers at Sangiran, which cover a large time span from Early to Middle Pleistocene. These are the upper part of the Sangiran formation, Grenzbank and the Bapang formation. This study focuses on the diet of *Homo erectus* (S7-37) from the Sangiran formation. S7-37 is a right maxillary fragment with an incomplete P4 and complete M1 [1]. We took four serial samples from the first molar and analyzed the stable carbon and oxygen isotope signal. In this way we detect dietary changes from the beginning to the end of the molar crown formation. The *Homo erectus* M1 took c. 2.5 years to crown completion, which starts shortly before the birth of this individual [2]. So we can identify the dietary progress of an infant *Homo erectus* individual from breastfeeding to the weaning phase. Weaning is defined as introduction to non-breastmilk food and not the complete cessation of breastfeeding. Oxygen isotope values reflect the water source of an individual. Breastmilk incorporates body water, which is enriched in the heavier isotope 18O in comparison to other water sources for the infant [3]. For this reason the oxygen isotope values should be decrease, if the infant is weaned. The changes of stable carbon isotope values reflect the introduction to solid food as dietary supplementation to breastmilk. With isotope mixing models we analyze the composition of this dietary supplementation. To do so we take pollen and faunal data from the Sangiran formation to determine which food resources occurred. Because the diet of an infant during the first months consists complete of breastmilk, we take the first δ13C value of *Homo erectus* minus the diet-apatite spacing to calculate the approximate carbon isotope value of the breastmilk from the mother. These data are the basis for an isotope mixing model with IsoSource [4], which is used to analyze possible diet compositions in different live stages of an infant *Homo erectus* from Sangiran.

**References:**[1] Grine, F. E., Franzen J.L. 1994. Fossil hominid teeth from the Sangiran dome (Java, Indonesia). Courier Forschungs-Institut Senckenberg 171, 75-103.[2] Dean, C., Leakey, M.G., Reid, D., Schrenk, F., Schwartz, G. T., Stringer, C., Walker, A., 2001. Growth processes in teeth distinguish modern humans from Homo erectus and earlier hominins. Nature 414, 628-631.[3] Wright, L. E., Schwarcz, H. P. 1998, Stable carbon and oxygen isotopes in human tooth enamel: identifying breastfeeding and weaning in prehistory. Am. J. Phys. Anthropol. 106, 1-18.[4] Phillips, D. L., Gregg J.W., 2003. Source partitioning using stable isotopes: coping with too many sources. Oecologia 136, 261-269.

Poster Presentation Number 21, We (17:00-19:00)

## Exploring the incidence frequencies of non-metric dental traits in Great Apes

**Rebecca Haywood**[1]

1 - Department of Archaeology, University of Sheffield, U.K.

The incidence of non-metric traits in humans and our earliest hominid ancestors is well reported in the literature, but the prevalence of these traits is not well documented in extant, non-human primates. This study presents an analysis of the non-metric traits of the mandibular dentition, documenting the frequency of occurrence of these traits in a sample of 314 Great Apes (112 *Gorilla* (9 *G. beringei beringei*, 44 *G. b. graueri*, 59 *G. gorilla gorilla*), 72 *Pongo* (28 *P. pygmaeus*, 40 *P. p. pygmaeus*, 4 *P. p. wurmbii*, 12 *P. abelii*) and 130 *Pan* (43 *P. troglodytes schweinfurthii*, 50 *P. t. troglodytes*, and 37 *P. t. verus*)). The traits observed in this study are: C6, C7, ectostylid and supernumerary teeth (4th molar). For the purposes of this report, traits are identified as present/ absent. The total frequency for each non-metric trait was recorded by species and tooth, and Chi-square tests were then applied to assess differences in frequency of occurrence between genera and subspecies. Each trait, with the exception of the supernumerary 4th molar, is found on $M_1$-$M_3$ with varying frequency. The results are as follows:

- The frequency of occurrence of the C6 was observed to increase in *Pan* and *Pongo* in the order: $M_1$ (12.1%; 2.4%), $M_2$ (22%; 10.8%), $M_3$ (30.1%; 13.8%), but in *Gorilla* the C6 frequency increases in the order: $M_1$ (4.5%), $M_3$ (33.4%), $M_2$ (35.7%). Significant differences ($p = <0.05$) were obtained for the $M_2$ (0.048) and $M_3$ (0.034) in *Gorilla*, and $M_3$ in *Pan* (0.000).
- The frequency of occurrence of the C7 was observed to increase in *Gorilla* and *Pan* from $M_1$ (22.3%; 0%), $M_2$ (48.3%; 4.4%), $M_3$ (66.5%; 7.5%), and increases in *Pongo* from $M_1$ (12%), $M_3$ (16.7%), $M_2$ (12.6%). Significant differences were not obtained for this trait in any of the sample.

Reports of the presence of the ectostylid in non-human primates are rare. In this sample it was observed in all three ape genera, and was most often expressed in *Gorilla*. The presence of the ectostylid decreases in frequency in *Gorilla* from $M_1$ (16.2%), $M_2$ (5.4%), $M_3$ (2.7%), remains constant in *Pan* $M_1$-$M_3$ (0.7% throughout) and was recorded only on $M_3$ (2.5%) in *Pongo*. Significant differences were only obtained for $M_1$ (0.010) and $M_2$ (0.008) in *Gorilla*. In all cases, *Gorilla* displays the highest frequencies of the three traits, as previous researchers have reported [1], but the order of incidence of traits by tooth differs in this sample. Previous reports recognised the presence of a supernumerary 4th molar only in *Pongo* [1], but 4th molars were observed in each of the three ape genera in this sample.

- In the sample analysed, a 4th molar occurs in 2.1% of the *Pan* sample (4.7% in *P. t. schweinfurthii*, 1.7% in *P. t. troglodytes*, 0% in *P. t. verus*), in 3.6% of the *Gorilla* sample (11.1% in *G. b. beringei*, 6.8% in *G. b. graueri*, 0% in *G. g. gorilla*) and in 9.6 % of the *Pongo* sample (12.5% in *P. p. pygmaeus*, 25% in *P. p. wurmbii*, 0% in *P. abelii*). No significant differences in frequency of occurrence were obtained for this trait.

The frequencis obtained for this trait were higher in the *P. pygmaeus* subspecies and *G. b. beringei*, with the latter comparable to the percentages obtained in *P. p. pygmaeus*. The total absence of this trait observed in the western chimpanzees and gorillas, and the Sumatran Orangutans suggests that this is a species/ region specific trait that may reflect gene drift and other population-level processes. This work demonstrates the range of variation present in Great Ape dental morphology, even within the same genus. These results will help to enhance the ability to classify unknown fossil hominid dental specimens.

This research was funded by the University of Sheffield Faculty Scholarship. Many thanks to my supervisors Dr Kevin Kuykendall and Dr Pia Nystrom for their continued support and guidance with this research. Thank you also to the following museums and their staff for allowing me access to their collections: Adolph Schultz Anthropological Institute and Museum, Bavarian State Collection of Zoology, Berlin Museum of Natural History, Max Planck Institute for Evolutionary Anthropology, Powell Cotton Museum and the Royal Museum for Central Africa

**References:** [1] Swindler, D. R. (2002). Primate Dentition: An Introduction to the Teeth of Non-human Primates. Cambridge University Press, Cambridge

Poster Presentation Number 96, Th (18:00-20:00)

## The costs of fire

**Amanda Henry**[1], **Thomas Büdel**[1], **Pierre-Louis Bazin**[2]

1 - Plant Foods in Hominin Dietary Ecology Research Group, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 2 - Department of Neurophysics and Department of Neurology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

The development of fire technology, or the regular use, maintenance and manufacture of fire, is considered one of the defining moments in human evolutionary history. A predominant argument for the development of and reliance on fire technology has been that cooked food provides significant energetic benefits over raw food, releasing early hominins from an energetic constraint that allowed the development of larger brains, the colonization of inimical environments, and the development of human sociality [1]. However, little attention has been paid to the idea that fire, like any other technological development, comes with inherent costs. Following predictions from behavioral ecological models, the creation and use of certain tools can be related to their relative costs and benefits in certain environments (e.g., [2]). It is possible that at certain times and in certain environments, the energetic benefits of cooked foods were not offset by the energetic costs of creating and maintaining fire.

We tested this idea by measuring the energetic costs of collecting fuel in the Massif Central area of France. This region contains various wooded and open habitats, some above the treeline, many of which are likely analogues to those inhabited by Neanderthals during MIS 4 and 3. These time periods are of particular interest, because Sandgathe and colleagues [3] have proposed that Neanderthals at some sites in western France used fire during the warmer periods such as MIS 5a, but did not appear to use fire during colder ones, including later MIS 4 and 3. We proposed that fuel collection would be energetically costly compared to other activities, and would also be increasingly costly as tree cover diminished. Wearing a heart-rate monitor and GPS tracker, three volunteers collected wood for a half hour in three different areas each. One area was a relatively open heather meadow with occasional hazelnut (*Corylus* sp.), Scots pine (*Pinus sylvestris*), and silver fir (*Abies alba*). A second area included both very open pasture above the treeline, with rare Scots pine, and a thick stand of rowan (*Sorbus* sp.) along the slope of the hill. The third was a closed, beech (*Fagus sylvatica*) dominated forest. We compared the energetic costs of hiking around the landscape, collecting wood, carrying wood to a central point, and resting states. Results indicate that wood collection is by far the most energetically intensive activity, based on both average heart-rate per individual and calculated cost in kiloJoules, followed closely by carrying loads of wood. On average, 30 minutes of wood collection on a relatively flat landscape required more energy even than hiking from about 900 to 1100 meters up a steep hill, and returning back down over the course of one hour. Surprisingly, there was no consistent pattern of variation among the energetic costs of fuel collection in the three habitats. Peak energetic costs were higher in the area above the treeline, but surprisingly the averages of the three collection areas were all similar. However, the amount of fuel collected in the thirty minutes varied significantly, with all volunteers collecting more than twice the weight of fuel in the beech forest than in the meadow and at the treeline. Much of this fuel had to be abandoned at the local collection area and could not be carried back to camp. Compared to the amount of energy in the fuel collected, the energy spent during these thirty minute fuel collecting sessions was quite high. We therefore predict that fuel collection was potentially a major constraint on fire-related behaviors by early hominins.

This work was funded in part by the Max Planck Society.

**References:**[1] Wrangham, R.W., 2009. Catching Fire: How Cooking Made Us Human. Basic Books. [2] Bettinger, R.L., Winterhalder, B., McElreath, R., 2006. A simple model of technological intensification. Journal of Archaeological Science. 33, 538–545.[3] Sandgathe, D.M., Dibble, H.L., Goldberg, P., McPherron, S.P., Turq, A., Niven, L., Hodgkins, J., 2011. On the role of fire in Neandertal adaptations in western Europe: evidence from Pech de l'Azé IV and Roc de Marsal, France. PaleoAnthropology. 2011, 216–242.

Poster Presentation Number 64, Th (18:00-20:00)

## On the Role of Precuneal Expansion in the Evolution of Cognition

**James Hicks**[1] , **Frederick Coolidge**[1]

1 - University of Colorado Colorado Springs

Recently, Bruner and Iriki [1] have elucidated upon the morphological brain differences between Neandertals and modern *Homo sapiens*. They noted that both shared a lateral bulging of the parietal areas but the latter also had a distinct longitudinal bulging of the parietal lobes, particularly in the superior dorsolateral (intraparietal sulcus) and medial (precuneus) regions. As the intraparietal sulcus and precuneus have been well-documented to be critical to a variety of visuospatial and cognitive functions, it is the purpose of the present paper to elaborate upon some of the more critical social and technical functions that precuneal expansion may have afforded in the evolution of modern *Homo sapiens* cognition. First, and perhaps the most important of these precuneal functions may be the increasing evidence for their role in the simulation of alternative future realities and events, be they the means and ways of fashioning tools or simulating possible interactions with others [2]. Drawing upon previous work on the role of the precuneus in episodic memory, Addis, Wong, and Schacter[3] hypothesized that the mere reminiscence of past memories, i.e., episodic memory, would not be evolutionarily advantageous if it did not confer the ability to imagine and alter future outcomes. Indeed, because of the ability of this cognitive system to modify current behavior to achieve future goals and needs, Schacter and his colleagues labeled the episodic memory system *constructive episodic simulation* (CES). As indirect evidence for CES, they noted imperfections of the human memory system, e.g., forgetfulness and distortions, which they reasoned occurred because of the important flexibility of this particular memory system in constructing and simulating various future scenarios. A second critical function of precuneal expansion, related to the first, may have been the ability to construct and imagine the thoughts, attitudes, and feelings of other people vis-à-vis one's own thoughts, attitudes, and feelings in order to be successful in social interactions, e.g., diplomatic, manipulative, etc. This latter ability has been labeled *Theory of Mind* (ToM) and in modern humans, it has been empirically demonstrated to rely on the precuneus, the temporo-parietal junction, and medial prefrontal cortex [2]. A third sequela of precuneal expansion may have been the concomitant increase in technical cognition afforded by mental time travel [4]. These cognitive abilities may have been important in managed foraging, remote resource gathering (snares/weirs/kites), and other technical innovations such as compound technologies (hafted points, bows-and-arrows). A fourth advantage of precuneal expansion may have derived from its intimate neurological and functional relationship with the retrosplenial cortex[5] , the latter of which has been shown empirically critical to *de novo* navigation—useful for extended and expanded sociocultural and economic networks. In summary, the neuropsychological and behavioral sequelae of an expanded precuneus may have had multiple adaptively advantageous effects on modern human cognition.

**References:**[1] Bruner, E., & Iriki, A. (2015). Extending mind, visuospatial integration, and the evolution of the parietal lobes in the human genus. Quaternary International. http://dx.doi.org/10.1016/j.quaint.2015.05.019[2] Coolidge, F. L. (2014). The exaptation of the parietal lobes in Homo sapiens. Journal of Anthropological Sciences, 92, 295-298.[3] Addis, D. R., Wong, A. T., & Schacter, D. L. (2007). Remembering the past and imagining the future: Common and distinct neural substrates during event construction and elaboration. Neuropsychologia, 45(7), 1363-1377.[4] Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? Behavioral and Brain Sciences, 30(03), 299-313.[5] Vann, S. D., Aggleton, J. P., & Maguire, E. A. (2009). What does the retrosplenial cortex do?. Nature Reviews Neuroscience, 10(11), 792-802.

Podium Presentation: Session 9, Sa (11:10)

## Chronology of the European Aurignacian: towards spatio-temporal mapping of the early spread of modern humans

**Tom Higham[1], Katerina Douka[1], Rachel Wood[2], Thibaut Devièse[1], Marine Frouin[3], Jean-Luc Schwenninger [3], Rachel Hopkins[1], Daniel Comeskey[1]**

1 - Oxford Radiocarbon Accelerator Unit, RLAHA, University of Oxford, Oxford UK · 2 - Research School of Earth Sciences, The Australian National University, ACT 0200, Australia · 3 - Luminescence Dating Laboratory, RLAHA, University of Oxford, Oxford UK

For more than half a century Palaeolithic archaeologists have grappled with radiocarbon-based chronologies that are often contradictory and imprecise. Several key debates in the Palaeolithic have their roots in basic issues related to chronology; did the Aurignacian predate the Chatelperronian in some regions of Europe? When did Neanderthals disappear? How long did anatomically modern humans (AMH) and Neanderthals overlap, and what implications did this have for interaction, acculturation or interbreeding? Without reliable time control, these questions are unanswerable and unravelling the Palaeolithic remains a distant and virtually unachievable goal. It is only recently that the extent of the problems with applying 14C to the period has become appreciated. Major challenges arise from inadvisable and poor selection of samples for dating on the one hand, to the analytical, chemical and instrumental challenges of dating the low residual radiocarbon in these samples on the other. These issues have dogged the field and led to several seemingly irresolvable debates. Recent work in AMS dating has seen significant improvement in the situation, however. There have been significant technical improvements; better measurement precision, lower backgrounds in particle accelerators and more accurate subtraction of laboratory derived 14C background using sample-specific standards. There have been improvements in chemical pretreatment and sample decontamination that have resulted in superior purification of bone proteins, shell carbonates and charcoal samples; the main items targeted for dating. This has led to an increasing number of samples predating the 40 ka BP barrier that formerly constituted the routine maximum dating limit in laboratories such as Oxford. We also have calibration curve is now available that stretches back to the  50,000 cal BP limit of radiocarbon. Not only does this allow calibration into sidereal time but it offers the opportunity of building Bayesian age models incorporating results from other dating techniques and comparisons against climate records, such as those from Greenland. Over the last few years we have dated several hundred samples of bone, shell and charcoal from more than 50 key European Palaeolithic sites. The main focus has been on sites with a succession of contexts containing lithic industries attributed to the Mousterian, Châtelperronian, Uluzzian, Aurignacian and Gravettian. In this talk we will present a synthesis of the chronometric data for the Aurignacian and initial Upper Palaeolithic in Europe. The results will be presented in the form of posterior density estimates derived via Bayesian models and will describe the pattern of dispersal of modern humans in Europe between 45-35 ka Cal BP.

Poster Presentation Number 124, Th (18:00-20:00)

## Upper Paleolithic sites in northern Saudi Arabia and the extent of the Levantine UP contextual zone: implications for human movements across the northern Arabian Peninsula during MIS 3

**Yamandu Hilbert**[1], **Remy Crassard**[1]

1 - CNRS UMR 5133 Archeorient

The Al-Jawf region in northern Saudi Arabia has thus far experienced only sporadic archaeological investigation. Here we present some result of the prehistoric survey campaign undertaken between 2013 and 2015. A total of 136 prehistoric sites have been located, mapped and sampled. Special consideration was given to the identification of Paleolithic sites. In this respect the identification of three Upper Paleolithic sites in northern Saudi Arabia are of some importance given the elusive character of this cultural period across the Arabian Peninsula. These sites have been mapped during the survey activities conducted along the Jal Ajrubah area northwest of the city of Dumat al-Jandal. Sites DAJ-64, 65 and 66 have all been recorded along the edge of the limestone plateau. These sites have all been found directly overlooking a box canyon. DAJ-64 was submitted to a selective intensive collection of both blanks and cores. Artifacts are made of fine grained yellow and brown chert of exquisite quality. The site is situated within what seems to be an erosional feature at the edge of the plateau. Although not in primary position, a conjoin was made indicating that the surface scatter did not suffer intense redeposition. The site is found across an approximately 30 by 50 meter surface. Artifacts have been analyzed using a chaine opératoire approach, which aims at distinguishing specific elements of the technical procedures undertaken by the Paleolithic artisans when producing specific desired artifact forms.

As above-mentioned cores, tools and blanks have been collected and analyzed. Patination is very homogenous; little discoloration of the actual artifacts could be detected while edges show some degree of rounding possibly the cause of wind abrasion or chemical dissolution. Cores are strictly unidirectional parallel blade/bladelet cores showing intensive reduction. In general specimens have a well discernible hierarchy between working surface, striking platform and back. At the intersection of the striking platforms and the working surface, the discarded specimens show abrasive treatment, a technical feature that enhances the control over the detachment process. Striking platforms are prepared by the removal of core tablets and in few cases short hinged removals. Tools collected consist of endscrapers, retouched core tablets, large flakes and some laterally retouched blades.

The absence of carinated pieces and backed bladelets, coupled with the primarily unidirectional blade/bladelet oriented reduction and use core maintenance elements such as core tablets and crested blades strongly suggests an affiliation of the Al-Jawf Upper Paleolithic sites with the Levantine Upper Paleolithic industries. These typo-technological affinities and the presence of such a industry in the Al-Jawf quadrangle indicates that Upper Paleolithic groups (such as those of the Ahmarian tradition for instance), possibly pioneers venturing into the arid zones of northern Saudi Arabia, made short incursions into these territories during late MIS 3. The general low density of Upper Paleolithic sites in the areas, however, suggests that occupation was rather sporadic, if compared to the high density of Middle Paleolithic sites (1). Although some sites in Southern Arabia, specifically in Dhofar, may be considered "Upper Paleolithic" in terms of some technological and typological aspects they present (2); the majority are attributed to the Late Paleolithic period (3). The identification of Upper Paleolithic technologies in North Arabia represents a novelty and hints at connections between this area and the Levant, rather than with the Late Paleolithic of Southern Arabia.

**References:**[1] Hilbert, Y.H., Crassard, R., Charlaux, G., Loreto, R. 2015 Nubian technology in northern Arabia: impact on interregional variability of Middle Paleolithic industries. Quaternary International. http://dx.doi.org/10.1016/j.quaint.2015.11.047[2] Rose, J.I., Usik, V.I., 2009 The "Upper Paleolithic" of South Arabia. In: Petraglia, M.D., Rose, J.I., (Ed.), Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics. Springer Academic Publishers, Dodrecht, pp. 169-185.[3] Hilbert, Y.H., Parton, A., Morley, M.W., Galletti, C. S., Linnenlucke, L., Jacobs, Z., Roberts, R. G., Galletti, C.S., Clark-Balzan, L., Schwenninger, J.-L., Rose, J.I. 2015 Terminal Pleistocene and Early Holocene Archaeology and Stratigraphy of the Southern Nejd, Oman. Quaternary International 382, 250-263.

Pecha Kucha Presentation: Session 6, Fr (15:50-16:15)

## Did modern humans enter Europe via the Danube corridor? New results from high precision chronometric modelling

**Rachel Hopkins**[1], **Nikolay Sirakov**[2], **Jean-Luc Guadelli**[3], **Bibiána Hromadová**[4], **András Markó**[5], **Thomas Higham** [1]

1 - RLAHA, University of Oxford · 2 - National Institute of Archaeology and Museum, Bulgarian Academy of Sciences · 3 - PACEA/IPGQ-UMR5199 CNRS, University of Bordeaux · 4 - Institute of Archaeology of the Slovak Academy of Sciences · 5 - Hungarian National Museum

Recent research has shown the need for a reliable, high-resolution chronology to understand the complexity of the spatio-temporal distribution of Neanderthals and anatomically modern humans (AMH) during the transitional period between the Middle to Upper Palaeolithic. One region that has not yet benefited from the developments in dating sciences and the application of Bayesian modelling approaches is eastern Europe. Our research focuses on this region, especially the key area of the Danube fluvial corridor, which has been suggested as one of the conduits for early modern humans on their dispersal route into western Europe (e.g.[1]). We will present new radiocarbon data and models that will expand the picture that has started to emerge from recent studies conducted in western Europe which showed many sites to be older than previously thought.

This research forms part of a doctoral dissertation within the University of Oxford's PalaeoChron ERC project. It applies recent improvements in radiocarbon dating methodologies such as ultrafiltration [2] and single amino acid dating (modified from [3] and [4]). On the one hand, key sites with a deep stratigraphic record are targeted, e.g. Kozarnika (Bulgaria), and Temnata (Bulgaria) to initially establish site specific high resolution chronologies using Bayesian modelling. On the other hand, type fossils such as osseous points from e.g. Istállóskő (Hungary), Dzerava Skala (Slovakia), Jankovich (Hungary), and human remains (both Neanderthal and AMH) from e.g. Vindija (Croatia), Šal'a (Slovakia), Manastira (Bulgaria), are directly or indirectly dated, to establish regional spatio-temporal boundaries, i.e. dating the appearance and disappearance of an industry or species. Previously published dates from Central and Eastern European sites are re-evaluated, e.g. Stránská Skála (Czech Republic), Szeleta (Hungary), and Bacho Kiro (Bulgaria) . Where deemed reliable, they complement our results and are incorporated into larger regional models.

Together with further analysis on the attribution of transitional industries, we hope to establish a reliable, tight knit chronological framework of the area, thus improving our understanding of both the dispersal of AMH and the disappearance of Neanderthals, as well as exploring aspects of their co-existence.

This research was made possible through the support of the PalaeChron ERC project. I would also like to thank our (local) colleagues for their support and help in accessing the material for radiocarbon dating. Following the flow of the Danube: Walpurga Antl-Weiser, Maria Teschler-Nicola, Christine Neugebauer-Maresch (Austria), Alena Šefčáková, L'ubomíra Kaminská (Slovakia), Mihály Gasparik, Klára Palotás, László Makádi (Hungary), Ivan Karavanić (Croatia), Dušan Borić (Serbia), Alena Guadelli, Svoboda Sirakova (Bulgaria).

**References:**[1] Conard, N.J., Bolus, M., 2003. Radiocarbon dating the appearance of modern humans and timing of cultural innovations in Europe: new results and new challenges. Journal of Human Evolution. 44, 331–371.[2] Brock, F., Higham, T., Ditchfield, P., Bronk Ramsey, C., 2010. Current pretreatment methods for AMS radiocarbon dating at the Oxford Radiocarbon Accelerator Unit (ORAU). Radiocarbon. 52, 103–112.[3] Marom, A., McCullagh, J.S.O., Higham, T.F.G., Hedges, R.E.M., 2013. Hydroxyproline Dating: Experiments on the 14C Analysis of contaminated and low-collagen bones. Radiocarbon. 55, 698–708.[4] Nalawade-Chavan, S., Zazula, G., Brock, F., Southon, J., MacPhee, R., Druckenmiller, P., 2014. New single amino acid hydroxyproline radiocarbon dates for two problematic American Mastodon fossils from Alaska. Quaternary Geochronology. 20, 23–28.

Poster Presentation Number 102, Th (18:00-20:00)

## Phytolith Environments from Olduvai Gorge (Bed II)

**Makarius Itambu[1], Robert Patalano[1], Fernando Diez-Martín[2], Manuel Domíguez-Rodrigo[3], Charles Egeland[4], Julien Favreau[1], Patrick Lee[1], Audax Mabulla[5], Alfredo Pérez González[6], Manuel Santoja Gomez[6], Laura Tucke[1], Julio Mercader[1]**

1 - University of Calgary · 2 - University of Valladolid · 3 - Complutense University · 4 - University of North Carolina · 5 - The National Museums of Tanzania · 6 - CENIEH-Centro Nacional de Investigación sobre la Evolución Humana, Burgos, Spain

Hominin adaptations to changing environments and increasing aridity in East Africa are central to current palaeoanthropological debate, particularly in regards to the Oldowan-Acheulian transition. Reconstructions of past vegetation landscapes require a multi-disciplinary approach that includes paleoethnobotany, archaeology, and geoarchaeology to illustrate long term environmental trends observed in sedimentary sequences. Olduvai Gorge (Tanzania) contains bedded deposits of recognized value to address questions such as the habitat types that existed along paleo-lake Olduvai during the deposition of upper Bed II (1.5-1.3 Ma). Phytoliths are silica bodies that form within and between cells of different plant parts. When preserved, they can be used as a marker of plant family and ecosystem. These silica particles are morphologically distinct, consistent, and resistant to decomposition. Opal silica has been used to understand phytolith production by modern plants in various ecosystems, the correlation between subsurface assemblages and overlying analog vegetation, and Plio-Pleistocene ecosystems. In Olduvai Gorge, phytolith analysis has focused on reconstructing the diversity of landscapes that framed hominin evolution during Bed I and lowermost Bed II. However, almost no information exists about the middle to upper part of Bed II. This poster introduces ongoing doctoral phytolith work on three sites: 1) Sam Howard Korongo (SHK) (1.5-1.34 Ma), 2) Bell's Korongo (BK) (1. 3-Ma), and 3) Thiongo Korongo (TK) (1.3-1.1 Ma). The lithofacies represented in these sites include both lacustrine, fluviatile, and low energy channels and paleosols. SHK is found in a fluviatile context that was an integral part of a wider lacustrine system, while BK contains both alluvial and fluvial deposits, and TK supports low energy paleosols and several channel facies. Sampling procedures involved both a site specific and landscape approach; horizontally (spatial) and vertically (temporal) to reconstruct paleovegetation at each of the three locations. Sediments were also collected from trenches, according to stratigraphic layering and features. In the laboratory, sediment samples were sieved, dispersed, and treated with acids prior to heavy liquid separation. After phytolith extraction, counting and classification ensued. Morphometric characteristics are recorded as the basis to making ecological inferences and explain the environmental context of upper Bed II.

Podium Presentation: Session 5, Fr (11:50)

## Luminescence chronologies for Denisova and Chagyrskaya Caves, southern Siberia, Russia

**Zenobia Jacobs[1], Bo Li[1], Anatoly Derevianko[2], Michael Shunkov[2], Sergei Markin[2], Richard Roberts[1]**

1 - University of Wollongong · 2 - Russian Academy of Sciences, Siberian Branch

The Altai region of southern Siberia was home to at least two archaic hominin groups, Neanderthals and Denisovans. Fossils of both have been found at Denisova Cave, and Neanderthal remains also occur at other sites in the region, including Chagyrskaya Cave. The current chronologies for these two sites are based largely on radiocarbon ($^{14}$C) dating of animal bones and charcoal, which is limited to the last 50 ka. Most of the $^{14}$C ages for the Neanderthal-bearing units at Chagyrskaya Cave fall at or beyond this limit, as do many of the $^{14}$C ages reported for the Neanderthal- and Denisovan-bearing units at Denisova Cave. Some of the latter deposits show signs of disturbance, especially Layer 11 in the east gallery where the original discovery of a Denisovan phalanx was made. Ages extending to the early Late Pleistocene and late Middle Pleistocene have been estimated for two Denisovan molars, based on their mitochondrial DNA branch lengths, and ages of up to 280 ka have been reported for the lowest artefact-bearing unit in the central gallery (Layer 22), based on radiothermoluminescence dating of the sediments. Both of these chronologies are subject to considerable uncertainty.

In 2012 and 2014, we collected sediment samples for single-grain optical dating of the sedimentary deposits in Chagyrskaya Cave and in all three galleries of Denisova Cave. Optical dating gives an estimate of the time since mineral grains were last exposed to sunlight. A single grain is the smallest meaningful unit of measurement in optical dating, because each grain has experienced its own history of erosion, transport and deposition. Single-grain measurements can be used to assess whether samples consist of grains that were well-bleached at the time of deposition and have since remained undisturbed, or if they contain grains of mixed ages due to incomplete bleaching or post-depositional disturbance, for example.

We made single-grain optically stimulated luminescence (OSL) measurements on sand-sized grains of quartz from Denisova Cave, and infrared stimulated luminescence (IRSL) measurements on individual potassium feldspar (K-feldspar) grains from both sites. At Chagyrskaya Cave, we dated the Neanderthal-bearing units and the underlying unit. The OSL traps were saturated with respect to absorbed dose, so we measured individual K-feldspar grains using a post-infrared IRSL procedure, as the IRSL traps saturate at higher doses than does quartz. These measurements allowed us to identify a small proportion of grains thought to be derived from degraded roof spall and to reject these grains before age determination. The Neanderthal-bearing units have IRSL ages of between 47 and 59 ka. These are consistent with the mostly infinite $^{14}$C ages on bison bones and with pollen, faunal and sedimentological interpretations of a late MIS 4 or early MIS 3 environment.

At Denisova Cave, the upper units (including Layer 11 in the east gallery) could be dated using both single-grain OSL and IRSL techniques, but signal saturation prevented OSL dating of quartz grains from the deeper units. It also proved challenging for IRSL dating of K-feldspar grains, but we were able to overcome this difficulty and date the full Pleistocene sequence in the central gallery (including Layer 22) and the deposits exposed in the east and south galleries at the time of sample collection. Our ages span the entire Late Pleistocene, extending into the late Middle Pleistocene in the central and east galleries. The OSL and IRSL ages are in broad agreement with each other and with the published $^{14}$C ages, but they confirm previous concerns of disturbance of Layer 11 (and the overlying units) in the east gallery. By contrast, the underlying layers appear to be largely stratigraphically intact. We will report on our ongoing program of optical dating at Denisova Cave and the implications of these chronologies for the ages of the hominin and cultural remains.

This research was funded by the Australian Research Council through Future Fellowship grants (FT150100138) to Jacobs and (FT140100384) to Li, and an Australian Research Council Australian Laureate Fellowship (FL130100116) to Roberts. Yasaman Jafari and Terry Lachlan gave valuable support in the OSL dating laboratory.

Poster Presentation Number 97, Th (18:00-20:00)

## Using fish phylogeography to resolve hominin dispersal opportunies between the Chad Basin and Turkana Basin (Africa) in the past ~5 Ma

**Josephine Joordens[1], Laura Bertola[1], Christ Leemans[2], Aurelie Pinton[3], Agnes Dettai[4], Olga Otero [3]**

1 - Leiden University · 2 - NKI Amsterdam · 3 - Universite de Poitiers · 4 - MNHN Paris

The influence of climate change on early human evolution in Africa is a hotly debated topic. Climate-forced cycles of population expansion and contraction are a major driver for speciation and extinction processes in many species, including hominins. Biogeography therefore plays a central role in our understanding of climate change affecting hominin dispersal and evolution in Africa [1]. Rivers are crucial, since they constitute corridors for dispersal of expanding populations of water-dependent hominins. The occurrence of the hominin *Australopithecus bahrelghazali* in Chad 3.5 million years ago (Ma), 2500 km west of the East African Rift System, demonstrates that hominins were capable of ranging widely at this time [2]. Observed morphological similarity tentatively suggests taxonomic affinities between hominins from the Chad and Turkana Basins at 3.5 Ma [3], underlining the importance of considering hominin evolution from a biogeographical perspective. A possible dispersal route for hominins between Chad and eastern Africa may have been provided by hydrographic connections between the Chad Basin (Chad) and Turkana Basin (Kenya), following ancient Cretaceous rift topography. Aquatic faunal evidence indicates that Chad and Turkana basins were hydrographically connected in the past. However, it is likely that after 7 Ma these connections were not permanent but temporary, constrained by occurrence of wet episodes that allowed temporary river corridors to establish [4]. The timing of these humid episodes and hence of the possible temporary hydrographic connections is not well known.

Since the evolutionary history of fish species depends on (dis)connections between drainage systems, the genetic distance between species, and between different populations of the same species, is an ideal proxy for hydrographic history and landscape development [5]. In our study we therefore use extant freshwater fish phylogeography to resolve existence and timing of connecting river corridors that may have created intermittent opportunities for hominin dispersal between Chad and Turkana Basins during the past 5 Ma. We performed full mitochondrial genomic analyses, plus analyses of several nuclear genes, on different populations of the Squeaker catfish *Synodontis schall*, a species that occurs in both Chad and Turkana Basins. In addition to specimens from Chad and Turkana Basins we included specimens from other drainages in northern Africa, such as the Sénégal, Ouémé, Niger and Nile river basins. We use this dataset of sequences, in combination with calibration points provided by well-dated fossil specimens of the genus Synodontis, to obtain (with BEAST software) a phylogenetic tree that sheds light on past hydrographic connections and disconnections, and hence possible migration pathways for African fauna including hominins.

We thank the Service de Systématique Moléculaire (SSM) of the Département Systématique et Evolution, Museum National d'Histoire Naturelle in Paris for providing a platform to conduct our analyses.

**References**:[1] Joordens, J.C.A., Feibel, C.S., Spoor, F., Vonhof, H.B., Schulp, A.S., Kroon, D., 2012. A biogeographical model for hominin evolution in Africa between 5 and 2.5 Ma. Proceedings European Society for the Study of Human Evolution 1: 110.[2] Brunet, M., Beauvilain, A., Coppens, Y., Heintz, E., Moutaye, A.H.E., Pilbeam, D., 1995. The first australopithecine 2,500 kilometres west of the Rift Valley (Chad). Nature 378: 273-275.[3] Spoor, F., Leakey, M.G., Leakey, L.N., 2010. Hominin biodiversity in the Middle Pliocene of eastern Africa: the maxilla of KNM-WT 4000. Philosophical Transactions of the Royal Society B 365: 3377-3388.[4] Otero, O., Pinton, A., Mackaye, H.T., Likius, A., Vignaud, P., Brunet, M., 2009. Fishes and palaeogeography of the African drainage basins: relationships between Chad and neighbouring basins throughout the Mio-Pliocene. Palaeogeography, Palaeoclimatology, Palaeoecology 274:134–139.[5] Pinton, A., Agnese, J.-F., Paugy, D., Otero, O., 2013. A large-scale phylogeny of Synodontis (Mochokidae, Siluriformes) reveals the influence of geological events on continental diversity during the Cenozoic. Molecular Phylogenetics and Evolution 66: 1027–1040.

Pecha Kucha Presentation: Session 6, Fr (15:50-16:10)

## Transport patterns of Armenian obsidian based on pXRF analysis of Upper Paleolithic artifacts from Aghitu-3 Cave

**Andrew W. Kandel**[1], **Boris Gasparyan**[2], **Ellery Frahm**[3]

1 - Heidelberg Academy of Sciences and Humanities, ROCEEH · 2 - Institute of Archaeology and Ethnography, Armenian National Academy of Sciences · 3 - Department of Anthropology, University of Minnesota

The Upper Paleolithic site of Aghitu-3 Cave in southern Armenia offers an excellent opportunity to study changes in the transport patterns of tool stone over time. The five-meter sequence preserved at this basalt cave shows evidence of human activities between 40,000 and 24,000 cal BP. During this period, obsidian remained the preferred raw material that people used to make laminar artifacts manufactured mainly from small (2-3 cm), unidirectional bladelet cores. Obsidian use predominates, comprising 84% of the assemblage on average, while the next most common material is chert at 15%, followed by occasional volcanic rocks at <1%. In addition, well preserved assemblages of macrofauna allow us to study changing subsistence strategies, while paleoecological indicators such as micromammals, charcoal, and pollen allow for detailed climatic reconstructions.

Using portable X-ray fluorescence (pXRF), we measured 1140 artifacts manufactured from various types of obsidian found in the archaeological deposits of Aghitu-3. We then compared the elemental spectra of each artifact to our database of known volcanic sources in order to identify each source location precisely. By examining the attribution of the sourced artifacts to their archaeological horizons, we determined that each phase of settlement shows a different pattern of raw material acquisition. Spatial plots of the data also indicate special areas where the knapping of obsidian from different sources took place.

In the oldest archaeological horizons (AH VII-VI) dating from 40,000-31,000 cal BP, we see only obsidian from regional volcanoes of the Syunik Highlands, about 30-40 km north of the site. During this earlier period, settlement is sparse, based on the overall low number of artifacts. In the youngest horizons (AH IIId-a) dating from 29,000-24,000 cal BP, we see an explosion of large-scale movement across the landscape. People began to exploit distant obsidian sources from central and northwestern Armenia, 200-250 km away, as well as from eastern Turkey, almost 300 km to the southwest. This later period is also when the most intensive occupation of the cave occurred.

This significant change in both raw material behavior and settlement intensity coincides with increased evidence for a colder climate based on the ongoing analysis of micromammals, pollen, and isotopes, among the other climate proxies. We interpret this shift in transport patterns as an indication of greater long-distance transport and/or exchange. We understand the increased use of the cave to indicate longer or more frequent stays, or perhaps an increase in the local population. We hypothesize that, as the climate cooled towards the Last Glacial Maximum, human populations increasingly exploited the landscape of the Lesser Caucasus. As a result, more groups came into contact with one another, and the exchange of obsidian from distant sources proliferated. Other cultural changes coincide with these changes in behavior as well. The first bone tools from Aghitu-3 are found in AH IIId, which dates from 29,000-28,000 cal BP. These include an eyed bone needle that suggests the ability to make complex clothing. The presence of several shell beads of *Theodoxus pallasi* suggests they may have adorned their clothing. Moreover, the shell beads expand the area of exchange to include the Caspian region, about 100 km to the east.

Pecha Kucha Presentation: Session 2, Th (13:00-13:25)

## Three-dimensional Morphometric Analysis of Human Hand Entheses

**Fotios Alexandros Karakostis** [1], **Carlos Lorenzo**[2]

1 - Paleoanthropology, Eberhard Karls Universität Tübingen · 2 - IPHES

Until present, the methods of assessing entheseal development present generally low repeatability [1] mainly due to high subjectivity either in delimiting the entheseal surfaces on the bone or ranking their stage of development. Moreover, the entheses of the modern human hand, which performs a vital role in physical activities, have not been thoroughly investigated. In this framework, the present study aims at putting forth a new and precise methodology for quantifying the 3D surface size of specific hand entheses. Furthermore, it will explore the effect of muscle recruitment on hand entheses through a series of hypotheses that rely on the relationship among entheseal surface size, bone length, articular surface size, sex, as well as age group. Fifty individuals (25 males and 25 females) from late-medieval San Pablo were studied. The sample consisted of high-definition 3D models of 17 entheses from the first, second, and fifth hand rays. In particular, the bone types analyzed were the first metacarpal, the second metacarpal, the fifth metacarpal, the first proximal phalanx, the second proximal phalanx, the fifth proximal phalanx, and the first distal phalanx. A new methodology was introduced for quantifying entheseal 3D areas. Precision was verified using intraobserver and interobserver tests. Both raw and relative entheseal size (ratio of entheseal size to total bone surface size) were quantified digitally on the 3D models. Bivariate analyses were used to assess the effect of age-group on entheses as well as the correlations across entheses of muscles that act synergistically. Furthermore, these analyses investigated the association between each entheseal surface and the corresponding element's bone length, and articular surface size. The morphometric patterns among hand entheses were investigated using a multivariate analysis. Based on the results, the methodology introduced in this study presented no significant repeatability error. The 3D surface size of entheses seems to be not significantly affected by age-group variation. In raw size, the entheses of muscles acting synergistically were strongly intercorrelated. At the same time, however, they presented strong association with bone length and articular surface size. These dimensions are not considered to be importantly affected by lifelong biomechanical stress [2]. By contrast,in relative size, hand entheses did not present any correlation with these two bone dimensions. On this basis, if muscle recruitment influences entheseal dimensions, this may have a higher impact on the relative surface size of entheses. The results of the multivariate analyses suggested that the two morphometric patterns among entheses observed appear to reflect the performance of human prehensile grips. These patterns seem to be not associated with overall entheseal size. There was extensive sexual dimorphism in the overall size of entheses but both observed morphometric patterns were present in both sexes [3].

**References:**[1] Noldner, L.K., Edgar, H.J.H., 2013. Technical note: 3D Representation and analysis of enthesis morphology. Am. J. Phys. Anthropol. 152, 417-424.[2] Rauch, F., 2005. Bone growth in length and width. The yin and yang of bone stability. J Musculoskelet. Neuronal. Interact. 5, 194-201.[3] Karakostis, F.A., Lorenzo, C., 2016. Morphometric patterns among the 3D surface areas of human hand entheses. Am. J. Phys. Anthropol., DOI: 10.1002/ajpa.22999.

Poster Presentation Number 35, We (17:00-19:00)

## Re-assessing the quality of published radiocarbon dates of the late Middle and Upper Palaeolithic in Europe

**Monika Knul[1], Phillipa Gillingham[1], Amanda Korstjens[1], William Davies[2], John Stewart[1]**

1 - Bournemouth University · 2 - University of Southampton

Palaeolithic archaeology relies on absolute dating techniques to construct chronologies of human presence in Europe. Radiocarbon dating is a widely used absolute dating technique that is able to date the past 55.000 years and has been used by researchers for over 60 years. Because of the longevity of this dating method, there are differences in the accuracy and reliability of radiocarbon dates. Over the past years, the accuracy and precision of the radiocarbon dates has greatly improved following changes in sampling methods, dating techniques and analyses [1]. However, radiocarbon dates of varying reliability are being compared due to the increased popularity of comparative chronological studies that use large databases of radiocarbon dates. To separate the reliable from the unreliable radiocarbon dates, an auditing process is required that evaluates every radiocarbon date [2]. Unfortunately, there is no consistency in the auditing process and many researchers still create their own auditing criteria specific to their research focus (i.e. [3]). This results in scholars including radiocarbon dates that others have excluded, what in turn leads to incomparable chronologies, making it more difficult to study human presence in Europe.

We present validation schemes to standardise the auditing process. The validation schemes are based on the information that is available in the published record and considers technological advances (i.e. AMS, ultrafiltration) in the dating method. Each radiocarbon date is considered individually by methodological and contextual criteria, after which a verdict is given that represents the reliability of each radiocarbon date. After the initial validation, the radiocarbon dates can contribute towards research questions that are based on the contextual quality of the sample.

The validation schemes have been applied to three sites (Abri Pataud, L'Arbreda, Grotte des Romains) of which the first two have been redated, to account for both the older as well as more recent techniques. The validation schemes prove successful and easy to use. The schemes are strict and show that the more recent dates, as well as certain well published older dates (predominantly on charcoal) come out as the better radiocarbon dates. This is in agreement with the redating programmes of Abri Pataud and L'Arbreda. The validation schemes are of importance to archaeological interpretation, for they provide an objective way to include and exclude radiocarbon dates that can be replicated. By doing so they also increase the certainty on the age of the (associated) archaeology involved. We argue that by adopting this standardised way of auditing radiocarbon dates, comparison of studies in Palaeolithic Europe is improved and will lead to more realistic results.

**References:**[1] Wood, R.E., 2015. From revolution to convention: The past, present and future of radiocarbon dating. Journal of Archaeological Science. 56, 61–72.[2] Pettitt, P.B., Davies, W., Gamble, C., Richards, M.B., 2003. Palaeolithic radiocarbon chronology: quantifying our confidence beyond two half-lives. Journal of Archaeological Science. 30, 1685–1693.[3] Stuart, A.J., Lister, A.M., 2012. Extinction chronology of the woolly rhinoceros *Coelodonta antiquitatis* in the context of late Quaternary megafaunal extinctions in northern Eurasia. Quaternary Science Reviews. 51, 1–17.

Podium Presentation: Session 4, Fr (9:10)

## Biological Bases for Interpreting Hominin Dental Ontogeny and Life History

**Rodrigo Lacruz[1], Timothy Bromage[1], Christopher Dean[3], Russell Hogg[4]**

1 - College of Dentistry, New York University, U.S.A · 2 - AMIS UMR 5288 CNRS - Université Paris V. Faculté de Chirurgie Dentaire, France · 3 - University College London, U.K. · 4 - Florida Gulf Coast University, U.S.A.

Enamel microanatomy contains two important growth features known as cross striations and striae of Retzius that form in an incremental manner. These features have been widely used to interpret growth and development of fossil species. Cross striations are associated with daily growth increments. Hominins show increased daily growth rates in thicker-enameled taxa. Superimposed on this daily growth, mammalian enamel also contains longer growth periods delineated by the number of cross striations found between adjacent striae of Retzius. This value is known as the periodicity or repeat period. Some studies have suggested that the repeat period correlates with body mass which in itself is an important predictor of life history in primates. Here we address the biological mechanisms associated with the development of cross striations and the repeat period. We have used mice to investigate the potential role of the circadian clock in the development of cross striations and show that the murine dentition express key components of the circadian clock which likely underlies the cross striations. We found that matrix secretion occurs at different times of the day than the expression of other products involved in mineralization. The swine metabolome was investigated to assess changes in metabolomics signatures that may reveal longer-period activity peaks. A 5-day repeat period in pig enamel correlated with a 5-day period in a number of biological markers including cell proliferation and protein synthesis, among others. These data combined provide an important window into biological processes shaping hominin growth and development. We also anticipate that mammals, including hominins, inherently modulated longer period rhythms to produce increased body mass and hence life history diversity. Examples of this modification include the Australopithecus to Homo transition which is characterized by a decrease in osteocyte number per bone volume. We surmise that daily rhythms modulated by the circadian clock are responsible for forming cross striations which can be used to calibrate the timing of important biological parameters. Among these are the repeat period found in enamel. But as circadian rhythms are common to all mammals, other biological features occurring at periods longer than a day (or multidien) reflect the wide range of mammalian and hominin life history diversity.

Poster Presentation Number 137, Th (18:00-20:00)

## Another sequence, same evidence: human presence at the end of the Pleistocene in America. The Toca da Janela da Barra do Antonião, Piauí, Brazil

**Christelle Lahaye[1], Eric Boëda[2], Ignacio Clemente-Conte[3], Michel Fontugne[4], Maria Gluchy[5], Christophe Griggo [6], Christine Hatté[4], Amélie Da Costa[2]**

1 - Bordeaux Montaigne University (France) · 2 - Paris Ouest University (France) · 3 - Departamento de Arqueologia y Antropologia, Barcelona (Spain) · 4 - UMR8212 CNRS-CEA-UVSQ (France) · 5 - Rio grande do Sul University (Brazil) · 6 - Savoie University (France)

The site of Toca da Janela da Barra do Antonião (TJBA) is situated in the calcareous massif of Antero, in the Serra da Capivara National Park, Piauí State, Brazil. The entire rockshelter is more than 150m long, with few meters deep recesses. Part of the site was extensively studied in the 1990s [1]. Our team begun a wide archaeological program in the region in 2008 [2,3], focusing on different archaeological sequences. New archaeological excavations started in TJBA in 2013, at an extremity of the Toca, without possible stratigraphic correlation with previous excavations. After 3 archaeological campaigns, the bedrock was not reached. At the time of writing this abstract (April 2016), the site presents a 1.5 m thick chrono-cultural sequence, inside of which six sedimentary layers and four archaeological levels were identified. All the four archaeological layers delivered lithic and faunal remains. The two archaeological layers at the top of the sequence are separated by a thin sterile sediment layer, but present a cultural homogeneity, and both can be attributed to the Itaparica facies of the region. The two underlying archaeological levels are poorer in lithic artefacts; the lithics can be divided in three categories: small artefacts on quartz, big artefacts on quartz, and hammers. These two lower levels also delivered skeletal remains of a giant sloth corresponding to Eremotherium (megafauna); in particular, it seems that certain bones were used to produce artefacts. Charcoal samples from the upper part of the sequence were radiocarbon dated. In addition, six sediment samples were collected from the profile for luminescence dating. Sand-sized (180-250 μm) and fine (20-41μm) quartz grains were extracted from the samples and prepared following a standard chemical treatment. For all six samples, the quartz OSL signal is bright, reproducible and dominated by the fast component, which indicates good luminescence characteristics for obtaining accurate and precise ages. OSL measurements were performed on both multi-grain and single-grain aliquots. The ages obtained for the two upper archaeological levels (Itaparica) correspond to the beginning of the Holocene. Conversely, the other two archaeological levels are dated to the end of the Pleistocene. Thus, the Toca da Janela da Barra do Antonião constitutes the fifth Pleistocene-Holocene chrono-cultural sequence studied by our team in the region [2,3,4]. As such, it provides new evidence of an ancient human presence in South America, more than 20, 000 years ago.

**References:**[1] Guidon, N., Luz, M.F., Guerin, C., Faure, M., 1993. La Toca de Janela da Barra do Antonião et les autres sites paléolithiques karstiques de l'aire archéologique de São Raimundo Nonato (Piauí, Brésil): état des recherches. Actes XIIème Congrès international Sciences préhistoriques et protohistoriques (Bratislava, septembre 1991), Bratislava, 3, 483-491. [2] Boëda, E., Lourdeau, A., Lahaye, C., Daltrini, F. G., Viana, S., Clemente-Conte, I., Pino, M., Fontugne, M., Hoeltz, S., Guidon, N., Pessis, AM., Da Costa, A., Pagli, M., 2013. The Late-Pleistocene Industries of Piauí, Brazil: New Data, Paleoamerican Odyssey, Edited by Kelly E. Graf, Caroline V. Ketron, and Michael R. Waters, Center for the Study of the First Americans, Department of Anthropology, Texas A&M University, College Station, 445-465.[3] Boëda, E., Clemente-Conte, I., Fontugne, M., Lahaye, C., Pino, M., Felice, G.D., Guidon, N., Hoeltz, S., Lourdeau, A., Pagli, M., Pessis, A.M., Viana, S., Da Costa, A., Douville, E., 2014. A new late Pleistocene archaeological sequence in South America: the Vale da Pedra Furada (Piauí, Brazil). Antiquity 88, 927-955.[4] Lahaye, C., Hernandez, M., Boëda, E., Daltrini Felice, G., Guidon, N., Hoeltz, S., Lourdeau, A., Pagli, M., Pessis, A.-M., Rasse, M., Viana, S., 2013. Human occupation in South America by 20,000 BC: the Toca da Tira Peia site, Piauí, Brazil. Journal of Archaeological Science 40, 2840-2847.

Poster Presentation Number 4, We (17:00-19:00)

## Investigating locomotion from cranial base morphology and foramen magnum position in primates and hominins

**Federica Landi[1], Antonio Profico[1], Alessio Veneziano[2], Isabelle De Groote[2], Giorgio Manzi[1]**

1 - Sapienza University of Rome · 2 - Liverpool John Moores University

Primates exhibit high variability in their locomotion. The main pattern adopted by each species is strictly connected to the surroundings in which it moves and is part of its ecological niche. The way a primate moves influences its morphological evolution, with limb proportions and long bone morphology often used as proxies for locomotion. Nonetheless, other skeletal structures may have been involved in important locomotory adaptations during primate evolution. The skull base provides a substrate for the growth of the brain and interlaces the neurocranium and the face. Also, it is directly connected to the vertebral column, which is pivotal for locomotion. This cranial district, as well as the relative position of the foramen magnum along the cranial base, are often found in literature as crucial elements for the comprehension of locomotion in fossil hominins [1,2,3]. In this study we adopted a Geometric Morphometric approach to investigate the capability of the cranial base morphology in discriminating between different locomotory patterns in a broad sample of living primates, modern humans and fossil hominins. The dataset consists of 308 adult specimens (males and females), for a total of 74 species. The sample is made of 3D surfaces obtained by computerized tomography. The 3D landmark configuration used for the analysis consists of 17 landmarks which synthesize the morphology of the whole cranial base. Three additional landmarks were acquired (prostion, left orbital and opistocranion) in order to capture the position of the foramen magnum along the Frankfurt plane. We tested for the multivariate correlation between cranial base shape/size, foramen magnum position and locomotor categories . The observed correlations were corrected for the effect of phylogenetic relatedness. The results showed that the shape of the cranial base and the position of the foramen magnum are not suitable for distinguishing between different types of locomotion in primates, while the cranial base size exhibited a clear discriminating power, likely due to the ecological importance of body size in primates. When modern humans and fossil hominins were included in the sample, the same correlations did not appear clear, probably due to the small sample of bipedal species. Further studies including other fossil hominins will help to clarify the results. This study suggests that cranial base morphology may have evolved as a non-specialised structure in primates and is probably the result of the multiple connections it has in the skeleton. In addition, the occipital bone and the position of the foramen magnum may not be as informative as previously thought for the interpretation of locomotion in fossil hominins.

**References:**[1] Ahern, J.C.M., 2005. Foramen magnum position variation in Pan troglodytes, Plio-Pleistocene Hominids, and recent Homo sapiens: implications for recognizing the earliest Hominids, American Journal of Physical Anthropology 127, 267-276.[2] Dean, M.C., Wood, B.A., 1984. Phylogeny, neoteny and growth of the cranial base in Hominoids, Folia Primatologica 43, 157-180.[3] Luboga, G.G., Wood, B.A., 1990. Position and Orientation of the Foramen Magnum in Higher Primates, american journal of physical anthropology 81, 67-76.[4] Fleagle, J. G., 2013. Primate Adaptation and Evolution: 3rd Edn. Academic Press.

Poster Presentation Number 48, We (17:00-19:00)

## Middle Paleolithic macro-lithic artifacts from Neumark Nord 2/2 (Germany): Unraveling the Neandertal toolkit

**Geeske Langejans**[1], **Dimitris Charalampopoulos**[0], **Eduard Pop**[0]

1 - Leiden University

Here we present the results of a functional analysis of 351 macro-lithic pieces from the Last Interglacial Middle Paleolithic site Neumark-Nord 2/2 (Germany). The rocks have a similar horizontal distribution as the flint and bone finds; the archaeological finds were brought to site and deposited in fine-grained silt loams. The 'manuports' were analyzed for size attributes, rock type and macroscopic wear traces (e.g. striations and pitting).

The rock types from the site are similar to those found in nearby Saalian till outcrops and it is likely that the 'manuports' were selected from these outcrops. There is evidence for some selection prior to transport: sandstone/quartzite, is overrepresented in the archaeological assemblage, while quartz and porphyry appear underrepresented. Our use wear analysis provides evidence for Neandertal use/modification of 85 elements. However, this number is probably an underestimation as it was difficult to identify wear on the coarse grained materials and the post depositional surface modification obscured some rock surfaces.

Sixty eight elements have wear traces, mostly relating to percussive use. The macro-lithics show no extensive (surface covering) wear and the tools were probably only used for a short time. The focused and well-developed pitting and crushing on the hammerstones (N=58) indicate contact with a hard material, e.g bone and stone. The hammerstones were preferentially made on quartz and quartzite, and are heavier than the unmodified rocks. Eight pieces can be refitted into five anvils. The wear on the anvils consists of striations and pitting and is, compared to the hammerstones, more dispersed. The pitting is most probably the result of contact with a medium to hard material like bone or stone. All five anvils are (step) flaked, and three anvils have battered sides. This flaking and battering of edges may have been caused by breaking open bones. We also identified three flaked tools, but it was not possible to identify their exact function. Five flakes, some of which are refits, and 11 flaked stones with no use wear traces were also identified. Considering its square shape and flake removals along the sides, one flaked piece could be an anvil blank, prepared and shaped to be used later.

The locally selected hammerstones were expedient, yet effective tools to produce flint tools and to process carcasses. However, Middle Paleolithic macro-assemblages can be much more informative than this when more are published in detail (morphometrics, use wear, raw materials) and when diachronic and geographical comparisons can be made. For example, because of their relative abundance and limited wear, the Neumark Nord 2/2 hammerstones appear not to be curated, but at other Middle Paleolithic sites this may be different; a detailed comparative study may help explain (different) curation strategies, which in turn may help illuminate mobility strategies. Manuports/macro-lithics also provide information about technological investments. Although there are clear indications for forward planning (raw material selection, blanks), extensive modifications are rare. Interestingly, however, even limited modification/investment can make activities, such as seed grinding, more cost-effective. This raises questions as to why such modifications are absent in the Middle Paleolithic. This apparent lack of modification may result from a research bias, or if the Neumark Nord 2/2 sample is the norm, could indicate an evolutionary or behavioral/subsistence difference compared to the Upper Paleolithic and more recent periods. More and detailed analyses of macro-lithic assemblages can help clarify this.

Poster Presentation Number 51, We (17:00-19:00)

## Buena Pinta Cave: Neanderthals in a mountain environment in central Spain during MIS3

**César Laplana[1], Juan Luis Arsuaga[2], Enrique Baquedano[1], Alfredo Pérez-González[3], Mari Carmen Arriaza[4], M. Ángeles Galindo-Pellicena[2], Belén Márquez[1], Nuria García[2], Diego Álvarez-Lao[5], M. Blanca Ruiz-Zapata[4], M. José Gil-García[4], Ana Isabel Ortega[3], Paloma Sevilla[6], Hugues-Alexandres Blain[7]**

1 - Museo Arqueológico Regional, Alcalá de Henares, Spain · 2 - Centro Mixto UCM-ISCIII de Evolución y Comportamiento Humanos, Madrid, Spain · 3 - CENIEH, Burgos, Spain · 4 - Departamento de Geología, Geografía y Medio Ambiente, Universidad de Alcalá, Alcalá de Henares, Spain · 5 - Departamento de Geología, University of Oviedo, Oviedo, Spain · 6 - Departamento de Paleontología, Facultad de Ciencias Geológicas, UniversidadComplutense de Madrid, Madrid, Spain · 7 - IPHES Tarragona, Spain

Fossil evidence of Neanderthals during MIS3 in central Spain is rather scarce. Until now, the few remains from Los Casares Cave, Jarama VI site and Los Torrejones Cave constituted the bony record for this species in this region for this period. Recently, two Neanderthal teeth were recovered in Buena Pinta cave, a site discovered in 2003 situated in the Spanish Central System range (northern Madrid region). The purpose of this communication is to establish the cultural, chronological and environmental context of this finding, through the study of the geology, the stratigraphy, the lithic tools and the palynological and faunistic record of the site. The Buena Pinta Cave lies some 80 km north of Madrid in the upper reaches of the Lozoya Valley in the Sierra de Guadarrama (Spanish Central System) [1]). To the west of the valley lies the Peñalara Massif, which reaches an altitude of 2428 m. The bottom of the valley lies between the altitudes of 1000 and 1100 m. The cave itself (1105 m a.s.l.) consists of a straight gallery at least 10 m long that was full of sediments when it was discovered in 2003. In the past, this inner gallery was connected to a now dismantled entry chamber.

Excavations of the site have been conducted annually since its discovery until today. All the archaeological and palaeontological remains found were spatially referenced on an excavation grid. For the detection of microvertebrate remains, samples of sediment were taken at 10 cm depth intervals in each 1 × 1 m grid square, and the collected samples were washed through a series of fine-mesh sieves (down to 0.5 mm). Pollen was extracted from the sediment by flotation on Thoulet's solution without acetolysis. The faunal remains have been identified anatomical and taxonomically, as well as analysed taphonomically in order to determine what might have been behind the bone accumulation. Laboratory analyses and field observations have allowed to establish a detailed stratigraphy of its sedimentary filling. At the mouth of the inner gallery, five distinguishable levels have been recognized (1 to 5 from top to bottom). Level 1 represents a Holocene colluvium, whereas levels 2 to 5 are composed mainly of silt-clay sands containing disperse carbonate clasts and abundant animal bone remains [2]. Two different approaches to establish the age of these last levels have been applied: thermoluminiscence on the sandy sediments and radiocarbon on the mammal bones. The resulting ages differ according to the employed method, thermoluminiscence ages being slightly older (circa 60 ka) than radiocarbon ones (between 40-50 ka cal BP). This difference could be the result of the reworking in dark conditions of sandy sediments coming from previous filling phases of the karstic system and their mixing with younger sediments at the moment of the formation of units 2 to 5. For this reason thermoluminiscence ages would be older than the real ages of the sediments. Among the large mammals, *Crocuta crocuta* remains (bones, teeth and coprolites) are very abundant along levels 2 to 5. This fact, together with the bone fracture patterns, the large number of chewed and digested bones, and the rare occurrence of lithic evidence indicate that at the middle of the Late Pleistocene this cave acted as a spotted hyena den. Both Neanderthal teeth come from level 3. The presence in these levels of some rodent species typical of cold climates, such as *Microtus oeconomus, Microtus gregalis, Ochotona* cf. *pusilla* and *Marmota marmota* [3,4] indicates that the climatic conditions of the surrounding region during the MIS3 were colder than they are today. This agrees with conclusions drawn from the types of pollen found at the site [5], which indicate that the vegetation was predominantly herbaceous, and indicative of cold, dry conditions that would inhibit the development of a complex floristic entourage.

This work was performed as part of project S2010/BMD- 2330, funded by the I + D activities programme for research groups of the Consejería de Educación de la Comunidad de Madrid. Excavation and other work at the Pinilla del Valle sites was also funded by the Museo Arqueológico Regional (MAR) de la Comunidad de Madrid, Grupo Mahou and Canal de Isabel II. The authors thank the Pinilla del Valle excavation team, without whose help this work would not have been possible.

**References:**[1] Baquedano, E., Márquez, B., Laplana, C., Arsuaga, J. L., Pérez-González, A. 2014. The archaeological sites at Pinilla del Valle (Madrid, Spain). In: Sala Ramos, R. (Ed.), Pleistocene and Holocene hunter-gatherers in Iberia and the Gibraltar Stait: the current archaeological record. Universidad de Burgos-Fundación Atapuerca, Burgos, pp. 577-584. [2] Pérez-González, A., Karampaglidis, T., Arsuaga, J. L., Baquedano, E., Bárez, S., et.al. 2010. Aproximación geomorfológica a los yacimientos del Pleistoceno Superior del Calvero de la Higuera en el Valle Alto del Lozoya (Sistema Central Español, Madrid). Zona Arqueológica 13, 403-420.[3] Laplana, C., Sevilla, P., Arsuaga, J. L., Arriaza, M. C., Baquedano, E., et.al. 2015a. How far into Europe Did Pikas (Lagomorpha: Ochotonidae) Go during the Pleistocene? New Evidence from Central Iberia. PLos One 10 (11), e0140513. [4] Laplana, C., Sevilla, P., Blain, H.-A., Arriaza, M. C., Arsuaga, J. L., et.al. 2015b. Cold-climate rodent indicators for the Late Pleistocene of Central Iberia: New data from the Buena Pinta Cave (Pinilla del Valle, Madrid Region, Spain). C. R. Palevol, doi:10.1016/j.crpv.2015.05.010.[5] Ruiz Zapata, B., Gómez González, C., Gil García, M.J., Pérez-González, A., López-Sáez, J. A., et.al. 2008. Evolución de la vegetación durante el Pleistoceno Superior y el Holoceno en el valle alto del río Lozoya. Yacimiento arqueopaleontológico de la cueva de la Buena Pinta (Pinilla del Valle, Sistema Central Español). Geogaceta 44, 83-86.

Poster Presentation Number 107, Th (18:00-20:00)

## Testing the potential of violet-stimulated luminescence (VSL) on quartz from the Acheulean- to Middle Stone Age sedimentary sequence at Montagu Cave, Western Cape Provence, South Africa

**Tobias Lauer**[1], **Will Archer**[1]

1 - MPI EVA

Montagu Cave is an archaeological site located on the edge of the Langeberg mountain range, about 160 km NE of Cape Town, in South Africa. The archaeological and sedimentary units at Montagu Cave comprise two stratigraphically separated Acheulean sequences, with a substantial body of archaeologically sterile sediments in between them. There is an additional Middle Stone Age sequence which overlies the Acheulean horizons, and contains layers likely attributed to the Howiesons Poort, as well as potentially multiple other Middle Stone Age sub-stages. Hence, Montagu Cave provides a unique opportunity to investigate complex demographic questions concerning (a) the chronological association of late Acheulean and MSA occupations in southern Africa, as well as (b) the relative adaptive capacities and overall behavioral differences between modern and late archaic populations in southern Africa. However, thus far, the absolute chronological context of the sediment-layers at the site remains unclear. This study concerns the potential of luminescence dating for the sedimentary sequence preserved at Montagu cave. The deposits encompassing the Acheulean stone artefact assemblages comprise layered, quartz-rich sandy deposits, as well as silty- clay-rich sediments which are partly enriched with organic components. The sediments are interpreted to derive mainly from the inside of the cave system. There, metamorphic quartzite was weathered and transported to the entrance part of the cave probably during intensive Pleistocene rain-events which flooded the cave system. The upper deposits (MSA) host a clear silty component, and for these upper deposits a partly aeolian input from the sedimentary environment surrounding the cave may have been possible. The sedimentological background and the heterogeneity in sedimentary dose rate make this site challenging for luminescence dating. Due to the absence of K-feldspar within most sedimentary layers, quartz has to be used for OSL dating, however, for most samples the natural quartz luminescence signal is in saturation. It was previously demonstrated that the saturation-limit of quartz can be significantly extended by measuring the violet-stimulated luminescence (VSL) signal of quartz [1,3,4]. The VSL signal behavior of samples from Montagu is tested here and, we focus on the potential of the measurement-protocol as outlined by Hernandez & Mercier [3] Results of dose-recovery tests will be presented along with studies on the VSL-bleaching behavior, saturation-limit and equivalent dose distribution.

**References:**[1] Ankjærgaard, C., Jain, M., Wallinga, J., 2013. Towards dating Quaternary sediments using the quartz Violet Stimulated Luminescence (VSL) signal. Quat. Geochron. 18, 99-109.[2] Ankjærgaard, C, Guralnik, B., Buylaert, J.P., Reimann, T., Yi, S.W., Wallinga, J., 2016. Violet stimulated luminescence dating of quartz from Luochuan (Chinese loess plateau): Agreement with independent chronology up to 600 ka. Quat. Geochron. 34, 33-46.[3] Hernandez, M., Mercier, N., 2015. Characteristics of the post-blue VSL signal from sedimentary quartz. Radiat. Meas. 78, 1-8.[4] Jain, M., 2009. Extending the dose range: probing deep traps in quartz with 3.06 eV photons. Radiat. Meas. 44, 445-452.

Podium Presentation: Session 11, Sa (17:00)

## Dental reduction in Late Pleistocene and Early Holocene human populations: a reappraisal in a whole crown perspective

**Mona Le Luyer**[1]

1 - UMR 5199 PACEA, CNRS, MCC, Université de Bordeaux, France

Since the Late Pleistocene, a reduction in size together with a morphological simplification of human teeth have been observed and arguably linked to cultural and environmental changes [1-2]. Based upon external assessment of the crown, several models have been proposed to explain this structural reduction. Among the most evoked factors, cultural and dietary modifications [1] and demographic changes [2] have been proposed as having played an active role in this phenomenon. Despite extensive discussions during the last 50 years, interpretation of the time-related trend of crown structural reduction still lacks consensus. Recently, tooth size along the row has been demonstrated to be governed by an inhibitory cascade during development [3-4]. While teeth provide a wealth of information at the meso- and microstructural levels, Late Pleistocene and Early Holocene humans have been poorly investigated by means of advanced methods of virtual anthropology. Following new discoveries along with the revision of key archaeological contexts, a re-assessment of the nature of crown variations on more than 1900 teeth is proposed for 176 Late Paleolithic, Mesolithic and Early Neolithic individuals from the Aquitaine Basin, southwest of France, and its margins. Besides external analyses, a non-invasive assessment of internal tooth structure variability (enamel thickness, dental tissue proportions, enamel-dentine junction morphology) has been performed using 3D imaging methods (microtomography) and geometric morphometrics in order to characterize and interpret dental evolution from a whole crown perspective. Results from the morphometric analyses show discontinuities between Late Pleistocene and Early Holocene populations. External dimensions, enamel thicknesses and tissue proportions are reduced in Mesolithic individuals compared to those of the Late Paleolithic, while major differences are observed in occlusal wear patterns and enamel distribution between Mesolithic and Early Neolithic samples. Combining external and internal assessment of the crown, discontinuities found between Late Pleistocene and Early Holocene human groups suggest that environmentally-driven modifications during the Early Holocene had a major impact on dental reduction in human populations while Neolithic cultural changes had mostly affected enamel distribution. Moreover, a correlation between occlusal wear pattern and distribution of enamel thickness is observed and associated with dietary changes [5], suggesting that enamel thickness may have evolved as a selective response to functional changes in masticatory biomechanics.

Study supported by the Research National Agency through the DHP project (dir: S. Rottier; 2012-14; Université Bordeaux 1/LaScArBx; ANR-10-LABX-52) and the PEPS 3Dent'in (dir: P. Bayle; 2013-14; PEPS IdEx Bordeaux/CNRS; ANR-10-IDEX-03-02). MicroCT data used in this study were produced through the microCT facilities of the MRI platform and LabEx CeMEB. Thanks to Renaud Lebrun (ISEM, Université Montpellier 2).

**References:**[1] Brace, C.L., Mahler, P.E., 1971. Post-Pleistocene changes in the human dentition. Am. J. Phys. Anthropol. 34, 191-203.[2] Macchiarelli, R., Bondioli, L., 1986. Post-Pleistocene reductions in human dental structure: a reappraisal in terms of increasing population density. Hum. Evol. 1, 405-418.[3] Kavanagh, K.D., Evans, A.R., Jernvall, J., 2007. Predicting evolutionary patterns of mammalian teeth from development. Nature 449, 427-432.[4] Evans, A.R., Daly, E.S., Catlett, K.K., Paul, K.S., King, S.J., Skinner, M.M., Nesse, H.P., Hublin, J.-J., Townsend, G.C., Schwartz, G.T., Jernvall, J., 2016. A simple rule governs the evolution and development of hominin tooth size. Nature 530, 477-480.[5] Le Luyer, M., Rottier, S., Bayle, P., 2014. Brief communication: comparative patterns of enamel thickness topography and oblique molar wear in two Early Neolithic and medieval population samples. Am. J. Phys. Anthropol. 155, 162-172.

Podium Presentation: Session 8, Sa (9:50)

## Living at the transition. The lithic raw material economy of the Banat (SW-Romania) and its implications for land use strategies across the Carpathian Basin during the early Upper Palaeolithic" Thank you in advance

**Ine Leonard**[1]

1 - Collaborative Research Centre (SFB) 806 Our Way to Europe | Culture-Environment Interaction and Human Mobility in the Late Quaternary (Universität zu Köln)

Estimating modern human dispersal is a tricky task, especially considering the many gaps in our current knowledge of past land use and provisioning strategies. Hence, before something meaningful can be said on such a broad scale, these mechanisms should be understood on the local and regional scales along the assumed migratory routes in Africa and beyond. One such key-area in the early modern human peopling of Europe is the Banat in Southwest Romania, which is home to the famous Oase Cave early modern human remains (± 40 ka cal BP). Sadly, these fossils are deprived of a reliable archaeological context. Fortunately, three open-air localities, of which two multi-layered, comprise rich lithic artefact records that have been dated to this crucial point in time.

Since organic preservation at these sites is poor, the focus of research is on the lithic artefacts. To establish understanding of the aforementioned mechanisms contained within these archaeological assemblages, the lithic records are evaluated regarding the represented technological strategies, modification intensity, raw materials and cortex relicts. For the raw material provenance study, macroscopic evaluation was complemented by geochemical –X-ray fluorescence spectroscopy– and petrographic analysis to avoid the impediment of country-/language-specific nomenclature. The integration of these data enabled the estimation of the lithic raw material economy of the Banat during the early Upper Palaeolithic that involved a peculiar technological organization of the landscape along with the manifold usage of local and regional raw materials, which corresponded to provisioning strategies ranging from *ad hoc* to specialized in nature.

Moreover, an interesting relation between the open-air localities and the cave sites could also be inferred, in which the hilly onset of the Carpathian Mountains is preferred for either high-frequentation or long-term occupation, whereas the lower and higher areas of the region were only occasionally visited leaving behind few and fragmented traces – a tendency that has also been observed elsewhere along the fringes of the Carpathian Basin.

Prof. Dr. Jürgen Richter (CRC 806 Our way to Europe - Universität zu Köln); Dr. Thomas Hauck (CRC 806 Our way to Europe - Universität zu Köln); Dr. Wei Chu (CRC 806 Our way to Europe - Universität zu Köln); Dr. Mircea Anghelinu (Universitatea Valahia Târgoviște); Dr. Loredana Nița (Universitatea Valahia Târgoviște); Dr. Rolf Hollerbach (Universität zu Köln); Dr. Stephan Opitz (Universität zu Köln); Florian Steininger (Universität zu Köln); Dr. Otis Crandell (Universitatea Babeș-Bolyai)

Pecha Kucha Presentation: Session 6, Fr (15:00-15:25)

## Middle Stone Age and early Late Stone Age lithic assemblages at Enkapune Ya Muto (Kenya)

**Alice Leplongeon**[1,2]

1 - McDonald Institute for Archaeological Research, University of Cambridge (UK) · 2 - Département de Préhistoire, UMR 7194 CNRS, Muséum national d'Histoire naturelle, Sorbonne Universités, Paris, France

Recent research has pushed back in time the shift from the Middle Stone Age (MSA) to the Late Stone Age (LSA) in Africa, such as the site of Mumba rockshelter in Tanzania (ca. 60ka, [1,2]), the site of Border Cave in South Africa (after 56ka, [3]) or the site of Enkapune Ya Muto in Kenya (ca. 50ka, [4]). However, the process of change from the MSA to the LSA remains poorly understood. This paper focuses on the lithic assemblages from Enkapune Ya Muto in order to better understand the nature of changes in lithic technology during the Late Pleistocene at this site and how the early LSA assemblage (Nasampolai industry) distinguishes itself from the other levels.

Enkapune Ya Muto, located west of Lake Naivasha in Kenya, has yielded three levels dated to the Late Pleistocene: (1) RBL4 stratum with low densities of MSA material (Endingi industry), (2) GG and OL strata with low densities of one of the earliest known LSA (Nasampolai) industries (>50ka) and (3) DBL stratum with high densities of an early LSA (Sakutiek) industry (ca 35-40ka) . In the original description of the assemblages, Ambrose [4] notes that the later Sakutiek industry has more "transitional" characteristics (such as low frequencies of parti-bifacial knives, discoidal cores and faceted-platform flakes) than the early LSA Nasampolai industry. This would suggest a non-linear change from the MSA to the LSA in this region. This paper aims to further investigate and quantify changes in lithic technology across these three levels and provides a detailed comparative typo-technological analysis of these assemblages.

Methods used rely on the *chaîne opératoire* concept combined with an attribute analysis. In particular, for each category of artefact studied (i.e. flakes/blade(let)s, core trimming elements (CTE's), cores, retouched tools) a specific set of attributes is recorded in order to reconstruct and quantify the differences between the assemblages for each step of the *chaîne opératoire* (conception of debitage, technique of percussion, preparation of the striking platform(s) and flaking surface, modification of the blanks by retouch, etc.).

The lithic material from Enkapune Ya Muto is mostly made on obsidian. Results suggest a major change in technology between the MSA level, characterised by an assemblage oriented towards the production of faceted-platform flakes and in a lesser extent of pointed blanks, and the two LSA levels, which have yielded blade(let)-based assemblages. Despite the discrepancy in lithic numbers between the two LSA levels, the analysis shows that the early LSA assemblage (Nasampolai) is characterised by the presence of few volumetric blade cores, high number of CTE's and retouched tools including large backed segments, whereas the later LSA assemblage (Sakutiek) is characterised by numerous cores-on-flakes/blades for bladelet production, few CTE's and rare retouched tools including end-scrapers, scaled pieces and few geometrics. Large flakes with faceted platforms were also noted, although no core could be associated with this production. This study provides new data on one of the earliest known LSA industries in Africa. The early LSA at Enkapune Ya Muto is another example of the variability of early LSA industries and these results add to the evidence of many regionally-different shifts from the MSA to the LSA across Africa.

I sincerely thank Stanley H. Ambrose for kindly providing data on the site. I thank the National Museums of Kenya in Nairobi for permission to study the collections, as well as the staff at the Archaeology Section in the Earth Sciences department for their welcome and help in accessing the collections. Many thanks to Philip Nigst for helpful and constructive comments. This research project has received funding from the European Union's horizon 2020 research and innovation programme under the Marie Sklodowska Curie grant agreement No 655459 and the Agence Nationale Pour la Recherche (ANR-14-CE31-0023).

**References:**[1] Diez-Martin, F., Dominguez-Rodrigo, M., Sanchez, P., Mabulla, A.Z.P., Tarriño, A., et.al. 2009. The Middle to Later Stone Age technological transition in East Africa. New data from Mumba rockshelter Bed V (Tanzania) and their implications for the origin of modern human behavior. Journal of African Archaeology. 7, 147–173.[2] Gliganic, L.A., Jacobs, Z., Roberts, R.G., Domínguez-Rodrigo, M., Mabulla, A.Z.P., 2012. New ages for Middle and Later Stone Age deposits at Mumba rockshelter, Tanzania: Optically stimulated luminescence dating of quartz and feldspar grains. Journal of Human Evolution. 62, 533–547.[3] Villa, P., Soriano, S., Tsanova, T., Degano, I., Higham, T.F.G., et.al. 2012. Border Cave and the beginning of the Later Stone Age in South Africa. Proceedings of the National Academy of Sciences. 109, 13208–13213.[4] Ambrose, S.H., 1998. Chronology of the Later Stone Age and Food Production in East Africa. Journal of Archaeological Science. 25, 377–392.

Poster Presentation Number 67, Th (18:00-20:00)

## On the Evolutionary Implications of Expanded Olfactory Bulbs in *Homo sapiens*

**Leah Levulis**[1], **Frederick Coolidge**[1]

1 - University of Colorado, Colorado Springs

*Homo sapiens* and Neanderthals are two lineages of the genus *Homo*. These two human types have similar but not identical encephalization patterns [1] and similar but perhaps not identical cognitive abilities [2]. Estimates for their overall cranial capacities varies from claims that they are nearly identical to 13% larger for Neandertals. Neanderthals went extinct somewhere between 28,000 and 24,000 years ago, and explanations for their extinction range from mere quirks of fate to small but meaningful cognitive differences [2]. Through three-dimensional geometric morphometric analyses, Bastir et al. [3] have demonstrated that one previously unrecognized brain difference between the two human types was an increased olfactory bulb size in *Homo sapiens*, based upon their absolute and relative size of their cribriform plates. As human olfactory bulb size has been shown to be correlated to both olfactory performance, i.e., odor threshold detection and odor identification, it is possible that there may have been some evolutionary advantages to a heightened sense of smell in Homo sapiens. The purpose of the present paper is to elucidate further upon the evolutionary advantages of a heightened sense of smell. It has been demonstrated that olfactory neural circuitry is highly and intimately integrated into cerebral regions involved in higher cognitive functions, particularly the limbic system, where memory and emotionality are intertwined, and it projects to brain regions (orbitofrontal cortex, hippocampus, amygdala) involved in mating, fear, reward, motivation, and stimuli evaluation systems (e.g., good vs. bad). Thus, it can be argued that olfaction may be considered a higher cognitive function and serves a much more sophisticated role than simply smell. Animal studies of olfactory bulbectomies have been shown to be a causative factor in cellular immunity. Human olfactory impairments are associated with autoimmune diseases such as Lupus. Human studies have also shown that olfactory impairments herald many neurodegenerative diseases including Parkinson's and Alzheimer's disease. Olfactory impairments have also been demonstrated in disease known to have significant social and emotional impairments such a schizophrenia and obsessive-compulsive disorders [4]. Interestingly, congenitally anosmic people also have been shown to have significantly more social and reproductive problems than congenitally blind or deaf people. Possible hypotheses for these complicated relationships focus on olfactory ensheathing cells which may have differential regenerative capabilities and olfaction's relationship to inflammatory processes which have been shown to be one of the causes of neurodegenerative diseases [5]. Thus, even marginally larger olfactory bulbs and better discriminatory olfactory functions in Homo sapiens may have resulted in significant behavioral consequences regarding general immunity, resistance to autoimmune diseases, and social, emotional, and sexual/mating functions.

**References:**[1] Bruner, E. (2010). Morphological differences in the parietal lobes within the human genus. Current Anthropology, 51(S1), S77-S88.[2] Wynn, T., Overmann, K. A., & Coolidge, F. L. (2016). The false dichotomy: a refutation of the Neandertal indistinguishability claim. Journal of Anthropological Sciences, 94, 1-22.[3] Bastir, M., Rosas, A., Gunz, P., Peña-Melian, A., Manzi, G., Harvati, K., ... & Hublin, J. J. (2011). Evolution of the base of the brain in highly encephalized human species. Nature communications, 2:588, 1-8.[4] Kivity, S., Ortega-Hernandez, O. D., & Shoenfeld, Y. (2009). Olfaction–a window to the mind. Israel Medical Association Journal, 11(4), 238-243.[5] Savic, I. (2002). Brain imaging studies of the functional organization of human olfaction. The Neuroscientist, 8(3), 204-211.

Podium Presentation: Session 1, Th (9:20)

## Further context of the 3.3 Ma archaeological assemblage from Lomekwi 3, West Turkana, Kenya

**Jason Lewis[1], Sonia Harmand[1], Xavier Boës[2], Sandrine Prat[2], Nicholas Taylor[1], Sophie Clément[3], Vincent Arrighi[3], Craig Feibel[4], Rhonda Quinn[5], Jean-Philip Burgal[6], Hélène Roche[7]**

1 - Turkana Basin Institute and Department of Anthropology, Stony Brook University · 2 - CNRS, UPR 2147, Dynamique de l'Evolution Humaine, Paris, France. · 3 - Inrap, La Courneuve, France. · 4 - Department of Anthropology and Center for Human Evolutionary Studies, Rutgers University, New Brunswick, USA · 5 - Department of Sociology, Anthropology and Social Work, Seton Hall University, South Orange, USA · 6 - Aix-Marseille Université, CNRS, MCC, UMR 7269, LAMPEA, 13094 Aix-en-Provence Cedex 2, France · 7 - CNRS, UMR 7055, Préhistoire et Technologie, Université de Paris Ouest Nanterre La Défense, Nanterre Cedex, France

The results of exploratory archaeological survey and systematic excavations at Lomekwi in West Turkana, Kenya during 2011-2012 have firmly established the significance of this region for understanding the timing and context of the origins of early stone technology [1]. Continuing multidisciplinary paleoanthropological field and laboratory studies are helping elucidate the environmental settings and natural selective factors leading to the appearance of stone knapping and the reasons for the physical and behavioural changes seen in Late Pliocene–Early Pleistocene hominids. New results from the 2014, 2015, and 2016 excavations at LOM3 are presented here to provide further information on the artefact and faunal assemblages and their context. New squares are being opened every year under 3 meters of sterile overburden, uncovering new lithic artefacts faunal specimens in situ. As the artefact- and fossil-bearing level still continues under the hill, excavation will continue for the foreseeable future. New application of community analyses (e.g. [2]) mesowear methods [3], recently developed dental ecometric methods [4], and stable isotopic sampling and analyses to the fossil faunal material from the Kataboi, Lomekwi, and Lokalalei Members of the Nachukui Formation in West Turkana help reconstruct mammalian paleodiets and paleoenvironments from 3.97 - 2.33 Ma. Preliminary results indicate that during Kataboi and Lower Lomekwi Member times (3.97 - 3.1 Ma), the southern West Turkana area was predominantly a wooded grassland environment; during Middle Lomekwi Member time ( 3.1-2.8 Ma) the area was a poorly defined transitional open environment; and during Upper Lomekwi and Lokalalei times ( 2.8 - 2.33 Ma) the area was a wetter and more woodland environment. Such a multi-modal transition towards the clearly open environments after 2 Ma [5] may help explain the asynchronous appearance of stone tool making, the first appearance of the genus *Homo*, and the coalescence of traits that would define our genus' representatives after 2 Ma.

We thank the office of the President of Kenya, the Ministry of Education, Science and Technology, the National Council for Science and Technology (NCST/RCD/12B/012/25) and the National Museums of Kenya for permission to conduct research. Funding was provided by the French Ministry of Foreign Affairs (Nu681/DGM/ATT/RECH, Nu986/DGM/DPR/PRG), the French National Research Agency (ANR-12-CULT-0006), and INTM Indigo Group France. We thank the Turkana Basin Institute and Total Kenya Limited for logistical support and the GeoEye Foundation for satellite imagery; the Turkana communities from Nariokotome, Kokiselei and Katiko for field assistance, and the 2014-15 WTAP team: M. Boyd, J.-P. Chirey, H. Duke, B. Ekure, T. Ekuru, F. Foster, E. Glaze, W. Kamais, S. Lokorodi, L.P. Martin, B. K. Mulwa S. M. Musyoka, A. Mutisiya, J. Mwambua, S. Nariamao, M. Ngicherin, C. Ngugi, M. Pazat, F.M. Wambua, and N. Taylor. We are very grateful to T. White, M. Dominguez-Rodrigo, S. McPherron and W. Archer for useful comments.

**References:**[1] Harmand, S., Lewis, J., et al., 2015. 3.3-million-year-old stone tools from Lomekwi 3, West Turkana, Kenya. Nature 521, 310-315.[2] Alemseged, Z., 2003. An integrated approach to taphonomy and faunal change in the Shungura Formation (Ethiopia) and its implication for hominid evolution. J. Hum. Evol. 44, 451–478.[3] Fortelius, M., Solounias, N., 2000. Functional Characterization of Ungulate Molars Using the Abrasion-Attrition Wear Gradient: A New Method for Reconstructing Paleodiets. American Museum Novitates 3301, 1-36.[4] Liu, L.P., et al. 2012., Dental functional traits of mammals resolve productivity in terrestrial ecosystems past and present. Proc. Roy. Soc. B 279, 2793–2799.[5] Bobe, R., Leakey, M.G. 2009., Ecology of Plio-Pleistocene mammals in the Omo-Turkana Basin and the emergence of Homo. In: Grine, F.E., Fleagle, J.G., Leakey, M.G. (Eds.), The First Humans: Origin and Early Evolution of the Genus Homo. Springer, Berlin, pp. 173-184.

Poster Presentation Number 121, Th (18:00-20:00)

## Giant deers and large-sized bovids exploited by Quina Neanderthals in the North of Italy

**Alessandra Livraghi**[1], **Matteo Romandini**[1], **Marco Peresani**[1]

1 - Dipartimento di Studi Umanistici, Sezione di Scienze Preistoriche e Protostoriche, Università degli Studi di Ferrara

The variability of Neanderthal hunting behavior is a topic subject of research in the North-east of Italy, a well-known region where the reconstruction of the Late Middle Palaeolithic settlement system is largely supported by several palaeoenvironmental archives and archaeological deposits. During the Late Pleistocene, Neanderthals exploited different landscapes between the highlands (the Alpine fringe) and the lowlands (the border of the Plain and the subalpine area), supporting their subsistence by hunting a varied range of ungulates. A singular case is represented by the evidence produced from De Nadale Cave, which is a small cavity located at 80 m a.m.s.l., in the Southern slope of the Berici hills. Under a superficial and reworked layer (Unit 1Rim), only one layer (Unit 7) has been recognized as archaeological and contains dense osteological remains and lithic implements ascribed to the Quina method [1,2]. This anthropic layer dates back to 70.2 +1/-0.9 ky BP, on the base of the Uranium-series (U-Th) . The faunal assemblage reveals that the most frequent species are the Giant Deer and the Red Deer, followed by large-sized bovids. The Chamois and the Roe Deer have also been identified, but in a lower quantities. Carnivores are scarcely present, while the presence of birds of different size is relevant; an epiphysis of tarsometatarsus has been recognized as belonging to the Black Vulture (Aegypius cf. monachus). Furthermore, also a deciduous tooth of H. neanderthalensis was identified during the study of the osteological remains . A taphonomic analysis has been carried out and revealed an excellent preservation of the osteological remains. Nearly half of the total amount of bones bears butchering marks: scraping and cut marks, impact notches and spiral fractures have been identified on the surface of several bones shafts. Furthermore, the high number of pieces carrying retouch induced stigmata is astonishing: 204 bone shafts, counting also those coming from Unit 1Rim, showed to have been used as tools in the lithic chaînes opératoires. The faunal association reflects an open plains environment, in a generally cold-temperate climatic context. Moreover, large-sized cervids and Auroch confirm this point of view and suggest the presence of a swampy area with water sources . In general, the zooarchaeological analyses reveal how Neanderthals intensively exploited large-sized herbivores such as the Giant Deer and the bovids, as food supplies. This hunting behavior is peculiar of the site and clearly diverges from the predation model recognized in other sites on the Pre-Alpine belt and can be mostly ascribed to the age and the position of the site, in the middle of the Venetian plain. This unique feature and the presence of the Quina method make the De Nadale Cave an important site to understand the complexity of Neanderthal behavior and his settlement pattern in the North of Italy.

Acknowledgments: Research at De Nadale Cave is coordinated by the University of Ferrara in the framework of a project supported by the Ministry of Culture - Veneto Archaeological Superintendency and the Zovencedo Municipality, financed by the H. Obermaier Society, local private companies (Saf) and local promoters.

**References:**[1] Jéquier C., Delpiano D., López-García J.M., Lembo G., Livraghi A., Obradovic M., Romandini M., Peresani M., 2015, First report from the excavations at the De Nadale Cave, a single layered Mousterian site in the North of Italy, 57th Annual Meeting of the Hugo Obermaier Society for Quaternary Research and Archaeology of the Stone Age, Heidenheim, April 7th-11th, 2015.[2] Livraghi A., Romandini M., Jéquier C., Peresani M., 2014, The record of human activity impressed on the bone surfaces of a late Pleistocene zooarchaeological assemblage in the North of Italy. Results from the first investigations. In Bassi D., Posenato R. (Eds), 2014, Abstract book of the 7th International Meeting on Taphonomy and Fossilization, Taphos 2014, Ferrara, September 10th – 13th, 2014. Annali dell'Università di Ferrara, Sez. Fisica e Scienze della Terra, volume speciale.[3] Arnaud J., Benazzi S., Romandini M., Livraghi A., Panetta D., Salvadori P.A., Volpe L., Peresani M., in press, A Neandertal deciduous human molar with incipient carious infection from the Middle Palaeolithic De Nadale cave, Italy. (JHE in press).[4] Jéquier C., Peresani M., Romandini M., Delpiano D., Lembo G., Livraghi A., Lòpez-Garcia J-M., Obradovic M., 2015, The De Nadale Cave, a single layered Quina Mousterian site in the North of Italy. Quartär 62, 7-21.

Poster Presentation Number 11, We (17:00-19:00)

## Upper molar enamel thickness of Plio-Pleistocene hominins

**Annabelle Lockey**[1], **Zeresenay Alemseged**[2], **Jean-Jacques Hublin**[3], **Matthew Skinner**[1,3,4]

1 - School of Anthropology and Conservation, University of Kent, U.K. · 2 - Department of Anthropology, California Academy of Sciences, U.S.A. · 3 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 4 - Evolutionary Studies Institute, Department of Human Evolution, University of Witwatersrand, South Africa

Enamel thickness is a frequently recorded morphological characteristic in hominin descriptions and linked to dietary reconstructions. Previous studies relied on linear measurements gained from physical slicing of teeth or natural fractures which irregularly exposed enamel on different teeth, tooth positions, regions, and sides. Recent advancements in microtomography have allowed for an increasingly systematic, non-destructive method to be applied to fossil teeth. In this study we extend a recent analysis of mandibular molar enamel thickness in Plio-Pleistocene hominins to maxillary molars [1]. We employ microtomography and standard measures of enamel thickness on 2D mesial planes of section for 63 fossil hominins attributed to *Australopithecus anamensis, Australopithecus afarensis, Australopithecus africanus, Paranthropus boisei*, and *Paranthropus robustus*. A comparative sample of extant apes (n=49) is also examined comprising *Gorilla, Pan*, and *Pongo*. Average and relative enamel thickness and average enamel thickness across lingual, occlusal, and buccal regions is measured. Our results indicate similar temporal, metameric, and regional trends to those observed in mandibular molars. Specifically, there is an increase in enamel thickness from 4 million years ago through the Pliocene resulting in both absolutely and relatively thick enamel in *Paranthropus* species. Similarly, enamel thickness tends to increase from first to third molars. Due to high variability and overlap between taxa (and small sample sizes in some cases) enamel thickness did not differ significantly between any australopith taxa, confirming it as a weak taxonomic discriminator for this group. However, post-hoc comparisons reveal statistically significant differences between thickly enamelled hominins and thinly enamelled extant apes. Regarding the regional distribution of enamel across the crown, hominins tend to exhibit thick occlusal enamel, and all hominins exhibit thicker lingual than buccal enamel; a finding consistent with greater loading on the lingual cusps of upper molars that occlude with the buccal cusps of the lowers. *Pongo* displays intermediate enamel thickness and follows a similar regional distribution to Pliocene hominins. *Gorilla* and *Pan* have thin occlusal enamel, with *Pan* displaying the thinnest average enamel.

This research was supported by The Max Planck Society. For scanning assistance we thank David Plotzki, Patrick Schoenfeld and Heiko Temming. For access to specimens we thank the following institutions: National Museum of Ethiopia, National Museums of Kenya; University of Witwatersrand,Ditsong National Museum of Natural History, Berlin Museum for Natural History, Royal Museum for Central Africa, Max Planck Institute for Evolutionary Anthropology.

**References:**[1] References: Skinner, Matthew M., Zeresenay Alemseged, Charleen Gaunitz, and Jean-Jacques Hublin. "Enamel thickness trends in Plio-Pleistocene hominin mandibular molars." Journal of human evolution 85 (2015): 35-45.

Poster Presentation Number 84, Th (18:00-20:00)

## The preparation of two hominin scapulae from TD6 unit at Gran Dolina site (Sierra de Atapuerca, Spain)

**Lucía López-Polín[1,2], José María Bermúdez de Castro[3], Eudald Carbonell[1,2], Jordi Rosell[1,2]**

1 - IPHES · 2 - URV · 3 - CENIEH

Two child hominin scapulae strongly adhered to a compacted cave sediment pose challenge from the very moment of the excavation. There are extremely thin parts present in those bones that may break during separation. In fact, the first question is: should we try to separate them from the block of sediment? This poster presents the conservation treatment of two child Homo antecessor scapulae from Lower Pleistocene unit TD6 at the Gran Dolina site (Sierra de Atapuerca, Spain). The fossils were quite complete and well preserved, but the sediment in which they were found was compact and strongly adhered to them. In fact, to prevent serious damage, the fossils were recovered from the site partially included in the surrounding sediment. The 'block lifting' technique protected them during recovery and allowed to bring them safely to the conservation laboratory to be treated. In the conservation laboratory, the fossils were treated following methods and criteria used with the rest of collection but with technical solutions adapted to each specimen problems [1,2,3,4]. In fact, each fossil was prepared in a completely different way. While the specimen ATA6-116 was left in the block of sediment in which it was lifted, ATD6-118 was separated from it. The treatment of the fossils was decided based on their initial state. While the first scapula was still strongly attached to the block of sediment, the second was almost completely released during the excavation. Its separation, however, involved some breakage, and the subsequent preparation work consisted of lifting the pieces in an orderly way and to assemble them in place. But the thinness of the fossil was a major difficulty and a temporary fixing system of fiberglass cloth strips adhered with an acrylic resin was used as to assemble the pieces; then afiller was used for the voids. This poster aims to show graphically the technical solutions for each fossil. The treatments here described were an indispensable step before the paleoanthropological study, which is currently being conducted. The different preparation treatments carried out on the fossils condition the methodology of study: one of the sides of the unseparated specimen ATD6-116 is not visible and, consequently, for its study some kind of CT scanning would be needed. But, thanks to the block of sediment, the thinnest parts of this scapula have not shattered. On the other hand, the released ATD6-118 scapula is entirely visible, but the thinner parts of the fossae have lost some parts. Discussing the advantages and disadvantages of each case may help to increase case studies literature which help to tackle future preparation treatments of similar fossils.

The research was funded by 1) MINECO Project 'Comportamiento ecosocial de los homínidos de la Sierra de Atapuerca durante el Cuaternario III´ (CGL2012-38434-C03-03); 2) AGAUR project 'Evolució social, cultural i biològica al Plistocè inferior i mitjà´ (SGR899).

**References:**[1] López-Polín, L., Ollé, A., Cáceres, I., Carbonell, E., Bermúdez de Castro, J.M., 2008. Pleistocene human remains and conservation treatments: the case of a mandible from Atapuerca (Spain). Journal of Human Evolution. 54, 539–545.[2] López-Polín, L., 2012. Possible interferences of some conservation treatments with subsequent studies on fossil bones: A conservator's overview. Quaternary International. 275, 120–127.[3] López-Polín, L., 2015. Interventive conservation treatments (or preparation) of Pleistocene bones: Criteria for covering information from the archaeopalaeontological record. Quaternary International. 388, 199–205.[4] López-Polín, L., Bermúdez de Castro, J.M., Carbonell, E., (in press). The preparation and conservation treatments of the human fossils from Lower Pleistocene unit TD6 (Gran Dolina site, Atapuerca) – the 2003-2009 record. Quaternary International. 10.1016/j.quaint.2015.09.036 [5] Bermúdez de Castro, J.M., Martinón-Torres, M., Martín-Francés, L., Modesto-Mata, M., Martínez de Pinillos, M., García, C., Carbonell, E., 2015. Homo antecessor: The state of the art eighteen years later. Quaternary International.

Pecha Kucha Presentation: Session 6, Fr (15:00-15:25)

## Loiyangalani: A Middle Stone Age Site in Serengeti National Park, Tanzania

**José-Manuel Maíllo-Fernández[1], Frank Masele[2], Jessica C. Thompson[3], Pastory G. Bushozi[2], Audax Z. P. Mabulla[4], John F. R. Bower [5]**

1 - Dept. of Prehistory and Archaeology, UNED, Spain · 2 - Department of Archaeology and Heritage Studies, University of Dar es Salaam, Tanzania · 3 - Department of Anthropology, Emory University, USA · 4 - National Museum of Tanzania. · 5 - University of California Davis, USA

The Loiyangalani site is located in the valley of its eponymous river, which drains into Lake Victoria through the Serengeti National Park, Tanzania. This open site was discovered by F. Bower and it was been subjected to test excavations in 1979, 2000, 2003-2005. Recent excavations in the site has unearthened a new large well-preserved faunal and lithic assemblage from its Middle Stone Age (MSA) deposits that contributes both to the understanding of the MSA human group subsistence strategies and the technological aspects of their tool kit. Here we present new results on the faunal and lithic assemblages studies. Major long limb bones identified to skeletal parts, 13.7% preserved cut marks, 15.86% percussion marks and 6.77% carnivore tooth marks. The relative proportions of these modification datasets fall perfectly within the scenario that models homomin primary access to fully fleshed carcass as provided in experimental studies. The taphonomic results also suggest human played a major role in the accumulation of the faunal assemblage at the site and carnivores played a rather marginal part [1].

The new lithic study has identified the most commonly used raw materials in tools manufacture were mainly quartzite and quartz, whereas chert and sandstone were only used sporadically. Levallois, discoid and bipolar methods of reduction are the most common at Loiyangalani. There is also a clear pattern in the kinds of methods employed on the different raw materials. Whereas quartzite is mainly used in Levallois- and Discoid-type lithic operative schemes, whereas quartz is, almost exclusively, used in bipolar knapping. The majority of operative schemes, with the exception of bipolar knapping, have been identified by the types of flakes found, as there were hardly any cores available to study. The most abundant types of retouched tools are those known as "domestic tools" including side-scrapers, notches and denticulates, whereas end-scrapers are scarce and burins are practically absent. Pieces linked to hunting activities are hardly found, but nonetheless present great variability and comprise Levallois points, backed pieces and bifacial points.

Earlier studies classed this industry as Loiyangalanian as it was different to the Kisele industries of Mumba or Nasera based on the kinds of raw materials and number of retouched tools found in each [2,3]. To summarize, the new faunal and lithic datasets underscore the notion that the MSA human group at Loiyangalani possessed the necessary technology and ability to hunt both dangerous and large animals in relation to the evolution of modern behavior.

**References:**[1] Masele, F., nd. Animal Resources Exploitation during the MSA in Tanzania: An Archaeozoological Analysis from the Loiyangalani Open-Air Site and Magubike Rockshelter. Ph.D Dissertation, University of Alberta.[2] Bower, J. R. F., 1985. Excavations at the loiyangalani Site, Serengeti National Park, Tanzania. National Geographic Society Research Reports (1979 projects) 20, 41-56.[3] Bower, J. R. F., Mabulla, A. Z. P., 2008. Settling In: Evidence of Territorial Exclusion in the Late Middle Stone Age of Northern Tanzania. SAFA abstract book, 12 pages.

Pecha Kucha Presentation: Session 10, Sa (15:50-16:15)

## Dental morphology and morphometrics of Upper Paleolithic human remains from Dzudzuana and Satsurblia caves, western Georgia

**Cristiana Margherita[1], Gregorio Oxilia[1,2], Veronica Barbi[1], Daniele Panetta[3], Jean–Jacques Hublin [4], David Lordkipanidze[5], Tengiz Meshveliani[5], Nino Jakeli[5], Zinovi Matskevich[6], Ofer Bar-Yosef[7], Anna Belfer-Cohen[8], Ron Pinhasi[9], Stefano Benazzi[1,4]**

1 - Department of Cultural Heritage, University of Bologna, Ravenna, Italy · 2 - Department of Biology, University of Florence, Firenze, Italy · 3 - Institute of Clinical Physiology – CNR, Pisa, Italy · 4 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 5 - Georgian State Museum, Department of Prehistory, Tbilisi, Georgia · 6 - Israel Antiquities Authority, Jerusalem, Israel · 7 - Department of Anthropology, Peabody Museum, Harvard University, USA · 8 - The Institute of Archaeology, The Hebrew University of Jerusalem, Israel · 9 - School of Archaeology and Earth Institute, University College Dublin, Ireland

Located in the southern Caucasus, Georgia was a major geographic corridor for hominin dispersal into Eurasia since the Early Pleistocene. During the Late Pleistocene it has been suggested that the region was inhabited by Neandertals until 37 ka cal BP [1], potentially replaced by modern humans 38-34 ka cal BP [2]. However, the scanty fossil human remains retrieved from Late Pleistocene deposits in Georgia did not provide to date sufficient information to identify the makers of specific technocomplexes. Here we use non-invasive digital methods to provide the first dental morphological description and morphometric analyses of Upper Paleolithic human remains from Dzudzuana and Satsurblia caves, in western Georgia. The Upper Palaeolithic sequence at Dzudzuana cave comprises three occupational episodes separated by millennia long hiatuses: the lowermost UP phase, Unit D, dated to 34.5–32.2 ka cal. BP; the following Unit C, dated to 27–24 ka cal. BP (the human teeth studied were retrieved from the lower part of this Unit); and the latest UP phase, Unit B dated to 16.5–13.2 ka cal. BP [3]. Human occupational layers at Satsurblia Cave yielded a series of living surfaces dated to (a) prior to the Last Glacial Maximum (LGM) at 25.5–24.4 ka cal. BP and (b) after the LGM at 17.9–16.2 ka cal. BP. Human remains were from Area B, from layers dated to the post-LGM phases dated to 13 ka cal BP [4]. Dzu 1 (Rdm2, Layer C3) and Dzu 2 (Rdm2, Layer C4) from Dzudzuana, SATP5-2 (Rdi1, Area B) and a left fragment of a juvenile mandible (bearing an erupted $Ldm_2$, ID= SATP5-3, and $LM_1$, and un-erupted $LP_3$, $LP_4$, and $LM_2$, Area B) from Satsurblia were scanned using micro-CT system. The resulting image data were segmented in order to produce three-dimensional digital copies, which were used for both morphological description and morphometric analyses. Besides mesio-distal (MD) and bucco-lingual (BL) crown diameters, we used crown (for Dzu 1 and SATP5-3) and cervical (for SATP5-3) outline analyses and we assessed the 3D enamel thickness of the permanent teeth. The morphometric data were compared with a sample of Neandertals, Early *H. sapiens*, UP *H. sapiens* and recent /textitH. sapiens teeth available from the literature, except for MD and BL diameters of the permanent teeth as well as the 3D enamel thickness, for which an ex novo comparative dataset was created. All morphological features (e.g., cusp numbers, fissure pattern) observed in all teeth align with modern humans. BL crown diameters of Dzu 1 and Dzu 2 are small and fall closer to the modern human variability, as also confirmed by the crown outline analysis of Dzu 1. Similar morphometric results were obtained for the human remains from Satsurblia Cave. Crown diameters for deciduous and permanent teeth are closer to the modern human range of variation. Also the crown and cervical outlines of SATP5-3 fall within the modern human range of variability. Finally, all permanent teeth of the Satsurblia mandibular fragment show thick enamel, higher than the mean values computed for Neandertals but within modern human variability. Overall, our results support the attribution of the Upper Paleolithic technocomplexes of both Dzudzuana and Satsurblia caves to modern humans. Moreover, the human remains from Dzudzuana represent, up to now, the oldest evidence of modern humans from southern Caucasus.

**References:**[1] Pinhasi, R., Nioradze, M., Tushabramishvili, N., Lordkipanidze, D., Pleurdeau, D., Moncel, M.H., Adler, D.S., Stringer, C., Higham, T.F.G., 2012. New chronology for the Middle Palaeolithic of the southern Caucasus suggests early demise of Neanderthals in this region. Journal of Human Evolution. 63, 770–780.[2] Adler, D.S., Bar-Yosef, O., Belfer-Cohen, A., Tushabramishvili, N., Boaretto, E., Mercier, N., Valladas, H., Rink, W.J., 2008. Dating the demise: Neandertal extinction and the establishment of modern humans in the southern Caucasus. Journal of Human Evolution. 55, 817–833.[3] Bar-Yosef, O., Belfer-Cohen, A., Mesheviliani, T., Jakeli, N., Bar-Oz, G., Boaretto, E., Goldberg, P., Kvavadze, E., Matskevich, Z. 2011. Dzudzuana: an Upper Palaeolithic cave site in the Caucasus foothills (Georgia). Antiquity 85, 331–349.[4] Pinhasi, R., Meshveliani, T., Matskevich, Z., Bar-Oz, G., Weissbrod, L., Miller, C.E., Wilkinson, K., Lordkipanidze, D., Jakeli, N., Kvavadze, E., Higham, T.F.G., Belfer-Cohen, A. 2014. Satsurblia: New Insights of Human Response and Survival across the Last Glacial Maximum in the Southern Caucasus. PLoS ONE 9, e111271.

Poster Presentation Number 120, Th (18:00-20:00)

## Ungulate carcass transport strategies at the Middle Palaeolithic site of Abric Romaní (Capellades, Spain)

**Juan Marín**[1], **Palmira Saladié**[1], **Antonio Rodríguez-Hidalgo**[1]

1 - IPHES

We evaluated the skeletal profiles from several levels of the sequence of the Neanderthal site of Abric Romaní. All the levels have been described as product of the anthropic activities, been the carnivore activities testimonial. The mainly taxa recorded are the Cervus elaphus, which represent the medium-sized animals, and equids (Equus ferus/Equus hydruntinus), which represent the main large sized animals. However, Stephanorhinus sp. hemitoechus and Bos primigenius have been also identified in many levels. The faunal remains of Abric Romaní are characterized by a high presence of high survival elements, mainly mid shaft of long bones and teeth. This study is focused on the methodology proposed by Faith and Gordon [1]: differences in the skeletal distribution of animals according to their size and weight; the statistical correlation between the skeletal profiles and standard food utility index; and the anatomical diversity of size-weight categories Results indicate an unconstrained transport strategy in all the studied levels and in all size-weight categories. However, we found differences in the skeletal distribution of medium-sized and large animals, which may be due to different transport strategies. We applied the same analysis to Hadza assemblages in order to compare them with the assemblages of Abric Romaní. The analogy reveals similar results to those found at Abric Romaní. The most striking feature of the examined Hadza assemblages is the superposition of several transport events as a result of successive occupation/deposition events. This fact support that the superposition of several transport strategies and occupation events could be responsible of an unconstrained transport strategy deduced from our results. This suggests that the transport strategies used by Neanderthals at Abric Romaní are also characterized by a high degree of diversity in transport decisions. However, some transport strategies could be identified. The significant correlations between the unsaturated marrow index and the high survival elements indicate transport strategies based on the rates of economic return. Therefore one of these transport types in the Abric Romaní sequence is related to the nutritional marrow and grease richest. These conclusions can be extrapolated to other Middle Palaeolithic assemblages with similar skeletal profiles, in which human activity is the main cause of the accumulation.

We want to express our deepest gratitude to all the researchers and the fieldwork team of the Abric Romaní Project. This research was supported by Ministry of Economy and Competitiveness (MINECO) of the Spanish Government, projects No. CGL2012-38434-C03-03 and Government of Catalonia project No. SGR2014-899. A. Rodríguez-Hidalgo is the beneficiary of a pre-doctoral research fellowship (FPI) from the MINECO (CGL2009-12703-C03-02). Financial support for Abric Romaní fieldwork and archaeological excavations is provided by the Ajuntament de Capellades and Departament de Cultura (Servei de Arqueologia i Patrimoni) of the Government of Catalonia.

**References:**[1] Faith, J.T., Gordon, A.D. (2007). Skeletal element abundances in archaeofaunal assemblages: economic utility, sample size, and assessment of carcass transport strategies. J. Archaeol. Sci. 34 (2007), pp. 872–882.[2] Lupo, K. 2001. Archaeological skeletal part profiles and differential transport: an Ethnoarchaeological example from Hadza bone assemblages. J. Anthropol. Archaeol. 20 (2001), pp. 361–378.

Podium Presentation: Session 8, Sa (10:10)

## Late middle and early Upper Palaeolithic palaeoenvironmental conditions in the Cantabrian region, northern Spain. How did Neanderthals and Anatomically Modern Humans cope with climatic oscillations

**Ana B. Marin-Arroyo[1], Jennifer Jones[1], Michael Richards[2], Jesus Altuna[3], Koro Mariezkurrena[3]**

1 - Instituto Internacional de Investigaciones Prehistóricas de Cantabria, Universidad de Cantabria, Spain. · 2 - Department of Archaeology. Simon Fraser University, Burnaby, B.C. Canada. · 3 - Arkaios Investigaciones, San Sebastian, Spain.

When Anatomically Modern Humans (AMH) encountered Neanderthals in Europe around 45,000 years ago, the latter had successfully inhabited Eurasia for more than 200,000 years. They had survived harsh environmental conditions, coping with extreme climatic events, thereby demonstrating the ability to adapt to different ecological contexts. Climate has long been proposed as a possible trigger for the extinction of Neanderthals and the rapid colonization of Europe by AMH. In particular, rapid acute climate oscillations are potentially threatening as they push ecosystems beyond inflexion points towards catastrophic scenarios. Neanderthal extinction is now understood to be have happened on a more regional scale rather a uniform pan-European one [1]. Climate cannot be claimed anymore as a homogeneous cause that affected Neanderthals demise across the continent in a single event. Although it has been proposed in the past [2], the lack of quantifiable verification data and appropriate testing methods means that there is currently no direct evidence to support this claim, unlike with megafauna extinction events, whose correlation with abrupt climate oscillations have been recently proven [3].

The Cantabrian Region in northern Iberia comprises an important archaeological record during this period. However, most of the current information about human behavior come from lithic assemblages [4]. The relationship between humans and their environmental conditions and how these affected their economic decisions has not been systematically approached yet. Besides, there is a lack of a continuous, fine-grained and well-dated terrestrial palaeoclimatic sequence. In order to fill this essential gap, we carried out stable isotope analyses (Carbon, Nitrogen and Sulphur) on macromammal remains with evidence of human consumption. Here we present the first results of the environmental conditions across the Vasco-Cantabrian Region where late Neanderthals and AMH lived in order to assess their behavioral flexibility and resilience.

Nearly 200 bone samples and 18 new ultrafiltration dates from Aitzbitarte III, Labeko Koba, Amalda, Ekain, Lezetxiki, Axlor and Bolinkoba sites suggest climatic oscillations during the late Mousterian to Gravettian as represented by two separate clusters of δ15N values from bone collagen of hunted red deer and horse, which might be reflective of rapid changes in temperature and aridity, causing dietary stress among human populations. An increase in nitrogen values at the beginning of the Aurignacian suggests a more arid environment at this time, and recent studies achieved in ungulates on southwestern France shown similar results [5]. Investigating these shifts in terrestrial foodwebs and comparing with human subsistence and adaptation patterns is crucial to understand late Neanderthals and AMH diet composition as well as Neanderthals demise at the Middle to Upper Palaeolithic transition.

This research has been supported by European Commission through FP7-PEOPLE-2012-CIG (Ref.N 322112) and the Spanish Ministry of Economy and Competitiveness (HAR2012-33956). ABMA has a contract of the Ramón y Cajal Research Program (RYC-2011-00695. The authors want to acknowledge the Basque Government, Arkeologi Museoa Bilbao and Gordailua, Centro del Patrimonio Cultural Mueble de Gipuzkoa for the access and facilities provided during the sampling material.

**References:**[1] Higham et al. 2014. The timing and spatiotemporal patterning of Neanderthal disappearance. Nature 512, 306-309.[2] Jiménez-Espejo, F. et al. 2007. Climate forcing and Neanderthal extinction in Southern Iberia: insights from a multiproxy marine record. Quaternary Science Reviews 26, 836–852.[3] Cooper, A. et al 2015. Abrupt warming events drove Late Pleistocene Holarctic megafaunal turnover. Science 349,6248, 602-606.[4] Rios, J. 2016. A new chronological and technological synthesis for Late Middle Paleolithic of the Eastern Cantabrian Region. Quaternary International http://dx.doi.org/10.1016/j.quaint.2016.02.020 [5] Bocherens, H. et al. 2014. Evidence for a 15N positive excursion in terrestrial food webs at the Middle to Upper Palaeolithic transition in south-western France: implications for early modern human palaeodiet and palaeoenvironment. Journal of Human Evolution 69, 31-43.

Poster Presentation Number 45, We (17:00-19:00)

## Communicating Human Evolution: The impact of non-formal advanced courses on high school students

**Richard Marques[1,2,3], Ana Santos-Carvalho[1,4], Eugénia Cunha[5,6], Ana Luísa Santos[5,7], Ana Maria Silva[5,6,7], Cláudia Umbelino[5,7], Paulo Mota[5,8], Sónia Ferreira[1,4]**

1 - Institute of Education and Citizenship (IEC) · 2 - Institute of Interdisciplinary Research, University of Coimbra (III-UC) · 3 - University of Aveiro · 4 - Center for Neuroscience and Cell Biology (CNC), University of Coimbra · 5 - Department of Life Sciences, University of Coimbra (UC) · 6 - Centre for Functional Ecology (CFE), University of Coimbra · 7 - Research Center for Anthropology and Health (CIAS), University of Coimbra · 8 - Research Center in Biodiversity and Genetic Resources (CIBIO)

The Institute of Education and Citizenship (IEC) is a non-profit organization which acts as an interface between schools, universities and research institutes. The IEC is located in a rural area, Mamarrosa, Aveiro, Portugal, where the dissemination of the scientific knowledge has increased due to the initiatives of IEC.

The IEC developed an educational program, designated Advanced Studies Program, which is composed of advanced courses, conferences, Science clubs, and visits to museums, universities and research institutes by the students who attend the program. This program is unique because their activities are permanent. Each advanced course has a duration of ten weeks, three hours per a week. The advanced courses are taught by young scientists from universities or research institutes.

Between January and March 2016, IEC organized two non-formal advanced courses in Human Evolution, which were held at two Portuguese schools: Instituto Educativo de Souselas (INEDS), located at Souselas, Coimbra, and Escola Secundária de Oliveira do Bairro (ESOB), located at Oliveira do Bairro, Aveiro. These courses were attended by a total of 20 students (17 high school students and 3 high school teachers), and were taught by six university professors and researchers of the University of Coimbra (UC) and IEC.

At the INEDS, the non-formal advanced course was attended by nine students: eight high school students and one high school teacher. These students are regular students of the course of Sciences and Technologies of the formal education national curriculum. On the other hand, at the ESOB, the non-formal advanced course was attended by 11 students: nine high school students and two high school teachers. These students are regular students of the course of Languages and Humanities of the formal education national curriculum.

Throughout the ten sessions, students attended lectures on subjects of Human Evolution, such as Evolutionary Biology, Primatology, Biological Anthropology, Paleoanthropology, Primate Archaeology and Prehistoric Archaeology. During some of these lectures, the students had the opportunity to observe and analyze non-human primate and human skeletal remains. Besides that, the students performed nut-cracking activities, similar to those carried out by extant chimpanzees.

At the end of the courses, the students visited the Department of Life Sciences (DCV) of the Faculty of Sciences and Technology of the University of Coimbra (FCTUC), where the Anthropology and related areas' courses are held. In these facilities, the students had a hands-on opportunity to explore fossil cast of hominins and stone tools molds.

In order to evaluate these courses, at the beginning and the end of the courses, the students answered the same multiple choice test, composed by ten questions, each one related with one of the ten sessions of the course. Moreover, at the end of the courses, the students answered a satisfaction survey.

The INEDS students answered correctly to 41.1% of the questions at the beginning of the course, and to 84.4% at the end. The ESOB students answered correctly to 47.2% of the questions at the beginning of the course, and to 84.5% at the end. Besides that, all the students agree that the courses' subjects were highly interesting, and that the professors dominated the subjects and transmitted them in a very good way. These results show that the courses had a significant impact in the students' knowledge concerning Human Evolution, independently of their different backgrounds.

Thus, we conclude that advanced courses are an efficient strategy to teach Human Evolution to students with different backgrounds. Therefore, more investment has to be done in Human Evolution non-formal education programs, in order to engage students in this topic.

Pecha Kucha Presentation: Session 6, Fr (15:25-15:50)

## The Navalmaíllo Rock Shelter (Pinilla del Valle, Madrid, Spain). A Neanderthal Camp at the Centre of the Iberian Peninsula

**Belén Márquez[1], Enrique Baquedano[1], Alfredo Pérez-González[2], César Laplana[1], Rosa Huguet[3], Nuria García [4], Diego Alvarez-Lao[5], Juan Antonio Espinosa[6], Juan Luis Arsuaga[4]**

1 - Museo Arqueológico Regional, Alcalá de Henares, Madrid, Spain · 2 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain. · 3 - Institut de Paleoecologia Humana I Evolució Social (IPHES), Tarragona, Spain · 4 - Centro Mixto UCM-ISCIII de Evolución y Comportamiento Humanos, Madrid, Spain · 5 - Área de Paleontología, Departamento de Geología, Universidad de Oviedo, Oviedo, Spain · 6 - CIEMAD, Madrid Spain)

The Calvero de la Higuera hill (Pinilla del Valle, Madrid, Spain), at the centre of the Iberian Peninsula, has five archaeological sites: the Cueva del Camino, the Navalmaíllo Rock Shelter, the Cueva de la Buena Pinta, the Abrigo del Ocelado, and the Cueva Des-Cubierta sites. These are all of Late Pleistocene age, although some also have Middle Pleistocene levels. The Cueva del Camino, Cueva de la Buena Pinta and Cueva Des-Cubierta are home to the remains of *Homo neanderthalensis*[1].

- Human occupation of the Navalmaíllo Rock Shelter:

The ca. 300 m² rock shelter, which was discovered in 2002, now has no roof; this collapsed long ago. At the time of its discovery the site was completely filled with sediment and quite invisible against the slope that houses it. Closer inspection, however, has shown it to possess rich, well-preserved archaeological and palaeontological records; indeed, they are outstanding in the region. The main period of occupation is reflected in the site's Level F, for which thermoluminiscence datings have provided ages of 71.6±5.0 and 77.2±6.0 ka [2]. By 2015 the site had provided over 13,000 records of Mousterian lithic industry. Most of the pieces collected (78.5%) are of quartz. Flint (10.4%), metamorphic rocks (5.3%) like quartzite (2%) pieces make up the rest [3,4]. Except for the flint, for which no provenance is known, the raw materials were found locally. Simple flakes are the most common elements. Among the retouched pieces, denticulates and notches are the most common. Bifacial and unifacial knapping were the most frequently used knapping techniques. These were combined with centripetal, unipolar-longitudinal, orthogonal, *levallois* and discoid techniques. As seen at European sites of similar age, the pieces show a trend towards microlithism, although at Navalmaíllo this is not explained by any lack of availability of raw materials, nor by any restriction in the size of the pieces available to work [4]. The animal remains found at the rock shelter are mainly those of herbivores, especially *Bos primigenius, Cervus elaphus, Dama dama, Equus ferus* and *Stephanorhinus hemitoechus*. Those of a few carnivores, including *Vulpes vulpes, Canis lupus, Panthera leo, Crocuta crocuta* and *Ursus arctos* have also been discovered. Taphonomic studies on herbivores have revealed these remains to show ample anthropic fracturing and cut marks, signs that the shelter was used as a butchering site [5]. Traceological studies on the lithic industry confirm the use of different quartz tools in this activity, as well as in hide and wood working [3]. The hearths in different levels of the site, abundant charcoal and burnt limestone blocks, bones and stone tools etc., all unearthed in the excavation campaigns undertaken since 2002, confirm that Neanderthals made intense use of this rock shelter.

Research at the Navalmaíllo Rock Shelter is conducted as part of project S2010/BMD-2330 funded by the I+D activities programme for research groups run by the Education Secretariat of the Madrid Regional Government. The study is also partly funded by the Museo Arqueológico Regional de la Comunidad de Madrid, Grupo Mahou and Canal de Isabel II-Gestión. The authors thank the members of the Pinilla del Valle excavation team for their work in the field.

**References:**[1] Baquedano, E., Márquez, B., Laplana, C., Arsuaga, J.L., 2014. The Archaeological sites at Pinilla del Valle (Madrid, Spain). In: Sala, R. (Ed.), Pleistocene and Holocene hunter-gatherers in Iberia and the Gibraltar Strait: The current archaeological Record. Universidad de Burgos and Fundación Atapuerca. [2] Arsuaga, J. L., Baquedano, E., Pérez-González, A. 2011. Neanderthal and carnivore occupations in Pinilla del Valle Sites (Community of Madrid, Spain). In: Oosterbeek, L., Fidalgo, C., (Eds.), Miscellania. Proceedings of the XV World Congress of the International Union for Prehistoric and Protohistoric Sciences. B.A.R. Int. Series, 2224: 111-119. [3] Márquez, B., Baquedano, E., Pérez-González, A., Arsuaga, J. L. In press. Microwear analysis of Mousterian quartz tools from the Navalmaíllo Rock Shelter (Pinilla del Valle, Madrid, Spain), Quatern. Int. DOI: 10.1016/j.quaint.2015.08.052 [4] Márquez, B., Mosquera, M., Baquedano, E., Pérez-González, A., Arsuaga, J. L., Panera, J., Espinosa, J. A., Gómez, J. 2013, Evidence of a neanderthal-made quartz-based technology at Navalmaíllo rockshelter (Pinilla del Valle, Madrid Region, Spain), J. Anthropol. Res. 69, 373-395. [5] Huguet, R., J. L. Arsuaga, A. Pérez-González, et al. 2010. Homínidos y hienas en el Calvero de la Higuera (Pinilla del Valle, Madrid) durante el Pleistoceno superior. Resultados preliminares. In: Baquedano, E., Rosell, J., (Eds.), Zona Arqueológica. Actas de la 1ª Reunión de científicos sobre cubiles de hiena (y otros grandes carnívoros en los yacimientos arqueológicos de la Península Ibérica),13: 444–58.

Poster Presentation Number 127, Th (18:00-20:00)

## Exploring lithic variability during the Gravettian in Iberia: lithic technology, use-wear analysis and raw material sourcing from the Gravettian occupation of L'Arbreda Cave (Catalunya, Spain)

**Joao Marreiros[1], Joaquin Soler[2], Juan Gibaja[3], David Ortega[3], Narcis Soler[2]**

1 - ICArEHB. Universidade do Algarve. Portugal · 2 - Àrea de Prehistòria, Universitat de Girona · 3 - Institució Milà i Fontanals (CSIC-IMF)

The Paleolithic sites from the region of Serinyà, (Catalonia, Spain), provide a complete and important chronostratigraphic record for the Middle and Upper Paleolithic sequence of Northeast Iberian Peninsula. From this territory, the site of l'Arbreda Cave shows the most important evidence for the initial phase of the Upper Paleolithic, illustrated by Aurignacian and Gravettian occupations [1, 2, 3]. Recently the origins and expansion of the Gravettian in Iberia has been one of the most debate topics, particularly regarding the meaning of the variability of the Gravettian lithic industries in this region. In this work we focus on the study of the Gravettian lithic assemblage from level E of Arbreda Cave dated from c.26 kaBP [4], combining techno-typological, use-wear analysis and raw material characterization and sourcing. Technological analysis shows that Gravettian lithic assemblage from Arbreda is characterized by prismatic reduction strategies focuses on laminar debitage, reflected in the high frequency of backed technology among retouched tools, including well-preserved La Gravette and Microgravette points. Preliminary use-wear analysis focused on macro analysis of the projectile points and preservation conditions of micro wear traces. Local flint, in NE Iberia, is characterized by small nodules with low quality, and during the Gravettian laminar debitage was preformed on imported raw materials from sources that are located north of the Pyrenees Basin Narbonne-Sigean (approx. 100 km away to the north of Arbreda) and Costières du Gard (about 240 km) in the Rhone river mouth. Combining all lithic analyses, our data shows that, during the Gravettian, the site occupation was likely characterized by the exploitation of local resources, during which, hunting might have been one of the most important human activities at the site. Data presented here contributes to our investigation on the lithic variability, in order to understand how humans adapt during the origins of the Gravettian in Iberia.

**References:**[1] Bischoff, J.L., Soler, N., Maroto, J., Julià, R., 1989. Abrupt Mousterian/Aurignacian boundary at c. 40 ka bp: Accelerator 14C dates from l'Arbreda Cave (Catalunya, Spain). Journal of Archaeological Science. 16, 563–576.[2] Soler, J., Soler, N., Solés, A., Niell, X., 2014. Cova de l'Arbreda from the Middle Paleolithic to the Neolithic, Pleistocene and Holocene Hunter-gatherers in Iberia and the Gibraltar Strait. The Current Archaeological Record. Universidad de Burgos, Fundación Atapuerca, Burgos, pp.266-276[3] Soler, J., Soler, N., Maroto, J., 2005. L'Arbreda's Archaic Aurignacian Dates Clarified. Eurasian Prehistory. 5, 45–55.[4] Wood, R.E., Arrizabalaga, A., Camps, M., Fallon, S., Iriarte-Chiapusso, M.-J., Jones, R., Maroto, J., de la Rasilla, M., Santamaría, D., Soler, J., Soler, N., Villaluenga, A., Higham, T.F.G., 2014. The chronology of the earliest Upper Palaeolithic in northern Iberia: New insights from L'Arbreda, Labeko Koba and La Viña. Journal of Human Evolution. 69, 91–109.

Podium Presentation, Session 1, Th (11:00)

## The Engel Ela-Ramud Basin: a new Plio-Pleistocene archeo-paleontological site in Eritrea

**Bienvenido Martínez-Navarro[1], Eudald Carbonell[2], Tsegai Medin[3], Oriol Oms[4], Xosé-Pedro Rodríguez-Álvarez[2], Sergio Ros-Montoya[5], Dawit Araia[6], Lalemba Tsehaie[7], Yosief Libsekal[7]**

1 - ICREA, Institut Català de Paleoecologia Humana i Evolució Social-IPHES, Universitat Rovira i Virgili, Tarragona, Spain · 2 - Institut Català de Paleoecologia Humana i Evolució Social-IPHES, Universitat Rovira i Virgili, Tarragona, Spain · 3 - Institut Català de Paleoecologia Humana i Evolució Social-IPHES, URV, Tarragona, Spain, and National Museum of Eritrea, Asmara, Eritrea · 4 - Departament de Geologia, Universitat Autònma de Barcelona, Spain · 5 - Departamento de Ecología y Geología, Universidad de Málaga, Spain · 6 - National Museum of Eritrea, Asmara, Eritrea · 7 - National Museum of Eritre, Asmara, Eritrea

The Engel Ela - Ramud Basin is a new complex site with a good potential of paleontological and archaeological Plio-Pleistocene record in the northern Afar Region, Eritrea. It is situated 20 km south of the Buia Basin, close to Eritrean-Ethiopian border. This new Eritrean- Spanish project started in 2012, and since then four field seasons have been developed during 2012, 2013, 2014 and 2016. The geological and geo-chronological work, shows a succession of more than 300 meters of a tilted stratigraphic series, which is covered in the eastern margin by a horizontal volcanic tuff and at the western region by conglomerates. The paleontological record, based on the finding of a *Nyanzachoerus* mandible, starts to be representative from the Latest Miocene, and continue with Pliocene and Pleistocene large mammals and other vertebrates. During the seasons of 2014 and 2016 a small systematic excavation (12 square meters) was conducted at the site of Ado Qwaleh (Engel Ela D-1), and a stratigraphic archaeo-paleontological level with lithic artifacts associated with large mammals fauna was identified. An assemblage of 38 lithic artifacts, 1 coprolite, and 6 bone fragments (including 1 cranium of large mammal in the process of restoration, 1 identifiable tooth of small size bovid, and 4 unidentifiable bone fragments), was recorded. The level is characterized by the presence of flakes and debris of small size (less than 2 cm), all of them in quartz, and it is important to remark the presence of an artifact of middle size, around 7 cm. It seems that one sporadic occupational event has been identified, related to the exploitation of a large mammal carcass by a group of hominins. Occupation likely took place in a palustrine setting at the basin margin. The chronology of this site is in the process of dating. This systematic excavation, based on the provisional stratigraphic information, confirms the record of early lithic artifacts, probably latest Pliocene or earliest Pleistocene tools. But the basin also records abundant Acheulian sites in assemblage with large vertebrate fauna (*Elephas* cf. *recki*, *Hippopotamus gorgops*, *Kolpochoerus* cf. *majus*, *Pelorovis oldowayensis*, Carnivora indet. large size, *Crocodylus* sp., and others). The archaeological record is complemented with several Middle and Late Stone Age lithic assemblages.

This research has been financed by the Spanish Minitry of Education, Culture and Sports "Proyectos arqueológicos en el exterior", and by the Spanish Ministry of Economy and Competitiveness (CGL2010-15326 and CGL2015-65387-C3-1-P). We thank the Government of Eritrea for authorizing the research at the Engel Ela-Ramud basin.

Podium Presentation: Session 5, Fr (12:50)

## The earliest unequivocal *H. sapiens* in China: the evidence from the early-Late Pleistocene site of Fuyan (Daoxian) cave

**Maria Martinon-Torres[1,4], Wu Liu[2], Jose Maria Bermudez de Castro[1,3], Song Xing[2], Xiujie Wu[2]**

1 - UCL Anthropology, Unviersity College London · 2 - Institute of Vertebrate Paleontology and Paleoanthropology (IVPP, Beijing) · 3 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH, Spain) · 4 - Laboratorio de Evolución Humana, University of Burgos, Spain

There is growing evidence in support of *H. sapiens* presence in Asia during the first half of the Late Pleistocene [1-3]. New fossil, archaeological and genetic data are furnishing an unknown episode of our own species's past, refueling the scientific interest in the Late Pleistocene of Asia. However, the lack of a precise chrono-stratigraphic context for some of the Chinese fossil samples, their unclear taxonomic status and/or the reluctance of the scientific community to change the current paradigm, have contributed to cast doubts about their definitive assignment to H. sapiens and/or to the early-Late Pleistocene. To date, the 47 human teeth found at the Fuyan (Daoxian) cave in South China, represent the earliest and soundest evidence of the presence of modern humans in China in the early-Late Pleistocene [1]. These fossils can be unequivocally attributed to *H. sapiens* and they have been securely dated between 80,000 to 120,000 years. Here, we present an overview of the Daoxian site and other key Late Pleistocene sites with hominin remains from continental Asia, with a particular emphasis on the dental evidence. Our study suggests a pattern of more archaic populations in northern China versus more derived groups in southern latitudes. Most of the early-Late Pleistocene localities that have been claimed to have fossils attributable to *H. sapiens* are restricted to southern China [4], whereas the earliest unequivocal *H. sapiens* fossils from northern China, like those from Tianyuan Cave, are not older than ca. 40,000 years. This pattern of more derived (south) versus more primitive (north) can be found as early as the Middle Pleistocene, especially if we compare the morphology of the Panxian Dadong sample with that of other Middle Pleistocene groups such as Zhoukoudian, Hexian or Yiyuan [4]. The Daoxian site, together with other localities such as Luna Cave and Zhirendong [5], also in South China, are posing new exciting questions about the source and fate of the first *H. sapiens* in Asia. Hopefully, future and multidisciplinary studies will shed light about their routes of dispersals, their adaptations/behaviour, whether they have left traces in present-day populations and how they may have interacted with other archaic hominins in the continent.

This work has been supported by the grants from the Chinese Academy of Sciences (KZZD-EW-03, XDA05130101, GJHZ201314), National Natural Science Foundation of China (41272034, 41302016, 41271229), Dirección General de Investigación of the Spanish Ministerio de Economía y Competitividad (CGL2015-65387-C3-1, 3-P), Consejería de Educación de Junta de Castilla y León (CEN074A12-2) and The Leakey Foundation through the personal support of D. Crook (2014, 2015, 2016) and G. Getty (2013) to one of the authors (M.M.-T.).

**References:**[1] Liu, W., Martinón-Torres, M. et al. 2015). The earliest unequivocally modern humans in southern China. Nature 526,696-699.[2] Kuhlwilm, M., Gronau, I. et al. (2016), Ancient gene flow from early modern humans into Eastern Neanderthals. Nature 530, 429-433[3] Dennell, R. and Petraglia, M.D. (2012). The dispersal of Homo sapiens across southern Asia: how early, how often, how complex? Quaternary Science Reviews 47, 15-22.[4] Martinón-Torres, M., Xing, S., Liu, W., Bermúdez de Castro, J.M. (2016). A "source and sink" model for East Asia? Preliminary approach through the dental evidence. Comptes Rendus Palevol, in press.[5] Liu, W., Jin C.-Z. et al. (2010). Human remains from Zhirendong, South China, and modern human emergence in East Asia. Proceedings of the National Academy of Sciences 107: 19201-19206.

Poster Presentation Number 60, We (17:00-19:00)

## Implementation of photogrammetry to the three-dimensional reconstruction of cut marks: an alternative to the Scanning Electron Microscopy

**Miguel Ángel Maté-González[1,2], Juan Francisco Palomeque-González[3], José Yravedra[3], Manuel Domínguez-Rodrigo[3,4], Diego González-Aguilera[1]**

1 - Department of Cartography and Terrain Engineering, Polytechnic School of Avila, University of Salamanca, Spain. · 2 - C.A.I. Arqueometry and Archaeological Analysis, Complutense University, Madrid, Spain · 3 - Department of Prehistory, Complutense University, Madrid, Spain · 4 - IDEA (Institute of Evolution in Africa), Origins Museum, Madrid, Spain.

During the last decades taphonomy has proven to be a discipline of great importance for the explanation of archaeological and palaeontology sites. Among the different taphonomic processes that can be associated to human actions, cut marks have been of great interest to explain human nutritional behaviour and it is a key tool in the explanation of hunting-scavenging debate. The presence, the frequency, the distribution, and the meaning of cut marks of bones have been thoroughly used to interpret Palaeolithic and archaeological sites. Thus, at this point, the right definition of these marks, the information obtained from them, as well as the identification of raw materials used in animal processing is crucial. Therefore, various researchers have experimented with different methods to better observe cut marks. The best method known to date is the one based on Scanning Electron Microscopy (SEM), by which during the last years researchers have been able to achieve spectacular results generating three-dimensional models of cut marks of bones.

The main problem that these techniques pose is their high cost in money and time that is necessary to gather the necessary equipment, and to carry out the preparation that marks must experiment before being processed. In order to solve this problem and with the aim of increasing the volume of data susceptible to be analysed, in this work we outline the use of photogrammetry by macro lens to carry out these studies, we describe the previous process of investigation in detail, as well as the technique used, and we show the results that arise from their use. Statistical and morphometric studies were carried out on several hundreds of silhouettes of experimental cut marks made with different raw materials (flint, basalt, quartzite, and metal). This sample constitutes one of the biggest databases of this kind of data compiled up to the present day. Finally, we suggest new lines of investigation to which this procedure could be easily applicable.

**References**[1] Bello, S.M., De Groote, I., Delbarre, G., (2013a). Application of 3-dimensional microscopy and micro-CT scanning to the analysis of Magdalenian portable art on bone and antler. J. Archaeol. Sci. 40, 2464e2476. [2] Domínguez-Rodrigo M, de Juana S, Galán AB, Rodríguez M (2009b). A new protocol to differentiate trampling marks from butchery cut marks. Journal of Archaeological Science 36: 2643–2654. [3] Greenfield HJ (2006b). Slicing cut marks on animal bones: diagnostics for identifying stone tool type and raw material. Journal of Field Archaeology 31: 147-163. [4] Maté-González MA, Yravedra J, González-Aguilera D, Palomeque-González JF, Domínguez-Rodrigo M (2015). Micro-photogrammetric characterization of cut marks on bones. Journal of Archaeological Science 62: 128-142. [5] Olsen SL (1988). The identification of stone and metal tool marks on bone artefact BAR 452: 337-360.

Poster Presentation Number 89, Th (18:00-20:00)

## EVOBREATH®. A new database for Evolutionary Bioenergetics Research on Paleoanthropology

**Ana Mateos[1], Olalla Prado-Nóvoa[1], Marco Vidal-Cordasco[1], Guillermo Zorrilla-Revilla[2], Jesús Rodríguez[1]**

1 - National Research Centre on Human Evolution (CENIEH) · 2 - Escuela Interuniversitaria de Posgrado en Evolución Humana, Universidad de Burgos

Databases represent an essential positive response to the increasingly important challenge of developing collaborative models of data sharing. Palaeoanthropology is a field with a tradition of withholding the primary data on human fossils, but it is time to follow the lead of other research areas, as genetics or ecology, and encourage researchers to share their data with others in a way that will enhance scientific progress while protecting the interests of the individual researchers. Awareness is growing among scientists that collaborative databases can facilitate these aims. Datasets force us to articulate our conception of the data and, furthermore, to address long-standing questions in Human Evolution. The accumulation of long-term empirical and experimental data over the past several decades and the recognition of the need for broad collaborative research efforts, bring us face to face to new challenges and opportunities for the scientific community. However, obtaining empirical and experimental datasets is a complicated, tedious and time consuming process for scientists, but datasets facilitate their reuse by other researchers. These are some of the reasons to promote a culture of collaboration between data producers's and data user's. Human bioenergetics is nowadays a particularly promising field for understanding Human Evolution but, at present, palaeoanthropology cannot easily answer basic questions about the physiology of past humans. Extensive data on recent human physiology and energetics and on their relationship to body proportions and composition are required to interpret the hominin fossil record, to understand the evolutionary ecophysiological constraints and to model hominin palaeophysiology. Only the design and implementation of databases can accommodate the complex dynamic datasets typical of the physiological research, favoring the synthetic analysis of the palaeobiology of our human ancestors. What is EvoBreath®? It is a new database aimed to the analysis of human bioenergetics in an evolutionary perspective. It was built by the PHEG (Palaeophisiology and Human Ecology Group) and the PMG (Palaeoecology of Mammals Group) of the National Research Centre on Human Evolution (CENIEH, Burgos, Spain). It was gradually developed since 2013 to store and manage all the data obtained in the programs on experimental energetics developed either in the CENIEH BioEnergy Laboratory or in the field, using mobile devices. It was conceived as a database that includes quantitative experimental data related to human anthropometry, body composition and energetics obtained in multiple studies with in vivo subjects. Development of EvoBreath® occurred through two parallel and interactive processes. The first one involved intensive discussions among the researchers of the groups to define the attributes, design their relationships and analyze the functionality of the database. EvoBreath® was designed and implemented in parallel to the former process as a fairly simple set of relational tables that reflect the individual based nature of our data. We are currently working in the next phase, the development of a web-based user interface to enable data entry, editing and retrieval by researchers and collaborators of the Working Groups. This online interface will also provide public access to larger parts of the database. The major strength of EvoBreath® resides, however, in the high quality data it includes: many anthropometric parameters and indexes, composition of body tissues, basal metabolic rates, energy expenditure during different protocols, metabolic substrates used, VO2 and VCO2 thresholds, etc. The design of the database facilitates routine updates and data management, and it has the potential to expand to include over time new data from additional devices and studies. The final aim of EvoBreath® is, in short, to serve as an efficient tool to improve our knowledge on the role of Palaeophysiology in Human Evolution.

Podium Presentation: Session 3, Th (17:20)

## The oldest case of polyarticular arthritis in the hominin fossil record: the MH2 skeleton (*Australopithecus sediba*) — a trade-off of bipedalism?

**Sandra Mathews[1], Nakita Frater[1], Noémie Bonneau[2], Martin Haeusler[1]**

1 - University of Zurich, Institute of Evolutionary Medicine (IEM), Switzerland · 2 - Muséum National d'Histoire Naturelle, Paris, France

Musculoskeletal disorders are a growing contributor to health costs today. They include osteoarthritis, osteoporosis, inflammatory rheumatoid diseases and other problems of muscles, ligaments and joints such as the lower back, knee and shoulder. In contrast to the high prevalence of musculoskeletal disorders in modern and prehistoric humans, they are surprisingly uncommon among wild-living non-human primates [1]. The increased lifespan of modern humans can only partly explain this difference. Another hypothesis describes some of these disorders as evolutionary trade-offs of bipedalism [2]. Bipedalism was the key innovation in the evolution of early hominids and involved several adaptations in the musculoskeletal system, such as a reorganization of the shoulder and pelvic girdles, knee joint, foot and the adoption of the lumbar lordosis. In contrast to the predictions of this hypothesis, however, no evidence for musculoskeletal disorders is known so far from the hominid fossil record of the appendicular skeleton predating Neanderthals. The only exception is an isolated proximal femur of an *Australopithecus africanus* that perhaps can be explained in the context of a haematological condition like sickle cell anaemia rather than as degenerative joint disease [3]. One of the best preserved early hominin skeletons is MH2 (*Australopithecus sediba*) from Malapa, South Africa, with is dated to two million years ago [4]. Evidence from the pelvis and advanced dental attrition suggest that MH2 was a relatively old female. Our detailed analysis of the skeleton revealed several pathological alterations, including osteophytes and hyperostosis at the shoulder joint, pitting at the sternoclavicular joint, a possible cyst in the subchondral bone of the acetabulum and osteophytes at the proximal tibia. As multiple joints are involved, this suggests some kind of polyarticular arthritis. Here we discuss the differential diagnosis of polyarticular arthritis and focus on three distinct pathologies. We also discuss the implications of these findings in the context of an evolutionary theory explaining the pathogenesis of musculoskeletal disorders in correlation with bipedalism. We show that there is no evidence that these pathologies in MH2 resulted from a trade-off of bipedalism. On the other hand, the presence of a polyarticular arthritis is typically associated with a variable degree of joint pain, but also with reduced mobility, morning stiffness, and fatigue. This raises interesting questions regarding the biology and life history of early hominins that merit further investigation.

We would like to thank Bernhard Zipfel and Lee R. Berger (University of the Witwatersrand) for access to the fossils, Frank Rühli and Thomas Böni (University of Zurich) for discussion, and the Swiss National Science Foundation and the Mäxi Foundation for financial support.

**References:**[1] Jurmain, R.D., 2000. Degenerative joint disease in African great apes: an evolutionary perspective. J Hum Evol 39:185-203.[2] Haeusler, M., Frater, N., Mathews, S., Landis, S., Boeni, T., Zipfel, B., Ruehli, F., 2015. Are musculoskeletal disorders evolutionary trade-offs of bipedalism? Proceedings of the European Society for the study of Human Evolution 4:107.[3] Haeusler, M., Landis, S., Zipfel, B., 2015. Hip joint osteoarthritis in the MLD 46 (*Australopithecus africanus*) proximal femur. Am J Phys Anthropol Suppl 60:157.[4] Berger, L.R., de Ruiter, D.J., Churchill, S.E., Schmid, P., Carlson, K.J., Dirks, P.H., Kibii, J.M., 2010. *Australopithecus sediba*: a new species of *Homo*-like australopith from South Africa. Science 328:195-204.

Podium Presentation: Session 7, Fr (18:40)

## Regourdou 1 (Dordogne, France): one of the oldest nearly complete Neandertal skeletons?

**Bruno Maureille[1], Trenton Holliday[2], Aurélien Royer[3], Maxime Pelletier[4], Stéphane Madelaine[5], France Lacrampe-Cuyaubère[6], Xavier Muth[7], Erwan Le Gueut, Christine Couture-Veschambre[1], Asier Gómez-Olivencia[8], Emmanuel S Discamps[9], Jean-Pierre Texier[4] Christelle F. Lahaye[10]**

1 - CNRS - UMR5199 PACEA · 2 - Dpt of Anthropology - Tulane University · 3 - EPHE - UMR6282 · 4 - Université d'Aix-Marseille - UMR7269 · 5 - Musée national de la Préhistoire · 6 - Archéosphère - F · 7 - Get in Situ, Lausanne, Switzerland · 8 - Dpt Estratigrafiay Paleontologia - Euskal Herriko Unibersitatea/Ikerbasque · 9 - AHKR institute - University of Bergen · 10 - Université Bordeaux Montaigne - UMR5060 IRAMAT, France

Nearly complete Neandertal skeletons with an indisputable association of cranial and postcranial bones are most frequently associated with potential primary burials . However, most such burials are relatively recent, corresponding to the final Neandertal populations of MIS 3. Older examples of such nearly complete Neandertal skeletons are rare, and include the Tabun C1 (Israel), Altamura (Italy) and Regourdou (France) discoveries. The site of Regourdou (Montignac-sur-Vézère commune, Dordogne, France) is located at the top of the hill where Lascaux cave and the Pleistocene site of La Balutie are also located. In 1957, part of a Neandertal skeleton (Regourdou 1) was accidentally discovered. E. Bonifay subsequently excavated the site between 1961 and 1964, and indicated that the Neandertal skeleton was associated with numerous remains of brown bear and a fauna that primarily reflects temperate conditions, including red and roe deer, wild boar and wood mouse . This level underlies one characterized by the presence of cold-adapted mammals, such as reindeer, steppe lemming and tundra vole. Considering faunal and lithofacies data, E. Bonifay thus proposed that the Regourdou 1 skeleton could be chronologically placed in the MIS 5. Since 2013, a new scientific project has been conducted to reevaluate the Regourdou site. This project notably led to the identification of new hominid remains belonging to Regourdou 1 within the site's faunal collections . In addition, revision of the lithic assemblage challenged previous chrono-cultural attributions: the Mousterian industry, previously described as Quina type, is dominated by discoid products including pseudo-Levallois points (Turq, unpublished). Taphonomic analyses of the faunal material highlighted important potential post-depositional perturbations, with evidence of extensive bioturbation . Study of the original archival documents (photographs, drawings, and letters) challenges previous descriptions of the position of the Neandertal corpse. Yet, above all, a preserved stratigraphy has been investigated. It is from an artificial pit located in the northeastern part of the site that was dug after 1964. Preliminary OSL dates of distinguishable facies indicate that this layer (i.e., potentially Bonifay level 3) could be related to the beginning of MIS 5d. Consequently, the skeleton of Regourdou 1, which comes from the level just below, could be contemporaneous or related to the end of MIS 5e. If so, it would be the oldest nearly complete Neandertal skeleton presently known.

We want to thank Jean-Jacques Cleyet-Merle, head of the Musée national de Préhistoire (Les Eyzies-de-Tayac – F), and Véronique Merlin-Anglade, head of the Musée d'Art et d'Archéologie du Périgord (Périgueux – F), for the authorization to study the collections conserved at their institutions. We are grateful to Michèle Constant for the possibility to study the collections of Musée de Regourdou and her authorization to work at Regourdou as well as to E. Bonifay and B. Vandermeersch for their help and comments on this research as well as all the archives that they gave us. This research was supported by the project « Transitions » convention 20051403003AB of Région Aquitaine, the ANR (French National Research Agency) projects : LabEx Sciences archéologiques de Bordeaux n° ANR-10-LABX-52, sub-project NéMo and A*MIDEX n°ANR-11-IDEX-0001-02. AGO received support from the project CGL2012-38434-C03-01 of the Ministerio de Economía y Competitividad (Spain) and the investigating group IT834-13 of the Eusko Jaurlaritza/Gobierno Vasco. TH received support from the Louisiana Board of Regents LEQSF(2015-18)-RD-A-22.

**References:**[1] Pettitt, P., 2011. The Palaeolithic origins of human burials. Routledge, London.[2] Bonifay, E., 1964. La grotte de Régourdou (Montignac, Dordogne). Stratigraphie et industrie lithique moustérienne. L'Anthropologie 68, 49-64.[3] Maureille, B., Gómez-Olivencia,A., Couture-Veschambre C., Madelaine, S., Holliday, T., 2015. Nouveaux restes humains provenant du gisement de Regourdou (Montignac-sur-Vézère, Dordogne, France). Paleo, 26 : 117-138.[4] Pelletier, M., Royer, A., Holliday, T., Maureille, B., 2015. Lièvre et lapin à Regourdou (Montignac-sur-Vézère, Dordogne, France) : études paléontologique et taphonomique de deux accumulations osseuses d'origine naturelle. Paleo 26 : 161-183.

Poster Presentation Number 73, Th (18:00-20:00)

## The completeness of the early hominin fossil record

**Simon J. Maxwell[1], Philip J. Hopley[1], Paul Upchurch[2], Christophe Soligo[3]**

1 -Department of Earth and Planetary Sciences, Birkbeck, University of London · 2 -Department of Earth Sciences, University College London · 3- Department of Anthropology, University College London

The early hominin fossil record is notoriously poor, particularly during the period molecular clock studies estimate the lineage originated, and there is much scope for a quantitative analysis of the biotic, geological and anthropogenic factors controlling specimen and taxon completeness. Here we assess the completeness of the early African hominin fossil record using the Skeletal Completeness Metric, that calculates the percentage of the skeleton preserved, and the Character Completeness Metric, that calculates the percentage of phylogenetic characters that can be scored. Both metrics are calculated for the most complete specimen and the entire taxon [1]. The average completeness score is plotted through geological time and compared to taxic diversity, number of hominin-bearing formations (HBF) and localities (HBL), stratigraphic range, abundance of hominin specimens, and a record of continental-scale aridity. Completeness of the East African fossil record is also analysed separately to evaluate the purported relationship between the number of ephemeral deep lakes in the East African rift (EAR) and taxic diversity [2]. Time-series were de-trended and corrected for autocorrelation prior to regression, and evaluated using Spearman's rho, Kendall's tau and significance values corrected for multiple tests. Multiple regressions were also applied to explore the possibility of multiple explanatory variables. Preliminary results for the character completeness analysis [3, 4] reveal hominin fossil record completeness varies greatly from less than 19.3% between 7 and 4 mya to 75.3% ca. 1 mya, remaining high through the Pleistocene with a peak of 86.8% ca. 500 kya. Pairwise tests reveal the only significant control of completeness is stratigraphic range. Whether this is related to the longevity of a species influencing the probability of more complete specimens being preserved, or completeness affecting the proportion of a species' actual longevity that is likely to be recovered, is unclear. However, multiple regression model fitting reveals that completeness is best explained by a combination of taxic diversity, HBF, and HBL. That character completeness correlates with taxic diversity, HBF, and HBL suggests (1) completeness has a significant effect on the ability of palaeoanthropologists to recognise species, and (2) early hominin fossil record completeness is controlled largely by sampling. East African fossil record completeness is best explained by the lake variability index, continental-scale aridity and, to a lesser extent, taxic diversity. This implies larger lake margin area and the wetter local conditions linked to these lakes may have imposed a taphonomic bias, encouraging the preservation of specimens with more phylogenetically diagnostic characters. The mechanism linking climate and evolution is unlikely to be directly causal. Whether lake variability is driving completeness, which in turn is driving diversity (the rock record bias hypothesis), or completeness and diversity are both independently being driven by lake variability (the common-cause hypothesis), or another, as yet unexplored, factor influenced the completeness of hominins in the EAR remains unclear. What is clear is that taxic perspectives (i.e., literal interpretations of the fossil record lacking a thorough consideration of its quality) are inappropriate. Overall, these findings demonstrate completeness is an adequate continental-scale proxy for sampling but reveal a complex interplay between completeness, genuine evolutionary dynamics, and the systematic influence of sampling bias.

This work was funded by NERC doctoral training grant NE/L002485/1 to SJM.

**References**:[1] Mannion, P.D., Upchurch, P., 2010, Completeness metrics and the quality of the sauropodomorph fossil record through geological and historical time, Paleobiology 6 (2), 283 – 302. [2] Shultz, S., M.A. Maslin, 2013, Early human speciation, brain expansion and dispersal influence by African climate pulses. PLoS One, 8 (10), e76750. [3] Strait, D.S., F.E. Grine, 2004, Inferring hominoid and early hominid phylogeny using craniodental characters: the role of fossil taxa. Journal of Human Evolution, 47 (6), 399 – 452. [4] Dembo, M., N.J. Matzke, A.Ø. Mooers, M. Collard, 2015, Bayesian analysis of a morphological supermatrix sheds light on controversial fossil hominin relationships. Proceedings of the Royal Society B, 282, 1 – 9.

Poster Presentation Number 95, Th (18:00-20:00)

## Did the agriculture revolution in the Levant improve peoples' nutrition? 40 years of ongoing debate

**Hila May**[1,2], **Christopher Ruff**[3]

1 - Department of Anatomy and Anthropology, Sackler Faculty of Medicine, Tel Aviv Univeristy · 2 - The Dan David Research Center for Human Evolution and Bio-history, The Steinhardt Museum of Natural History and National Research Center, Tel Aviv University· 3 - Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, Baltimore, MD 21205, USA

Introduction: In the late 70's of the previous century a new revolutionary concept evolved, which focused on the negative impact of the transition from hunting and gathering to farming on human physical burden, health and nutrition . Almost 40 years later, the debate is still ongoing: was it bad or good from nutritional perspective? In the current study we challenge this question using cross-sectional morphology of long bone diaphyses. Albeit this method has traditionally been used to investigate a variety of issues with regard to human skeletal adaptation to physical demands , it can also be used for nutritional evaluation [1, 2]. Studies have been shown that in malnourished populations, low bone mass is expected with an enlargement of the endosteal surface . The deterioration in nutrition is related to various factors, among which is the transition to monotypic diets (based on few domesticated animals and plants) with lower nutrient diversity. Accordingly, we hypothesized that if a decline in nutritional quality occurred following the transition to sedentism, then Levantine Neolithic farmers will manifest a greater medullary cavity with lower cortical bone area relative to total cross-sectional area, compared to their preceding Natufian hunter-gatherers. Objectives: To examine femoral midshaft morphological characteristics in hunter-gathering Natufian and farming Pre-pottery Neolithic (PPN) populations in the southern Levant and relate these to changes in nutrition as well as mobility and physical burden. Materials and Methods: 32 Natufian, 41 PPNB, and 26 PPNC femora, dating from 14,900 to 8,250 cal BP, were studied. Femoral diaphyseal cross-sectional images were obtained from CT scans. Dedicated software was used to measure cross-sectional breadths, areas, cortical bone thickness, rigidity and strength. Results: Two general temporal trends in femoral bone architecture were observed: the first, a continuous expansion of the medullary cavity, resulting in a decline in the relative amount of bone tissue (cross-sectional cortical area/total area). The second, an increase in circularity of the femoral mid-shaft region (reduced antero-posterior to medio-lateral ratio) together with a decline in bone rigidity and strength, especially in the later PPNC. Conclusions: Continuing gradual decline in nutritional quality had occurred during the transition from the Natufian hunter-gatherers to the late PPN farmers in the southern Levant. The direct dietary effects on femoral cross-sectional parameters appeared earlier than reductions in mobility. Only toward the end of the PPN with increasing sedentism, marked effects of reduced physical stress and mobility occurred.

**References:**[1] Trinkaus, E., Churchill, S.E., Ruff, C.B., 1994. Postcranial robusticity in homo. II: Humeral bilateral asymmetry and bone plasticity. Am J Phys Anthropol. 93, 1-34.[2] Gosman, J.H., Stout, S.D., Larsen, C.S., 2011. Skeletal biology over the life span: a view from the surfaces.Am J Phys Anthropol. 146, 86-98.[3] Cohen, M.N., 1977. The food crisis in prehistory: Overpopulation and the origin of Agriculture. New Haven, CT: Yale Univ. Press.[4] Ruff, C.B., Trinkaus, E., Walker, A., Larsen, C.S., 1993. Postcranial robusticity in homo. I: Temporal trends and mechanical interpretation. Am J Phys Anthropol. 91, 21-53.[5] Garn, S.M., Guzman, M.A., Wagner, B., 1969. Subperiosteal gain and endosteal loss in protein-calorie malnutrition. Am J Phys Anthropol. 30, 153-155.

Poster Presentation Number 28, We (17:00-19:00)

## Who was robuster? A comparative study of small tubular bone inner robusticity in Neanderthals and the AMH of the Upper Palaeolithic

**Maria Mednikova**[1]

1 - Institute of archaeology of Russian Academy of Sciences

The original study is devoted to morphological comparison of manual middle phalanges of the second to fourth rays of fossil inhabitants of Eurasia in the late Pleistocene. There are Neanderthals from Europe (La Ferrassie 1, Kiik-Koba 1), from Altai (caves Okladnikov and Chagyrskaya), the AMH from Eastern (Kostenki 14, Kostenki 8A&B, Sunghir 1) and Western Europe (Abri Pataud). Diaphyseal structure of tubular bones most often was evaluated from point of view of physical activity. Biomechanical analysis dominated in interpretation of the inner robusticity. But it is accepted apriori that relative thickness of diaphyseal walls also depends on biological sex, age or from hereditary reasons or that it can have a taxonomic value. In the absence of larger tubular bones manual phalanges serve as a "model" for the postcranial skeleton overall. Their study allows to include in comparison of the representatives of different Eurasian groups the isolated finds from Siberia. MicroCT scanning was performed. Xradia software was used to create 3D models and virtual cross-sections, as well Avizo program was used for further segmentation of 3D images. The examination shows high diversity of inner robusticity of manual phalanges, which doesn't seem to be dependent from the taxonomic attribution or sex and age of individuals. The high diversity was detected both for Neanderthals and for CroMagnons. Basing on the total area values of the midshaft section (TA) among Neanderthals the most volumentary diaphyses had males La Ferrassie 1 and Okladnikov 2. The highest and the lowest levels of inner robusticity (%CA) for Neanderthals represent women from Altai caves. The most thick walls in AMH and in the total studied sample had Kostenki 14 and the most (relatively) thin-walled AMH was Sunghir 1. In general, CroMagnons demonstrate the higher level of inner robusticity of manual phalanges in comparison with Neanderthals excepting one group of Altai Neanderthals. It could be proposed that morphology of manual phalanges of fossil humans reflect occupational hypertrophy of bone tissue connected with stone tools operating. Bouldering was another factor influenced hand morphology of inhabitants of rocky places, to whom belonged all studied Neanderthals from Dordogne, Crimea or Altai. But the majority of robust CroMagnons under the study inhabited open Eastern European plains. That means the common explanation of high inner robusticity as the developmental response to increased mechanical loading is questionable in this case. The earliest Eastern European AMH Kostenki 14 had exceptionally heavy skeleton. In particular, his distal and medial phalanges of the both hands demonstrate medullary stenosis indicating systemic bone condition, probably, hereditary disease. Recently genetic study of that young male who lived 38,700 to 36,200 years ago has discovered K14 origin from a meta-population, ancestral for many modern people as well for the Upper Palaeolithic humans. His nuclear DNA contains longer tracts of Neanderthal DNA than present Europeans. The calculated approximate interbreeding time of K14 sapient ancestor and Neanderthal is around 54 thousands BP. The most robust or, correctly, thick walled Altai Neanderthals also had hybrid origin: they lived in contact area with Denisovans. Moreover, the early hybridization of their ancestors with anatomically modern humans somewhere in the Middle East was recently discovered.

It can be supposed that the inner robusticity in these morphological variants mainly depended on the origin of peoples and lesser from external influences. The tropical anatomically modern humans participated in origin of both Neanderthal and AMH robust forms are hypothetically best candidates as people with the thickest walls of tubular bones.

Author is deeply grateful to Profs. A.P. Derevianko, M.V. Shunkov, S.V.Markin, who granted access to the Altai fossils, to Dr. V.Khartanovich for permission to study Kiik-Koba, Kostenki 14 and 8, to Museum of Natural History (Paris) for permission to scan La Ferrassie and Abri Pataud samples.

**References:**[1] Ruff Ch. B., 2000. Biomechanical analyses of archaeological human skeletons // Biological Anthropology of the Human Skeleton. – eds. M.F.Katzenberg, Sh.R.Saunders – Wiley-Liss, Inc., 71-102.[2] Mednikova M., Moiseev V., Khartanovich V., 2016. Structure of manual tubular bones of inhabitants of the Upper Palaeolithic sites Kostenki 14 and 8 (evolutionary and bioarchaeological aspects) /Vestnik Moskovskogo universiteta. Series 23. 1. (in Russian, Eng. summary)[3] Mednikova M., 2016. Evolutionary history of osteosclerosis: a case study of the earliest CroMagnon from the Eastern Europe // Abstracts of Meeting of Palaeopathology Accosiation. Moscow, 15-18 August. In press.[4] Seguin-Orlando A., Korneliussen T.S., Sikora M., Malaspinas A.-S., Manica A., et.al. 2014. Paleogenomics. Genomic structure in Europeans dating back at least 36,200 years // Science. 346,1113–1118.[5] Kuhlwilm M., Gronau I., Hubisz M. J. , de Filippo C, Prado-Martinez J., et.al. 2016. Ancient gene flow from early modern humans into Eastern Neanderthals // Nature. doi:10.1038/nature16544

Pecha Kucha Presentation: Session 2, Th (12:35-13:00)

## Structural effects of human clavicle variation

**Stephanie Melillo[1], Philipp Gunz[1], Hélène Coqueugniot[2], Stefan Reske[3], Jean-Jacques Hublin[1]**

1 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology · 2 - UMR 5199 PACEA, University of Bordeaux · 3 - Klinik für bildgebende Diagnostik und Interventionsradiologie, BG Kinikum Bergmannstrost Halle

It has long been noted that extinct species of *Homo* exhibit clavicle morphology that is uncommon in modern human skeletal collections. Neanderthal and *"Homo antecessor"* clavicles are absolutely long, whereas some *Homo erectus* clavicles are described as relatively short, and both species exhibit pronounced clavicular curvature [1-4]. These features have been used to create reconstructions of the shoulder girdle and upper thorax that provide the basis for hypotheses about functional capabilities and ecogeographic adaptation in these species [2-5]. However, such reconstructions lack empirical support. The clavicle is a notoriously variable bone that articulates at poorly constrained joints. Very little is known about how variation in clavicle form affects the overall configuration of the articulated shoulder girdle, or how it may reflect upper thorax shape. An understanding of these relationships was previously limited by the difficulty of gathering detailed data on individual bone morphology while capturing information about the geometric relationship among bones in their in vivo positions.

This study examines the relationship between clavicle form, upper thorax shape and the position of the scapula on the thorax. We use 3D CT scans of living humans to collect landmark data from the clavicle, scapula and upper ribs. Patterns of covariation between the clavicle and remaining articulated elements are assessed using geometric morphometric methods.

Our results show that clavicle length and upper rib size are correlated, but unexpectedly this relationship explains only a small amount of the observed variation. Residual clavicle length affects scapula posture and is associated with variation in upper thorax depth and rib declination. Clavicles that are short relative to rib size are associated with 1) a more protracted and cranially rotated resting posture of the scapula and 2) upper ribs that are straighter and exhibit greater declination. Clavicle shape and length, in isolation, impart little information about shoulder girdle configuration or thorax shape, contrary to previous suggestions. Thus, clavicle morphology is most informative when associated with other elements of the upper thorax. These results identify potential pitfalls and contribute to improving methods of reconstructing the shoulder girdle of fossil hominins.

We thank Pr. Michel Panuel and Pr. Olivier Dutour for their assistance in arranging access to CT scans from the Hôpital Nord de Marseille.

**References:**[1] Carretero, J.M., Lorenzo, C., Arsuaga, J.L., 1999. Axial and appendicular skeleton of Homo antecessor. J. Hum. Evol. 37(3), 459-499.[2] Larson, S.G., 2009. Evolution of the hominin shoulder: early Homo. In: Grine, F.E., Fleagle, J.G., Leakey, R.E. (Eds.), The First Humans–Origin and Early Evolution of the Genus Homo. Springer, Netherlands, pp. 65-75.[3] Trinkaus, E., Holliday, T.W., Auerbach, B.M., 2014. Neandertal clavicle length. PNAS. 111(12), 4438-4442.[4] Voisin, J.L., 2004. Clavicule: Approche architecturale de l'épaule et réflexions sur le statut systématique des néandertaliens. C. R. Palevol. 3, 133–142.[5] Churchill, S.E., 1994. Medial clavicular length and upper thoracic shape in Neandertals and European early modern humans. Am. J. Phys. Anthropol. S18, 67–68.

Poster Presentation Number 92, Th (18:00-20:00)

## Altitude is associated with craniofacial shape variation in late Holocene southern South Americans

**Lumila Menéndez**[1]

1 - DFG Center for Advanced Studies. Eberhard Karls Universität Tübingen

Populations of southern South America (SSA) are characterized by large morphological variation, which has been interpreted as the result of both random and non-random processes. Ecological factors like climate, diet and altitude explain a large amount of cranial and postcranial diversification of prehistoric populations. Because human populations lived for at least eleven millennia in high altitudes[1], some of the morphological variation may reflect adaptations to such environments. The main environmental change tied to the increase in altitude is atmospheric pressure, which leads to a progressive reduction in the partial pressure of oxygen, resulting in hypoxic conditions. Experimental and comparative studies suggest that hypoxia alters the relative growth of different tissues, with the lungs and brain most susceptible to change [2,3]. Toward this end, a reduction of body measurements with increasing altitude have been reported in Andean populations, including those associated with stature, chest circumference, and head length [4,5]. Although some studies included the evaluation of craniofacial changes in extant populations, discussion of craniofacial shape variation along a geographical continuum of altitude is currently lacking. The purpose of this study is to analyze the role that altitude may have had on shaping craniofacial variation of SSA populations. To achieve this goal, samples from the late Holocene ranging from 10 to 3500 meters above sea level (MASL), were selected. A total of 58 3D landmarks covering the entire skull were registered using a Microscribe G2X digitizer and subjected to a Principal Component Analysis (PCA). Geostatistical analyses, including spatial regression and multi-model inference, were performed in order to account for spatial autocorrelation in the model. The PCA and wireframe results showed that there is a shape pattern associated with altitude variation in SSA populations, in which samples of the highlands exhibit a shortening of the cranial vault, more ventrally oriented facial skeletons and wider cranial bases than samples of the lowlands. Moreover, the spatial regression results showed that altitude explains most of shape variation, while the magnitude is less when considering form and size. Altitude explains 94% of cranial vault shape, 89% of facial skeleton shape variation, and 52% of cranial base shape. When the interaction of morphological variation and different ecological factors (i.e. diet hardness, diet composition, temperature, altitude) was evaluated, altitude contributed to explain most of the variation in the first five models, for which the quality was estimated using Akaike Information Criteria (AIC), based on the goodness of fit and the complexity of the model. It is concluded that altitude contributes to explain the complex scenario of rapid SSA diversification. In agreement with previous studies, and as a result of hypoxia, craniofacial shape variation in highland populations might be an outcome of the low availability of oxygen during brain development.

I would like to thank Hugo Reyes-Centeno, S. Ivan Perez and Emiliano Bruner for their valuable suggestions. This work is supported by the Deutsche Forschungsgemeinschaft (DFG FOR 2237: Project "Words, Bones, Genes, Tools: Tracking Linguistic, Cultural and Biological Trajectories of the Human Past").

**References:**[1] Rademaker K, Hodgins G, Moore K, Zarrillo S, Miller C, Bromley GRM, Leach P, Reid DA, Álvarez WY, and Sandweiss DH. 2014. Paleoindian settlement of the high-altitude Peruvian Andes. Science 346(6208):466-469. [2] Hammond KA, Szewczak J, Krol E. 2001. Effects of altitude and temperature on organ phenotypic plasticity along an altitudinal gradient. J Exp Biol 204, 1991–2000. [3] Petajan JH 1973. Neuropsychological Acclimatization to High Altitude. J Hum Evol 2: 105-115. [4] Frisancho AR. 2013. Developmental Functional Adaptation to High Altitude: Review. Am J Hum Biol 25:151–168. [5] Mueller WH, Schnull VN, Schnull WJ, Soto P, Rothhammer F. 1978. A multinational Andean Genetic and Health Program: Growth and development in an hypoxic environment. Ann Hum Biol 5(4): 329-352.

Poster Presentation Number 119, Th (18:00-20:00)

## Micromorphological analyses of the Middle Stone Age deposits in Bizmoune Cave (Morocco)

**Susan M Mentzer**[1], **Steven Kuhn**[2], **Abdeljalil Bouzouggar**[3]

1 - University of Tübingen, Germany · 2 - University of Arizona, USA · 3 - l'Institut National des Sciences de l'Archéologie et du Patrimoine, Rabat, Morocco

Bizmoune Cave is a karstic cavity formed in dolomite and limestone. The site is located just inland of the Atlantic coast of Morocco near the modern city of Essaouira. The cave contains two large chambers, with two main entrances. The larger of the two chambers contains thick sedimentary deposits that extend past the modern dripline. Test excavations in 2007 revealed the presence of Middle and Later Stone Age archaeological materials, including shell ornaments and the youngest known specimen of *Megaceroides algericus* Lydekker, 1890 . A geoarchaeological study was initiated in 2014 and continued in 2015 in conjunction with full excavations of several different areas of the site. As part of this study, oriented blocks of sediment were collected from excavation profiles for micromorphological analyses. Sampling specifically targeted deposits containing Middle Stone Age materials, including several that can be attributed to the Aterian, with the aim of understanding site formation processes, human use of fire, and taphonomic factors that impact the preservation of burned materials. Additionally, loose sediment samples were collected for grain mount analysis, and mineral identifications using Fourier transform infrared spectroscopy (FTIR) and x-ray diffraction (XRD). The results of the analyses of the 2014 samples demonstrate that components of the sedimentary sequence source from within the cave system as well as from human activities. Burned materials and combustion residues are present; however, intact combustion features were not encountered during excavation. Post-occupation geogenic inputs include the formation of calcareous flowstones atop former ground surfaces, as well as subsurface formation of calcite and aragonite. In several areas of the site, flowstones served to protect the archaeological deposits from downslope erosion. These materials also indicate that during some parts of the late Pleistocene, the environment within the site was much wetter than present.

**References:**[1] Bouzouggar, A., Barton, R. N. E., 2012. The identity and timing of the Aterian in Morocco. In: *Modern Origins*. Springer Netherlands, pp. 93-105.[2] Fernandez, P., Bouzouggar, A., Collina-Girard, J., Coulon, M., 2015. The last occurrence of *Megaceroides algericus* Lyddekker, 1890 (Mammalia, Cervidae) during the middle Holocene in the cave of Bizmoune (Morocco, Essaouira region). *Quaternary International* 374, 154-167.

Podium Presentation: Session 1, Th (9:40)

## Acheulean Ecology, Diet, and Technological Behavior: Plant Residues from Olduvai Gorge

**Julio Mercader Florin[1], Fernando Diez-Martín[2], Manuel Domínguez-Rodrigo[3], Julien Favreau[1], Makarius Itambu[4], Patrick Lee [1], Audax Mabulla[5], Joaquín Panera[6], Robert Patalano[1], Alfredo Pérez-González[6], Raquel Rojas[7], Manuel Santonja[6], Laura Tucker[1]**

1 - Department of Anthropology and Archaeology, University of Calgary · 2 - Department of Prehistory and Archaeology, Universidad de Valladolid · 3 - Department of Prehistory, Universidad Complutense Madrid · 4 - Departmentof Archeology and Heritage, University of Dar es Salaam · 5 - National Museum of Tanzania · 6 - CENIEH (Centro Nacional de Investigación sobre la Evolución Humana) · 7 - Asociación el Hombre y el MedioSusana Rubio-JaraIDEA (Institute of Evolution in Africa)

Several compendia have illustrated the reach of conventional approaches to exploring the evolutionary origin of omnivorous diets. Included are the cost of developing unusually large brains and bodies; tooth size, shape, enamel thickness, and mechanics and wear; and the chemical signal from diet left on bones and teeth. Over the last decade, a new interpretation of human origins has proposed a long history of dependence on fire, suggesting that humans are biologically adapted to cooked food. However, these studies have not provided direct indication of eco-niche exploitation, plant utilization, or the kind of food that was processed with stone tools.

As palaeoanthropologists, we are interested in proxies that link environments, diets, and technological behavior; especially during a time in human evolution when there may have been a shift towards complex omnivore diets. Lithic residue may contain multipronged proxies such as phytoliths and starches. These plant residues constitute a new source of data to understand landscape use, dietary adaptation, and tool function at early hominin sites. Great strides are now being made to increase the reliability of recovered signals by deploying stringent anticontamination protocols in both field and laboratory settings; along with utilizing new experimentation to understand the taphonomic durability and taxonomy of labile molecules.

Much has been revealed about the vegetation context of hominin activities at Olduvai Gorge (Bed I and II) through macrobotany, ethnoarchaeology, and the analysis of pollen, phytoliths, and biomarkers. However, no studies have explored the human ecology, dietary dimension, and functionality of Acheulean technologies as seen through direct evidence in the form of plant residue that may still reside on stone tool surfaces. Here, we study materials from the 'lower floor' of Thiongo Korongo (TK: upper Bed II >1.353±0.035Ma); a site first reported by L. Leakey [1], and later excavated by M. Leakey [2] and Santonja et al [3]. Stratigraphically, we concentrate on materials from approximately 4 m below the contact with Bed III: Achuelean percussion implements, hand-axes, core-tools, and light duty pieces. This lithic collection was expressly excavated for plant residue analysis and retrieved in the field under stringent anti-contamination conditions. Similarly, all analyses presented here were conducted in a clean-room laboratory. The evidence is more abundant than expected and includes epidermal and woody tissue, resin, fibers, starches, and phytoliths; all of which indicate recurrent plant processing.

Funding provided by the Social Sciences and Humanities Research Council of Canada, and the University of Calgary.

**References:**[1] Leakey, L. (1951). Olduvai Gorge. A report on the evolution of the hand-axe culture in Beds I-IV. Cambridge, Cambridge University Press.[2] Leakey, M. D. (1971). Olduvai Gorge, vol III. Cambridge, Cambridge University Press.[3] Santonja, M., J. Panera, S. Rubio-Jara, A. Pérez-González, D. Uribelarrea, M. Domínguez-Rodrigo, A. Mabulla, H. Bunn and E. Baquedano (2014). "Technological strategies and the economy of raw materials in the TK (Thiongo Korongo) lower occupation, Bed II, Olduvai Gorge, Tanzania." Quaternary International 322-323: 181-208.

Podium Presentation: Session 8, Sa (10:30)

## The Middle to Upper Paleolithic transition: A multidisciplinary approach to the chronostratigraphy of climate change and human occupation at Trou Al'Wesse (Belgium)

**Rebecca Miller[1], Pierre Noiret[1], John Stewart[2], Monika Knul[2], Yann Waersegers[1], Edith Stassart[1], Luc Janssens[3], Johannes van der Plicht[4], Christina Ankjærgaard[5], Tony Reimann[5], Pierre Dardenne[6], Vincent Baeten[6], Juan Fernándet Pierna[6], Damien Vincke[6], Keith Wilkinson[7]**

1 - Service of Prehistory, University of Liège · 2 - Department of Life and Environmental Sciences, Bournemouth University · 3 - Department of Archaeology, Leiden University · 4 - Center for Isotope Research, Groningen University · 5 - Soil Geography and Landscape Group & Netherlands Centre for Luminescence Dating, Wageningen University 6 - Department of Valorisation of Agricultural Products, Walloon Agricultural Research Centre · 7 - Department of Archaeology, University of Winchester

The cave site of Trou Al'Wesse is currently the only one known in Belgium that still contains intact deposits for the Middle to Upper Paleolithic transition (units 17-15), complementing data from recent and old excavations at other sites in the region that also cover this period. Modern excavations have been conducted on the terrace since 1988, directed by R. Miller since 2003. Test excavations inside the cave have reached the Pleistocene levels. Trou Al'Wesse is a cave oriented southwest with a large terrace sloping to the alluvial plain of the Hoyoux River, a tributary south of the Meuse. The site provides the opportunity to address climate change and patterns of human occupation from the Late Mousterian to the Aurignacian. Of key interest is correlating the presence of humans, whether Neandertal or anatomically modern, and cold- and warm-adapted fauna to the chronology of rapid climate fluctuations (Dansgaard-Oeschger events) during MIS 3. A multidisciplinary approach incorporates geology, archaeology, zooarchaeology, ancient DNA, luminescence and AMS dating and near infrared spectroscopy. The overall objective is to reconstruct the chronostratigraphy of climate change and human occupation from ca. 50,000 to 30,000 BP. More field-specific objectives include 1) stratigraphic interpretation, taphonomic processes, site formation processes and deposit geometry, site function and spatial organization, 2) lithic and bone technology, lithic procurement strategies, territorial exploitation and mobility, 3) environmental reconstruction, 4) subsistence strategies, carcass processing, 5) paleobiogeography and chronology of selected species and 6) evaluation of collagen preservation in bone using NIRS. Among this range of analyses, this paper focuses on the Late Mousterian occupations on the terrace in unit 17, excavated in 2015 and 2016, discussing the stratigraphic context and initial results of lithic analyses conducted. It also presents a preliminary interpretation of the chronostratigraphy of units 17 to 15 and implications for the presence or absence of hominins.

This project is funded annually by the Service public de Wallonie (SPW, Belgium). Funding was also granted by the L.S.B. Leakey Foundation (2015), the University of Liège (Fonds spéciaux de recherche (FSR); 2015-2017) and the Fonds national de la Recherche scientifique-Fonds de la Recherche Fondamentale Collective (FNRS-FRFC 2.4621.126) for the ArcheoNIR project. Additional funding is provided by the University of Winchester and Bournemouth University. We thank Vivaqua, owner of the site and the nature preserve in which it is located, for their ongoing logistical assistance. Finally, we thank our international team of students who participate in each field season.

Podium Presentation: Session 3, Th (16:00)

## The "cliff edge model" of obstetric selection in humans

**Philipp Mitteroecker**[1]

1 - Dept. of Theoretical Biology, University of Vienna, Austria

The incidence of obstructed labor in humans is strikingly high, in the range of 3-6% worldwide. Most of these cases result from the misfit of the mother's pelvic dimensions to the newborn's head. Without medical care, cephalo-pelvic disproportion often results in maternal and neonatal death. Given this enormous – and in many parts of the world still persisting – selection pressure, it is puzzling why the pelvic canal has not evolved to be wider. It has been claimed that widening the pelvis is disadvantageous for bipedal locomotion, hence constituting a selection gradient opposed to that of obstetrics ("obstetric dilemma") [1]. However, empirical support for this explanation is weak.

I present a model that explains the high rate of obstructed labor by the very specific properties of the selection scenario involved in human childbirth. Central to this explanation is the "cliff-edged" fitness function [2] associated with the difference between neonatal head size and maternal pelvic canal size: fitness continually increases until it drops sharply when the neonate cannot pass through the mother's pelvis any more. By contrast, most phenotypic traits, including dimensions of the head and the pelvis, tend to be approximately symmetrically distributed. For that reason, the phenotype distribution cannot fit the cliff-edged fitness distribution well; the optimal symmetric phenotype distribution always involves a fraction of individuals with cephalo-pelvic disproportion.

I suggest a simple mathematical model that allows for an estimation the selection gradient on neonatal and maternal dimensions, given the observed rates of cephalo-pelvic mismatch. This model explains why the rate of obstructed labor could not have been reduced by directional selection in human evolution and why the likelihood of obstructed labor is highly variable and difficult to predict in human populations. Furthermore, the model explains the increased incidence of cephalo-pelvic mismatch over the last decades [3] and allows for a prediction of future trends.

**References:**[1] Washburn, S., 1960. Tools and human evolution. Sci. Am. 203,63–75.[2] Mountford, M. D., 1968. The significance of litter-size. J. Anim. Ecol. 37, 363–367.[3] WHO, 2015. WHO Statement on Caesarean Section Rates. World Health Organization, Geneva, Switzerland.

Poster Presentation Number 12, We (17:00-19:00)

## New methodology to reconstruct in 2D the enamel of human lower molars and its application to *Homo antecessor*

**Mario Modesto-Mata[1,5], Cecilia García-Campos[1], Laura Martín-Francés[1,6], Marina Martínez de Pinillos[1,6], Rebeca García-González[2], Yuliet Quintino [2], Antoni Canals[3,5,7], Marina Lozano[3], Christopher M. Dean[4], María Martinón-Torres[2,6], José María Bermúdez de Castro[1,6]**

1 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain · 2 - Laboratorio de Evolución Humana, Área de Paleontología, Dpto. de Ciencias Históricas y Geografía, Universidad de Burgos, Edificio I+D+i, Burgos, Spain · 3 - IPHES, Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain · 4 - Department of Cell and Developmental Biology, University College London, London, UK · 5 - Equipo Primeros Pobladores de Extremadura, Casa de la Cultura Rodríguez Moñino, Cáceres, Spain · 6 - Anthropology Department, University College London, U.K.· 7 - Àrea de Prehistòria, Universitat Rovira i Virgili (URV), Tarragona, Spain

In the last years different methodologies have been developed to reconstruct worn teeth [1,2]. In this study we propose a new 2D methodology to reconstruct the worn enamel of lower molars in modern humans. Our main goal is to reconstruct molars with a high level of accuracy when measuring relevant histological variables and to validate the methodology calculating the errors associated with the measurement. To test whether this methodology is useful when applied to fossil teeth, we selected two unworn lower molars of *Homo antecessor* and reconstructed them by using the new methodology. This new methodology is based on polynomial regression equations and its accuracy has been validated measuring the crown height of the protoconid. This variable has been measured on a defined microcomputed tomography plane [3]. To perform the validation process in order to know the associated error of the measurements we followed the steps described by [4]. We also measured and calculated their associated errors following methodologies previously described [1,2]. Our sample consisted of a total of 25 unworn lower molars that belong to different historical and archaeological modern human populations from the Iberian Peninsula. 21 molars were used to perform the polynomial regression and 4 were used in the validation process. This second group of teeth were artificially worn and then reconstructed by using previously described methodologies and the new methodology based on polynomial regressions. We also tested if this polynomial model generated from a modern human sample was applicable to *H. antecessor*. To do it, we used two unworn lower molars that belong to this species. These molars were digitally worn and reconstructed with the polynomial regression based on modern humans, and compared their real and estimated crown height values. By using the new methodology, the mean percentage of error estimated in reconstructed molars for the crown height in comparison with its own real value is below 5%. This error significantly improves the results of other methodologies, both in the interobserver error and in the accuracy of the measurements. The interobserver error is also significantly lower than those obtained by other methods. When applied to *H. antecessor*, we observed that the percentage of error between the real and estimated values in the two unworn molars is 0.5% and 2.9%. The new methodology proposed in this study can be confidently applied to the reconstruction of lower molars of modern humans, as it improves the accuracy of the measurements and reduce the interobserver error. This new methodology can also be easily exportable to the human fossil record. Furthermore, we successfully applied our methodology to *H. antecessor* lower molars. By this way, we can confidently estimate real crown heights in slightly worn molars and thus divide their distances in deciles and assess perikymata packaging distribution.

This research was supported with funding from the Dirección General de Investigación of the Spanish Ministerio de Educación y Ciencia (MEC) and Spanish Ministerio de Economía y Competitividad (MINECO), Project No. CGL2012-38434-C03-01/02/03, CGL2015-65387-C3-3-P, and 2014 SGR 900 Group of Analyses on Socio-ecological Processes, Cultural Changes and Population dynamics during Prehistory (GAPS) of the Generalitat de Catalunya. We also express thanks for the support of Acción Integrada España Francia (HF2007-0115); Consejería de Educación de Junta de Castilla y León (CEN074A12-2) and The Leakey Foundation through the personal support of Gordon Getty (2013) and Dub Crook (2014, 2015) to one of the authors (MM-T). MM, CG and MMP research has been supported by a predoctoral grant of the Junta de Castilla y León (BOCYL-D-30122013-33 and BOCYL-D-20052013-14) and economic support by the Atapuerca Foundation. LMF has a Post-Doctoral Grant from the Fundación Atapuerca. Acknowledgement to the Cáceres Museum and Extremadura Government for their permission to study Maltravieso materials, as well as to José Miguel Carretero. Without the remarkable participation of the Atapuerca and EPPEX teams, this work would have never been possible to carry through. The mCT scanner of the dental collection was performed in the Microscopy Laboratory at CENIEH facilities. Thanks to the European Social Fund for its monetary support.

**References:**[1] Guatelli-Steinberg, D., Reid, D.J., 2008. What molars contribute to an emerging understanding of lateral enamel formation in Neandertals vs. modern humans. Journal of Human Evolution. 54, 236–250.[2] Smith, T.M., Olejniczak, A.J., Zermeno, J.P., Tafforeau, P., Skinner, M.M., et.al. 2012. Variation in enamel thickness within the genus Homo. Journal of Human Evolution. 62, 395–411.[3] Benazzi, S., Panetta, D., Fornai, C., Toussaint, M., Gruppioni, G., Hublin, J.-J., 2014. Technical Note: Guidelines for the digital computation of 2D and 3D enamel thickness in hominoid teeth. American Journal of Physical Anthropology. 153, 305–313.[4] Saunders, S.R., Chan, A.H.W., Kahlon, B., Kluge, H.F., FitzGerald, C.M., 2007. Sexual dimorphism of the dental tissues in human permanent mandibular canines and third premolars. American Journal of Physical Anthropology. 133, 735–740.

Pecha Kucha Presentation: Session 6, Fr (15:25-15:50)

## A southern snapshot of the Middle-to-Upper Paleolithic transition: Foradada Cave (Calafell, Tarragona, Spain)

**Juan I. Morales[1,2], José-Miguel Tejero[3,4], Artur Cebrià[4], Antonio Rodríguez-Hidalgo[1,2], Maria Soto[1,2], Josep Vallverdú[1,2], Palmira Saladié[1,2], Ethel Allué[1,2], Gala García-Agudo[1,2], Juan Fernández-Marchena[1,4], Juan Manuel López-García[1,2], Josep María Fullola[4]**

1 - IPHES Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain · 2 - URV Universitat Rovira i Virgili, Tarragona, Spain· 3 - CNRS, Centre National de la Recherche Scientifique de France, UMR 7041, ArScAn équipe Ethnologie préhistorique, Nanterre, France· 4 - SERP Seminari d'Estudis i Recerques Prehistòriques, Universitat de Barcelona, Spain.

This paper intends to present the preliminary results of the lower sequence of Cova Foradada site (Calafell, Tarragona, Spain). During the last fieldwork seasons, sporadic events of anthropic activity dating back to the Early Upper Paleolithic (EUP) have been identified. These events have been culturally attributed to the Late Aurignacian, Early Aurignacian and Chatelperronian. Cova Foradada is a small cave developed in the miocene calcarenites of the littoral Mediterranean ranges, situated less than 2km away from the actual shoreline. Since the end of 1990's the excavations, were focused on the documentation of a Late Neolithic collective burial in the main room of the cave. More recently, in 2012, the work on the underlying sequence started. As a result, 2 meters of a complex litho-stratigraphy have been described combining travertine crusts and archeo-paleontological layers. Within this sequence, at least 3 episodes of human presence have been detected, corresponding to the layers III-n, III and IV. The whole sequence displays a general pattern of carnivore-dominated cave with a continuous and dominant presence of *Lynx sp*. *Crocuta crocuta*, *Panthera leo*, *Panthera pardus*, *Canis lupus*,*Vulpes vulpes*, *Ursus arctos* and large raptors. Archaeological artifacts are scarce, mainly in layers III and IV, but display some diagnostic traits allowing to propose a cultural attribution. In this way, layer III is characterized by the presence of some backed and Dufour bladeletes and a small assemblage of bone and antler tools. The presence of the longitudinal splitting procedure for the extraction of antler blanks and two fragmented split-based point links layer III occupations with the Early Aurignacian [1]. The archaeological assemblage of the underlying layer IV is even scarcer, notwithstanding 4 abruptly retouched backed blades or Chatelperronian points have been recovered. The chronological characterization of the cultural events and the carnivore dynamics is actually ongoing. By the time, preliminary information suggests a Heinrich 3 chronology for layer III-n and a Heinrich 4 for the layer III. The underlying layer IV, containing the Chatelperronian artifacts is still undated. The presence of EUP at the south of the Cantabrian façade and the Pyrenees is uncommon in the Iberian Peninsula. Since the excavation of the Abric Romani's layer A, a century ago, and its radiometric dating [2], only few generic EUP evidences have been published [3,4] at Cova Foradada similar latitudes. The typological attribution of layer IV to the Chatelperronian, or at least, the presence of Chatelperronian artifacts, constitutes the southernmost evidence of this tool-kit in the European context, being also an important novelty for the EUP sequence of the Iberian Peninsula and for the geography of the Middle-to-Upper Paleolithic transition in southern Europe [5].

The Cova Foradada excavation is funded by the 2014/100482 project of the Culture Department of the Generalitat de Catalunya. Funds and support are also provided by the AGAUR projects 2014SGR-108 (SERP, Universitat de Barcelona, Josep M. Fullola) and 2014SGR-900 (IPHES, Manuel Vaquero) and Spanish MINECO projects HAR2013-41197-P (Francesc Burjachs & Javier Fernández-López de Pablo) and HAR2014-55131( Josep M. Fullola & José Miguel Tejero).

**References:**.[1] Tejero, J.-M., 2014. Towards complexity in osseous raw material exploitation by the first anatomically modern humans in Europe: Aurignacian antler working. Journal of Anthropological Archaeology 36, 72-92. [2] Bischoff, J.L., Ludwig, K., Garcia, J.F., Carbonell, E., Vaquero, M., Stafford Jr, T.W., Jull, A.J.T., 1994. Dating of the Basal Aurignacian Sandwich at Abric Romaní (Catalunya, Spain) by Radiocarbon and Uranium-Series. Journal of Archaeological Science 21, 541-551 [3] Daura, J., Sanz, M., García, N., Allué, E., Vaquero, M., Fierro, E., Carrión, J.S., López-García, J.M., Blain, H.A., Sánchez-Marco, A., Valls, C., Albert, R.M., Fornós, J.J., Julià, R., Fullola, J.M., Zilhão, J., 2013. Terrasses de la Riera dels Canyars (Gavà, Barcelona): the landscape of Heinrich Stadial 4 north of the "Ebro frontier" and implications for modern human dispersal into Iberia. Quaternary Science Reviews 60, 26-48. [4] Martínez-Moreno, J., Mora, R., de la Torre, I., 2010. The Middle-to-Upper Palaeolithic transition in Cova Gran (Catalunya, Spain) and the extinction of Neanderthals in the Iberian Peninsula. Journal Human Evolution 58, 211-226. [5] Hublin, J.-J., 2015. The modern human colonization of western Eurasia: when and where? Quaternary Science Reviews 118, 194-210.

Poster Presentation Number 30, We (17:00-19:00)

## ESR dating of fluvial deposits from the Middle Tagus Basin (Central Spain): new numerical age results for the Acheulean sites of Pinedo and Cien Fanegas

**Davinia Moreno[1], Mathieu Duval[1], Joaquín Panera [1], Susana Rubio-Jara[2], Manuel Santonja[1], Alfredo Pérez-González [1]**

1 - CENIEH · 2 - Instituto de Evolución en África (IDEA)

The Middle Tagus basin is characterized by a stepped terrace system where 12 terraces have been identified in addition to the present foodplain (named T1 to T12 from top to bottom) in the Toledo area (Spain). Some of these fluvial deposits have delivered numerous key archaeo-palaeontological sites to understand the characteristics and timing of the Acheulean settlement in the Iberian Peninsula [1]. However, the amount of chronological data available is surprisingly very scarce, making the present-day chronostratigraphic framework of the Middle Tagus basin quite limited. Palaeomagnetic study carried in T7 (+60m) suggests that the Matuyama-Brunhes boundary may be registered in this deposit [2]. T10 (+25-30m) has delivered two archaeological sites both showing an important collection of Acheulean stone tools in association with Middle Pleistocene large mammals [3]: Pinedo (Toledo) and Cien Fanegas (Aranjuez), located 1.5 km and 14 km upstream of Toledo, respectively. Because the high dose rate values measured for quartz precluded standard OSL analyses, these sites have been dated using post-IR IRSL, indicating chronologies older than 250 ka (Pinedo: >280ka; Cien Fanegas: 292±17ka) . Amino Acid Racemization has been also employed at Pinedo site and provides a somewhat younger age of 226±37 ka [4]. To refine this chronology, the Electron Spin Resonance (ESR) dating method has been applied to optically bleached quartz grains from both T10 and T7 terraces. Samples were processed following the Multiple Centre approach which consists in measuring the ESR signals of both the Aluminium (Al) and Titanium (Ti) centers (more details in [5]). The present work presents not only the first ESR age estimates obtained for Pinedo and Cien Fanegas sites in T10 (+25-30m), but also the first numerical ages ever obtained for T7 (+60m). These results demonstrate the interest of using a combination of different dating methods to achieve more accurate chronologies for fluvial terraces systems.

**References:**[1] Rubio-Jara, S., Panera, J., Rodríguez-de-Tembleque, J., Santonja, M., Pérez-González, A. In press. Large flake Acheulean in the middle of Tagus basin (Spain): Middle stretch of the river Tagus valley and lower stretches of the rivers Jarama and Manzanares valleys. Quaternary International.[2] Pinilla, L., Pérez-González, A., Sopeña, A., Parés, A., 1995. Fenómenos de hundimientos sinsedimentarios en los depósitos cuaternarios del río Tajo en la Cuenca de Madrid (Almoguera-Fuentidueña de Tajo). Monografías del Centro de Ciencias Medioambientales. 3, 125-139[3] Querol, M.A., Santonja, M., 1979. El yacimiento achelense de Pinedo (Toledo). Excavaciones Arqueológicas en España, 106. Ministerio de Cultura, Madrid. Pp 181[4] López-Recio, P.G., Silva, P.G., Roquero, E., Cunha, P.P., Tapias, F., Alcaraz-Castaño, M., Baena, J., Cuartero, F., Morín, J., Torres, T., Ortiz, J.E., Murray, A.S., Buylaert, J.P., 2015. Geochronology of the Acheulean sites of Pinedo and Cien Fanegas (Tagus River valley), and implications for the fluvial evolution in the environs of Toledo (Spain). Estudios Geológicos. 71 (1), 1-14[5] Duval, M., Sancho, C., Calle, M., Guilarte, V., Peña-Monné, J. L., 2015. On the interest of using the multiple center approach in ESR dating of optically bleached quartz grains: Some examples from the Early Pleistocene terraces of the Alcanadre River (Ebro basin, Spain). Quaternary Geochronology. 29, 58-69.

Poster Presentation Number 49, We (17:00-19:00)

## Colonization dynamics and the diffusion of the Protoaurignacian in Italy and Southern France: The Rhône-Marche corridors and its chrono-cultural implications

**Fabio Negrino[1], Julien Riel Salvatore[2], Stefano Bertola[3]**

1 - DAFIST, Università di Genova, Italy · 2 - Département d'Anthropologie, Université de Montréal, Canada · 3 - Institut für Geologie und Paläontologie, Universität Innsbruck, Austria

The Protoaurignacian is largely considered one of the first unambiguous cultural manifestations of the presence of Anatomically Modern Humans (AMH) in Europe. Its appearance in the region's archaeological record appears to reflect a new perception of the natural world, one in which new technologies and symbolic behaviors play a key role. While it is distributed over a very large area that stretches over Spain, south-central France, Italy, and the Balkans, the greater number of known sites dating to 42-40ka cal BP in the Ligurian and Franco-Spanish areas suggests it originated in the western part of its range. That said, the site of Kozarnika (Bulgaria) has yielded assemblages with Protoaurignacian characters and dates to broadly the same period, which leaves open the question of the technocomplex's origins and its potential links to the Levantine area, an idea which is still the topic of much discussion. An important consideration to keep in mind, however, is that such techno-typological affinities might be independent regional developments rather than evidence of these industries belonging to the same evolutionary phenomenon. This would call into question the logic of assigning all assemblages displaying *Protoaurignacian* affinities to a single 'culture.' The region between the Rhône valley of France and the Marche region of Italy is bordered by the Maritime Alps and the northern Apennines. In this region, the Protoaurignacian is unevenly distributed, being concentrated mostly in Provence. As concerns Italy, the most important sites are located near the French border, in the Balzi Rossi di Grimaldi site complex. In spite of this location, these sites have yielded evidence of raw material transfers over the entire region, reaching almost 400km as-the-crow-flies. These are dramatically longer transfers than those documented in the preceding Mousterian and they attest to the emergence of fundamentally different social dynamics at the very beginning of the Upper Paleolithic. It further appears that this dynamism is not only the result of a greater mobility, but also of the development of a resilient social network. This is further suggested by extremely rugged nature of the regional landscape and the episodic presence of Alpine raw material from across the Po Valley (i.e., Late Jurassic flint from the Lessini Mountains, near Verona), both of which imply that direct procurement would have been extremely costly and challenging. The basal Protoaurignacian from Riparo Mochi (Balzi Rossi, Imperia) has been dated to ca. 41.5ka cal BP and is coeval to that found at nearby Riparo Bombrini. The lithic assemblages from both sites comprise a significant proportion of elements made on Adriatic raw materials. This raises another salient issue, namely that of their potential contemporaneity (and potential interactions) with Uluzzian groups present at that time in Tuscany perhaps Veneto which display a decidedly more local and less far-ranging adaptive pose than the Protoaurignacian. To this open question, we must add that of why, when it first appears in Liguria, the Protoaurignacian is essentially 'mature' in terms of its social and geographic dimensions. Recent ethnographic studies indicate that the colonization of a new landscape by human groups is associated with an initial "locational" (or exploratory) phase, a later "limitational (or cognitive) phase, and a final "social" phase, in which regional resources have already been culturally assimilated and fully incorporated in the group's human landscape. The paradox here lies in the fact that we seem to only find for the Ligurian Protoaurignacian this third phase. This leaves open yet another question: what was the situation like immediately before this social phase of the Protoaurignacian?

Poster Presentation Number 72, Th (18:00-20:00)

## Endocranial shape and taxonomic affinities of KNM-ER 42700

**Simon Neubauer**[1], **Philipp Gunz**[1], **Meave Leakey**[2], **Louise Leakey**[2], **Jean-Jacques Hublin**[1], **Fred Spoor** [1,3]

1 - Max Planck Institute for Evolutionary Anthropology, Department of Human Evolution · 2 - Turkana Basin Institute, Nairobi, Kenya, and Department of Anthropology, Stony Brook University, USA · 3 - Department of Cell and Developmental Biology, University College London, UK

The small calvaria KNM-ER 42700 from Ileret, Kenya has been originally described as *Homo erectus*, in large part based on qualitative features [1]. It extends the cranial variation of this species and implies high levels of sexual dimorphism. Based on a geometric morphometric analysis of external neurocranial shape Baab [2] questioned this species assignation because KNM-ER 42700 did not cluster with other *Homo erectus* individuals. However, Baab's study [2] did not account for post-mortem damage and deformation of the fossil, and the fact that this specimen has not reached full adult morphology [3]. Here we present a virtual reconstruction of KNM-ER 42700 and a comparative geometric morphometric shape analysis. We focus on endocranial morphology, as it is known to reach its adult shape earlier than ectocranial morphology and therefore allows for comparisons of the subadult Ileret cranium with adult specimens.

We used medical and high-resolution CT data of the original specimen to electronically remove stone matrix attached to the endocranial surface, to isolate bone fragments, to mirror-image parts of the bony braincase, to reassemble the fragments according to anatomical and smoothness criteria, to correct for taphonomic distortion and finally to generate a virtual endocast of the reconstructed braincase. We measured endocranial landmarks and semilandmarks on curves and the surface [4] for the reconstructed KNM-ER 42700 endocast as well as a comparative sample of recent modern humans and African and Asian *Homo erectus* individuals. Procrustes shape variables extracted from these 3D landmark coordinates were then analysed using geometric morphometric methods. As the endocranial volume (EV) of KNM-ER 42700 is small, our analyses take into account the covariation of endocranial shape and size using multivariate regressions on EV.

Our results show that all *Homo erectus* s.l. endocrania are clearly separated from *Homo sapiens* in shape space. Moreover, African and Asian *Homo erectus* individuals form distinct clusters. The reconstructed KNM-ER 42700 endocast, however, does not cluster with its supposed conspecifics. The reconstructed EV is 728 ml (that is 37 ml more than previously estimated [1]). We predicted the endocranial shape for a *Homo erectus* s.l. with this EV and compared this allometric prediction to the reconstructed endocast of KNM-ER 42700: the vault of the Ileret cranium is more globular, the cranial base is more flexed, and the brain stem area more narrow than expected for a *Homo erectus* of its size. Our data therefore support Baab's [2] previous findings but we suggest that the contrasting results of qualitative and quantitative data do not warrant interpreting KNM-ER 42700 as a different, potentially previously unknown *Homo* species. We rather advise caution and want to stimulate discussion about the meaning and interpretation of such data.

We thank the government of Kenya, the National Museums of Kenya, E. Mbua and F.K. Manthi for research permission and support. This work was supported by the Max Planck Society.

**References**:[1] Spoor, F., Leakey, M.G., Gathogo, P.N., Brown, F.H., Antón, S.C., McDougall, I., Kiarie, C., Manthi, F.K., Leakey, L.N., 2007. Implications of new early Homo fossils from Ileret, east of Lake Turkana, Kenya. Nature 448, 688-691.[2] Baab, K.L., 2008. A re-evaluation of the taxonomic affinities of the early Homo cranium KNM-ER 42700. J. Hum. Evol. 55, 741-746.[3] Spoor, F., Leakey, M.G., Antón, S.C., Leakey, L.N., 2008. The taxonomic status of KNM-ER 42700: A reply to Baab (2008). J. Hum. Evol. 55, 747-750.[4] Neubauer, S., Gunz, P., Hublin, J.J., 2009. The pattern of endocranial ontogenetic shape changes in humans. J. Anat. 215, 240-255.

Poster Presentation Number 101, Th (18:00-20:00)

## Functional analysis of the Acheulian assemblages from the Áridos elephant butchery sites (Madrid, Spain)

**Andreu Ollé**[1,2], **Marina Mosquera**[1,2]

1 - IPHES Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain.· 2 - URV Universitat Rovira i Virgili, Avinguda de Catalunya, Tarragona, Spain

Many archaeological sites in Europe yield megaherbivore remains and stone tools, but in only a few has it been possible to confirm the association, in a single event, of one of these animals and its processing by means of a usually reduced tool assemblage. These are the cases of Áridos 1 and Áridos 2 (Madrid, Spain), which represent outstanding examples of Middle Pleistocene (MIS 11) elephant single-carcass butchery sites [1,2]. This poster focuses on the results obtained after a systematic microwear analysis of the well preserved lithic sample of both localities . This analysis was based on Scanning Electron Microscope observation, for which some common problems in such a kind of assemblages (raw materials, tool's dimensions...) forced researchers to develop specific methodological aspects . Use-wear traces were identified on a high proportion of the analysed tools, while postdepositional surface modifications revealed to be scarce. The traces recorded in both sites are strongly related to the butchery activities. On most of the tools just a cutting action on soft animal tissues has been identified, and thus, no clear differentiation between skinning, evisceration and defleshing has been possible (only sporadically fresh hide cutting has been inferred, pointing then to skinning). Working on vegetal materials has been identified only in Áridos 1, and in an extremely isolated way. In Áridos 1, mainly small ad hoc-produced flint flakes were used to perform the butchery activities. Only one of them had been previously modified as a side-scraper. In Áridos 2, the pieces used were both small flint flakes and large cutting tools made on quartzite. These include a cleaver and two handaxes, for which no evidences of production in place have been found. Use-wear results were combined with techno-typological, refitting and spatial information in order to illustrate the close association between the lithic and the faunal record. This enabled to reconstruct the processing of the elephants carcasses at the spot, and provided a behavioural lecture of this type of singular archaeological associations . Besides the functional information, features as the fragmentation of the operative chain, the refitting evidence, the techno-typological composition of the assemblages, and also the raw materials the tools were made of, revealed crucial to characterise the strategies in terms of technological planning and forecasting of the Middle Pleistocene populations in relation to the organised exploitation of their resources.

We are grateful to C. Cacho (MAN) for facilitating the microscopic analysis of the materials, and to M. Santonja for giving us access to unpublished spatial data. The microscopic analysis and the experimental programmes where carried out in collaboration with J.M. Vergès. This research has been developed within the frame of the projects CGL2015-65387-C3-1-P (MINECO-FEDER) and SGR 2014-899 (AGAUR).

**References:**[1] Santonja, M., López Martínez, N., Pérez-González, A. (Eds.), 1980. Ocupaciones Achelenses en el Valle del Jarama. Arqueología y Paleoecología 1. Servicios de Extensión Cultural y Divulgación, Diputación Provincial de Madrid, Madrid.[2] Yravedra, J., Domínguez-Rodrigo, M., Santonja, M., Pérez-González, A., Panera, J., Rubio-Jara, S., Baquedano, E., 2010. Cut marks on the Middle Pleistocene elephant carcass of Áridos 2 (Madrid, Spain), Journal of Archaeological Science 37, 2469-2476.[3] Ollé, A., 2003. Variabilitat i patrons funcionals en els sistemes tècnics de Mode 2. Anàlisi de les deformacions d'ús en els conjunts lítics del Riparo Esterno de Grotta Paglicci (Rignano Garganico, Foggia), Áridos (Arganda, Madrid) i Galería-TN (Sierra de Atapuerca, Burgos), Dept. d'Història i Geografia. Universitat Rovira i Virgili, Tarragona, p. 589. Url: http://tdx.cat/handle/10803/8603.[4] Ollé, A., Vergès, J.M., 2014. The use of sequential experiments and SEM in documenting stone tool microwear, Journal of Archaeological Science 48, 60-72.[5] Mosquera, M., Saladié, P., Ollé, A., Cáceres, I., Huguet, R., Villalaín, J.J., Carrancho, Á., Bourlès, D.L., Braucher, R., Vallverdú, J., 2015. Barranc de la Boella (Catalonia, Spain): an Acheulean elephant butchering site from the European late Early Pleistocene, Journal of Quaternary Science 30, 651-666.

Poster Presentation Number 88, Th (18:00-20:00)

## A networked approach to the analysis of integration and modularity in the primate shoulder and thoracic skeleton

**Thomas O'Mahoney**[1]

1 - University of Manchester

Recent work [1] has established Anatomical Network Analysis as a new method for generating hypotheses regarding anatomical modules. In short, connections between differing skeletal components are visualised as branching networks, and hypothetical anatomical modules are extracted depending on the density of connections between components. This is done by enumerating all muscular or ligamentous attachments between bones, and bony articulations themselves. Networks for bony articulations themselves, or networks which also include this soft tissue data are then generated. This method has the potential to be a robust way of testing traditional ideas about modularity of different skeletal components by grounding it in actual anatomical data. Here, I extend this idea through the interrogation of these hypothesised modules using geometric morphometrics and standard statistical tests for modularity, including the RV coefficient and the newer technique of the covariance ratio. I apply this new integrated methodology to two areas of interest to evolutionary anthropologists: the hominin upper body, including the thorax and shoulder. Using a modern patient dataset from the National Cancer Imaging Archive (NCIA), and standardised anatomical descriptions of musculature [2,3] it is demonstrated with the analysis of the thorax that common hypotheses of functional units are not born out by either network analysis or subsequent geometric morphometric analysis. The costal skeleton in particular partitions into four modules in network analysis. With regards the shoulder area, this is either integrated more with the thorax when muscle attachment data is taken into account, or as a discrete unit if one only includes bony articulations. When the landmark data is analysed using the RV coefficient and covariance ratio, overall morphological integration overrides this. I then apply the same technique to our closest living primate relative, *Pan troglodytes*, and to hypothetical reconstructions of the fossil homini species *Homo erectus*, *Australopithecus afarensis* and *Australopithecus sediba*. The results are discussed in the light of hypothesised arborealism in *Australopithecus sp.* and obligate bipedalism in *Homo erectus*.

Primate data is from KUPRI's collection, Homo sapiens is from NCIA, *Homo erectus* scans are from research quality casts courtesy of R. Foley and M. Lahr (LCHES Cambridge); *Au. afarensis* is from a new reconstruction by the author; *Au. sediba* scans are from Morphosource.

**References:**[1] ] Esteve-Altava B, Boughner JC, Diogo R, Villmoare BA, Rasskin-Gutman D. 2015. Anatomical network analysis shows decoupling of modular lability and complexity in the evolution of the primate skull. PLoS ONE 10(5): e0127653[2] Gray, H. 1985. Gray's Anatomy. 15th ed. London: Chancellor press (reprint)[3] Musculino, J. 2005. The Muscular System Manual: The Skeletal Muscles of the Human Body. London:Elsevier.

Poster Presentation Number 39, We (17:00-19:00)

## Galería Complex site: The sequence of Acheulean site of Atapuerca (Burgos, Spain)

**Ana Isabel Ortega[1,2], Josep Vallverdú[3,4], Isabel Cáceres[3,4], Alfonso Benito-Calvo[1], Josep M. Parés [1], Raquel Pérez[5], Isodoro Campaña[1], Christoph Falgueres[6], Alfredo Pérez-González[1], José M. Bermúdez de Castro[1], Eudald Carbonell[3,4,7]**

1 - CENIEH, Centro Nacional de Investigación sobre la Evolución Humana, Burgos, Spain · 2 - GEE, Grupo Espeleológico Edelweiss, Diputación Provincial de Burgos, Spain · 3 - Àrea de Prehistòria, Universitat Rovira i Virgili (URV), Tarragona, Spain · 4 - IPHES, Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain · 5 - TAUP, Topografs Alt Urgell i Pirineus SLT, Lleida, Spain · 6 - Département de Préhistoire, Muséum national d'histoire naturelle, UMR7194 du CNRS, Paris, France · 7 - IVPP, Institute of Vertebrate Paleontology and Paleoanthropology of Beijing, China

The record of Middle Pleistocene cave site of Galería Complex shows the oldest Acheulean settlements of the Sierra de Atapuerca, which are linked to Homo heidelbergensis emergence in Western Europea. Galería Complex is an archaeological site located at the ancient cave of Trinchera del Ferrocarril (Sierra de Atapuerca, Burgos), about 50 m south of Gran Dolina. This cave had been originated under phreatic conditions and later vadose development, and corresponded to the former discharge zone of stability base level of the T4 terraces (+60-67 m) of Arlancón River, of the end Early Pleistocene. The vadose phase represents the new drop in the water table, drying out the water springs, and deepened the bottom of the conduits (T5 (+50-58 m) beginning of Middle Pleistocene) [1]. During this phase the gravity processes increase and collapses of cave roof take place, resulting in the occurrence of the new entrance of Tres Simas[1], a shaft of about 10 m of deep, which acted as a natural trap for herbivores. The entrance of Zarpazos, situated to the northeastern Galería, was used for the Hominid and the carnivores to access carcasses. The stratigraphic sequence of Galería shows an important archaeological and paleontological record from the Middle Pleistocene [2]. It consists of five lithostratigraphic units [2], from at least two entry points, the colapse sinkhole of Tres Simas (TN), and Zarpazos. The oldest unit, GI, comes from autochthonous facies, and at the top level was where the Matuyama-Brunhes boundary was detected. Thus, this Unit is archaeologically sterile. The GII, GIII and GV units are allochthonous units, from around the entrance cave area, which filled the section of the cavity. These units are arranged in erosional unconformities with respect to each other and are composed of heterometric carbonates clasts and debris flow that laterally pass towards the north to detrital facies finer laminated clay-loam sandy. The latter facies interfinger with facies of debris flow inputs coming from further north. On the bottom of GII unit organic facies are identified as bat guano, which suggest the initial opening cave. The GV unit ends up filling this part of cavity. Paleomagnetic dating revealed a switch from reverse to normal geomagnetic polarity at the top of GI level, interpreted as the Matuyama-Brunhes boundary. Subsequent chronometric analysis by Electron Spin Resonance (ESR) and luminescence further provide data of GI-GIII Middle Pleistocene age, between about 500 and 250 ka years ago [4]. A speleothem on the GIV unit, in the central part of Galería Complex, has been dated by Uranium Series around 118 +71/-49 ka and by Electro Spin Resonance (ESR) about 200 ka. The GII unit displays the oldest Atapuerca Acheulean culture [5] and in GIII (TG11 level) there has been identified a sequence of 12 floors occupation, formed by alternating clay and gravel with traces of archaeo-paleontological evidence, that sporadically uses the cavity as a means to supply meat resources[2]. The fossil human presence is also associated with two fossil human remains and an abundant Middle Pleistocene paleontological record.

The first author is a beneficiary of a Funcacion Atapuerca Postdoctoral Grant. Research at the Sierra de Atapuerca sites are supported by the MINECO project CGL2015-38434-C03-02 and archaeological fieldwork is also supported by the Consejería de Cultura y Turismo of the Junta de Castilla y León.

**References**:[1] Ortega, A.I., Benito-Calvo, A., Pérez-González, A., Martín-Merino, M.A., Pérez-Martínez, R. et.al. 2013. Evolution of multilevel caves in the Sierra de Atapuerca (Burgos, Spain) and its relation to human occupation. Geomorphology 196, 122–137 [2] Carbonell, E., Rosas, A., Díez, J.C. (Eds.) Atapuerca: Ocupaciones Humanas y Paleoecología del Yacimiento de Galería. Arqueología en Castilla y León 7. Valladolid [3 ]Pérez-González, A., Parés, J. M., Carbonell, E., Aleixandre, T., Ortega, A. I., Benito, A., Martín Merino, M. Á. (2001), Géologie de la Sierra de Atapuerca et stratigraphie des remplissages karstiques de Galería et Dolina (Burgos, Espagne), L'Anthropologie 105, 27-43 [4] Demuro, M., Arnold, L.J., Parés, J.M., Pérez-González, A., Ortega, A.I., et.al. 2014. New Luminescence Ages for the Galería Complex Archaelogical Site: Resolving Chronological Uncertainties on the Acheulean Record of the Sierra de Atapuerca, Northern Spain, Plos One 9(10), e110169 [5] García-Medrano, P., Ollé, A., Mosquera, M., Cáceres, I., Díez, C., Carbonel, E., 2014. The earliest Acheulean technology at Atapuerca (Burgos, Spain): Oldest levels of the Galería site (GII Unit), Quaternary International), http://dx.doi.org/10.1016/j.quaint.2014.03.053

Poster Presentation Number 76, Th (18:00-20:00)

## The cuboids from Sima de los Huesos (Atapuerca, Burgos, Spain)

**Adrián Pablos**[1,2,3,4], **Ana Pantoja-Pérez**[4], **Nohemi Sala**[4,5], **Ignacio Martínez**[3,4], **Juan Luis Arsuaga**[4,6]

1 - Centro Nacional de Investigación sobre Evolución Humana (Spain). · 2 - Paleoanthropology. Eberhard Karls Univ. Tübingen (Germany). · 3 - Cc de la Vida. Univ. Alcalá (Spain). · 4 - Centro Mixto UCM-ISCIII (Spain) · 5 - Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters Abteilung für Ältere Urgeschichte und Quartärökologie, Eberhard-Karls Universität Tübingen.· 6 - Dpto. Paleontología. Universidad Complutense de Madrid (Spain)

The preservation of *Homo* fossil foot remains prior to modern humans and Neandertals is very scarce throughout the fossil record. Several cuboid bones have been recovered belonging to genus *Homo* previous to Neandertals and modern humans (e.g. Jinniushan, OH8, Omo-Kibish 1, LB1 and those from *Homo naledi*). However, it is unknown exactly when the modern morphology of the cuboid has arisen and its morphological relationship with Neandertals.

In the Middle Pleistocene site of Sima de los Huesos (SH) more than 6,800 human fossil fragments, belonging to at least 28 individuals, have been recovered up to date. Using a variety of techniques, the hominin-bearing layer could be assigned to a period around 430 thousand years ago [1]. Morphologically, these fossils are believed to represent an ancestral European population that evolved into the Neandertals [1]. From this sample of human fossils, 22 correspond to cuboid bones, which represent more than the 40% of the *Homo* fossil record prior to *Homo sapiens* (more than 68% if we exclude the Neandertals). These 22 fragments correspond to a minimum of 18 elements from to at least 10 individuals (seven adult and three immatures). From the adult individuals identified in the sample, three of them are probably males and one likely belonged to a female individual [2]. Due to the evolutionary and morphological relationship between Neandertals and the Sima de los Huesos hominins [1, 3], important information can be extracted from the SH cuboids that is relevant to understanding the evolution of the Neandertal and modern foot.

The analysis of 15 metrical variables in the collection of the cuboid bones from the Sima de los Huesos site allows us establishing similarities or differences with other samples/populations. The cuboid of the Sima de los Huesos hominins, as that of Neandertals, is robust and antero-posteriorly short. Furthermore, the SH cuboids display long facets for lateral cuneiform and calcaneus. These last traits probably are related to the general robusticity of these hominins from the Middle Pleistocene [3]. Trinkaus [4] established a modern morphology of the Neandertal foot indistinguishable of modern humans in the implied locomotor capabilities. Nevertheless, this author established a pronounced wedging and a general robusticity for this bone in Neandertals relative to modern humans. In the cuboid bones from Sima de los Huesos this character is also observed through the wedging index, which is significantly lower than that in modern humans. The presence of a wedged cuboid in the Asian specimen of Jinniushan [5] suggests that this trait could be primitive in the last phases of genus *Homo*.

The conclusions of this study of the human cuboids from SH confirms the evolutionary relationship between this Middle Pleistocene population and the Neandertals as sister groups. Nevertheless, some traits in the foot, as well as those from the cranium and the other postcranial elements, allow us to differentiate the SH hominins and Neandertals. These results are also in accordance with the proposed large corporal size for the population from Sima de los Huesos and the primitive biotype of this hominins from the Middle Pleistocene [3].

We are deeply grateful to SH excavation team, especially to Ana Gracia and Carlos Lorenzo, and our colleagues from ISCIII. We are indebted to many people who have allowed access to some important skeletal collections. This research is funded by Junta de Castilla y León, Fundación Atapuerca, Ministerio de Economía y Competitividad of Spain (Projects CGL2012-38434-C03-01 & CGL-2015-65387-C3-2-P). We would like to thank also the BBP/R3 and "Grupo de Bioacústica Evolutiva y Paleoantropología (BEP)" research groups.

**References:**[1] Arsuaga, J.L., Martínez, I., Arnold, L.J., Aranburu, A., Gracia-Téllez, A., et.al. 2014. Neandertal roots: Cranial and chronological evidence from Sima de los Huesos. Science 344, 1358–1363 [2] Pablos, A., Pantoja-Pérez, A., Martínez, I., Lorenzo, C., Arsuaga, J.L., In press. Metric and morphological analysis of the foot in the Middle Pleistocene population of Sima de los Huesos (Sierra de Atapuerca, Burgos, Spain). Quaternary International 10.1016/j.quaint.2015.08.044 [3] Arsuaga, J.L., Carretero, J.M., Lorenzo, C., Gómez-Olivencia, A., Pablos, A., et.al. 2015. Postcranial morphology of the middle Pleistocene humans from Sima de los Huesos, Spain. Proceedings of the National Academy of Sciences 112, 11524-11529 [4] Trinkaus, E., 1975. A functional analysis of the Neandertal foot. Ph.D. Dissertation, University of Pennsylvania [5] Lu, Z., Meldrum, D.J., Huang, Y., He, J., Sarmiento, E.E., 2011. The Jinniushan hominin pedal skeleton from the late Middle Pleistocene of China. Homo - Journal of Comparative Human Biology 62, 389–401

Poster Presentation Number 18, We (17:00-19:00)

## A new methodological approach for analysing dental topographic variability

**Daniela Pacheco[1], Elisabeth Cuesta-Torralvo[2], Alejandro Romero[3], Mert Sarigöcek[2], Claudia Umbelino[1], Aroa Casado[1], Juan Manuel Becerra[1], Alejandro Pérez-Pérez[2]**

1 - Universidade de Coimbra · 2 - Universidad de Barcelona · 3 - Universidad de Alicantea

Traditional Geometric Morphometric methods for the characterization of dental crown topography are based on the definition of homologous landmarks on the dental crown. Frequently, these are the cusp tips, since they are reference points easily detectable on unworn teeth. In fact, in human populations occlusal crown loss is a frequent trait that has been used to characterize attritional patterns of tooth use in relation economic activities (hunter-gatherers, pastoralists, agriculturalists), sex related differences in tooth use or differences in dietary habits or access to food sources. Therefore, morphometric studies have focused on recently erupted, unworn teeth. As a consequence, sample sizes available for study were greatly limited and the reliability of the available samples in relation to age and sex fragmentation decreased. Ideally, the whole dental sample, including all age groups, should be considered. Dental crown shape changes through time by the effect of dental wear causing an increasing loss in cusp slope and crown height. Along this process, dental crown shape is expected to change through time. However, crown shape might not significantly change until the degree of occlusal wear severely affects crown relief. In this research we attempt a novel methodological approach to the study of dental topography that reflects the process of dental wear through time while preserving dental shape discrimination. The method is based on Geometric Morphometrics analyses [1] of pseudo-landmarks defining the relief and curvature of the dental crown, from the cement-enamel junction to the occlusal surface. Variable numbers of pseudolandmarks, from 600 to 4,800, were considered and differences in the results are compared. Inter-observer measurement error was computed, showing low levels of discrepancies. At the same time, measurements of dental crown curvature, relief and patch count were obtained to correlate with GM variability. These topographic variables were shown to vary depending on the number of point coordinates derived from the 3D scan process. Great levels of mesh manipulations were required to homogenized for point densities. To overcome this difficulty, an homogeneous 3D mesh with a fixed number of point coordinates was derived using the *digitsurface* command within Geomorph in R was used. The resulting topographies showed a consistent number of faces that provided comparative results for topographic analyses . The topographic variables defines were used as covariates for morphometric analysis of dental crown shape. A standardized methodological procedure is proposed for the study of significantly large collections of dental casts. The methods proposed requires definition of 8 homologous landmarks on dental crowns that are independent of the analysed molar tooth (M1 or M2, upper or lower), as well as of the degree of dental wear, dentine exposure or curs height. Classifier variables can be easily analysed for detecting dental shape and dental wear differences by sex, age groups, population, and even among different species, et least within the hominoidea primates.

**References:**[1] Adams DC, Otarola-Castillo E (2013)Geomorph: an R package for the collection and analysis of geometric morphometric shape data. *Methods in Ecol. & Evol.* 4, 393-399.[2] Winchester JM (2016) MorphoTester: An Open Source Application for Morphological Topographic Analysis. *PLoS One* 11(2), e0147649.

Poster Presentation Number 74, Th (18:00-20:00)

## Virtual assessment for the study of the cranial fractures. Application to the Sima de los Huesos hominin crania

**Ana Pantoja-Pérez[1], Nohemi Sala[1,2], Juan Luis Arsuaga[1], Adrián Pablos[1,2,3,4], Ignacio Martínez[4]**

1 - Centro Mixto UCM-ISCIII · 2 - Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters Abteilung für Ältere Urgeschichte und Quartärökologie, Eberhard-Karls Universität Tübingen. · 3 - Centro Nacional de Investigación sobre Evolución Humana (Spain). · 4 - Cc de la Vida. Univ. Alcalá (Spain).

A differential diagnosis between fresh bone fractures (antemortem and perimortem) and dry bone fractures (postmortem) allows for an interpretative approach to the cause of death (in forensic sciences), to the behavior of the populations studied (in anthropology) and to the taphonomic processes involved in the site formation (in archaeological contexts) [1]. The timing of antemortem (i.e. before death) fractures, perimortem trauma (i.e. at or around the time of death), and postmortem modifications (i.e. occurring after death) is discernible [2], especially in cranial remains. Fossil hominin crania can provide valuable information about the taphonomic processes from the individual's death until its excavation and, therefore, about the formation processes of the site. The Sima de los Huesos (SH) site has provided a large cranial collection composed of more than 1,850 bone fragments. Of these, 565 cranial fragments have been fitted together to form 17 individual crania [3]. This collection offers an unprecedented opportunity to perform a complete forensic taphonomic study of a population from the Middle Pleistocene. In order to determine the timing (perimortem vs. postmortem) of cranial bone fracturing and the possible causes of perimortem injuries (accidental vs intentional) of skull bone fracture of the SH sample, we studied the following parameters: fracture type, fracture location, fracture trajectory, fracture angle, presence/absence of cortical delamination and edge texture. 3D imaging provides an opportunity to analyze critical aspects of the fracture properties, especially when the different cranial fragments are glued together. The SH crania were CT scanned in the coronal plane using an industrial YXLON MU 2000- CT scanner. CT images were used to assess cranial fractures and accurately assess fracture timing. Virtual (3D CT) models of each cranium were generated from the resulting slices using the Mimics 16.0 (Materialise N.V.) software package. Both, fracture angle and cortical delamination were measured on the virtual reconstructions using Mimics 16.0 software tools. The results of the present study show that the main fracturation in SH occurred during the dry bone stage and are obviously postmortem fractures. Using a comparative study, the fracture properties are similar to those described in the bibliography for intentional burials of archaeological collections, as well as to the study of fracture patterns in *Homo* specimens (Neandertals and Late Paleolithic *Homo sapiens*) interpreted as intentional burials. Nevertheless, a small portion (around 4% of the fractures analyzed) display the criteria considered to be perimortem traumas and are present in Cr-3, Cr-5, Cr-7, Cr-9, Cr-11, Cr-13, Cr-14 and Cr-17. This proportion is similar to those found in the postcranial remains studied previously by classic taphonomic methodologies [3], indicating that virtual techniques operate successfully. The results show that interpersonal violence can be confirmed in one of the skulls, Cr-17 [4]. For the rest of the crania, although we cannot rule out that the perimortem fractures could be caused by the free fall down the vertical shaft that gives access to the SH chamber, the similarity of the traumatic fractures and their similar location makes the violence-related scenario the most plausible. This virtual approach to the study of breakage patterns on hominin fossils allows the application of both taphonomic and forensic criteria, including trauma analysis, that are crucial to approaching the study of the behavior of ancient populations. It is a clear example of how the virtual paleontology can help elucidate fundamental aspects of hominin behavior.

The authors wish to thank to the Atapuerca research and excavation team, especially those involved in the excavations at the Sima de los Huesos site. CT scanning was carried out in collaboration with the Laboratorio de la Evolución Humana at the Universidad de Burgos (Spain). Thanks also to the MNHN curators for providing CT data of some fossil specimens. Field work at the Sierra de Atapuerca sites was financed by the Junta de Castilla y León and the Fundación Atapuerca. The research was funded by the MINECO project CGL2012-38434-C03-01. Thanks also to the Fundación Atapuerca (Predoctoral grant to APP in 2015 and Postdoctoral grant to NS in 2014). This research received support from the SYNTHESYS Project http://www.synthesys.info/ which is financed by European Community Research Infrastructure Action under the FP7 "Capacities" Program.

**References:**[1] Jordana, F., Colat-Parros, J., Bénézech, M., 2013. Breakage patterns in human cranial bones. Romanian J. Leg. Med. 21, 287-292.[2] Wedel, V.L., Galloway, A., 2014. Broken bones: Anthropological analysis of blunt force trauma. Charles C. Thomas, Springfield, IL. [3] Arsuaga, J.L., Martínez, I., Arnold, L.J., Aranburu, A., Gracia, A., et.al. 2014. Neandertal roots: Cranial and chronological evidence from Sima de los Huesos. Science 344, 1358-1363.[4] Sala, N., Arsuaga, J.L., Martínez, I., Gracia-Téllez, A., 2015a. Breakage patterns in Sima de los Huesos (Atapuerca, Spain) hominin sample. J. Archaeol. Sci. 55, 113-121.[5] Sala, N., Arsuaga, J.L., Pantoja-Pérez, A., Pablos, A., Martínez, I., et.al. 2015b. Lethal interpersonal violence in the Middle Pleistocene. PLoS ONE 10, e0126589.

Podium Presentation: Session 5, Fr (11:30)

## Extending the chronostratigraphy at Gran Dolina archaeological site, Atapuerca

**Josep M. Pares[1], Claudia Alvarez[1], Mark Sier[2], Mathieu Duval[1], Ana I. Ortega[3], Jordi Rosell [4], José M. Bermúdez de Castro [1], Eudald Carbonell[4]**

1 - CENIEH · 2 - Utrecht University, Leiden University · 3 - Fundación Atapuerca-CENIEH · 4 - IPHES-URV

Numerous key findings at the Lower Paleolithic cave site of Gran Dolina, Sierra de Atapuerca, northern Spain, have led to major advancements in our understanding of human evolution and occupation of Eurasia [1]. The Gran Dolina site has produced thousands of fossils and artifacts since 1995, when the first hominin remains were reported, and has become a Pleistocene landmark in studies on early human settlement outside the African continent. Specifically the stratigraphic layer TD6 has yielded over 90 human fossil remains, more than 200 lithic artifacts, classified as Mode 1, as well as several thousand small and large vertebrate animal remains [2]. Paleomagnetic dating has always been the first line of attack in providing the chronologies, not only in Atapuerca, but in a vast number of archaeo/paleontological localities. The original paleomagnetic dating at Gran Dolina, twenty years ago, revealed a switch from reverse to normal geomagnetic polarity above TD6 level, interpreted as the Matuyama-Brunhes boundary, and hence revealing a minimum age of 0.78 Ma for the archaeological layer [3]. Subsequent chronometric analysis by Electron Spin Resonance (ESR) and luminescence further reinforced the paleomagnetic age, and currently an age of around 0.85 Ma is accepted for TD6 level [4]. About four meters below TD6, stratigraphic layer TD4, a breccia of boulder-size clasts in a muddy matrix, is known to contain archaeological artifacts although no human fossil has been found yet. The chronology of the ensemble TD4-TD5 levels is constrained by ESR dates on quartz grains and ranges between 0.9 to 1.13 Ma [5]. Such ages overlap with the Jaramillo Subchron (0.9-1.07 Ma) and therefore paleomagnetism allows testing whether TD4 and associated lithic tools has a pre or post-Jaramillo age. In addition, and thanks to the progress of the excavation during the past five years, it has been possible to reach lower and hence older stratigraphic layers than TD4, expanding by ten more meters the current stratigraphic profile. We therefore extended by 16 meters the reversal magnetic stratigraphy below the MB boundary recorded in TD7/TD8, with the aim of detecting the presence of older subchrons along the Gran Dolina section that allow placing additional time lines to the sedimentary infill. Specifically we collected oriented samples from layers TD6 to TD4 and up to ten meters below, including laminated clastic deposits that precede the opening of large entrances to the cave. Samples were taken in red clays and sandy clays units when possible, using either standard 8 cc plastic boxes or else small cubic block were cut with a non magnetic knife. Most samples generally show stable behavior during demagnetization and both alternating field and thermal produce give similar results. Maximum peak fields of about 40 mT were high enough to isolate the Characteristic Remanent Magnetization (ChRM) directions, or temperatures of around 500oC. Both observations suggest that magnetite is the main carrier of stable remanence in the sediments. Hysteresis curves are also indicative of a low coercivity magnetic phase, and the associated ratios reveal magnetite in the pseudo-single domain. Virtual Geomagnetic Pole (VGP) positions reveal the presence of a normal magnetozone well below the MB boundary, and its significance and implications will be discussed in the light of the available chronometric data and the most recent geomagnetic polarity time scale.

**References:**[1] Carbonell, E., Bermúdez de Castro, J.M., Arsuaga, J.L. et al. 1995. Lower Pleistocene hominids and artifacts from Atapuerca-TD6 (Spain). Science 269, 826-829.[2] Bermúdez de Castro, J.M., Arsuaga, J.L., Carbonell, E., Rosas, A., Martínez, I., Mosquera, M. 1997. A hominid from the lower Pleistocene of Atapuerca, Spain: possible ancestor to Neandertals and modern humans. Science 276, 1392–1395.[3] Parés, J.M. & Pérez-González, A. 1995. Paleomagnetic age for hominid fossils at Atapuerca Archaeological site, Spain. Science 269: 830-832.[4] Parés, J.M., Lee., A., Duval., M., Demuro, D., Pérez-González, A., Bermúdez de Castro, J.M., Carbonell, E., and Arsuaga, J.L., 2013. Reassessing the age of Atapuerca TD-6 (Spain): New paleomagnetic data, Jour. Archaeol. Sci. 40, 4586–4595.[5] Moreno, D., Falguères, C., Pérez, A., Voinchet, P., Ghaleb, B., Despriée, Bahain, J.J., Sala, R., Carbonell, E., Bermúdez de Castro, J..M., Arsuaga, J.L. 2015. New radiometric dates on the lowest stratigraphical section (TD1 to TD6) of Gran Dolina site (Atapuerca, Spain). Quat. Geochron. 30, 535-540.

Poster Presentation Number 43, We (17:00-19:00)

## Recycling for functional needs: case study from the Late Lower Paleolithic site of Qesem Cave Israel

**Yoni Parush**[1], **Flavia Venditti**[2]

1 - Tel-Aviv University · 2 - Roma University

Qesem Cave is a Middle Pleistocene site in Israel, assigned to the Acheulo-Yabrudian Cultural Complex of the Late Lower Paleolithic Levant. The cave yielded rich and well preserved lithic and fauna remains that revealed a broad set of innovative behaviors. One of the most surprising phenomena documented during the excavations and analysis of the lithic finds includes unprecedented evidence for the production of small and sharp items by means of recycling along the two hundred thousand years during which the cave was inhabited [1,2]. Although identifying lithic recycling may sometimes be difficult, due to the subtractive nature of this technology, understanding its role in assemblage variability and the prime movers behaind recycling behavior have significant implications on the interpretation of lithic assemblages and human behavior. The possible prime movers for lithic recycling in the Paleolithic can be due to raw-material constrains and availability; a form of the technology of the assemblage (i.e., curated or expedient behaviors) or due to a functional need (i.e., in order to create specific working edges and specific morphologies of tools). This presentation will present the possible reasoning behind recycling behavior at Qesem Cave. At Qesem we have found, that though, raw-material is very abundant in the vicinity surrounding of the cave [3], recycling behavior is significantly present in all contexts and layers. Following a detailed technological analysis in which we identified thousands of recycled items, we are able to reconstruct several recycling modes: handaxes recycled as cores; patinated blanks recycled as scrapers; patinated cores recycled/reused as "regular" cores; and small blanks production from previously discarded parent blanks. In this presentation we will focus on the mode of recycling that uses previously discarded parent blanks (cores-on-flakes) in order to produce from them smaller and very sharp blanks. The results from a detailed techno-typological study show that these blanks are the desired end products, and are characterized by a functional regular and very sharp edge, a standardized morphology, and areas that allow for a comfortable grip. In addition, these items can be divided into two types of items, depending on their morphology and the location from which they were removed from the parent blanks: regular items-removed from the ventral face of the parent blank in a flat and straightforward manner;and lateral items that were removed in a longitudinal axis of the parent flake taking the lateral edge and part of the ventral face of the parent blank. Use-wear was found on 31% (n= 131) out of 417 analyzed items produced from the discarded parent flakes and only on 15% of the parent blanks suggests that these items were the desired end products that answer a functional need. The use wear analyses show that regular items were mainly used for cutting soft tissues (e.g., meat) and lateral items were mostly used for the processing of vegetation. Thus, it seems that this form of recycling using existing blanks for the production of smaller flakes was not made due to a lack of raw materials, but probably due to specific decision making about what types of tools were needed for the tasks at hand. The formal characteristics of the recycled items were extremely specific. The blanks had very sharp and regular edges, with standardized morphology. Reconstructing the chaîne opératoire of these items contributes to our understanding of human behavior and the activities carried out at the cave. It appears that products of lithic recycling at Qesem Cave reflect a decision-making process that followed a repetitive set of rules and conceptions. It seems to us that the Qesem Cave knappers had a clear conception for the production of small flakes and blades from previous, larger parent flakes or blades that reflects a deliberate and planned action.

The Qesem Cave field work and lithic analysis are supported by the Israel Science Foundation, the Leakey foundation, the Dan David foundation and by CARE archaeological foundation.

**References**:[1] Lemorini, C., Assaf, E., Parush, Y., Barkai, R. & Gopher, A. 2015. Functional Meaning of Recycling at Qesem Cave, Israel: An Overview of the Use-Wear Data. Quaternary International 361: 103-112.[2] Parush, Y., Assaf, E., Slon V., Gopher, A., & Barkai, R. 2015. Looking for Sharp Edges: Modes of Flint Recycling at Middle Pleistocene Qesem Cave, Israel. Quaternary international 361: 61-87.[3] Wilson, L., Agam, A., Barkai, R., Gopher, A. 2016. Raw Material Choices in Amudian versus Yabrudian Lithic Assemblages at Qesem Cave: A Preliminary Evaluation. Quaternary International 398: 61-69.

Poster Presentation Number 100, Th (18:00-20:00)

## Innovations in Isotopes: Plant Biomarkers and the Environmental Context of the Earliest Acheulean, Olduvai Gorge

**Robert Patalano[1], Makarius Itambu[2], Fernando Diez-Martín[3], Manuel Domínguez-Rodrigo[4], Julien Favreau[1], Patrick Lee [1], Audax Mabulla[5], Laura Tucker[1] Julio Mercader[1]**

1 - Department of Anthropology and Archaeology, University of Calgary · 2 - Department of Anthropology and Archaeology, University of Calgary & Departmentof Archeology and Heritage, University of Dar es Salaam · 3 - Department of Prehistory and Archaeology, Universidad de Valladolid · 4 - Department of Prehistory, Universidad Complutense Madrid · 5 - National Museum of Tanzania

Paleoenvironmental studies focusing on human evolution provide insight into hominin adaptation to ecological variables in diverse habitats. Emerging techniques in the reconstruction of Pleistocene environments involve using biological markers to understand ecological variables. Plant biomarkers, such as normal (n-) alkanes, are chemically inert and resistant to biodegradation in sediments over geologic time, making them excellent compounds to investigate human-environment interactions. These molecules serve as proxy measures of the continental vegetation that synthesized them, but also for the isotopic contents of environmental carbon and hydrogen incorporated during plant biosynthesis. Hydrogen and carbon isotopes act as a proxy record for changes in water availability, vegetation communities, precipitation or aridity, evapotranspiration of leaf and soil moisture, and the relative abundance of C3 and C4 plants in response to climate changes [1, 2]. The Frida Leakey Korongo West (FLK-W) archaeological site of Olduvai Gorge (Bed II) offers a unique opportunity to investigate climatic triggers and technological innovations, and the impact on human evolution. FLK-W provides evidence of the earliest Acheulean, dating to c. 1.7 Ma, and the oldest, most sophisticated symmetrical and bifacially flaked handaxe in the world. The site consists of a  40 m wide and 130 cm deep fluviatile river channel infilled with a sequence of six archaeo-stratigraphic levels . This channel represents a high-energy depositional environment, isolated in a wide and flat area that includes concentrations of hominin activities situated near paleo-lake Olduvai. The lowermost levels (L5 and L6) are the most dense and important in terms of their archaeological contents. Based upon a recent geologic model, the FLK-W sequence is dated between 1.698±0.015 Ma and 1.664±0.019 Ma, and consists of fluviatile conglomerates and sands fixed within a clay unit at the base of Bed II . We present a high-resolution isotopic analysis of molecular carbon (δ13C) and hydrogen (δD) from n-alkane biomarkers sampled throughout the 130 cm sedimentary sequence. Twenty-five samples were collected through the six archaeological levels in order to reveal climate changes that coincided with the early appearance of Acheulean stone tools. Samples were collected in a 2 cm high, by 9.5 cm wide (on average), by 4.5 cm deep (on average) arrangement, with 4 cm intervals between each sample. This strategy allowed for a thorough investigation into the climate conditions over the roughly 300,000-year period exposed at FLK-W, by utilizing Gas Chromatography Isotope Ratio Mass Spectrometry to quantify carbon and hydrogen isotopes extracted from sediment samples. Although abundant environmental data exist for Olduvai Gorge, very few studies have utilized hydrogen and carbon isotope compositions of n-alkanes from terrestrial sources [4, 5]. Our results from the FLK-W sediments show that plant biomarkers are a valuable analytical tool for understanding the association between ecological variables and Acheulean stone tools. Furthermore, this study represents an innovative application for plant biomarker research in Olduvai Bed II. The work presented represents a step forward in applying new analytical methods to interpret the environmental component within the framework of evolutionary change in hominins throughout the Pleistocene.

This research was made possible by the Social Sciences and Humanities Research Council of Canada and the University of Calgary's Eyes High International Doctoral Scholarship program.

**References:**[1] Liu, W., Yang, H., Li, L., 2006. Hydrogen isotopic compositions of n-alkanes from terrestrial plants correlate with their ecological life forms. Oecologia 150, 330-338.[2] Lockheart, M.J., van Bergen, P.F., Evershed, R.P., 1997. Variations in the stable carbon isotope compositions of individual lipids from the leaves of modern angiosperms: implications for the study of higher land plant-derived sedimentary organic matter. Organic Geochemistry 26, 137-153.[3] Diez-Martín, F., Sánchez Yustos, P., Uribelarrea, D., Baquedano, E., Mark, D.F., Mabulla, A., Fraile, C., Duque, J., Díaz, I., Pérez-González, A., Yravedra, J., Egeland, C.P., Organista, E., Domínguez-Rodrigo, M., 2015. The Origin of The Acheulean: The 1.7 Million-Year-Old Site of FLK West, Olduvai Gorge (Tanzania). Nature Scientific Reports 5, 1-9.[4] Magill, C.R., Ashley, G.M., Freeman, K.H., 2013. Water, plants, and early human habitats in eastern Africa. Proceedings of the National Academy of Science 110, 1175-1180.[5] Magill, C., Ashley, G.M., Freeman, K., 2013a. Ecosystem variability and early human habitats in eastern Africa. Proceedings of the National Academy of Science 110, 1167-1174.

Poster Presentation Number 53, We (17:00-19:00)

## New insights on the lithic assemblage of Gruta Nova da Columbeira

**Telmo Pereira**[1], **Claudia Manso**[2], **Eduardo Paixao**[1]

1 - ICArEHB - FCHS, University of Algarve, PORTUGAL · 2 - Museu Municipal do Bombarral, PORTUGAL

Gruta Nova da Columbeira is a cave site found in 1962 on a karstic canyon located in the Western Coast of Portugal, due to the exploitation of a limestone quarry. The excavation almost emptied a room with c. 20m long by 2m (min.) and 7m (max.) in 52 days. The sedimentary deposit consists in two main sectors: a sequence of Mousterian layers and a sequence of Upper Paleolithic layers. This last seems to truncate the first. Based on a set of old and new U-series dates Zilhão et al [1] propose the Mousterian sequence to be dated between 101.5/-55.9/+38.4 ka and 35.9/-35.6/+27.3ka ($1\sigma$), while the Upper Paleolithic one between 28,900±950 and 14,800±120, based on a set of new 14C dates. Both deposits are rich in lithics, fauna, charcoal and from the Mousterian set was even possible to recovered a human tooth. Together, these two deposits make Columbeira one of the very few long Middle-Upper Paleolithic sequences in Portugal and, consequently, relevant for the interpretation of the Middle-Upper Paleolithic transition in the western-most Eurasia. In this poster we present the preliminary results of the analysis done on the lithic assemblage, especially focusing the technological and typological traits. Our results show that the presence of chert, quartzite and quartz is fairly even through the Mousterian sequence, but chert is more frequent in the Upper Paleolithic, with frequencies differing from layer to layer. Chert has a wide variability suggesting a multiplicity of sources or a secondary source – such as gravels – feed by nodules coming from different places. The Upper Paleolithic sequence is marked by typically prismatic debitage and retouched tools on elongate blanks, while the Middle Paleolithic one is marked by levallois, discoidal, centripetal and chopper-like cores to produce levallois flakes, pseudo-levallois points, and blades, many of them retouched into sidescrappers, denticulates and notches. Our analysis also showed a considerable amount of piece esquilee in quartz, a type of artifact never been reported for the site. With these preliminary results it was possible to bring Columbeira to the discussion of the Middle-Upper transition using new data and also to make the first tentative to relate the discreet shifts seen in the Mousterian assemblage with the shifts seen in the paleoecological record.

We would like to thank Museu Municipal do Bombarral for letting us study the assemblage of Gruta Nova da Columbeira.

**References:**[1] Zilhão, J., Cardoso, J., Pike, A., Wenninger, B. 2011 Gruta Nova da Columbeira (Bombarral, Portugal): Site stratigraphy, age of the Mousterian sequence, and implications for the timing of Neanderthal extinction in Iberia. Quartär. 58, 93-112.

Poster Presentation Number 69, Th (18:00-20:00)

## The brain and the braincase: fronto-temporal morphology and the orbital space

**Sofia Pereira-Pedro**[1], **Michael Masters**[2], **Emiliano Bruner**[1]

1 - Centro Nacional de Investigación sobre la Evolución Humana, Burgos, Spain · 2 - Montana Tech of the University of Montana, Butte, MT, USA

Modern human skulls are characterized by globularity of the neurocranium, increased flexion of the cranial base, and reduced faces. During morphogenesis, the facial block, the braincase and the cranial base exert reciprocal influences, channelling variation and introducing structural constraints [1]. The contiguity between orbits and endocranial elements may generate a spatial conflict during growth and development, leading to minor deformation of the orbital axis, with possible effects on vision [2]. In this shape analysis, we evaluated whether and to what extent the morphology of the middle and anterior endocranial fossae covary with orbital form in a sample of adult modern humans. We also considered the same relationships in human fossils belonging to species in which there is only a partial overlap between frontal lobes and the orbital roof, such as in *Homo erectus* and *Homo heidelbergensis*. We used tomographic lateral scout views in 2 dimensions after projection of the CT stacks, so as to overlap midsagittal and parasagittal elements into the same plane, in order to evaluate longitudinal shape changes of the orbital space. Variation within modern humans is mostly influenced by the orientation of the orbits and frontal lobes, the vertical dimensions of the orbital aperture, and the spatial relationship between the anterior and middle fossae. Despite minor patterns of morphological integration, the orbits do not seem to be particularly influenced by the relative position of the frontal and temporal lobes. Fossil specimens display larger and more protruding faces, and a more pronounced separation between the face and temporal poles. However, in modern humans the temporal tips are positioned more anteriorly than in fossil species, beyond the optic channel [3]. Our analysis shows that this shift of the temporal tips is subtle, and mostly when compared with the patent longitudinal deformation of the orbital area. Although this change is also associated with bulging of the frontal areas, orbits in modern humans undergo a marked horizontal flattening, but not a relative vertical flattening. It must be evaluated whether or not, beyond a direct morphological effect, such a pattern of variation is associated with changes in visual acuity.

Sofia Pereira-Pedro is funded by a grant of the Atapuerca Foundation, Spain. Michael Masters is funded by Montana INBRE - National Institute of General Medical Sciences of the National Institutes of Health, award number 8 P20 GM103474-12. Emiliano Bruner is funded by the Spanish Government (CGL2012-38434-C03-02). Digital data come from the University of Vienna (Bodo), the National Museum of Kenya (KNM-ER3883), and from the EVAN/NESPOS collections (modern humans and Kabwe).

**References:**[1] Bastir, M., Rosas, A., 2005. Hierarchical nature of morphological integration and modularity in the human posterior face. Am. J.Phys. Anthropol. 128, 26–34.[2] Masters, M.P., 2012. Relative size of the eye and orbit: An evolutionary and craniofacial constraint model for examining the etiology and disparate incidence of juvenile-onset myopia in humans. Med. Hypotheses. 78, 649–656.[3] Bastir, M., Rosas, A., Lieberman, D.E., O'Higgins, P., 2008. Middle cranial fossa anatomy and the origin of modern humans. Anat. Rec. 291, 130–140.

Poster Presentation Number 44, We (17:00-19:00)

## Human-birds interactions during the Pleistocene in Southern Europe. An updated review

**Marco Peresani** [1], **Ruth Blasco**[2]

1 - University of Ferrara, Italy · 2 - Centro Nacional de Investigación sobre la Evolución Humana, Burgos, Spain

Investigations into hominin diets, specifically those of the Neanderthals, ineluctably feed into debates that revolve around the presumed capabilities, or lack thereof, of these hominins in the exploitation of small game as a food resource [1]. This is the case of the human-bird relationship, so common nowadays but which provides a fascinating and somewhat controversial debate if we look back to the past. Birds appear to have always played a marginal or even non-existent role as a food source among the hominins that preceded anatomically modern humans. This is due to the birds' characteristics as small prey that is difficult to capture essentially due to their ability to fly and their elusiveness. Nevertheless, the fact is that in the late Palaeolithic (and before the emergence of productive economies), the presence of fast small mammals and quick-flying small animals appears to multiply in sites with anthropic presence. This led us to associate the intensive exploitation of these animals with anatomically modern humans, offering a variety of answers to this change in the selection of resources derived from parameters such as population growth and environmental, hunting and/or technological pressure [1]. However, these principles are based on theoretical and predictive models of human behaviour and the environment and they suggest further research to explore other possible variables that may cause certain alterations in the selection of resources, e.g. factors related to nutritional ecology, site functionality, mobility of human groups and/or sociocultural factors. In addition, the animals do not only provide meat but also other edible and non-edible resources that could substantially alter the predictions within the Optimal Foraging Theory [2] at certain times.

In the last few years, several studies have shown direct evidence of the anthropogenic use of birds prior to the arrival of anatomically modern humans in Europe, and especially from Late Pleistocene sites associated with Middle Palaeolithic industries. This evidence includes avian exploitation not only as a food source –either to complement the diet or as occasional sources– but also for the presumably ornamental use of their feathers, and the talons of large raptors [3]. These recent findings not only raise the possibility that other species of the Homo genus were able to occasionally vary the selection of resources according to certain variables (ability to adapt to the environment), but also reopen debates on cognitive, behavioural and symbolic skills among hominids of Neanderthal lineage.

Aside an ethnographic and historical perspective in bird studies, as well as on their potential to carry out palaeoclimatic and biogeographical reconstructions [4], the topics of our contribution mostly concern taphonomic studies (also based on experimental tests) of avian sets from the Middle Pleistocene and early Late Pleistocene, focusing on those generated in Neanderthal contexts of the Mediterranean Rim [5]. In all of them we observe the aforementioned dichotomy of human use of birds compared with anthropogenic sets in which no marks have been detected to link them to human activity.

The role of birds in assessing the complexity of Hominin subsistence and symbolic behavior plays an indisputable role, especially when the evidence of avifaunal resource exploitation occurs in different periods and cultures. Although their contribution in the diet balance is far from the amount of protein provided by herbivore prey, birds in the sites surroundings might be not an elusive resource, possibly favored by the ecological conditions. These conditions are not unique in the contexts taken into account and stimulate future investigations.

**References:**[1] Stiner, M.C., Munro, N.D., 2002. Approaches to prehistoric diet breadth, demography, and prey ranking systems in time and space. Journal of Archaeological Method and Theory 9, 181-214. [2] Smith, E.A., 1983. Anthropological applications of optimal foraging theory: a critical review. Current Anthropology 24, 625-651. [3] Romandini, M., Peresani, M., Laroulandie, V., Metz, L., Pastoors, A., Vaquero, M., Slimak, L., 2014. Convergent evidence of Eagle talons used by Late Neanderthals in Europe: a further assessment on symbolism. PLoS One 9 (7), e101278. [4] Negro, J.J., Blasco, R., Rosell, J., Finlayson, C., in press. Potential exploitation of avian resources by fossil hominins: An overview from ethnographic and historical data. Quaternary International, http://dx.doi.org/10.1016/j.quaint.2015.09.034 .[5] Blasco, R., Peresani, M. (eds), in press, Human-bird interactions in Prehistory. The humankind and the avian world: zooarchaeological evidence for inferring behavioural evolutionary signatures. Quaternary International.

Pecha Kucha Presentation: Session 10, Sa (15:25-15:50)

## Buccal dental microwear patterns in African hominines support greater dietary specialization than previously thought

**Alejandro Pérez-Pérez[1], Laura Mónica Martínez[1], Ferran Estebaranz[1], Jordi Galbany[2], Alejandro Romero[3]**

1 - Universitat de Barcelona · 2 - George Washington University · 3 - Universidad de Alicante

There is much debate on dietary adaptations of the robust hominin lineages during the Pliocene-Pleistocene transition. The shift from C3 to C4 ecosystems in Africa has been argued as the main factor responsible for the robust dental and facial anatomical adaptations of *Paranthropus* taxa, indicative of consumption of hard plant foods in open environments. However, occlusal dental microwear data fail to provide evidence of such dietary adaptation and are not consistent with isotopic evidence that support greater C4 food intake for the robust clade than for the gracile australopicethines. We provide independent evidence from buccal dental microwear data [1] that supports softer dietary habits for all the paranthropine taxa, *P. aethiopicus*, *P. boisei*, and *P. robustus*, than expected based both on masticatory apomorphies and isotopic analyses. The South africa robust taxon shows, though, dietary specializations that diverge from those of the East African ones. In addition, *A. africanus* more closely resembles the hominoidea from closed, forested areas [2] and *A. afarensis* [3] and *A. anamensis* [4] show very distinct microwear patterns that suggest significant dietary diversification and specializations in the hominin clade that previously expected. In particular, *A. anamensis* shows a highly specialized diete based on consumption of hard and brittle nuts and seeds, resembling the cercopitecoidea primates from open environments, such as *Papio* and *Theropithecus*. Striation densities on buccal enamel surfaces of *H. habilis* are low, not resembling those of *H. ergaster* that display high densities of scratches not consistent with a highly specialized, mostly carnivorous diet, independently of the significance of scavenging and hunting activities, and support consumption of a wide rage of highly abrasive foodstuffs. The results question a strict interpretation of isotopic evidence as a dietary indicator for hominines, as well as some interpretations based on occlusal microwear analyses, in particular that of *A. anamensis*, since some occlusal microwear texture variables do not show enoght interspecific variability.

We thank the curators of all the institutions that granted permission for studying the hominin specimens. This research was funded by Spanish MEC projects BMC2004, BMC2007 to APP.

**References:**[1] Romero A, Galbany J, De Juan J, Pérez-Pérez A (2012) Brief communication: short and long-term in vivo human buccal-dental microwear turnover. *Am J Phys Anthropol* 148, 467–472.[2] Galbany J, Estebaranz F, Martínez LM, Pérez-Pérez A (2009) Buccal dental microwear variability in extant African Hominoidea: taxonomy vs. ecology. *Primates* 50, 221–230.[3] Estebaranz F, Martínez LM, Galbany J, Turbón D, Pérez-Perez A (2009) Testing hypotheses of dietary reconstruction from buccal dental microwear in Australopithecus afarensis. *J Hum Evol* 57, 739–750.[4] Estebaranz F, Galbany J, Martínez LM, Turbón D, Pérez-Pérez A (2012) Buccal microwear analyses support greater specialization in consumption of hard foodstuff for Australopithecus anamensis. *J Anthrop Sci* 90, 1–24.

Podium Presentation: Session 7, Fr (17:40)

## Short-term occupations at the lakeshore: a technological reassessment of Königsaue open-air site

**Andrea Picin**[1,2]

1 - Bereich für Ur- und Frühgeschichtliche Archäologie, Friedrich Schiller Universität Jena, Germany · 2 - Neanderthal Museum, Mettmann, Germany

In the last decades, an increasing number of studies has been focused on the understanding of the settlement dynamics and movements of Palaeolithic hunter-gatherers on the landscape. The fundamental concepts of these investigations are based on the works of Binford [1] whom firstly contributed to the comprehension of the mobility settlements and types of anthropogenic occupations in modern foragers. In his model, Binford [1] proposed the differentiation between residential mobility, in which all members of the group displaced from locality to another, and logistical mobility, in which only few individuals moved from the residential camp for specialized tasks. In this perspective, residential mobility is associated with domestic activities in long-/short-term settlements (residential camps) whereas logistical mobility is related with short-term occupations (locations) served as hunting stations, killing sites or bivouacs. Ethnographic studies documented that hunters-gatherers relocate frequently in order to avoid foraging in previously depleted areas and that the frequencies of these movements are influenced by the richness of biotic resources.

North-central Europe is an interesting area to study the mobility of hunters-gatherers since during the Pleistocene, the different climatic oscillations affected the extent of ecological habitats and the spread of vegetal and animal species between the different regions. From a technological point of view, Central Europe, between MIS 5-3, document lithic assemblages characterized by the production of *Keilmesser* knives or by the use of Levallois technology and the absence of bifacial tools [2]. An important site that documented the succession of *Keilmesser* and Levallois-Mousterian facies in Central Europe is Königsaue (Aschersleben, Germany), an open-air site located on the shore of the Aschersleben Lake, an ancient lake that was silted up in historic times [3]. This paper aims to contribute with new data to the debate on the mobility of prehistoric hunter-gatherers, by exploring the lithic assemblages from levels A, B and C of Königsaue.

The results of the technological analysis document the use of Levallois technology in the modalities preferential and recurrent uni-bidirectional in all archaeological levels. In the lithic assemblages are also common unidirectional, discoid and hierarchized cores. In levels A and C, within *Keilmesser* knives and bifacial tools have been recorded some flakes characteristics of bifacial shaping. The small amount of these blanks suggests that these tools were only reshaped and not produced at the site. In Level B, these byproducts are absent. A comparison between the archaeological materials and the results of experimental knapping on Levallois technologies [4,5] indicate high fragmentations of the *chaînes opératoires*. In levels A and C, Levallois cores were exported off-site whereas in level B Levallois flakes were transported off-site. The study proposes that levels A and C could be interpreted as repeated short-term occupations of logistical mobility. Conversely in level B, the fragmentation of the operative chains and the few faunal remains discovered, support the hypothesis of repeated short-term occupation of residential mobility. The changes in the transported toolkits suggests that the differences between *Keilmesser* and Levallois-Mousterian facies in Central Europe could be related to different mobility patterns and land use.

The author would like to thank Prof. Dr. Harald Meller, director of the Landesamtes für Denkmalpflege und Archäologie Sachsen-Anhalt (Halle, Germany), for the permission to study the Königsaue materials, and Dr. Roman Mischker and Dr. Bettina Stoll-Tucker for their kind assistance during his research stay. The author would also like to thank Dr. Michel Brenet for giving the permission of using the experimental data of his PhD thesis. A. Picin is beneficiary of the Alexander von Humboldt Postdoctoral Research Fellowship.

**References:**[1] Binford, L. R. 1980. Willow smoke and dogs' tail: Hunter-gatherer settlement system and archaeological site formation. Am. Antiq. 45, 4-20 [2] Conard, N.J., Fischer, B., 2000. Are there recognisable cultural entities in the German Middle Palaeolithic?. In: Ronen, A., Weinstein-Evron, M. (Eds.), Toward Modern Humans: the Yabrudian and Micoquian 400-50 K-years. B.A.R. International Series 850, Oxford, pp. 7-24 [3] Mania, D., Toepfer, V., 1973. Königsaue. Gliederung, Ökologie und mittelpaläolithische Funde der letzten Eiszeit, Berlin [4] Brenet, M., 2011. Variabilité et signification des productions lithiques au Paléolithique moyen ancien. L'exemple de trois gisements de plein-air du Bergeracois (Dordogne, France). PhD Dissertation, Université Bordeaux 1, Bordeaux [5] Picin, A., 2014. The technological change in the Western Mediterranean during the MIS 3. PhD Dissertation, Universitat Rovira I Virgili, Tarragona.

Podium Presentation: Session 8, Sa (8:30)

## Reconstructing Neanderthal mobility and range at Gruta da Oliveira, Portugal, using high resolution laser ablation Sr isotope analysis

**Alistair W.G. Pike[1], Diego Angelucci[2], Matthew J. Cooper[3], Bethan Linscott[4], Henrique Matias[5], João Zilhão[5,6,7]**

1 - Department of Archaeology, University of Southampton, UK · 2 - Dipartimento di Lettere e Filosofia, Università degli Studi di Trento, Italy. · 3 - NOCS, University of Southampton, UK · 4 - RLAHA, University of Oxford · 5 - UNIARQ, Centro de Arqueologia da Universidade de Lisboa, Portugal · 6 - Department of History and Archaeology, University of Barcelona, Spain · 7 - ICREA (Catalan Institution for Research and Advanced Studies), Barcelona, Spain

Understanding Neanderthal mobility and landscape use is important in reconstructing subsistence behaviour, range and group size, and may contribute to our understanding of phenomena such as Neanderthal inbreeding or extinction due to competitive exclusion. Sr isotope analysis of bulk enamel is a routine methodology for exploring past mobility but, until the recent application of laser ablation ICP-MS analysis, the sample size required has precluded many studies on Palaeolithic human material. Now, the spatial resolution of laser ablation ICP-MS analysis allows >1500 individual 87Sr/86Sr measurements along a typical human enamel sample, and by utilizing samples detached during excavation, is only minimally destructive.

Here we present highly spatially resolved Sr isotope measurements made by Laser-Ablation ICP-MS along the enamel growth axis of a Neanderthal tooth from Gruta da Oliveira, in the Almonda karst system. This complex of sites is located on the >40 km-long, NE-SW-oriented fault escarpment that separates the Mesozoic Central Limestone Massif of Estremadura from the Tertiary and Quaternary terrain of the Tagus basin. Strontium isotopic mapping of the region was undertaken using conventional TIMS analysis on sediment leachates and ashed plant leaves. The map shows extreme variation in 87Sr/86Sr with values ranging from 0.708 to 0.716 over a distance of c.50 km potentially allowing short distance (and arguably short-duration) movement to be detected.

The enamel results show systematic but not seasonal movement (visits and revisits) between six different strontium isotope catchments. Sr isotopic mapping of the region shows that these strontium catchments can be accounted for in the limestone country adjacent to the site and in a range of c.30 km in the alluvial plain of the Tagus river. This is in contrast to our comparative analyses of a Late Magdalenian individual from Galeria de Cisterna, also in the Almonda system, which shows highly seasonal movement and a strontium catchment that can be accounted for along the 20 km-long course of the Almonda river alone, between the spring and its confluence with the Tagus. Given the presence of significant amounts of fish remains and of fishhooks in the coeval site of Lapa dos Coelhos, also in the Almonda karst system, this pattern may reflect increased territoriality.

Poster Presentation Number 132, Th (18:00-20:00)

## A Portable and Low Cost Open Design Rig for Reflectance Transformation Imaging

**Samantha Porter**[1]

1 - University of Minnesota

Reflectance Transformation Imaging (RTI) is one of several portable and low cost imaging techniques that has seen increasing use within a diverse range of disciples within the last several years. A series of images of an object are captured from a stable camera position, while changing the position of a single source of illumination [1]. With the aid of additional software, the data derived from this process allow users to virtually illuminate surfaces, and produce several kinds of enhanced visualizations.

Setups used to capture images for RTI are highly variable and as far as we know, no complete pre-built, low cost rigs are currently available for purchase. One common solution is to affix automatically triggered LEDs to the interior of a dome. However, the construction of these setups can require hundreds of Euros in parts, and require users to have an understanding of basic computer programing and how to wire electronic components. Other solutions, such as using a handheld light source while estimating required lighting positions, are likely to produce less consistent results.

The goal of this project was to produce a collapsible low cost rig that does not require electricity to operate, produces consistent results, and can be recreated by other researchers with relative ease. The rig presented here is based on a more expedient setup designed by researchers at the University of Tübingen [2]. Inexpensive LED flashlights are fixed to an arm, which rotates around a stable base. The rig is principally comprised of 3D printed and laser cut components, and is designed to accommodate small artifacts up to approximately 10 cm in size. Two-dimensional and three-dimensional source files for these parts will be made freely available online and will be hosted long term by the Data Repository for the University of Minnesota (DRUM). Users will be able to download these files and then 3D print / laser cut the required components to assemble their own rigs. Users will also be able to modify the source files in order to fit their particular needs. Additional parts (i.e. flashlights, nuts, bolts, rubber bands, and bearings) can be purchased online without much difficulty. In total, users should be able to acquire all necessary components (excluding a digital camera and tripod) for under approximately €100. The associated software applications (RTI Builder and RTI Viewer) are available for free [3].

The potential applications for the use of RTI within the field of Paleoanthropology are numerous. We present a series of visualizations produced with the aid of our rig that demonstrate its utility to the disciplines of taphonomy, lithic analysis, and the study of prehistoric art (engravings in particular). We hope this project not only aids researchers in their investigations, but also contributes to the broader goal of fostering the open design, open source, and open access movements within the academy.

I thank Kele Missal and Matt Edling for their assistance in designing and building this rig through its various iterations. This work was supported by a grant from the Leakey Foundation and a Doctoral Dissertation Fellowship from the University of Minnesota

**References:**[1] Malzbender, T., Gelb, D., & Wolters, H., 2001. Polynomial texture maps. In: Proceedings of the 28th Annual Conference on Computer Graphics and Interactive Techniques. ACM, pp. 519-528.[2] Porter, S., Huber, N., Hoyer, C., and Floss, B., Submitted. Portable and Low-cost Solutions to the Imaging of Paleolithic Art Objects: A Comparison of Photogrammetry and Reflectance Transformation Imaging. Journal of Archaeological Sciences: Reports.[3] Cultural Heritage Imaging. 2016. http://culturalheritageimaging.org/What_We_Offer/Downloads.

Poster Presentation Number 116, Th (18:00-20:00)

## Dental calculus indicates widespread plant use within the Neanderthal dietary niche

**Robert Power[1,2], Domingo C. Salazar Garcia[3,4,5], Mauro Rubini[6], Andrea Darlas[7], Katerina Harvati [8], Michael Walker[9], Amanda Henry[1]**

1 - Research Group on Plant Foods in Hominin Dietary Ecology, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 2 - Department of Archaeology, Max Planck Institute for the Science of Human History, Jena, Germany · 3 -Department of Archaeology, University of Cape Town, South Africa · 4 - Department of Archaeogenetics, Max-Planck Institute for the Science of Human History · 5 - Department of Human Evolution, Max-Planck Institute for Evolutionary Anthropology · 6 - Department of Archaeology, University of Foggia, Italy. / Anthropological Service of S.A.L.E.M. (Ministry of Culture Italy), Rome, Italy · 7 - Ephoreia of Paleoanthropology and Speleology, Greek Ministry of Culture and Sports, Athens, Greece · 8 - Paleoanthropology, Senckenberg Center for Human Evolution and Paleoecology, Eberhard Karls University of Tübingen, Germany · 9 - Departamento de Zoología y Antropología Física, Universidad de Murcia, Murcia, Spain.

Neanderthal ecology is a pressing question in the study of hominin evolution. Neanderthals (and their sister lineages) are relatively unusual among Pleistocene hominins in occupying high latitude cold environments [1]. Neanderthals occupied environments drastically different from those where hominins first evolved, and thus experienced drastically different evolutionary pressures, particularly with regard to the kinds of foods available to them. In this context, subsistence strategies that accommodated seasonally restricted food supply may have been a particularly important adaptation in Eurasian environments. Isotope and zooarchaeological studies indicate that Neanderthals ate large quantities of meat, typically from large to medium ungulates. Researchers have reported little variation or broadening in their diet across Eurasia [2,3,4]. However, we have only a fragmentary picture of their dietary ecology, because these methods provide limited information about how Neanderthals used plants and a variety of other foods. It is unclear how plant consumption may have varied among different habitats in their range, and if it was confined to milder regions. To explore if Neanderthal plant use varied across western Eurasia, we recovered and examined plant microremains in Neanderthal dental calculus from five archaeological sites from across their range in time and space. These include sites from the western, central and eastern Mediterranean as well as from the northern Balkans. The recovered microremains revealed the consumption of a variety of non-animal foods, including grass seeds, possible true lily tubers, legumes and other starchy plants that leave no taxon-attributable types. Neanderthals clearly were aware of a variety of plants in their environment, and when such plants would have been seasonally available. Using a modelling approach, we explored the relationships among the diversity of microremains, and chronological, climatological and ecological variation. We find no evidence that plant use is confined to the southern-most areas of Neanderthal distribution. Although Neanderthals were predominately big game hunters, evidence of diet from dental calculus indicates that plant exploitation was a widespread and deeply rooted subsistence strategy. Given the limited dietary variation across Neanderthal range in both time and space for plant food exploitation, we argue that vegetal consumption was a feature of a generally stable dietary niche.

**References:**[1] Hublin, J.-J., 2009. The origin of Neandertals. Proceedings of the National Academy of Sciences of the United States of America. 106, 16022–7.[2] Richards, M.P., Trinkaus, E., 2009. Out of Africa: modern human origins special feature: isotopic evidence for the diets of European Neanderthals and early modern humans. Proceedings of the National Academy of Sciences of the United States of America. 106, 16034–9.[3] Stiner, M.C., 2013. An Unshakable Middle Paleolithic? Trends versus Conservatism in the Predatory Niche and Their Social Ramifications. Current Anthropology. 54, S288–S304.[4] Wißing, C., Rougier, H., Crevecoeur, I., Germonpré, M., Naito, Y.I., Semal, P., Bocherens, H., 2015. Isotopic evidence for dietary ecology of late Neandertals in North-Western Europe. Quaternary International.

Pecha Kucha Presentation: Session 2, Th (12:10-12:35)

## Morphological analysis of variation in the Sima de los Huesos (Atapuerca, Spain) brain endocast collection

**Eva María Poza Rey**[1,2], **Juan Luis Arsuaga**[1,2]

1 - Centro UCM-ISCIII de Investigación sobre la Evolución y Comportamiento Humanos, Avda. Madrid, Spain · 2 - Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Madrid, Spain

The Spanish Sima de los Huesos (SH) brain endocast collection is one of the largest fossil sets for humans that inhabited Europe during the Middle Pleistocene. This collection is composed of a group of sixteen specimens from a single locality, and provides fundamental data for studying hominin brain evolution. This material allows for inter- and intra populational comparative studies, and provides invaluable information for the study of brain development throughout human evolution, or at least, during the Pleistocene period. Methods: Sixteen crania from SH were CT scanned, and their virtual brain endocasts were reconstructed using 3d reconstruction software (MIMICS v.14). The gross morphology of the endocasts from SH and from other fossil specimens (comparative sample) were analyzed. We examined several traits on each cerebral lobe, using both qualitative and quantitative methods. Our observations made on both the SH and the comparative sample and data from the literature have been used to make interpretations on the developmental and evolutionary state of the SH endocasts. Results and conclusions: The maximum width is located in the temporal lobes (mid-posterior region of the second temporal convolution) in the SH endocasts as it is in other Middle Pleistocene European groups and Middle and Upper Pleistocene Asian groups. This trait occurs in the temporo-parietal región in Neandertals, while it is clearly located in the parietal lobes in early Homo sapiens. Thus, this trait appears to show the primitive condition in the SH endocasts for this trait. In the frontal lobe, the morphology of the pre-frontal region and the encephalic bec in the SH endocasts shows an intermediate developmental state between a primitive group (early Homo and Homo erectus), and the most modern groups in the fossil record (Neandertals and Homo sapiens). In the parietal lobes, the general morphology of the parietal walls along with the morphology of the upper part of the endocast displays a “tent like” profile in the analyzed SH specimens as is observed in other Middle Pleistocene fossils and Homo erectus. An “in bombe” profile is the common morphology in Neandertals and a “domed” profile is generally exhibited by Homo sapiens. Thus, the SH endocasts show a primitive morphology in their parietal lobes. In the temporal lobes, a temporal notch can be distinguished in the fronto-temporal region of the analyzed SH sample as well as all other human fossils except Homo sapiens. Thus, this is a plesiomorphic feature shared by SH endocasts and most of the human specimens within the fossil record. The thickness of the parietal lobe exhibits the same range of values in both the SH sample and Neandertals. This feature shows some variability in the fossil record. The angle of the projection of the temporal pole shows an increase over time in both Asian and European human lineages. This feature could be related to an increase of the encephalic volume in humans. In the occipital region, both the morphological appearance and occipital angle are very similar in all the examined fossil human specimens, including SH, and these appear to show the primitive character state. The modern human group is distinguished by very rounded, not projected occipital lobes, and large occipital angles. The disappearance of the notch in the fronto-temporal region, the decrease of the angle of projection of the temporal pole and the general morphology of the occipital lobe in modern humans could be associated with the globularization process, which is unique to Homo sapiens.In summary, , this morphological study shows a mosaic of character states for various features in the SH hominin endocasts. The analyzed SH specimens still preserve some primitive features that are maintained throughout the fossil record and are also observed in other Middle Pleistocene individuals, while other features show more modern characteristics that approach those observed in Neandertals.

Acknowledgments: The authors want to thank the Sima de los Huesos excavation team. Special thanks for Ana Gracia (curator) and Maria Cruz Ortega (fossil restorer) for their excellent work in the reconstruction of the SH crania collection. Financial support for this project was provided by: Comunidad de Madrid (S2010/BMD-2330), Junta de Castilla y León (BU032A06) and Ministerio de Ciencia e Innovación of the Government of Spain (CGL2009-12703-C03-03, CGL2012-38434-C03-01). E.M. Poza-Rey is funded by Fundacion Atapuerca. CT scanning was carried out in collaboration with Jose Miguel Carretero and Laura Rodriguez at the Universidad de Burgos (Spain) and Hospital 12 de Octubre in Madrid.

Poster Presentation Number 90, Th (18:00-20:00)

## Energetic efficiency of acorn gathering for the Atapuerca middle Pleistocene populations

**Olalla Prado-Nóvoa[1], Ana Mateos[1], Marco Vidal-Cordasco[1], Guillermo Zorrilla-Revilla[2], Jesús Rodríguez[1]**

1 - National Research Centre on Human Evolution (CENIEH), Paseo Sierra de Atapuerca, 3, 09002 Burgos, Spain. · 2 - Escuela Interuniversitaria de Posgrado en Evolución Humana, Edificio I+D+I, Universidad de Burgos, Pza. Misael Bañuelos s/n, 09001 Burgos, Spain.

Despite the known importance of vegetable consume in the human diet, there is a lack of studies evaluating this kind of food as a significant feeding source in the past. We evaluate here the efficiency of acorn gathering as a foraging method for a middle Pleistocene human population living in the Sierra de Atapuerca (Burgos, Spain). Acorns were the more abundant nuts in the Atapuerca Pleistocene landscape and they are rich in nutrients and energy. Thus, acorns must be treated as an important, and seasonally abundant, edible resource for the Atapuerca populations. With this aim, an innovative experimental approach, based on the Human Bioenergy studies common in biomedicine, is presented here. We measured the energy expenditure with Indirect Calorimetry devices during nuts gathering: searching and collecting them and carrying 3 kg of nuts on a bag near the waist. The data obtained are used to compare the cost of this daily activity with the caloric return of acorns feeding. The experimental project was carried out by 9 volunteer women performing the gathering re-enactment in a natural environment. Two different itineraries were followed with and without the weight: the first path was located along an abrupt terrain with almost 20% gradient while the second path runs along a flat terrain, both on the proximities of the Sierra de Atapuerca archaeological sites. The caloric outputs are extrapolated to an averaged Sima de los Huesos female individual (SH), whose height, weight and age agree with those of the women in our sample, to hypothesize about the efficiency of acorn gathering for that middle Pleistocene population. Our results show that gathering 3 kg of acorns in 1 hour represents a moderate physical activity in energetic terms, that consumes not more than 300 kcal on average. Thus, the energetic return of just 1.5 kg of acorns would be enough to cover in excess the daily energetic requirements of one SH female individual with a vigorous lifestyle. Therefore, due to the high energetic and nutritional content of nuts, their availability and the lack of competition to acquire them, nuts gathering reveals itself as a highly efficient foraging method. Its high efficiency is evidenced when this provisioning method is compared with the return provided by red deer and horse butchering, two of the taxa most commonly hunted by the SH hominins according to the archaeo-palaeontological record.

We are sincerely grateful to all the volunteers who participated in this experimental study. Our research was performed at the CENIEH facility Bioenergy Laboratory and the Sierra de Atapuerca sites. This study was funded by National Research Centre on Human Evolution (CENIEH) and supported by the MINECO project (CGL2012-38434-C03-02).

Poster Presentation Number 112, Th (18:00-20:00)

## The Nahr Ibrahim technique and side-scraper resharpening at the Unit III of the Middle Paleolithic open-air site of Nesher Ramla (Israel); what is the link?

**Marion Prévost**[1], **Yossi Zaidner**[2]

1 - Institute of Archaeology, The Hebrew University of Jerusalem, Jerusalem, Israel · 2 - Institute of Archaeology, The Hebrew University of Jerusalem, Jerusalem, Israel and Zinman Institute of Archaeology, University of Haifa, Mount Carmel, Haifa, Israel

The Middle Paleolithic open-air site of Nesher Ramla (Israel), located in a funnel-shaped depression, differs from other Levantine cave and open-air sites in the geomorphological settings and formation processes and thus provides a unique opportunity to study hominids adaptations in a different context. The large lithic assemblage from the Unit III, situated in the middle of the sequence and dated between 175 and 145 ka BP, has revealed complex technical processes, including the use of the Nahr Ibrahim technique and side-scraper resharpening technique [1]. The Nahr Ibrahim technique, which consists of a facetted truncation used as striking platform for the removal of one or several small secondary flakes, generally on the dorsal surface of the blank, is a relatively common phenomenon in the Levantine Middle Paleolithic [2]. The finality of this technique is however still under debate; it is unclear whether it aimed at the production of small flakes or had functional purposes, like thinning and hafting. On the other hand, the side-scraper resharpening has been rarely described in the Levant and elsewhere. At Nesher Ramla, this technique consists of the removal of a long lateral spall that removes the entire, or part of the retouched edge of the side-scraper. The resharpening spall is generally parallel to the longitudinal axes of the side-scrapers and is removed from a facetted truncation commonly created on the distal part of the blank. Like for the Nahr Ibrahim technique the truncated-facetted extremity of the blank act as a striking platform. Formations of a new plain cutting edge or a "bifunctional" edge (ie, a partially raw sharp edge associated with a partially retouched edge) are so far, the main interpretations [3]. The aim of this presentation is to shed light on specific artifacts, which show evidence for both, the Nahr Ibrahim and the side-scraper resharpening spall removal techniques. Several side-scrapers from Unit III at Nesher Ramla present a truncated-facetted striking platform from where small secondary flakes where removed in addition to the scraper resharpening spall. These side-scrapers were divided in three technological categories: 1) Items showing the negative of the scraper resharpening spall associated with small secondary removals of Nahr Ibrahim type, in this case it is impossible to know the hierarchy of all the removals, 2) Items showing the negative of the scraper resharpening spall posterior to small secondary removals of Nahr Ibrahim type, 3) Items showing at least one secondary removal of Nahr Ibrahim type posterior to the scraper resharpening spall removal. Several hypotheses concerning the aims of production of these pieces can be raised. The ridges of the secondary flakes removals created by the Nahr Ibrahim technique could serve as a "guide" for the scraper resharpening spall removal [4]. Another possibility is that the secondary flakes removals (Nahr Ibrahim) could help to create a better angle for the removal of the resharpening spall. In both cases, the side-scraper resharpening technique could be seen as dependent on the other. In the case where the secondary flake removals from the Nahr Ibrahim technique is observed to be produced after the scraper resharpening spall removal, one can argued that both techniques (which present a similar preparation) were not dependent on each other and that two distinct objectives were desired; the production of small flakes and the complete or partial removal/resharpening of the side-scraper edge. The Unit III at Nesher Ramla has yielded a rich and well preserved lithic assemblage that exhibits specific and unique technical features previously unknown or undescribed in the Levantine Middle Paleolithic record and shed light on the complexity of the lithic technology used by the Nesher Ramla's inhabitant at the end of MIS 6.

**References:**[1] Zaidner, Y., Frumkin, A., Porat, N., Tsatskin, A., Yeshurun, R., Weissbrod, L., 2014. A series of Mousterian occupations in a new type of site: The Nesher Ramla karst depression, Israel. J. Hum. Evol. 66, 1-17.[2] Solecki, R.L., Solecki, R., 1970. A new secondary flaking technique at the Nahr Ibrahim Cave site, Lebanon. Bulletin du Musée de Beyrouth 23, 137–142.[3] Zaidner, Y., Grosman, L., 2015. Middle Paleolithic sidescrapers were resharped or recycled? A view from Nesher Ramla, Israel. Quatern. Int. The Origins of Recycling: A Paleolithic Perspective 361, 178-187.[4] Bourguignon, L., 1992. Analyse du processus opératoire des coups de tranchet latéraux dans l'industrie moustérienne de l'abri du Musée (Les Eyzies-de-Tayac, Dordogne). Paléo 4, 69-89.

Poster Presentation Number 29, We (17:00-19:00)

## Exploring the microevolutionary processes acting on Primate cranial form using morphometric data and quantitative genetic models

**Miguel Prôa**[1]

1 - Centro de Investigação em Antropologia e Saúde, Universidade de Coimbra, Departamento de Ciências da Vida, Apartado 3046, 3001-401 Coimbra, Portugal

Primates have a most idiosyncratic cranial form when compared with other terrestrial mammals. A medial approximation of the orbits (facing forward), a post-orbital bar, and a large, domed braincase are just some of the primate apomorphies which influence overall primate cranial form. Yet, primate cranial form is also widely variable among primate groups, while being constrained by their close phylogenetic relationships. Evolutionary, cranial form is driven by the action of microevolutionary processes. The knowledge of why and how those processes act provides insight into the evolutionary history of primate groups, and eventually a tentative prediction of the future evolution of such groups. How evolutionary processes like genetic drift and natural selection contribute to biological diversification is a central issue in evolutionary biology. While it is generally agreed that both processes operate to produce evolutionary change, the question of which contributes most to that change at any particular organizational level is still open. Here I apply quantitative genetic models to a sample of primate cranial linear measurements and geometric morphometric data to study the morphological divergence of the cranium of primate groups and establish what the evolutionary processes are that have acted (and are acting) on that anatomical structure to produce its current form. Preliminary results indicate that genetic drift alone would not be able to produce the current differences in shape and size of the cranium of diverging primate groups. A considerably large contribution of natural selection seems to have occurred, but divergent groups of primates have suffered distinct selective pressures which are not easy to discern. Further quantitative analyses should clarify the natural selective agents acting on the different primate groups cranial form (for example, dietary differentiation has been largely associated with the morphological divergence of the primate cranium). The extension of the sample size to include fossils will also be a welcomed addition to further analyses.

Podium Presentation: Session 1, Th (9:00)

## Wild monkeys flake stone tools

**Tomos Proffitt[1], Lydia Luncz[1], Tiago Falotico[2], Eduardo B. Ottoni[2], Ignacio de la Torre[3], Michael Haslam[1]**

1 - RLAHA, School of Archaeology, University of Oxford, U.K. · 2 - Institute of Psychology, Department of Experimental Psychology, University of São Paulo, Brazil · 3 - Insitiute of Archaeology, University College London, UK

The Oldowan techno-complex has long been identified as the first archaeological example of uniquely hominin tool production [1], recently superseded by the discovery of the Lomekwian, dated to 3.3 Mya [2]. Both industries are understood to be solely authored by hominins with the intention of sharp edged flake production. The identification of intentionally produced lithic assemblages is based on a number of shared technological characteristics, including: (i) the useof conchoidal fracture mechanics for the production of sharp edged flakes; (ii) the repeated superimposed removal of flakes from either lightly or highly exploited cores; and (iii) the targetting of naturally formed knapping platforms with impact points located close too, but not on the edge of, the intersection between the knapping platform and flaking surface. These features are often used to differentiate late Pliocene hominin archaeological assemblages from naturally fragmented stones. Here, we present the first technological and refit analysis of surface and archaeological lithic material directly associated with intentional primate stone-on-stone percussion, observed in wild capuchin monkeys from Serra da Capivara National Park, Brazil. These assemblages are produced by a technique that closely resembles passive anvil knapping. The capuchin lithics show that the repeated, unintentional production of fully conchoidal flakes and cores can closely mimic lithic assemblages produced through intentional flaking, including a number of the earliest examples of hominin lithic assemblage assigned to the Lomekwian and Oldowan industries. This recently identified and newly described non-human primate tool-use behaviour raises questions regarding the fundamental characteristics by which archaeologists and palaeoanthropologists identify uniquely hominin behaviour in the archaeological record.

**References:**[1] Semaw, S., Rogers, M.J., Quade, J., Renne, P.R., Butler, R.F., Dominguez-Rodrigo, M., Stout, D., Hart, W.S., Pickering, T., Simpson, S.W., 2003. 2.6-Million-year-old stone tools and associated bones from OGS-6 and OGS-7, Gona, Afar, Ethiopia. Journal of Human Evolution 45, 169–177 [2] Harmand, S., Lewis, J.E., Feibel, C.S., Lepre, C.J., Prat, S., Lenoble, A., Boës, X., Quinn, R.L., Brenet, M., Arroyo, A., Taylor, N., Clément, S., Daver, G., Brugal, J.-P., Leakey, L., Mortlock, R.A., Wright, J.D., Lokorodi, S., Kirwa, C., Kent, D.V., Roche, H., 2015. 3.3-million-year-old stone tools from Lomekwi 3, West Turkana, Kenya. Nature 521, 310–315

Poster Presentation Number 62, Th (18:00-20:00)

## Digital alignment: an automatized protocol for virtual reconstruction of incomplete fossil specimens

**Antonio Profico**[1], **Fabio Di Vincenzo**[1], **Mary Anne Tafuri**[1], **Giorgio Manzi**[1]

1 - Sapienza Università di Roma, Dipartimento di Biologia Ambientale

Museal collections include a large amount of cranial specimens of living and fossil primates. This material served as the basis for detailed morphological studies also relatively to their internal anatomy. Unfortunately, until recently, the study of the cranial cavity (e.g. the endocranial cavity) was often possible only by removing mechanically extensive portions of the cranial vault and of other skeletal portions, in fact compromising the physical integrity of the specimens. Many specimens have gone through fractures and unintentional damage, which may also have caused the loss of original morphological information. Thanks to increasing advances in both computer technology and 3D imaging software, it is possible to virtually acquire the morphology of a physical specimen [1,2]. Consequently, paleoanthropological studies often focus on anatomy, virtual reconstruction, and on the development of algorithms to improve the digital acquisition [3]. In addition to CT scan other techniques have been introduced, such as laser scanner and photogrammetry. Virtual procedures, on the basis of digital reconstruction, are frequently applied to restore human fossil specimens. A digital operation on a 3D specimen is appropriate and/or necessary when the object is fragmented/damaged and/or deformed by taphonomical pressures. Here we present a protocol, developed in R environment, able to align automatically two portions belonging to the same 3D model. In this communication, we introduce the method and we report the results of the application of this tool applied on a skull of *Homo sapiens* (target model). The target model was divided in two halves and each portion was shifted in the xyz reference Cartesian system. The aim was to compare the efficacy of this protocol (full computer assisted alignment) with a manual alignment. The digital alignment consists of the extrapolation of the rotation matrix to translate, rotate, and scale a fragment of a target model using a reference model. In literature, almost all digital reconstructions of fossil specimens start from an arbitrary model chosen as reference [4]. The first part of the tool is dedicated to the detection of the reference model using a landmark configuration as guide. Once chosen, the reference model was symmetrized using a bilateral configuration landmark. The two halves of the target model were aligned on the symmetrized version of the reference model, and optionally the alignment could be corrected on the basis of an external ratios or angles (in this case the angle-glabella-inion). Finally, the alignment performed using this protocol was compared with 10 manually-performed alignments carried out by 10 anonymous researchers expert in the field. In this case the target model aligned automatically results to be the closer to the starting model; in fact the mesh distance values is minor than alignments manually performed. In sum, the digital alignment of a fragmentary fossil specimen is the first stage of a reconstruction procedure and the correct choice of the reference model is the crucial point of the digital reconstruction of a damaged specimen. The application of a computer-assisted reconstruction implies that the efficiency of the reconstruction depends on the comparative sample (3D models and landmark/semi-landmark sets) and not on the skills of the operator. This first release of the tool will be fully open-access and available to the scientific community for application and methodological improvements. A first application of this protocol is represented by the work done on the Altamura Neanderthal [5].

**References:**[1] Bates, K., Falkingham, P., Rarity, F., Hodgetts, D., Purslow, A., Manning, P., 2010. Application of high-resolution laser scanning and photogrammetric techniques to data acquisition, analysis and interpretation in palaeontology, International Archives of the Photogrammetry, Remote Sensing, and Spatial Information Sciences, 68-73.[2] Falkingham, P.L., 2012. Acquisition of high resolution three-dimensional models using free, open-source, photogrammetric software. Palaeontologia electronica 15(1): 15.[3] Cunningham, J. A., Rahman, I. A., Lautenschlager, S., Rayfield, E. J., & Donoghue, P. C., 2014. A virtual world of paleontology. Trends in ecology & evolution, 29 (6): 347-357.[4] Senck, S., Bookstein, F. L., Benazzi, S., Kastner, J., & Weber, G. W., 2015. Virtual reconstruction of modern and fossil hominoid crania: consequences of reference sample choice. The Anatomical Record 298 (5): 827-841.[5] Di Vincenzo, F., Profico,A., Tafuri, M.A., Caramelli, D. & Manzi, G., 2016.The cranium of the Altamura Neanderthal (Puglia, Italy): virtual extraction, digital restoration and morphological notes. PESHE 5 (submitted).

Poster Presentation Number 6, We (17:00-19:00)

## The Evolution of the Platyrrhine Talus

**Thomas Püschel**[1], **Justin Gladman**[2], **René Bobe**[3], **William Sellers**[1]

1 - Computational and Evolutionary Biology Group, Faculty of Life Sciences, University of Manchester, UK · 2 - New York Consortium in Evolutionary Primatology · 3 - Institute of Cognitive and Evolutionary Anthropology, School of Anthropology, University of Oxford, UK

Platyrrhines are a diverse group of primates that presently occupy a broad range of tropical and equatorial environments in the Americas. They represent approximately one third of all extant primates, with new species regularly being discovered in Neotropical forests. Even though it still highly debated how platyrrhines arrived to South America, there is some consensus that the present day diversity is the result of a single colonization event by a group of primitive anthropoids. Currently one of the main difficulties in platyrrhine palaeontology is the scarcity of Eocene and Oligocene data, as most fossil platyrrhine remains have been dated to the Miocene or the Pleistocene of South America and the Caribbean. Intriguingly, most of the fossil platyrrhine species of the Early Miocene have been found in middle and high latitudes in areas that are currently not occupied by platyrrhines (e.g. Patagonia). Although the fossil record of New World monkeys has considerably improved over the last several years, it is still difficult to trace back the origin of major modern clades, especially when considering that the earliest fossil taxa seem to be outside the crown radiation. One of the most commonly preserved anatomical structures of early platyrrhines are tali. Therefore this work provides an analysis of morpho-functional affinities of the extant platyrrhine tali and their Miocene counterparts by carrying out geometric morphometric (GM) and finite element analyses (FEA). GM was used to quantify talar shape affinities, while FEA was used to analyse the biomechanical performance of different platyrrhine tali by simulating a static postural scenario. The GM results showed that the fossils exhibit conserved talar morphologies when compared to their modern relatives. Additionally, shape data presented significant phylogenetic signal and the comparative analysis carried out support an early radiation and niche-filling scenario. Moreover, FEA provided evidence that supports the perspective that most fossil forms showed biomechanical performances similar as those expected for arboreal quadrupedal platyrrhine species. This study shows that a combined approach using GM and FEA was able to contribute in a better insight regarding the evolution of the platyrrhine talus and to reconstruct the possible locomotor repertoires of fossil species.

This project was partially funded by a Becas Chile scholarship programme (TP). We are grateful to the following people and institutions for the access granted to analyse some of the specimens under their care: Institut des Sciences de l'Evolution de Montpellier (ISE-M), Montpellier RIO Imaging (MRI) and the LabEx CeMEB; Micro CT scan operator Renaud Lebrun, IR CNRS; Laurent Marivaux; John Fleagle; Marcelo Reguero; Marcelo Tejedor; David Rubilar-Rogers; Rodolfo Salas-Gismondi ; MorphoSource and Doug Boyer. We also thank Hugo Benítez for his help regarding some of the GM analyses.

Podium Presentation: Session 3, Th (16:40)

## Early hominin auditory capacities

**Rolf Quam[1,2,3], Ignacio Martínez[2,4], Manuel Rosa[5], Alejandro Bonmatí[2,6], Carlos Lorenzo[7,8,2], Darryl de Ruiter [9], Jacopo Moggi-Cecchi[10], Mercedes Conde Valverde[4], Pilar Jarabo [5], Colin G. Menter [11], J. Francis Thackeray [12] and Juan Luis Arsuaga [2,6]**

1 - Department of Anthropology, Binghamton University (SUNY), USA. · 2 - Centro de Investigación (UCM-ISCIII) sobre Evolución y Comportamiento Humanos, Spain. · 3 - Division of Anthropology, American Museum of Natural History, USA · 4 - Departamento de Ciencias de la Vida, Universidad de Alcalá, Spain. · 5 - Departamento de Teoría de la Señal y Comunicaciones, Universidad de Alcalá, Spain. · 6 - Departamento de Paleontología, Universidad Complutense de Madrid, Spain. · 7 - Área de Prehistoria, Universitat Rovira i Virgili, Spain · 8 - Institut Català de Paleoecologia Humana i Evolució Social (IPHES), Spain · 9 - Department of Anthropology, Texas A&M University, USA. · 10 - Dipartimento di Biologia, Universita' di Firenze, Italy · 11 - Centre for Anthropological Research, University of Johannesburg, South Africa. · 12 - Evolutionary Studies Institute, University of the Witwatersrand, South Africa

Studies of sensory capacities in past life forms have offered new insights into their adaptations and lifeways. Audition is related to basic aspects of an organism's survival, particularly localization of sound sources, including potential dangers in the environment, and acoustic communication. Of all the special senses, audition is particularly amenable to study in fossils because it is strongly related to physical properties that can be approached through their skeletal structures. We have studied the anatomy of the outer and middle ear in the early hominin taxa *Australopithecus africanus* and *Paranthropus robustus* and estimated their auditory capacities. We have relied mainly on CT scans and virtual reconstructions of the outer and middle ear to measure a series of linear, areal, and volumetric variables in the early hominin specimens SK 46 (*P. robustus*), STW 98 (*A. africanus*), and STS 25 (*A. africanus*), as well as samples of *Pan troglodytes* and *Homo sapiens*. Compared with chimpanzees, the early hominin taxa are derived toward modern humans in their slightly shorter and wider external auditory canal, smaller tympanic membrane, and lower malleus/incus lever ratio, but they remain primitive in the small size of their stapes footplate. Compared with chimpanzees, both early hominin taxa show a heightened sensitivity to frequencies between 1.5 and 3.5 kHz and an occupied band of maximum sensitivity that is shifted toward slightly higher frequencies. Studies of habitat acoustics have suggested that the structural properties of primate vocalizations are related to environmental characteristics. In particular, the combination of higher signal attenuation and lower ambient background noise in open habitats means that short-range intragroup communication is favored. The heightened auditory sensitivity to midrange frequencies in both early hominin taxa may have facilitated an increased emphasis on short-range vocal communication in open habitats, and the results of the present study have implications for sensory ecology and communication.

We thank S. Potze, M. Raath, B. Latimer, L. Jellema, Y. Haile-Selassie, C. de los Rios, A. Esquivel, M. Loeches, M.C. Ortega, J.J. Ruíz, J.M. Carretero, J. Cabot and B. Tatchell for valuable help and access to specimens under their care. Financial support has been provided by Fundación Atapuerca, National Research Foundation (GUN 2065329), Leakey Foundation, American Museum of Natural History, Binghamton University (SUNY), Junta de Castílla y León (Project Nos. BU032A06 and BU005A09) and the Spanish Ministry of Economía y Competitividad (Project Nos. CGL2012-38434-C03-01/03).

Podium Presentation: Session 3, Th (15:00)

## What Do We Really Know about the Origin of Humans?

**Yoel Rak**[1], **Ella Been**[1,2]

1 - Department of Anatomy and Anthropology, Sackler Faculty of Medicine, Tel Aviv University · 2 - Department of Physical Therapy, Ono Academic College.

From the time they were discovered, the so-called robust australopiths—*Australopithecus robustus* and *A. boisei* —were recognized as too derived to serve as ancestors of modern humans. Robert Broom came to this conclusion in 1936 the moment he placed a pencil across the face of specimen TM 1517 and saw that the specimen's midface is sunken relative to the facial periphery (i.e., the zygomatic bones). For many years, *A. africanus* has been regarded as a perfect candidate for the role of a generalized ancestor of *Homo*. Other australopiths —*A. afarensis* and *A. anamensis* —are viewed as a more primitive links in the chain leading to humans.

Recently, an assemblage of hominin fossils discovered in South Africa was proposed as a new species representing a transitional link between *A. africanus* and <*Homo* The species was named *A. sediba* . We tested that hypothesis by examining the morphology of the mandibular ramus in the new species and in other hominoids and by comparing the lumbar vertebrae of *A. sediba* with those of *H. sapiens, H. erectus* , and other australopiths.

Our results indicate that of the six bones attributed to *A. sediba* (two mandibles and four lumbar vertebrae), three show the *Homo* morphology and three show the australopith morphology. None of these bones represents an intermediate morphology. The shape of the mandibular ramus of one specimen (MH1) is identical to that of the australopiths and differs significantly from that of *Homo*. On the other hand, the mandibular ramus of the specimen that we refer to as MH2 is identical to that of *Homo* and differs significantly from the australopith ramus. Similarly, the shape of the two lumbar vertebrae of MH1 resembles that of representatives of the genus *Homo (H. erectus* Neandertals, and modern humans), whereas the shape of the two lumbar vertebrae of MH2 resembles that of the australopiths and differs considerably from that of *Homo*.

Discussion: Our analysis suggests that the proposed species is actually an artificial amalgam of two taxa: Australopithecus and *Homo*. The presence of australopiths and early representatives of the genus *Homo* at the same site has been documented elsewhere in other caves of South Africa [1]. Furthermore, our results suggest that all of the australopiths on which the ramus and vertebrae are preserved are too specialized to serve as an ancestor of modern humans. To find this elusive ancestor, we must look farther back in the geological record.

**References:**[1] Hughes A.R., Tobias P.V. 1977. A fossil skull probably of the genus Homo from Sterkfontein, Transvaal. Nature 265(5592):310–312.

Poster Presentation Number 70, Th (18:00-20:00)

## A preliminary automatic procedure for vascular morphometrics and diploic patterns in modern human and fossil crania

**Gizéh Rangel de Lázaro**[1,2], **Emiliano Bruner**[2]

1 - Universitat Rovira i Virgili (URV) Tarragona, Spain · 2 - Centro Nacional de Investigación sobre la Evolución Humana, Burgos, Spain

**Introduction:** Diploic channels represent the passages of large, thin-walled and valveless vessels, running within the vault bones, between the inner and outer cranial tables [1,2]. They are supposed to be involved in brain thermoregulation, allowing a bidirectional blood flow between endocranial and ectocranial surfaces [3,4]. They appear to be more developed in modern humans than in other primates or fossil hominids, suggesting changes associated with *Homo sapiens* brain evolution [5,6]. **Objectives:** We present a protocol for automatic morphometric evaluation for diploic vessels from tomographic data, able to provide measurements of lumen size, branch length and volume of diploic channels in modern humans and fossil specimens. Materials and Methods: In this survey we analyze the relationship between cranial vault thickness, diploic channels lumen width, and branch length in modern and non-modern human skulls. We measure the volume occupied by the diploic channels, the distribution of the branches and the correlation between left and right side. **Results:** Diploic vessels are reconstructed following a segmentation protocol, reducing the noise associated with the cancellous bone. Quantitative parameters have been calculated for the frontal, parietal, and occipital diploic districts. Diploic channels display a symmetric distribution and a proportional vascularization in the three vault bones, more pronounced in the parietal area. There is no correlation between bone thickness and vessel size. **Discussion:** Vascular geometric organization of the vault bones vary among modern humans and fossil specimens, although the factors influencing this variability remain unclear [7]. Because of the difficulties in quantify vascular morphology, proper morphometric approaches must be developed to test hypotheses on their variations and changes. The absence of correlation between bone thickness and vessel size suggest independent factors involved in osteogeneis and vasculogenesis. Structural interaction between bones and vessels are, at present, not evidenced.

This study is funded by the Wenner-Gren Foundation International Collaborative Research Grant (ICRG) "Cranial anatomy, anthropology, and vascular system". GRL is funded by the International Erasmus Mundus Doctorate in Quaternary and Prehistory consortium (IDQP). EB is funded by the Spanish Government (CGL2012-38434-C03-02) and by the Italian Institute of Anthropology (Isita). The NESPOS platform provided the modern samples used in this study. Special thanks are given to Marteyn Van Gasteren for administrative support. We thank José Manuel de la Cuétara, Ana Sofia Pereira-Pedro, Stanislava Eisová, Hana Píšová and Carlos Lorenzo for their collaboration.

**References:**[1] Zenker W, Kubik S (1996) Brain cooling in humans—anatomical considerations. Anat Embryol 193:1–13. [2] Toriumi H, Shimizu T, Shibata M, Unekawa M, Tomita Y, Tomita M, Suzuki N (2011) Developmental and circulatory profile of the diploic veins. Microvasc Res 81:97–102. [3] Falk D, Gage T (1997) Flushing the radiator? A reply to Braga Boesch. J Hum Evol 33:495–502. [4] Caputa M (2004). Selective brain cooling: a multiple regulatory mechanism. J Therm Biol 29:691–702. [5] Hershkovitz I, Greenwald C, Rotschild B, Latimer B, Dutour O, Jellema LM, Wish-Baratz S, Pap I, Lenoetti G (1999) The elusive diploic veins: anthropological and anatomical perspective. Am J Phys Anthropol 108:345–358. [6] Rangel de Lázaro G, de la Cuétara JM, Píšová H, Lorenzo C, Bruner E (2016) Diploic vessels and computed tomography: segmentation and comparison in modern humans and fossil hominids. Am J Phys Anthrop 159:313–324. [7] Eisová S, Rangel de Lázaro G, Píšová H, Pereira-Pedro S, Bruner E (2016) Parietal bone thickness and vascular diameters in adult modern humans: a survey on cranial remains. Anat Rec 299:888–896

Poster Presentation Number 25, We (17:00-19:00)

## Postnatal ontogeny of the hyoid and tongue on human and chimpanzee (*Pan troglodytes*) cadavers – implications for the relationship of the skeletal and muscular components of the hominoid supra-laryngeal vocal tract

**Karyn Rehbock**[1], **Sandra Martelli**[2]

1 - UCL Psychology and Language Sciences · 2 - UCL,Cell and Developmental Biology, Life Sciences

Since the discovery of the Kebara hyoid (*Homo neanderthalensis*) there has been a debate about what information can be extracted from its size and shape. Such information is necessary to interpret the configuration of the soft tissues of the fossil hominin vocal tract as well as the functions (swallowing and speech) of the hyoid and mandibular complex (e.g. [1,2,3] ). The debate is fuelled by difficulties establishing these relationships due to the lack of quantitative information from soft tissues such as the tongue. An understanding of these relationships is crucial for reconstructing the dimensions of the supra-laryngeal vocal tract when assessing fossil hominins. We used an aged growth series of 23 chimpanzee and 50 human cadavers, 12 osteological 3D-landmarks on the hyoid, orbit width as a proxy for body weight and statistical analyses (general procustes analysis, canonical variant analysis, two-block partial least square regression, linear regression models and ANOVA) to ask a) how intra-and inter-specific differences of human and chimpanzee hyoid shape and size and the volume of the intrinsic tongue muscles are established postnatally and b) how hyoid size and shape relate to tongue volume. b) Intra-specifically, both human and chimpanzee hyoid size and shape vary statistically significantly throughout postnatal ontogeny. The shape changes, closely linked to size changes, are the same in modern humans and chimpanzees and involve increased greater horn length and distance between the horns and increased hyoid body height, width and depth, from neonate to adult. Tongue volume is strongly positively correlated to increase in body weight in both species and follows a general musculoskeletal growth pattern. The inter-specific differences in hyoid shape are of note as they only become statistically significant after the deciduous dentition has erupted (older than 6 years in humans and 3 in chimpanzees). These differences are observed in body height and depth (shorter and less excavated in humans), horn length and distance (shorter and broader in humans). Inter-specifically, hyoid size is not statistically significant but when resolving size differences at the level of different age groups, based on dental development, hyoid size is statistically significant between the adult groups. Tongue volume is not. c) Regression on hyoid shape and tongue volume reveals no meaningful relationship for both humans and chimpanzees. Hyoid size on the other hand is strongly positively correlated with tongue volume in both species. This study reveals two important findings. Firstly that inter-specific hyoid shape and size differences only become statistically significant in late infancy. This coincides with the onset of increased rates of laryngeal air sac growth in the chimpanzee [4], known to influence both hyoid body shape and size. The difference in adult hyoid shape and size arise due to an extension, in chimpanzees, of the common growth trajectory. In this, the study provides the missing information from the comparative adult hyoid size and shape study [3]. Secondly, this study shows that the postnatal increase of intrinsic tongue muscle volume closely tracks body weight increase. However, regarding the relationship between the tongue and the hyoid, tongue volume increase is not linked to hyoid shape. Rather, the presence or absence of a laryngeal air sac is more closely related to the shape of the hyoid and thus accounts for the differences in hyoid shape between humans and chimpanzees. Thus, this study adds quantitative evidence to Lieberman's argument that inferences about the supra-laryngeal vocal tract cannot be made based on hyoid shape alone. However, while hyoid shape does not yield any significant information regarding tongue volume, hyoid size does and thus reconstructions of supra-laryngeal vocal tracts based on hyoid size may be more fruitful.

We thank C.E.P. Zollikofer and M. Ponce de Leon, Universität Zürich, F. Spoor, UCL, P. O'Higgins, University of York and Takeshi Nishimura and the Digital Morphology Museum at the Primate Research Institute, Kyoto University for access to comparative chimpanzee material and J. Hodler and his team at orthopaedic University hospital Zurich for CT scan access and support. We are also very grateful to Frédéric Richard, Aix-Marseille Université, S. Blau and VIFM, Monash University Melbourne for providing the human CT scan data set.

**References**:[1] Arensburg, B., Tillier, A.M., Vandermeersch, B., Duday, H., Rak, Y., 1989. A middle palaeolithic human hyoid bone. Nature 338, 758-760.[2] Lieberman, P., 1993. On the Kebara KMH-2 hyoid and Neanderthal speech. Curr. Anthrol. 34, 172-175.[3] Steele, J., Clegg, M., Martelli, S.A., 2013. Comparative morphology of the hominin and African ape hyoid bone, a possible marker of the evolution of speech. Hum. Biol., 639-672.[4] Nishimura, T., Mikami, A., Suzuki, J. ,Matsuzawa, T., 2007. Development of the laryngeal air sac in chimpanzees. Int. J. Primatol. 28, 483-492.

Poster Presentation Number 56, We (17:00-19:00)

## The paleoclimatic and archaeological implications of the micromammalian assemblages from Geißenklösterle Cave in southwestern Germany

**Sara E. Rhodes**[1], **Reinhard Ziegler**[2], **Britt M. Starkovich**[1,3], **Nicholas J. Conard**[3,4]

1 - Institute for Archaeological Sciences, University of Tübingen, Germany · 2 - Staatliches Museum für Naturkunde Stuttgart – Paläontologie · 3 - Senckenberg Center for Human Evolution and Paleoenvironment, Tübingen, Germany · 4 - Department of Early Prehistory and Quaternary Ecology, University of Tübingen, Germany

The Swabian Jura is a region of both exceptional technological and symbolic innovation during the Palaeolithic, and as such has been the subject of intensive research spanning nearly 150 years . Despite this long academic tradition important questions remain, particularly surrounding the context of the Middle to Upper Palaeolithic cultural transition. The most well known models proposed to explain the replacement of the Swabian Middle Palaeolithic hominins by Aurignacian groups include the *Kulturpumpemodel* and the Danube Corridor hypothesis . The occurrence of climatic stress and a generally harsh environment during OIS 3 is one of the key hypotheses of the *Kulturpumpemodel*, and has inspired research into the climatic signatures evident in the micromorphological and faunal records of this region. This paper presents the new data on the climatic and palaeoecological record of the Ach Valley as indicated by the micromammalian (insectivore, rodent, and bat) assemblages recovered from Geißenklösterle cave. These results are compared with previous environmental models and the applicability of the *Kulturpumpemodel* in light of these new data is discussed. Micromammal assemblages function as excellent palaeoenvironmental proxies since many rodents and some insectivores are particularly sensitive to variations in environmental conditions. Furthermore, when deposited by nonhuman predators these materials lack the complicating bias of human selective predation or peri-depositional modification. Here we present a detailed taphonomic analysis of cranial and post-cranial remains in order to address the potential influence of selective predation on the paleoenvironmental record from Geißenklösterle. Insectivore, rodent and, in some contexts, bat remains are among the most numerous faunal remains reported from cave sites, and they generally experience limited post-depositional modification. Thus they provide much paleoenvironmental and climatic information that can augment other important lines of evidence including data from the study of macrofauna and micromorphological studies.

The rodent assemblage from Geißenklösterle is dominated by five species of vole (Microtus) as well as cold-indicative taxa such as the collared lemming ( *Dicrostonyx gulielmi*) and the Norwegian lemming ( *Lemmus lemmus*). The overall predominance of the common vole ( *Microtus arvalis/agrestis* ) indicates that the area surrounding the cave likely included pastures with moderate humidity and moisture during the Middle Paleolithic and the occupational hiatus immediately preceding the earliest Aurignacian strata. A decrease in the proportion of this species in the early Upper Paleolithic coincides with a moderate increase in the cold-indicative taxa, suggesting a broad shift towards a cold, dry climate. The proportion of species that prefer boreal/open forests and rocky outcrops remains steady throughout. These results are quite similar to previous studies [1,2] and suggest that the only signal of climatic change present in the micromammal assemblage from Geißenklösterle includes a gradual increase in the presence of tundra cold-steppe environments in the Upper Paleolithic. While this climatic trend likely had an effect on the technological and social behaviours of late Neanderthal and Aurignacian populations and may be in part responsible for some differences in the material culture between these groups, comparison of the microfaunal record between the Middle and Upper Paleolithic at Geißenklösterle cave suggests that climate played only a weak role in the population dynamics observed in the Swabian Jura.

**References:**[1] Conard, N. J., Kitagawa, K., Krönneck, P., Böhme, M., & Münzel, S. C. 2013. The importance of fish, fowl and small mammals in the Paleolithic diet of the Swabian Jura, Southwestern Germany. In Zooarchaeology and Modern Human Origins (pp. 173-190). Springer Netherlands.[2] Münzel, S. C. & Conard, N. J. 2004. Change and continuity in subsistence during the Middle and Upper Palaeolithic in the Ach Valley of Swabia (South-west Germany). International Journal of Osteoarchaeology 14: 225–243.[3] Conard, NJ, Bolus, M, Dutkiewicz, E, and Wolf, S. 2015. Eiszeitarchäologie auf der Schwäbischen Alb: die Fundstellen im Ach-und Lonetal und in ihrer Umgebung. Kerns Verlang, Tübingen.[4] Conard. N.J, and Bolus, M. 2003. Radiocarbon dating the appearance of modern humans and timing of cultural innovations in Europe: new results and new challenges. Journal of Human Evolution 44. Pp. 331-371.[5] Miller, Christopher E. 2015 A Tale of Two Swabian Caves. Geoarchaeological Investigations at Hohle Fels and Geißenklösterle. Kerns Verlang, Tübingen.

Poster Presentation Number 32, We (17:00-19:00)

## Towards a better definition of the chronological framework for Upper Pleistocene prehistoric sites in Western Europe

**Maïlys Richard**[1], **Christophe Falguères**[1]

1 - Muséum national d'Histoire naturelle

The timing of events is of a great interest in the study of human evolution and behaviour, particularly during the Middle to Upper Palaeolithic transition. The establishment of a well-defined and reliable chronological framework for Upper Pleistocene prehistoric sites is crucial, especially beyond the limits of radiocarbon around 50 ka. In order to succeed radiocarbon for the dating of Middle Palaeolithic sites between MIS 5 and 3, palaeodosimetric methods such as OSL on sedimentary deposits, TL on burnt flints and ESR/U-series on enamel teeth can be applied. ESR/U-series dating can be implemented from around 1-2 Ma until 30 ka, despite the difficulties encountered for young periods in karstic context (e.g., low equivalent dose correlated with low uranium content in dental tissues and short burial time of the teeth in the site, dosimetric heterogeneity of sediments). However, several arguments support the development of ESR/U-series application for Upper Pleistocene sites: 1) The method allows the direct dating of archaeological material older than 50 ka. Moreover, teeth are abundant in prehistoric sites and contemporaneous of human occupation; 2) Its reliability can be evaluated by comparing the data with radiocarbon ages between 50 and 30 ka; 3) The age obtained on the tooth by ESR/U-series can be compared with the age of the embedding matrix using OSL, allowing the cross-checking of the data acquired from independent methods. We present here the contribution of ESR/U-series to the chronology of Upper Pleistocene sites from Swabian Jura in Germany (Geißenklösterle and Hohlenstein-Stadel) and Rhône valley in France (Abri du Maras and Grotte des Barasses II). Populated by Neanderthals until MIS 3, these regions provided among the most ancient testimonies of *Homo sapiens* presence. The results of ESR/U-series dating are in agreement with $^{14}C$ ages obtained on Early Aurignacian layers in Swabian Jura [e.g., 1; 2], confirming the presence of *Homo sapiens* in this area as soon as 40 ka. In both areas, the Middle Palaeolithic layers were dated between around 100 ka et 40 ka; the most recent ESR/U-series ages obtained for the late Neanderthal occupations in these regions are close to those obtained on other European sites that bear witness to the first evidences of transitional industries and early Aurignacian. Towards the elaboration of a spatiotemporal framework for the end of the Middle Palaeolithic and the transition towards the Upper Palaeolithic in Western Europe, ESR/U-series dating method has good potential in the establishment of a chronology for prehistoric sites between MIS 5 and 3, especially for Neanderthal occupations older than 50 ka.

**References:**[1] Conard, N.J., Bolus, M., 2008. Radiocarbon dating the late Middle Paleolithic and the Aurignacian of the Swabian Jura. Journal of Human Evolution 55, 886-897.[2] Higham, T., Basell, L., Jacobi, R., Wood, R., Bronk Ramsey, C., Conard, N.J., 2012. Testing models for the beginnings of the Aurignacian and the advent of figurative art and music: the radiocarbon chronology of Geißenklösterle. Journal of Human Evolution 62, 664-676.

Poster Presentation Number 85, Th (18:00-20:00)

## Congenital conditions in Neandertal remains from El Sidrón (Asturias, Spain)

**Luis Rios[1], Antonio Rosas[1], Almudena Estalrrich[1], Antonio García-Tabernero[1], Rosa Huguet[2,3], Francisco Pastor[4], Marco Rasilla de la [5]**

1 - Paleoanthropology Group, Paleobiology Department, Museo Nacional de Ciencias Naturales (MNCN-CSIC), Spain · 2 - Institut Catalá de Paleoecologia Humana i Evolució Social (IPHES), Campus escelades URV (Edifici W3), Spain ·3- Àrea de Prehistoria, Universitat Rovira i Virgili (URV), Tarragona, Spain · 4 - Department of Anatomy and Radiology, Facultad de Medicina, Universidad de Valladolid, Spain · 5 - History Department, Universidad de Oviedo, Spain

Inbreeding in the Neandertal group of El Sidrón [1] has been suggested as a possible explanation for the presence of retained deciduous mandibular canine in two individuals, and the presence of congenital clefts in two first cervical vertebrae [2]. This scenario is in agreement with genetic data that point to frequent mating between closely related individuals in the Neandertal lineage [3]. Further support for this interpretation could come from new findings of congenital conditions in Neandertal remains. We present here a paleopathological review of the 1661 identified skeletal specimens from El Sidrón, out of the 2567 remains recovered at the site [1]. The remains were first visually inspected and those who presented potential anomalies were further studied under binocular lens and Environmental Scanning Electron Microscope (ESEM Fei-Quanta 200, 25.0 kv accelerating voltage and low vacuum mode). For some remains CTscans (Axial medical CT GE Light Speed 16) and microCT (Nikon XT H 160) images were obtained. The study of the remains from El Sidrón resulted in the identification of the following six new congenital conditions: an anterior cleft of a first cervical vertebra; aplasia of the right transverse foramen of a second cervical vertebra; an isolated lumbar rib; three developmental defects in an articulated partial thoraco-lumbar spine; a tripartite patella; developmental defects in tarsals and metatarsals from an articulated partial left foot. These new observations join previous ones to reach a total of 10 congenital conditions observed in El Sidrón Neandertal remains. The minimum number of individuals with congenital conditions is defined by the observation of three atlases (out of four observables) with dehiscence of the posterior or anterior arches. It is interesting to note the concentration of low frequency congenital conditions in the spine, specially the presence of anterior clefts in two atlases (frequency in extant modern human populations ranging from 0.087% to 0.1%), and the presence of two lumbar ribs (frequency in extant modern human populations ranging from 0.04% to 2%). Lumbar ribs have also been observed in Kebara 2 and Shanidar 3 [4]. Interestingly, in the analysis of the Neandertal exome it has been observed that after the split from Denisovans only the phenotype category "hyperlordosis" is overrepresented [5]. These observations seems to reveal that the lumbar region is of special genetic significance in Neandertal evolution. In isolation, some of the above conditions cannot be related to any clinical manifestation and are usually incidental findings in routine medical examination. But other conditions affecting several elements from the same individual could have had clinical implications, like the developmental defects observed in the articulated spine and in the articulated foot. Taken together, these findings could be considered a significant support for the presence of inbreeding in this group of genetically related Neandertals, pointing to low genetic variability as a fundamental factor in Neandertal demography.

We thank all the people working during the El Sidron fieldwork seasons.

**References:**[1] Rosas, A., Estalrrich, A., Garcia-Tabernero, A., Bastir, M., Garcia-Vargas, S., et.al. 2012. The Neandertals from El Sidron (Asturias, Spain). Updating of a new sample. Anthropologie 116, 57-76.[2] Ríos L, Rosas A, Estalrrich A, Garcia-Tabernero A, Bastir M, et.al. 2015. Possible Further Evidence of Low Genetic Diversity in the El Sidron (Asturias, Spain) Neandertal Group: Congenital Clefts of the Atlas. Plos One 10(9).[3] Prüfer, K., Racimo, F., Patterson, N., Jay, F., Sankararaman, S., et.al. 2014. The complete genome sequence of a Neanderthal from the Altai Mountains. Nature 505, 43-49.[4] Ogilvie, M.D., Hilton, C.E., Ogilvie, C.D., 1998. Lumbar anomalies in the Shanidar 3 Neandertal. J. Hum. Evol. 35, 597-610.[5] Castellano, S., Parra, G., Sanchez-Quinto, F.A., Racimo, F., Kuhlwilm, M., et.al. 2014. Patterns of coding variation in the complete exomes of three Neandertals. Proc. Natl. Acad. Sci. 111, 6666-6671.

Pecha Kucha Presentation: Session 2, Th (13:00-13:25)

## Climatic and neutral evolution of the human femur and tibia, both worldwide and in high latitude populations

**Michael B. C. Rivera**[1], **Lia Betti**[2], **Jay T. Stock**[1]

1 - Phenotypic Adaptability, Variation and Evolution (PAVE) Research Group, Department of Archaeology and Anthropology, Cambridge, UK · 2 - Centre for Research in Evolutionary, Social and Inter-Disciplinary Anthropology (CRESSIDA), Department of Life Sciences, University of Roehampton, London, UK

Studies of cranial and pelvic shape variation have shown that neutral processes (*e.g.* genetic drift, random mutation and gene flow) and selective processes (such as thermal adaptation) both have influenced morphological variability between different human populations worldwide [1,2]. In this paper, we investigate the relative importance of neutral processes and climate in shaping the modern human femur and tibia and the proportions between the two lower limb long bones. We combined original data with the Goldman dataset [3] to derive a uniquely large dataset of femoral and tibial morphometric measurements. In total, this comprised morphometric data taken from 2,504 individuals representing 51 different human populations distributed across 6 continents. Matrices of between-population phenotypic distances were derived using this morphometric data, and matrices of between-population temperature differences were derived using climatic data from WORLDCLIM [4]. By using geographic distances along landmasses as a proxy for genetic differentiation between populations [5], we first tested the relationship between phenotypic and geographic distances. This was then followed by tests of temperature's influence on global femoral and tibial shape variation. Our results concur with previous studies showing that absolute temperatures have played a larger role than neutral processes in driving differences in lower limb proportions between human populations. We also identified a signal of temperature instability (*i.e* isothermality and seasonality) having affected limb bone shape and crural index variance globally. Additional tests performed using only the populations living in high-latitude regions further suggest that the signal of natural selection driven by climate comes largely from populations living in cold conditions. Our research highlights the differential degrees to which neutral and selective processes have shaped morphology worldwide and in populations living in high latitude regions. It is therefore important to bear in mind such factors as neutral processes, climatic instability and population sampling in studies of global variation in skeletal morphology.

Funded in part by the Social Sciences and Humanities Research Council of Canada, Natural Environment Research Council and European Research Council, and support from St. Catharine's College (Cambridge, UK).

**References:**[1] Relethford, J.H., 2004. Global patterns of isolation by distance based on genetic and morphological data. Hum. Biol. 76, 499–513.[2] Betti, L., von Cramon-Taubadel, N., Manica, A., Lycett, S.J., 2014. The interaction of neutral evolutionary processes with climatically-driven adaptive changes in the 3D shape of the human os coxae. J. Hum. Evol. 73, 64–74.[3] Auerbach, B.M., Ruff, C.B., 2006. Limb bone bilateral asymmetry: variability and commonality among modern humans. J. Hum. Evol. 50, 203–218.[4] Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G., Jarvis, A., 2005. Very high resolution interpolated climate surfaces for global land areas. Int. J. Clim. 25, 1965–1978.[5] Relethford, J.H., 1994. Craniometric variation among modern human-populations. Am. J. Phys. Anthropol. 95, 53–62.

Pecha Kucha Presentation: Session 2, Th (12:35-13:00)

## Neandertal remains from Pinilla del Valle (Madrid, Spain)

**Laura Rodriguez[1], Rold Quam[2,3,4], Rebeca García-Gonzalez[1], Eva M. Poza-Rey[3,5], Alfredo Perez-Gonzalez[6], Enrique Baquedano [7,8], Juan Luis Arsuaga[3,5]**

1 - Laboratorio de Evolución Humana. Dept. CC. Historicas, Geografía y Comunicación. Universidad de Burgos · 2 -Department of Anthropology, Binghamton University (SUNY), Binghamton, USA · 3 - Centro UCM-ISCIII de Investigación sobre la Evolución y Comportamiento Humanos, Madrid, Spain · 4 - Division of Anthropology, American Museum of Natural History, New York, USA · 5 - Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Madrid, Spain · 6 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain · 7 - Museo Arqueológico Regional de la Comunidad de Madrid, Alcalá de Henares, Madrid, Spain · 8 - Instituto de Evolución en África, Museo de los Orígenes, Madrid, Spain

Located in the Lozoya River basin, north of Madrid, the Pinilla del Valle locality contains four Late Pleistocene sites. Neandertal remains have been recovered from three of them: Cueva del Camino, Cueva de la Buena Pinta and Cueva Des-Cubierta. Two of these sites, Camino and Buena Pinta, are interpreted as hyena dens, while Des-Cubierta is an archaeological site. To date, ten permanent and deciduous teeth and one fragmentary juvenile mandible (MNI = 3) have been recovered.

Material and Methods: The Pinilla del Valle fossils have been compared principally with Neandertals and modern humans. The Des-Cubierta remains were CT scanned to assess the dental development of the unerupted permanent dentition and to make a virtual reconstruction of the mandible.

Results: The two permanent teeth from the Camino site, a right M1 and M3, are compatible with a Neandertal morphology. In particular, the relative cusp areas and occlusal polygon of the M1 show clear Neandertal affinities . Both molars likely represent the same young adult individual based on similar dental wear and tooth size.

Two teeth, a left M2 and M3, were recovered from the Buena Pinta site during the 2007 field season. Both teeth represent the same adult individual and show a pronounced degree of dental attrition, subvertical grooves in the interproximal contact facets, toothpick grooves and marked hypercementosis of the roots. At the Des-Cubierta site, six isolated deciduous teeth and a fragmentary mandible were recovered during the 2011 field season. The teeth correspond to the left di2, dc1, and dm1 and the right di1, dm2 and dc1 and represent a single immature individual. The upper teeth show some Neandertal features, such as shoveling of the incisors, and the general size of the teeth compares well with other immature Neandertals . The mandible fragment preserves the symphysis and left corpus, as well as the broken roots of several teeth. The Des-Cubierta mandible shows a single mental foramen located under the dm1, a developed alveolar planum on the internal symphysis and an absence of chin structures on the external symphysis. The stage of dental development of the unerupted permanent teeth is compatible with that seen in the isolated deciduous teeth, indicating the mandible also represents this same individual. The age at death is estimated at 2-5 years and the minimal wear on the teeth suggests an age close to that of the Roc de Marsal Neandertal infant [1,2].

The authors want to thank the Pinilla del Valle excavation and research team. Financial support for this project was provided by: Comunidad de Madrid (grant number: S2010/BMD-2330), , grupo Mahou, Canal de Isabel II and Ministerio de Ciencia e Innovación of the Government of Spain (Grant number: CGL2009-12703-C03-03). E.M. Poza-Rey is funded by Fundacion Atapuerca. CT scanning was carried out in collaboration with Jose Miguel Carretero at the Laboratorio de la Evolución Humana at the Universidad de Burgos (Spain) and financed by a grant from the Junta de Castilla y León (Project No. BU005A09).

**References:**[1] Skinner, M., 1997. Dental Wear in Immature Late Pleistocene European Hominines. J. Archaeol. Sci. 24, 677-700.[2] Bermudez de Castro, J.M., Martinón-Torres, M., Sarmiento, S., Lozano, M., Arsuaga, J.L., Carbonell, E., 2003. Rates of anterior tooth wear in Middle Pleistocene hominins from Sima de los Huesos (Sierra de Atapuerca, Spain). Proc Natl Acad Sci USA 100, 11992-11996.[3] Arsuaga, J.L., Baquedano, E., Perez-Gonzalez, A., Sala, N., Quam, R., Rodríguez, L., García-González, R., García, N., Alvarez-Lao, D., Laplana, C., Huguet, R., Sevilla, P., Maldonado, E., Blain, H., Ruiz-Zapata, M.B., Sala, P., Gil-Garcia, M., Uzquiano, P., Pantoja, A., Marquez, B., 2012. Understanding the ancient habitats of the last-interglacial (late MIS 5) Neanderthals of central Iberia: Paleoenvironmental and taphonomic evidence from the Cueva del Camino (Spain) site. Quater. Int. 275, 55-75.[4] Quam, R., Bailey, D.A., Wood, B.A., 2009. Evolution of M1 crown size and cusp proportions in the genus Homo. J.Anat. 214, 655-670.[5] Madre-Depuoy, M., 1992. L´enfant du Roc de Marsal : Étude analytique et comparative. Editions du CNRS, Paris.

Pecha Kucha Presentation: Session 2, Th (12:10-12:35)

## Hunting, butchering, carrying and sharing along the Gran Dolina sequence: The ancient origin of the modern subsistence dynamics

**Antonio Rodríguez-Hidalgo[1], Palmira Saladié[1], Juan Luis Arsuaga[2], José María Bermúdez de Castro[3], Eudald Carbonell[1]**

1 - IPHES · 2 - UCM-ISCIII · 3 - CENIEH

Traditionally the subsistence of hunter-gatherers has been interpreted in terms of gradual evolution: the oldest hominin species have been presented as passive opportunistic actors with heavy reliance on resources generated by third parties, while our own species is presented as the top of the evolutionary process, epitomized by the expansion of diets during the broad spectrum revolution and the sophistication on the methods and techniques for obtaining animal resources. However, the archeological evidences contradicts this gradual evolution, as some of the subsistencial traits and technological implements traditionally associated with modernity are presented in the early stages of human evolution and emerge suddenly in the fossil record [1,2,3]. Gran Dolina site at Atapuerca (Spain), represent one of the most complete lower Paleolithic archeological sequences in Europe. Hominins groups (presumably *Homo antecessor* and Sima de los Huesos paleodeme) used recurrently the cave such as refuge, home base and kill site within different occupational dynamics contributing to the formation of several fossil accumulations. Within the stratigraphical discrete assemblages recovered, four of them stand out for being almost exclusively anthropogenic, the TD6.2 layer (980 ka), TD10.2 bison bone bed layer (400 ka), TD10.1 bone bed layer and (337 ka) and TD10.1 upper (240 ka) [4, 5]. Taking into account the diachrony of these deposits and the long span they represent, our objective is to assess the validity of the gradual sophistication on the subsistence strategies concept along the lower Paleolithic. Our research is based in the zooarcheological and taphonomic analysis of more than 35,000 faunal remains. To obtain the results we studied the taphonomic modifications in bone surfaces, taxonomic diversity rates, skeletal representation, mortality profiles and statistical approaches to density mediated attrition. The taphonomic results show invariably the immediate primary access to the carcasses in a recurrent way, evidencing hunting as the base of subsistence. Scavenging is not supported by the data not even in the oldest occupations. All the sets are dominated by young and prime age ungulates, especially cervids, bovids and equids although other taxa are also exploited as prey including carnivores and other hominins, placing the last as top predators. Important differences in butchering process between assemblages have not been recorder. The exploitation of the carcasses was systematic and a sequence of activities, from the visceral removal/skinning to bone breakage, can be predicted in all assemblages. In addition the butchering patterns are analogous to those observed among modern hunters. Anatomical profiles are dominated by high or low survival elements depending on the type of occupation and the intensity of the carnivores ravaging. However along the sequence, we always documented systematic transportation of the products of carcasses from the kill site to the home base in direct correlation to the economic utility, especially regarding its grease and marrow content. This input of resources suggests deferred consumption and meat sharing as two central elements of the socioeconomic strategy along the entire sequence. Despite the fact that studied assemblages were presumably generated by various human species, with different cultural traditions and within diverse occupational dynamics, the faunal record of the Gran Dolina suggest that at least since 1Ma the subsistence was based on the hunting of medium and large ungulates whose carcasses were systematically exploited to be transported to places where resources were subsequently shared. This dynamic is sustained over time without significant changes and agrees with those observed in other early lower Paleolithic sites suggesting that these subsistencial traits are in fact linked to the genus *Homo*.

This research was financed by the Ministry of Economy and Competitiveness (MINECO) of Spanish Government, project no. CGL2012-38434-C03-03, and the Catalan Government, project no. SGR2014-899. Funding for the fieldwork cames from the Cultural and Tourism Council of Castilla y León and the Atapuerca Foundation.

**References**:[1] Stiner, M.C., Barkai, R., Gopher, A., 2009. Cooperative hunting and meat sharing 400-200 kya at Qesem Cave, Israel. PNAS 106, 13207-13212.[2] Domínguez-Rodrigo, M., Mabulla, A.Z.P., Bunn, H.T., Diez-Martin, F., Baquedano, E., et.al. 2010. Disentangling hominin and carnivore activities near a spring at FLK North (Olduvai Gorge, Tanzania). Quaternary Res. 74, 363-375.[3] Conard, N.J., Serangeli, J., Böhner, U., Starkovich, B.M., Miller, C.E., et.al. 2015. Excavations at Schöningen and paradigm shifts in human evolution. J. Hum. Evol. 89, 1-17.[4] Saladié, P., Huguet, R., Díez, C., Rodríguez-Hidalgo, A., Cáceres, I., et.al. 2011. Carcass transport decisions in Homo antecessor subsistence strategies. J. Hum. Evol. 61, 425-446.[5] Rodríguez-Hidalgo, A., 2015. Subsistencial dynamics during the middle Pleistocene in the Sierra de Atapuerca: The archeological assemblages of TD10.1 and TD10.2. (In Spanish) Departament d'Història i Història de l'Art, Universitat Rovira i Virgili. Ph. D. p: 292.

Podium Presentation: Session 7, Fr (18:00)

## There's no place like home! Investigating Neanderthal socio-economic behaviour in intra-site activity areas and housing space

**Francesca Romagnoli**[1,2], **Manuel Vaquero**[1,2]

1 - IPHES -Institut Catalá de Paleoecologia Humana i Evolució Social, Tarragona, Spain. · 2 - Area de Prehistoria, Universitat Rovira i Virgili (URV), Tarragona, Spain.

The social organisation of Palaeolithic societies is usually understudied. Investigating this topic is central in human evolution since it is strictly related with the fact of 'becoming human'. The evolution of a large brain took on new socialised perspectives allowing greater cooperation and cultural development [1]. Usually the social cooperation and the gender division of labour is analysed from the economic, subsistence viewpoint and considering demographic factors in comparison with ethnographic data. It has been considered that some socio-economic dimensions of Neanderthal life were different from those of historic foraging groups: a diet mainly oriented toward meat and a reduced mobility both for foraging and raw material supply. However, recent works have also showed the exploitation of a large spectrum of alimentary resources, capacity for long distance transfer, technical innovation, and combining tool elements [2,3].

The organisation of technology preserved in the archaeological record reflects human needs; the productive strategies, transport, use and discard of tools; the capacity for planning; and the predictability, redundancy and intensity of task demanding tools. The intra-site timing and location of these tasks, in turn, reflect the way in which people organised their living space. The living space was a social space and was shaped by the social dynamics of the human group [4]. The link between social relations and intra-site spatial structure has been rarely investigated in Middle Palaeolithic especially due to few extended surface excavations. Moreover, this research line in Middle Palaeolithic contexts is lacking a connection between the empirical analysis of the material culture and a quantitative approach which are needed to make diachronic comparisons and understand demographic and cultural long-term processes.

Our research is trying to fill this gap analysing how the socio-economic organisation reflected itself in the spatial and temporal organisation of technical activities in a Neanderthal residential camp. The investigation is focused on the Abric Romaní Middle Palaeolithic site (Barcelona, north-east of Iberian Peninsula). The site is studied with multidisciplinary approach. It has been investigated on more than 200 m2 and has a well detailed stratigraphy dated between approximately 40 kyr and 110 kyr [5].

The lithic assemblages are studied with a high-resolution approach, identifying single technical events, detecting their spatial patterns, and relating each event to a temporal scale in the organisation of stone technical activities. Methods include Raw Material Units analysis, refitting, GIS and geostatistical analysis using spatial packages in R language. Point process models are applied to explore and test hypotheses relating to site formation processes and anthropic intra-site spatial distribution.

Results show spatial patterns well preserved by taphonomic processes, spatial variation in event intensity, and a differentiated used of functional areas. The variation in intensity of technological categories within the housing space suggests differences between 'domestic' and 'specialised' areas. Furthermore the use of high-resolution approach with refitting and single event scale of analysis allows to highlight transport events among different site areas and to discuss time as significant variable in the formation of the archaeological assemblage.

F.R. is funded from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 653667. We are grateful to Anne Delagnes and Andrew Bevan who are collaborating to the project. The project would not be possible without the collaboration of the Abric Romaní lithic team. The Departament de Cultura of Generalitat de Catalunya, Diputació de Barcelona, Ajuntament de Capellades, and Arts Grafiques Romanya-Valls S.A. provided support for the Abric Romaní excavations.

**References:**[1] Gowlett, J., Gamble, C., Dunbar, R., 2012. Human evolution and the archaeology of the social brain. Curr. Anthropol. 53, 693-722 [2] Slimack, L., Giraud, Y., 2007. Circulations sur plusieurs centaines de kilomètres durant le Paléolithique moyen. Contribution à la connaissance des sociétés néandertaliennes. Palevol 6, 359-368 [3] Romagnoli, F., Baena, J., Sarti, L., 2016. Neanderthal retouched shell tools and Quina economic and technical strategies: an integrated behaviour. Quat. Int. 407, Part B, 29-44 [4] Ashmore, W., 2002. "Decisions and dispositions": socializing spatial archaeology. Am. Anthropol. 104, 1172-1183 [5] Sharp, W.D., Mertz-Kraus, R., Vallverdú, J., Vaquero, M., Burjachs, F., Carbonell, E., Bishoff, J.L., 2016. Archaeological deposits at Abric Romaní extend to 110 ka: U-series dating of a newly cored, 30 meter-thick section. J. Archaeol. Sci.: Reports 5, 400-406.

Poster Presentation: Session 4, Fr (10:30)

## Tempo and mode in the neandertal evolutionary lineage: a renewed attention to the mandible.

**Antonio Rosas**[1]

1 - Museo Nacional de Ciencias Naturales, CSIC

Presently, most of the scholars identify "neandertal" as a discrete morphological "entity" within the hominin realm. And also they would recognize that neandertals emerged through a unique evolutionary net of processes (e.g. evolutionary history) accomplished throughout a sequence of genetically linked populations, all together grouped under the name of "neandertal lineage" (also referred to as "neandertal clade", e.g.[1] ). Most of us would also agree with the notion that Late Pleistocene neandertal populations were genetically rooted in (some of the) European Middle Pleistocene populations, at times called "anteneanderthaliens" [2]. Yet, a hot debate continues over the "tempo" (cadence or pace) and mode (way of arrangement) of the neandertal features emergence. For instance, should Mauer and/or Arago samples be included in its direct ancestry as proposed by [3]? What was the genetic and geographic origin of the lineage? What sort of evolutionary forces shaped their phenotype? Two general models have been put forward for framing these questions: the accretion model [4] and the two-phase organismic model [5], respectively inspired by population genetics or phenotypic integration theories. In spite of certain differences, two facts seem to be largely recognized: a) European Middle Pleistocene samples (and/or populations) show a large amount of variability; b) once the standard neandertal morphological pattern is achieved, a low level of variation is observed in their populations, even though regional fine-scale diversity has been detected. Unraveling the meaning of changes in variability is central to the clarification of the processes, either from a population perspective (presence of several lineages and bottlenecking) or from an organismic viewpoint (varying strength of integration). Was "neandertalization" a gradual process? Were there uneven rhythms along the process? As for the mode, did the evolutionary forces affect the organism as a whole (e.g. life-history and/or early development alterations with pervasive pleiotropic effects)? Or could specific mechanical or physiological functions selectively be modified? Or, perhaps, was everything just a matter of random processes, grouped under genetic drift? These questions are revisited in this paper by means of morphometric comparative analyses of distinct anatomical systems. Because of its relative abundance, taxonomic significance and structural complexity, the mandible occupies again a central position in the discussion, with the Mauer mandible still being pivotal. Neandertals play a fundamental role in our concept of human evolution and, therefore, clarifying the tempo and mode of their phenotypic change is fundamental to the debate about human species diversification.

This research is funded by MINECO of Spain, Grant number: CGL2012-36682.

**References:**[1] Tattersall, I. 2011. Before the Neanderthals: Hominid Evolution in Middle Pleistocene Europe. In: S. Condemi and G.-C. Weninger (eds), Continuity and Discontinuity in the Peopling of Europe: One Hundred and Fifty Years of Neanderthal Study. Heidelberg: Springer, pp. 47-53.[2] Lumley, MA de 1973. Anteneanderthaliens et Neanderthaliens du Bassin Mediterranean Occidental Europeen. Etudes Quaternaires, Memoires 2. Marseilles: Universite de Provence.[3] Rosas, A. & Bermúdez de Castro, J.M. 1998. The Mauer mandible and the evolutionary significance of Homo heidelbergensis. Geobios 31, 687-697.[4] Hublin, J.-J. 1998. Climatic changes, paleogeography, and the evolution of the Neandertals. In T. Akazawa, K. Aoki and O. Bar-Yosef. Neandertals and Modern Humans in Western Asia. New York: Plenum Press. pp. 295–310.[5] Rosas, A., Bastir, M., Martínez-Maza, C., García-Tabernero, A. & Lalueza-Fox, C. 2006. Neandertal cranio-dental evolution and development. A review in the light of new methods and fossils. In: K. Harvati and T. Harrison (eds). Neandertals revisited. Kluwer Academic Publishers, New York.

Podium Presentation: Session 5, Fr (12:30)

## There is more to life than subsistence: use-wear and residue analyses on pre-Still Bay stone tools at Sibudu

**Veerle Rots**[1], **Carol Lentfer**[1], **Viola C. Schmid**[2], **Guillaume Porraz**[3,4], **Nicholas J. Conard**[2,5]

1 - TraceoLab / Prehistory, University of Liège, Liège, Belgium · 2 - Department Early Prehistory and Quaternary Ecology University of Tübingen, Schloss Hohentübingen, Tübingen, Germany; UMR 7041, Equipe AnTET, Université Paris Ouest Nanterre La Défense · 3 - UMR 7041, Equipe AnTET, Université Paris Ouest Nanterre La Défense, Nanterre Cedex, France · 4 - CNRS, USR 3336, UMIFRE 25, French Institute of South Africa, Johannesburg, South Africa · 5 - Tübingen-Senckenberg Center for Human Evolution and Paleoecology

The rich and long MSA sequence of Sibudu Cave in KwaZulu-Natal has provided many new insights [1,2], including insights on the use and hafting of various projectile forms [3,4]. Since 2011, the new excavations under the direction of N. Conard continue to contribute significantly to our understandings of the technological variability in the MSA [5] and have further exposed a so-called "pre-Still Bay" industry containing bifacial points and a laminar technology pre-dating 75 ka.

Previous functional analyses at Sibudu Cave have mainly focused on points and segments from the Howiesons Poort and late MSA and these were identified as weapon armatures. Here we present the first results from the "pre-Still Bay" layers focusing both on points and other tool categories. Independent residue and use-wear analyses were performed in a phased procedure involving two separate analysts, which allowed the confrontation of two separate lines of functional evidence. Thanks to the excellent preservation at Sibudu Cave, a wide range of animal, plant and mineral residues was observed in direct relation with diagnostic wear patterns. We present the results obtained for serrated bifacial points and for non-bifacial pointed tools (perforators). In addition to subsistence-related activities linked with the use of the serrated points as resin-hafted weapon tips, manufacturing activities were identified for the perforators. The perforators prove to form a new and intriguing tool category, not described before, and devoted to perforating and grooving activities on different types of materials, including hard animal material, several of them while mounted in a hafted arrangement. Their abundance testifies to the importance of special manufacturing activities at the site. The identification of hafting for industries older than 75ka contributes to an improved understanding of the development of complex technologies and the variability in human behaviors.

The research of V.R. and C.L. is supported by the European Research Council under the European Union's Seventh Framework Programme (FP/2007-2013) / ERC Grant Agreement n. 312283.

**References:**[1] Jacobs, Z., A.G. Wintle, G.A.T. Duller, R.G. Roberts, L. Wadley, 2008. New ages for the post-Howiesons Poort, late and final Middle Stone Age at Sibudu, South Africa. Journal of Archaeological Science 35, 1790–1807 [2] Wadley, L. 2007. Announcing a Still Bay industry at Sibudu Cave, South Africa. Journal of Human Evolution 52, 681–689 [3] Lombard, M. 2005. Evidence of hunting and hafting during the Middle Stone Age at Sibidu Cave, KwaZulu-Natal, South Africa: a multianalytical approach. Journal of Human Evolution 48, 279-300 [4] Wadley, L., Hodgskiss, T., Grant, M. 2009. Implications for complex cognition from the hafting of tools with compound adhesives in the Middle Stone Age, South Africa. Proceedings of the National Academy of Sciences 106, 9590-9594 [5] Conard, N.J., G. Porraz & L. Wadley, 2012. What is in a name? Characterising the 'Post-Howieson's Poort' at Sibudu. South African Archaeological Bulletin *67*, 180–199

Podium Presentation: Session 11, Sa (16:40)

## The Troisième caverne of Goyet (Belgium): An exceptional site with both Neandertal and Upper Paleolithic human remains

**Hélène Rougier[1], Isabelle Crevecoeur[2], Cédric Beauval[3], Damien Flas[4], Cosimo Posth[5], Christoph Wißing [6], Anja Furtwängler[5], Mietje Germonpré[7], Asier Gómez-Olivencia [8,9], Patrick Semal[7], Johannes van der Plicht[10], Hervé Bocherens[6], Johannes Krause[11]**

1 - Department of Anthropology, California State University Northridge, USA · 2 - Université de Bordeaux, CNRS, UMR 5199-PACEA, France · 3 - Archéosphère, France · 4 - TRACES – UMR 5608, Université Toulouse Jean Jaurès, France · 5 - Institute for Archaeological Sciences, Archaeo- and Palaeogenetics, University of Tübingen, Germany · 6 - Department of Geosciences, Biogeology, University of Tübingen, Germany · 7 - Royal Belgian Institute of Natural Sciences, Belgium · 8 - Estratigrafía y Paleontología, Euskal Herriko Unibertsitatea, Spain · 9 - IKERBASQUE, Basque Foundation for Science, Spain · 10 - Centre for Isotope Research, Groningen University, Netherlands · 11 - Max Planck Institute for the Science of Human History, Germany

The Troisième caverne (or "Third cave") of Goyet is part of a large cave system located in the Mosan Basin in Belgium. Excavated in the latter half of the 19th and beginning of the 20th century, and again at the end of the 1990s, it yielded a rich archeological sequence ranging from the Middle and Upper Paleolithic to historical times. In 2008, we began documenting the Paleolithic occupations of the Troisième caverne by reassessing the collections from the site which heretofore had only been partially studied. The updated inventory of human remains was accomplished by revising the human collections and conducting a systematic sorting of the faunal material in order to identify any overlooked human remains. Implementing an original, multidisciplinary approach which combined the results of morphometrics, taphonomy, stable isotope, dating, and genetic analyses, we identified numerous new human remains in addition to excluding several bone fragments and a tooth erroneously identified as human. As a result, the human remain sample from the Troisième caverne of Goyet is now comprised of 244 bone specimens and 39 isolated teeth that represent at least 18 individuals (12 adults/adolescents and six juveniles) corresponding to a mix of specimens from different time periods. Of particular interest is a series of 100 human remains with elements from the cranial and infracranial skeleton that we attribute to Neandertals, making the Goyet collection the largest Northern European Neandertal collection currently known. At least six different individuals are represented and radiocarbon dated to ca. 44-45.5 ky calBP, making them some of the youngest Neandertals in Northern Europe. Genetic analyses conducted on seven specimens nearly doubled the number of complete Neandertal mtDNA sequences recovered thus far and confirmed low mitochondrial diversity of European late Neandertals. The dietary ecology of the Goyet Neandertals was quite homogeneous and they occupied the most specific ecological niche among the omnivorous/carnivorous guild. Finally, anthropogenic traces present on the specimens show that they were subjected to butchery activities and that some of them were used for technical activities. As such, Goyet provides the first evidence of Neandertal cannibalism in Northern Europe and is the first site to have yielded several retouchers made on Neandertal bones. Additionally, we have identified a set of 24 modern human specimens that we attribute to three periods of the Upper Paleolithic, namely the Aurignacian, Gravettian and Magdalenian, based on the direct dating of several of them. Although multiple archeological sites attest to the presence of humans in Belgium during the Upper Paleolithic, Goyet is the first one thus far to have yielded human remains securely associated to this time period. They include fragmentary elements from the cranial and infracranial skeleton that represent at least 10 individuals (seven adults/adolescents and three juveniles). Interestingly, those from the Gravettian and Magdalenian present anthropogenic traces and ochre traces, which shed new light on the mortuary practices of Northern European early modern humans. Genetic analyses of the Upper Paleolithic remains have also contributed new data towards the understanding of the demography of early modern European populations, including the surprise finding of the major mtDNA clade M in two Aurignacian specimens, which is otherwise absent in extant Europeans. Our reassessment of the Goyet collections has shown that the Troisième caverne is a truly unique site in that it has yielded human remains from at least four different Paleolithic periods. Multidisciplinary analyses of these remains and of their associated context has contributed new crucial data on their biological features, mortuary practices, and more generally help document human occupations of Northern Europe through the Paleolithic.

This research was funded by the Wenner-Gren Foundation (Gr. 7837 to HR), the College of Social and Behavioral Sciences of CSUN, the CSUN Probationary Faculty Support Program, the CSUN Competition for Research, Scholarship and Creative Activity Awards, and the RBINS. AGO was supported by a Marie Curie Intra-European Fellowship, the research group IT834-13 (Eusko Jaurlaritza/Gobierno Vasco), and the Spanish Ministerio de Economía y Competitividad (project CGL2012-38434-C03-01). JK and CP were supported by the DFG grant KR 4015/1-1 and the Baden Württemberg Foundation.

Podium Presentation: Session 11, Sa (17:20)

## Mortuary practices during Magdalenian in the Swabian Jura

**Nohemi Sala**[1,2,3], **Nicholas Conard**[1]

1 - Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters Abteilung für Ältere Urgeschichte und Quartärökologie, Eberhard-Karls Universität Tübingen · 2 - Centro Mixto UCM-ISCIII. Madrid · 3 - Departamento de Ciencias de la Vida. Universidad de Alcalá, Spain.

The Swabian Jura (Baden-Württemberg, Germany) and in particular, the Ach and Lone valleys, contains occupation layers from the Magdalenian period in several sites [1] accompanied by some human remains [2]. The relative abundance of Magdalenian hominins, especially in Brillenhöhle, allowed us to address mortuary behavior from a taphonomic perspective. Since the discovery of the Brillenhöhle remains, two different hypotheses have been proposed for explaining the composition of human skeletal material at the cave. Shortly following the fieldwork, Gieseler and Czarnetzki [3] and the excavator, Riek [4] discussed the presence of anthropic cut marks on the human bones. This fact, together with the fragmentary preservation of skeletal remains, the spatial distribution over several square meters mixed with faunal bones, and the association of the bones with a hearth, led the researchers to interpret the accumulation as an act of cannibalism [3]. A second careful taphonomic examination by Orschiedt [4] also reports traces of human manipulation on the bones. Orschiedt, however, rejected the earlier researchers' interpretation of these modifications. Based on the high percentage of cut marks on the skeletal remains, especially on the hand and foot phalanges and on the cranium, the absence of deliberate breaking of the bones, as well as the presence of scraping marks, he interpreted these manipulations reflecting the freeing of the skeletal remains as far as possible from their soft tissues [5]. Orschiedt also claims that the skeletal part representation, with a bias against large bones (only smaller bones of the post-cranial skeleton are represented in addition with one calotte), is indicative of a secondary burial origin instead of an act of anthropophagy [5]. In order to address this issue, we reanalyzed the human bones from Brillenhöhle including three new hominin remains found among the faunal assemblage, in addition to all the non-human larger mammalian material from the Magdalenian horizon for comparative purposes.

The taphonomic analysis of both new and old finds indicates that the assemblage displays evidence of butchering similar to those reported for the non-human faunal remains, mainly *R. tarandus*, and includes: skinning, defleshing, evisceration and disarticulation. In addition to the cut marks, intentional breakage has been documented in the form of percussion marks and peeling. The association of these anthropic traces with human tooth marks allows us to conclude that the consumption of human corpses took place during the Magdalenian in Brillenhöhle. Traces of anthropic modification, such as cut marks and intentional breakage of long bones, have also been documented in the Magdalenian horizons of Hohle Fels. This suggests that cannibalism probably was a recurrent behavior during the Magdalenian in the Swabian Jura.

The research was funded by the UNESCO project 1347021/3900/3034003301. We would like to thank Prof. Dr. Claus-Joachim Kind their confidence to carry out this research. Prof. Dr. Katerina Harvati and Michael Francken from the Paleoanthropology department of the Tübingen University, Dr. Henriette Obermaier from the "Staatssammlung für Anthropologie und Paläoanatomie München" and Johannes Wiedmann from the "Urgeschichtliches Museum Blaubeuren" for their support with the access to the original specimens. Thanks to Dr. Antonio Rodríguez-Hidalgo, Dr. Asier Gómez-Olivencia, Dr. Andreas Taller and R3 group for their contributions to this research.

**References:**[1] Taller, A., 2014. Das Magdalénien des Hohle Fels. Chronologische Stellung, Lithische Technologie und Funktion der Rückenmesser. Kerns, Tübingen.[2] Conard, N.J., Bolus, M., 2003. Radiocarbon dating the appearance of modern humans and timing of cultural innovations in Europe: new results and new challenges. J. Hum. Evol. 44, 331-371.[3] Gieseler, W., Czarnetzki, A., 1973. Die menschlichen Skelettreste aus dem Magdalénien der Brillenhöhle, in: Riek, G. (Ed.), Das Paläolithikum der Brillenhöhle bei Blaubeuren (Schwäbische Alb). Müller & Gräff, Stuttgart, pp. 165-168.[4] Riek, G., 1973. Das Paläolithikum der Brillenhöhle bei Blaubeuren (Schwäbische Alb) Müller & Gräff, Stuttgart.[5] Orschiedt, J., 1997. Der Nachweis einer Sekundärbestattung aus dem Magdalénien der Brillenhöhle, Alb-Donau-Kreis (Baden-Württemberg). Archäologisches Korrespondenzblatt 27, 193-206.

Podium Presentation: Session 11, Sa (17:40)

## Continuities and discontinuities in human craniofacial morphology from the Final Palaeolithic to the Late Mesolithic in Western Europe: preliminary results.

**Mathilde Samsel[1], Christopher Knüsel[1], Frédérique Valentin[2], Michel Toussaint[3], Sébastien Villotte[4]**

1 - UMR 5199 PACEA, Université de Bordeaux · 2 - UMR 7041 Arscan Ethnologie Préhistorique, CNRS · 3 - Association Wallonne d'Etudes Mégalithiques, independant researcher · 4 - UMR 5199 PACEA, CNRS

The Final Palaeolithic is considered to date between *ca.* 12.5 and 9.6 ky calBC, and it is defined by a global warming punctuated by climate fluctuations. The Mesolithic extends between *ca.* 9.6 and 5.5 ky calBC, and it is characterized by a temperate environment similar to the current one. For some researchers, Mesolithic populations share continuity with Final Palaeolithic groups in terms of lifestyles [1]. However, a mosaic of cultures has been highlighted during the Mesolithic period. A major partition has been proposed in Western Europe between the Early and Late Mesolithic in the middle of the 7th millennium calBC on the basis of major changes in stone-working techniques and tool types [2]. Nevertheless in palaeobiological studies to date, Mesolithic groups have been considered as a single entity [3,4]. Here, we employ cranial morphological variation to address the biological variability and affinities of Late Pleistocene and Early Holocene populations of Western Europe. We aim particularly to characterize geographical and chronological patterns between Final Palaeolithic, Early Mesolithic and Late Mesolithic groups. The sample covers Belgium, France, Germany, Spain, Portugal, Switzerland and Italy. A set of 13 original craniometric variables is considered for a sample comprised of 34 neurocrania, 27 facial skeletons, and 16 mandibles directly dated from the end of the Upper Palaeolithic to the end of the Mesolithic, or associated with reliable chrono-cultural attributions. The results show significant differences between groups dating from the Early Mesolithic to the Late Mesolithic on selected neurocranial variables, whereas there are no significant differences between Final Palaeolithic and Early Mesolithic groups. Facial characteristics are significantly different between Final Palaeolithic and Late Mesolithic groups, and geographical patterns emerge for mandibular variation. From a more general perspective, our results confirm that coastal groups from the Late Mesolithic show quite different cranial morphological patterns to those of other groups [5]. More significantly, our results are consistent with internal chronological distinctions within the Mesolithic in Western Europe, which should be considered in future palaeobiological research. In addition, while Late Pleistocene and earlier Holocene groups appear to be biologically closely related, some distinctions based on geography are highlighted. These results would be complemented and refined by additional samples and by considering other biological indicators, such as infra-cranial measurements and epigenetic variants, to further elucidate this issue of group affinities of the last hunter-gatherers in Western Europe from a micro-evolutionary perspective.

We thank all institutions and curators who gave us access to collections. This research is part of a Ph.D. thesis and was supported by grants from the University of Bordeaux, Partenariat Hubert Curien (Programme Tournesol 34228WD, French resp. S. Villotte, Belgian resp. C. Polet), and Agence Nationale de la Recherche (ANR-15-CE33-0004, resp. S. Villotte).

**References:**[1] Rozoy, J.G., 1980. La délimitation des groupes humains à l'Epipaléolithique. Bulletin de l'Association scientifique Liégeoise pour la Recherche Archéologique XVI, 35-41 [2] Costa, L.-J., Marchand, G., 2006. Transformations des productions lithiques du premier au second Mésolithique en Bretagne et en Irlande. Bull. Soc. Préhist. Fr. 103, 275-290 [3] Holliday, T.W., 1999. Brachial and crural indices of European Late Upper Paleolithic and Mesolithic humans. J. Hum. Evol. 36, 549-566 [4] Brewster, C., Meiklejohn, C., von Cramon-Taubadel, N., Pinhasi, R., 2014. Craniometric analysis of European Upper Palaeolithic and Mesolithic samples supports discontinuity at the Last Glacial Maximum. Nat. Commun. 5, 4094 [5] Meiklejohn, C., Babb, J., 2015. Cranial morphology and population relationships in Portugal and Southwest Europe in the Mesolithic and terminal Upper Paleolithic. In: Bicho, N., Detry, C., Price, T.D., Cunha, E. (Eds.), Muge 150th: The 150th Anniversary of the Discovery of Mesolithic Shellmiddens - Volume 1. Cambridge Scholars Publishing, Newcastle upon Tyne, pp. 239-254

Poster Presentation Number 138, Th (18:00-20:00)

## Faunal bone discrimination for archaeological purposes by laser plasma spectroscopy

**Antonio Jesús Sánchez Flores**[1], **Alicia Marin-Roldan**[1], **José Yravedra**[1], **Jorge Omar Caceres**[1]

1 - Complutense University of Madrid

The origin of human beings and their behavior is one of the most addressed issues in the history. For this reason, elements such as bipedalism, cranial capacity, the ability to make tools and planning, reduced sexual dimorphism or changes in diet have been constant objects of study.

Over the past 30 years, the debate has been monopolized by two types of analysis: 1) Paleoanthropological, focused on the evolutionary physical traits of human beings, and 2) analysis of subsistence strategies of early humans for meat, either through hunting or scavenging. That they had the capability to hunt implies greater cooperation between all members of the group, previous planning and organization, and a distribution of the prey; while the scavenging denotes a more individualistic and opportunistic attitude.

It is now known that the early humans were essentially social primates capable of hunting. But despite the progress made, we know nothing about their social behavior or organization and how they consumed the hunted animal. It can be inferred that they defleshed the prey, transported to another place and distributed among the group. However, still today, there is no adequate technology that allows us to verify these assumptions.

This study is a first step to analyze social behavior of hominoids, using Laser Induced Breakdown Spectroscopy (LIBS) to identify bones from different, current individuals. Thus, further studies will analyze, with archaeological individuals, how hominoids managed and processed meat resources after obtaining and transporting them to the site. LIBS technique involves the ablation of a small portion (micrograms) of the sample surface when interact with a laser pulse, generating a plasma that emits radiation corresponding to the elemental composition of the sample. It is a fast, multilemental and microdestructive method, which requires no sample preparation. Mathematical method such as Neural Network (NN) has shown successful results in discrimination of human remains [1], but in this case, the living environment of all individuals have been exactly the same, so the differences between their bones only lies in their inherent differences, such as metabolism.

Nine bones from 3 current juvenile deer were collected. Samples were brushed to remove soft tissues and soil, washed with warm water without using soap to avoid the superficial chemical contamination and rinsed several times with distilled water. The samples were left to dry at room temperature before LIBS measurement. Finally, NN was able to reassemble correctly individual, which could

**References:**[1] Moncayo,S., Manzoor, S., Ugidos, T., Navarro-Villoslada, F., Caceres, J. O.,2014. Discrimination of human bodies from bones and teeth remains by Laser Induced Breakdown Spectroscopy and Neural networks. *Spectrochimica Acta Part B: Atomic Spectroscopy* (101) 21-25.

Poster Presentation Number 40, We (17:00-19:00)

## Accumulation processes assessment in Ambrona site (Soria, Spain) through density and orientation analysis of spatial datasets from 1960 to present

**Laura Sánchez-Romero[1], Alfonso Benito-Calvo[1], Alfredo Pérez-González[1], Manuel Santonja[1]**

1 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain

The Palaeolithic site of Ambrona (Soria, Spain) constitutes one of the references in the european Acheulean studies. The investigation of the Palaeolithic site of Ambrona (Soria) began in 1914 on initiative of Enrique de Aguilera y Gamboa (1845-1922). In 1962-1963, 1980, 1981 and 1983, the international team led by the Prof. F. Clark Howell developed wide fieldworks of excavation and investigation in Ambrona. Later, since 1993 to 2000 a total amount of 688 m2 was excavated by the team of the Profs. Santonja and Pérez-González. The Santonja and Pérez-González excavations focused their investigations on the properties of the different lithostratigraphic units and their levels. The initial idea of the accumulation processes of this site was anthropogenic origin, but subsequent studies demonstrated that the origin was mainly natural. Ambrona site has been excavated since 1914 and by several research groups, which has generated a great amount of information which has never been unified before. The current work was based on the orientation spatial analysis of the archaeological remains, in order to infer the accumulation processes. We have unified all the published and unpublished excavation plans available from 1960s to present. Using these maps, we present the spatial study of the LSM (Lower Stratigraphic Member) at the Ambrona site, combining stratigraphic criteria with GIS density and orientation analysis. Through this study we have defined the main concentrations of the LSM site and we have contributed to assess their accumulation processes. Most of the concentrations located in the border of the current preserved site show strong orientation patterns, which coincide which the direction of the main discharge inputs to the Ambrona wetland. Nevertheless, random orientation pattern have been described in centre position of the site (Alpha concentration), which could be preserved mainly in situ, such as previous taphonomical studies also confirm. Keywords: Ambrona site, orientation patterns, density analysis, GIS analysis, spatial archaeology.

Research at Ambrona site is funded by the Junta de Castilla y León, Consejería de Educación, Dirección General de Universidades e Investigación (CEN186A12). L. Sánchez-Romero is beneficiary of a predoctoral grant of the Junta de Castilla y León (EDU/1083/2013). We are very grateful to Prof. Tim D. White for providing the access to the Clark Howell "HERC" Library and the unpublished documentation. Josh Carlson and Katheryn Rieck (Human Evolution Research Center, University of California in Berkeley) for their help to manage all the documentation.

Podium Presentation: Session 8, Sa (8:50)

## Functional vs. genetic influence in humeral trabecular bone – a comparison of Neanderthals, Neolithic and extant humans, and great apes

**Heike Scherf[1], Joachim Wahl[2], Jean-Jacques Hublin[3], Katerina Harvati[1]**

1 - Paleanthropology, Senckenberg Center for Human Evolution and Paleoenvironment, Eberhard Karls University (Tübingen, Germany) · 2 - Landesamt für Denkmalpflege Konstanz, Regierungspräsidium Stuttgart (Germany) · 3 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology (Leipzig, Germany)

The genetic blueprint of skeletal elements has been shown to adapt to the functional loadings to which the skeleton is subjected through an individual's lifetime. *In vivo* observations of orthopedic, biomedical, and anthropological research indicate that the highly load-sensitive trabecular bone is structurally altered during frequent remodeling by the common activities an individual. While the femoral trabecular bone is in the focus of adaptation of trabecular bone for decades, the humeral trabecular bone was identified recently to contain signatures of habitual loading, too [1-3].

Here we investigated specimens of humeral trabecular bone from four Neanderthals (Kebara 2 (left and right side), Le Regourdou 1 (right side), and Feldhofer 1 (right side)), as well as Neolithic humans from SW- Germany (11), extant humans (18), chimpanzees (12) and orangutans (13) to characterize and understand the humeral trabecular architectures of different genera and of different human groups with diverse subsistence strategies. The humeral trabecular bone of all groups was visualized using high-resolution computed tomography at the University of Tübingen Computing Tomography Laboratory (GE v|tome|x s), and in the Department of Human Evolution of the Max Planck Institute for Evolutionary Anthropology (BIR ACTIS 225/300). Care was taken that all individuals were adults and showing no sign of pathological or degenerative alterations. No zoo animals were included among the ape samples.

A spherical volume of interest (VOI) of trabecular bone was sampled in the central part of the humeral head from each specimen. We quantified the trabecular architectures by measuring seven standard 3D-morphometric parameters (BV/TV, Tb.Pf, SMI, Tb.Th, Tb.N, Tb.Sp, DA). A principal components analysis was conducted on the correlation matrix. PC1 (50.54% of the total variance) separated chimpanzees on the positive side from recent modern humans on the negative side, with the orangutan, Neolithic human and Neanderthal samples overlapping with each other and partly also with the *Pan* and recent *Homo* samples, in the middle of the axis. Separation was driven mainly by BV/TV, Tb.N (loading positively) and Tb.Pf and SMI (loading negatively). PC2 (26.71%) separated Neanderthals (more positive scores) from Neolithic humans (more negative scores), while both overlapped with orangutans. Feldhofer 1 plotted at the extreme positive end of the axis. PC3 (13.53%) pulled Neolithic humans and Neanderthals together (more negative scores) away from orangutans (more positive scores). Tb.Th, Tb.Sp (positively) and Tb.N (negatively) influenced PC2 most, while PC3 was overwhelmingly influenced by DA (loading positively).

These morphological differences in the trabecular architectures reflect the strong influence of functional adaptation over genetic predisposition in the five groups investigated. Despite being closely related, the samples had distinct trabecular architectures, likely as a response to different loading regimes on their forelimbs. A differentiation between the genera is expected, since they perform different kinds of locomotion, using their forelimbs in different ways. The diverse signatures identified in Neanderthals, Neolithic and extant humans, are likely the result of their different manual habits (agricultural work for Neolithic humans, hunting for Neanderthals). Similarities in the trabecular architecture of orangutans, Neolithic humans and Neanderthals, as reflected in their overlap on PC1 and 2, might be due to hands-over-shoulder activities, occurring for orangutans during suspensory locomotion, for Neanderthals during hunting, for Neolithic humans during agricultural work, and sometimes for recent humans during occupational work or leisure exercises.

This study was supported by DFG INST 37/706-1 FUGG grant, the Senckenberg Gesellschaft für Naturforschung (SGN), and by the Max Planck Society.

**References:**[1] Ryan, T.M., Shaw, C.N., 2012. Unique Suites of Trabecular Bone Features Characterize Locomotor Behavior in Human and Non-Human Anthropoid Primates. PLoS One 7, e41037.[2] Scherf, H., Harvati, K., Hublin, J.-J., 2013. A comparison of proximal humeral cancellous bone of great apes and humans. J. Hum. Evol. 65, 29-38.[3] Scherf, H., Wahl, J., Hublin, J.-J., Harvati, K., 2016. Patterns of activity adaptation in humeral trabecular bone in Neolithic humans and present-day people. Am. J. Phys. Anthropol. 159, 106-115.

Poster Presentation Number 46, We (17:00-19:00)

## How (not) to model Neanderthal extinction

**Fulco Scherjon**[1], **Krist Vaesen**[2], **Alexander Verpoorte**[1]

1 - Leiden University · 2 - Leiden University, Eindhoven University of Technology

Models are increasingly relied on to explain the replacement of Neanderthals by anatomically modern humans (AMH) [1-4]. We first argue that this series of models faces two major problems, and subsequently present more promising ways of modelling Neanderthal extinction.

In the critical part of the paper, we start by showing that existing models [1-4] are begging the question as to the demise of Neanderthals. Each of the models assumes a large difference between Neanderthals and AMH: increasing mortality rates for Neanderthals, but decreasing rates for AMH [1]; or decreasing growth rates for Neanderthals, but increasing rates for AMH (due to differences in technological development [3,4] or in social organization [2]). Evidently, under such conditions the replacement of Neanderthals by AMH is inevitable. In order to move beyond trivial explanations, one either "just" needs decisive empirical evidence for the superiority of AMH (but see the concerns raised by [5]), or, if models are to contribute anything, models that are more conservative in what they assume about the two sister species.

A second problem concerns what has been inferred from the models. Especially the early model by Zubrow [1] has made popular the idea that it would take only a small demographic difference in favor of modern humans to end the Neanderthal era. Beside the fact that Zubrow's model actually assumes large demographic differences (see above), the proposition conflicts with the available ethnographic evidence. We review the ethnographic literature, showing that differences in mortality rates (as assumed by Zubrow [1]) or in social organization (as assumed by [2]) do not prevent neighboring populations from co-existing. Populations thus appear to be able to regulate their numbers despite inter-group variation.

In a final, more constructive part of the talk, we introduce a conservative model, which assumes no difference between Neanderthals and AMH other than their respective population size. This null model suggests that stochasticity and allee effects (i.e., populations at low numbers are affected by a positive relationship between population growth rate and density) might have been sufficient for the Neanderthals to have gone extinct.

The research was supported by the Netherlands Organisation for Scientific Research (NWO VIDI Grant 016.144312) (KV) and the N.W.O. Spinoza program (FS).

**References:**[1] Zubrow, E., 1989. The demographic modelling of Neanderthal extinction. In: Mellars, P., Stringer, C. B. (Eds.), The Human Revolution: Behavioural and Biological Perspectives on the Origins of Modern Humans. Edinburgh University Press, Edinburgh, pp. 212-231.[2] Horan, R.D., Bulte, E., Shogren, J.F. 2005. How trade saved humanity from biological exclusion: an economic theory of Neanderthal extinction. J. Econ. Behav. Organ., 58(1), 1-29.[3] Flores, J.C., 2011. Diffusion coefficient of Modern Humans outcompeting Neanderthals. J. Theoret. Biol., 280(1), 189-190.[4] Gilpin, W., Feldman, M.W., Aoki, K., 2016. An ecocultural model predicts Neanderthal extinction through competition with modern humans. Proc. Natl. Acad. Sci. 113(8), 2134-2139.[5] Villa, P., Roebroeks, W., 2014. Neandertal Demise: An Archaeological Analysis of the Modern Human Superiority Complex. PLoS ONE 9(4).

Poster Presentation Number 136, Th (18:00-20:00)

## Prospection between excavations – nondestructive field methods for understanding the old documentation of the Middle to Upper Paleolithic site of Ranis-Ilsenhöhle, Germany

**Tim Schüler[1], Marcel Weiß[2], Shannon P. McPherron[2], Jean-Jacques Hublin[2]**

1 - Thuringian State Office for the Preservation of Historical Monuments and Archaeology, Weimar, Germany · 2 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

The cave site of Ranis-Ilsenhöhle, Saale-Orla Kreis, Thüringen [3], is an important data point for the Middle to Upper Paleolithic transition in central Germany and northern Europe. It was excavated between 1932 and 1938 by Werner M. Hülle [3]. The finds from Layer X (Ranis 2) were given the name Ranisian and form one part of the Lincombian-Ranisian-Jerzmanowician (LRJ) transition period complex of northern Europe [1,2]. Recent studies have shown that bifacial leaf points similar to those from Ranis [4] and Jerzmanowice blade points can be assigned to the final Middle Paleolithic [1,2]. The stratigraphy of Ranis seems to reinforce the typo-technological arguments for a late, transition period assemblage, as it is probably the only LRJ site in northern Europe where the final Middle Paleolithic is overlain by an early Upper Paleolithic assemblage [1].

However, Ranis, like many key transition period sites, was excavated early in the history of prehistory, and there are reasons to be cautious about interpreting the results The site was excavated with shovels, sediments were not screened and parts of the site were excavated in a tunnel underneath a huge block of limestone. Hülle [3] used very simple equipment for the surveying work and the two fixed points which he used for the documentation no longer exist, making it difficult to place the old excavation in relation to existing site topography. The reconstruction of the depth-values is especially difficult, because neither the old zero point nor remains of the old surface from the beginning of the excavation could be found. It seems that the old grid values have an uncertainty in the 0.5m range.

To further assess the situation at this site, we use tomography based on DC ground resistivity measurements and percussion core drilling equipment. Six resistivity profiles (in each case 48 electrodes with 0.5m distance) were measured. Unfortunately, it was not possible to obtain data for greater depths on the end of the electrode line by using standard electrode configurations like Wenner or Schlumberger (the profile has the shape of a triangle). To reduce this effect we used the combination of dipol-dipol and the pole-dipole configuration. It was possible to get values to a depth of 8 m over a length of 23.5 m. A 2D-inversion algorithm based on the incomplete Gauss-Newton method with consideration of topography was used to compute pseudosections. To obtain more information, we measured the induced polarization in addition to the resistivity. As result, the value of the chargeability gives an impression about the ion behavior in the soil and so about its chemistry. Using the entire data set, a 3-dimensional volume could be calculated which allows a "virtual excavation" to get a better idea of where the previous trenches were located, the presence of boulders, and the configuration of the bedrock. The calculated virtual plans and profiles from this data set provide some insights into the depth of the layers and potential starting points for new excavations. Additionally, the material from the percussion core drilling was used to better interpret the resistivity data and to help confirm a distinction between refilling and intact deposits. Here we achieved a depth up to 4.1 m. Based on this initial work, it seems that intact deposits close to the previously reported finds do exist.

With these results and given the importance of the Ranis sequence for understanding the LRJ and the transition from the late Middle Paleolithic to the Upper Paleolithic in central Europe, we are reopening and excavating Ranis starting in the summer of 2016. In addition to obtaining new artifact and faunal assemblages from the sequence using modern excavation techniques, the excavations will emphasize site formation processes and will include dating attempts using ESR, OSL and AMS.

**References:**[1] Flas, D. (2006). La transition du Paléolithique moyen au supérieur dans la plaine septentrionale de l'Europe: Les problématiques du Lincombien-Ranisien-Jerzmanowicien. Doctoral dissertation, University of Liège.[2] Flas, D. (2011). The Middle to Upper Paleolithic transition in Northern Europe: the Lincombian-Ranisian-Jerzmanowician and the issue of acculturation of the last Neanderthals. World Archaeology 43 (4): 605-627.[3] Hülle, W. M. (1977). Die Ilsenhöhle unter Burg Ranis/Thüringen. Eine paläolithische Jägerstation. Verlag Gustav Fischer, Stuttgart.[4] Uthmaier, T. (2004). Micoquian, Aurignacien und Gravettien in Bayern: eine regionale Studie zum Übergang vom Mittel-zum Jungpaläolithikum. Archäologische Berichte 18. Habelt, Bonn.

Podium Presentation: Session 4, Fr (9:30)

## Evolution of hominin tooth size explained through development-based models

**Gary T. Schwartz[1], E. Susanne Daly[1], Kierstin K. Catlett[1], Kathleen S. Paul[2], Stephen J. King[3], Matthew M. Skinner [4], Hans P. Nesse[5], Jean-Jacques Hublin[6], Grant C. Townsend[7], Jukka Jernvall[8], Alistair R. Evans[9]**

1 - Institute of Human Origins, Arizona State University · 2 - Center for Bioarchaeological Research, Arizona State University · 3 - Dept. of Anthropology, University of Massachusetts at Amherst · 4 - School of Anthropology and Conservation, University of Kent · 5 - School of Human Evolution and Social Change, Arizona State University · 6 - Dept. of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig · 7 - School of Dentistry, The University of Adelaide, South Australia. · 8 - Institute of Biotechnology, University of Helsinki. · 9 - School of Biological Sciences, Monash University, Australia

Tooth and jaw function are frequently relied upon to explain the variation in molar proportions among humans, the great apes, and our closest extinct relatives (the hominins), laying the foundations for our interpretations of human evolution. Beginning almost a century ago, some researchers have interpreted the systematic pattern of size variation along the tooth row in mammals as the result of a 'morphogenetic gradient', but the specific developmental mechanism(s) underlying tooth size have remained elusive, with hypotheses ranging from morphogenetic fields to the clone theory. In this study we test whether the inhibitory cascade, an activator-inhibitor mechanism that affects relative tooth size in mammals, produces the default pattern of tooth sizes for all lower primary postcanine teeth (deciduous premolars and permanent molars) in hominins. In other words, are there developmental rules constraining how hominin tooth size evolves? If the primary postcanine dentition follows the patterning predicted by the inhibitory cascade, then a potential developmental mechanism underlying the morphogenetic gradient exists.

Using maximum occlusal areas of the primary postcanine dentition, we found that the hominins follow the linear pattern predicted by the inhibitory cascade. Furthermore, in species of *Homo*, including modern humans, there is a tight link between tooth proportions and absolute m1 size such that a single developmental parameter can explain both the relative and absolute sizes of primary postcanine teeth. This contrasts with the australopiths (including *Ardipithecus*, *Australopithecus*, and *Paranthropus*), where the patterning of tooth size remains constant with absolute m1 size. As a result of the relationship between tooth size and inhibitory cascade patterning, we can use the size at one tooth position to predict the mean sizes of the remaining four primary postcanine teeth in the row for hominins. This study provides a development-based expectation for predicting the evolution of tooth proportions in the hominin lineage.

Podium Presentation: Session 3, Th (15:20)

## Lateral stability and footfall sequences in primate locomotion

**William Sellers**[1], **Eishi Hirasaki**[2]

1 - Faculty of Life Sciences, University of Manchester · 2 - Primate Research Institute, Kyoto University

One of the key innovations in the human lineage was the adoption of habitual, upright bipedalism. However the timing of the transition from a quadrupedal ancestor is currently uncertain. This transition may have been a gradual process of increasing orthogrady occurring throughout the evolutionary history of the hominoids. Alternatively it may have been a much more sudden change that occurred primarily in the hominin lineage after the human-chimpanzee common ancestor. To help us gain a better understanding of this evolutionary process we need to discover whether there are features of primate quadrupedal locomotor mechanics that may have assisted in this fundamental gait shift and whether there are indicators in the fossil record that can be used to accurately document the likely proportion of bipedalism in a particular species' locomotor repertoire. One approach to understanding the mechanics of quadrupedalism is to create computer simulations that accurately match the anatomy of primates. These simulations can then be used as a test bed for exploring the form and function relationships within the locomotor system. Here we show how we can use a high biofidelity musculoskeletal model of a chimpanzee to explore how the hind-limb drive features of the primate locomotor system [1] are linked to the habitual use of diagonal gaits [2] through the caudal shift of the centre of mass compared to most non-primate cursorial mammals as suggested by recent work on quadrupedal robots [3]. The model is based on CT and dissection data and is able to generate a range of quadrupedal gaits with differing footfall patterns. Some of these match well with kinematic data obtained from 3D photogrammetric motion capture on free-ranging chimpanzees. In addition key aspects of the model such as limb lengths and mass distributions can be altered to investigate their effects on the generated gaits. We find that the footfall patterns generated are primarily dependent on the stability criteria used within the simulation. This suggests that quadrupedal footfall patterns are strongly linked to lateral stability and lends weight to ideas of support reliability in an arboreal context being the driver behind gait selection among primates [4]. The associated shift in centre of mass and the increase in hindlimb dominance may be an important factor for increasing bipedal competency within the hominoid lineages. Our results demonstrate that simple models of locomotion may be insufficient to answer the complex, multi-factorial questions posed by the evolution of the human locomotor system and that we need a better understanding of the mechanics of quadrupedalism transitioning to facultative bipedalism if we are to understand the evolution of our own unique locomotor pattern.

**References:**[1] Kimura, T., Okada, M., Ishida, H., 1979. Kinesiological characersitics of primate walking: its significance in human walking, in: Morbeck, M.E., Preuschoft, H., Gomberg, N. (Eds.), Environment, Behavior, and Morphology: Dynamic Interactions in Primates. Gustav Fischer, New York, pp. 297-311.[2] Hildebrand, M., 1967. Symmetrical gaits in primates. Am J Phys Anth 26, 119-130.[3] Owaki, D., Kano, T., Nagasawa, K., Tero, A., Ishiguro, A., 2012. Simple robot suggests physical interlimb communication is essential for quadruped walking. J R Soc Interface 10, 20120669-20120669.[4] Cartmill, M., Lemelin, P., Schmitt, D., 2002. Support polygons and symmetrical gaits in mammals. Zool J Linnean Soc 136, 401-420.

Poster Presentation Number 31, We (17:00-19:00)

## The exceptional microvertebrate record of the Calvero de la Higuera sites (Pinilla del Valle, Spanish Central System): a key to understanding the natural environment of Neanderthals in central Iberia

**Paloma Sevilla[1], César Laplana[2], Hugues-Alexandre Blain[3], Juan Luis Arsuaga[4], Enrique Baquedano[2], Alfredo Pérez-González [5]**

1 - Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Spain · 2 - Museo Arqueológico Regional, Alcalá de Henares, Spain · 3 - SpaincIPHES, Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain · 4 - Centro Mixto UCM-ISCIII de Evolución y Comportamiento Humanos, Madrid, Spain · 5 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain

Microvertebrate record is a useful proxy for reconstructing past environments. In Quaternary sites, most of the microvertebrate fossils found in the assemblages belong to extant species, making easier this task as their ecological requirements are known from the study of their living populations. For Quaternary microvertebrates that are extinct there are a variety of methods to infer their ecological preferences (ecomorphology, phylogenetic relationships,...) used for this purpose. The Calvero de la Higuera is a small promontory in the Spanish Central System range. It contains numerous karstic cavities, some of which were occupied during the Quaternary either by carnivores or by Neanderthals. Many of these cavities are filled with sediments rich in vertebrate bones, in which microvertebrate remains are sometimes particularly abundant. The chronology of the sites range from the final part of the Middle Pleistocene to the beginning of the last third of the Late Pleistocene. The purpose of this communication is to summarize the exceptionally rich and diverse microvertebrate record of the Calvero de la Higuera sites and to reconstruct the environmental setting of this area during the time spam in which the Neanderthals and carnivores occupied the sites. Excavations at these sites have been conducted annually since 2002 until today. The sediment was removed separately according to 10 cm depth intervals and 1 × 1 m grid squares. Microvertebrate remains were recovered by washing each of these sediment samples using superimposed sieves, down to 0.5 mm diameter. Subsequent lab work involved anatomical and taxonomical identification as well as taphonomical observations in order to establish the origin of the bone accumulation. Different methods of paleoenvironmental reconstruction (mutual climatic range, bioclimatic model) were applied to the microvertebrate assemblages, to establish the prevailing environmental conditions while Neanderthals were present in the valley. The older site, called Galería Pit, contains a microvertebrate association consisting mainly of rodents, among which *Microtus vaufreyi* is by far the most abundant species [1]. Together with *Microtus brecciensis*, both species are typical taxa in Middle Pleistocene sites in the Iberian Peninsula. In absence of numerical datings, the advanced evolutionary stage observed in the *M. vaufreyi* population enabled to infer a latest Middle Pleistocene age for this site (MIS 6). Considering the taxa making up the small mammal assemblage in Galería Pit, the climate must have been more humid than today and with a lower thermal amplitude. Numerical datings place Camino Cave between the end of MIS 5 and the beginning of MIS 4, that is, within the first half of the Late Pleistocene. This site includes a large and rich record of small mammals, amphibians and reptiles [1,2]). The successive associations of microvertebrates recorded in this site evidence fluctuating climatic conditions concerning both temperatures and rainfall, a characteristic of this time interval. Buena Pinta Cave is another site at the Calvero de la Higuera. Values obtained from AMS datings place its main stratigraphical succession at the beginning of the last third of the Late Pleistocene (MIS 3). Several small mammal species typically distributed in cold climate regions, such as *Microtus oeconomus*, *Microtus gregalis*, *Marmota marmota* and *Ochotona* cf. *pusilla*[3,4] are part of the assemblages and indicate that the surrounding region had colder climatic conditions during the MIS3 than today. Other sites, such as Navalmaillo Rock-Shelter and Des-Cubierta Cave at the Calvero de la Higuera also contain a rich microvertebrate record, but so far only preliminary data are available.

This work was performed as part of project S2010/BMD- 2330, funded by the I + D activities programme for research groups of the Consejería de Educación de la Comunidad de Madrid. Digging campaigns and other research activities dealing with the Pinilla del Valle sites also received funding from the Museo Arqueológico Regional (MAR) de la Comunidad de Madrid, Grupo Mahou and Canal de Isabel II. The authors thank the Pinilla del Valle excavation team, without whose help this work would not have been possible.

**References**:[1] Laplana, C., Sevilla, P., Blain, H.-A., Araujo, C., Arsuaga, J. L., et.al. 2013a. Microvertebrados del nuevo yacimiento "Sondeo Galería" del Calvero de la Higuera (Pleistoceno Medio final, Pinilla del Valle, Madrid). XXIX Jornadas de Paleontología, 87-88.[2] Blain, H.-A., Laplana, C., Sevilla, P., Arsuaga, J. L., Baquedano, E., et.al.2014. MIS5/4 transition in a mountain environment: Herpetofaunal assemblages from Cueva del Camino, central Spain. Boreas 43, 107–120.[3] Laplana, C., Sevilla, P., Arsuaga, J. L., Arriaza, M. C., Baquedano, E., et.al. 2015a. How far into Europe Did Pikas (Lagomorpha: Ochotonidae) go during the Pleistocene? New Evidence from Central Iberia. PLos One, 10 (11), e0140513.[4] Laplana, C., Sevilla, P., Blain, H.-A., Arriaza, M. C., Arsuaga, J. L., et.al. 2015b. Cold-climate rodent indicators for the Late Pleistocene of Central Iberia: New data from the Buena Pinta Cave (Pinilla del Valle, Madrid Region, Spain). C. R. Palevol 15(6), 615-752 [5] Laplana, C., Blain, H.-A., Sevilla, P., Arsuaga, J. L., Baquedano, E., Pérez-González, A. 2013b. Un assemblage de petits vertébrés hautement diversifié de la fin du MIS5 dans un environnement montagnard au centre de l'Espagne (Cueva del Camino, Pinilla del Valle, Communauté Autonome de Madrid). Quaternaire 24, 207-216.

Podium Presentation: Session 1, Th (10:40)

## Geochronological correlation of Turkana Basin core and outcrop. Paleoclimate and environmental reconstruction in Early-Middle Pleistocene East Africa

**Mark J. Sier[1], Catherine Beck [2], Jeroen Van der Lubbe [3], Josephine Joordens[4], Guillaume Dupont-Nivet [5], Cor Langereis [1], Hubert Vonhof [6], Andrew Cohen [7], Dan Olago[8], Chris Campisano[9], Craig Feibel[10]**

1 - Fort Hoofddijk, Utrecht University · 2 - Hamilton College, Clinton (NY), USA · 3 - VU University Amsterdam, The Netherlands · 4 - Leiden University, Faculty of Archaeology, Leiden, Netherlands · 5 - CNRS, France · 6 - Max Planck Institute for Chemistry Mainz, Germany · 7 - University of Arizona, Tucson (AZ), USA · 8 - University of Nairobi, Nairobi, Kenya · 9 - Arizona State University, Tempe (AZ), USA · 10 - Rutgers University, Piscataway (NJ), USA

The Hominin Sites and Paleolakes Drilling Project (HSPDP) has collected around 2000 metres of cored lake sediments in five paleoanthropological key localities in East Africa in order to better understand paleoenvironmental/paleoclimatic context of human evolution. One of the five localities is West Turkana (Kenya) were a core (WTK-13) was drilled in the sediments of paleolake Lorenyang. The WTK-13 site is near the location where the famous Homo erectus skeleton of "Turkana boy" was found. The 216 metres of cored sediments can be correlated to the rich paleontological and archaeological sites found in outcrops around the Turkana Basin. A parallel outcrop record along the Kaitio lagga (dry river bed), close to the Turkana drill site, has 180 meters of exposed sediments and is also being investigated. We present a geochronological correlation between the WTK core and the Kaitio outcrop. Correlation of the records is based on the identification of the top of the Olduvai subchron (C2N) at 1.78 Ma, six tephrostratigraphic markers, magnetic susceptibility and key marker beds. Our research shows a lithostratigraphic record with first order transition from deeper but highly fluctuating lake environments to lake margin and finally deltaic settings. Very notable is that the correlation shows a clear loss of quality of the paleomagnetic data from core to outcrop due to weathering. The unexposed core sediments not only preserve a better paleomagnetic signal, but also enable reconstruction of an excellent climate and environmental record (biomarkers, phytoliths, pollen etc). The detailed record of climate and environmental change is closely linked to the rich paleontological and archaeological discoveries from nearby sites and around the Turkana Basin. Our data will contribute to understanding the influence of climate and environmental change on the occurrence of key adaptive changes in anatomy, morphology, and/or behaviour (such as the earliest Acheulean stone tool use) of our hominin relatives during that period.

Podium Presentation: Session 5, Fr (13:10)

## Reconstructing past biodiversity by DNA analysis of Middle and Late Pleistocene sediment

**Viviane Slon[1], Charlotte Hopfe[1], Marie Soressi[2], Anatoly P. Derevianko[3,4], Michail V. Shunkov[3,5], Richard G. Roberts [6], Zenobia Jacobs[6], Bo Li[6], Henry de Lumley[7,8], Christian Perrenoud [7], John R. Stewart [9]; Rebecca Miller[10], Pavao Rudan[11], Željko Kućan [11], Ivan Gušić[11], Sarah Nagel[1], Birgit Nickel[1], Kay Prüfer[1], Janet Kelso[1], Svante Pääbo [1], Matthias Meyer[1]**

1 - Department of Evolutionary Genetics, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany · 2 - Faculty of Archaeology, Leiden University, Leiden, The Netherlands · 3 - Institute of Archaeology and Ethnography, Russian Academy of Sciences, Siberian Branch, Novosibirsk, Russia · 4 - Altai State University, Barnaul, RU-656049, Russia · 5 - Novosibirsk National Research State University, Novosibirsk,Russia · 6 - Centre for Archaeological Science, School of Earth & Environmental Sciences, University of Wollongong, Australia · 7 - Centre Européen de Recherches Préhistoriques de Tautavel, Tautavel, France · 8 - Institut de paléontologie humaine, Paris, France · 9 - School of Applied Sciences, Bournemouth University, Poole, Dorset, UK · 10 - Service de Préhistoire, Université de Liège, Liège, Belgium · 11 - Anthropology Center of the Croatian Academy of Sciences and Arts, Zagreb, Croatia

Sediment constitutes a ubiquitous feature of archaeological sites that can be used for dating, site formation analyses and the reconstruction of ancient environments. Previous work has shown that mitochondrial (mt) or chloroplast DNA of animals and plants can be retrieved from ancient sediment by targeting specific regions in their genomes [1, 2]. Here we describe a more generalized approach, previously developed for the screening of undiagnostic bones for DNA preservation [3], to the large-scale study of mammalian DNA retrieved from sediment.

DNA was extracted from eighty-four sediment samples originating from Middle and Late Pleistocene layers of six archaeological sites across Eurasia: Caune de l'Arago (France), Chagyrskaya Cave (Russia), Denisova Cave (Russia), Les Cottés (France), Trou Al'Wesse (Belgium) and Vindija Cave (Croatia). Using the most sensitive techniques currently available, each DNA extract was converted into a DNA library, from which mammalian mtDNA fragments were isolated. These fragments were then sequenced and used to identify the taxa present in the layer. To ensure that the DNA fragments retrieved are of ancient origin, sequences were evaluated for the presence of nucleotide substitutions typical of ancient DNA [4].

Ancient mammalian mtDNA could be isolated from five out of six sites. These belonged to twelve taxonomic families, ranging from megafauna such as elephants, bears and rhinoceroses, to smaller animals such as martens. In many cases, the taxa identified matched the zooarchaeological and/or the paleogenetic record for the relevant sites and layers. The presence of mtDNA sequences from extinct animals, such as woolly rhinoceroses, mammoths, cave hyenas and cave bears, further emphasizes our ability to retrieve genuine ancient DNA from sediment. We conclude that molecular analyses of sediment by DNA capture is a highly parallelizable and non-destructive approach to identify the past presence of animals and potentially hominins at archaeological sites.

**References:**[1] Haile, J., Froese, D.G., Macphee, R.D., Roberts, R.G., Arnold, L.J., Reyes, A.V., Rasmussen, M., Nielsen, R., Brook, B.W., Robinson, S., Demuro, M., Gilbert, M.T., Munch, K., Austin, J.J., Cooper, A., Barnes, I., Moller, P., Willerslev, E., 2009. Ancient DNA reveals late survival of mammoth and horse in interior Alaska. Proc Natl Acad Sci U S A 106, 22352-22357.[2] Willerslev, E., Hansen, A.J., Binladen, J., Brand, T.B., Gilbert, M.T., Shapiro, B., Bunce, M., Wiuf, C., Gilichinsky, D.A., Cooper, A., 2003. Diverse plant and animal genetic records from Holocene and Pleistocene sediments. Science 300, 791-795.[3] Slon, V., Glocke, I., Barkai, R., Gopher, A., Hershkovitz, I., Meyer, M., 2016. Mammalian mitochondrial capture, a tool for rapid screening of DNA preservation in faunal and undiagnostic remains, and its application to Middle Pleistocene specimens from Qesem Cave (Israel). Quaternary International 398, 210-218.[4] Briggs, A.W., Stenzel, U., Johnson, P.L., Green, R.E., Kelso, J., Prüfer, K., Meyer, M., Krause, J., Ronan, M.T., Lachmann, M., Pääbo, S., 2007. Patterns of damage in genomic DNA sequences from a Neandertal. Proc Natl Acad Sci U S A 104, 14616-14621.

Poster Presentation Number 58, We (17:00-19:00)

## Microbial attack on bones: Experimental analogy and its implication in archaeological contexts

**Radka Šmídová**[1], **Sandra Sázelová**[1], **Martin Krsek** [2]

1 - Department of Anthropology at Faculty of Science, Masaryk University · 2 - Department of Microbiology and Molecular Biotechnology at Faculty of Science, Masaryk University

Approach: Taphonomy represents useful tool for osteologists who want to understand the complex of pre/post-burial processes and agents. In this sense microbial attack proved to be a detectable agent destructing bone tissue structure on its microscopic/histological scale. The soil microorganisms together with gut microbes (such as *Bacillus putrificus*, *Clostridium histolyticum* etc.) feed on bone organic matter (namely colagen) and decompose the tissue structure of the corpse. Such effect was firstly mentioned by C. Wedl in 1864 and in 1981 C. J. Hackett described four main types of microbial bone destruction as follows: Wedl's, linear longitudinal, budded and lamellate, suggesting that different types of focal destruction in bone structure is caused by different microbial groups [1]. Analysis: We have analysed thin sections in bones under the light microscope (Nicon Eclipse Ci-L). The sample contains selected sheep bones (*Ovis orientalis aries*; mostly humerus, radius, femur, tibia, etc.) which have been experimentally buried in different conditions in 2014; and selected animal and human bones (mostly occipital bone and femur) from two archaeological sites in southern Moravia dated to the Late Bronze age and Roman period. In order to describe the histological stage of degradation in bone tissue the six degree Oxford Histological index was used [2]. Additional analysis such as pH measuring and genetic analysis of soil microorganisms from experimental soil environment and Fourier transform infrared spectroscopy (FTIR) of bones were applied. Results: In total, we have evaluated 42 thin sections of different animal and human bones from recent and archaeological contexts. We verify the presumption that manner in which the body was buried reflects the prevalence of specific microbial attack. Results of additional analyses will be valuable in designing specific conditions for possible future experiments (such as depth, soil moisture, terrain, time of deposition etc.) despite the fact that recently they did not bring sufficient evidence in closer interpretation of microbial attack itself. We expect that our results based on experimental analogies might be potentially beneficial in search of adequate methodological protocol for taphonomic history interpretation of various paleoanthropological material.

This poster was supported by the Specific University Research Grant no. MUNI/A/1170/2015 provided by the Ministry of Education, Youth and Sports, Czech Republic. I am grateful to The Department of Evolutionary Anthropology at Max Planck Institute for Human Evolution in Leipzig and namely to Raquel Isidoro Da Silva Maria for facilitate the FTIR analysis. I also thank Balázs Komoróczy for access to the archaeological material.

**References:**[1] Hackett, C. J., 1981. Microscopical Focal Destruction (Tunnels) in Exhumed Human Bones. Med. Sci. Law. 21 (4), 243-265.[2] Hedges, R. E. M., Millard, A. R., 1995. Measurements and Relationships of Diagenetic Alteration of Bone from Three Archaeological Sites. J. Archaeol. Sci. 22, 201-209.

Poster Presentation Number 77, Th (18:00-20:00)

## Human gnaw marks on bones (Pilot experimental analysis)

**Michaela Stančíková**[1], **Sandra Sázelová**[1]

1 - Department of Anthropology at Faculty of Science, Masaryk University, Brno, Czech republic

Approach: Hman teeth marks and gnaw marks found on bone surfaces represent an important taphonomic agent suggesting economic and symbolic aspects in past human behavior. Therefore human gnaw marks research display great potentiality in paleoanthropology documenting human eating habits and attitudes in comparison to other animal species [1,2], or tendencies to cannibalism [3]. Our experimental study aims on documentation of human gnaw marks produced by approximately 40 people from Slovak Republic on pig ribs (Sus scrofa f. domestica). These people were divided into two groups – the first (sample A) was fully informed about experiment, its aims and basic information about teeth condition was collected via questionnaire per each participant. The second group (sample B) consisted of anonymous visitors in restaurant, who just ordered pork ribs and remained uninformed about the experimental project. From each of 40 participants, two pork ribs were chosen, followed by cleaning of meat residues, degreasing and peroxiding. Analysis: Commonly observed traces were represented by pits, punctures and scores, which are typical for both – human and carnivores [2]; beside them also peeling [4] was observed and documented as present or absent. According to position of pits, punctures and scores on rib, were these marks then divided into six categories, partially based on classification developed by Andrews, Fernandéz-Jalvo [5]. Further consideration of human teeth, cleaning and eating process produced creation of four subcategories (marks caused by human teeth with 99% probability, marks caused by human teeth with more than 60% probability, marks caused by cleaning, cooking and eating with more than 60% and marks caused by cleaning, cooking and eating with more than 99% probability). Sample A consisted of 38 bones of which 30 were in most cases marked by human teeth. Together 162 marks were observed – 76 pits, 70 scores, 11 punctures and 5 pairs of pits caused by multi-cusped teeth (such as premolars and molars). The second sample B consisted of 40 bones, however the occurrence and visibility of marks was extremely low if compared to sample A. Only 10 bones were marked in total of 16 modifications – 15 scored and one puncture; we did not observed pits at all. Just one score could be interpreted as produced by human teeth within the level of 99% probability; remaining marks were perhaps caused by knifes or during cleaning process. Traces of peeling were observed in 68 cases, although its occurrence should be most probably linked to cleaning process rather than to human consumption. Results: The sample A was highly marked by human teeth, because the participants were asked to consume ribs without cutlery too, using their teeth in bone cleaning as much as possible. The participants from sample B were allowed to use cutlery while eating their pork ribs, so the low occurrence of human teeth marks could be interpreted by their eating habits (relying on knife and fork rather than on their own teeth). Although our pilot experimental sample is still small, and eating habits are naturally influenced by culture, we hope that these results will contribute to broader discussion on human gnaw marks in Central European paleoanthropological context.

This study was supported by the Specific University Research Grant no.MUNI/A/1170/2015 provided by MŠMT, Czech Republic.

**References:**[1] Martínez, G.,2009. Human Chewing Bone Surface Modification and Processing of Small and Medium Prey Amongst the Nukak (Foragers of the Colombian Amazon). Journal of Taphonomy, 7 (1), 1-20.[2] Binford, L.R., 1981. Bones. Ancient Men and Modern Myths. Academic Press, Inc., London.[3] Fernandéz-Jalvo, Y. ,Andrews, P., 2011. When human chew bones. Journal of Human Evolution. 60, 117-123.[4] White, T.D., 1992. Prehistoric Cannibalism at Mancos 5MTUMR-2346. Princeton University press, New Jersey.[5] Andrews, P., Fernandez-Jalvo, Y., 1997. Surface Modifications of the Sima de los Huesos Fossil Humans. Journal of Human Evolution, 33, 191-217.

Podium Presentation: Session 11, Sa (18:20)

## Modern humans before the transition to agriculture: What are the implications for the evolution of our species?

**Ekaterina Stansfield (Bulygina)**[1,2], **Paul O'Higgins**[3]

1 - Archaeology Department, University of York · 2 - Research Institute and Museum of Anthropology, Moscow State University· 3 - Archaeology Department and Hull York Medical School, University of York

Gracilization of the masticatory system among modern humans [1] is associated with the development of food processing technologies, which reduced demands on the jaws. In the present study we investigate the form and function of the mandible of one of the earliest European Upper Palaeolithic hunter-gatherers, Peștera cu Oase (Romania). We compare its form, mechanical efficiency and skeletal deformations due to biting with a modern human by means of the Finite Element Analysis and Geometric Morphometrics. The mandibular dental arcade of Oase is a close fit to that of the modern human, and it possesses worn posterior teeth. Our results show that these mandibles differ in the a-p length of the ascending ramus and in the form of the angle of the mandible, with Oase being longer (a 'wide ramus') and more square. Oase produces lower biting forces than the modern individual when equal muscle forces are applied. However, when Oase muscle forces are scaled to match its larger muscle attachment areas, biting forces become more similar to those produced by the modern human. Assessment of Greave's [2] triangle of support indicates that, consistent with the dental arcade of Oase being relatively more anteriorly located with respect to the condyles and basal mandible, it was better able to bite on posterior teeth. Considering the ability of the mandible to resist biting, the Oase specimen deforms to slightly greater degree and develops similar levels of strains, when size is taken into account. However, higher strains are found at the condyle and in a few other localised regions of the mandible. Our findings indicate that the differences in mandibular form mean that the dental arcade is more anteriorly placed in the Oase mandible relative to the condyles and its' basal part resulting in a less pronounced chin. As previously noted [3], these features may well reflect Oase's ancestry and DNA studies have shown it had a recent Neanderthal ancestor [4]. This more anterior placement, also increases out-lever lengths and so decreases mechanical efficiency. It is also associated with a peak of stress over the anterior aspect of the symphyseal region of Oase during more posterior bites. This mandible, despite appearing more 'robust' [3] likely was used to generate similar bite forces to those in modern humans, rather than significantly greater ones, however, it could generate bites over more posterior teeth without distraction of the temporomandibular joints. This, together with the form of the angle of the jaw and dental wear points to frequent, possibly long period, chewing relative to the modern human, likely reflecting a tougher, more abrasive diet that required more intraoral processing. This is consistent with known differences in ecology and culture. We conclude that the differences in Oase's mandibular morphology from the modern human do not translate into marked differences in biting forces. However this individual appears well adapted to intraoral processing of tough foods by repetitive chewing. It is unclear if this reflects evolutionary or ontogenetic adaptation, or is simply a consequence ancestry. Further studies are required comparing mandibular form and function in the earliest modern humans.

This work is supported by the European Commission Marie Curie Action Grant No PIIF-GA-2013-62284.

**References:**[1] Eng C, Lieberman DE, Zink KD, Peters MA. (2013). Bite force and occlusal stress production in Hominin evolution. Am J Phys Anth 151:544–557[2] Greaves, WS. (2012). The Mammalian Jaw. Cambridge University Press: Cambridge, New York, 144pp.[3] Trinkaus E, Moldovan O, Milota S, Bilgăr A, Sarcina L, Athreya S, Bailey S, Rodrigo R, Mircea G, Higham T, Ramsey CB, van der Plicht J. (2003). An early modern human from the Peștera cu Oase, Romania. PNAS , 100(20):11231–11236 [4] Fu, Q., Hajdinjak, M., Moldovan, O. T., Constantin, S., Mallick, S., Skoglund, P., & Viola, B. (2015). An early modern human from Romania with a recent Neanderthal ancestor. Nature. doi:10.1038/nature14558

Pecha Kucha Presentation: Session 10, Sa (15:25-15:50)

## Using the covariation of extant hominoid upper and lower jaws to identify group affinity of fossil hominins

**Stefanie Stelzer**[1], **Philipp Gunz**[1], **Simon Neubauer**[1], **Fred Spoor**[1,2]

1 - Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig 04103, Germany · 2 - Department of Cell and Developmental Biology, University College London, London WC1E 6BT, UK

Upper and lower jaws make up a considerable part of the hominin fossil record, and their diagnostic morphology is frequently used to define species. Since most of these specimens are isolated mandibles or maxillae, the question is how we can know that a mandible of one individual and a maxilla of another belong to the same species. The amount of morphological within-group variation of these structures is not fully understood; therefore uncertainty exists over the amount of difference acceptable between two non-associated jaws for their inclusion in one taxon. Here we show that the covariation of extant hominoid upper and lower jaws represents a valid baseline for the application to fossil hominin specimens. First we apply multiple multivariate regression on associated upper and lower dental arcades of extant *Homo*, *Pan*, *Gorilla*, *Pongo*, and *Hylobates* to predict mandibular arcades from maxillae and vice versa. Using extant hominoids as a framework for this purpose bears potential errors since fossil morphologies might not be represented in the reference sample. We account for this by using different models for the estimations. In the "correct model" (1) the multivariate regression is based on a reference sample consisting only of the species that is to be predicted; the "pooled model" (2) includes all specimens of all species. The "exclusion model" (3) simulates a case of absence of morphology in the reference sample by excluding the correct species from the reference sample. We then apply our approach to two fossil hominin specimens consisting of an associated upper and lower jaw, KNM-WT 15000 (*Homo erectus*) and Sts 52 (*Australopithecus africanus*), as well as two non-associated *Paranthropus boisei* specimens, OH 5 and Peninj. We find that using shape and size information, all fossil predictions can be identified as belonging to the correct fossil group. Our results demonstrate that extant hominoids are a valid framework for estimating arcades, even where shapes are not included in the reference sample. The data provided here might be helpful for the evaluation of specimens with unclear taxonomic affiliation, or assist in finding specimens belonging to taxa with small sample sizes, and could provide a reference data set for the amount of intraspecific variation that is to be expected in fossil species.

Podium Presentation: Session 3, Th (17:00)

## Different shapes but similar function of Neandertal and anatomically modern human ear ossicles

**Alexander Stoessel**[1], **Romain David**[1], **Philipp Gunz**[1], **Tobias Schmidt**[2], **Fred Spoor**[3], **Jean-Jacques Hublin** [1]

1 - Max Planck Institute for Evolutionary Anthropology · 2 - Hals-Nasen-Ohrenklinik, Friedrich-Schiller-Universität Jena · 3 - Department of Cell and Developmental Biology, University College London & Max Planck Institute for Evolutionary Anthropology

The hominin fossil record can only provide indirect information about auditory capacities of our extinct relatives. The diminutive middle ear ossicles (malleus, incus, stapes) housed in the tympanic cavity of the temporal bone play an important role in audition [1]. Although hitherto hardly known from the hominin fossil record, the growing availability of micro-computed tomography (micro-CT) has recently led to the discovery of an increased sample of ear ossicles in fossils attributed to *Homo neanderthalensis* (Neandertals). Subsequent comparative analyses of these bones have shown that Neandertal ossicles are distinctly different from those of *Homo sapiens* (anatomically modern humans, AMH), despite the close relationship between both human species [2, 3]. Given these findings the question arises whether differences in ear ossicle morphology may affect hearing capacaties, reflect co-variation with structures of the surrounding temporal bone or relate to both. In order to start answering these questions we set up a comparative study of Neandertal (N = 5 mallei, 12 incudes, 5 stapedes) and AMH ear ossicles that combines shape analyses of ossicles with surrounding structures. Moreover, functionally important measures of the middle ear were computed (e.g., ossicles' center of mass (COM), tympanic membrane size, and middle ear width). Micro-CT scans and 3D geometric morphometrics were used to quantify shape and functional properties of the ossicles and the tympanic cavity and to make comparisons with recent (N = 41, 44, 19) and extinct AMH (N = 4, 4, 1) as well as African apes. Alongside distinct differences in ossicle morphology we found striking differences ($P<0.05$) between Neandertals and AMH in tympanic cavity architecture (e.g., the orientation of the tympanic sulcus relative to the oval window of the bony labyrinth). Despite their distinct morphology, the functional properties of the middle ear of both human species are largely similar. Instead, there exists a significant ($P<0.05$) co-variation of ossicle shape variation with changes in tympanic cavity architecture. We assume that the evolutionary independent increase in brain size in AMH and Neandertals has led to the distinct differences in the tympanic cavity and consequently the shape and spatial configuration of the ossicles of AMH and Neandertals. However, despite these different evolutionary trajectories, functional properties of the middle ear of AMH and Neandertals do not differ. The relevance of these functionally equivalent solutions is likely to conserve a similar auditory sensitivity level inherited from their last common ancestor.

We thank A. Balzeau, I. Bechmann, C. Boesch, C. Feja, M.S. Fischer, S. Flohr, C. Funk, I. Hershkovitz, A. Hoffmann, F. Mayer, R.M. Quam, J. Radovčić, T. Schüler, J.F. Tournepiche, B. Vandermeersch and Y. Rak for access to specimens and H. Temming and D. Plotzki for scanning. This research was funded by the Max Planck Society.

**References:**[1] Rosowski, J.J., 2013. Comparative middle ear structure and function in vertebrates. In: Puria, S., Fay, R.R., Popper, A.N. (Eds.), The Middle Ear. Science, Otosurgery, and Technology. Springer Handbook of Auditory Research. Springer, New York, pp. 31-65.[2] Quam, R.M., Martínez, I., Arsuaga, J.L., 2013a. Reassessment of the La Ferrassie 3 Neandertal ossicular chain. J. Hum. Evol. 64, 250-262.[3] Stoessel, A., Gunz, P., Spoor, F., David, D., Schmidt, T., Hublin, J.J., 2014. Small bones, big differences - A comparison of modern human and Neandertal ear ossicles. PESHE 3, 160.

Poster Presentation Number 50, We (17:00-19:00)

## Heat treatment: understanding complexity, innovative impact and implications for the cultural development during the Middle Stone Age

**Regine Stolarczyk**[1], **Patrick Schmidt**[2]

1 - Eberhard Karls University Tübingen, Department of Prehistory and Quaternary Ecology, Cognitive Archaeology Unit, Schloss Hohentübingen, 72070 Tübingen, Germany. · 2 - Eberhard Karls University Tübingen, Department of Prehistory and Quaternary Ecology, Schloss Hohentübingen, 72070 Tübingen, Germany.

In recent years, the South African Middle Stone Age (MSA) has become increasingly important for our understanding of the beginnings of 'modern human behaviours'. Several key innovations like an elaborate bone-tool technology, symbolic engravings and complementary tool sets, seem to have appeared for the first time in this region, predating their European Upper Palaeolithic equivalents by several tens of thousands of years. One of these innovations is heat treatment of stone: the intentional transformation of the properties of raw materials by heating them. Heat-treated rocks can be knapped with better precision and less force than untreated raw material, hence facilitating the production of stone tools. Since its discovery in the MSA, heat treatment can be regarded as one of the earliest techniques for intentionally altering a material in general. It has therefore been thought of as indicating an early profound understanding of fire use [1] and complex cognitive abilities [4,5]. The discovery of so-called "tempering-residue" from the intermediate Howiesons Poort at Diepkloof Rock Shelter, a hitherto unknown organic residue on heat-treated artefacts, constitutes the first direct archaeological evidence for heat treatment in the embers of open-air fires. Nonetheless an alternative technique, heat treatment in a sand-bath beneath a fire, is also discussed in the current literature [1,5]. Sand-bath heating requires a higher investment in time and resources because of the long process and the need for a specially dedicated fire that must be maintained over the duration of the treatment [3]. Most interpretations of the complexity and evolutionary meaning of heat treatment in the MSA are based on the sand-bath hypothesis [1,4,5]. However, most of these works lack a thorough methodological basis and no direct comparison between the complexities of alternative heat treatment procedures is made. In this presentation we present a detailed analysis of the four heat treatment techniques most commonly found in literature (heat treatment in embers next to a fire, in embers directly in a fire, in a sand-bath and in a Polynesian oven-type pit). We analyse the actions required to conduct these four alternative methods and code them in cognigrams [2], a method that makes it possible to compare the techniques and evaluate their differences in terms of complexity and innovative impact. Our analyses show that heat treatment in embers next to a fire and directly in a fire are relatively technically simple. In comparison, heat treatment in a sand-bath and in a firing-pit are distinctly more technically complex, requiring not only an extended sequence of actions but also more foci of attention and phases. However, the overall technical complexity of all analysed procedures falls within the normal range of complexity of other contemporaneous behaviours known from the South African MSA. Regarding heat treatment's innovative impact, one new component was identified in all four analysed procedures: a subject initiated agent (SIA). In the case of a SIA the intended effect of a tool / agent is initiated by a person but not actively controlled during its agency. This indicates a clear extension of the problem-solution distance and can be interpreted as one initial prerequisite for any automated system. Heat treatment is the earliest direct archaeological evidence for the use of a tool / agent as a SIA and marks therefore an important step in the increasing behavioural complexity in human evolution and may have opened up the possibility for a whole set of new behaviours.

**References:**[1] Brown, K.S., Marean, C.W., Herries, A.I., Jacobs, Z., Tribolo, C., Braun, D., Roberts, D.L., Meyer, M.C., Bernatchez, J., 2009. Fire as an engineering tool of early modern humans. Science 325, 859-862.[2] Haidle, M.N., 2012. How to think tools? A comparison of cognitive aspects in tool behvior of animals and during human evolution., in: Haidle, M.N. (Ed.). Eberhard Karls Universität Tübingen, http://tobias-lib.uni-tuebingen.de/, p. 393.[3] Schmidt, P., Paris, C., Bellot-Gurlet, L., 2015. The investment in time needed for heat treatment of flint and chert. Archaeological and Anthropological Sciences published online since 03/07/2015, DOI: 10.1007/s12520-015-0259-y, 1-10.[4] Wadley, L., 2013. Recognizing Complex Cognition through Innovative Technology in Stone Age and Palaeolithic Sites. Cambridge Archaeological Journal 23, 163-183.[5] Wadley, L., Prinsloo, L.C., 2014. Experimental heat treatment of silcrete implies analogical reasoning in the Middle Stone Age. Journal of Human Evolution 70, 49-60.

Poster Presentation Number 13, We (17:00-19:00)

## Patterns of craniofacial and dental covariation in relation to wisdom teeth impaction

**Inga Stolbovaya**[1], **Michael Coquerelle**[1], **Cinzia Fornai**[1,2], **Fred. L. Bookstein**[1,3], **Gerhard W. Weber**[1,4]

1 - Department of Anthropology, University of Vienna, Austria · 2 - Institute of Evolutionary Medicine, University of Zurich · 3 - Department of Statistics, University of Washington, USA · 4 - Core Facility for Micro-Computed Tomography, University of Vienna, Austria

The frequency of impaction of third molars (M3) has dramatically increased since the beginning of the 20th century. Association between M3 eruption and crowding of lower incisors, inclination of the lower premolars and molars, and the vertical growth of the face has been widely discussed, but remains controversial [1, 2]. We applied geometric morphometric methods to describe the form of the craniofacial skeleton in relation to M3 position and orientation, and to explore covariation between M3 position and orientation and size and shape of the dental arches. The landmark data was gathered from a sample of living humans whose upper and lower M3s ranged from fully impacted to fully erupted. We digitized 108 landmarks and curve semilandmarks on lateral cephalograms synthesized from CT-scans of 65 patients (age 22.9 ± 7.8 years) with complete dental arches not altered by previous orthodontic treatments or extensive prosthodontic restorations. We explored craniofacial form variation and tooth position and orientation via form-space principal component analysis (PCA), and we visualized form variation along the male and female allometric vectors using thin-plate splines. Dissimilarities among the four subgroups in our sample defined according to M3 impaction/eruption in one or both jaws were quantified and inspected using between-group PCA. The pattern of integration between alveolar bone and teeth was estimated using two-block Partial Least Square (2PLS) analysis [3, 4]. For this sample of adult and subadult specimens, we found that M3 impaction is strongly associated with size. Males tend to show a lower frequency of M3 impaction than females. The divergence of the two groups defined according to M3 impacted only on one jaw is independent of size and is characterized by: i) the relative position of the jaws; ii) the shape of the mandible; and iii) posterior facial height. We also found that the relationship between the alveolar bone in the sagittal direction and the posterior facial height correlates with M3 impaction, but M3 impaction is independent of craniofacial type. Geometric morphometric method applied to the alveolar and dental landmarks showed that not only the size and size-related shape changes but also some size-independent shape changes of the alveolar bone are associated with M3 impaction. This allows better forecasting of M3 impaction pattern from the cephalogram. We are grateful to the JSC "Medicina", Moscow, for providing us with computerized tomography and clinical data.

We are grateful to the Joint stock Company "Medicina", Moscow, for providing us with computerized tomography and clinical data.

**References:**[1] Bishara, S. E. (1999). Third molars: a dilemma! Or is it?. American journal of orthodontics and dentofacial orthopedics, 115(6), 628-633. [2] Lindauer, S. J., Laskin, D. M., Tüfekçi, E., Taylor, R. S., Cushing, B. J., & Best, A. M. (2007). Orthodontists' and surgeons' opinions on the role of third molars as a cause of dental crowding. American Journal of Orthodontics and Dentofacial Orthopedics, 132(1), 43-48. [3] Rohlf, F. J., & Corti, M. (2000). Use of two-block partial least-squares to study covariation in shape. Systematic Biology, 49(4), 740-753. [4] Mitteroecker, P., & Bookstein, F. (2007). The conceptual and statistical relationship between modularity and morphological integration. Systematic biology, 56(5), 818-836.[5] Bookstein, F. L. (1991). Morphometric Tools for Landmark Data: Geometry and Biology, Cambridge University Press, Cambridge (UK), New York.

Poster Presentation Number 3, We (17:00-19:00)

## Dietary composition and tooth wear in forest chimpanzees (*Pan troglodytes verus*): implications for the dietary reconstruction in fossil hominins

**Julia Stuhlträger**[1], **Ellen Schulz-Kornas**[1], **Roman Wittig**[2], **Kornelius Kupczik**[1]

1 - Max Planck Institute for Evolutionary Anthropology, Max Planck Weizmann Center for Integrative Archaeology and Anthropology · 2 - Max Planck Institute for Evolutionary Anthropology, Department of Primatology

Primate diets are highly diversified and including fruits, leaves, pith, flowers, bark, and animal resources. Previous studies on primates focused on inter-species variation on the surface texture (ST) of teeth in connection with diet [1], using published dietary data from the literature only. The present study made use of primary feeding ecological data from the long-term chimpanzee behavior database [2] of the MPI-EVA, which contains detailed information on specific food sources and their feeding times of the Western Chimpanzee (*Pan troglodytes verus* Schwarz, 1934) of the Taï National Park (Côte d'Ivoire). Long-term dietary data (LD) of known chimpanzee individuals were matched with 3D tooth wear data (ST [3] and occlusal topography, OT) obtained from cheek teeth of the same 17 adult individuals. The first aim was to establish whether there was sexual dimorphism in the wear signal as suggested by the feeding ecological data (LD). The second aim was to assess whether the tooth wear signal varied accordingly with observed seasonal dietary differences. Results from the ST analysis indicated that the facets of males are characterized by a more heterogeneous surface texture with more and higher peaks as well as deeper texture furrows varying in size. We link the ST of males with higher fruit and meat consumption. Females had more plateaus, smaller peaks and lesser volume values on the enamel surfaces, which we relate to higher amounts of dicotyledonous plants and insect consumption. In addition, the OT analysis revealed that females had a larger hypocone radius on the upper first molar than males. The seasonality results showed that during the dry season the ST is characterized by flatter features with smaller peaks and valleys while during the wet season the opposite is observed. Since during the dry season the harmattan trade wind carries dust and grit particles into the Taï forest, we suggest that the more abrasive STs were caused by these higher amounts of external abrasives. Compared to existing dietary literature on chimpanzees our results help to reconstruct diet compositions of hominins in higher detail and with respect to intraspecific sexual segregation. Although the results of the OT analysis have to be confirmed with larger samples, the sexual dimorphism in hypocone size is already intriguing. It can only be speculated that the larger hypocone in females might have to compensate for higher wear rates during lactation. With regard to the dietary variation, our findings clearly show that both insect and meat consumption can be picked up by the ST signal. Our data therefore will be a very useful reference dataset for the reconstruction of the diets and habitats of early hominins.

**References:**[1] Calandra I., Schulz E., Kaiser T. M., 2012. Teasing apart the contribution of hard items on 3D dental microtextures in primates. Journal of Human Evolution 63:85-98.[2] Database on long-term observations of chimpanzees of the Taï chimpanzee project (founded in 1979 by Christophe and Hedwige Boesch) https://primatdb.eva.mpg.de/chimps/queries/queries.html, [accessed 08-May-2015][3] Schulz E., Calandra I., Kaiser T. M., 2010. Applying tribology to teeth of hoofed mammals. Scanning 31:1-21.

Pecha Kucha Presentation: Session 10, Sa (15:50-16:15)

## Modern humans on Flores by 46 thousand years ago: New evidence from Liang Bua

**Thomas Sutikna[1], Matthew W. Tocheri[2], J. Tyler Faith[3], Jatmiko[4], Rokus Due Awe[4], Hanneke J. M. Meijer [5], Katerina Douka[6], Mike W. Morley[1], Paul Goldberg[1], E. Wahyu Saptomo[4], William Jungers[7], Richard Roberts[1],**

1 - Centre for Archaeological Science, School of Earth and Environmental Sciences, University of Wollongong, Wollongong, New South Wales 2522, Australia. · 2 - Department of Anthropology, Lakehead University, Thunder Bay, Ontario P7B 5E1, Canada. · 3 - Archaeology Program, School of Social Science, University of Queensland, Brisbane, Queensland 4072, Australia. · 4 - Pusat Penelitian Arkeologi Nasional, Jakarta 12510, Indonesia. · 5 - Department of Natural History, University Museum of Bergen, University of Bergen, 5007 Bergen, Norway. · 6 - Oxford Radiocarbon Accelerator Unit, Research Laboratory for Archaeology and the History of Art, University of Oxford, Oxford OX1 3QY, UK. · 7 - Department of Anatomical Sciences, Stony Brook University Medical Center, Stony Brook, New York 11794, USA

When and how modern humans dispersed through Island Southeast Asia is a longstanding research problem. Archaeological evidence suggests that modern humans first reached Sahul by at least 47–48 thousand years (ka) ago and probably as early as 50–60 ka ago [1,2]. However, compelling evidence of modern human skeletal or behaviour in Island Southeast Asia around this time has remained elusive.

Liang Bua, the type site of *Homo floresiensis*, is a limestone cave on the Indonesian island of Flores with sedimentary deposits that range in age from 190 ka ago to the present . Recent revision of the stratigraphy and chronology of this depositional sequence suggests that evidence of *H. floresiensis* occurs until 50 ka ago, rather than nearer to the Late Pleistocene–Holocene boundary . Here we examine the compositions of the faunal communities (by broad taxonomic groups) and stone artefacts (by raw materials) throughout the 190 ka time interval preserved in the sequence. Major shifts are observed in both the faunal and stone artefact assemblages that reflect marked changes in palaeoecology and hominin behaviour.

The results of these analyses suggest that *H. floresiensis* and *Stegodon florensis insularis*, along with giant marabou stork (*Leptoptilos robustus*) and vulture (*Trigonoceps* sp.), were likely extinct by 50 ka ago. Moreover, a significant shift in raw material preference for chert, coupled with the presence of burning and two likely modern human teeth, provide credible evidence that *H. sapiens* arrived on Flores by 46 ka. Subsequent deposits, dated to between 41 ka and the present, include further evidence of a preference for using chert, the construction of hearth-like structures, and additional modern human dental and skeletal remains. Together, this evidence records the earliest behavioural and biological evidence of *H. sapiens* in Indonesia and provides a relatively continuous and complete Late Pleistocene–Holocene sequence of modern human presence from 46 ka at a single site in Island Southeast Asia.

Funding support was provided by the University of Wollongong (postgraduate scholarship to T.S.), the Social Sciences and Humanities Research Council (Canada Research Chair to M.W.T.), the Smithsonian Institution (Scholarly Studies Program award to M.W.T.), the Waitt Foundation/National Geographic Society (grant to M.W.T and T.S.) and the Australian Research Council (Australian Laureate Fellowship to R.G.R.). Additional funding was provided by the Peter Buck Fund for Human Origins Research and the Smithsonian Institution's Human Origins Program. Fieldwork was authorised by Pusat Penelitian Arkeologi Nasional (Jakarta, Indonesia) and Pemerintah Daerah Kabupaten Manggarai (Flores, Nusa Tenggara Timur). We thank also I Made Geria, Valentinus N. Sene, Rick Potts, Grace Veatch, Vince Rossi, Adam Metallo, Ai Duc Nguyen, I Dewa Kompiang and the entire Liang Bua Team from Teras, Golo Manuk and Bere.

**References:**[1] Roberts, R.G., Jones, R., Smith, M.A., 1990. Thermoluminescence dating of a 50,000-year-old human occupation site in northern Australia. Nature 345, 153–156.[2] Clarkson, C., Smith, M., Marwick, B., Fullagar, R., Wallis, L.A., Faulkner, P., Manne, T., Hayes, E., Roberts, R.G., Jacobs, Z., Carah, X., Lowe, K.M., Matthews, J., Florin, S.A., 2015. The archaeology, chronology and stratigraphy of Madjedbebe (Malakunanja II): a site in northern Australia with early occupation. J. Hum. Evol. 83, 46–64. [3] Allen, J., O'Connell, J.F., 2014. Both half right: updating the evidence for dating first human arrivals in Sahul. Austr. Archaeol. 79, 86–108.[4] Roberts, R.G., Westaway, K.E., Zhao, J-x., Turney, C.S.M., Bird, M.I., Rink, W.J., Fifield, L.K., 2009. Geochronology of cave deposits at Liang Bua and of adjacent river terraces in the Wae Racang valley, western Flores, Indonesia: a synthesis of age estimates for the type locality of *Homo floresiensis*. J. Hum. Evol. 57, 484–502.[5] Sutikna, T., Tocheri M.W., Morwood, M.J., Wahyu Saptomo, E., Jatmiko, Due Awe, R., Wasisto, S., Westaway, K.E., Aubert, M., Li, B., Zhao, J-x., Storey, M., Alloway, B.V., Morley, M.W., Meijer, H.J.M., van den Bergh, G.D., Grün, R., Dosseto, A., Brumm, A., Jungers, W.L., Roberts, R.G. Revised stratigraphy and chronology for *Homo floresiensis* at Liang Bua in Indonesia. Nature 532, 366–369.

Podium Presentation: Session 9, Sa (13:10)

## Beyond terms. Proto- & early Aurignacian: two distinct techno-typological phases of the Aurignacian technocomplex?

**Yvonne Tafelmaier[1], Gerd-Christian Weniger[1]**

1 - Neanderthal Museum, Mettmann, Germany

Widely perceived as the material output of modern human migration into Europe, the Aurignacian undeniably marks a turning point in the history of human evolution. Diverse dispersal scenarios have been postulated, including those reconstructing at least two routes of modern human spread: one along the Danube, mainly evidenced by early Aurignacian occupations, and one along the Mediterranean coast, indicated by Protoaurignacian sites [1]. Thereby, techno-typological differences of the Protoaurignacian on the one and the early Aurignacian on the other hand are highlighted. While some understand the Proto- & the early Aurignacian as two synchronous phases of the Aurignacian, others emphasize their diachronic emergence [2]. However, an indispensable presupposition for model building is the secure attribution of the archaeological material to either of both phases. Basically two ways of distinguishing assemblages of either type exist: a typological approach, mainly based on the work of Laplace [3], and a technological one put forward by F. Bon & colleagues [e.g. 4]. An empiric study of the laminar and lamellar production system & the lithic typological variability of Proto- and early Aurignacian assemblages of three sites (Labeko Koba, Ekain, Arbreda) of northern Spain revealed broad technological & typological overlaps between the claimed phases contradicting the above mentioned definitions. A common operational sequence for the Protoaurignacian laminar and lamellar production system was only of minor importance in the respective assemblages (Labeko Koba layer VII & Arbreda layer H). Blades and bladelets in the Protoaurignacian have been manufactured following different approaches including carinated technology. To test the empirically gained results, a database including information on assemblage variability and chronology of other Aurignacian sites distributed all over Europe has been established. The evaluation of these data further questioned the validity of a strict distinction of the two postulated phases. A cultural interpretation featuring different technological traditions (cf. [4]) is thus rejected. To the contrary, a model is proposed that considers Proto- & early Aurignacian occupations as more complex adaptive manifestations (*adaptive facies*) drawing upon a common technological repertoire [5].

Thanks to Koro Mariezkurrena & Jesús Altuna (former GOAZ/ Donostia), Josep Tarrús (Museu Arqueològic de Banyoles), Álvaro Arrizabalaga & Maria José Iriarte(Vitoria), Aritza Villaluenga (Monrepos), Narcis Soler & Julià Maroto (Girona), Bernhard Weninger (Cologne).

**References:**[1] Mellars, P. 2004. Neanderthals and the modern human colonization of Europe. Nature 432, 461-465 [2] Banks, W. E., d´Errico, F., Zilhão, J. 2013. Human-climate interaction during the Early Upper Paleolithic: testing the hypothesis of an adaptive shift between the Proto-Aurignacian and the Early Aurignacian. Journal of Human Evolution 64, 39–55 [3] Laplace, G. 1966. Recherches sur l'origine et l'évolution des complexes leptolithiques. Paris, Ed. de Boccard [4] Teyssandier, N., Bon, F., Bordes, J.-G. 2010. Within projectile range. Some thoughts on the appearance of the Aurignacian in Europe. Journal of Anthropological Research 66, 209–229 [5] Tafelmaier, Y. 2015. Technological variability at the beginning of the Aurignacian in northern Spain and its implications for the Proto- & early Aurignacian distinction. Ph.D. Dissertation, University of Cologne.

Poster Presentation Number 129, Th (18:00-20:00)

## Domestic tools, hafting, and the evolution of technology: The Upper Palaeolithic of Hohle Fels as a case study

**Noora Taipale**[1], **Veerle Rots**[1], **Nicholas J. Conard**[2,3]

1 - TraceoLab / Prehistory, University of Liège, Belgium · 2 - Department of Early Prehistory and Quaternary Ecology, University of Tübingen, Germany · 3 - Tübingen-Senckenberg Center for Human Evolution and Paleoecology, Tübingen, Germany

Innovations relevant to human evolution often involve subsistence technology, which can affect the success of individual groups, and *Homo sapiens* in general. However, Palaeolithic technologies include more than just hunting tools, and a proper understanding of hunter-gatherer ways of living requires knowledge of the organisation of diverse tasks and activities, including the manufacture and maintenance of tools and other equipment. One central aspect of technological evolution is the development of tool hafting [1, 2], which is not only restricted to hunting and gathering implements, but also affects so-called domestic tool categories.

We present the results of an on-going project that focuses on hafting and use of stone tools in the Upper Palaeolithic through detailed functional analysis of selected assemblages from European key sites (Hohle Fels, Abri Pataud, Maisières-Canal), which have yielded rich lithic and organic assemblages from secure chronological contexts. Here the focus is on classic Upper Palaeolithic tool categories, such as endscrapers and burins, from the Gravettian and Magdalenian levels of the cave site Hohle Fels (Germany) [3,4]. We suggest that domestic tools can offer a valuable source material, since for most of them, hafting is not a necessity as it is for spear and arrow tips. An increase in hafting implies an increase in time investment, which has implications for task organisation and specialisation.

The Hohle Fels assemblage offers an interesting case study for temporal changes (or continuity) in the frequency and techniques of tool hafting. The projectile technology shows a clear shift from the Gravettian to the Magadalenian, marked by the introduction of a microlithic technology (backed bladelets). For other tool categories, the changes seem more subtle. Our goal is to characterise the tools used in manufacture and maintenance tasks, and to evaluate whether the Gravettian to Magdalenian transition witnesses changes in tool design and use that go beyond hunting equipment. The observed differences between tool classes and time periods are explained with a reference to details of tool use, such as the rate of edge wear development and stone tool exhaustion, as well as shifts in treatment of organic raw materials. The results suggest that domestic tools can aid in understanding long-term technological evolution, and create a baseline against which we can (re)assess the role of shifts observed in technologies that are more susceptible to morphological change, such as projectiles.

This research is supported by the European Research Council under the European Union's Seventh Framework Programme (FP/2007-2013) / ERC Grant Agreement n. 312283.

**References:**[1] Rots, V., 2013. Insights into early Middle Palaeolithic tool use and hafting in Western Europe: The functional analysis of level IIa of the early Middle Palaeolithic site of Biache-Saint-Vaast (France). J. Archaeol. Sci. 40, 497–506.[2] Barham, L., 2013. From Hand to Handle: The First Industrial Revolution. Oxford University Press, Oxford.[3] Conard, N. J., Bolus, M., 2003. Radiocarbon dating the appearance of modern humans and timing of cultural innovations in Europe: New results and new challenges. J. Hum. Evol. 44, 331–371.[4] Taller, A., Bolus, M., Conard, N. J., 2014. The Magdalenian of Hohle Fels Cave and the Resettlement of the Swabian Jura after the LGM. In: Otte, M., Le Brun-Ricalens, F. (Eds.), Modes de contacts et de déplacements au Paléolithique eurasiatique: Actes du Colloque international de la commission 8 (Paléolithique supérieur) de l'UISPP, Université de Liège, 28–31 mai 2012. Centre National de Recherche Archéologique, Luxembourg.

Podium Presentation: Session 9, Sa (11:50)

## Lifting the veil over the 'Neanderthal' mandible from Riparo Mezzena (Monti Lessini, Italy) using direct radiocarbon dating and genetic analyses

**Sahra Talamo[1], Mateja Hajdinjak[2], Marcello A. Mannino[1,3], Leone Fasani[4], Frido Welker[1], Fabio Martini[7], Francesca Romagnoli[7,8,9], Roberto Zorzin[5], Matthias Meyer[2], Jean-Jacques Hublin[1]**

1 - Department of Human Evolution, MPI Leipzig, Germany. · 2 - Department of Evolutionary Genetics, MPI Leipzig. · 3 - Department of Archaeology, School of Culture and Society, Aarhus University, Højbjerg, Denmark. · 4 - Università degli Studi di Milano-Bicocca, Milano, Italy. · 5 - Museo Civico di Storia Naturale di Verona, Sezione di Geologia e Paleontologia, Verona, Italy. · 6 - BioArCh, University of York, UK. · 7 - Università degli Studi di Firenze, Dipartimento di Storia, Archeologia, Geografia, Arte e Spettacolo. Cattedra di Paletnologia (Prehistory), Firenze, Italy. · 8 - Institut Català de Paleoecologia Humana i Evolució Social (IPHES) Zona Educacional 4, Tarragona, Spain. · 9 - Area de Prehistoria, Universitat Rovira i Virgili (URV), Tarragona, Spain

The debate surrounding Neanderthals and their interaction with Anatomically Modern Humans (AMH) is one of the major intellectual challenges in Paleolithic archaeology. Recent studies on the chronological interaction between these two species suggested that Neanderthals disappeared approximately 39,000-41,000 years ago in Western Europe, concluding that they overlapped with AMH, between 2,600 and 5,400 years at the continental scale. Their co-existence in some regions is supported by the paleogenetic analysis of a 37,000-42,000 year old modern human from Romania, with between 6 and 9% of its genomic sequence derived from a Neanderthal ancestor 4 to 6 generations older. However, the duration of the chronological overlap between the two groups and the intensity of their interactions remain unknown in most parts of Europe. In 1957 the two 'sister sites' of Riparo Mezzena and Riparo Zampieri were discovered in the Monti Lessini mountain range, in northern Italy. These two sites are only 50 m apart and contain similar Mousterian lithics. The Monti Lessini lie just north of the Po Plain and were inhabited by Neanderthals and AMH during the late Middle and early Upper Palaeolithic, as testified by sites such as Riparo Tagliente, Grotta della Ghiacciaia and Grotta di Fumane. After an initial publication by Palma di Cesnola in 1961, Riparo Zampieri was not studied further, while Riparo Mezzena, where human remains were recovered, was the object of different investigations published by Bartolomei and colleagues in 1980. The human remains, which include a fragmentary mandible, 11 cranial fragments and one post-cranial fragment, were first described by Corrain in 1968. The mandible fragment was originally attributed to a Neanderthal female, presumably because of its purported Mousterian association, rather than for its size and morphology that suggested it had some modern traits. In the course of the last decade, the human remains from Riparo Mezzena have been re-examined by means of anatomical and palaeogenetic analyses, the latter being performed on three small bone fragments (MLS 1, 2 and 3). Mitochondrial and nuclear DNA analyses were performed only on MLS 1, because the other two specimens were badly preserved and had low levels of endogenous DNA. MLS 1 was genetically attributed to a Neanderthal, showing a) greater genetic diversity in European Neanderthals than previously estimated, and b) the presence of pale skin color and red hair receptor (MC1R) among them [1,2]. In 2012, a single radiocarbon date on a bovid bone from the lower layer (layer I) of Riparo Mezzena was published, with a 14C age of 34,540 ± 655 BP ((68.2%) 39,870-38,420 cal BP; (95.4%) 40,780-37,480) [3]. The relatively young age for this Mousterian layer, prompted Longo et al. [3] to suggest the presence of late-surviving Neanderthals in northern Italy. Moreover, on the basis of new morphological and genetic studies of the mandible from Mezzena, Condemi et al. [4] and Longo and Condemi [5] concluded that a "certain degree of interbreeding" between Neanderthals and AMH took place in the Monti Lessini. Our paper presents the results of new investigations, involving the application of a suite of state-of-the-art scientific methods (i.e. 14C dating, ZooMS, ancient DNA, and isotope analyses), to correctly assign the human remains from Riparo Mezzena both chronologically and taxonomically. Based on the concordant results of the suite of techniques employed in our study, we reject the claim put forward by Condemi et al. [4] and Longo and Condemi [5] that Riparo Mezzena and its surroundings was an area of long chronological overlap, where Neanderthals and AMH interbred.

We are indebted to Lysann Rädisch, Annabell Reiner and Sven Steinbrenner of the Department of Human Evolution at the MPI-EVA for technical assistance. We would like to acknowledge the Max Planck Society for funding this research. The Dr. Simonetta Bonomi and Dr. Federica Gonzato from the Soprintendenza Archeologica del Veneto and Dr. Giuseppe Minciotti, the Director of the Natural History Museum of Verona, for authorizing it; whilst the Library staff at the MPI-EVA were essential in providing us with copies of the old papers on Riparo Mezzena, which are not easily accessible. F.R. has been founded by H2020 MSCA GA 653667. We are indebted to Ronny Friedrich and Bernd Kromer for invaluable discussions on the 14C results. Last, but not least, thanks to Mikaela Lui for the English revision.

**References:** [1] Caramelli, D., Lalueza-Fox, C., Condemi, S., Longo, L., Milani, L., et.al. 2006. A highly divergent mtDNA sequence in a Neandertal individual from Italy. Current Biology 16, R630-R632. [2] Lalueza-Fox, C., Römpler, H., Caramelli, D., Stäubert, C., Catalano, G., et.al. 2007. A Melanocortin 1 Receptor Allele Suggests Varying Pigmentation Among Neanderthals. Science 318, 1453-1455. [3] Longo, L., Boaretto, E., Caramelli, D., Giunti, P., Lari, M., et.al. 2012. Did Neandertals and Anatomically Modern Humans coexist in Northern Italy during the late MIS 3? Quaternary International 259, 102-112. [4] Condemi, S., Mounier, A., Giunti, P., Lari, M., Caramelli, D., Longo, L., 2013. Possible Interbreeding in Late Italian Neanderthals? New Data from the Mezzena Jaw (Monti Lessini, Verona, Italy). PLoS ONE 8, e59781. [5] Longo, L., Condemi, S., 2014. What Role for Mediterranean Europe in the MP/EUP shift, in: PESHE (Ed.), ESHE. Proceedings of the European Society for the study of Human Evolution 3, Florence, p. 107.

Poster Presentation Number 126, Th (18:00-20:00)

## Gravettian origins? Hohle Fels Cave and its significance for the cultural evolution of the Central European Upper Palaeolithic

**Andreas Taller**[1], **Nicholas J. Conard**[1]

1 - Eberhard Karls Universität Tübingen, Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters, Abteilung für Ältere Urgeschichte und Quartärökologie, Germany

Hohle Fels Cave in the Ach Valley of the southwestern German Swabian Jura yielded three Gravettian assemblages each representing a basecamp-type settlement. The cave served repeatedly as a base camp in all Upper Palaeolithic technocomplexes present in Swabia (Aurignacian, Gravettian and Magdalenian (for the latter see [1]). The assemblages from the Gravettian archaeological horizons (AHs) IIb, IIc and IIcf include extensive lithic and organic collections as well as symbolic artefacts. Distinctive lithic tool types include Gravette- and Micrograveттepoints, Fléchettes, and a small number of Font-Robert-points as well as numerous burins. Lithic production in all AHs focused on the knapping of straight blades and bladelets, and about 70% of the lithic tools were made on laminar blanks. AH IIcf is a feature and represents a prominent dump zone associated with an occupation phase of the Gravettian, it consists of burnt bone almost exclusively and is exceptionally find rich [2].

The radiocarbon dates indicate a very early Gravettian, from 34 to 31 ka cal BP [3]. The Gravettian of nearby Geißenklösterle Cave is of similar or probably even higher age [4]. Therefore in the Ach Valley we have the situation of a very old yet fully developed Gravettian, which means that the Swabian Jura might well represent one of the regions of origin of the Gravettian.

In Hohle Fels there is no recognizable sterile horizon separating the Gravettian from the underlying Aurignacian. Between these two entities are two layers (AHs IId and IIe) which are relatively poor in finds. It has yet to be determined whether these intermediate assemblages reflect direct settlement activities or if they are taphonomic accumulations of archaeological material. AH IId appears to be affiliated with the overlying Gravettian, whereas AH IIe contains a majority of Aurignacian artefacts. The dates show a chronological continuum from Aurignacian to Gravettian, thus if there was a period without settlement, it must have been very short. Here we discuss the nature of the transition from Aurignacian to Gravettian, also in light of data from other sites like Geißenklösterle [5], where a continuous stratigraphy between Aurignacian and Gravettian shows that there is no general hiatus between these two technocomplexes in the Swabian Jura. Possible connections of the process of this transition to Upper Pleistocene climatic events will be tested.

We would like to thank the DFG (for funding A.T.; DFG-GZ TA 1039/3-1), the Alb-Donau-Kreis and the State Office for Cultural Heritage Baden-Württemberg for their support.

**References:**[1] Taller, A., 2014. Das Magdalénien des Hohle Fels. Chronologische Stellung, Lithische Technologie und Funktion der Rückenmesser. Kerns, Tübingen.[2] Schiegl, S.; Goldberg, P.; Pfretzschner, H.-P. & Conard, N.J., 2003. Paleolithic Burnt Bone Horizons from the Swabian Jura: Distinguishing between in situ Fire Places and Dumping Areas. Geoarchaeology 18, 541-565.[3] Conard, N.J.; Moreau, L., 2004. Current Research on the Gravettian of the Swabian Jura. Mitteilungen der Gesellschaft für Urgeschichte 13, 29-60.[4] Higham, Th.; Basell, L.; Jacobi, R.; Wood, R.; Bronk Ramsey, Ch. & Conard, N.J., 2012. Testing models for the beginnins of the Aurignacian and the advent of figurative art and music: The radiocarbon chronology of Geißenklösterle. Journal of Human Evolution 62/6, 664-676.[5] Moreau, L., 2009. Geißenklösterle. Das Gravettien der Schwäbischen Alb im Europäischen Kontext, Kerns, Tübingen.

Podium Presentation: Session 8, Sa (9:30)

## Toward complexity in the osseous raw material work at the beginning of the Early Upper Palaeolithic in Eurasia. The Manot Cave (Israel) osseous tools in the Aurignacian emergence and diffusion context

**José-Miguel Tejero[1], Reuven Yeshurun[2], Omry Barzilai[3], Mae Goder-Goldberger[4], Israel Hershkovitz[5], Ron Lavi [6], Nehora Schneller-Pels[2], Ofer Marder[7]**

1 - CNRS ArScAn (France) and SERP Barcelona University · 2 - Zinman Institute of Archaeology, University of Haifa, Mount Carmel. Haifa (Israel) · 3 - Israel Antiquities Authority, POB 586, Jerusalem (Israel) · 4 - Max Planck Weizmann Joint Center for Integrative Archaeology and Anthropology, Weizmann Institute for Science (Israel) · 5 - Tel-Aviv University (Israel) · 6 - Independent researcher · 7 - Department of Bible, Archaeology and Ancient Near Eastern Studies, Ben-Gurion University of the Negev, P.O.B. 653, Beer Sheva, 84105

The Early Upper Palaeolithic in the Levant plays an important role in understanding the emergence, dispersal, and adaptations of the first Anatomically Modern Human (AMH) populations in Eurasia. The exploitation of osseous raw materials for technical and conceptual behaviours is recognised as one of the several innovations that have occurred both in the Levant and in Europe during this time. Previous works demonstrated that the complex and innovative working of osseous materials in Europe is restricted to antler working at around 40 Ka cal BP and are thus chronologically coincident with the emergence of the Early Aurignacian. Conversely, bone exploitation (known from the Lower Palaeolithic), shows a continuity through the Mousterian, the Proto-Aurignacian and the Early Aurignacian, invalidating the argument that osseous material exploitation represents a radical difference between the Middle and Upper Palaeolithic in Europe [1]. Here we present the results of a technological analysis conducted on the bone and antler industries from the Early Upper Palaeolithic layers attributed to the Aurignacian techno-complex at Manot Cave, Israel. Comparing the technical concepts of the bone and antler working, through the operational sequence ("chaîne opératoire"), between the European and the Levantine Aurignacian allow us to discuss the significance of the hard animal raw material exploitation in the framework of the different proposed hypothesis on the emergence and diffusion of the Aurignacian techno-typological tradition over Eurasia [2,3,4]. The osseous industry of the Manot Cave displays several similarities with its European counterpart, such as the choice of bone for making "domestic" tools (recurrent morpho-types like awls) while antler was used predominantly for hunting equipment (projectile points) [5]. The complex technical exploitation of antler, almost exclusively devoted to making hunting weapons, constitutes a major feature both in the European Early Aurignacian and in the Levantine Aurignacian. While simple-based antler points are common in both regions, split-based antler points, characteristic of the European Early Aurignacian are only anecdotally documented in the Levant. Unique to the Levantine industry is the common exploitation of fallow deer antler. While some of these particularities seem to be related to the different ecological niches exploited, others, such as the different type of hunting weapons, need to be assessed against different cultural contexts.

This work is part of the HAR2014-55131 research project of the MICINN and the Quality Research Group of the Generalitat de Catalunya SGR2014-108. J.-M Tejero's research was supported by a Beatriu de Pinos grant (2013 BP-B0013) co-funded by the Catalan Government and European Community via the Marie Curie Actions of Seventh Framework Programme for Research and Technological Development. The Manot Cave excavations are supported by the Dan David Foundation, the Irene Levi-Sala CARE Foundation, the Israel Science Foundation, Case Western Reserve University, and the Leaky Foundation

**References:**[1] Tejero, J.-M., 2014. Towards complexity in osseous raw material exploitation by the first anatomically modern humans in Europe: Aurignacian antler working. J. Anthropol. Archaeol. 36, 72-92.[2] Bar-Yosef, O., 2007. The dispersal of Modern Humans in Eurasia: a cultural interpretation. In: Mellars, P., Boyle, K., Bar-Yosef, O., Stringer, C. (Ed.), Rethinking the Human Revolution. McDonald Institute, Oxford, pp. 207-217.[3] Bar-Yosef, O., Belfer-Cohen, A., 2013. Following Pleistocene road signs of human dispersals across Eurasia. Quatern. Int. 285, 30-43.[4] Hublin, J.-J., 2015. The modern human colonization of western Eurasia: when and where? Quatern. Sci. Rev. 118, 194-210.[5] Tejero, J.-M, Yeshurun, R., Marder, O., Barzilai, O., Goder-Golberger, M., Hershkovitz, I, Schneller-Pels, N., Lavi, R., 2016. The osseous industry from Manot Cave (Western Galilee, Israel): technological and conceptual behaviours of bone and antler exploitation in the Levantine Early Upper Palaeolithic. Quatern. Int.

Pecha Kucha Presentation: Session 6, Fr (15:00-15:25)

## What's the difference? Results of a functional study of Aterian and Mousterian tools from the site of Ifri n'Ammar (Morocco)

**Sonja Tomasso**[1], **Veerle Rots**[1]

1 - Traceolab/ Prehistory, University of Liège, Belgium

Until today, the definition of the North African Mousterian has been based on a systematic comparison with the European Mousterian. Particularly the "Aterian" and its tanged tools have been widely discussed. Researchers considered the tanged Aterian tools as early indications of the existence of hafting techniques [1]. It is currently not entirely understood how the Aterian relates to the Mousterian in North Africa, whether tanged tools can indeed be linked with hafting, and whether non-tanged tools were also hafted, which could indicate that a variety in hafting techniques existed. The site of Ifri n'Ammar presents an ideal chance to compare Aterian and Mousterian technocomplexes. The rock shelter is located in the eastern Moroccan Rif and has a rich and well preserved stratigraphy where Middle Paleolithic tools are abundantly represented [2]. At Ifri n'Ammar, the Aterian and Mousterian assemblages are inter-stratified, which means that the relationship of these industries cannot simply be explained in terms of chronological succession [2,3]. The density of retouched artefacts differs between the Aterian and the Mousterian levels and tanged tools are present in the denser Aterian levels only. These levels also show a higher overall tool frequency. We present the results of a functional study focusing on the artefacts from the upper levels ("Occupation supérieure") of Ifri n'Ammar, dated between 83 ± 6 ka and 130 ± 8 ka [3]. The functional study was combined with a specific experimental program designed to address questions raised during the analysis of the archaeological material, with a specific focus on hafting. Diagnostic microscopic wear patterns confirm that the tanged tools were used while hafted. Tanged tools did not prove to be related to hunting activities only, but various tool uses could be identified. They all fit, however, within the context of hunting and animal processing activities. The reuse of hafted armatures for other activities is not evident in the present sample.

The authors are indebted to the European Research Council under the European Union's Seventh Framework Programme (FP/2007-2013) / ERC Grant Agreement Nr. 312283. The project at Ifri n'Ammar is a Moroccan-German collaboration and it is supported by the "Institut National des Sciences de l'Archéologie et du Patrimoine du Maroc" (INSAP) and the "Kommission für die Archäologie Außereuropäischer Kulturen des Deutschen Archäologischen Instituts" (KAAK).

**References:**[1] Clark, J. D., 1970. The prehistory of Africa. Thames and Hudson, London [2] Nami, M., Moser, J., 2010. La Grotte D'Ifri N'Ammar. Le Paléolithique Moyen. In: Forschungen Zur Archäologie Außereuropäischer Kulturen, vol. 9. Reichert Verlag, Wiesbaden [3] Richter, D., Moser, J., Nami, M., Eiwanger, J., Mikdad, A., 2010. New chronometric data from Ifri n'Ammar (Morocco) and the chronostratigraphy of the Middle Palaeolithic in the Western Maghreb. J. Hum. Evol. 59, 672-679

Poster Presentation Number 5, We (17:00-19:00)

## Pitting enamel hypoplasia in *Paranthropus robustus*

**Ian Towle**[1], **Joel Irish**[1], **Isabelle De Groote**[1]

1 - Liverpool John Moores University

Enamel defects can provide insight into the health, diet and environmental stresses of past populations. Hominin research has focused on differences in Linear Enamel Hypoplasia (LEH) frequencies between populations, including South African species. This study focusses on Pitting Enamel Hypoplasia (PEH) and its occurrence in different hominin populations, but specifically the high frequency and severe form found in *Paranthropus robustus*. PEH is characterized by circular depressions across the crown of a tooth and can be caused by numerous factors, meaning it is often difficult to interpret the defects, both in terms of developmental timing and etiology. Causes include non-specific stress episodes but can often be linked to conditions such as amelogenesis imperfecta and vitamin deficiencies . A number of researchers have noted the presence of PEH in *P. robustus* [1,2]. These studies have been in the context of enamel hypoplasia rates as a whole. This study builds on this research by looking at the difference in frequencies of PEH and LEH between South African hominins, specifically looking at the very high PEH rates in the deciduous and permanent molars of *P. robustus*. The number of teeth affected by LEH is similar across South African hominin species and sites, ranging from 9.6% in *P. robustus* to 14.8% in *Homo naledi*. There are however considerable differences in enamel pitting frequencies. *P. robustus* has particularly high rates, with 14% of the permanent teeth and 47% of the deciduous teeth affected compared to 4.3% and 6.7%, respectively, for all other South African hominin teeth. In both the permanent and deciduous teeth of *P. robustus* the severe pitting often covers large areas of the crown and is characteristically made up of numerous relatively uniform small depressions. When pits do not cover the whole crown, they are typically more defined and prevalent toward the occlusal surface. Research on severe enamel pitting in deciduous teeth in modern humans covers a range of causes, from high fluoride levels in drinking water and vitamin D deficiency through congenital diseases and genetic disorders related to malnutrition during pregnancy. A differential diagnosis concerning causes for the high rate in *P. robustus* is presented, including the potential for a genetic, developmental, or environmental component, with comparisons with modern day and other archaeological samples. All molars, both deciduous and permanent, have high rates of PEH but because anterior teeth show relatively low rates of any type of hypoplasia it seems unlikely a genetic condition such as amelogenesis imperfecta is the cause. Instead the unique morphology of the molars may make them more predisposed to enamel pitting. Relatively minor periods of stress may therefore create this PEH. Due to the fact that first, second and third permanent molars all show similar high rates of PEH also supports this hypothesis. The very high rates of pitting in the deciduous molars may suggest a different cause, but it is more likely individuals in this stage of development may be more susceptible to the same etiology. The morphology of the deciduous molars may also be significant. Potential environmental influences may include vitamin deficiencies, malnutrition or a dietary component.

**References:**[1] White, T.D., 1978. Early hominid enamel hypoplasia. Am. J. Phys. Anthropol. 49, 79-83.[2] Robinson, J.T., 1956. The dentition of the Australopithecinae. Transvaal Museum.[3] Hillson, S., 1996. Dental anthropology. Cambridge University Press.[4] Aldred, M.J., Savarirayan, R. and Crawford, P.J.M., 2003. Amelogenesis imperfecta: a classification and catalogue for the 21st century. Oral diseases. 9, 19-23.

Pecha Kucha Presentation: Session 2, Th (13:00-13:25)

## Ontogenetic trajectories of talo-crural joint shape in extant ape African lineages: insights into the study of fossil hominins

**Kevin Turley**[1], **Evan A. Simons**[1], **Stephen Frost**[1]

1 - University of Oregon

Talo-crural joint shape has been extensively studied among fossil hominins for interpretation of phylogeny and behavior. Morphometric Analysis of shape provides insights into many issues of Hominin diversity. The current study explores the ontogenetic trajectories of the four extant African Hominoids. Differences in shape over ontogeny are examined using dental developmental stage to reflect ontogenetic changes which result in either more flexible or stable adult talo-crural joint morphology. These provide a baseline for study on fossil hominin joint complexes and the individual elements found in fossil assemblages. Two hundred twenty one adult and subadult African Hominoid talo-crural osteological specimens formed the study group. They were divided by dental age of teeth erupted into occlusion (M1, M2, M3) including *G. gorilla* (13,13,39), *H. sapiens* (16,8,56), *P. troglodytes* (23,12,21) and *P. paniscus* (7,9,10). Specimens were Laser Scanned and 15 Talar and 12 Tibial landmarks were placed. Generalized Procrustes, Relative Warps (RW), and Singular Warp (SW) analysis was performed, and the ontogenetic trajectories calculated by Geomorph were examined both in the total hominoid group and *Pan*-only subgroup. In the total hominoid sample, the species were all distinct even by M1. RW1&2 of tali revealed parallel trajectories of stable shape with *P. paniscus* changing to a flexible shape at M2. RW1&2 tibiae were parallel among all species with flexible morphology until M2 when all but *P. paniscus* changed to a stable morphology trajectory. SW1 revealed a parallel trajectories among all groups, but with that of *H. sapiens* more developed and stable in shape at M1 consistent with their advanced chronological age at M1 and bipedal locomotion, and *P. paniscus* changing to a flexible shape at M2. The *Pan* subgroup revealed RW1&2 of tali distinct stable morphology trajectories for the two species but with a change of *P. paniscus* at M2 to a flexible profile. RW1-2 tibia was parallel trajectories with a flexible shape profile in M1-M2 but *P. troglodytes* changed to a stable profile. SW1 revealed parallel trajectories with an acute change in *P. paniscus* at M2 to a flexible morphology. Examination of the ontogenetic trajectories of the extant African hominoids provides insights into the developmental patterns of fossil hominins. The talus is a stable platform consistent with the terrestrial group, while the tibial plafond presents a flexible component which changes in response to the strain presented to the whole tibia (presentation), and the plafond components (medial malleolus and trochlea) effected individually. Finally, SW provides analysis of covariance in the shape of the joint interface itself. Changes in trajectories were consistent with life history events in the study species. Comparison of these data with fossil hominin talo-crural shape may provide insights into the processes which alter shape, how each component, such as the proximal talus (OH-8) may be affected, and the greater information afforded by the rare total matched joint (AL-288-1).

Poster Presentation Number 47, We (17:00-19:00)

## The Oldest Middle Paleolithic Portable Art from the Caves of Georgia

**Nikoloz Tushabramishvili**[1]

1 - Ilia State University

The earliest recorded examples of human art were created during the Lower Paleolithic (Central India, Golan Heights, Morocco etc.) The facts that Neanderthals thought symbolically had popped up as well. Evidence for art of Neanderthals, in the form of isolated pierced teeth and engraved bone fragments, and red and yellow ocher, has been reported from a few sites.

The evidences of one of the oldest portable arts in Georgia in XX-XXI [1,2]. They come from Tsona and Djruchula Caves.

Both Caves are located in the same Rioni-Kvirila Basin. Distance between them is 45 km.

The industries of Djruchula and Tsona Caves belong to the same Djruchula-Kudaro local-cultural group. Technical behaviours are similar to the "Djrujula-Koudaro facies" and Tabun-D type [3]. The composition is typical of material brought by humans for short-term occupations. Both caves represent the seasonal camps of hunters. Supposedly, the dates of the Middle Paleolithic layers of Tsona Cave are the same we have in Djruchula Cave (260-130 Ka) [4]

The expedition led by A. Kalandadze worked at Tsona Cave (2200 meters a.s.l.) in 1959, 1960, 1961, 1965 and 1968. That time was found the plaque with engraved cross on it.

The limestone blank with engraved cross was found in the Middle Paleolithic layer 2. The lines of the cross are quite straight. One natural crack crossed by three by engraved lines. Microscopic analysis show us that three grooves of the line of the cross were human made, one line is natural. Presence of the cross on the blank is a result of deepening of existed natural lines.

Two interesting Portable Art objects have been found in the Middle Paleolithic layers of Djruchula Cave (Djruchula Cave was discovered and excavated in 1958-1967 by Prof. David Tushabramishvili). One figurine was found in the layer 1, another- in the layer 2. The objects are made on the argillite and limestone raw-material. The object №1 has a female (venus) or a fish shape. The object was discovered in the MP Layer I, sq. I-7 (depth-2, 40m). Size-5,4cmX3,5cmX3,4cm. The object is covered by the deep patina. The engraved lines are quite deep and well-shaped. The object №2 was found in the II Middle Paleolithic layer, sq.9, depth-4,05m. We consider the object as a statue of the tur, or Capra caucasica (?). It is perforated and polished as a result of using (hanging, or holding). Possibly, it was used as a talisman, or as a baton. The figurine has a deep patina. Size-6,0cmX4,0cmX2,6cm. The object is with deep patina. The engraved lines are quite deep and well-shaped. We have very important find from the Layer II- It is the Neanderthal tooth. In 1961, In Djruchula Cave, The first upper left adult molar was discovered in a second MP layer in 1961 [2] L.Gabunia and T. Chevalier consider that this is a Neanderthal tooth, due to the dimensions, the fusion of the roots and the presence of taurodontism.

The evidences of prehistoric art and religious in Georgia are represented: by the Neanderthal bear-cult (Tsutskhvati multi-staged cave system); by the useless Acheulean handaxe on the fossilized qoquina pebble; engraved signs (rock-art) in the caves and some other Portable forms of Upper Paleolithic art as well.

We agree with a number of archeologists who propose that Middle Paleolithic societies - such as that of the Neanderthals - may also have practiced the earliest form of Totemism. The animal sculptures are found in the caves of Georgia are confirming this hypothesis.

We wish to thank Prof. Ofer Bar-Yosef, Prof. Anna Belfer-Cohen, Prof. Liliane Meignen, Prof. Daniel Samuel Adler, Dr.Norbert Mercier and Dr. Olaf Jöris for their collaboration in study of the lithics and dating of Djruchula cave.

**References:**[1] Kalandadze A. 1968. Tsonskaia peshchera I ee kultura. 1969. IV Mejdunarodnaii speleologicheskii congress v Iugoslavii. Pp.3 [2] Gabunia L.K., Tushabramishvili D.M., Vekua A.K., 1961: Pervaia nakhodka ostatkov mustierskogo cheloveka na Kavkaze. Voprosy Antropologii, Moskva, pp.154-164 [3] Tushabramishvili, N. 2002. The Levallois Industries of Georgia. levaluauri .In: ACADEMIA, Historical-Philological Journal, t.4. pp. 25-43. In Georgian.[4] Meignen, L.&Tushabramishvili, N. 2007. Djruchula cave, on the southern slopes of the Great Caucasus: an extension of the Near Eastern Middle Palaeolithic blady phenomenon to the North (co-author: L. Meignen). Paleolrient. N32-2. pp.81-104 [5] N. Mercier, H. Valladas, L. Meignen, J-L. Joron, N. Tushabramishvili, D. S. Adler, O. Bar-Yosef. 2010. Dating the Early Middle Palaeolithic Laminar Industry from Djruchula Cave, Republic of Georgia. Paléorient Volume 36. Issue 36-2, pp. 163-173

Poster Presentation Number 128, Th (18:00-20:00)

## Modified ochre pieces, ochre-related artefacts, and symbolic behaviours at Hohle Fels Cave in southwestern Germany

**Elizabeth Velliky**[1,4], **Martin Porr**[2,4], **Nicholas J. Conard**[3]

1 - Institut für Naturwissenschaftliche Archäologie, Mathematisch-Naturwissenschaftlichen Fakultät,Tübingen, Germany · 2 - Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters, ROCEEH - The Role of Culture in Early Expansions of Humans, Tübingen, Germany · 3 - Department of Early Prehistory and Quaternary Ecology & Senckenberg Center for Human Evolution and Quaternary Ecology, University of Tübingen, Tübingen, Germany · 4 - Archaeology/Centre for Rock-Art Research and Management, M257, Faculty of Arts, School of Social Sciences, The University of Western Australia, Australia

Here we present preliminary results from an on-going study of the ochre assemblage from Hohle Fels. Located in the Swabian Jura of southwestern Germany, Hohle Fels contains Middle and Upper Palaeolithic deposits. The site holds an extensive Aurignacian cultural sequence (30 – 37 kyr non-cal. BP), which has yielded numerous artistic and symbolically related artefacts [1]. The archaeological evidence has been interpreted to suggest that the peoples of the Swabian Aurignacian were fully behaviourally modern, implying the presence of syntactical and symbolic language and advanced cognitive capabilities [2]. Excavations here have yielded red and yellow ochre artefacts, and other artefacts bearing traces of red pigment. Ochre compromises one facet of the earliest material evidence supporting symbolic behaviours in ancient hominins, and thus "modernity" [3]. To date, research has focused on only four anthropogenically modified ochre artefacts. To explore the nature of symbolic and artistic behaviours at Hohle Fels during the whole of the Upper Palaeolithic sequence, we have begun a detailed study of the ochre assemblages.

The ochre assemblage of Hohle Fels contains several fragments of limestone with patterns of painted red dots, faunal elements with traces of red pigment, and red ochre pieces containing anthropogenic use-traces. Most of these date from the Magdalenian (ca. 12.5 – 13.5 kyr cal. BP) [4]. Our ongoing assessment has uncovered new ochre artefacts, some showing clear traces of anthropogenic modification. We conducted a macroscopic identification of the artefacts to identify pieces with use-traces, followed by a microscopic analysis to confirm anthropogenic origin and identify traces resulting from post-depositional processes. We then conducted a qualitative evaluation with categories such as colour of streak, weight, and size. Many of the pieces are <1cm which causes greater difficulty when verifying anthropogenic traces. Therefore, we present only pieces bearing definite artificial use-traces. We classified the forms of modification under Hodgskiss' 2010 [5] model which includes striations and micro-striations from scoring, faceting, grinding, rubbing, smoothing, and polish. The modified ochre pieces are largely hematite-rich and produce a red streak. They bear both macro- and micro-striations from grinding and/or rubbing, and have a high presence polish. The approximate dating of the pieces ranges from the Magdalenian (12.5 – 13.5 kyr cal. BP) to the Gravettian (27 – 30 kyr cal. BP). The presence of these use-traces suggests the utilization of red ochre primarily for creating pigment powder, which was likely used as an artistic component. Yellow ochre is also present in the assemblage, yet only one piece from the Aurignacian layer AH IIIa (30 – 37 kyr non-cal. BP) displays clear evidence of modification. This piece features two deep and precise score marks with two small holes in between them. The score marks taper to one end and appear to form a pattern; no other macro-striations are visible on the artefact. This is the only piece of modified ochre, red or yellow, dating to the Aurignacian found at this stage of the analysis.

The presence of anthropogenic traces on red ochre pieces, in combination with the previously published painted limestone artefacts from Hohle Fels, document the likely production and use of pigments made from red ochre. The presence of numerous pieces of modified red and yellow ochre suggests that the collection, procurement and use of ochre was a regular behaviour at the site by at least the Gravettian. These findings and future research on the use of ochre at Hohle Fels and other sites in the region will greatly increase our knowledge of ochre acquisition and manipulation during the Upper Palaeolithic, and will impact on our understanding of early symbolic behaviours.

This research is supported by an International Postgraduate Research Scholarship, awarded by the University of Western Australia.

**References**:[1] Conard, N.J., 2003. Palaeolithic ivory sculptures from southwestern Germany and the origins of figurative art. Nature. 426, 830-832.[2] Conard, N.J., 2005. An overview of the patterns of behavioural change in Africa and Eurasia. In: d'Errico, F. and Blackwell, L. (Eds.), From Tools to Symbols: from Early Hominids to Modern Humans. Witwatersrand University Press, Johannesburg, pp. 294-332.[3] McBrearty, S. and Brooks, A.S., 2000. The revolution that wasn't: a new interpretation of the origin of modern human behavior. J. Hum. Evol. 39, 453-563.[4] Taller, A., 2014. Das Magdalénien des Hohle Fels: Chronologische Stellung, Lithische Technologie und Funktion der Rückenmesser. Kerns Verlag, Tübingen.[5] Hodgskiss, T., 2010. Identifying grinding, scoring and rubbing use-wear on experimental ochre pieces. J. Archaeol. Sci. 37, 3344-3358.

Podium Presentation: Session 4, Fr (9:50)

## Mandibular and dental reduction in *Homo*: discarding the functional hypotheses?

**Alessio Veneziano[1], Joel Irish[1], Carlo Meloro[1], Chris Stringer[2], Isabelle De Groote[1]**

1 - Liverpool John Moores University; School of Natural Sciences and Psychology · 2 - Earth Sciences Department, The Natural History Museum, London, United Kingdom

Mandible and teeth reduced in size throughout the evolution of the genus *Homo* [1, 2], relative to body mass. This trend has been suggested to result from a decrease in function of the masticatory apparatus. A shift in dietary habits or improvements in food processing techniques were proposed as triggers of oral reduction. In particular, the use of lithic tools would have allowed our ancestors to chew food in smaller bites and the adoption of fire for cooking would have resulted in food softening . Although these explanations may sound plausible, they rely on the unproven assumption that chewing tough foods requires large mandibles and teeth. Different foods determine different loads and strains on the masticatory apparatus of primates and an adapted shape is likely to counteract the stresses of mastication. Nonetheless, the role of mandibular and dental size in resisting these stresses is not known. To state that mandibular and dental size reduction in *Homo* is caused by changes in masticatory loads, we would expect significant size differences to be associated with different dietary regimes in primates.

In this study, we aimed to understand if mandibular and dental size is critical to functional adaptations in the masticatory apparatus in catarrhini. We adopted a primate perspective on oral reduction and used a 3D Geometric Morphometric approach. We collected data on 3D surfaces of mandibles belonging to 70 species of catarrhini, including six species of fossil hominina and modern humans. A configuration of 27 3D landmarks was collected on each mandible, outlining mandibular ramus, corpus and the tooth row. Data and categories on diet quality, diet evenness (calculated as the Shannon diversity index of all food sources exploited), percentage of frugivory or folivory and food toughness in diet were incorporated in the analyses to test if differences in mandibular and dental size in catarrhini can be explained functionally. Correlations between size and diet were analysed by means of Phylogenetic Generalized Least Squares (PGLS) and phylogenetic Procrustes ANOVA. Also, since changes in mandible and tooth row size may be linked to variation in shape, we analysed the allometric alteration of mandibular and tooth row shape by means of multivariate regression methods. The correlations between the allometric component of shape and diet data were tested using PGLS and Procrustes ANOVA.

Our results indicate that differences in mandibular and dental size are not highly related to changes in diet. Though frugivorous and folivorous primates exhibit different size in mandible and molars, this is mostly an effect of phylogenetic relatedness: indeed, the correlation disappears when phylogeny is taken into account. We obtained a similar result concerning food toughness and molar size. Diet evenness and quality fail to discriminate size. The main allometric changes in mandibular shape occur in the ramus and in the symphysis; larger mandibles develop wider rami and the lower transverse torus of the symphysis is more evident than in smaller mandibles. Smaller tooth rows exhibit relatively bigger incisors than larger ones, but post-canine dentition is shortened mesio-distally. The shape differences due to size allometry did not correlate with any of the tested diet categories and data due to phylogeny.

These results suggest that differences in mandibular and dental size are not strictly associated with changes in diet and function in catarrhini. The reason may be found in the high phenotypic plasticity of the primate lower jaw: primates with similar mandibles can chew different foods and vice versa. We conclude that mandibular and dental size reduction in *Homo* may have not occurred because of a functional relaxation, since there is no evidence that a larger jaw would adapt to a different diet than a smaller one in other catarrhini.

**References:**[1] Franciscus, R. G., and Trinkaus, E. 1995. Determinants of retromolar space presence in Pleistocene Homo mandibles. J Hum Evol, 28(6), 577-595.[2] McHenry, H. M., and Coffing, K. 2000. Australopithecus to Homo: transformations in body and mind. Annu rev Anthropol, 125-146.[3] Zink, K.D., Lieberman, D.E., Lucas, P.W., 2014. Food material properties and early hominin processing techniques, Journal of Human Evolution 77, 155-166.[4] Carmody, R.N., Wrangham, R.W., 2009. The energetic significance of cooking. Journal of Human Evolution 57, 379-391.[5] Williams, S. H., Wright, B. W., Truong, V. D., Daubert, C. R., & Vinyard, C. J. 2005. Mechanical properties of foods used in experimental studies of primate masticatory function. American Journal of Primatology, 67, 329-346.

Poster Presentation Number 24, We (17:00-19:00)

## The dentition from Montmaurin-La Niche cave (Haute-Garonne, France). New insights in the *Homo heidelbergensis* debate

**Amélie Vialet [1,4], Marina Martínez de Pinillos [2,3], María Martinón-Torres [3,5], José María Bermúdez de Castro[2,3]**

1 - Department of Prehistory, National Museum of Natural History (Paris) · 2 - National Research Center on Human Evolution (CENIEH), Burgos, Spain · 3 - University College London (UCL) Anthropology, London, UK · 4 - UMR 7194 of CNRS, University of Perpignan Via Domitia. European Research Center of Prehistory in Tautavel (CERP), Tautavel, France. · 5 - Laboratorio de Evolución Humana. Departamento Historia, Geografía y Comunicación), Burgos, Spain

Due to an increasing Middle Pleistocene human fossil record in Europe, *Homo heidelbergensis* species has become one of the most debated species in the last two decades. While the Middle Pleistocene populations of Europe have been generally related to Neanderthal clade, the precise taxonomic and phylogenetic relationship with *H. neanderthalensis* remains unclear. Interestingly, recent studies confirm that teeth and mandibles are the first anatomical parts to show a clear Neanderthal signature . This fact has been interpreted as evidence of a less linear model for the origin of the Neanderthal lineage . The present study contributes to this question by considering human fossils from a restricted geographical area (i.e. the French and Spanish sides of the Pyrenees and surroundings) in order to at least control one possible evolutionary factor. We focus on the Montmaurin-La Niche (MLN) mandible which together with a tibia and a cervical vertebra was discovered in 1949 in a karst system in South-West of Toulouse (Haute-Garonne). An updated synthesis on the geomorphological context and the fauna from this site was published recently attributing the layer bearing human fossils (C3) to the MIS 7 (around 200 ka). We present the first detailed comparison of the dentition of the MLN specimen, with a particular focus on the similarities and differences to the Tautavel-Arago cave (mainly from MIS 12) in France and the Atapuerca-Sima de los Huesos (SH) site (MIS 11) in Spain. A metrical and morphological study was carried out on the teeth, including an analysis of the dental inner features by means of micro-computed tomography (microCT). We have particularly focused on the assessment of the trigonid crest pattern expression at both the enamel and the enamel dentine junction as it bears a significant taxonomic and phylogenetic value . Our study reveals that all the MLN teeth display a continuous middle trigonid crest that is also high at the level of the EDJ . In this feature, MLN would be similar to Arago, SH as well as to the Neanderthal lineage in presenting high prevalence of continuous middle trigonid crest at the EDJ (75%, 72% and 76% of the individuals, respectively) . However, in both Montmaurin and Arago the distal trigonid crest is absent whereas this feature has been described as typical of the Neanderthal species and is present in a 23.2% and 14.7% of our SH and Neanderthal samples, respectively. To the light of our study we offer some insights about the relationship among hominins living in a restricted geographical area from MIS 7 to MIS 12 and that show a varied combination of primitive and derived traits. This study is part of an ongoing analysis that will include the mandible and a large comparative sample and expect to shed light on the Middle Pleistocene populations' variability and the different models suggested for Neanderthal's origin.

This report has been supported by the Dirección General de Investigación of the Spanish Ministerio de Economía y Competitividad (MINECO) grant number: CGL2015-65387-C3-1, 3-P, the Consejería de Cultura y Turismo of the Junta de Castilla y León, and the Fundación Atapuerca. One of the authors (MM-P) have Predoctoral contract of the Junta de Castilla y León financed by European Social Funds through the Consejería de Educación. We also acknowledge The Leakey Foundation through the personal support of Dub Crook and Gordon Getty to one of the authors (MM-T). The mandible was scanned at the microCT site on the Laboratoire d'Anthropologie Moléculaire et Imagerie de Synthèse located in the Faculté de Médecine of Toulouse (France) with the collaboration of Jean Dumoncel and José Braga.

**References:**[1] Martinón-Torres, M., Bermúdez de Castro, J.M., Gómez-Robles, A., Prado-Simón, L., Arsuaga, J.L., 2012. Morphological description and comparison of the dental remains from Atapuerca-Sima de los Huesos site (Spain). J. Hum. Evol. 62, 7–58.[2] Arsuaga, J.L., Martínez, I., Arnold, L.J., Aranburu, A., Gracia-Téllez, A., et.al. 2014. Neandertal roots: Cranial and chronological evidence from Sima de los Huesos. Science. 344, 1358–1363[3] Crégut-Bonnoure, E., Boulbes, N., Guérin, C., Pernaud, J., Tavoso, A., Cammas, R. 2010. Le contexte géomorphologique et faunique de l'homme de Montmaurin (Haute-Garonne). Préhistoires méditerranéennes, 1, 35-85.[4] Bailey, S.E., Skinner, M.M., Hublin, J.-J., 2011. What lies beneath? An evaluation of lower molar trigonid crest patterns based on both dentine and enamel expression. Am. J. Phys. Anthropol. 145, 505–518.[5] Martínez de Pinillos, M., Martinón-Torres, M., Skinner, M.M., Arsuaga, J.L., Gracia-Téllez, A., et.al. 2014. Trigonid crests expression in Atapuerca-Sima de los Huesos lower molars: Internal and external morphological expression and evolutionary inferences. C. R. Palevol. 13, 205–221.

Poster Presentation Number 75, Th (18:00-20:00)

## Born to walk: a wider pelvis reduces the energetic costs of locomotion

**Marco Vidal-Cordasco[1], Ana Mateos[1], Guillermo Zorrilla-Revilla[2], Olalla Prado-Nóvoa[1], Jesús Rodríguez[1]**

1 - National Research Centre on Human Evolution (CENIEH), Paseo Sierra de Atapuerca, 3, 09002 Burgos, Spain. · 2 - Escuela Interuniversitaria de Posgrado en Evolución Humana, Edificio I+D+I, Universidad de Burgos, Pza. Misael Bañuelos s/n, 09001 Burgos, Spain.

Ecomorphological approaches linking anatomy to locomotor performance have identified several relationships between lower limb length, locomotor efficiency and daily travel distance. In addition to the effect of lower limb length, pelvic width has been shown to influence locomotor dynamics and costs by altering hip abductor mechanics. This hypothesis is central to many arguments concerning the nature of bipedalism in extinct hominins and the differences in locomotion between men and women. However, it has been suggested recently that this biomechanical model needs to be re-evaluated, since it does not predict locomotor costs and abductors mechanics. The main purpose of our study is to look for correlations between locomotion energetic cost and a number of pelvic dimensions related to abductors size and hip mechanics. Furthermore, although the attention on modeling locomotor costs has been focused on lower limb length in most previous research, here the effect of other somatic dimensions on the energy expenditure of walking will be tested. In order to achieve the aim of the study, a sample of 28 healthy, physically active and non-smoker males, aged between 23 and 50, was selected. The sample was exhaustively controlled by means of exclusion criteria aimed to eliminate factors that influence metabolism. The experimental design was developed at BioEnergy Laboratory at National Research Centre on Human Evolution (CENIEH, Burgos, Spain). The study was approved by the Hospital Universitario de Burgos Ethical Committee (Spain). It is based on several protocols. 1) The Anthropometric Protocol consists of direct measurements of the body employing an anthropometric tape, a Holtain stadiometer and anthropometer. Other measures deserve special attention. *Gluteus medius* size depends on the outer edge of the iliac crest and the distance between iliac crest and greater trochanter. Aiming to determine this distance, the bi-trochanteric breadth minus bi-iliac breath was computed, from here on this difference will be called Relative Abductors Size. 2) The Indirect Calorimetry Protocol was carried out with an ergospirometer MasterScreen CPX JAEGERTM. Oxygen consumption and carbon dioxide production was monitored in several trials: Resting Metabolic Rate (RMR) during 30 minutes and walking during 10 minutes on a treadmill hp COSMOS. Both locomotion energetic costs and anthropometric measurements are influenced by body mass. As expected, after the effect of body mass has been accounted for, there is still a significant negative correlation between femur length and locomotion costs but, interestingly, bi-iliac breath explains a greater portion of variance than femur length. The significant negative correlation between locomotion costs and bi-iliac breadth means that subjects with broader pelvises expend less energy while walking. On the other hand, Relative Abductors Size shows a significant correlation with energy expenditure, as well. These results suggest that pelvises did not face antagonistic selection pressures on locomotor efficiency and fetal brain size, as recently hypothesized. Furthermore, results suggest that this plesiomorphic feature may have favoured substantially locomotor costs and mobility in Pleistocene hominins. Finally, Relative Abductor Size is proposed as a measurement related to the efficiency of the abductors during the stance phase of a gait cycle in the genus *Homo*.

We are sincerely grateful to all the volunteers who participated in this experimental study. Our research was performed at the CENIEH facility Bioenergy Laboratory and the Sierra de Atapuerca sites. This study was funded by National Research Centre on Human Evolution (CENIEH) and supported by the MINECO project (CGL2012-38434-C03-02).

Poster Presentation Number 113, Th (18:00-20:00)

## The earliest evidence of a smoking hearth? a palaeoeconomical approach from El Salt (Eastern Iberia)

**Paloma Vidal-Matutano**[1], **Isabelle Théry-Parisot**[2]

1 - Departament de Prehistòria i Arqueologia, Universitat de València · 2 - CNRS UMR 7264 CEPAM

Anthracology has been traditionally focused on the botanical identification of the charcoal fragments and, therefore, the observation of a generalized pattern in the use of wood species in different combustion structures has been understood as the absence of selection criteria. However, ethnographic studies reveal the existence of an organized firewood gathering activity oriented to the different physiological and phenological states of the wood: green, drift, healthy, dead and rotten wood [1,4]. In order to characterize the macroscopic state of the firewood used by hunter-gatherer groups during the past, several experimental and ethnoarchaeological studies have been carried out shedding light on the palaeoeconomical approach from charcoal analysis [3,5].

We present here the results of the charcoal analysis carried out in four Middle Palaeolithic combustion structures from two sites located in Eastern Iberia: combustion structures H4 and H11 from Abric del Pastor, unit IV (> 75 ka BP) and combustion structures H50 and H57 from El Salt, unit Xb (ca. 52 ka BP). In Abric del Pastor *Juniperus* sp. (junipers) and *Pistacia* sp. (terebinth) were the main taxa while in El Salt most of the firewood used was from *Pinus nigra-sylvestris* (Black/Scots pine) and *Acer* sp. (maple). We defined a protocol for the microscopic observation of the anatomical alterations caused by fungi activity on wood before combustion processes. We classified the wood charcoal fragments in three alteration levels (A.L.) and we calculated the alteration index (A.I.) according to the previous experimental studies . The classification of wood charcoals according to their alteration degree revealed differences between the hearths studied: while combustion structures H4, H11 and H50 showed values equal or lower than 0.35, hearth H57 showed a considerably higher degree of alteration (0.46). The comparison between archaeological remains and the previous experimental and ethnographic data point out to several firewood acquisition criteria: the low values of alteration from the first three combustion structures suggest a firewood gathering activity based on the collection of dead wood branches regardless of the taxa. On the other hand, hearth H57 showed an Ai which corresponds to the limit between the dead and rot wood of the experimental study. In addition to this, a total of 253 seed fragments of cf. *Acer* sp. were identified inside the structure suggesting the hypothesis of the use of green *Acer* sp. wood with the seeds still inserted in the cut branches. In the smoking hearths from ethnographic contexts the humidity rate of the wood is more important than the species itself and large part of the fuel is composed of green wood with the addition of dead wood that makes combustion to function . Thus, the selection of green wood mixed with very altered or rotting conifer firewood could be related with a function of the structure to produce smoke. Finally, the production cycle of the maple, beside the nut-shells preservation inside the combustion structure, has given us some clues about the seasonality pattern during the occupation event related to hearth H57.

In conclusion, the applied methodology has allowed us to detect nuances between the anthracological record of the different combustion structures that would not be visible by merely following the traditional anthracological methodology. Furthermore, these data support the idea, experimentally and ethnographically defined, that there is no particular "good fuel" but a diverse range of physiological and phenological states of the wood linked to the aims pursued and the fuel needs.

This work was carried out in context of a research stay at the CEPAM laboratory (UMR 7264 CNRS, Nice, France) and a pre-doctoral fellowship funded by the Valencian Government (ACIF/2013/260). The anthracological fieldwork in the Middle Palaeolithic sites has been supported by the Spanish Government (project HAR2912-32703) and Direcció General de Cultura.

**References:**[1] Alix, C., Brewster, K., 2004. Not all driftwood is created equal: wood use and value along the Yukon and Kuskowim Rivers, Alaska. Alaska journal of anthropology. 2, 48–65.[2] Binford, L.R., 1967. Smudge pits and hide smoking: the use of analogy in archaeological reasoning. American Antiquity. 32, 1–12.[3] Henry, A., Théry-Parisot, I., 2014. From Evenk campfires to prehistoric hearths: charcoal analysis as a tool for identifying the use of rotten wood as fuel. Journal of Archaeological Science. 52, 321–336.[4] Henry, A., Théry-Parisot, I., Voronkova, E., 2009. La gestion du bois de feu en forêt boréale: problématique archéo-anthracologique et étude d'un cas ethnographique (Région de l'Amour, Sibérie). In: I. Théry-Parisot, S. Costamagno, A. Henry (Eds.). Fuel management during the Palaeolithic and Mesolithic period: New tools, new interpretations. Proceedings of the XV World Congress (Lisbon, 4-9 September 2006). Archaeopress: 13-33.[5] Moskal del Hoyo, M., Wachowiak, M., Blanchette, R., 2010. Preservation of fungi in archaeological charcoal. Journal of Archaeological Science. 37, 2106–2116.

Pecha Kucha Presentation: Session 10, Sa (15:25-15:50)

## The position of the malar process in relation to the dentition in recent and fossil hominids

**Gerhard W. Weber**[1,2], **Viktoria Krenn**[1,2]

1 - Department of Anthropology, University of Vienna, Vienna, Austria · 2 - Core Facility for Micro-Computed Tomography, University of Vienna

The location of the zygomatic root plays a crucial role in determining the overall strength of the face in response to bite forces. Particularly relative position of the the zygomatic root to the postcanine dentition is of interest. The masseter arises at the root and major strains occur in that region during chewing. The zygomaticoalveolar crest (ZAC) is discussed as a buttressing feature of the face [1]. We can recognize changes in size and shape of the face, and the dentition in the course of human evolution [2,3]. Changes such as a more forwardly or backwardly positioned zygomatic root or a shorter or higher vertical distance of the latter to the dentition could be related to dietary shifts and the increasing use of extra-oral food processing techniques that altered the masticatory loading regimes [1,4].

We therefore examined the morphology of this maxillary region using state-of-the-art 3D Geometric Morphometric methods. The data set includes five landmarks [Prosthion, Orale, Zygomaxillare, lingual and buccal midpoint of second molar (M2) alveoli] and three curves with semilandmarks along the lingual and buccal alveolar rim, and the ZAC. Measurements were taken from either virtual specimens (Computed Tomography - CT, Micro-Computed Tomography - μCT, Surface Scan - SS), or from casts (CA). We included extant apes [*Pan troglodytes* (Pt; n=3), *Gorilla gorilla* (Gg; n=3), *Pongo pygmaeus* (Pp; n=4)], recent humans from different geographical populations [RMH; Africa, Asia, Australia, Europe, (n=17)], upper Paleolithic modern humans (upMH; n=8), early anatomically modern humans (eAMH; n=5), Neanderthals (NEA; n=5), Middle Pleistocene hominins (MPH; n=4), Erectines (Er; n=3), Habilines (Ha; n=2), Paranthropines (Pa; n=4), and Australopithecines (Au; n=4). All procedures of the analyses follow in principle the guidelines published in [5].

Although the spectrum of hominids included is very large, the results show a stunning overlap in shape variation. We find no pattern of shape that would allow separating different hominid groups with confidence, except two extreme forms – Paranthropines and Neanderthals. There is also no obvious general trend over time. Australopithecines, Habilines, Erectines, and Middle Pleistocene *Homo* can be very similar to modern humans. Even the great apes are within or not far from the central shape distribution of *Homo*. Apes and Australopithecines lie, however, at opposite poles of the distribution which indicate mainly a more curved or straight ZAC, and not so much a more forward or backward position of the zygomatic root. Only Paranthropines and Neanderthals are clearly different and form separate clusters. Paranthropines for their high and steeply inclined ZAC, broad postcanine tooth row, and for their forwardly positioned zygomatic root in some cases (OH5, SK12), Neanderthals because of their far backwardly positioned zygomatic root but featuring a moderate ZAC height. Sima des los Huesos (SH) specimen Atapuerca 5, and the Zambian fossil Kabwe 1 are very close to Neanderthals. Early anatomically modern humans feature a shape between Neanderthals and modern humans, but closer to the latter.

The fact that only a few hominids deviate markedly from a predominant pattern of variation would be in agreement with the idea of a general "Bauplan" for the architecture of this crucial maxillary region. The geometry studied allows simple measurements and analyses and is thus potentially interesting to distinguish the two extreme forms (Paranthropines, Neanderthals) from the rest of the hominids.

We thank Israel Hershkovitz and Julia Abramov (Tel Aviv University), George Koufos (Aristotle University of Thessaloniki), Juan-Luis Arsuaga (Universidad Complutense de Madrid), Lee Berger (University of the Witwatersrand), Fred Spoor (University College London, MPI Leipzig) and Emma Mbua (National Museums of Kenya), Francis Thackeray (University of the Witwatersrand) and Stephanie Potze (Transvaal Museum), Cassian Magori (Bugando University College of Health Sciences Mwanza), Donatius Kamamba (Dept. of Antiquities Dar-es-Salaam) and Charles Sanane (University of Dar-es-Salaam), Ato Jara (ARCCH Addis Ababa) and Horst Seidler (University of Vienna), Chris Stringer and Rob Kruszynski (Natural History Museum London), Xinzhi Wu and Yaming Cui (IVPP Beijing) for access to fossils, respectively for scanning fossils. Gerlinde Gruber (Medical University Vienna), Maria Teschler-Nicola, Frank Zachos, and Eduard Winter (Natural History Museum Vienna) granted access to fossil and recent hominids, and fossil casts. This research was supported by Department of Anthropology at University of Vienna, and the Oesterreichische Nationalbank, Anniversary Fund, project number 16121.

**References:**[1] Rak, Y., 1983. The Australopithecine Face. Academic Press, New York, London [2] McHenry, H.M., Coffing, K., 2000. Australopithecus to Homo: Transformations in body and mind, Annual Review of Anthropology, pp. 125-146 [3] Lieberman, D.E., 2011. The Evolution of the Human Head. The Belknap Press of Harvard University Press, Cambridge MA [4] Wrangham, R.W., Jones, J.H., Laden, G., Pilbeam, D., Conklin-Brittain, N., 1999. Cooking and the ecology of human origins. Current Anthropology 40, 567-594.[5] Weber, G.W., Bookstein, F.L., 2011. Virtual Anthropology - A Guide to a New Interdisciplinary Field. Springer Verlag. ISBN 978-3-211-48647-4, Wien, New York

Podium Presentation: Session 9, Sa (12:10)

## Palaeoproteomic evidence identifies archaic hominins associated with the Châtelperronian at the Grotte du Renne

**Frido Welker[1,2], M. Hajdinjak [3], S Talamo[1], K. Jaouen[1], M Dannemann[3,4], F. David[5], M. Julien[5], M Meyer[3], J Kelso[3], I Barnes [6], S brace[6], P. Kamminga[7], R. Fischer[8], B Kessler[8], J.R. Stewart[9], S Pääbo[3], M.J. Collins[2], J.J. Hublin[1]**

1 - Department of Human Evolution, MPI-EVA, Leipzig · 2 - BioArCh, University of York, U.K · 3 - Department of Evolutionary Genetics, MPI-EVA, Leipzig · 4 - Medical Faculty, University of Leipzig, Germany · 5 - Paris Unité Mixte de Recherche 7041 du Centre national de la Recherche Scientifique Arhcoéologies et Sciences de l'Antiquité, Nanterre, France · 6 - Department of Earth Sciences, Natural History Museum, London, U.K. · 7 - Naturalis Biodiversity Center, Leiden, The Netherlands · 8 - Target Discovery Institute, Nuffield Department of Medicine, University of Oxford, Oxford · 9 - Faculty of Science and Technology, Bournemouth University, Bournemouth, U.K.

In western Europe, the Middle to Upper Palaeolithic transition is associated with the disappearance of Neandertals and the spread of Anatomically Modern Humans (AMHs). The Châtelperronian assemblage at the Grotte du Renne, Arcy-sur-Cure, France, takes a central role in models explaining the transition but the association of hominin fossils at this site with the Châtelperronian is debated. At the site, morphological Neandertal specimens are not directly dated but contextually associated to the Châtelperronian, which contains colorants, bone points and beads. The association between Neandertals and the Châtelperronian assemblage has been controversial because of the lack of a direct hominin radiocarbon date or molecular confirmation of the Neandertal affiliation, in conjunction with the suggestion of taphonomic issues with the Neanderthal-Châtelperronian association [1,2]. Pending the discovery of further hominin specimens at other Châtelperronian sites, the Châtelperronian at the Grotte du Renne remains crucial in order to obtain a coherent biological and chronological view of the transitional period in Europe. Here we provide further support for a Neandertal-Châtelperronian association at the Grotte du Renne through biomolecular and chronological analysis. We identified 28 additional hominin specimens through ZooMS (Zooarchaeology by Mass Spectrometry, [3,4]) screening of morphologically uninformative bone specimens at the Grotte du Renne, and utilize these to obtain further osteological, isotopic, chronometric and biomolecular data (ancient proteins and ancient DNA) on the Grotte du Renne hominins. We obtained an ancient hominin bone proteome through LC-MS/MS analysis and, as molecular contamination is an important issue when studying ancient biomolecules, we applied a range of approaches to minimize and monitor exogenous protein contamination. After introducing our methodology, we will present some functional and taxonomic aspects of the palaeoproteomic results and their relevance to previous research on the Grotte du Renne hominins. For example, several of the ancient proteins identified suggest that the fragmented bone specimens derive from juveniles, an observation consistent with morphological and isotopic observations. The mitochondrial genome and the amino acid sequence data confirm that these hominins are Neanderthals, as suggested by previous morphological observations . Combined with direct radiocarbon dating of one confirmed hominin bone specimen, our results have direct relevance to the debate on the makers of the Châtelperronian at the Grotte du Renne, and provide a new research avenue towards an increased biological understanding of the Middle to Upper Palaeolithic transition in Europe.

**References:**[1] Higham, T., Jacobi, R., Julien, M., David, F., Basell, L., et.al. 2010. Chronology of the Grotte du Renne (France) and implications for the context of ornaments and human remains within the Châtelperronian. Proceedings of the National Academy of Sciences 107, 20234–20239.[2] Hublin, J.-J., Talamo, S., Julien, M., David, F., Connet, N., et.al. 2012. Radiocarbon dates from the Grotte du Renne and Saint-Césaire support a Neandertal origin for the Châtelperronian. Proc. Natl. Acad. Sci. U. S. A. 109, 18743–18748.[3] Buckley, M., Collins, M., Thomas-Oates, J., Wilson, J.C., 2009. Species identification by analysis of bone collagen using matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry. Rapid Commun. Mass Spectrom. 23, 3843–3854.[4] Welker, F., Soressi, M., Rendu, W., Hublin, J.-J., Collins, M., 2015. Using ZooMS to identify fragmentary bone from the late Middle/Early Upper Palaeolithic sequence of Les Cottes, France. J. Archaeol. Sci. 54, 279–286.[5] Hublin, J.J., Spoor, F., Braun, M., Zonneveld, F., Condemi, S., 1996. A late Neanderthal associated with Upper Palaeolithic artefacts. Nature 381, 224–226.

Pecha Kucha Presentation: Session 2, Th (12:35-13:00)

## The evolution of body size within the genus *Homo*: new empirical data and theoretical perspectives

**Manuel Will**[1,3], **Adrián Pablos**[2,4,5,6], **Jay T. Stock**[3]

1 - Department of Early Prehistory and Quaternary Ecology, University of Tübingen, Germany · 2 - Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain · 3 - PAVE Research Group, Department of Archaeology and Anthropology, University of Cambridge, United Kingdom · 4 - Paleoanthropology, Senckenberg Center for Human Evolution and Paleoenvironment, Eberhard Karls Universität Tübingen, Germany · 5 - Área de Antropología Física, Departamento de Ciencias de la Vida. Universidad de Alcalá, Spain · 6 - Centro Mixto UCM-ISCIII de Investigación sobre Evolución y Comportamiento Humanos, Madrid, Spain.

Body size is one of the most important determinants of the biology of a species, as it correlates with life history, energetic expenditure, diet, thermoregulation, and home range size, among other factors. Although the evolution of body size within the genus *Homo* is an important issue, the most influential large-scale studies have been performed over 20 years ago, with a recent interest in this issue only in the last few years. In the meantime, the widely accepted interpretation that there was a major shift in body size with the origin of *Homo ergaster/erectus* when compared *Homo habilis*, *Homo rudolfensis*, and australopithecines has come under criticism. Recent analyses have demonstrated that body size within early *Homo* is spatially and temporally variable, only showing significant increase in the Koobi Fora region after 1.7 Mya [1]. Broad temporal analyses of body size have highlighted the significant rise in body mass during the late Middle and Late Pleistocene [2], and that brain size increases correspond closely with body mass increases throughout the Pleistocene [3]. Even though new body size data is now accumulating rapidly for various parts of the hominin record [1, 4, 5], no study comparable to the scope of Ruff *et al.* in 1997 [3] has since been performed.

In this paper we investigate taxonomic, spatial and temporal variation in two components of body size within the genus *Homo*: body mass and stature. We combine size estimates of hominin fossils from our own studies with other published data, resulting in the largest sample for a single study so far (n=319). The body size estimates cover roughly four million years (4.1 Mya – 11 ka) and derive from African, European and Asian specimens, including several genera and species of hominins. This data set allows for a detailed assessment of body size evolution within the genus *Homo* and relative to earlier hominins.

Analyses of the body size estimates demonstrate that: a) the origins of the genus *Homo* are characterized by a significant increase in body size compared to australopithecines and paranthropines, but also feature abundant spatial and temporal variation within an enlarged size range; b) members of *Homo erectus/ergaster* are marked by a diversification in body mass and stature rather than directional increase; c) a consistent and universal increase in body size is only established in Middle Pleistocene hominins (e.g. Sima de los Huesos, Atapuerca; *Homo heidelbergensis*), Neanderthals and modern humans after ca. 0.5 Mya; d) selection against smaller body mass and stature occurred in the late Early and Middle Pleistocene, and; e) there are no simple latitudinal trends in the variation of body size estimates within Middle and Late Pleistocene *Homo* in Europe. These results have implications for studies concerned with human dispersal and encephalization, and more generally for how we interpret the evolution and biology of our genus. In light of the above, rather than focusing exclusively on species means and unidirectional models, perspectives that emphasize spatio-temporal variability and phenotypic plasticity might be more fruitful frameworks for interpreting the evolution of body size in our genus.

**References:**[1] Will, M., Stock, J.T., 2015. Spatial and temporal variation of body size among early Homo. Journal of Human Evolution 82, 15-33 [2] Ruff, C.B., Trinkaus, E., Holliday, T.W., 1997. Body mass and encephalization in Pleistocene Homo. Nature 387, 173-176 [3] Grabowski, M., 2016. Bigger brains led to bigger bodies? The correlated evolution of human brain and body size. Current Anthropology 57, 174-196 [4] Arsuaga, J L., Carretero, J.M., Lorenzo, C., Gómez-Olivencia, A., Pablos, A., Rodríguez, L., et al., 2015. Postcranial morphology of the Middle Pleistocene humans from Sima de los Huesos, Spain. Proceedings of the National Academy of Sciences 112, 11524-11529 [5] Grabowski, M., Hatala, K.G., Jungers, W.L., Richmond, B.G., 2015. Body mass estimates of hominin fossils and the evolution of human body size. Journal of Human Evolution 85, 75-93. .

Poster Presentation Number 109, Th (18:00-20:00)

## New data on the late Middle Palaeolithic in Poland: current discussion on chronological framework and typo-technological variability

**Andrzej Wiśniewski**[1]

1 - Institute of Archaeology, University of Wrocław, 50-139 Wrocław, Poland

Recent research of the Polish Late Middle Palaeolithic resulted in the intensification of field works and restudy of old collections [1-3]. The turning point was an application of geophysical methods for dating sediments and obtaining new lithic assemblages on a large scale. This work presents a new model of variability of lithic assemblages using new chronological records and results of techno-typological studies. It is a fact that new data do not correspond with the previous idea of evolution of Middle Palaeolithic industries in Poland. Earlier concept emphasized linear transmission of cultural information as a main factor of assemblage variability [4]. We have combined different radiometric data (OSL, TL, U-Th, 14C) together with biostratigraphical and lithostratigraphical records. Unfortunately, insufficient number of radiometric records is visible in case of sites dated between MIS5 and MIS4. Taking into account new records, an increase in the number of MP cultural layers over Weichselian period can be seen. At the same time, these records do not confirm the previous idea of settlement hiatus at the beginning of Stage 3. From the new technological studies, it follows that humans occupying Polish territory used almost all types of technical innovation known from other regions of Central Europe. It is worth mentioning that between MIS5-MIS3 a wide diversity of core reduction and method of tool preparing is observed. This phenomenon corresponds not only with mental templates but also with such factors like: type of activity, raw material or environmental conditions. Currently, one can distinguish following kinds of industries: Keilmesser assemblages, Mousterian assemblages based on flake or on flake and blade technology. Some collections show various techno-typological directions which are an indicator of a palimpsest or/and presence of more complex production structures like ramification. This situation can be illustrated by finds from Biśnik Cave, Kraków-Księcia Józefa and possibly Stajnia Cave. Taking the general spatio-temporal variability of Polish assemblages into consideration, it is impossible to empirically prove the existence of evolution buisonnante in the late phase of Middle Palaeolithic. Currently it is hard to register any trends in regional or interregional perspective. However, it cannot be excluded that this is a result of insufficient number of reliable records or/and a high settlement dynamic.

**References:**[1] Valde-Nowak, P., Alex, B., Ginter, B., Krajcarz, M.T., Madeyska, T., Miękina, B., Sobczyk, K., Stefański, D., Wojtal, P., Zając, M. and Zarzecka-Szubińska, K., 2014. Middle Paleolithic sequences of the Ciemna Cave (Prądnik valley, Poland): The problem of synchronization. Quaternary International 326-327, 125-145.[2] Wiśniewski, A., Adamiec, G., Badura, J., Bluszcz, A., Kowalska, A., Kufel-Diakowska, B., Mikołajczyk, A., Murczkiewicz, M., Musil, R., Przybylski, B., Skrzypek, G., Stefaniak, K. and Zych, J. 2013. Occupation dynamics north of the Carpathians and Sudeten during the Weichselian (MIS5d-3): the Lower Silesia (SW Poland) case study. Quaternary International 294, 20-40.[3] Bobak, D., Płonka, T., Połtowicz-Bobak, M., Wiśniewski, A., 2013. New chronological data for Weichselian sites from Poland and their implications for Palaeolithic, Quaternary International 296, 23-36.[4] Kozłowski, J. K., 2014. Middle Palaeolithic variability in Central Europe: Mousterian vs Micoquian. Quaternary International 326-327, 344-363.

Poster Presentation Number 10, We (17:00-19:00)

## Innovative approaches to quantify and statistically compare tooth enamel thickness distribution

**Clément Zanolli[1], Margot Cantaloube[1], Priscilla Bayle[2], Luca Bondioli[3], Jean Dumoncel[1], Stanley Durrleman [4], Jean-Pierre Jessel[5], Gérard Subsol[6], Roberto Macchiarelli[7,8]**

1 - UMR 5288 CNRS, Université Toulouse III – Paul Sabatier, France · 2 - UMR 5199 PACEA CNRS, Université de Bordeaux, France · 3 - Sezione di Bioarcheologia, Museo Nazionale Preistorico Etnografico "L. Pigorini", Roma, Italy · 4 - INRIA/ICM, Pitié Salpêtrière Hospital of Paris, France · 5 - UMR 5505 IRIT CNRS, Université Toulouse III – Paul Sabatier, France · 6 - UMR 5506 LIRMM CNRS, Université de Montpellier, France · 7 - UMR 7194 CNRS, Muséum National d'Histoire Naturelle, Paris, France · 8 - Département Géosciences, Université de Poitiers, France

Primates are heterodont and diphyodont mammals, thus growing two sets of dental elements during their life, i.e., the primary (deciduous) teeth and the replacing secondary (permanent) dentition. In addition to differences in developmental timing and patterning distinguishing these two sets, deciduous teeth are in functional occlusion for a much shorter period of time and commonly subject to considerably lower functional constraints (at least until weaning). It is by now recognized that the hominid tooth enamel thickness (ET) patterns stem from an evolutionary compromise between functional/adaptive constraints and strict control mechanisms of the morphogenetic program, though its variability is also presumably linked to a number of biological and environmental factors. ET is considered to be a reliable parameter for tracking diet-related structural adaptations and exploring life-history trajectories, phylogenetic relationships and evolutionary trends [1-2], even if bi-dimensional studies of relative ET show marked overlap among fossil and extant hominin taxa [3]. However, the degree of co-variation of this tissue in deciduous and permanent crowns is still poorly understood in extinct and extant hominids and remains to be assessed in an evolutionary morpho-functional perspective. In order to set free from "average" estimates (generally limited to a gradient scale of single values) and to comparatively quantify the local absolute and relative ET distribution patterns, new investigative approaches based on advanced virtual imaging are necessary. We use here two original methods to measure the degree of intra-taxic co-variation of the deciduous and permanent ET molar variation as possible taxon-specific marker in Miocene (*Ouranopithecus*=1, *Oreopithecus*=1) and extant apes (*Pongo*=5, *Gorilla*=4, *Pan*=1), in nonhuman Plio-Pleistocene hominins (*Australopithecus africanus*=1, *Paranthropus robustus*=2), and in representatives of our own taxon (*H. erectus*=1, Neanderthals=2, extant humans=12). In total, we used 30 couples of lower dm2 and M1 belonging to the same individual (except for *Oreopithecus* and *H. erectus*, where the deciduous and the permanent molars sample different individuals). The first method corresponds to an improvement of the routine originally developed for virtually unrolling and mapping the long bone shaft and the tooth root local morphometric properties [4] adapted to the lateral ET (in order to avoid occlusal wear). The second original method allows the statistical comparisons among the maps by performing a matching using biological features between a reference surface and the occlusal surfaces. At this stage, we applied this method to unworn M1s only, limiting the investigated sample to 29 tooth crowns representing all previously mentioned taxa except *H. erectus* (too worn occlusal surface). By using PCA and between-group PCA, we observe a distinction among the taxa compatible with a diet-related signal. However, larger samples and a better understanding of the intraspecific variation are necessary to sort the ecological-adaptive from the phylogenetic signal. In this perspective, the dm2 and M1 crown dimensions and proportions were recently shown to be linked by developmental inhibitory cascade mechanisms [5], but more research is needed in order to fully appreciate their relationships in fossil and extant hominids in terms of subtle inner structural organization and tissue proportions.

For their support, we are grateful to: French CNRS and MAEDI; ESRF [Grenoble]; Centre de Microtomographie Univ. Poitiers; AESOP+ program; Wits Univ. [Johannesburg]; Ditsong Museum [Pretoria]; Necsa [Pelindaba]; ICTP [Trieste]; Nespos Society.

**References**:[1] Pampush, J.D., Duque, A.C., Burrows, B.R., Daegling, D.J., Kenney,W.F., McGraw,W.S., 2013. Homoplasy and thick enamel in primates. J. Hum. Evol. 64, 216-224.[2] Horvath, J.E., Ramachandran, G.L., Fedrigo, O., Nielsen, W.J., Babbitt, C.C., et.al. 2014. Genetic comparisons yield insight into the evolution of enamel thickness during human evolution. J. Hum. Evol. 73, 75-87.[3] Smith, T.M., Olejniczak, A.J., Zermeno, J.P., Tafforeau, P., Skinner, M.M., et.al. 2012. Variation in enamel thickness within the genus Homo. J. Hum. Evol. 62, 395-411.[4] Bondioli, L., Bayle, P., Dean, C., Mazurier, A., Puymerail, L., et.al. 2010. Morphometric maps of long bone shafts and dental roots for imaging topographic thickness variation. Am. J. Phys. Anthropol. 142, 328-334.[5] Evans, A.E., Daly, E.S., Catlett, K.K., Paul, K.S., King, S.J., et.al. 2016. A simple rule governs the evolution and development of hominin tooth size. Nature 530, 477-480.

Poster Presentation Number 122, Th (18:00-20:00)

## New results from Ghār-e Boof and their implications for the shift from the Middle to the Upper Paleolithic in the Southern Zagros Mountains

**Mohsen Zeidi**[1], **Knut Bretzke**[2], **Nicholas Conard**[1]

1 - Department Early Prehistory and Quaternary Ecology University of Tübingen, & Tübingen-Senckenberg Center for Human Evolution and Paleoecology, Germany · 2 - Department Early Prehistory and Quaternary Ecology University of Tübingen, Germany

With its geographic position between the Levant, Mesopotamia, Arabia and the great expanses of Asia, the Zagros Mountain range is of critical importance for many questions related to the timing and spatial patterns of the spread of modern humans. One issue arising repeatedly is whether to view the Zagros as a corridor between east and west and north and south, or rather as a barrier for expansions and exchange. Both these approaches have their merits as well as their limitations, and in the end we are probably best served by establishing the Paleolithic record of the Zagros in its own right before we try to understand its role for human dispersals and cultural innovations. Systematic fieldwork by the Tübingen Iranian Stone Age Research Project (TISARP) in the northwestern Fars Province of Iran identified the Rostamian lithic tradition, an early Upper Paleolithic (UP) entity characterized by lithic technologies geared toward the production of bladelets. We collected extensive evidence for the Rostamian during survey in the Dasht-e Rostam-Basht and adjacent regions and during the excavations of Ghār-e Boof [1,2,3]. Radiocarbon dating of charcoal samples from the Rostamian bearing layers place the occurrence of this distinct bladelet technology between 35 ka cal BP and 41 ka cal. BP. Based on these age estimations, the UP at Ghār-e Boof currently represents one of the oldest UP assemblages in the Zagros Mountains. New excavations at Ghār-e Boof in 2015 extended the stratigraphic sequence of the site. For the first time we have recovered stratified finds from the Middle Paleolithic (MP). The small assemblages from the Middle Paleolithic layers provide new information on the MP - UP transition in the region as well as information on behavioral similarities and differences between the makers of MP technologies and the Rostamian occupants of the region during the early UP. One striking difference between MP and UP observed in both our excavated record and the record from our systematic surveys, is an ephemeral character of the Middle Paleolithic occupation, while our evidence for the early UP Rostamian indicates that these people spent much longer periods at Ghār-e Boof and exploited the region more intensively. Although we still need more data on the late MP in the region to draw final conclusion, we argue that the significant technological shift between MP and the early UP from flake technologies to sophisticated bladelet technologies of the Rostamian in addition to the lack of evidence for a large gap between these two occupation phases signals a replacement of one group by the other. New discoveries of hominin remains are needed to determine whether or not this technological shift was accompanied by a shift in hominin taxa.

**References:**[1] Conard, N.J., Ghasidian, E., 2011. The Rostamian cultural group and the taxonomy of the Iranian Upper Palaeolithic, in: Conard, N.J., Drechsler, P., Morales, A. (Eds.), Between sand and sea, the archaeology and human ecology of South-western Asia. Kerns Verlag, Tübingen, pp. 33-52.[2] Conard, N.J., Ghasidian, E., Heydari-Guran, S., 2013. The Paleolithic of Iran, in: Potts, D.T. (Ed.), The Oxford handbook of ancient Iran. Oxford University Press, Oxford, pp. 29-48.[3] Heydari-Guran, S., Ghasidian, E., Conard, N.J., 2015. Middle Paleolithic Settlement on the Iranian Central Plateau, in: Conard, N.J., Delagnes, A. (Eds.), Settlement Dynamics of the Middle Paleolithic and Middle Stone Age. Kerns Verlag, Tübingen, pp. 171-204.

Podium Presentation: Session 7, Fr (16:40)

## The Almonda karst system (Torres Novas, Portugal): a window into half a million years of long-term change in climate, settlement, subsistence, technology and culture

**João Zilhão[1,2,3], Diego E. Angelucci[4], Joan Daura[5], Marianne Deschamps[3,6], Dirk L. Hoffmann[7], Henrique Matias[5], Mariana Nabais[8], Montserrat Sanz[5]**

1 - Department of History and Archaeology, University of Barcelona, Spain · 2 - ICREA (Catalan Institution for Research and Advanced Studies), Barcelona, Spain · 3 - UNIARQ - Centro de Arqueologia da Universidade de Lisboa, Portugal · 4 - Università degli Studi di Trento, Italy · 5 - University of Lisbon, Portugal · 6 - UMR 5608-TRACES, Université Toulouse 2, France · 7 - Max Planck Institute for Evolutionary Anthropology, Germany · 8 - University College London, UK

The spring of the Almonda river, a tributary of the Tagus, is a karst outlet of the Central Limestone Massif of Portuguese Estremadura. The latter's boundary with the Tagus basin is tectonically active and eventually formed a >40 km-long escarpment that, at Almonda, is ca.70 m-high. Here, collapsed entrances connected to a "Swiss-cheese" network of underground passages document the successive stages of the spring's downward migration. These ancient outlets were identified through geophysics-aided speleoarcheological exploration of the system, and some have been excavated. Speleothems formed in the interior passages through the Pleistocene; human adaptation to climate change can thus studied based on immediate proxies and in a region that was extremely sensitive to the movements of the polar front along Iberia's Atlantic façade. The ecotonal position and geological setting at the crossroads between homogeneous domains of Paleozoic, Mesozoic and Cenozoic age allow ceteris paribus assessment of change over time in raw-material procurement, subsistence and mobility.

So far, the excavated and dated loci relate to: three moments of the Lower Paleolithic (Entrada Superior, Entrada do Vale da Serra, Gruta da Aroeira), the entire Middle Paleolithic (Gruta da Oliveira), the Solutrean and the Magdalenian (Galeria da Cisterna and Lapa dos Coelhos), later Prehistory (Galeria da Cisterna), and a Pleistocene hyena den (Gruta do Pinheiro). Here, we provide an overview of 30 years of research, and illustrate the potential of the system to address long-term change by reference to two much-debated issues of paleoanthropological significance it sheds light on: the use of fire in the Lower and Middle Paleolithic, and the exploitation of small prey.

Burnt bone is found in association with anthropogenic faunal assemblages in the basal deposit of Aroeira, ca. 400 ka, and is ubiquitous through the 70,000 years covered by the Middle Paleolithic sequence of Oliveira; in the latter, hearths were found at the base of layer 14, dated to MIS-4, and in layer 21, stratigraphically constrained to MIS-5. The layer 21 feature has a diameter of ca.1.5 m, was excavated into the underlying sediment along half of its periphery, and contained large amounts of burnt bone. In layer 22 below, the trench marginally cut through two features of similar size that extend outward to an unexcavated area of the site but are well apparent in cross-section. A nearly complete Levallois reduction sequence could be refitted from the flints scattered around the layer 21 hearth, corroborating the integrity of the context. The layer 14 hearth was smaller and lit on a bare ground but likewise associated with a scatter of burnt bone and refitting stone tools. In France, stratigraphic variation in the presence/absence of burnt bone and fire features has been used to argue that Neandertals did not master fire production, but in Oliveira such variation relates to changes in human use of the space relative to (a) changes in the morphology of the cave occurring through sediment accumulation and (b) the position of excavation trenches relative to the area of the site mainly occupied by humans at any given time.

Plains animals, namely horse, aurochs, rhino and red deer, form the bulk of hunted game through the entire Paleolithic. Rabbit, birds and tortoise are present through both the Aroeira and the Oliveira sequences, but so far only the tortoise remains from Oliveira show evidence of having been collected and processed by humans. River fish are found in significant amounts in the Late Magdalenian of Lapa dos Coelhos. Combined with patterns of raw-material procurement and isotope-derived data on the mobility of individuals, the evidence suggests that forager-type hunter-gatherer economies obtained in the area from the Acheulian onwards. It is not until the very end of the Pleistocene that increased territoriality and attendant dependence on small prey is documented.

Acknowledgements: Over the years, the principal sources of support for the archaeological investigation of the Almonda karst system have been Câmara Municipal de Torres Novas, Instituto Português de Arqueologia and Fundação para a Ciência e Tecnologia.