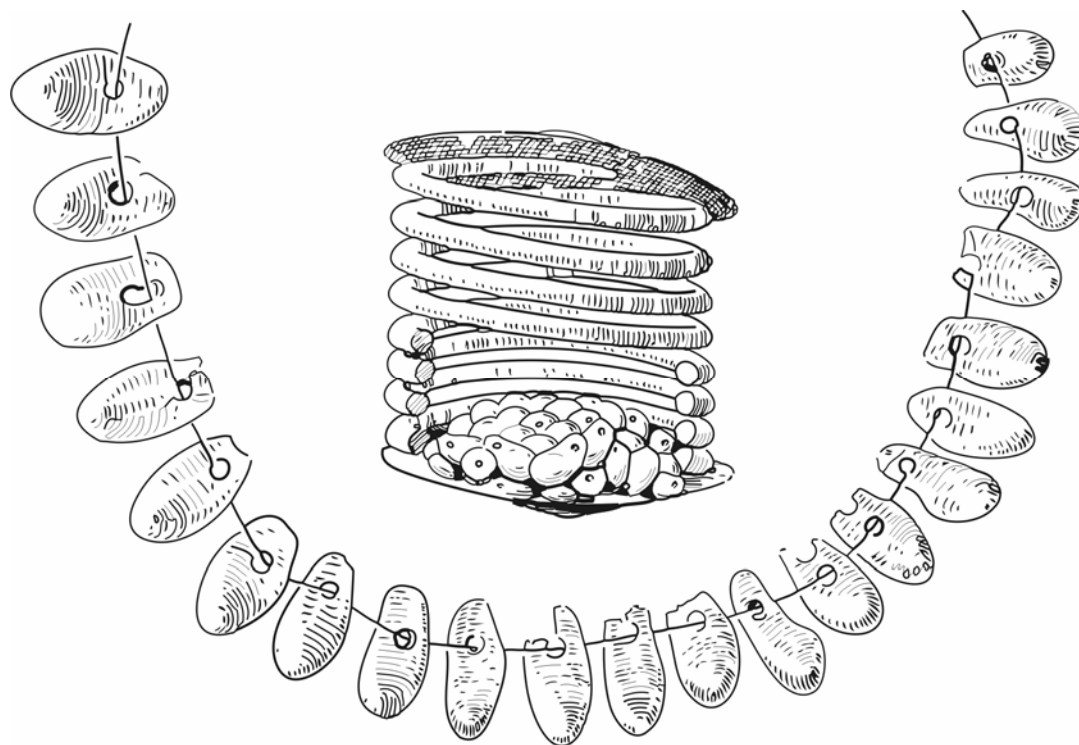


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SUMAR

Douglass W. BAILEY An interview with Kostas Kotsakis	7
Vincent OLIVIER, Paul ROIRON, Adrian BĂLĂȘESCU, Samuel NAHAPETYAN, Yvan GABRIELIAN, Jean-Louis GUENDON Milieux, processus, faciès et dynamiques morphosédimentaires des formations travertineuses quaternaires en relation avec les changements climatiques et les occupations humaines entre Méditerranée et Caucase.....	15
Gabriel POPESCU Estimating the size of lithic artifact assemblages. A view from the Southern Carpathians Middle Paleolithic.....	37
Adina BORONEANȚ, Vasile BORONEANȚ, Nicolae MIRIȚOIU, Andrei D. SOFICARU The Icoana burials revisited	51
Richard I. MACPHAIL, Constantin HAITĂ, Douglass W. BAILEY, Radian ANDREESCU, Pavel MIREA The soil micromorphology of enigmatic Early Neolithic pit-features at Măgura, southern Romania.....	61
Cristian Eduard ȘTEFAN Some observations on the Vidra axes. The social significance of copper in the Chalcolithic	79
Corneliu BELDIMAN, Diana-Maria SZTANCS Matière, artefact, symbole. Dents percées et imitations en os dans les dépôts d'objets de prestige de la culture Cucuteni	89
Alexandra ION Oseminte umane descoperite în așezări din arealul culturii Gumelnița	109
Cătălin LAZĂR, Radian ANDREESCU, Teodor IGNAT, Mihai FLOREA, Ciprian ASTALOȘ The Eneolithic Cemetery from Sultana- <i>Malu Roșu</i> (Călărași county, Romania)	131
Alexandra ION, Andrei D. SOFICARU Paleopathological conditions in an Eneolithic community from Sultana - <i>Malu Roșu</i>	153
Nona PALINCAȘ Public patriarchy in contemporary Romanian archaeology and the image of women in the Romanian Neolithic and Bronze Age.....	159
Ciprian F. ARDELEAN Before the End of the World: archaeological investigations about Maya Terminal Classic processes on the Middle Candelaria River, Campeche, Mexico.....	171

PREZENTĂRI DE CARTE

- Umberto Albarella, Keith Dobney, Anton Ervynck and Peter Rowley-Conwy Eds., *Pigs and Humans. 10,000 years of interaction*, Oxford University Press. Hdb., 2007, ISBN 978-0-19-920704-6, 488 pages (Adrian BĂLĂȘESCU)..... 207
- Douglass W. Bailey, *Prehistoric figurines. Representation and corporeality in the Neolithic*, 243 pages, 64 figures, 5 front photographs, London and New York, 2005, Routledge, ISBN 0-415-33152-8, Paperback, 44.95 USD (Alexandru DRAGOMAN)..... 209
- Paul Goldberg and Richard I. Macphail (cu contribuții de Wendy Matthews), *Practical and Theoretical Geoarchaeology*, Blackwell Publishing, 2006, 455 pages. (Constantin HAITĂ) 211
- Mark Pollard, Catherine Batt, Benjamin Stern, Suzanne M. M. Young, *Analytical Chemistry in Archaeology*, Cambridge University Press, New York, 2007, ISBN-13 978-0-521-65209-4, 404 pagini, Index (Marinela FLOREA) 212
- ABREVIERI 215

The soil micromorphology of enigmatic Early Neolithic pit-features at Măgura, southern Romania

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Abstract: *The site of Măgura-Buduiasca on the left bank of the River Teleorman in southern Romania is composed of pit complexes dating to the Early and Middle Neolithic Period (Starčevo-Criș, Dudești and Vădastra cultures, the 6th millennium BC). An integrated archaeological and palaeo-environmental study was carried out. Local soils are Mollisols formed in middle-upper Pleistocene loess that is present over similarly dated freshwater marls. A detailed soil micromorphology investigation of twenty-six thin sections (including microprobe analysis) was carried out in order to attempt to understand these pit complexes in terms of their exact origins, function and abandonment history. The combined study found that pits were dug through the loess into the underlying marl, and that fire was employed as a landscape management tool. Human activities included the processing of monocotyledonous plants, including probable wetland plants, the ashed waste of which became part of the pit fills; burned daub, unburned daub, melted phytoliths, aggregates of possible burned dung origin, bone, coprolites and strongly burned soil, all became incorporated into the fills. Pits were re-excavated and back-filled, rather than simply becoming mixed by biological processes, which implies re-visiting and re-use of the pit-complexes. The exact original function and suggested re-use of these pit complexes (pit houses, quarry/storage pits) remains enigmatic, however.*

Rezumat: *Situl Măgura-Buduiasca, situat pe malul stâng al râului Teleorman, în sudul României, este constituit din complexe de tipul unor gropi ce datează din perioada neoliticului timpuriu și mijlociu (culturile Starčevo-Criș, Dudești și Vădastra, mileniul VI BC). Un studiu integrat, arheologic și de paleomediu, a fost pus în practică. Solurile din zonă sunt din clasa Molisolurilor formate pe loessurile Pleistocen mediu-superior ce suprapun marnele de apă dulce aparținând aceleiași perioade geologice. Douăzeci și șase de secțiuni subțiri au fost analizate printr-un studiu micromorfologic de detaliu (incluzând analize chimice pe microprobe), în scopul înțelegerii acestor complexe în termenii originii exacte, a funcției și modului lor de abandon. Studiul complex a relevat faptul că aceste gropi au fost săpate traversând loessul, în marnele din bază, ca și faptul că focul a fost utilizat ca un instrument de gestiune a mediului înconjurător. Activitățile umane includ procesarea plantelor monocotiledonate, ce includ probabil plante caracteristice zonelor umede, reziduurile de cenușă ale acestora devenind parte componentă a umpluturii gropilor analizate; chirpici ars și nears, fitolite topite, agregate ce-și au originea, probabil, în bălegar ars, oase, coprolite și fragmente de sol puternic arse, toate acestea au fost integrate în umplutură. Gropile analizate au fost mai degrabă re-excavate și umplute din nou, decât să fi fost amestecate prin procesele biologice, ceea ce implică re-vizitarea și reutilizarea acestor complexe. Funcția originală exactă și reutilizarea acestor complexe - gropi ce a fost sugerată (locuințe adâncite, gropi de extracție sau de stocaj) rămâne enigmatică, totuși.*

Keywords: *Early and Middle Neolithic, pit structures, soil micromorphology.*

Cuvinte cheie: *neolitic timpuriu și mijlociu, gropi, micromorfologia solului.*

Introduction and archaeological questions

A series of excavations and geoarchaeological studies carried out within the Southern Romanian Archaeological Project (R. Andreescu, D. Bailey 2004; 2005; D. Bailey *et alii* 2004) identified early Neolithic (6000-5000 cal BC) pit-huts at the site of Măgura, which were poorly understood in terms of their exact origins, function and abandonment history.

A British Academy small grant was received by Professor Douglass Bailey (HISAR, Cardiff University), for a soil micromorphology investigation designed to address these crucial research questions.

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The grant was designed to fund thin section sample processing and the costs of a joint soil micromorphology study by R.I. Macphail (Institute of Archaeology, University College London, UK) and C. Haită (National Centre for Pluridisciplinary Researches, Romanian History National Museum, București, Romania).

Environmental background

The site Măgura *Buduiasca* is located just south of Măgura village some 10 km NE of Alexandria (fig. 1, 2), in the 'field of Burnas', the zone of the Romanian plain situated in the South of the country. The Romanian plain has a flat tabular relief, being fragmented by tributaries of the River Danube. This geomorphological unit is covered entirely by loess deposits of different ages, thickness and composition and has a mean altitude of 64 m.

The site is located on the west side of the 'field of Burnas', descending slightly to the Teleorman river valley. The valley is approximately 3 km wide in this area, near the confluence with the Clănița valley. Nowadays, the channel is slightly sinuous and modern swamp with wetland vegetation occurs in the area.

The loess deposits of Burnas, which are middle-upper Pleistocene (qp₂₋₃) consist of reddish yellowish clay and sandy fine silts, and include carbonate concretions. It overlies the marly complex formed in this area of marls, clays and sands, corresponding to the beginning of the middle Pleistocene (qp₂¹). This complex contains a fresh water fauna with *Corbicula fluvialis*, *Valvata piscinalis*, *Planorbis ombilicatus* and *Viviparus diluvianus* (T. Bandrabur *et alii* 1967, p. 18-19). The Burnas loess cover sits on the marly alluvial-lake deposits of the Frătești Beds (P. Coteș 1973, p. 371).

The climate of the area is characterized by the most elevated values of total and annual mean insolation for the whole country and the difference between the warm and the cold season is the most accentuated at 22-26 °C; there are between 30 and 50 days with a 'tropical climate', with temperatures frequently exceeding 30 °C.

The vegetation is characteristic for the steppe and silvo-steppe zone. The soils are represented by Mollisols described as Chernozems, with both cambic and argillic Chernozems occurring (Gh. Blaga *et alii* 1996).

Archaeological background

The site from Măgura-*Buduiasca* is spread over 27 ha on the left bank of the Teleorman River. The importance of the site is related to the existence of several habitations belonging to the Early and Middle Neolithic Period (Starčevo-Criș, Dudești and Vădastra cultures, the 6th millennium BC). The site is covered by crops, so the research had to be undertaken at several locations, depending on the kindness of their land owners. A 10x10 m sondage (S 10) was opened in 2003 in the Southern side, where 9 Neolithic complexes had been found.

The C 13 complex (fig. 5) is oval in shape, with the dimensions of 3.80x2.70 m and 1 m maximum depth. Archaeological material was composed of numerous sherds, a fragment of an anthropomorphic statuette, two zoomorphic statuettes fragments, together with flint, obsidian and bone tools. Burnt building material and numerous animal bones were also found. The complex was probably a pit house, abandoned and reused as a refuse pit Starčevo-Criș culture (R. Andreescu, D. Bailey 2004, p. 185).

The C 18 complex (fig. 6) is also oval in shape, with diameters of 2.80 and 2.50 m and 0.6 m depth. Sherds, animal bones, burnt building material, an anthropomorphic statuette fragment, flint and bone tools, and a pendant made of boar defences have been discovered. The complex probably was an abandoned pit house Starčevo-Criș culture (R. Andreescu, D. Bailey 2004, p.186).

A 12x12 surface was opened in 2004 on the North side of sondage S 10, and divided in 4 sondages (fig. 3) of 6x6 m (S 19-22). There are 18 complexes here (fig. 4), 15 of which belong to the Neolithic Age.

The C 22 complex (fig. 7) was identified in the area of S 20 sondage, at 0.90 m depth, and it was also visible in its Northern profile. It has the shape of a circular pit with 2 m diameter and a depth of 1 m. Artefacts include sherds, animal bones, building material and hearth remains, flint, bone and stone tools of the Vădastra culture (R. Andreescu, D. Bailey 2005, p. 225).

The C 35 complex (fig. 8) was found in the Eastern half of sondage 22 at 1.10 m depth. It has an oval shape, with the dimensions of 2.40 x 1.60 m and maximum depth of 0.5 m, and in the north-western area many hearth fragments were concentrated. Archaeological material is composed of sherds belonging to the Starčevo-Criş culture (R. Andreescu, D. Bailey 2005, p. 226).

The complexes were interpreted as storage pits or pit houses that were abandoned and later transformed into refuse pits. They contain: a mix of sherds, but not entire pots; bones; debris from different tools, including fragments; building material fragments; and sometimes, non-*in situ* hearth remains (R. Andreescu, D. Bailey 2005, p. 227).

Research programme and methods

During the summer of 2007, twenty-six resin impregnated soil monoliths (from pit-hut complexes C 13, C 18, C 22 and C 35) were received at UCL from Mr. Haită. These underwent subsampling and additional curing before being sent for thin section manufacture at Spectrum Petrographics, Washington State, USA. Thin sections were systematically described and counted employing standard soil micromorphology descriptive methods and protocols specially designed for archaeological investigations (P. Bullock *et alii* 1985; M-A. Courty *et alii* 1989; P. Goldberg, R. Macphail 2006; G. Stoops 2003). Thin sections were scanned on a flat bed scanner (figs. 11-12) and analysed employing a petrological microscope using plane polarised light (PPL), crossed polarised light (XPL), oblique incident light (OIL) and fluorescent microscopy (blue light - BL), at magnifications ranging from x1 to x200/400. Thin sections were described, ascribed soil microfabric types (SMTs) and microfacies types (MFTs). Natural and anthropogenic inclusions were similarly described. The study was complemented by detailed microprobe analyses employing sample M03-47 from 5200 cal BC Complex 22. This investigation comprised mapping elements (Si, Al, Ca, P, Fe, Mn, Na and K) across the thin section as a whole and from one detailed area, and the quantitative analysis ($n=30$ max) of these elements from five identified soil microfabric types (SMTs) and anthropogenic materials (see figs. 13-14), in order to more accurately characterise and identify these. This investigation found many characteristics in common with the Early Neolithic site of Ecsegfalva, Hungary in terms of the natural loessic parent materials, daub manufacture and the character of burned daub and anthropogenic deposits (Â. Carneiro, I. Mateiciucová 2007, p. 255-288; J. Crowther 2007, 227-254; R. Macphail 2007, p. 189-226; A. Whittle 2007).

This study commenced during October 2007, and continued into 2008. For two weeks during November 2007 (5th-16th November) C. Haită and R.I. Macphail worked jointly on these thin sections, and were able to discuss the formation processes associated with these complexes and their geoarchaeological background (R. Andreescu, D. Bailey 2004; 2005; D. Bailey *et alii* 2004).

Results

Soil structure, matrix materials (SMTs), natural and anthropogenic inclusions, and pedofeatures were described and counted; examples were recorded in photomicrographs (figs. 15-22). In all 31 (26 thin sections and 5 microprobe analyses) characteristics and inclusions were counted, and 12 SMTs were described during this analysis of the thin section suite. Examples of c. 40 microprobe element maps and c. 100 photomicrographs are given in figs. 13-14 and figs. 15-22, respectively.

Major results include:

- The identification of natural included coarse marl (with trace amounts of tufa) and loess (D. Bailey *et alii* 2004; T. Bandrabur *et alii* 1967). Marl occurs as raw coarse fragments (fig. 11) and as biologically mixed soil (figs. 12-13, 15). The loessic (micaceous) brown earth soil material includes fragments of Bw and Ah horizons, the latter sometimes as 1) burned and 2) fine charcoal-rich variants.
- The coarse anthropogenic materials include much daub and burned daub (figs. 11, 16) manufactured mainly from loessic subsoil material. Also present are aggregates of ash (fig. 12) and small amounts of coarse charcoal, pot, bone/coprolites (and burned variants of these), strongly burned soil (e.g., melted vesicular quartz), ashed plant residues (melted and vesicular phytolith remains) and fused aggregates containing phytoliths and ash/calcium oxalate/faecal spherulites (possible burned dung residues) (see R. Macphail 2007, p. 189-226).

- Fine anthropogenic materials are present as soil microfabric types (SMTs), a chief example being SMT 2b, which is rich in monocotyledonous charred plant remains and charcoal and is often associated with concentrations of phytoliths and articulated phytoliths (figs. 13, 19-21) presumed to be relict of plant processing; this material appears to include probable wetland plants.
- Microstructure, deposit heterogeneity and the very abundant quantity of aggregates, burrows and excrements of invertebrate mesofauna (see figs. 11-14), all indicate very marked mixing of different fill-types. The lowermost fills at and near the junction with the marl substrate is the most heterogeneous, with deposits becoming more homogenised by weathering processes and biological activity, upwards.
- No *in situ* features of burning (hearths, combustion zones) or occupation surface deposits were identified.
- Inwash of amorphous yellow 'cess' that embeds phytoliths and parasite eggs, and which has a Ca-P chemistry probably results from the disposal of faecal material (figs 14, 17-18); this affected fills that had already become mixed.
- Weathering effects in the form of secondary calcium carbonate and probable calcium phosphate (that is autofluorescent under blue light) features, mainly formed by the leaching of overlying deposits.
- The presence of relatively high amounts of sodium (Na) mainly within marly soil (mean 1.35% Na) and as concentrations (max 10.5% Na) in aluminium-silicates (Al-Si-Na), was unsuspected, but probably is due either to natural marl formation in the area and/or the influence of recent soil amelioration associated with cultivation.

Discussion

The early Neolithic site of Măgura occurs in an area of loess soils that overlie marl (a calcareous sediment that includes silt-size quartz), on the edge of high ground overlooking the floodplain of the River Teleorman (D. Bailey *et alii* 2004). The 2-3 m deep pit Complexes are cut into the marl. Soil micromorphology and complementary microprobe analyses were employed to help understand the origins/function and abandonment history of four Complexes.

A preliminary understanding of the fills suggests:

1. Excavation of the features into the marl geological substrate, with local occupation producing burned humic loessic topsoils, presumably associated with combustion zones (cf. Neolithic Windmill Hill, Wiltshire, R. Macphail 1999, p. 121-126); the presence of loessic topsoils that include very abundant fine charcoal testify to the development of landscapes managed by fire (A. Gebhardt 1993).

2. Basal fills tend to be dominated by marl, as coarse raw inclusions, as biologically worked soil and as weathered and burned variants. Fine and coarse aggregates of anthropogenic soil containing various concentrations of charred monocotyledonous plant remains, ash and phytoliths also occur alongside coarse anthropogenic inclusions (figs. 19-21). In addition to food waste and faecal matter (bone, burned bone, leached and iron-stained bone - some of which is coprolitic in origin), daub is a major component. The latter, includes daub and burned daub, and raw materials used in its manufacture, such as loess and rare examples of clay. Daub is commonly plant tempered (as are some pottery fragments); plant tempered daub has been investigated from early Neolithic Ecsefalva, Hungary (Â. Carneiro, I. Mateiciucová 2007, p. 255-288). Other burned materials include 'fused' phytoliths and ash aggregates that may have a possible burned dung origin (cf. Mediterranean caves and Neolithic stabling; (G. Boschian, E. Montagnari-Kokelji 2000; R. Macphail *et alii* 1997)), melted and vesicular phytoliths residues, and melted and vesicular quartz-rich soil - the last requiring a temperature of 1000-1200 °C (M-A. Courty *et alii* 1989, p. 110; F. Berna *et alii* 2007). The basal deposits do not contain any laminated sediments that would be indicative of primary silting, hence these dug features could not have been open to the elements for any long period of time.

3. Upwards in the fills, marly soil is less common, and microfibrils rich in fine monocotyledonous plant remains, ash, phytoliths become more dominant, indicating that plant processing and dumping of its associated ashed waste is a major activity. At some other early Neolithic sites, such as Ecsefalva, charred plant processing waste includes cereal processing residues. It is not clear what the chief plants being processed/burned at Măgura are, but included soil and phytoliths broadly indicate the

use/importation of wetland plants; macrobotanical, pollen, phytolith studies may be able to resolve this question.

Occupation at the site also led to the occurrence of calcium phosphate-rich faecal waste (cess) washing into the fills and this included phytoliths and an example of a *Trichuris* nematode egg (figs. 14, 17-18). Similar cess-like features were found in pits at Ecsefalva and early Neolithic Huizui, China (R. Macphail, J. Crowther 2007). Disposal and weathering of ash, along with bone and coprolitic material at Ecsefalva, led to phosphate concentrations measured in bulk samples (J. Crowther 2007, p. 227-254); here burned materials including burned daub enhanced magnetic susceptibility values.

4. The heterogeneity, microstructural characteristics, amount of aggregates of different character, overall fine fragmentation and occurrence of coarse fragments of raw marl especially in the lower fills, cannot be simply explained by bio-working. Such mixing of 'contexts' was not apparent in a major pit studied in detail at Ecsefalva, and which had similar ashy fills. It therefore seems likely that the features and their fills were re-excavated, and back-filled. In addition, the inclusion of weathered anthropogenic fill microfabrics (e.g., SMT 4a) mixed with comparably unweathered fill material (SMTs 2a-2c) is an anomaly which could also require a similar explanation.

The re-digging of these features would account for their enigmatic morphology, but implies that these sites were returned to and re-used.

5. Speculatively, these features are:

- *Storage pits*, into which occupation refuse was dumped, and that on return to these locations, these pits were re-dug, emptied and re-used.
- *Quarry pits* excavated through the loess soil into the marl, possibly to gain marl for some ritual (body 'painting?') or industrial purpose (for the manufacture of lime elsewhere; e.g., Y. Garfinkel 1987). (There is no evidence that these were wells).
- *Pit houses*, used after occupation for refuse disposal and site cleaning, and when returned to, re-dug and re-constructed.

In the last case, there is no *in situ* evidence of hearths, occupation or trampled floor deposit development as found in known pit houses (P. Goldberg 2000) or as obvious fragmented inclusions (T. Gé *et alii.* 1993). Occupation material can filter down below suspended floors in typical *grubenhäuser*, where in the 'air space' biologically worked microfabrics can develop (R. Macphail *et alii.* 2006); this still does not fully account for deposit heterogeneity found at Măgura, however. Nevertheless, abandoned *grubenhäuser* are commonly utilised as convenient repositories of cess. Such evidence of domestic occupation activity would have been part and parcel of site occupation. At present, other activities such as the exploitation of wetland for wild plants (as well as for hunting wild animals and grazing of domesticated stock), obviously require further investigation, but as yet there is no one clear explanation for the 'pit house' or 'pit' Complexes at Măgura.

Conclusions

The analysis of 26 thin sections using soil micromorphology, and microprobe studies of 5 different natural and anthropogenic materials, has produced the following preliminary findings and speculations.

1. Pits were dug through the loess soil cover into the underlying marl.
2. Local occupation produced combustion zones where both loess topsoil and marl became burned; fine charcoal-rich loessic topsoils were developed in the local area through the probable use of fire as a landscape management tool.
3. Human activities included the processing of monocotyledonous plants, including probable wetland plants, the ashed waste of which became part of the pit fills; burned daub, unburned daub, melted phytoliths, aggregates of possible burned dung origin, bone, coprolites and strongly burned soil, all became incorporated in the fills.
4. The above listed anthropogenic fills became mixed with marl from the geological substrate, but the overall mixing and fragmentation of the different materials suggests that the pits were re-excavated and back-filled, rather than simply becoming mixed by biological processes. This implies re-visiting and re-use of the Complexes.

5. Although the pit hut theory cannot be dismissed, the possibility that these are multiple used quarry pits/storage pits needs further examination in terms of the ritual, cultural or even industrial activity associated with the site and Early Neolithic activity of the region.
6. The enigmatic Complexes at Măgura are now much better understood in terms of their content, relationship to occupation activity and in terms of the dominant site formation processes but their exact original function and putative re-use function(s), remain unexplained.

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Fig. 1. Location of Măgura *Buduiasca* site.
Poziția sitului Măgura *Buduiasca*.



Fig. 2. Teleorman Valley. Măgura *Buduiasca* site.
Valea Teleormanului. Situl Măgura *Buduiasca*.

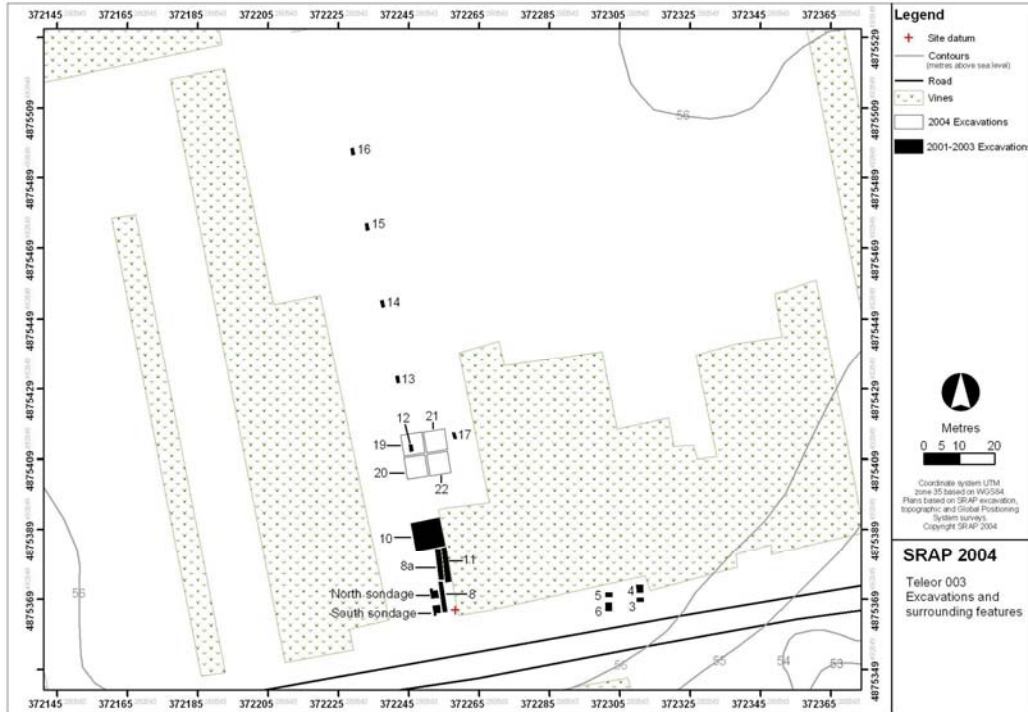


Fig.3. Măgura *Buduiasca*. General map of the sondages.
Măgura *Buduiasca*. Planul general al sondajelor.

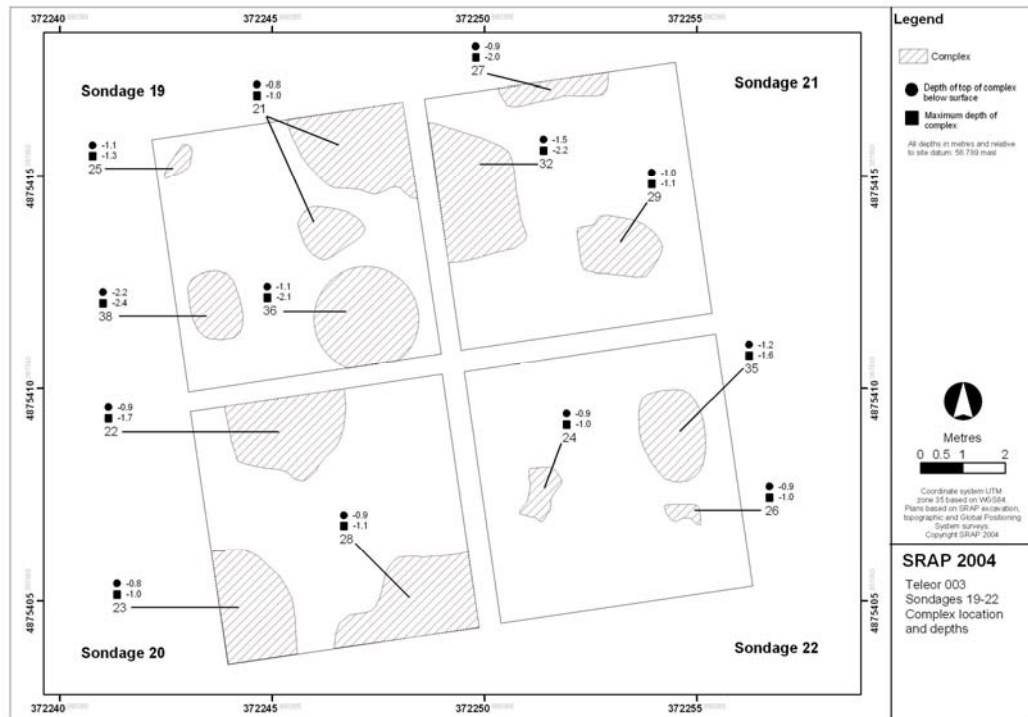


Fig. 4. Măgura *Buduiasca*. Map of the complexes from sondages S 19-22.
Măgura *Buduiasca*. Planul complexelor din sondajele S 19-22.



Fig. 5. Măgura *Buduiasca*. Complex C 13 (with the location of micromorphological samples).
Măgura *Buduiasca*. Complexul C 13 (cu poziționarea eșantioanelor micromorfologice).



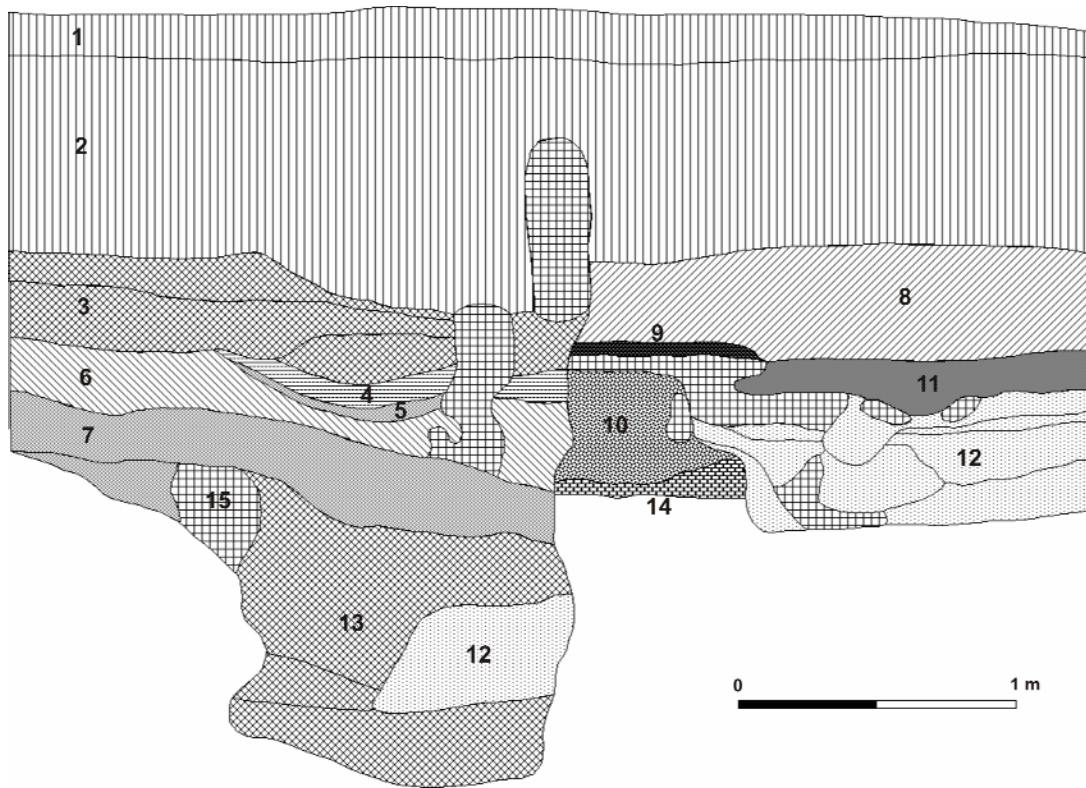
Fig. 6. Măgura *Buduiasca*. Complex C 18 (with the location of micromorphological samples).
Măgura *Buduiasca*. Complexul C 18 (cu poziționarea eșantioanelor micromorfologice).



Fig. 7. Măgura *Buduiasca*. Complex C 22.
Măgura *Buduiasca*. Complexul C 22.



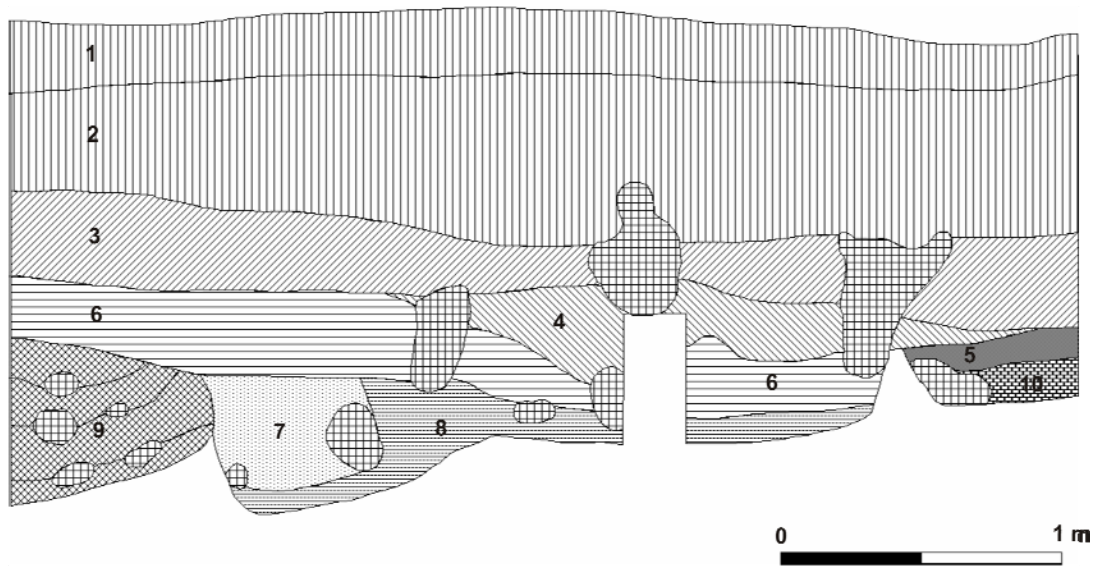
Fig. 8. Măgura *Buduiasca*. Complex C 35.
Măgura *Buduiasca*. Complexul C 35.



Legend:

1. black-gray plough soil;
2. gray soil, mixed layer;
3. gray soil, rough aspect, more or less compact;
4. black-gray soil, fine texture, compact, with ash pigments;
5. gray soil, fine texture, with burnt daub pigments;
6. brown-gray soil, medium granular structure, less compact;
7. gray soil, fine structure, more or less compact;
8. brown-yellowish, compact (ancient) soil;
9. brown-yellowish, compact (unburnt building material);
10. gray-yellowish soil, fine texture, less compact;
11. yellowish soil with sand (falling down of the sterile edges);
12. gray-yellowish soil, fine texture, compact;
13. brown soil, less compact;
14. white-yellowish virgin soil (marl horizon);
15. burrows.

Fig. 9. Măgura *Buduiasca*. The western profile of complex C 13.
Măgura *Buduiasca*. Profilul vestic al complexului C 13.



Legend:

1. black-gray plough soil;
2. gray soil, mixed layer;
3. dark-gray soil, mixed layer (pottery, bones, burnt daub);
4. light-gray soil with archaeological remains: pottery, bones, heart fragments (Iron Age level?);
5. yellowish soil with sand (falling down of the sterile edges);
6. gray soil, moderate compact;
7. dark-gray soil (pit filling);
8. gray soil, fine texture, compact;
9. gray-yellowish soil, more or less compact (pit filling);
10. white-yellowish virgin soil;
11. burrows.

Fig. 10. Măgura *Buduiasca*. The northern profile of complex C 18.
Măgura *Buduiasca*. Profilul nordic al complexului C 18.

Fig. 11. Scan of thin section M04-54 showing marked heterogeneity, in part from biological activity (B=burrow), and coarse inclusions of marl (M) from the geological substrate, and burned daub (BD). Width is ~50 mm.

Imagine scanată a secțiunii subțiri M04-54, indicând o eterogenitate ridicată, parțial datorită activității biologice (B=bioturbație), și incluziuni grosiere de marne (M) din substratul geologic și chirpici ars (BD). Lățimea imaginii ~50 mm.

Fig. 12. Scan of M03-47 showing locations of quantitative microprobe (grid) analyses: A – marly SMT (Soil Microfabric Type) 1b, B – burned daub, C – amorphous yellow 'cess' stained area, D – burned plant processing waste (charred monocotyledonous material and articulated phytoliths), and E – anthropogenic SMT 2c. A 45mm² area of the thin section including areas E and D, and Area C (in detail), were mapped for elements (See Figs 13 and 14). Width is ~50 mm.

Imagine scanată a secțiunii M03-47 ce indică locația analizelor cantitative pe microprobe: A – unitate marnoasă SMT (tip de dispunere a constituenților din sol, omogen la scara de observație) 1b, B – chirpici ars, C – zonă de impregnație amorfă galbenă (coprolitică?), D – resturi arse de procesare a plantelor (material de tip monocotiledonate și fitolite articulate) și E – facies antropogenic SMT 2c. O zonă de 45mm² a secțiunii, ce cuprinde zonele A și D și zona C (în detaliu), a fost cartată pentru conținutul în elemente (fig. 13, 14). Lățimea imaginii ~50 mm.

Fig. 13. Map of Al, Ca and Si; image analysis shows: ~20% macro voids, ~12% Si (red – quartz sand and silt) and ~16% Al-Si (pink - 'loessic clay'); areas of Ca, Al-Ca and Ca-Si are probably formed of individual and mixed marly, ashy and phytolith-rich microfabrics. Scale bar=5 mm.

Harta elementelor Al, Ca și Si; analiza de imagine indică: ~20% macro pori, ~12% Si (roșu – nisip și silt cuarțos) și ~16% Al-Si (roz – 'argilă loessică'); zonele de Ca, Al-Ca și Ca-Si sunt formate probabil din unități individuale și amestec de marne, unități cu cenușă sau bogate în fitolite. Scara=5 mm.

Fig. 14. Detail of Area C showing distribution of Ca and P; image analysis records ~72% macro voids, ~15% Ca and ~10% Ca-P (yellow – probable cess formed from calcium phosphate – autofluorescent under blue light). Note finely biologically worked burrow in centre of image. Scale bar=1 mm.

Detaliu al zonei C, indicând distribuția elementelor Ca și P; analiza de imagine indică ~72% macro pori, ~15% Ca și ~10% Ca-P (galben – probabil material coprolitic alcătuit din fosfat de calciu – autofluorescent în lumină albastră). A se observa bioturbația biologică cu structură fină din centrul imaginii. Scara=1 mm.

Fig. 15. Photomicrograph of M03-47 (Oblique Incident Light – OIL); microprobe Area A, SMT 1b. Whitish and pale brown colours indicate biologically mixed calcareous (mean 3.48% Ca) marl and loessic soil, and sand. Note SMT 1b contains mean 1.35% Na (Max 10.5% Na). Frame width is ~4.6 mm.

Fotografie la microscop a secțiunii M03-47 (lumină cu incidență oblică – OIL); zona de analiză pe microprobă A, tipul SMT 1b. Culorile albă și brun deschis indică un amestec biologic de marnă carbonatică (medie 3.48% Ca), sol loessic și nisip. A se remarca faptul că SMT 1b conține o medie de 1.35% Na (max. 10.5%). Lățimea imaginii ~4.6 mm.

Fig. 16. Photomicrograph of M03-47 (Plane Polarised Light – PPL); microprobe Area B – burned (moderately rubefied) plant-tempered daub. Darkish brown, ferruginous (mean 2.12% Fe) silt and sand-rich clay (mean 17.0% Si and 4.42% Al). Frame width is ~4.6 mm.

Fotografie la microscop a secțiunii M03-47 (lumină plan polarizată – PPL); zona de analiză pe microprobă B – chirpici cu amestec de vegetale ars (moderat rubefiat). Silt brun închis, feruginos (medie 2.12 % Fe) și argilă bogată în nisip (medie 17.0 % Si și 4.42% Al). Lățimea imaginii ~4.6 mm.

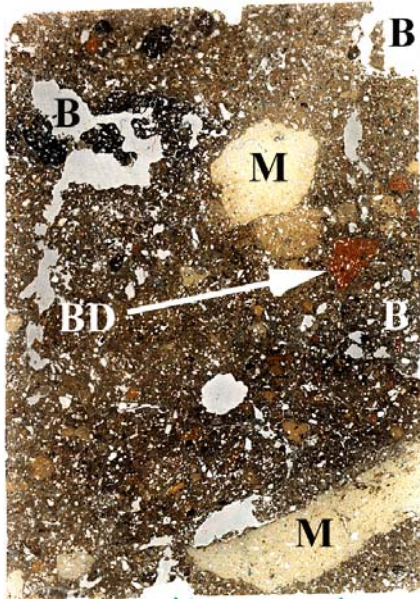


Fig. 11.



Fig. 12.

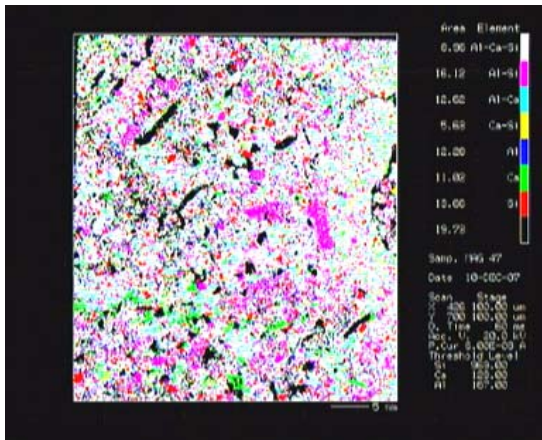


Fig. 13.

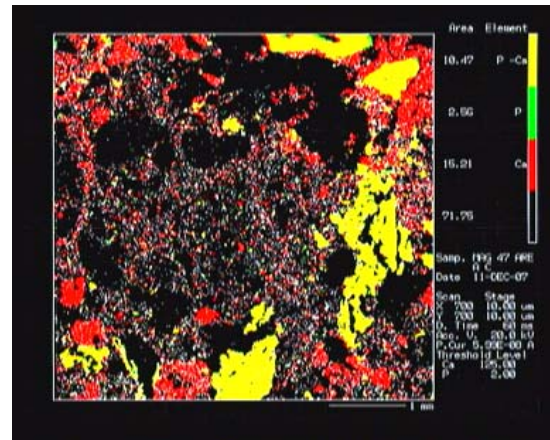


Fig. 14.

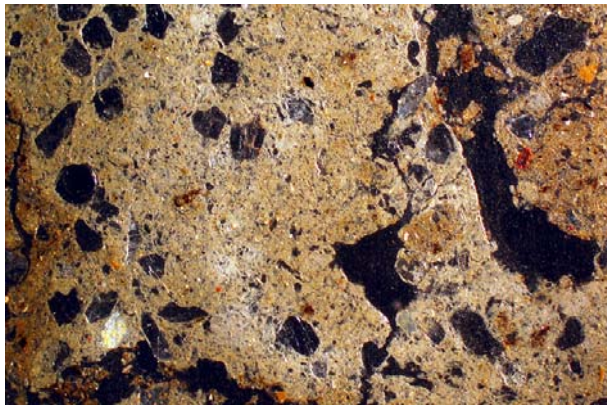


Fig. 15.

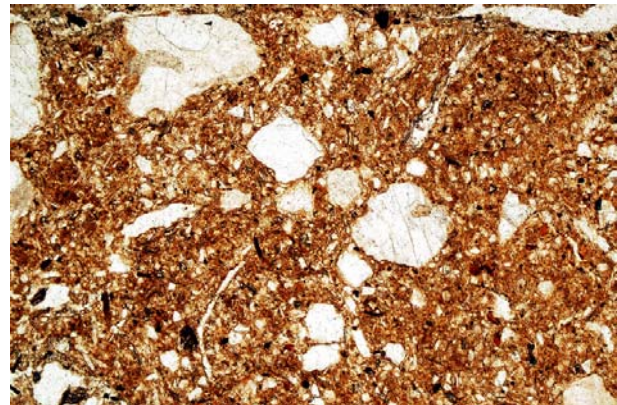


Fig. 16.

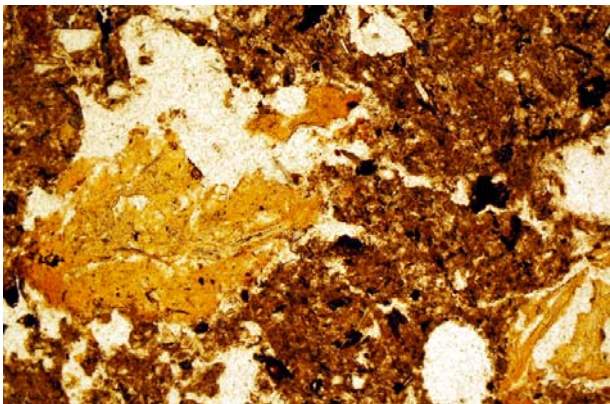


Fig. 17.

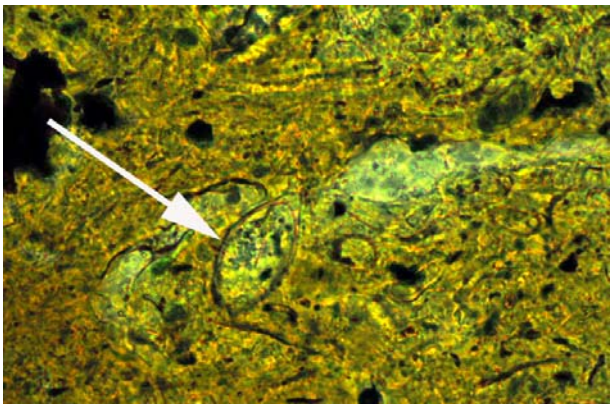


Fig. 18.

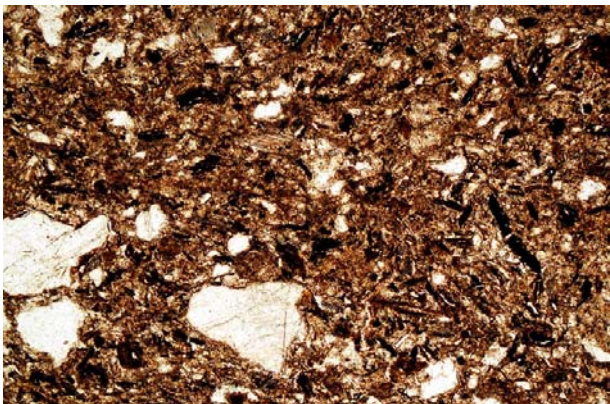


Fig. 19.

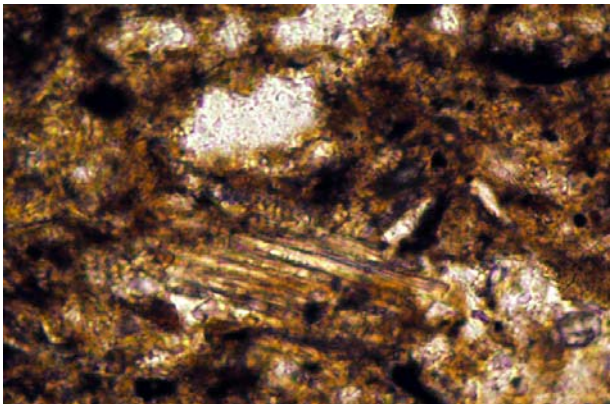


Fig. 20.

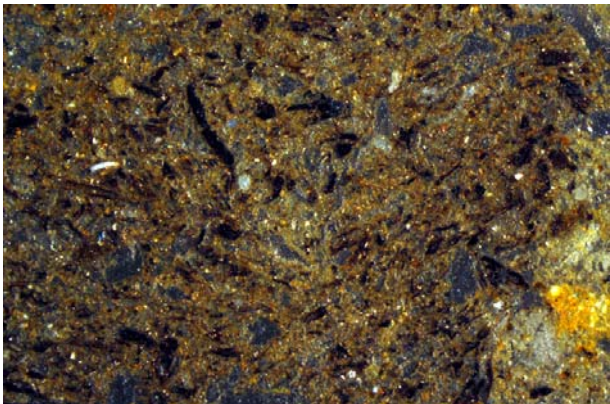


Fig. 21.

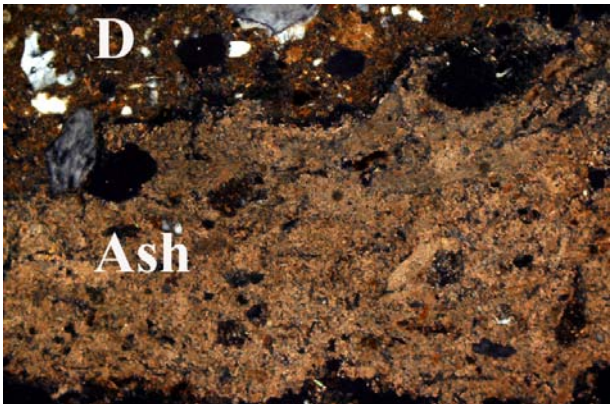


Fig. 22.

Fig. 17. Photomicrograph of M03-47 (PPL); microprobe Area C; amorphous yellow void infills with Ca-P chemistry (see Fig 4; Mean 3.47% Ca, 0.817% P; max 30.4% Ca, 9.93% P), which are anisotropic and autofluorescent under blue light, and are assumed to be cess (phytoliths from ingested cereal material? can be found as inclusions). Frame width is ~2.3 mm.

Fotografie la microscop a secțiunii M03-47 (PPL); zona analizată pe microprobă C; umpluturile amorfe gălbui ale porilor au chimism Ca-P (fig. 4; medie 3.47% Ca, 0.817% P; max. 30.4% Ca, 9.93% P), anizotrope și autofluorescente în lumină albastră, sunt atribuite unui material coprolitic (fitolite provenind din cereale (?)) ingerate sunt întâlnite ca incluziuni). Lățimea imaginii ~2.3 mm.

Fig. 18. Photomicrograph of M03-47 (Blue Light - BL); microprobe Area C; autofluorescent calcium phosphate (probable hydroxyapatite) contains embedded probable *Trichuris* nematode egg (arrow) implying that this is faecal matter. Frame width is ~0.27 mm.

Fotografie la microscop a secțiunii M03-47 (lumină albastră - BL); zona analizată pe microprobă C; fosfat de calciu autofluorescent (probabil hidroxiapatit) ce conține ouă de nematode, probabil *Trichuris* (vezi săgeată), ce indică faptul că acesta este un material fecal. Lățimea imaginii ~0.27 mm.

Fig. 19. Photomicrograph of M03-47 (PPL); microprobe Area D (SMT 2b). Note concentration of charred monocotyledonous charred plant remains and charcoal believed to be relict of plant processing. Frame width is ~2.38 mm.

Fotografie la microscop a secțiunii M03-47 (PPL); zona analizată pe microprobă D (SMT 2b). A se observa concentrarea resturilor de plante monocotiledonate descompuse și de cărbune considerate a proveni din procesarea plantelor. Lățimea imaginii ~2.38 mm.

Fig. 20. Detail of fig. 19 (SMT 2b), showing concentration of charred organic matter and articulated phytoliths (lower centre) of monocotyledonous origin. PPL, frame width is ~0.47 mm.

Detaliu al fig. 19 (SMT 2b), indicând concentrarea materiei organice descompuse și fitolite articulate (centru, jos) la origine plante monocotiledonate. PPL, lățimea imaginii ~0.47 mm.

Fig. 21. Photomicrograph of M03-43, showing exactly the same kind of monocotyledonous charcoal-rich SMT 2b as in M03-47, and again indicative of plant processing. OIL, frame width is ~2.38 mm.

Fotografie la microscop a secțiunii M03-43, indicând exact același tip de unitate SMT 2b, ca în M03-47, bogată în cărbune fin de monocotiledonate, ce indică din nou procesarea plantelor. OIL, lățimea imaginii ~2.38 mm.

Fig. 22. Photomicrograph of M03-49; a coarse fragment of unburned daub (D) embedded in calcitic ash (Ash) that includes fine burned loessic soil. Crossed Polarised Light (XPL), frame width is ~2.38 mm.

Fotografie la microscop a secțiunii M03-49; un fragment grosier de chirpici nears (D) într-o masă de cenușă calcitică (Ash) ce include un fragment fin de sol loessic ars. Lumină polarizată încrucișat (XPL), lățimea imaginii ~2.38 mm.