Rethinking architectural techniques of the Southern Caucasus in the 6th millennium BC: A re-examination of former data and new insights

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RETHINKING ARCHITECTURAL TECHNIQUES OF THE SOUTHERN CAUCASUS IN THE 6TH MILLENNIUM BC: A RE-EXAMINATION OF FORMER DATA AND NEW INSIGHTS

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Abstract. *On the basis of new data coming from recent excavations and the re-examination of former publications, a synthesis of architectural techniques in the Southern Caucasus Neolithic is proposed in this article. Using typological and technological analysis, and taking into account building materials, layout techniques and architectural morphology, an attempt has been made to define the technical characteristics of the Early Neolithic communities in this region. The evolution of architectural techniques consists of a complex and slow phenomenon where technical inertia and regional specificities were merged. Although no major technical change occurred throughout the 6th millennium BC, we nevertheless noticed the establishment of distinct construction processes that enabled the identification of well-defined "techno-cultural" groups, leading us to reconsider the model of a unique "Shulaveri-Shomu" culture. Finally, the development of the Caucasian communities' technical advancement is compared with that of the neighbouring Near Eastern ones in order to shed light on the origins of the Neolithic in the Caucasus.*

Résumé. *Sur la base de données inédites provenant de fouilles récentes et de la reprise de publications anciennes, une synthèse des techniques architecturales au Néolithique dans le Sud du Caucase est proposée dans cet article. Par une analyse typologique et technologique, tenant compte des matériaux de construction, des techniques de mise en œuvre et de la morphologie des bâtiments, on cherche à définir les caractéristiques techniques des premières communautés du Néolithique dans la région. L'évolution des techniques architecturales représente un phénomène complexe et lent où se mêlent inertie technique et particularismes régionaux. Si aucune évolution technique majeure n'est avérée durant cette période, on peut néanmoins distinguer une variété dans les procédés de construction qui invite à caractériser des ensembles « techno-culturels » bien marqués et permettent de reconsidérer le modèle d'une culture unique, celle de « Shulaveri-Shomu ». Enfin, le développement des techniques des communautés du Caucase est comparé à celui des communautés voisines du Proche-Orient afin d'apporter de nouveaux éléments quant à l'origine de la néolithisation du Caucase.*

Keywords. *Caucasus, Shulaveri-Shomu, Aratashen, Kültepe, Kamiltepe, Neolithic, earthen material, architecture, sedentary way of life*
Mots-clés. *Caucase, Shulaveri-Shomu, Aratashen, Kültepe, Kamiltepe, Néolithique, matériaux en terre, architecture, sédentarité*

The first discoveries of the 6th millennium BC Neolithic communities in the Southern Caucasus were made in the middle of the 20th century at Kültepe, Nakhichevan (Azerbaijan; see Abibullaev 1959). At this site, a complete Halaf vessel was found, thus raising for the first time the issue of the relationship between the Southern Caucasus and contemporary Mesopotamian communities.

A decade later, excavations were carried out almost simultaneously in the Middle Kura Valley, Azerbaijan, and in the Kvemo-Kartli Plain, Georgia, and a previously unknown culture, Shomu-Shulaveri, was identified (Dzhavakhishvili and Dzhaparidze 1975; Kiguradze 1986; Narimanov 1987; Kushnareva 1997). Later, excavations in the Ararat Plain (Armenia) at Aknashen-Khatunarkh yielded the archaeological

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remains of a contemporary occupation in the south of the Lesser Caucasus, which was considered as a regional variant of the Shulaveri-Shomu culture[1] (hereafter SSC; Badalyan and Harutyunyan 2014).

As a result of these discoveries, several issues on the origins of the SSC and more generally on the Neolithisation process in this region were raised, and three main hypotheses were confronted (Chataigner *et al.* 2014; Sagona 2018: 85-86):

1. Independent and local evolution. The Chokh site, on the north-east side of the Great Caucasus (fig. 1), testifies to the progressive development of domestication from the 7th millennium BC Mesolithic levels (Amirkhanov 1987)[2]. Likewise, at Darkveti (level IV, 7th millennium BC), on the eastern fringe of West Georgia, the excavators reported the discovery of domestic species (Niebieridze 1978). However, in both cases, there was no evidence of a link existing between these Mesolithic and the Neolithic communities in the Kura and Araxes Valleys;
2. Cultural interactions (mainly consisting of exchanges of traditional craftsmanship) between Syro-Mesopotamian communities (Hassuna, Samarra, Halaf) and those of the Southern Caucasus (Kiguradze 1986; Kushnareva 1997);
3. "Colonisation" by the Syro-Mesopotamian Neolithic communities (Abibullaev 1959; Narimanov 1987).

With the resumption of research since the beginning of the 2000s[3] in the Middle Kura Valley (Mentesh Tepe, Göy Tepe, Haci Elamxanlı Tepe and Kiçik Tepe), the Kvemo-Kartli Plain (Aruchlo and Gadachrili Gora), the Karabagh Plain (Ismail Tepe) and the Ararat Plain (Aratashen, Aknashen-Katunarkh and Masis Blur), the time has come to verify these hypotheses. Furthermore, the identification of contemporary sites in the Mil Plain has brought to light yet another culture, that of the Kamiltepe (Helwing and Aliyev 2012, 2017).

The model of a widely shared Neolithic culture in the South Caucasus (Chataigner *et al.* 2014: 11) is based on the almost simultaneous adoption of a sedentary way of life[4] with a farming and animal herding economy from the beginning of the 6th millennium BC. However, recent research on the architectural variability among these communities argues for the existence of at least four specific techno-cultural entities[5], each of which is located in a well circumscribed spatial area: SSC, in the Kvemo-Kartli Plain, the Middle Kura Valley and the Karabagh Plain; Aratashen culture (hereafter AC), in the Ararat Plain; Kültepe, in the Nakhichevan; and Kamiltepe, in the Mil Plain.

The purpose of this article is to precise our knowledge about architecture in the Neolithic Southern Caucasus by focusing on the architectural techniques used (*e.g.*, building materials, layout techniques and morphology of the buildings). Finally, on the basis of this data, we will try to define both the interrelationships between the Caucasian communities and their external relations with other cultures outside of this area during the Neolithic.

REGIONAL SETTINGS AND CULTURAL SEQUENCES

The Southern Caucasus is bounded on the west by the Black Sea, on the north by the Greater Caucasus mountains, on the east by the Caspian Sea, on the south-east by the Kara Dag and Talysh mountains and on the south-west by the Eastern Taurus (fig. 1).

Palynological studies show important climatic changes at the beginning of the Holocene. From 9000 to 8000 BP (*ca.* 8000-7000 BC), a warming of the climate led to the emergence of wetlands in the valleys south of the Lesser Caucasus (Araxes Valley) which could have favoured the onset of farming in the region. Geomorphological research demonstrates fluctuations of the Caspian Sea level and its impact on the formation of the alluvial terraces of the Kura River and its tributaries. These fluctuations had a "retroactive impact" (Ollivier *et al.* 2016: 80) on landscape changes and alluvial terrace organisation and influenced the choice of human settlement locations, as demonstrated by the location of most Neolithic settlements in the alluvial fans of the Kura River tributaries.

1. For convenience, we will use the term "Shulaveri-Shomu culture" (SSC), but the terms "Shomutepe" (Narimanov 1986), "Shulaveri-Shomutepe" (Kiguradze 1986) or "Aratashen-Shulaveri-Shomutepe" (Chataigner *et al.* 2014; Badalyan and Harutyunyan 2014) are also used in some publications.
2. It should be noted that the stratigraphic succession seems to be interrupted, these levels perhaps being separated by a hiatus of Neolithic levels (Lombard and Chataigner 2004: 69; Lyonnet *et al.* 2016: 181). See also Chataigner *et al.* 2014: 11.
3. See the following bibliography: Aratashen (Badalyan *et al.* 2007; Arimura *et al.* 2010), Aknashen-Katunarkh (Badalyan *et al.* 2007; Badalyan and Harutyunyan 2014), Aruchlo (Hansen *et al.* 2007; Hansen and Mirtskhulava 2012; Hansen and Ullrich 2017), Gadachrili Gora (Hamon *et al.* 2016), Göy Tepe (Guliyev and Nishiaki 2014; Nishiaki *et al.* 2015a), Haci Elamxanlı Tepe (Nishiaki *et al.* 2015b), Masis Blur (Martirosyan-Olshansky *et al.* 2013) and Mentesh Tepe (Lyonnet *et al.* 2012; Lyonnet *et al.* 2016; Lyonnet *et al.* 2017).
4. About the practice of semi-transhumance, see Nishiaki *et al.* 2018.
5. The notion of "technical group" comes from A. Leroi-Gourhan (1945: 367-368) and defines the set of technical characteristics specific to a given group. Nevertheless, for convenience and in order to avoid any confusion, we will use the notion of "culture" as it is defined in archaeology (Monge and Marquis 2008: 141).

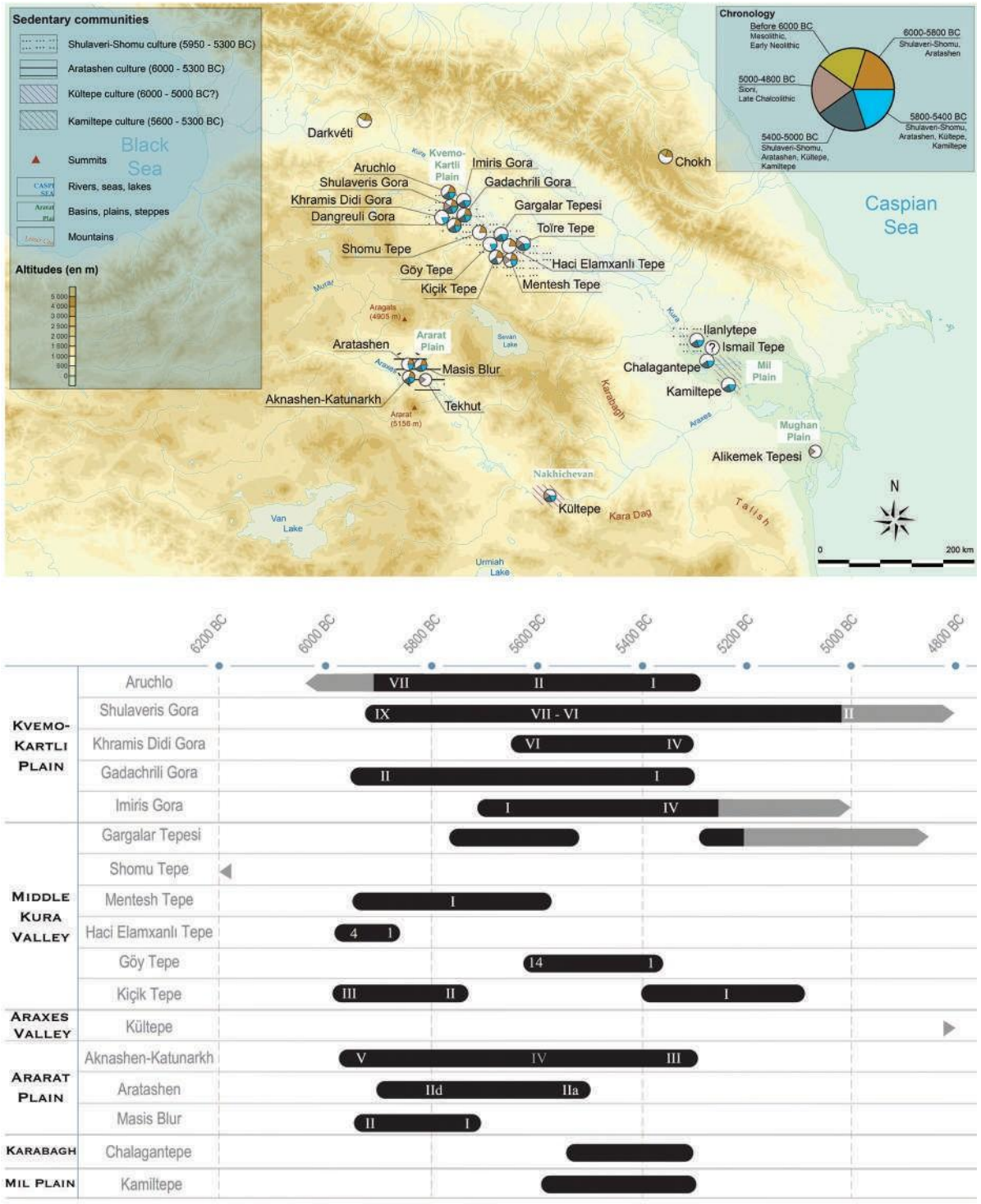


Fig. 1 – *General map of the Southern Caucasus with cultural entities, chronology and sites mentioned in the text (E. Baudouin). In grey, inconsistent chronological data.*

THE SHULAVERI-SHOMU CULTURE (SSC)

The chronological sequence of the SSC spans through almost the entire 6th millennium BC, *ca.* 6000-5300 BC. Recent excavations in the Kvemo-Kartli Plain and in the Middle Kura Valley have provided the earliest dates for this culture, at the beginning of the 6th millennium BC (table 1).
T. Kiguradze was the first to propose an internal phasing of the SSC (phases I to V) in Eastern Georgia (Kiguradze 1986). According to him, phase I ceramic material is characterised by a grey-brown coarse mineral-tempered ware with relief decoration, which is replaced in phase II by a vegetal-tempered ware with pink walls and incised decoration.

Recently, the discovery of a small number of pottery sherds, of which the painted ones are reminiscent of the Samarra or Hassuna cultures at Haci Elamxanlı Tepe (Nishiaki *et al.* 2015b: 2), and a grooved stone with a longitudinal groove at Kiçik Tepe,[6] an artefact otherwise known only in the Middle Euphrates and Zagros foothills from the 11th millennium BC, reinforces the hypothesis of close relationships with the Syro-Mesopotamian communities *ca*. 6000 BC.

Concerning the architecture, the circular plan, sometimes semi-buried, and the use of plano-convex mud-bricks are often considered to be the architectural markers of the SSC (Lombard and Chataigner 2004: 67).

THE ARATASHEN CULTURE (AC)

In the Ararat Plain, radiocarbon dates also place the beginning of the AC around 6000 BC or slightly earlier (table 1).

Again, pottery is very rare in the oldest levels (IId) at Aratashen (Badalyan *et al*. 2007: 43) and features both mineral and organic temper (Badalyan and Harutyunyan 2014: 163).

At Aknashen-Katunarkh and Aratashen, the finds of imported pottery attributed to the Samarra or Halaf horizons (Arimura *et al.* 2010: 81; Badalyan and Harutyunyan 2014: 66, 175, fig. 6, 176, fig. 7.3-4) also point to social relationships with the Syro-Mesopotamian communities. The presence of grooved stones with transversal grooves at Aratashen (Arimura *et al.* 2010: 80-81, fig. 6) confirm this view (Badalyan and Harutyunyan 2014: 164; Chataigner *et al.* 2014: 18).

In the architecture, circular or oval buildings are built with stacked mud or flat and elongated sun-dried mud-brick shaped by hand (Chataigner *et al.* 2014: 14).

THE KÜLTEPE CULTURE

Confined to Nakhichevan, the Kültepe culture has thus far only been documented at the eponymous site.[7] Kültepe, a 9 m high mound, has a long stratigraphic sequence that seems to span the entire 6th millennium BC (Abibullaev 1959).

The ceramic production is characterised by a red-buff coarse vegetal-tempered ware with few decorations (mostly applied and incised, although a few painted sherds are also known).

In addition to this local production, several elements considered as exogenous have been found in the earliest levels. This is the case of the terracotta spindle whorls and painted Late Halafian pottery typical of the Jezirah cultures from the middle/second half of the 6th millennium BC (Lombard and Chataigner 2004: 76-77).

The architecture seems to present all the characteristics of the Hassuna or Halaf cultures with, in the oldest levels, rectangular buildings built with stacked mud, which were later replaced by circular buildings with stone footings (Lombard and Chataigner 2004: 76).

THE KAMILTEPE CULTURE

Located in the Mil Plain, the Kamiltepe culture has recently been identified (Aliyev and Helwing 2009; Helwing and Aliyev 2012: 4-58). Excavations and surveys place the first stages of sedentarisation in the region *ca*. 5600 BC (table 1). Many sites of this culture have been documented as temporary occupations (Ricci *et al.* 2018).

The ceramic material, mainly chaff tempered, is decorated with painted geometrical motifs, which have little in common with the SSC (Helwing *et al.* 2017: 4, 7); however, they do present some similarities with Hajji Firuz Tepe in Northern Zagros, near Lake Urmiah (Voigt 1983).

In terms of the architectural evidence, Kamiltepe stands out due to the construction of an imposing mud-brick platform, the use of mud-bricks shaped by hand and specific layout techniques (Helwing and Aliyev 2017: 16). A nearby site, MPS 4, presents a circular buried architecture made of mud bricks similar to that of the SCC (Helwing and Aliyev 2017: 8-10).

6. Palumbi G., Guliyev F. and Celilov B. eds. (2018), *Mission "Boyuk Kesik", Azerbaïdjan : rapport 2018*. Unpublished report, Ministry of Europe and Foreign Affairs (MEAE).

7. Excavations resumed in 2012, under the direction of C. Marro, R. Berthon and V. Bakhshaliyev.

8. Bohener U. and Schyle D. (2006), Radiocarbon CONTEXT database 2002-2006 [URL: http://context-database.uni-koeln.de/].

Table 1 – *Radiocarbon dates for the Neolithic sites in Southern Caucasus (E. Baudouin).*

Site	Level	Context	nº Lab	Date BP	Cal. BC (1 s)	Cal. BC (2 s)	Bibliographical references
Aknashen-Katunarkh	V (lower level)	Trench A. UF 12	LY-13665	6920±55	5871-5734	5986-5661	Badalyan *et al.* 2010: 212, table 1
		Trench A. UF 11	AA-68561	7035±69	5991-5846	6085-5717	
		Trench A. UF 10/F5	AA-68560	6930±44	5868-5743	5984-5676	
		Trench A. UF 10	UGAMS 2292	6900±50	5837-5731	5980-5644	
	IV	Trench 5. UF 8a	UGAMS 5805	6970±25	5893-5810	5981-5740	
		Trench 1. UF 8	UGAMS 5802	6940±30	5870-5760	5975-5725	
		Trench A. UF7	AA-68559	6868±40	5800-5712	5888-5641	
		Trench 5. UF 7a	UGAMS 4081	6720±30	5662-5621	5721-5555	
		Trench 2. UF 7a F.7	UGALS 2821	6740±50	5707-5623	5766-5515	
		Trench 4. UF 7a, str. 8	UGAMS 5803	6800±30	5718-5667	5756-5624	
		Trench A. UF 8	UGAMS 2293	6550±50	5550-5476	5629-5367	
		Trench 3. UF 7b	UGAMS 4079	6640±30	5618-5556	5636-5486	
		Trench 3. UF 7b	UGAMS 4080	6590±30	5558-5490	5620-5477	
		Trench 6. UF 7a	UGAMS 4082	6560±30	5531-5482	5617-5471	
		Trench 4. UF 8b	UGAMS 5804	6600±25	5608-5513	5621-5481	
	III (upper level)	Trench I. UF 6	Poz-22745	6910±40	5837-5739	5975-5671	
		Trench 4. UF 6	Poz-22747	6790±40	5718-5659	5796-5569	
		Trench 6. UF 6b	UGAMS 2820	6690±50	5658-5560	5723-6486	
		Trench 3. UF 6a	Poz-22746	6420±40	5468-5367	5487-5299	
		Trench A. UF 6	LY-13664	6350±70	5465-5228	5511-5054	
Aratashen	IId (lower level)		AA-64176	6821±46		5791-5631	Badalyan *et al.* 2007: 40, table 1
			AA-64178	6866±49		5848-5658	
			AA-64177	6913±49		5905-5711	
	IIb		AA-64175	6948±73		5988-5713	
	IIa (upper level)		Ly-2269	6660±60		5663-5481	
			Ly-2268	6820±55		5811-5627	
Aruchlo		AR10B066-298	Hd-12879	6919±30	5836-5748	5877-5731	Hansen and Mirtskhulava 2012: 85, table 19
		AR05A108a	Bln-5854	6850±35	5759-5674	5835-5661	
		AR11U045-359/360	MAMS-14734	6844±26	5744-5676	5775-5665	
		AR11AA005-369	MAMS-14736	6814±27	5723-5673	5736-5645	
		AR11AA009-386	MAMS-14738	6800±26	5716-5669	5716-5669	
		AR11AA008-370	MAMS-14737	6788±27	5713-5663	5724-5639	
		AR11AA007-364	MAMS-14735	6784±26	5712-5661	5722-5638	
		AR07M013-181	Hd-28506	6650±28	5621-5559	5629-5530	
		AR07K044-191	Hd-28505	6591±22	5557-5491	5611-5485	
		AR06C021-151	Bln-5949	6451±40	5474-5378	5482-5341	
		AR06D013-146	Bln-5950	6369±46	5464-5306	5472-5229	
	7		TB-300	7135±70		6250-5645 6140-5860*	Kiguradze 1986: 112, table 5; Bohener and Schylde 2006* (see note 8)
	3		TB-309	6770±65		5820-5400 5780-5580*	
			TB-331	6365±140		5435-5180 5620-4980*	
	2		TB-277	6765±60		5805-5410 5770-5570*	Goridze 1979: 425; Bohener and Schylde 2006*
	1		TB-92	6525±60		5560-5280 5620-5340*	Chelidze 1979: 31; Bohener and Schylde 2006*
Chalagantepe		2.4m deep	TB-318	6507±60		5420-5215 5550-5260*	Kiguradze 1986: 112, table 5; Bohener and Schylde 2006*
Gadachrili Gora	II (lower level)	Charcoal	LTL13000A			5970-5720	Hamon *et al.* 2016: 158, fig. 4
		Seed	LTL13223A			5850-5650	
	I (upper level)	Charcoal	OS-63262			5640-5300	
		Seed	OS-63260			5860-5700	
Gargalar Tepesi		Fireplace dug into virgin soil	LE-1083	6750±60		5785-5400 5760-5560*	Narimanov 1977: 57; Bohener and Schylde 2006*
		Fireplace located 2 m upper the virgin soil	LE-1084	6125±60		5230-4945 5280-4880*	

Site	Level	Context	n° Lab	Date BP	Cal. BC (1 s)	Cal. BC (2 s)	Bibliographical references
Göy Tepe (Main Trench)	14 (lower level)	GOY13 4BIIX-129a	IAAA-132140	6700±30	5645-5565 (68.2%) 5670-5555 (95.4%)	5662-5605 (63.6%) 5596-5560 (31.8%)	Nishiaki *et al.* 2018: 122, table 1; Nishiaki *et al.* 2015a: 286, table 1
		GOY13 4BIIX-129b	IAAA-132141	6690±30	5640-5565 (68.2%) 5665-5555 (95.4%)	5659-5604 (60.4%) 5596-5560 (35.0%)	
	13	GOY12 4BIIX-124	IAAA-120686	6800±30	5720-5665 (68.2%) 5735-5640 (95.4%)	5731-5642	
	12	GOY10 4BIIX-92	IAAA-120058	6730±30	5665-5620 (68.2%) 5715-5570 (95.4%)	5714-5616 (92.4%) 5584-5571 (3.0%)	
		GOY11 4BIIX-109	IAAA-120684	6620±30	5615-5525 (68.2%) 5625-5490 (95.4%)	5621-5511	
		GOY12 4BIIX-113a	IAAA-120685	6590±30	5550-5510 (68.2%) 5560-5490 (95.4%)	5612-5590 (11.5%) 5565-5482 (83.9%)	
	11	GOY11 4BI-116	IAAA-120068	6680±30	5635-5560 (68.2%) 5660-5540 (95.4%)	5568-5546	
	10	GOY09 4BIIX-45	TKa-15171	6610±50	5615-5510 (68.2%) 5625-5480 (95.4%)	5623-5483	
		GOY11 4BI-111	IAAA-120067	6610±30	5615-5515 (68.2%) 5620-5490 (95.4%)	5617-5490	
		GOY09 4BIIX-51	TKa-15175	6580±80	5615-5475 (68.2%) 5645-5370 (95.4%)	5644-5374	
		GOY09 4BIIX-50	TKa-15172	6570±70	5615-5475 (68.2%) 5635-5375 (95.4%)	5632-5462 (87.6%) 5447-5379 (7.8%)	
		GOY09 4BIIX-53	TKa-15174	6530±80	5610-5380 (68.2%) 5625-5340 (95.4%)	5623-5343	
	9	GOY09 4BIIX-10	NUTA2-22555	6630±30	5620-5535 (68.2%) 5625-5510 (95.4%)		Nishiaki *et al.* 2018: 122, table 1
		GOY11 4BI-84	IAAA-120066	6620±30	5615-5525 (68.2%) 5625-5490 (95.4%)	5619-5508 (91.1%) 5502-5491 (4.3%)	Nishiaki *et al.* 2018: 122, table 1; Nishiaki *et al.* 2015a: 286, table 1
		AF06-no8	UBA-7616	6602±39	5615-5505 (68.2%) 5620-5485 (95.4%)	5617-5484	
		GOY09 4BIIX-5	TKa-15168	6400±50	5470-5320 (68.2%) 5480-5305 (95.4%)	5476-5306	
	8	AF06-no1	UBA-7614	6575±39	5555-5480 (68.2%) 5615-5475 (95.4%)	5615-5584 (13.5%) 5571-5476 (81.9%)	
		AF06-no4	UBA-7615	6574±41	5555-5480 (68.2%) 5620-5475 (95.4%)	5616-5584 (13.9%) 5572-5476 (81.5%)	
		GOY11 4BI-63	IAAA-120065	6560±30	5535-5480 (68.2%) 5610-5475 (95.4%)	5608-5593 (5.1%) 5562-5477 (90.3%)	
		GOY09 4BII-51	TKa-15173	6450±70	5485-5355 (68.2%) 5545-5300 (95.4%)	5543-5301	
	7	GOY09 4BII-21	TKa-15169	6520±70	5555-5380 (68.2%) 5620-5355 (95.4%)	5617-5357	
		GOY09 4BII-21	TKa-15170	6410±70	5470-5335 (68.2%) 5490-5225 (95.4%)	5490-5286 (91.0%) 5273-5226 (4.4%)	
	6	GOY11 3AII	IAAA-120063	6610±30	5615-5515 (68.2%) 5620-5490 (95.4%)	5618-5508 (90.3%) 5503-5490 (5.1%)	
	5	GOY11 4AI	IAAA-120064	6470±30	5480-5380 (68.2%) 5485-5370 (95.4%)	5483-5371	
		GOY10 4BI-17	NUTA2-22554	6418±29	5470-5365 (68.2%) 5475-5330 (95.4%)		Nishiaki *et al.* 2018: 122, table 1
	4	GOY08	TKa-14622	6575±35	5550-5480 (68.2%) 5615-5475 (95.4%)	5615-5585 (6.2%) 5570-5482 (79.2%)	Nishiaki *et al.* 2018: 122, table 1; Nishiaki *et al.* 2015a: 286, table 1
		GOY08 2B	TKa-14623	6500±35	5515-5385 (68.2%) 5530-5370 (95.4%)	5528-5374	
		GOY09 2AII	TKa-14999	6480±50	5485-5375 (68.2%) 5530-5330 (95.4%)	5528-5338	
		GOY09 2AI	TKa-15000	6480±45	5485-5375 (68.2%) 5530-5340 (95.4%)	5526-5356	
	3	GOY14 1A-3	IAAA-141122	6650±30	5625-5555 (68.2%) 5635-5525 (95.4%)	5631-5519	
		GOY14 1A-1	IAAA-141120	6565±30	5535-5480 (68.2%) 5610-5475 (95.4%)	5607-5595 (4.5%) 5562-5477 (90.9%)	
		GOY14 1A-2	IAAA-141121	6530±30	5515-5475 (68.2%) 5560-5390 (95.4%)	5558-5467 (94.7%) 5399-5392 (0.7%)	
		GOY09 1AII	TKa-14998	6460±50	5480-5375 (68.2%) 5510-5320 (95.4%)	5508-5502 (0.8%)	
	2	GOY14 1B-4	IAAA-141124	6565±30	5535-5480 (68.2%) 5610-5475 (95.4%)	5607-5595 (3.4%) 5561-5477 (91.6%)	
	1 (upper level)	GOY14 1B-3	IAAA-141123	6480±30	5485-5380 (68.2%) 5490-5370 (95.4%)	5486-5372	
		GOY14 1B-6	IAAA-141125	6385±30	5465-5315 (68.2%) 5470-5310 (95.4%)	5486-5400 (32.9%) 5391-5313 (62.5%)	

Site	Level	Context	nº Lab	Date BP	Cal. BC (1 s)	Cal. BC (2 s)	Bibliographical references
Göy Tepe (sector 97F)		GOY11 97F-13	IAAA-120061	6590±30	5560-5490 (68.2%) 5615-5480 (95.4%)		Nishiaki *et al.* 2018: 122, table 1
		GOY11 97F-hearth	IAAA-120062	6410±30	5470-5360 (68.2%) 5470-5325 (95.4%)		
		GOY11 97F-10	IAAA-120060	6530±30	5515-5475 (68.2%) 5560-5390 (95.4%)		
Göy Tepe (sector 96F)		GOY11 96F-5	IAAA-120059	6570±30	5540-5480 (68.2%) 5610-5475 (95.4%)		
Göy Tepe (sector 93A_2)		GOY11 93A-no1	IAAA-120056	6710±30	5660-5575 (68.2%) 5705-5560 (95.4%)		
		GOY11 93A-no2	IAAA-120057	6660±30	5625-5560 (68.2%) 5635-5530 (95.4%)		
		GOY12 93A1-23	IAAA-120691	6620±30	5615-5525 (68.2%) 5625-5490 (95.4%)		
		GOY12 93A1-13	IAAA-120690	6630±30	5620-5535 (68.2%) 5625-5510 (95.4%)		
Göy Tepe (sector 92A1)	Bottom layer	GOY13 92Al-18	IAAA-132143	6860±30	5775-5710 (68.2%) 5810-5665 (95.4%)		
	Middle layer	GOY13 92Al-17	IAAA-132142	6730±30	5665-5620 (68.2%) 5715-5570 (95.4%)		
	Upper layer	GOY12 92Al-11	IAAA-120687	6590±30	5560-5490 (68.2%) 5615-5480 (95.4%)		
Haci Elamxanlı Tepe	4b (lower level)	HAJ14 M11-102	IAAA-141127	6025±30		5987-5846	Nishiaki *et al.* 2015a: 287, table 2
	4a	HAJ2012 M10-96H	IAAA-120698	7080±30	6003-5974 (29.5%) 5951-5917 (38.7%)	6015-5895 (95.4%)	Nishiaki *et al.* 2013: 11, table 1
		HAJ2012 M10-96I	IAAA-120699	6950±40	5885-5783 (68.2%)	5969-5955 (2.7%) 5907-5739 (92.7%)	
	3b	HAJ14 L10-122	IAAA-141126	7015±30		5990-5837 (94.6%) 5822-5815 (0.8%)	Nishiaki *et al.* 2015a: 287, table 2
		HAJ14 L11-128	IAAA-141127	7030±30		5991-5843	
	3a	HAJ2012 M10-15	IAAA-120696	7070±30	6001-5974 (28.0%) 5952-5916 (40.2%)	6015-5893 (95.4%)	Nishiaki *et al.* 2013: 11, table 1
		HAJ2012 M10-79	IAAA-120697	7060±30	5992-5970 (20.6%) 5955-5907 (47.6%)	6012-5886 (95.4%)	
		HAJ13 L11-106	IAAA-132146	6990±30		5981-5944 (17.1%) 5926-5792 (78.3%)	Nishiaki *et al.* 2015a: 287, table 2
	2	HAJ2012 M10-48	IAAA-120694	6960±30	5890-5799 (68.2%)	5971-5954 (3.8%) 5912-5752 (91.6%)	Nishiaki *et al.* 2013: 11, table1
		HAJ2012 M10-68	IAAA-120695	6930±30	5838-5755 (68.2%)	5882-5733 (95.4%)	
		HAJ13 L11-22	IAAA-132145	7000±30		5983-5939 (23.6%) 5932-5807 (71.8%)	Nishiaki *et al.* 2015a: 287, table 2
	1 (upper level)	HAJ2012 M10-54	IAAA-120693	7000±30	5974-5951 (19.6%) 5917-5873 (36.8%) 5863-5846 (11.9%)	5985-5834 (92.6%) 5826-5810 (2.8%)	Nishiaki *et al.* 2013: 11, table 1
		HAJ13 M11-13	IAAA-132114	6890±30		5837-5723	Nishiaki *et al.* 2015a: 287, table 2
Imiris Gora	IV-I	Building 9-10	TB-19	6590±120		5635-5305 5730-4950*	Dzhavakhshvili and Dzhaparidze 1975: 127; Bohener and Schylde 2006*
		Upper level	TB-27	6300±120		5350-5085 5500-4950*	Burchuladze *et al.* 1976: 356; Bohener and Schylde 2006*
Kamiltepe		KAM09-111/57	KIA40368	6568±31		5610-5480	Aliyev and Helwing 2009: 38, fig. 21
		KAM09-307/1	KIA40371	6501±31		5580-5380	
		KAM09-220/13	KIA40369	6507±31		5570-5380	
		KAM09-223/8	KIA40370	6480±36		5570-5380	
		SU_111/57	KIA40368			5600-5460	
		SU_111/43	KIA51511			5480-5360	
		SU_137	Gif-12883			5600-5460	
		SU_220/13	KIA40369			5580-5360	
		SU_223/8	KIA40370			5520-5360	
		SU_307/31	KIA40371			5540-5380	Helwing and Aliyev 2017: 41, table 2
		SU_605/03	KIA51512			5460-5320	
		SU_606/5	KIA51508			5480-5340	
		SU_615	Gif-12884			5480-5340	
		SU_626	Gif-12885			5500-5340	
		SU_1005	Gif-12889			5500-5340	
		SU_1006	Gif-12890			5460-5340	
		SU_1008	Gif-12891			5480-5220	
		SU_519/3	KIA51510			5620-5500	
		SU_905	Gif-12887			5620-5500	
		SU704/28	KIA44738			5620-5480	
		SU704/28	KIA51509			5620-5500	
		SU_715	Gif-12886			5600-5460	

Site	Level	Context	n° Lab	Date BP	Cal. BC (2 s)	Bibliographical references
Kamiltepe		SU_1700	Gif-12893		5460-5320	Helwing and Aliyev 2017: 41, table 2
		SU_1818/2	MAMS-27328		5480-5360	
		SU_1849/9	MAMS-27327		5620-5480	
		SU_1801-22	Gif-13054		5560-5320	
Khramis Didi Gora	IV (lower level)		TB-301	6437±50	5485-5420 5510-5310*	Menabde *et al.* 1980: 34; Bohener and Schylde 2006*
	V	Close to Building 6	LJ-3270	6540±70	5580-5290 5640-5360*	Linick 1977: 30; Bohener and Schylde 2006*
	VI (upper level)		TB-322	6505±60	5545-5265 5600-5320*	Kiguradze 1986: 112, table 5; Bohener and Schylde 2006*
Kültepe		18.2 m deep	LE-477	5770±90	4745-4435 4820-4420*	lessen 1965: 12; Bohener and Schylde 2006*
		15.35 m deep	LE-434	4870±150	3870-3505 4040-3280*	Dolukhanov and Timofeev 1972: 42; Bohener and Schylde 2006*
	Late Bronze Age level	8.5 m deep	LE-163	4880±90	3860-3540 3890-3450*	Butomo 1965: 226 ; Bohener and Schylde 2006*
Masis Blur	II (lower level)	MB-2 2012.M9/1.212.2110	UCIAMS-121529	6995±20	5925-5835	Martirosyan-Olshansky *et al.* 2013: 145, table 1
	I (upper level)	MB-3 2012.M10/1.319.3085	UCIAMS-121530	6940±25	5885-5745	
		MB-1 2012.L10/4.105.1034	UCIAMS-121528	6935±25	5880-5740	
		MB-4 2012.M11/1.023.0259	UCIAMS-121531	6765±25	5715-5630	
Mentesh Tepe	I	MT 2012, ANT 02 (Str. 342)	SacA 41508/Gif-13016	7010±45	5993-5784	Lyonnet *et al.* 2017: 128, table 1
		MT 2011, ANT 12 (Str. 344, Burial 343)	SacA30643/Gif12232	6950±40	5971-5736	Lyonnet *et al.* 2016: 180, table 2
		MT 2014, ANT 04 (Str. 342)	Poz-68641	6930±40	5899-5726	Lyonnet *et al.* 2017: 128, table 1
		MT 2013, FLOT 302 (Su 588)	SacA37073/Gif-13045	6890±40	5882-5707	Lyonnet *et al.* 2016: 180, table 2
		MT 2012, FLOT 226 (Str. 536, Su 429)	SacA 31996/Gif-12992	6890±40	5882-5707	
		MT 2011, CHARB 35 (Loc. 231)	SacA 26232/Gif-12713	6875±35	5842-5676	
		MT 2012, FLOT 270 (Str. 336, Su 430)	SacA 31997/Gif-12993	6865±35	5837-5671	
		MT 2014, CHARB 25 (Su 685)	SacA 41340/Gif-13129	6835±35	5784-5645	Lyonnet *et al.* 2017: 128, table 1
		MT 2012, FLOT 269 (Str. 336, Su 451)	SacA 31998/Gif-12994	6825±40	5783-5637	Lyonnet *et al.* 2016: 180, table 2
		MT 2014, FLOT 513 (Str. 798)	SacA 41419/Gif-13139	6830±35	5777-5642	Lyonnet *et al.* 2017: 128, table 1
		MT 2012, ANT 8/CAZ 105 (Burial 578)	Poz-63145	6820±40	5771-5636	Lyonnet *et al.* 2016: 180, table 2
		MT 2014, FLOT 469 (Posthole 678)	SacA 41417/Gif-13137	6815±40	5763-6533	Lyonnet *et al.* 2017: 128, table 1
		MT 2012, ANT (Str. 342)	Beta-345514	6800±40	5741-5631	Lyonnet *et al.* 2016: 180, table 2
		MT 2013, CHARB 1 (Posthole 577)	SacA 37076/Gif-13048	6805±35	5738-5638	
		MT 2012, FLOT 281 (Str. 344, Su 548)	SacA 32000/Gif-12996	6805±35	5738-5638	
		MT 2014, ANT 05 (Str. 342)	Poz-68640	6790±40	5734-5630	Lyonnet *et al.* 2017: 128, table 1
		MT/KUR 2013, 09	SacA 37081/Gif-13053	6795±35	5732-5636	Lyonnet *et al.* 2016: 180, table 2
		MT 2011, CHARB 112 (Loc. 342)	SacA 26234/Gif-12715	6780±35	5726-5631	
		MT 2013, FLOT 303 (Su 582)	SacA 37072/Gif-13044	6745±45	5726-5567	
		MT 2013, CHARB 16 (Str. 536)	SacA 37079/Gif-13051	6775±35	5724-5630	
		MT 2012, CHARB 25 (Str. 568)	SacA 32003/Gif-12999	6680±35	5660-5537	
Shomu Tepe		1 m deep	LE-631	7510±70	6520-6200*	Kiguradze 1986: 112, table 5; Bohener and Schylde 2006*
Shulaveris Gora	IX (lower level)	2.4 m deep	SOAN-1292	6050±100	5210-4895 5260-4700*	Chubinishvili and Chelidze 1978: 66; Bohener and Schylde 2006*
			TB-16	6625±210	5715-5280 5930-5170*	Dzhavakhishvili and Dzhaparidze 1975: 127; Bohener and Schylde 2006*
			TB-72	6655±55	5680-5350 5680-5480*	Kiguradze 1986: 112, table 5; Bohener and Schylde 2006*
	VII-VI	1.6 m deep	LE-1099	6700±80	5745-5365 5760-5480*	Dzhavakhishvili and Dzhaparidze 1975: 127; Bohener and Schylde 2006*
	II (upper level)	0.2 m deep	TB-15	5920±300	5285-4440 5510-4150*	Kiguradze 1976: 168; Bohener and Schylde 2006*
		0.1 m deep	LE-1100	6310±130	5375-5070 5580-4940*	

ARCHITECTURAL MATERIALS AND METHODS

In order to study architecture, it is necessary to establish an adequate methodology. The first step is to set up a typology, taking into account the building materials, layout techniques and morphology of the buildings (fig. 2). After processing all the data at hand, it has been possible to underline different distributions of the building techniques used according to geographical, cultural and chronological parameters, ultimately leading to observed technical exchanges between the cultures previously described.

Fig. 2 – *Summary diagram of general typology (E. Baudouin).*

We consider the architecture as an archaeological object in its own right, with technical characteristics that can be decomposed as with other artefacts. Moreover, unlike the objects of material culture, architecture represents a specific vehicle for transmitting technical and cultural knowledge because it does not circulate as a finished artefact but rather as an idea, a technique and know-how. This approach is inspired by O. Aurenche's research: his typology of the architectural techniques in the Near East serves as a base for this study (Aurenche 1981). Analysis of the publications and excavation archives has to be considered as a second-hand dataset because it cannot be verified directly in the field; therefore, due to the absence of drawings or photos, we have used the authors' descriptions in order to build our own typology (Baudouin *et al.* 2018: 60, fig. 12).

Altogether, 23 sites are included in this corpus and nearly 400 buildings have been studied. However, a major bias has to be underlined, *i.e.*, the frequent absence of precise stratigraphic context. The lack of some crucial information, either because it was not possible to examine the archives or because the data is absent (*e.g.*, sections, plans, photographs), prevents a full re-evaluation of the documentation and does not allow the proposing of a sound reassessment of the stratigraphy.

Finally, my participation in the excavations at Mentesh Tepe[9], Gadachrili Gora[10] and Kiçik Tepe[11] allowed me to collect new data on SSC architectural techniques. To this field-

9. Directed by B. Lyonnet (Centre national de la recherche scientifique [CNRS]) and F. Guliyev (Institute of Archaeology and Ethnography, National Academy of Sciences, Azerbaijan) and financed by several institutions: ministère français des Affaires *é*trangères et du développement international (MAEDI), laboratoires internationaux associés (LIA du CNRS, AzArLi, AzAr2), Agence nationale de recherche (ANR) *Ancient Kura*, ANR *Kura in Motion!*.
10. Directed by M. Jalabadze (Georgian National Museum) since 2006, and C. Hamon (CNRS) in 2012-2013. Financed by the Georgian Wine Agency, LIA GATES, ANR *Kura in Motion!* and ANR *Orimil*. The site is actually being excavated by the Gadachrili Gora Regional Archaeological Project Excavation (GRAPE) directed by S. Batiuk (University of Toronto) and M. Jalabadze (Batiuk *et al.* 2017).
11. Directed by G. Palumbi (CNRS) and F. Guliyev, and financed by MAEDI.

work data is also added that from Göy Tepe and Haci Elamxanlı Tepe, which I was able to consult in the archives of the Azebaijan-Japan archaeological expedition at the University of Tokyo.[12]

RESULTS

BUILDING MATERIALS

The building materials used for construction fall into three main categories: earthen, stone and organic matter (fig. 2).

Earthen material

Over the last three decades, specialised studies have clarified our knowledge of mud-bricks (Aurenche *et al.* 2011; Chazelles and Klein 2003; Sauvage 1998), *pisé* (Chazelles and Klein 2003) and cob techniques (Roux and Cammas 2010). These studies have allowed a revision of the terminologies, as well as a more accurate definition of these building materials. Based on the evolutionary model of the Near Eastern PPN communities, it has been possible to identify and distinguish autonomous inventions (first occurrences of both cob and mud-bricks, for example) from processes of technical diffusion between different regions or cultures (Sauvage 2009: 193-194). Stacked mud (Roux and Cammas 2010) and prefabricated components (Sauvage 1998; 2001) need two different *chaînes opératoires* due to the use of different types of earthen material.

Stacked mud

The notion *terre massive* (stacked mud) indicates a building technique where mud is put directly on the spot where the wall will be built (Chazelles-Gazzal 1997: 85). It includes two main techniques: cob and *pisé*. Although their development and degree of technicality are distinct, their differences have only recently been noticed thanks to new research (Chazelles-Gazzal 1997). It is now becoming customary to strictly limit the use of the word *pisé* when the mud, used in a plastic state, is packed between shutters with a hammer (Aurenche *et al.* 2011: 16, fig. 2, 22). Cob is shaped directly on the spot to dry, so as to reach the necessary consistency before the elevation of the next bed. The mud is usually composed of earth, removed from near the site of the building, mixed with water and occasionally with an organic temper.

Table 2 – *Earthen material – cob (E. Baudouin).*
***L**: lumps; **LC**: layers of cob; **und.**: undetermined.*

Site	Culture/level	Building	Implementation	Bibliographical references
Aruchlo	SSC	9	und.	Chataigner 1995: 59
	SSC/I	4		
Gadahrili Gora	SSC/II	Wall 217	L	Hamon *et al.* 2016: 164-165, fig. 23
Kültepe	Kültepe	General	und.	Abibullaev 1963: 157-158
Masis Blur	SSC/I	S003, S004, S005	L	Hayrapetyan *et al.* 2014: 180
		S011	LC	
Shulaveris Gora	SSC	General	und.	Chataigner 1995: 59; Dzhavakhishvili and Dzhaparidze 1975: 203; Sagona 1993: 456

The establishment of a new typology (Roux and Cammas 2010: 222-223) also enables us to identify two layout techniques mainly used in the Southern Caucasus: lumps and layers of cob.

Several recent discoveries in the Kvemo-Kartli (Gadachrili Gora) and in the Ararat Plain (Masis Blur) argue for the use of lumps of mud and/or clay layers (fig. 3a and table 2). At other sites, as at Aruchlo, Shulaveris Gora and Kültepe, the use of the cob technique is documented but it is not possible to determine which specific layout was used. At Aruchlo and Shulaveris Gora, stacked mud and plano-convex mud-bricks were used simultaneously (see below).

Prefabricated components (mud-bricks)

Prefabricated components are made in series and prepared in advance. We distinguish between sun-dried mud-bricks shaped by hand and sun-dried moulded mud-bricks made in a wooden frame. The latter technique can afford the standardisation of both the shape and size of the mud-bricks at a high production rate (Aurenche 1981: 66). The composition of mud-bricks is almost always similar: it is a mixture of earth, water and often an organic temper, occasionally mineral (Aurenche 1977: 40).

In the Southern Caucasus, two morphological types of sun-dried mud-bricks have been identified: plano-convex mud-bricks, flat on one side and curved on the other, more characteristic of the SSC in the Kura Valley (table 3; fig. 4a), and elongated and flat mud-bricks, better known in the AC in the Araxes Valley, though they are also present at some sites in

12. I express my deepest thanks to the excavation directors at both sites, F. Guliyev and Y. Nishiaki, who gave me this opportunity. This research was carried out as part of a post-doctorate programme at The University Museum, The University of Tokyo, under the direction of Y. Nishiaki and with the financial support of the Japan Society for the Promotion of Science (JSPS).

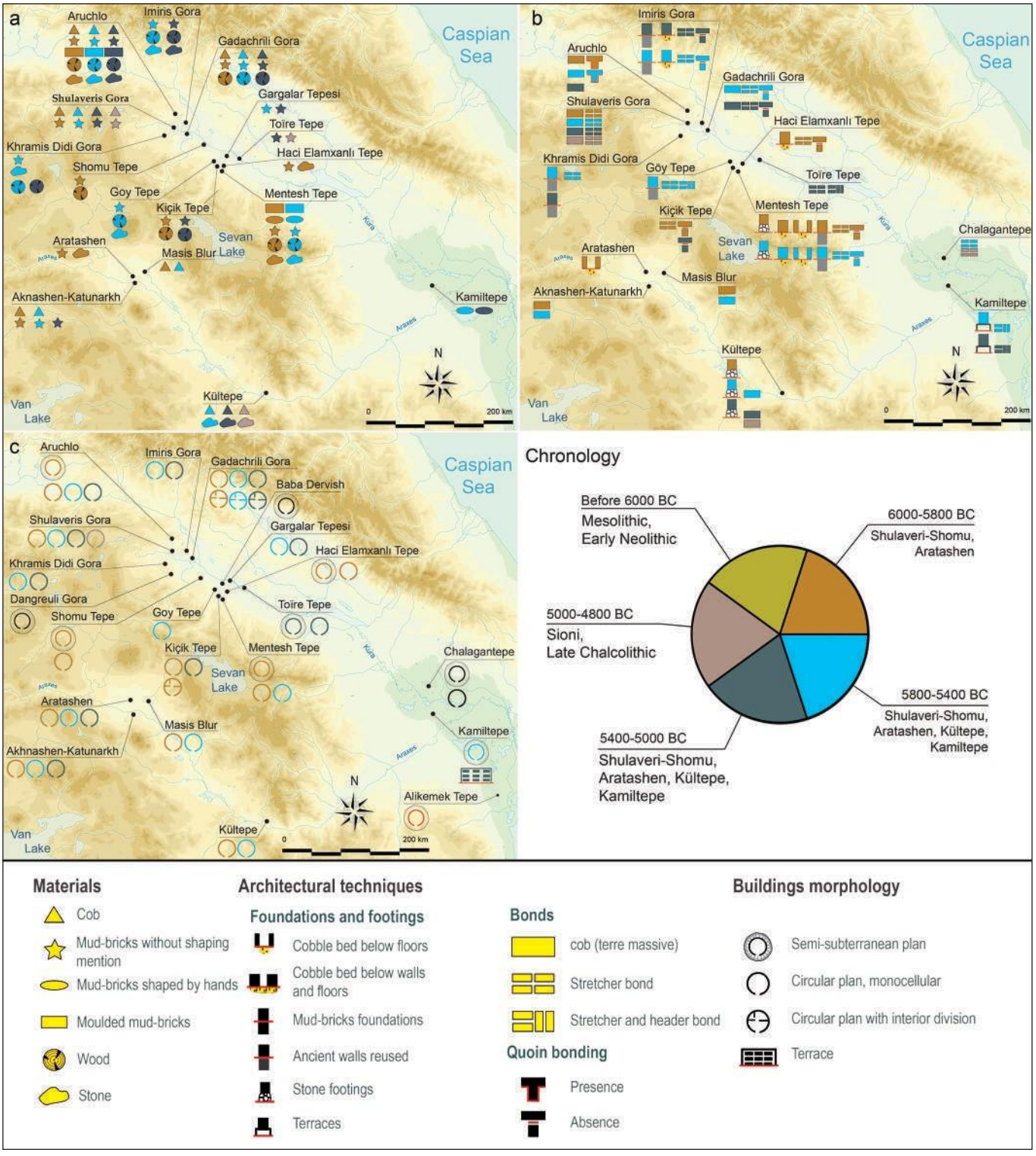


Fig. 3 – *Synthetic maps.* ***a.*** *Building materials;* ***b.*** *Layout techniques;* ***c.*** *Buildings morphology (E. Baudouin).*

Table 3 – *Earthen material – mud-bricks (E. Baudouin).* ***F****: flat;* ***M****: moulded;* ***m****: shaped by hands;* ***Pl-cx****: plano-convex.*

Site	Culture/level	Building	Length (in cm)	Width (in cm)	Height (in cm)	Ratio (L/w)	Technique and/or shape	Bibliographical references
Aknashen-Katunarkh	AC/VII		50	25		2	F	Badalyan and Harutyunyan 2014: 165
			19-20	14	5	1.4		
	AC/IV		50	30	20	1.7		
Aratashen	AC/I		45	25	8	1.8	F	Badalyan *et al*. 2004: 402
Aruchlo	SSC/Older Neolithic settlement	Complex III	30-50	20	5	1.5-2.5	Pl-cx	Hansen and Ullrich 2017: 202
	SSC	C030?	41	20	8	2.1		Dzhavakhishvili 1973: 80
		General	40	13-15	8	2.7-3.1		
			27-32	17-18	10	1.6-1.8		
			18-19	9-17	7.5-9	1.1-2		
			31-37	14-19	9-12	1.6-2.6	M	Ioseliani 2017a: 281. table 1.
Gadachrili Gora	SSC/I	2002	20-26	12-14	8	1.4-1.7	Pl-cx	Hamon *et al.* 2016: 160, 162-163; personal data
		2003	19	19	5	1	F	Hamon *et al*. 2016: 160-161; personal data
			40	19	9	2.1	Pl-cx	
	SSC/I	2004	50	25		2	F	Hamon *et al*. 2016: 159; personal data
			38-40	15-20	8-10	2.5-2.7		Personal data
	SSC	Wall 234	23		7			
Gargalar Tepesi	SSC/3	4	36	16	8	2.3		Narimanov 1992: 21
		9	26-40	15	7-8	1.7-2.7		
		General	50	20	8-10	2.5		
	SSC/2		34-44	14-18	7-11	2.4-2.8		
	SSC/1		40-48	16-18	7-9	2.5-3		Narimanov 1992: 20.
Göy Tepe	SSC/14 to 1	General	30-50	15-18	10	1.7-3.3	Pl-cx and F	Guliyev and Nishiaki 2014: 5
			40-60	20	8-10	2-3		
Imiris Gora	SSC/IV	35	38-41	16	10-11	2.4-2.6	Pl-cx	Dzhaparidze and Dzhavakhishvili 1971: 28
	SSC	General	38-50	15-20	10	2.5-2.6		Dzhavakhishvili 1973: 48
			32-35	16-20	7-11	1.6-2.2		
Kamiltepe	Kamiltepe/Phase Kamiltepe I		16-20	15-19		1.1	m	Aliyev and Helwing 2009: 29; Helwing and Aliyev 2017: 17
			34	18	15	1.9		Narimanov 1992: 35
Khramis Didi-Gora	SSC/III	27	42	20	7-7.5	2.1	Pl-cx?	Kiguradze 1986: 70
	SSC/I	34	42-49	16-24	7	2-2.7	Pl-cx?	
		29	42-43	20-22	7.5	1.9-2.2		
	SSC	General	36-48	18-24	7-7.5	2-2.3	Pl-cx	
Kiçik Tepe	SSC/III	STR-2	48-53	23	8-9	2.1-2.3	m?; F	Personal data
		STR-26	49	14	9	3.5		
		STR-21	20-25	19	9	1.1-1.3		
			42-44	19	9	2.2-2.3		
	SSC/II	STR-18	50	20	9	2.5		
Mentesh Tepe	SSC/I	285=689	44-45	15-16	9-10	2.8-3	M; Pl-cx	Personal data
		293	43	15	10	2.9		
		284	43	14	9	3.1	m or M?; Pl-cx	
		516	43	14	9	3.1		
		718=337	40	15	10	2.7		
		1025	43	12	10	3.6		
		1031	39	13	10	3		
		346	28	22	8	1.3	m	
Shomu Tepe	SSC	General	50-55	22-25	8	2-2.5	Pl-cx	Chataigner 1995: 72
			32-36	13.5-16	8-9	2.1-2.7		Narimanov 1987: 86
Shulaveris Gora	SSC	General	35-50	15-25	7-10	1.7-2.8	Pl-cx	Dzhavakhishvili 1973: 19
			25-30	15-20	7-8	1.4-1.7		
Toïre Tepe	SSC/I	15	37	17	8	2.2		Narimanov 1992: 14
	SSC/II		37	18	9	2.1		Narimanov 1992: 16
	SSC/III	1	36	18	9	2		
	SSC/V	22	50-55	22-25	7-8	2-2.5		Narimanov 1987: 86; Narimanov 1992: 18
	SSC	General	35-55	14-25	7-10	2-2.7		

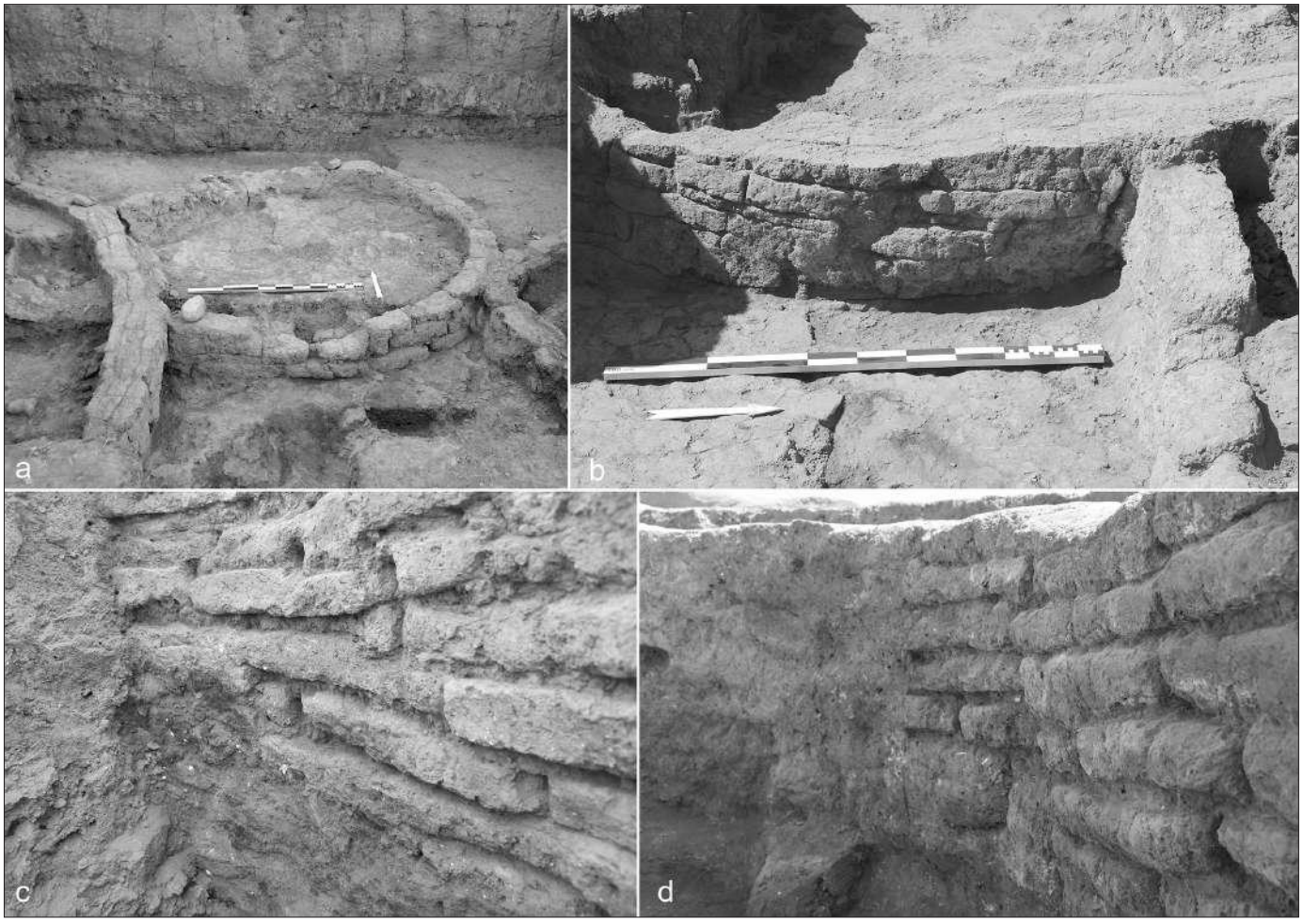


Fig. 4 – *Examples of mud-brick walls.* ***a.*** *Gadachrili Gora, Building 2003, trench 2, with plano-convex mud-bricks, view from the south (C. Hamon);* ***b.*** *Gadachrili Gora, detail of the south part of Building 2004, trench 2, with flat and elongated mud-bricks, view from the east (C. Hamon);* ***c.*** *Kiçik Tepe, detail of the burnt coating and flat and elongated mud-bricks of Building 21, view from the north-west (Mission Boyuk Kesik, MEAE);* ***d.*** *Kiçik Tepe, detail of the Building 2 with, on the left, the mud coating on the mud-brick wall and, on the right, the wall after removal of coating, view from the north-west (Mission Boyuk Kesik, MEAE).*

the Kura Valley (Göy Tepe[13]) and the Kvemo-Kartli Plain (fig. 4b-d). C. Chataigner (1995: 57) proposed to identify plano-convex bricks as mud-bricks shaped by hand, similar to the curved bricks produced during the PPNA in the Near East.

Mud-bricks can be classified into three dimensional categories (fig. 5): small (length less than 20 cm), medium (length *ca*. 25-35 cm) and large (length greater than 35 cm). Until the middle of the 6th millennium BC the size of mud-bricks is highly variable, longer than 40 cm long or shorter than 20 cm. After this period, the size of mud-bricks tends to be standardised: small mud-bricks are no longer produced and the difference between the medium and large mud-bricks decreases, while the ratio L:W tends to standardise between 2:1 and 3:1. At the scale of the same settlement, a decrease in size is observed at Gargalar Tepesi (Narimanov 1992: 20-21), Aruchlo (Hansen and Ullrich 2017: 209, fig. 33, 210, fig. 23) and Toïre Tepe (Narimanov 1987: 86; 1992: 14), while an increase in size is visible from levels 13 to 1 at Göy Tepe (Y. Nishiaki, personal communication).

Until now, no reliable information was available on the manufacturing technique of mud-bricks (fig. 3a; table 3). But

13. Plano-convex mud-bricks only appear in the lower levels, being replaced by flat mud-bricks in subsequent levels (Y. Nishiaki, personal communication).

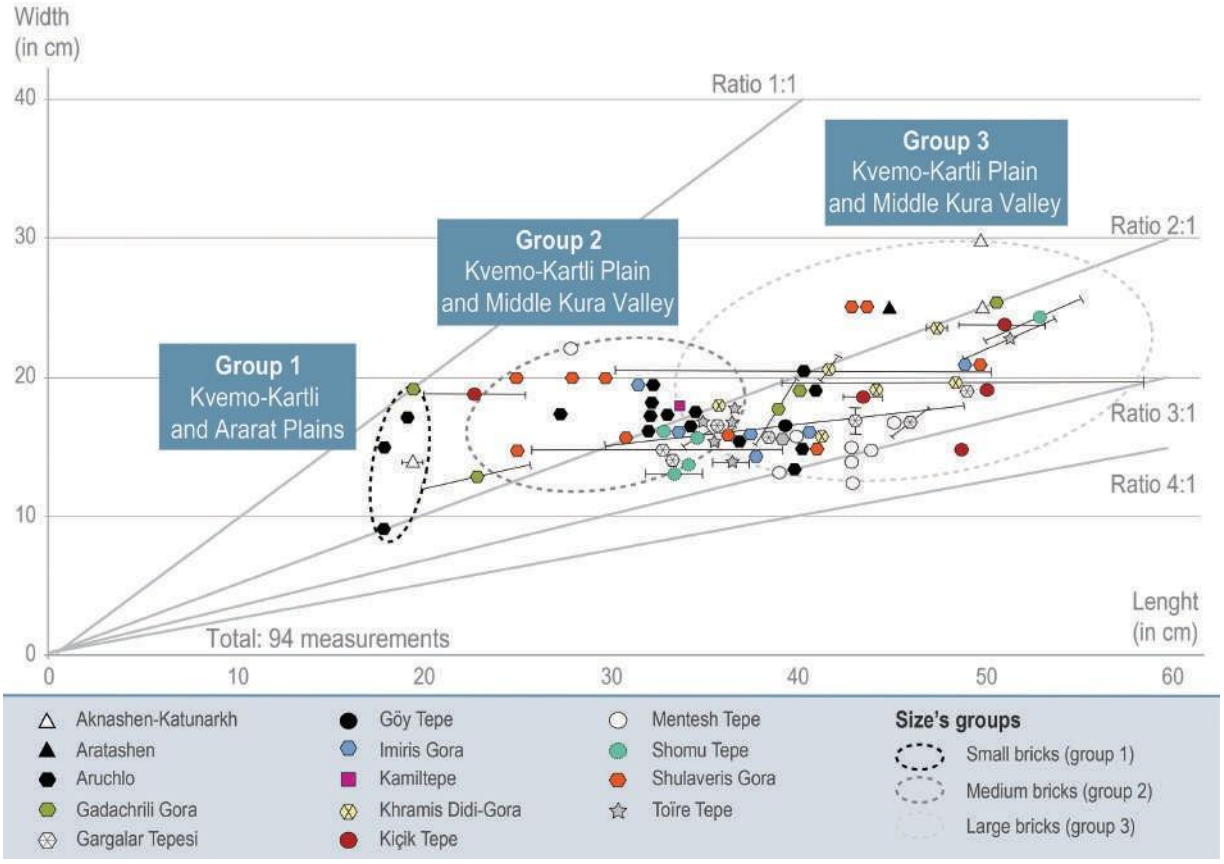


Fig. 5 – *Summary diagram of the attestations of mud-bricks during the 6th millennium BC (E. Baudouin).*

recent research at Aruchlo (Ioseliani 2017a) and Mentesh Tepe (Baudouin *et al.* 2018) confirms the use of moulded plano-convex mud-bricks during the first third of the 6th millennium BC in the SSC. At Mentesh Tepe (fig. 6), the moulded mud-bricks present edges which are perfectly straight with a tiny rim visible at the top due to the removal of the frame (Baudouin *et al.* 2017: 44-45, fig. 4). In addition, slight longitudinal ridges on the convex face of several mud-bricks possibly testify to an equalisation of the surface—probably with a tool—before the removal of the frame (fig. 6b-c).[14] At Aruchlo, the moulded plano-convex mud-bricks have been identified in a burnt collapsed level said to belong to the oldest occupation of the site. These mud-bricks have a standard size and specific stigmas (Ioseliani 2017a: 282) that are similar to those observed at Mentesh Tepe. These results will have to be confirmed by further research in the Southern Caucasus: the issue of a technical evolution from mud-bricks shaped by hand to moulded mud-bricks is essential to define a local evolution of techniques or, on the contrary, a diffusion of the moulded mud-brick technique, from Mesopotamia to the Southern Caucasus.

14. They could also be simply fingerprints, attested, for example, on the top of Sumerian plano-convex mud-bricks in Mesopotamia during the Early Dynastic period (Sauvage 1998: 41-42). In this case, the manufacturing technique is ambiguous: moulded (Delougaz 1933: 8, fig. 4) or shaped by hand (Tunca 1984: 122-123), according to the authors (Sauvage 1998: 115-116).

Stone

In addition to the earthen materials, and contrary to what is sometimes written (Kushnareva 1997: 31), stone was commonly used (table 4), but for specific needs (see below).

This is the case of the footings at Mentesh Tepe, with small river pebbles (Baudouin *et al.* 2018: 56, fig. 5), at Kültepewhere stone blocks were employed, and for the foundations at Mentesh Tepe (Baudouin *et al.* 2018: 56, fig. 5, 57, fig. 6), Haci Elamxanlı Tepe and Aratashen. Pebbles were also used to maintain posts at Aruchlo and Mentesh Tepe (Baudouin *et al.* 2017: 46, fig. 5).

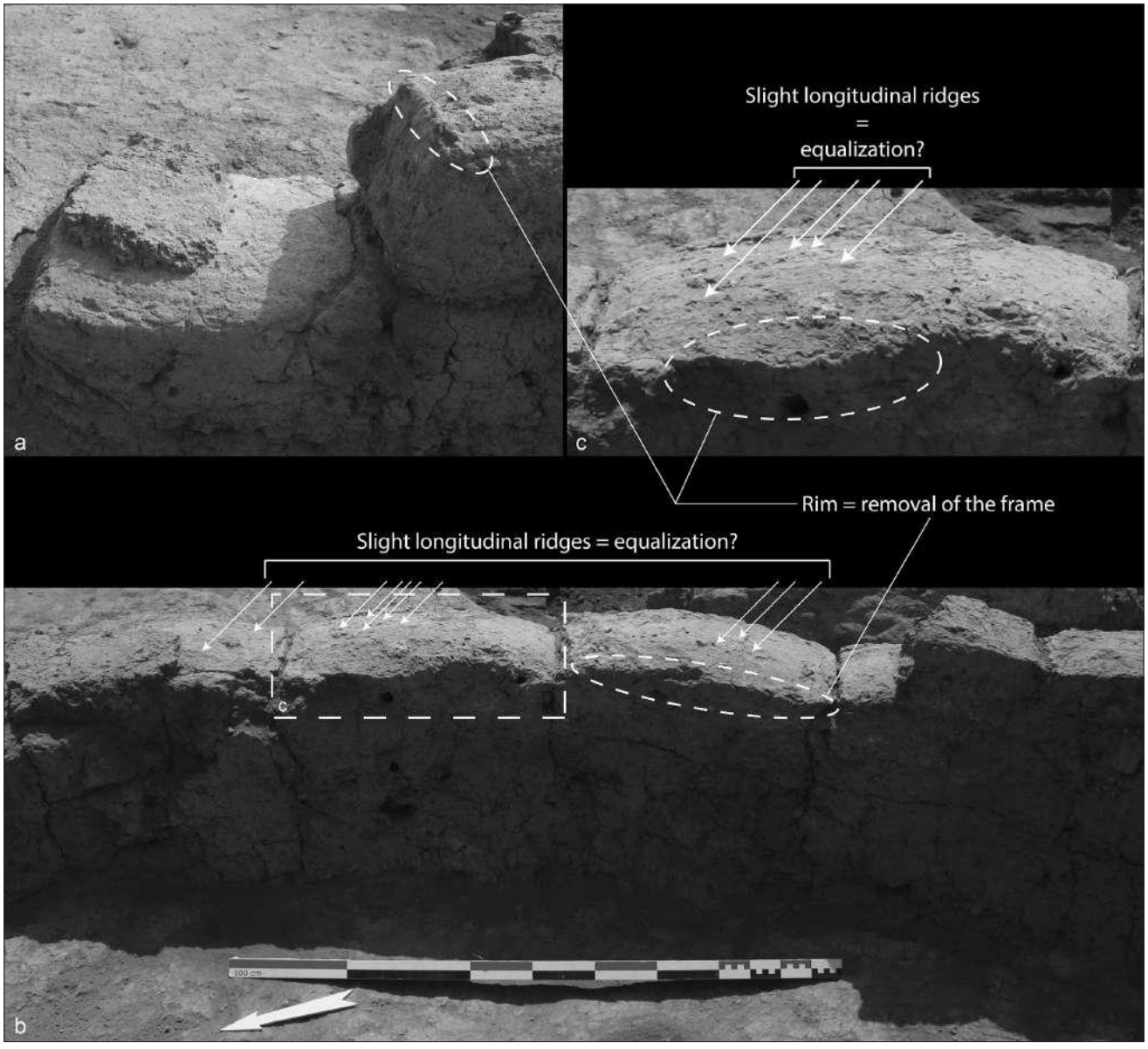


Fig. 6 – *Moulded plano-convex mud-bricks from Mentesh Tepe (Mission Mentesh Tepe).* ***a.*** *Detail of the mud-bricks, Wall 293, sector 10, with stigmas of removal of the frame, view from the west;* ***b.*** *First course of mud-brick, Wall 285, sector 15, with rims and slight longitudinal ridges at the top of mud-bricks, view from the north-west;* ***c.*** *Detail of a mud-brick, Wall 285, with equalisation marks on the top.*

Organic matter

In addition to earth and stone, organic matter (table 5), essentially consisting of wood, straw and reeds, were used in different aspects of the construction.[15]

In the SSC, the best evidence of the use of organic matter is represented by postholes for the roof supports. At Aruchlo, recent discoveries emphasise the use of load-bearing poles in several buildings (Hansen and Ullrich 2017: 203, 207, fig. 15), with occasional imprints of wood on pieces of daub (Ioseliani 2017a: 282, 285, fig. 10). At Kiçik Tepe, wood and straw imprints were identified on earthen materials from the collapsed roof (fig. 7). The sizes of the beams are estimated to

15. In the current state of knowledge, the wattle technique is not attested in the Southern Caucasus during the Neolithic period. Organic matter seems to be used preferentially for roof coverings and supporting posts.

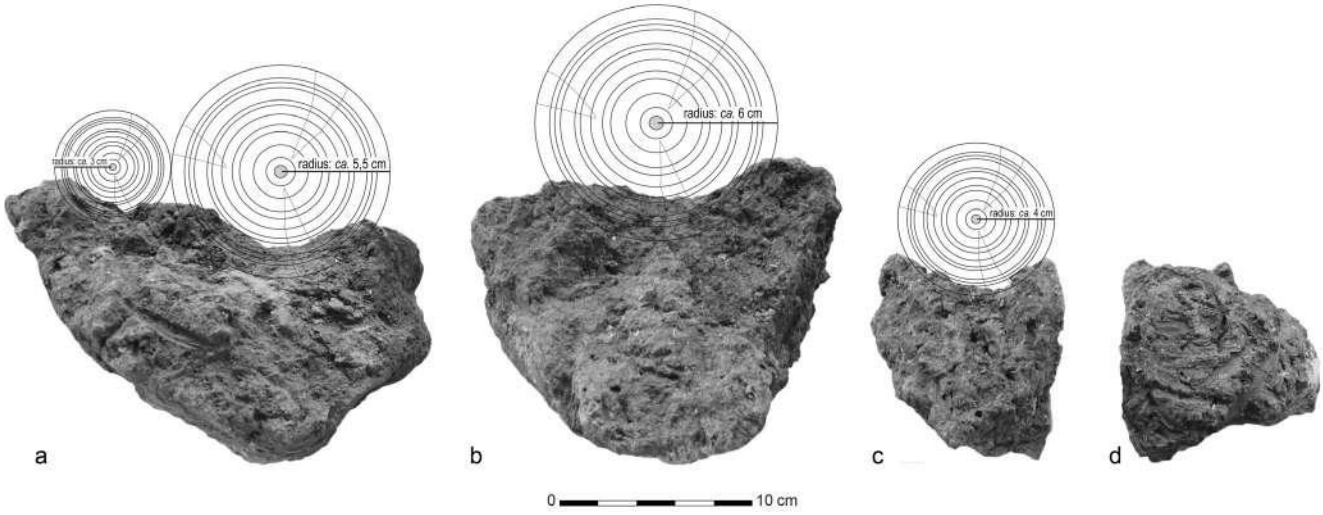


Fig. 7 – *Kiçik Tepe, Building 21, square G8 (Mission Boyuk Kesik, MEAE).* ***a-c.*** *Earthen fragment with imprints of pole (E. Baudouin);* ***d.*** *Earthen fragment with imprints of straw and reed (E. Baudouin).*

Table 4 – *Material – stones (E. Baudouin).*

Site	Culture/level	Building	Bibliographical references
Aratashen	AC/IIc, IIb	Str. 47; Str. X	Badalyan *et al*. 2007: 41
Aruchlo	SSC	Complex III	Hansen and Ullrich 2017: 203, 206, fig. 14, 207, fig. 15
Haci Elamxanlı Tepe	SSC/2	Wall 75	Nishiaki *et al*. 2013: 7
Kültepe	Kültepe	General	Chataigner 1995: 60; Abibullaev 1959: 445
Mentesh Tepe	SSC/I	293	Baudouin *et al.* 2017: 46, fig. 5
		782, 783	Baudouin *et al.* 2018: 56-57, fig. 4
		795	Baudouin *et al.* 2018: 56-57, fig. 6
		718	Baudouin *et al.* 2018: 56, fig. 5

Table 5 – *Material – organic matters (E. Baudouin).* ***I****: imprints;* ***P****: pole;* ***Ph****: posthole.*

Site	Culture/level	Building	Type	Bibliographical references
Aruchlo	SSC	General	Ph	Hansen and Ullrich 2017: 203
		Carbonised layer	I	Ioseliani 2017a: 282
Gadachrili Gora	SSC/I	2003	Ph	Personal data
Göy Tepe	SSC	General	Ph	Guliyev and Nishiaki 2014: 5
Imiris Gora	SSC/I	9-10	Ph	Dzhavakhishvili and Dzhaparidze 1975: fig. 1, pl. XV
Khramis Didi Gora	SSC	23 and 28	Ph	Sagona 1993: 460
Kiçik Tepe	SSC/III	21	P; I	Personal data
Mentesh Tepe	SSC/I	293	Ph	Baudouin *et al*. 2018: 61, 64, fig. 14
Shomu Tepe	SSC		Ph	Narimanov 1992: 12

have been *ca*. 6-12 cm; the excavation of the roof collapse layer also revealed a thick level of straw and charred wood remains. At Mentesh Tepe, the discovery of postholes on the periphery of a round building together with the imprint of one central pole enables us to restore a system of roof-supporting posts (see below). In a building at Gadachrili Gora, the presence of a small circular cavity near the entrance indicates the location of a door pivot (fig. 8d).

LAYOUT TECHNIQUES

Several layout techniques can be defined, according to the building materials used and their position below (infrastructures) or above (superstructures) the ground level.

Infrastructures

Two types of infrastructures have been identified: stone or clay beds and constructed foundations (fig. 2, fig. 3b and table 6). Three specific functions are assigned to the stone or clay beds depending on whether they are installed inside the building or only under the walls: 1) to protect it from humidity; 2) to level and/or raise the building surface; 3) to prevent moisture infiltration (Baudouin *et al.* 2018: 58, fig. 8). According to the typology established by Gasche and Birchmeier (Gasche and Birchmeier 1981: 8-9), two types of constructed foundations can be recognised in the Southern Caucasus: the reuse of previous walls or the construction of

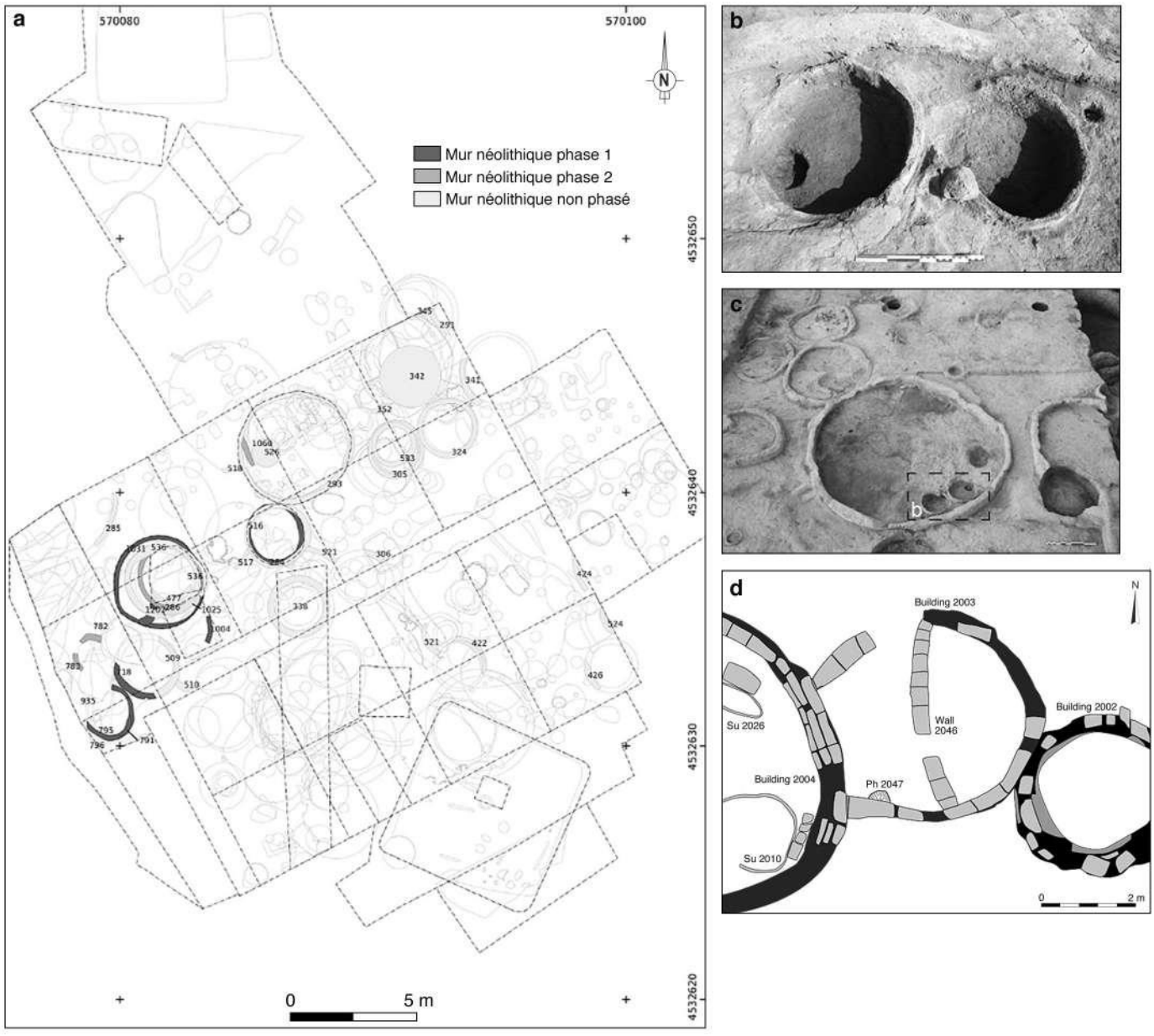


Fig. 8 – ***a.*** *Mentesh Tepe, plan of the Neolithic levels (drawing E. Degorre);* ***b.*** *Kiçik Tepe, square F9, Building 8, detail of two storage bins in the north-eastern part of the building, view from the south (Mission Boyuk Kesik, MEAE);* ***c.*** *Kiçik Tepe, general view of Building 8 with location of storage bins, view from the north (Mission Boyuk Kesik, MEAE);* ***d.*** *Gadachrili Gora, general plan of trench 2, level I (drawing C. Hamon, E. Baudouin).*

specific mud-brick foundations. In both cases, their function was to protect the walls from damp rising by capillarity and to reinforce the superstructure.

Stone or clay beds under floors

At Mentesh Tepe, the floor level of the semi-subterranean building rests on a compact silty clay levelling layer (fig. 9), probably chosen for its waterproof qualities (Houben and Guillaud 1989: 41) to avoid rising humidity, to fill the irregularity of the virgin soil and to level the ground for the layout of the floor, like in Building 795 (Baudouin *et al.* 2018: 57, fig. 6). At Aratashen, concentrations of pebbles have been found inside two buildings but we have no information on their layout.

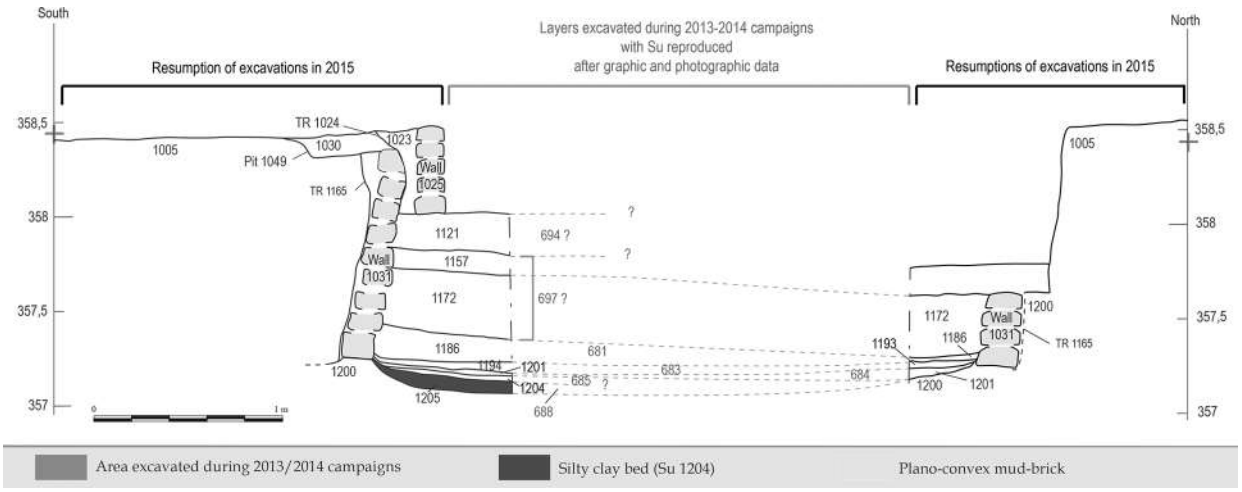


Fig. 9 – *Mentesh Tepe, section south/north of Building 1031, sector 15 (Mission Mentesh Tepe; drawing E. Baudouin).*

Table 6 – *Layout techniques – beds, foundations, footings and terraces (E. Baudouin).*

Site	Culture/level	Building	Type	Bibliographical references
Aratashen	AC/IIc, IIb	Str. 47; Str. X	Bed under floors	Badalyan *et al*. 2007: 41
Göy Tepe	SSC		Mud-bricks foundations	Guliyev and Nishiaki 2014: 7
Haci Elamxanlı Tepe	SSC/3	Wall 75	Bed under the wall	Nishiaki *et al*. 2015b: 7, fig. 2
Kamiltepe	Kamiltepe/ Kamiltepe I	Terrace	Terrace	Helwing and Aliyev 2017: 14-17
Khramis Didi Gora	SSC	General	Foundation: reused of walls	Dzhavakhishvili and Dzhaparidze 1975: 17, fig. 2
Kültepe	Kültepe	General	Footing	Chataigner 1995: 60
Mentesh Tepe	SSC/I	1031	Bed under floors	Personal data
		795		Baudouin *et al*. 2018: 56-57
		782/783	Bed under the entire building	
		533/324	Foundation: reused of walls	Personal data
		526/305		
		536/286		Lyonnet *et al*. 2016: 172
		718	Footing	Baudouin 2017: 155, fig. 2; Baudouin *et al*. 2018: 56

Cobble beds under the wall and floors

At Mentesh Tepe, two preliminary cobble beds were arranged before the installation of some buildings (Baudouin *et al.* 2018: 56-57, fig. 4). Both layers were used to level the building surface area and to protect the floors and walls from rising damp. At Haci Elamxanlı Tepe (fig. 10) a wall was built on a layer of cobbles, probably arranged to reinforce the wall installed over a large and soft ashy pit.

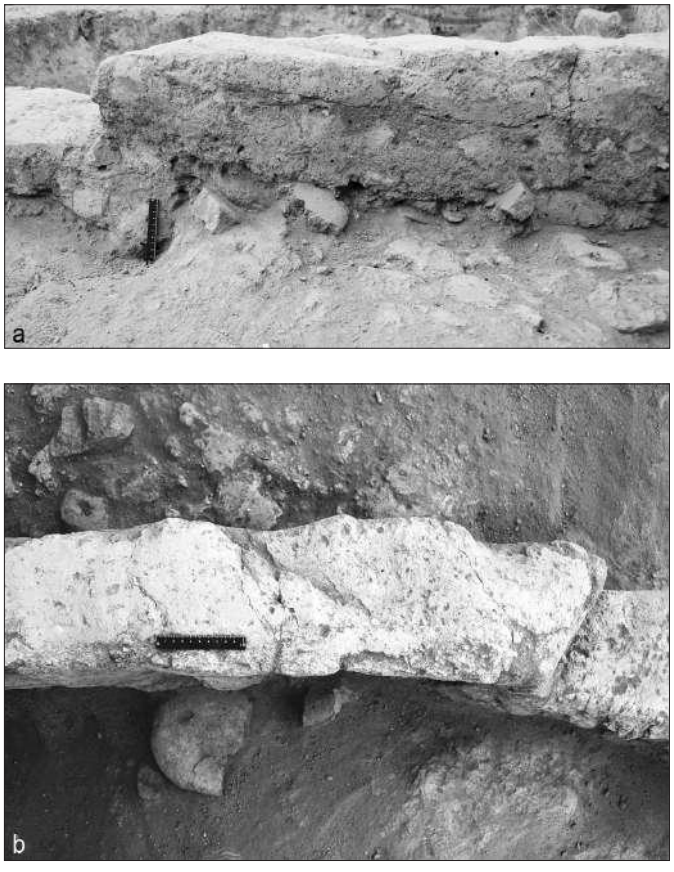


Fig. 10 – *Haci Elamxanlı Tepe, Wall 75, square M10 (courtesy Y. Nishiaki).* ***a.*** *Cobble bed under Wall 75, view from the north;* ***b.*** *The same cobble bed under Wall 75, view from the top.*

Foundations: reused walls

The levelling of previous construction layers is a common practice in the Near East (Aurenche 1981: 104; Sauvage 1998: 51): after the abandonment of a previous building its volume is filled up to the height of the levelling course. The identification of this layout is difficult and depends heavily on the quality of the documentation made during excavations and on a careful interpretation of the stratigraphic sequences. Indeed, it can be easily confused with a phase of reuse of the previous buildings. Three examples are clearly attested at Mentesh Tepe, and others at Khramis Didi Gora.

Mud-brick foundations

Evidence of mud-brick foundations is rare in the Southern Caucasus. Only one example is visible at Göy Tepe: a massive one-metre thick wall, located on the edge of the settlement, was built on a thick mud-brick foundation which protruded from the wall by 15-45 cm. According to Y. Nishiaki, this installation could be assimilated to a platform (Guliyev and Nishiaki 2014: 7).[16]

Superstructures

Superstructures designate the architectural elements present above the ground level. The functions of these installations are similar to infrastructures (see above).

Footings

The footing (Aurenche 1977: 160-161) is often made of a different material to the rest of the elevation. Its function is to raise the base of the wall (Pérouse de Montclos 2004: 164, col. 80) and to protect it from rising moisture by capillarity (Margueron 1985). Such a layout is documented at Mentesh Tepe (Baudouin 2017: 155, fig. 2) and Kültepe.

Terraces

Terraces designate built platforms (Aurenche 1977: 166) generally intended to support a building. The only clear example known in the Southern Caucasus is that of Kamiltepe, where a circular platform has been recovered (24 m in diameter, 2.6 m preserved height). Entirely constructed using mud-bricks, it was erected directly onto the virgin soil, requiring occasional levelling work (Helwing and Aliyev 2017: 17). No installation could be identified at the top of the terrace, but a set of rooms was arranged around it (Helwing and Aliyev 2017: 18, fig. 10).

16. The location in the foundations leads us to distinguish this layout from real terraces (see below).

Bonds

Bonds designate the way in which the masonry elements are assembled.

Stretcher bond

The stretcher bond consists of juxtaposing masonry elements with the longest face of the mud-bricks along the axis of the wall (Aurenche 1981: 132). This type of bond is the oldest and most widely represented in our corpus.

This layout is attested in all the buildings at eight sites (table 7). The only variation is found in the number of rows of mud-bricks in the thickness of the wall, most commonly one (fig. 3a and d) but reaching up to three rows in rare cases (fig. 3b).

Stretcher and header bond

The header bond consists of juxtaposing masonry elements with the longest face of the mud-brick set along the width of the wall (Aurenche 1977: 39). Generally, the stretcher and header bonds consist of alternating the stretcher bond on one course and the header bond on the other.

Only three examples of stretcher and header bond have been documented (Göy Tepe, Kamiltepe and Toïre Tepe). At Kamiltepe, the mud-bricks of the terrace core are arranged alternately in stretcher and header bonds from one course to the other (Aliyev and Helwing 2009: 38, fig. 21).

Absence of quoin bonding

Quoin bonding is the joining of two walls, the components of which are linked from one course to the next (Pérouse de Montclos 2004: 110).

Quoin bonding does not seem to have been mastered by the communities of Southern Caucasus (table 6)[17]. At Gadachrili Gora, the cross-wall of Building 2003 is not bonded to the peripheral wall, which itself leans against the exterior face of Building 2004. At Imiris Gora, the peripheral wall of Building 8 leans against the wall of Building 9-10. Inside Building 8, pilasters, which materialise the entrance of the building, are not bonded to the peripheral wall. At Mentesh Tepe, as at Haci Elamxanlı Tepe (Y. Nishiaki, personal communication) and

17. Until recently, some scholars argued that the occurrence of quoin bonding was contemporary with that of orthogonal architecture at the beginning of the PPNB period (7th millennium BC) in the Near East (Sauvage 2009: 197). But at Jerf el-Ahmar (Syria), the quoin bonding from level II/E in the round buildings (Stordeur 2015: 175, table 4) testifies the prior use of the technique compared to the rectangular architecture. It can be considered as an autonomous technical stage related to the need to reinforce masonry.

Table 7 – *Layout techniques – bonds (E. Baudouin).* ***N****: no;* ***NS****: not specified;* ***S****: stretcher;* ***SH****: stretcher and header;* ***Y****: yes.*

Site	Culture/level	Building	Bond	Number of rows	Quoin bonding	Bibliographical references
Aruchlo	SSC		NS		Y	Hansen and Ullrich 2017: 201
Chalagantepe	SSC	General	S	1	NS	Narimanov 1992: 45
Gadachrili Gora	SSC/I	2002, 2003	S	1	N	Hamon *et al.* 2016: 160
		2004	S	3	N	Hamon *et al.* 2016: 159
Göy Tepe	SSC	General	S	1	NS	Guliyev and Nishiaki 2014: 6
	SSC/3-4		S	3	NS	Guliyev and Nishiaki 2014: 13, fig. 3
	SSC/13	Massive wall in square 4B	SH		NS	Courtesy Y. Nishiaki
Haci Elamxanlı Tepe	SSC/1	9, 14, 15	S	1	N	Nishiaki *et al.* 2015b: 5, fig. 4
	SSC/2	9, 14	S		N	Nishiaki *et al.* 2015b: 7, fig. 6
	SSC/3	2002, 2003	S		N	Nishiaki *et al.* 2015b: 9, fig. 9
		34, 82	S	1 and 3	N	
		63, 65, 72, 75, 78	S	2	N	
Imiris Gora	SSC	General	S	1	NS	Narimanov 1992: 32
		8, 9-10	NS		N	Dzhaparidze and Dzhavakhishvili 1969: pl. III.2 and pl. IV.1
			NS		N	
Kamiltepe	Kamiltepe/Phase Kamiltepe I	Terrace	SH		NS	Helwing and Aliyev 2017: 18
Kiçik Tepe	SSC/3	General	S	1	N	Personal data
Mentesh Tepe	SSC/I	General	S	1	N	
Toïre Tepe	SSC/III	3	S	1	NS	Narimanov 1992: 15
	SSC/V	22	S		NS	Narimanov 1992: 17
	SSC/II	4	SH	1	NS	Narimanov 1992: 15

Kiçik Tepe, structures are always built adjacent to each other without the use of quoin bonding. Only at Aruchlo do the excavators describe "walls joined and built in one action" (Hansen and Ullrich 2017: 201), and, since other non-bonded walls are also attested, they relate them to modifications in the architectural organisation during phases of the building's use. We can also assume that in some cases the buildings were not all contemporary, which explains why later walls are not joined to the existing ones.

BUILDINGS MORPHOLOGY

This analysis takes into account all the morphological (*i.e.*, shape, size, covering) and functional (*e.g.*, facilities, organisation of settlements) characteristics of the buildings.

Semi-subterranean architecture

Semi-subterranean buildings are constructed by digging a pit and, often, by using the extracted earth to build low walls of stacked mud at the edge of the pit to support a wooden beam cover (Wulff 1966: 103).

In the Southern Caucasus, these buildings (called *zemlianka*) are geographically limited to the Kura Valley and the Mil Plain (fig. 3c and table 8). At Shomu Tepe, Aruchlo, Mentesh Tepe and Haci Elamxanlı Tepe, they have been dug into the virgin soil. At Shomu Tepe, Narimanov (Narimanov 1987: 16) describes a semi-subterranean building filled with a variety of materials. At Baba Dervish, four "pits" were identified, all containing important material, as well as a fireplace, but no arrangement for the walls and floors is specified (Narimanov 1987: 29; Dzhavakhishvili 1973: 83). At Haci Elamxanlı Tepe, a semi-subterranean building dug at a depth of 18 to 26 cm is mentioned. Even if the limit of the digging is unclear for the edge of the building (fig. 11b), the difference in height between the virgin soil inside and outside of the building leaves no doubt for its interpretation as a semi-subterranean building (fig. 11a and c; Y. Nishiaki, unpublished data). At Mentesh Tepe, the stratigraphy confirms the digging of a deep pit (fig. 9 and fig. 12g) with a terraced mud-brick wall bordering its edge (fig. 12a-b and f). The bottom was filled with a clay bed (see above), prior to the installation of floors painted in purple-red and the construction of two low internal walls of stacked mud, dividing the surface into two equal parts (fig. 12a and c-d). Many remnants of charred wood (fig. 12f), found in the level of abandonment, and the presence of two postholes may indicate the use of posts and beams for the roof of the building (fig. 12e). At Aruchlo, semi-subterranean buildings were located on the edge of the site (Ioseliani 2017b: 226-227) and possibly date to the oldest phase of occupation, before 5800 BC. In the Karabakh Plain,

Table 8 – *Buildings morphology – semi-subterranean plan E. Baudouin).* ***N****: no;* ***NS****: not specified;* ***Y****: yes.*

Site	Culture/level	Building	Diameter (in m)	Area (in m²)	Depth (in m)	Supporting elements	Bibliographic references
Aruchlo	SSC/Pit House	18	4.1-4.6	27		NS	Torosjan 1976: 23-27, fig. 2-3
		16		23.9		NS	
		15		13.5		NS	
Baba Dervish	SSC?		3.5-5	13.7	2.5	NS	Dzhavakhishvili 1973: 83
			4	12.6	0.8	NS	
			4	12.6	0.8	NS	
			4	12.6	0.8	NS	
Chalagantepe	SSC/level 405-390 m	Pit-House 71	3.1	7.6		NS	Azimov 2006: 50, fig. 6
Dangreuli Gora						NS	Dzhavakhishvili 1973: 70-71
Haci Elamxanlı Tepe	SSC/4b	A	More than 5 m		0.2-0.3	N	Courtesy Y. Nishiaki
Kamiltepe – MPS 4			2.8			NS	Helwing and Aliyev 2012: 9-10, fig. 8-9
Mentesh Tepe	SSC/I	1031	3.8		1.5 min	Y	Baudouin *et al.* 2017: 43
Shomu Tepe	SSC		3	7.1	1	NS	Dzhavakhishvili 1973: 85, 87-88
Toïre Tepe	SSC					NS	Dzhavakhishvili 1973: 83, 87-88

at Chalagantepe, the six lower layers of the Neolithic occupation contained semi-subterranean buildings. One of them (Pit-House 71) was dug into the virgin soil. The border of the pit was covered by thick clay layers and the floor was "painted wine-red and ochre" (Azimov 2006: 20). In the Mil Plain, on the site MPS 4, a circular semi-subterranean building had a terraced wall made of mud-bricks bordering the edge of the pit on its eastern side. The material found inside indicates that the building served as a workshop for shell beads. Although the chronological attribution of Alikemek Tepesi in the Mughan Plain is still controversial, the existence in the "middle horizon" of a semi-subterranean building with walls painted with red drawings on a white background should be noted (Mahmudov 1984: 59).

Above ground circular plan

In the Near East, the circular plan tends to disappear at the end of the PPNB to the benefit of the rectangular plan. However, it still occurs in some regions during the 6th and 5th millennia BC, especially in the Levant (Aurenche 1981: 185, map 17), Cyprus (Le Brun 1989: 162-163) and Northern Mesopotamia, mainly within the Halaf culture (Breniquet 1996), which is contemporary with the Caucasian Neolithic. In the Southern Caucasus, apart from a few cases, the circular plan is the only architectural plan attested during the whole Neolithic period and two different types of above ground circular buildings are recorded: plain monocellular buildings and buildings with an internal partition. Far from being exhaustive, a total of 372 buildings have been taken into account in the current study (table 9).

At Shomu Tepe (fig. 13c), differences in size has led to the identification of two types of circular buildings (Narimanov 1987: 16): small with a diameter *ca*. 2 m (area of 3.1 m²) and large with a diameter *ca*. 3.5 m (area of 9.2 m²). Narimanov also notes that the small and large buildings are linked to each other by low walls: the association of the different circular constructions around a central open area (courtyard) forming a compound. A similar organisation is attested at other sites of the SSC, as at Imiris Gora in level V (fig. 14b), Khramis Didi Gora (Menabde *et al.* 1978: 27, fig. 1, 33, fig. 2; Menabde *et al.* 1980: 21, fig. 1, 22, fig. 2), Toïre Tepe (Narimanov 1987: 207, fig. 11, 208, fig. 12, 210, fig. 14), Gargalar Tepesi (fig. 13b), Chalagantepe (Narimanov 1986: 423; Narimanov 1992: 44), Ilanlitepe[18], Aruchlo (Hansen and Ullrich 2017: 209, fig. 22, 210, fig. 23) and Göy Tepe (fig. 14a), all dated from the middle or the second half of the 6th millennium BC. In sites dated to the Early Neolithic (first third of the 6th millennium BC), the buildings are organised according to the so-called snowman-shape (Nishiaki *et al.* 2015b: 5), *i.e.*, a large building adjacent to a smaller one, as at Haci Elamxanlı Tepe (fig. 13a), Gadachrili Gora (fig. 8d), Mentesh Tepe (fig. 8a), Kiçik Tepe (fig. 8c), Imiris Gora, level I in the Kura Valley and Aknashen-Khatunarkh in the Araxes Valley.

At Shulaveris Gora three functional categories for these buildings have been proposed, based upon their diameter (Dzhavakhishvili and Dzhaparidze 1975: 204): water storage facilities (less than 1 m in diameter, area less than 0.8 m²), storage and domestic activities facilities (diameter *ca*. 1.3-2 m, area *ca*. 1.2-3.1 m²) and residential buildings (diameter *ca*. 2.5-5 m, area *ca*. 4.9-19.6 m²).

18. Radiocarbon dates of these last two sites and their attribution to the SSC are nevertheless controversial.

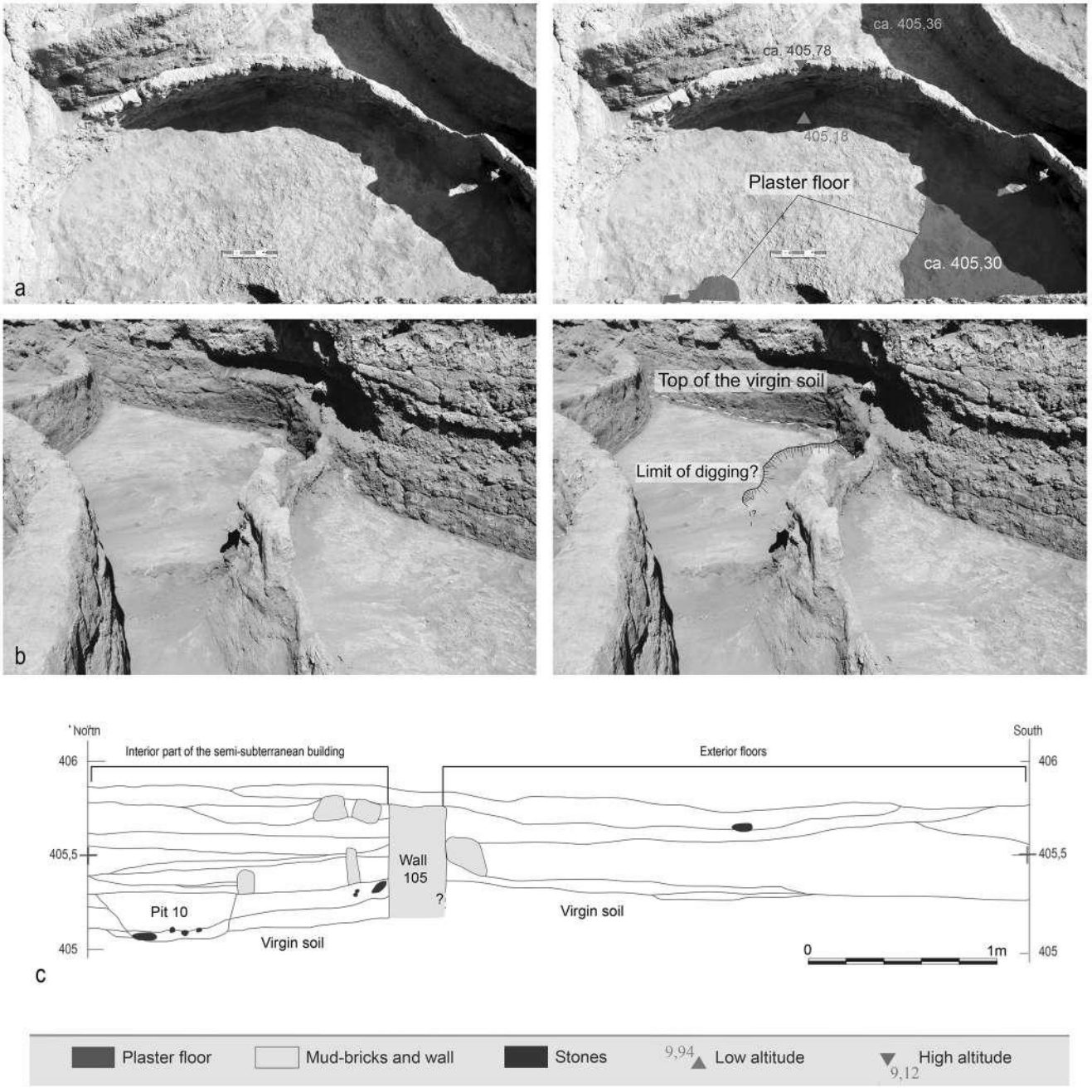


Fig. 11 – *Haci Elamxanlı Tepe, square M11, semi-subterranean building, Wall 105 (courtesy Y. Nishiaki).* ***a.*** *General view of the building with plaster floor on the west and central parts, view from the north;* ***b.*** *Detail of the northern corner of the building, view from the south-east;* ***c.*** *Section north-south of square M10 (drawing S. Kadowaki).*

Fig. 12 – *Mentesh Tepe, squares 15-16, semi-subterranean building 1031 (Mission Mentesh Tepe).* ***a.*** *General view of Building 1031 with, in grey, the excavated area before 2015, view from the west;* ***b.*** *Detail of the terrace wall and the floor (SU 1204), view from the north;* ***c.*** *Detail of a millestone in situ in the south-western part of the building, view from the north;* ***d.*** *Detail of the low walls of stacked mud, view from the south-west;* ***e.*** *Detail of a posthole inside building 1031, view from the south;* ***f.*** *Detail of charred wood found in abandonment level (SU 1172), view from the west;* ***g.*** *General view of the limit of the digging on the top of the building, view from the south.*

Table 9 – *Buildings morphology – circular buildings in superstructure (E. Baudouin).* ***N****: no;* ***NS****: not specified;* ***Y****: yes.*

Site	Culture/level	Number of buildings (and in % by level)				Bibliographical references
		Cat. 1 (< 5 m²)	Cat. 2 (5-9 m²)	Cat. 3 (9-15 m²)	Cat. 4 (> 15 m²)	
Aknashen-Katunarkh	AC/IV	0	0	0	1 (100)	Badalyan *et al.* 2010: 217, fig. 4.1
Aruchlo	SSC/Younger Neolithic settlement	1 (16.7)	3 (50)	1 (16.7)	1 (16.7)	Hansen and Ullrich 2017: 209, fig. 22, 210, fig 23
	SSC/Older Neolithic settlement	2 (25)	0	3 (37.5)	3 (37.5)	Hansen and Ullrich 2017: 209, fig. 22
	SSC/1	2 (40)	1 (20)	2 (40)	0	Ioseliani 2017b: 226, fig. 4
	SSC/1?	0	1 (100)	0	0	
	SSC/2	5 (50)	1 (10)	3 (30)	1 (10)	
	SSC/3	7 (58.3)	2 (16.7)	2 (16.7)	1 (8.3)	
	SSC/4	7 (58.3)	2 (16.7)	2 (16.7)	1 (8.3)	
	SSC/5	3 (100)	0	0	0	
	SSC/6	0	1 (100)	0	0	
	SSC/7	0	1 (100)	0	0	
Chalagantepe	SSC/1 (405-390 m)	2 (40)	3 (60)	0	0	Azimov 2006: 50, fig. 6
	SSC/2 (390-370 m)	2 (22.2)	6 (66.7)	0	1 (11.1)	Azimov 2006: 50, fig. 7
	SSC/3 (370-350 m)	6 (40)	7 (46.7)	1 (6.7)	1 (6.7)	Azimov 2006: 51, fig. 8
	SSC/4 (390-370 m)	7 (50)	5 (35.7)	1 (7.2)	1 (7.2)	Azimov 2006: 51, fig. 9
	SSC/5 (325-305 m)	5 (55.6)	3 (33.3)	1 (11.1)	0	Azimov 2006: 52, fig. 10
	SSC/6 (305-290 m)	6 (50)	6 (50)	0	0	Azimov 2006: 52, fig. 11
	SSC/7 (290-275 m)	7 (46.7)	8 (53.3)	0	0	Azimov 2006: 53, fig. 12
	SSC/8 (275-255 m)	7 (58.3)	5 (41.7)	0	0	Azimov 2006: 53, fig. 13
	SSC/9 (255-230 m)	9 (52.9)	8 (47.1)	0	0	Azimov 2006: 54, fig. 14
	SSC/10 (230-208 m)	7 (46.7)	8 (53.3)	0	0	Azimov 2006: 54, fig. 15
	SSC/11 (208-190 m)	5 (100)	0	0	0	Azimov 2006: 55, fig. 16
Gadachrili Gora	SSC/I	1 (33.3)	0	0	2 (66.7)	Personal data; Hamon *et al.* 2016: 161-162, fig. 17, 163, fig. 18
Gargalartepesi	SSC/1	4 (44.4)	3 (33.3)	2 (22.3)	0	Narimanov 1992: 19-21
	SSC/2	7 (70)	2 (20)	1 (10)	0	
	SSC/3	2 (100)	0	0	0	
Göy Tepe	SSC/1	1 (100)	0	0	0	Guliyev and Nishiaki 2014: 13, fig. 3
	SSC/2	3 (75)	1 (25)	0	0	
	SSC/3	3 (60)	1 (20)	1 (20)	0	
	SSC/4	5 (62.5)	3 (37.5)	0	0	
	SSC/5	4 (100)	0	0	0	
	SSC/6	1 (100)	0	0	0	
	SSC/11	0	1 (100)	0	0	
	SSC/7 to 13	1 (33.3)	2 (66.6)	0	0	
Haci Elamxanlı Tepe	SSC/1	2 (66.6)	0	0	1 (33.3)	Nishiaki *et al.* 2015b: 5, fig. 4
	SSC/2	2 (66.6)	0	0	1 (33.3)	Nishiaki *et al.* 2015b: 7, fig. 6
	SSC/3	3 (60)	0	1 (20)	1 (20)	Nishiaki *et al.* 2015b: 9, fig. 9
Imiris Gora	SSC/I	0	0	1 (100)	0	Kiguradze 1986: 31, fig. 21
	SSC/II	0	1 (100)	0	0	
	SSC/III	1 (50)	1 (50)	0	0	
	SSC/IV	5 (35.7)	4 (28.6)	5 (35.7)	0	
	SSC/V	0	1 (33.3)	1 (33.3)	1 (33.3)	
	SSC/VI	0	1 (100)	0	0	
	SSC/VII	0	1 (33.3)	2 (66.6)	0	
	SSC/VIII	1 (33.3)	1 (33.3)	1 (33.3)	0	
	SSC/IX	1 (50)	1 (50)	0	0	
Khramis Didi Gora	SSC/IX	3 (75)	1 (25)	0	0	Kiguradze 1986: 72, fig. 59
	SSC/VIII	2 (66.6)	0	1 (33.3)	0	Kiguradze 1986: 73, fig. 60
	SSC/VII	2 (100)	0	0	0	Kiguradze 1986: 74, fig. 61
	SSC/VI	4 (80)	0	1 (20)	0	Kiguradze 1986: 75, fig. 62
	SSC/V	2 (50)	2 (50)	0	0	Kiguradze 1986: 76, fig. 63
	SSC/IV	0	0	0	1 (100)	Kiguradze 1986: 76, fig. 64
	SSC/III	0	1 (100)	0	0	Kiguradze 1986: 78, fig. 65
	SSC/II	3 (60)	1 (20)	1 (20)	0	
	SSC/I	0	2 (50)	1 (25)	1 (25)	Kiguradze 1986: 78, fig. 66
Kiçik Tepe	SSC/III	0	1 (50)	0	1 (50)	Personal data
	SSC/II	7 (77.8)	1 (11.1)	0	1 (11.1)	
Masis Blur	AC/I	0	1 (100)	0	0	Hayrapetyan *et al.* 2014: 187, fig. 6
Mentesh Tepe	SSC/I	7 (87.5)	0	0	1 (12.5)	Personal data
Shomu Tepe	SSC	10 (58.8)	4 (23.5)	3 (17.6)	0	Narimanov 1987: fig. 3
Shulaveris Gora	SSC	7 (38.9)	6 (33.3)	3 (16.7)	2 (11.1)	Dzhavakhishvili and Dzhaparidze 1975: 17, pl. III
Toïre Tepe	SSC/II	1 (100)	0	0	0	Narimanov 1987: 207, fig. 11, 208, fig. 12, 210, fig. 14; Narimanov 1992: 14-17
	SSC/III	2 (66.6)	1 (33.3)	0	0	
	SSC/V	1 (50)	0	1 (50)	0	

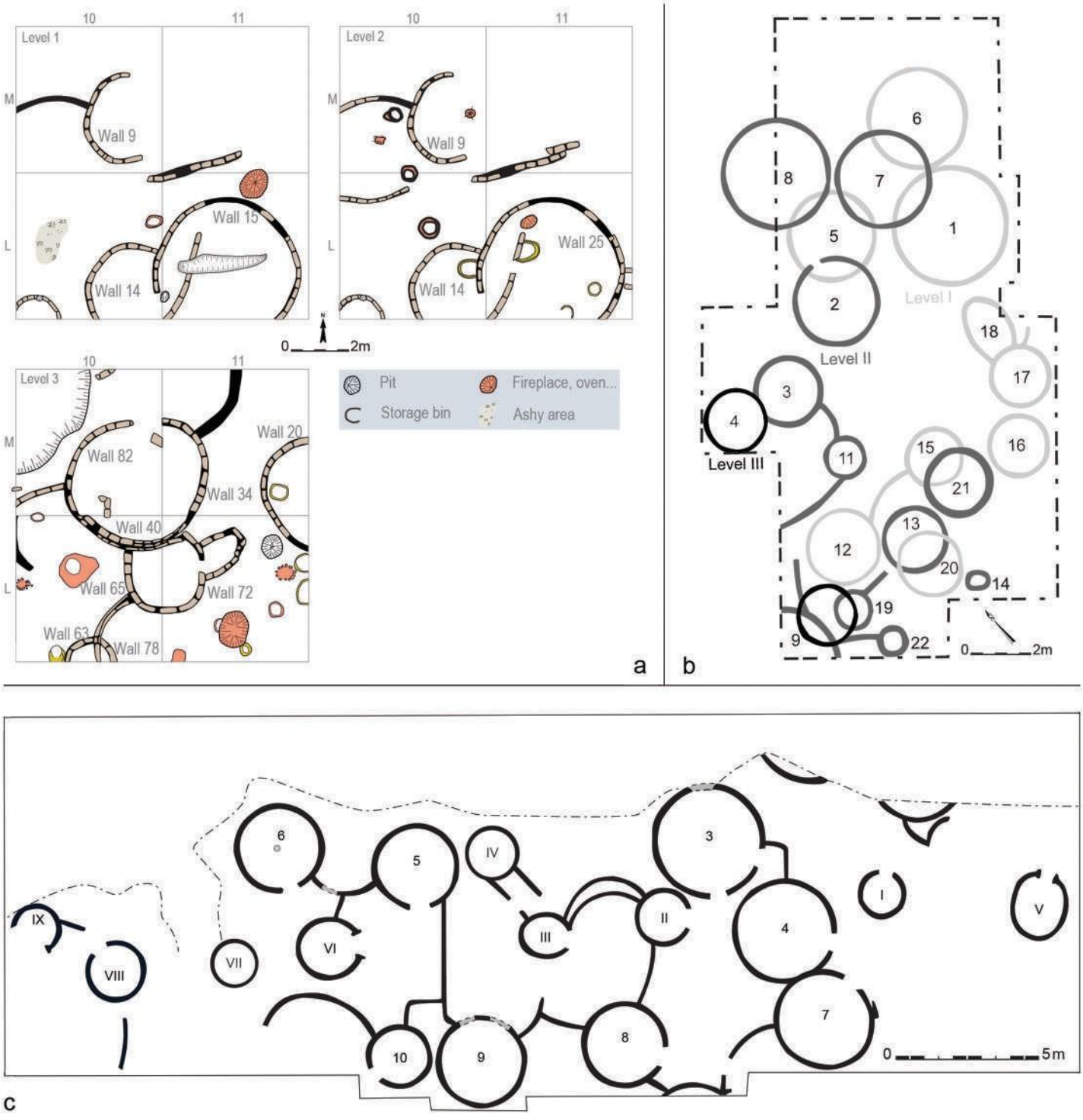


Fig. 13 – ***a.*** *Haci Elamxanlı Tepe, plan of levels 1 to 3 (after Nishiaki* et al. *2015b: 5, fig. 4, 7, fig. 6, 9, fig. 9);* ***b.*** *Gargalar Tepesi, plan of levels 1 to 3 (after Narimanov 1987: 216, fig. 20);* ***c.*** *Shomu Tepe, plan without orientation (after Narimanov 1992: 199, fig. 3).*

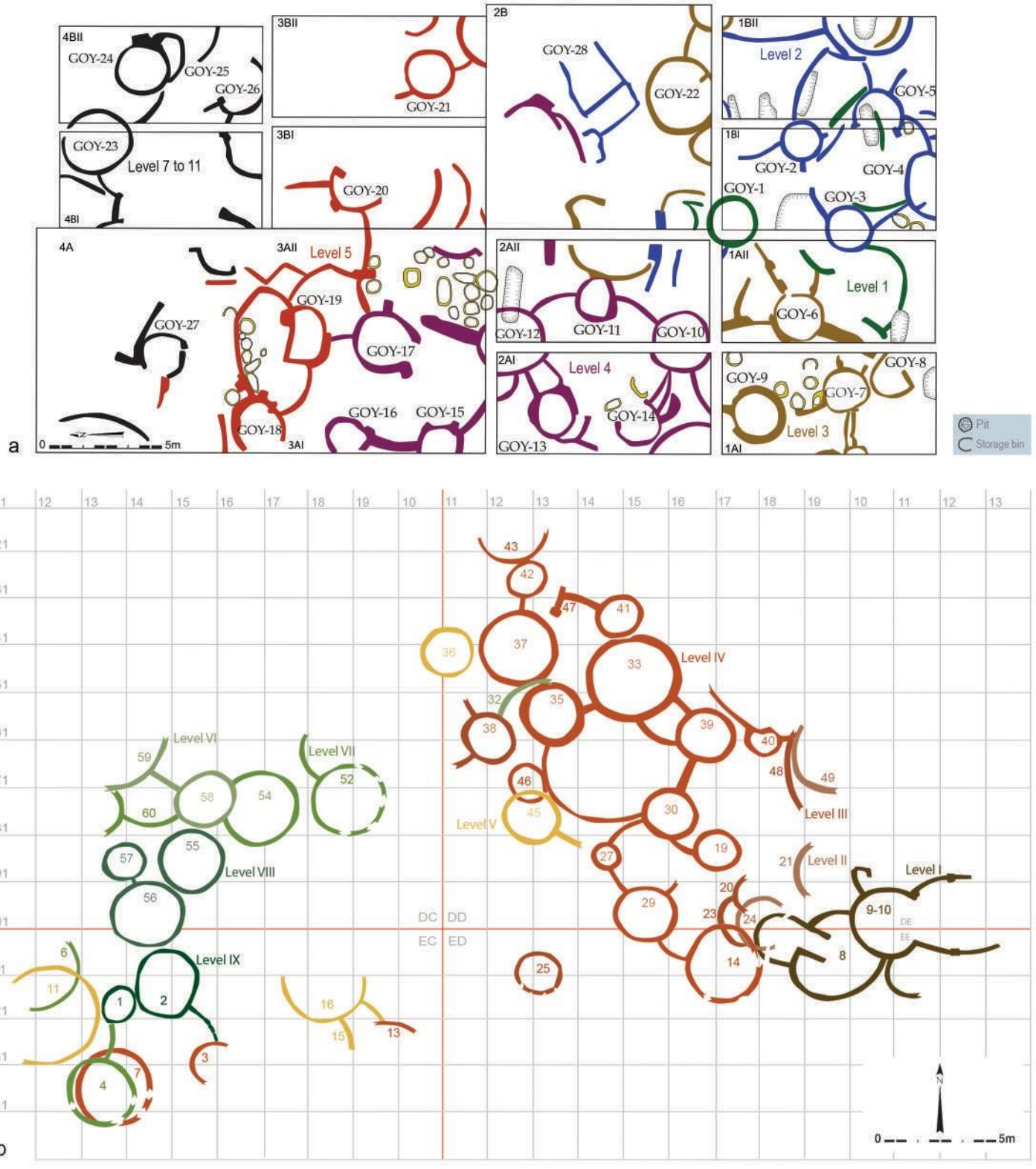


Fig. 14 – ***a.*** *Göy Tepe, plan of levels 1 to 11 (after Kadowaki* et al. *2015: 411, fig. 3);*
b. *Imiris Gora, plan of levels IX to I (based on Kiguradze 1986: 31, fig. 21).*

Monocellular buildings

I distinguished four categories based on their surface: less than 5 m^2 (category 1), between 5 and 9 m^2 (category 2), between 9 and 15 m^2 (category 3), and larger than 15 m^2 (category 4). There is a general tendency towards a reduction of the building surface area during the 6th millennium BC (fig. 15a and table 9).[19] This decrease in size is also visible at the scale of some sites such as Gargalar Tepesi, Aruchlo (between levels 1 to 7 and between the *Older* and *Younger Neolithic Settlement*), Chalagantepe, and Imiris Gora. Buildings bigger than 15 m^2 (diameter of 4.5 m) are mainly attested at the most ancient sites, before 5800-5700/5600 BC, but are not present afterwards when compounds appear (see above).

Storage facilities are predominant inside the buildings during the first third of the 6th millennium BC, as at Haci Elamxanlı Tepe (Nishiaki *et al.* 2015b: 5, fig. 4.7, fig. 6), Kiçik Tepe (fig. 8b-c, fig. 16a and c-d) and Gadachrili Gora (Hamon *et al.* 2016: 162, fig. 14- 15), but they are located in the courtyard of the compounds after this period, as it is attested at Göy Tepe (Guliyev and Nishiaki 2014: 6), Shulaveris Gora and Khramis Didi Gora, starting with level III. At Shulaveris Gora (Chataigner 1995: 61), Khramis Didi Gora (Kiguradze 1986: 47) and Imiris Gora (Dzhavakhishvili 1973: 24-25), hearths and fireplaces are always located inside the buildings, while combustion facilities such as at Göy Tepe (Guliyev and Nishiaki 2014: 6) are usually identified outside of the buildings.

Circular building with interior division

At Kiçik Tepe, a partition wall divides Building 2 in two parts (fig. 16a). Unfortunately, due to significant erosion in the western flank of the site, it was not possible to restore the organisation of the western part of the building. At Gadachrili Gora, the building was divided into two equal parts by a north/south mud-brick wall, located to the east of the northern and southern entrances (fig. 17b). Its 20 cm conservation height corresponds to its initial stage because the floor level rests on top of this low wall. The section (fig. 17a and c) showed a sudden break in the floor level, west of the wall, a likely indicator of a kind of crawl space, possibly an elevated floor, perhaps installed on pilettes in perishable materials.

To sum up, the evolution of the architectural organisation, from the snowman-shape to compounds, is confirmed at most of the sites with sound stratigraphic evidence. This change can be dated to the end of the first third of the 6th millennium BC, *i.e.*, contemporary with the disappearance of the larger buildings. This change also seems linked to a shift in domestic activities (Kadowaki *et al.* 2015: 423), carried out inside of the domestic structures in the oldest settlements and outside (but still in the interior of the compounds) from the middle of the 6th millennium BC. For the oldest buildings, it was not possible to distinguish the building functions according to their size because facilities are located both in small and large buildings (fig. 15b).

19. Only the Khramis Didi Gora site testifies to the inverse phenomenon of an increase in surface area. A review of the stratigraphy would certainly allow us to understand the reason for this phenomenon.

Covering and roofing

For a long time, archaeologists have proposed a dome-shaped (or beehive-shaped) roof, for the Neolithic buildings of the Southern Caucasus (Dzhavakhishvili and Dzhaparidze 1975: 26). The presence of a pronounced internal batter has often guided these interpretations, as at Shulaveris Gora, where it is understood as the departure of a corbelled vault (Dzhaparidze and Dzhavakhishvili 1971: 110).

Recently, F. Guliyev and Y. Nishiaki have emphasised the impossibility of a beehive coverage because of the thinness of the walls (Guliyev and Nishiaki 2014: 6). In other cases, a flat roof had been restituted thanks to the presence of postholes such as at Imiris Gora (Dzhavakhishvili and Dzhaparidze 1975: pl. XV, fig. 1) and Khramis Didi Gora. Wooden poles have also been identified at Göy Tepe (Guliyev and Nishiaki 2014: 5) and Aruchlo (Hansen and Ullrich 2017: 203). At Mentesh Tepe, the discovery of three postholes near the mud-brick wall, and of one pole imprint in the central part of the larger building enabled us to restore a system of supporting posts, and to reconsider the hypothesis of a curtain wall function for the mud-brick perimeter wall (Baudouin *et al.* 2017: 44, 46, fig. 5; Baudouin *et al.* 2018: 61). At Kiçik Tepe, the good preservation of Building 2 (fig. 16b) led to the restitution of part of its elevation (table 10). According to the archaeological (Margueron 1987) and ethnographic dataset (Houben *et al.* 2006: 279), it is possible to restore an overall height of *ca.* 3.2 m for this building.

DISCUSSION

The difference between a circular and rectangular plan has been used in the past to distinguish between nomadic and sedentary populations (Whithing and Ayres 1968; Flannery 2002). Although circular architecture is deemed to be the preferred plan for temporary occupations and mobile populations, its use does not exclude more stable occupations. This latter hypothesis deserves to be examined in detail, especially considering that

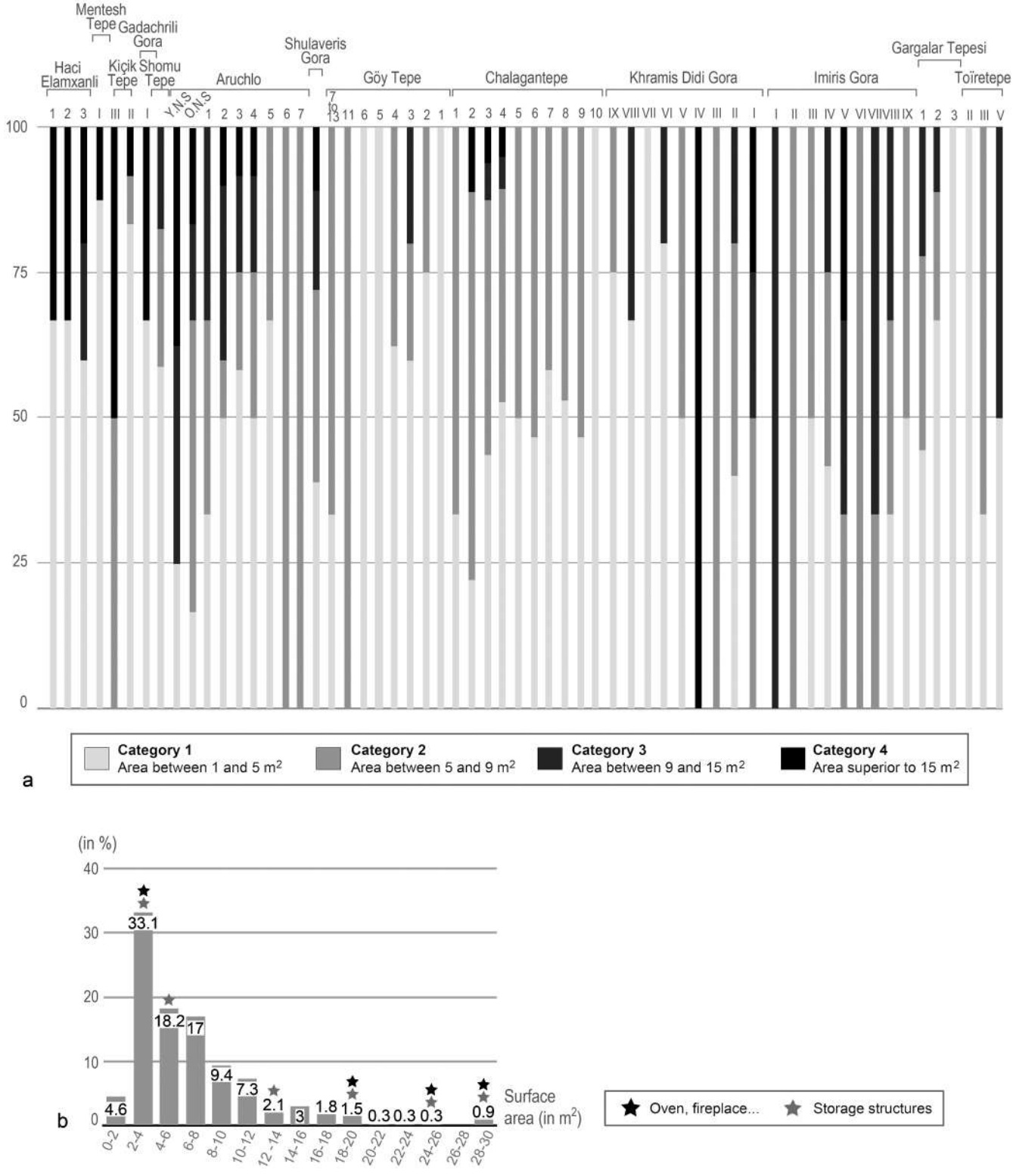


Fig. 15 – *Building's surface areas (E. Baudouin).* ***a.*** *Summary diagram of the building's surface areas in the 6th millennium BC, expressed as a percentage;* ***b.*** *Distribution of circular buildings according to surface area, expressed as a percentage.*

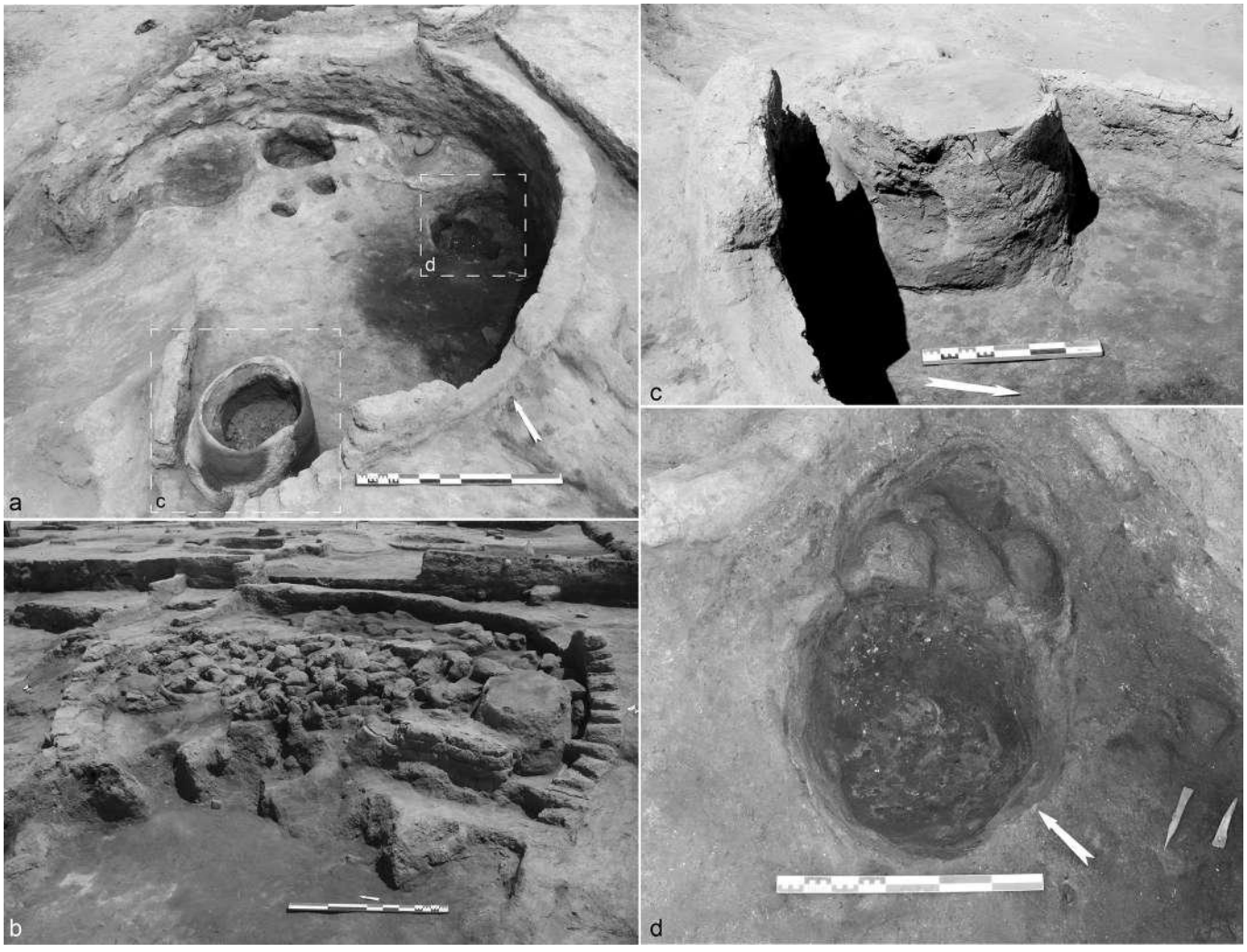


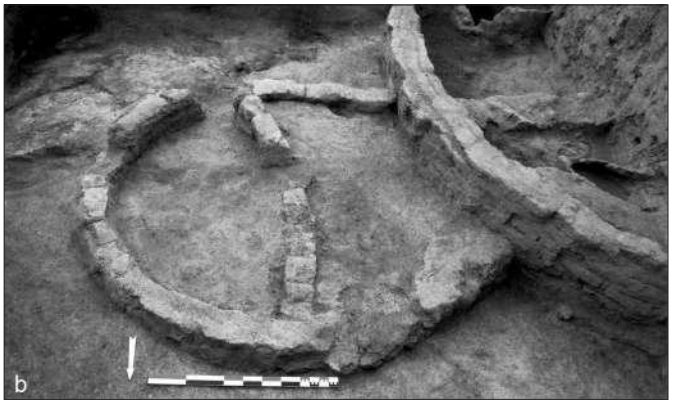
Fig. 16 – *Kiçik Tepe, square H8, Building 2 (photo mission Boyuk Kesik, MEAE).* ***a.*** *General view of Building 2 with location of structures, view from the south;* ***b.*** *The collapsed layer of mud-bricks and roof remains, view from the south-west;* ***c.*** *Storage bin (USC 19) in the southern part of the building, view from the east;* ***d.*** *Fireplace (Fy-5) in the eastern part of the building, view from the southwest.*

the circular plan is the only plan attested in a large area of the Southern Caucasus for more than seven hundred years. This apparent technical inertia in architecture could also be related to the absence of knowledge of quoin bonding and, more generally, of the technical evolution of bonds.

ARE ROUND HOUSES A CLUE FOR MOBILITY IN THE SOUTH CAUCASIAN NEOLITHIC?

At several sites (Mentesh Tepe, Imiris Gora, Khramis Didi Gora, Göy Tepe), the repeated reconstruction of buildings in the same place has been observed, which suggests a "temporary" but regular occupation of the same place. Nevertheless, the duration of occupation remains difficult to quantify (a few months? one year? several years?). Recent research at Göy Tepe has made it possible to estimate the occupation duration of the circular buildings to be between five and fifteen years (Nishiaki *et al.* 2018: 125-126).

The debate on the relations between mobility and circular architecture stems from an analogous discussion on the sedentary lifestyle of Halafian populations which often feature a circular house plan (Pollock 2013). In this latter case, the hypothesis of populations attached to several seasonal places



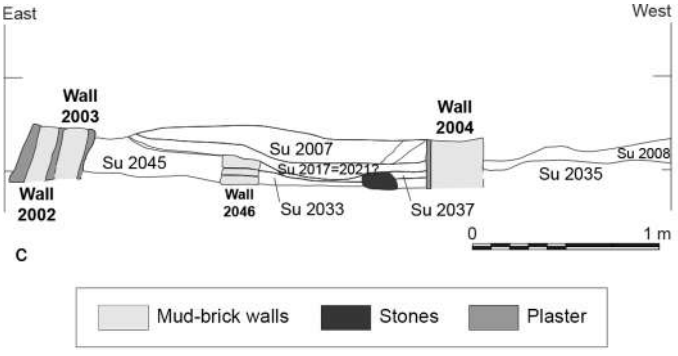


Fig. 17 – *Gadachrili Gora, Building 2003, trench 2:* ***a.*** *View of the south baulk in Building 2003, before excavation, view from the north (C. Hamon);* ***b.*** *General view of Building 2003 with Wall 2046 in the centre, view from the north (after Hamon* et al. *2016: 162, fig. 17);* ***c.*** *East-west section of Building 2003 (drawing E. Baudouin).*

Table 10 – *Summary table of measurements for the restitution of the elevations of Building 2 at Kiçik Tepe (E. Baudouin).*

External diameter (in m)	5.3
Overall surface area (in m^2)	22.06
Internal diameter (in m)	4.8
Usable surface area (in m^2)	18.1
Height of the preserved mud-brick wall (in m)	1.3
Height of the preserved collapse layer (in m)	0.6
Overall volume of the building (in m^3)	28.68
Usable volume of the building (in m^3)	23.52
Volume of the preserved mud-brick wall (in m^3)	5.16
Volume of the collapse layer inside the building (in m^3)	10.86
Presumed overall volume of the collapse layer (in m^3)	14.48
Presumed thickness of the roof (in m)	0.3
Presumed volume of the roof (in m^3)	8.2
Presumed volume of the collapse (mud-bricks and roof) (in m^3)	6.28
Presumed volume of the collapsed mud-brick wall (in m^3)	3.55
Presumed height of the missing elevation (in m)	1.58
Presumed height of the overall elevation (in m)	2.88

has been advanced in place of sedentariness. Mobility could have been linked to an economy founded on cyclical agriculture, although that does not necessarily exclude that part of the community was sedentary (Bréniquet 1996: 62).

In the Southern Caucasus, the seasonal occupation of settlements can be explained through two different perspectives: 1) the seasonal mobility of livestock leading to the practice of transhumance (Badalyan *et al.* 2010)[20]; indeed, indirect evidence of the transhumant lifestyle led by the South Caucasian communities could also be argued through the exploitation of obsidian in the highland mountains (Chataigner and Gratuze 2013); and 2) the abundant presence of *in situ* artefacts, like usable tools on the floors at Göy Tepe (Nishiaki *et al.* 2018: 128), or in caches "to store important items for future use" (Nishiaki *et al.* 2018: 129) at Göy Tepe, Aratashen (Badalyan *et al.* 2004: 402-404), Aknashen-Katunarkh (Badalyan *et al.* 2010: 189-190), Aruchlo (Hansen *et al.* 2007: 6), Haci Elamxanlı Tepe (Nishiaki *et al.* 2015b: 14) and Kiçik Tepe (see n. 6), which could point, according to ethnoarchaeological studies, to a shorter period of absence (Graham 1993).

DEFINITION OF "HOUSE" AND THE CHANGE IN THE SETTLEMENT PATTERNS

The concept of "house" is important in this study and relies on ethnographic parallels which shed light on the multipurpose use of built space. In the Kasena communities in Burkina Faso and Ghana, the "house" consists of a set of circular or

20. A programme of isotope analysis on animal teeth from Mentesh Tepe and Kamiltepe headed by M. Mashkour (Museum national d'Histoire naturelle, Paris) is in progress.

rectangular rooms (compound) grouped around a courtyard or scattered across an open area (Liberski-Bagnoud 2002: 67-73). In the case of courtyards, these include the bulk of domestic activities with storage facilities. If the "inside" and "outside" notions are pregnant, they do not exclude a certain porosity, as is the case for ritual-related rooms or meeting rooms, located physically outside of the "house" but considered as an integral part of it. Finally, these compounds are scattered within a sparse village complex (Liberski-Bagnoud 2002: pl. I).

During the Neolithic in the Southern Caucasus it is important to note an evolution of the house cells, moving from a snowman-shaped plan to a more complex organisation of compounds. This change in the organisation of the household could be related to the abandonment of the older small settlements, such as Gadachrili Gora or Kiçik Tepe, whose surface area was less than 1 ha, to the benefit of larger settlements, such as Göy Tepe or Khramis Didi Gora whose area reached 4-5 ha.

This transformation of settlement patterns could be explained by population pressure (Dzhavakhishvili 1973: 11). The absorption of the population into larger settlements corresponds to a different evolutionary pattern from the Halaf one, where population pressure could have been absorbed by the dynamics of segmentation, visible in an increase of small settlements. According to the typology proposed by C. Meillassoux (1975) and adapted by J.D. Forest (1996: 35) for the Near East, the organisation of the Halafian communities is "segmentary", while that of Caucasian communities would have been "integrated", as reflected by an increase in the size of the households living in the compounds. The disappearance of large and snowman-shaped buildings could have been a result of a change in the social organisation. This change may explain the withdrawal of the family unit from compounds because domestic activities are now taking place in and around the courtyards.

MEANING OF SEMI-SUBTERRANEAN ARCHITECTURE

Semi-subterranean architecture is a well-known phenomenon in archaeology and ethnography. It is usually associated with communities (Aurenche 1981: 101) who have recently adopted a sedentary way of life. For instance, the practice of digging soil to build a house is documented in the Near East during the Kebaran and Natufian (Aurenche 1981: 101). Some scholars have suggested that this solution was adapted to cultures with a limited building knowledge and not yet fully developed construction techniques (Cauvin 1978: 23; Aurenche 1981: 98).

Several ethnographic studies corroborate these interpretations. In Ghab (Syria), the correlation between historical (successive stages of settlement), natural (adjustment to the way of life and the environment) and social (different livelihoods) factors are essential to understand the establishment of semi-subterranean buildings of formerly nomadic populations from the mountains to the Jélémé Gulf (Thoumin 1936: 488-489). Similar accounts describe the winter huts (*debbadé*) of Bedouin tribes in the Syrian Middle Euphrates (Daker 1984).

In the Southern Caucasus, at Aruchlo, Mentesh Tepe and Haci Elamxanlı Tepe, it is clear that these installations date to the earliest occupation phases. Nevertheless, at both Mentesh Tepe (Lyonnet *et al.* 2017) and Haci Elamxanlı Tepe (Y. Nishiaki, unpublished data) semi-subterranean buildings are contemporary with the above ground buildings. The diffused presence of the semi-subterranean architecture in the Kura Valley at the beginning of the Neolithic and the absence, up until now, of an earlier phase of the "settled" history in the region could point to an autonomous genesis of this architectural technique in the region. This, however, does not exclude relationships with neighbouring regions. What is more, if we consider the use of plano-convex mud-bricks from Kvemo-Kartli and the Kura Valley (SSC) up to the Mil Plain (Kamiltepe culture), a common origin for the communities of the region may also be suggested: that they participated in the same regional network (Kadowaki *et al.* 2015: 423).

CONCLUSIONS

Architecture is an original approach to the questions on the Neolithisation process in the Southern Caucasus and for understanding the cultural dynamics in the region. Architectural data allows for new considerations on the South Caucasian Neolithic communities to be proposed. From this multiscale typo-technological approach, it is possible to determine the content of the technical exchanges between the Caucasian communities and to emphasise the convergences and differences that characterise the evolution of architecture in the region.

First of all, common architectural techniques link all the Southern Caucasus communities; this is the case of the stretcher bond, the circular plan and the recurrent lack of quoin bonding. These elementary techniques point to the similar and basic technical level of these communities. Although we have observed changes in the building layouts (from the snowman-shape to the compounds at the end of the first third of the 6th millennium BC, or the gradual reduction of the building's

size and gradual standardisation of mud-bricks during the 6th millennium BC), no real technical evolution is documented. At the scale of the Southern Caucasus, these convergences define similar requirements and technical skills; thus, marking the existence of a rather homogeneous "techno-cultural" entity.

Moreover, we noticed regional features characterising the Araxes (cob), the Kura Valley (plano-convex mud-bricks, semi-subterranean buildings) and the Mil Plain (terrace). These particularisms could testify to a cultural splitting, while privileged relationships were maintained between the Ararat Plain and the Kvemo-Kartli Plain. These regional differences question the presumed integrity or unity of the Neolithic phenomenon in the Araxes, Kvemo-Kartli and Middle Kura valleys (Badalyan and Harutyunyan 2014: 161). This evidence allows us to consider the Southern Caucasus as a segmented geographical area within which distinct "techno-cultural" entities developed and technical similarities were the possible result of networks of exchange between neighbouring communities.

The use of semi-subterranean architecture in the Middle Kura Valley represents a key element to propose autonomous sedentarisation in the Southern Caucasus, apart from the Near East developments.[20] In addition, the cultural isolation of the Caucasian communities could also be due to their geographical position, although it is clear that sporadic relationships existed at least since the beginning of the 6th millennium BC, as evidenced by the presence of ceramics with a "Mesopotamian" style at several South Caucasian sites.

To conclude, the study of architecture is a driving force to understand evolutive dynamics within sedentary communities. The results presented here are a first stage in the study of the Neolithic architecture in the Southern Caucasus and several questions will need to be reconsidered along with further excavations, especially as far as the origins and development of earthen materials are concerned.

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