McDONALD INSTITUTE CONVERSATIONS

Inspired geoarchaeologies: past landscapes and social change

Essays in honour of Professor Charles A. I. French

Edited by Federica Sulas, Helen Lewis & Manuel Arroyo-Kalin

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with contributions from
Michael J. Allen, Andrea L. Balbo, Martin Bell, Nicole Boivin, Christopher Evans, David Friesem, Kasia Gdaniec, Lars Erik Gjerpe, Michael Gill, Martin Green, Ann-Maria Hart, Robyn Inglis, Martin Jones, Gabriella Kovács, Helen Lewis, Johan Linderholm, Roy Loveday, Richard I. Macphail, Caroline Malone, Wendy Matthews, Cristiano Nicosia, Bongumenzi Nxumalo, Innocent Pikirayi, Tonko Rajkovaca, Rob Scaife, Simon Stoddart, Fraser Stuart, Federica Sulas
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On the cover: *Hand drawn illustration by Charly French, aged around 10 years old. Courtesy of Kasia Gdaniec.*

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Mike's (BSc, PhD, MCIfA, FLS, FSA) research and geoarchaeological interest was originally based around the analysis of colluvium and land snails, including in the South Downs, Dorchester, Cranborne Chase, Stonehenge and Avebury in particular; these were the subject of both his undergraduate and PhD research. He has combined a career dominated by commercial archaeology with involvement in university research projects and as a staff lecturer at Sussex, Bournemouth and Oxford Universities. He was Environmental Manager at Wessex Archaeology for twenty years and for fifteen years has run his own geoarchaeological consultancy from a purpose-built bespoke lab, where he is involved in research designs and coordination of environmental archaeology from fieldwork to publication. Projects have been as diverse as intertidal zone research and Maltese prehistoric temples. His interests now lie principally in landscape archaeology and the development and creation of landscapes through prehistoric human intervention. He has worked with – and still is working with – Charly French in Cranborne Chase, the Stonehenge Riverside Project, and both recent Avebury landscape projects. He is vice-president of the Conchological Society, and as founding editor of the Prehistoric Society Research Papers has seen ten peer-reviewed volumes through to publication.

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Martin began a fieldwalking survey as a lad on Cranborne Chase in the latter 1960s. Following experience gained on a number of field projects, he began excavating independently in the region in 1976. He joined Richard Bradley's and John Barrett's Cranborne Chase Project the following year, contributing four site excavations to *Landscape, Monuments and Society* in 1991. He continued independent fieldwork in the early 1990s in collaboration with Mike Allen, in particular on the Fir Tree Field shaft which revealed a remarkable sequence of deposits dating from the late Mesolithic to the Beaker period, and worked with Charly French on the Upper Allen Valley Project 1998–2003, contributing four further site excavations to *Prehistoric Landscape Development and Human Impact in the Upper Allen Valley, Cranborne Chase, Dorset* (2007). Since that time, he has continued independent research, also in collaboration with Josh Pollard and Southampton University, on the Dorset Cursus, on Down Farm and in the Knowlton environs whilst continuing to increase the biodiversity on his small farm. He was made an FSA (Fellow of the Society of Antiquaries) in 2004 and received an honorary Doctor of Science degree from Reading University in 2006.

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Richard trained in geology and geography, specializing in soil science (BSc Swansea University). An MSc in pedology and soil survey (Reading University) prepared him for a soil science PhD on podzol development on heathlands (Kingston Polytechnic). An English Heritage-funded archaeological soil contract at the Institute of Archaeology (University College London) provided further training and international research opportunities were developed, including working with the Soil Survey of England and Wales and Macaulay Institute, UK, the CNRS, France, and the Soprintendenza, Italy. This led to the publication of *Soils and Micromorphology in Archaeology* (with Courty and Goldberg; Cambridge University Press 1989), the founding of the International Archaeological Soil Micromorphology Working Group, and training weeks at UCL. As a result, *Practical and Theoretical Geoarchaeology* (Blackwell 2006; Wiley 2022) and *Applied Soils and Micromorphology in Archaeology* (Cambridge University Press 2018), both with Goldberg, were written. Macphail is a recipient of the Geological Society of America's Rip Rapp Award for Archaeological Geology (2009), and is a fellow of the Geological Society of America. He is also the 2021 co-awardee (with P. Goldberg) of the International Union of Soil Sciences Tenth Kubiëna Medal for Soil Micromorphology. The paper included here also reflects more than two decades of research across Scandinavia.

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Francis has studied the archaeology of the Fens since 1971. His major excavations in the region took place near Peterborough at Fengate, Maxey and Etton. In 1982 his team's survey of fenland drainage dykes revealed the timbers of a waterlogged Bronze Age timber platform and causeway at Flag Fen, which was opened to the public in 1989. He was a member of Channel 4's long-running series *Time Team*. He has written many popular books including *Seahenge* (2001), *Britain BC* (2003), *Britain AD* (2004), *The Making of the British Landscape* (2010), *Home* (2014), *Stonehenge* (2016) and *The Fens* (2019). His most recent book is *Scenes from Prehistoric Life* (Head of Zeus 2021).

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Figures

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Chapter 13

Soil micromorphological observations of construction techniques at Százhalombatta-Földvár Bronze Age tell settlement, Hungary

Gabriella Kovács & Magdolna Vicze

The Bronze Age tell site of Százhalombatta-Földvár, Hungary has been excavated for nearly twenty years now by the international Százhalombatta Archaeological Expedition (SAX) project. Scientific methods have been an integral part of the research from the beginning (Vicze 2005). One of these is archaeological soil micromorphology, which has been providing data since 2000 (Kovács 2009; 2012; 2013; Kovács et al. 2020). Microscopic examination of undisturbed soils and sediments via thin section analysis can be used effectively for the differentiation of building materials and for the observation of certain steps in construction techniques. Silty clay is one of the main construction materials used at the tell site. This chapter examines the building material and technique of the Vatya Culture. Furthermore, this paper is intended to demonstrate the potential of thin section soil micromorphology in relation to construction techniques in light of the SAX project's results.

Clay is one of the most extensively used raw materials of the prehistoric tell-forming societies of the Carpathian Basin. Clay/earthen architecture has been investigated worldwide in many sites through archaeological soil micromorphology (e.g. Courty *et al*. 1989; Milek 2012; Friesem *et al.* 2017b; Matthews 1995; 2020; Lisá *et al*. 2020; and see Friesem in this volume), with Near Eastern tells providing a great source of information at both macro- and micro-scale (e.g. Gé *et al*. 1993; Matthews & Farid 1996; Matthews *et al*. 1996). Clay is a durable substance that has long been used in construction (e.g. for dwellings, craft areas/workshops), and vast amounts of everyday household items are also made of it (pots, cups, bowls, loom weights, spindle whorls, etc.). This is what we find at the Vatya Culture Százhalombatta-Földvár tell site in Hungary (Fig. 13.1), dating to the Middle Bronze Age (2000/1900–1500/1450 BC). Over the past twenty years of excavation, countless forms of clay usage have been identified (Poroszlai 1998; 2000a; 2002; Poroszlai & Vicze 2004; Vicze 2013); the inhabitants of Százhalombatta-Földvár constantly used this naturally present material, and clay was of great importance for the Vatya people who lived at the site. Tons of it were used for the construction of walls and floors, and for making household items and some furnishings (e.g. hearths, containers, installations) (Fig. 13.2). The versatile use and conscious application of clay was an integral part of Bronze Age people's lives (Sofaer 2015, 15–16). Here, we employ soil micromorphology to add new details to our understanding of the socially embedded traditions and experience-based mastery of clay use by Bronze Age people. This chapter also aims to offer data from a temperate-zone tell site in the Carpathian Basin, as these sites have not been extensively investigated in such depth to date.

Natural clay deposits can contain components such as quartz, feldspar, lime, mica and other mineral fragments, and also metal oxides, gypsum, mollusc shells, and organic matter. Based on plasticity, 'fat' and 'lean' clays can be differentiated. These terms refer to liquid limits (fat clays have liquid limits >50, are expansive and/or shrink-swell clays, while lean clays have <50 liquid limits, and less plasticity due to the presence of sand/silt; the type of mineral making up the clay contributes greatly to these characteristics; Brady 1990). The fatter the clay is, the more it will shrink when dried or fired; shrinking, cracking, and bending are unfavourable properties for pottery production. Such clays need to be tempered to achieve a sufficient mixture that is suitable for a given task (e.g. wall construction, hearth renovation or vessel production). Heat resistance can also be changed by adding temper, which is an essential characteristic during firing. The type of temper greatly varies depending on the product to manufacture. Tempers can be either organic (e.g. straw, chaff or manure; Szakmány 2008) or non-organic (e.g. sand, grog; *ibid*.; Kreiter 2007; Kreiter *et al*. 2007).

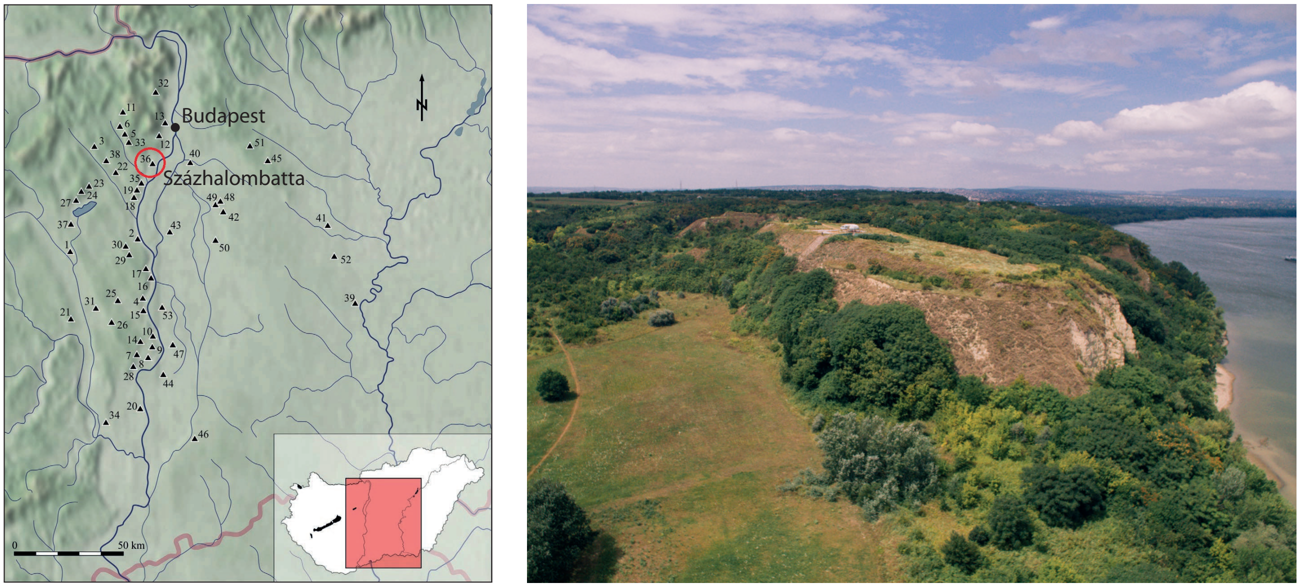


Figure 13.1. *Százhalombatta-Földvár (Map after Szeverényi & Kulcsár 2012, 289; aerial view photo by Márton Gorka). Images: authors.*

In the Hungarian archaeological terminology 'clay' refers to a very fine grained, yellow soil/sediment that is used for construction (e.g. Kovács 1963; Bóna 1982; Poroszlai 2000c). In soil science, clay is defined as the finest sediment, with grain diameters of less than 0.002 mm (Stefanovits *et al*. 1999). Therefore, for accuracy, in this paper the term 'silty clay' is used to describe construction materials as they do not reach the finest size limits.

In Hungary, analysis of 'archaeological clays' has mainly been covered by petrographic studies. Analysis of ceramic thin sections is carried out more and more frequently (e.g. Kreiter 2007; Gherdán *et al*. 2007; Szakmány & Nagy 2017). A limited number of studies have investigated types of clays employed in materials such as daub, loom weights, and floors from the Neolithic period (e.g. Kovács *et al*. 2009; Starnini & Szakmány 2009). Ceramic production is one of the major clay-consuming activities at Százhalombatta-Földvár. Numerous papers have discussed the typological, chronological, petrological and technological aspects of the ceramics found on the site (e.g. Poroszlai 2000a; Sofaer 2006; 2011; Kreiter 2007; Kreiter *et al*. 2007; Budden 2007; 2008; Budden & Sofaer 2009). The present study focuses on other major clay-utilizing activities, namely construction of house floors and walls, using soil micromorphological analysis.

Our knowledge of Vatya culture houses and buildings is mainly about their structure, dimensions and number of rooms (e.g. Bándi 1960; Kovács 1963; Bándi & Petres 1969; Bóna 1982; 1991; 1992; Poroszlai 1988; 1992a,bc; 2000b; Vicze 1992; 2013; P. Fischl *et al*. 1999). Some data are also available on the material of the walls and floors. Previously,

Figure 13.2. *House wall and silty clay floor, wall remains, installation (Site: Százhalombatta-Földvár). Images: authors.*

researchers believed that Bronze Age people lived in pit houses (Marosi 1930). Once it became evident that this was not the case, clay was recognized as a material used for floor preparation (Kovács 1963). This was observed at the following sites: Aba-Belsőbáránd-Bolondvár (*ibid*., 131), Alpár-Várdomb (Bóna 1982, 30, 33–8), Baks-Homokbánya (P. Fischl *et al*. 1999, 93), Baracs-Bottyánsánc (Bóna 1991, 75; Vicze 1992, 147), Bölcske-Vörösgyűrű (Poroszlai 2000b, 124), Kakucs-Turján (Jaeger *et al.* 2018, 103), Lovasberény-Mihályvár (Kovács 1982, 283), Nagykőrös-Földvár (Poroszlai 1991, 59; 1992c, 157–8), Solymár-Mátyásdomb (Valkó 1941, 99), Sárbogárd-Cifrabolondvár (Bándi 1960, 150), and Százhalombatta-Földvár (Poroszlai 1992b, 153; 1993b, 14; 2000c, 104). Earthen floors were registered in only two cases: at Százhalombatta-Fölvár, in an area bordered by stakeholes and postholes that was used for penning (Poroszlai 2000a, 26), and at the Alpár, where the interior of a house room was deliberately made and used with an earthen floor (Bóna 1982, 36). This highlights that the raw material used for flooring was not uniform.

Various materials and techniques are also documented in the case of walls. At least two main types of walls can be differentiated: wattle-and-daub walls and beaten clay/earth walls. Remains of wattle-and-daub walls have been found at the sites of Alpár-Várdomb (Bóna 1982, 33, 34), Baks-Homokbánya (Trogmayer 1966; P. Fischl *et al*. 1999, 102), Csongrád Vidre-sziget (Szénászky 1977, 18–22), Kakucs-Turján (Jaeger *et al*. 2018, 213), Solymár-Mátyás-domb (Valkó 1941, 99), Százhalombatta-Földvár (Poroszlai 1996, 11-12, 2000a, 25), Aba-Belsőbáránd (Kovács 1963, 131), Baracs (Vicze 1992, 147), Bölcske (Poroszlai 1993a, 62), Pákozd (Marosi 1930, 58) and Sárbogárd (Bándi 1960, 150). Beaten clay walls were noted at Alpár-Várdomb (Bóna 1982, 34), Bölcske-Vörösgyűrű (Poroszlai 2000b, 124), Nagykőrös-Földvár (Poroszlai 1992c, 157) and Százhalombatta-Földvár (Poroszlai 2000c, 104). It is very likely that various raw materials were used for the different wall types. Diversity is well illustrated from Alpár where Bóna (1982, 35) recorded the presence of: 'rammed, hard, brownish-yellow, brown or black walls…' Examples of re-plastering have also been documented in both main wall types, e.g. at Baks-Homokbánya (Trogmayer 1966, 217), Bölcske-Vörösgyűrű (Poroszlai 1993a, 62), Sárbogárd-Cifrabolondvár (Bándi 1960, 150) and Százhalombatta-Földvár (Poroszlai 1992b, 153). This clearly shows that walls, like floors, were also not uniform.

The Vatya houses of Százhalombatta-Földvár site provide a unique opportunity to investigate wall and floor construction, and their building materials, in great detail (e.g. composition, building technique) via soil micromorphology.

Methods

Thin sections (Table 13.1) were produced by G. Kovács at the McBurney Laboratory for Geoarchaeology (see French & Rajkovaca 2015 for protocols) and analysed using a Nikon Eclipse E200 polarizing microscope at 20x, 40x, 100x and 200x magnifications. Microphotographs were taken under plane (PPL) and cross polarized light (XPL) for the determination and presentation of the various components. The ratio of the coarse and fine materials (c:f distribution) was set at 100 μm. The proportion of components was estimated by visual estimation (Stoops 2003). Observations are shown in graphs. Structure was characterized by the coarse:fine ratio, the compactness of the layer (porosity) and by the level of bioturbation (Table 13.2). Only the most common minerals were recorded (quartz, polycrystalline quartz, muscovite, glauconite, biotite, chlorite and Sarmathian limestone). Inorganic residues of biological origin were also noted (e.g. phytoliths; Piperno 1988; and spherulites – an indicator of dung; Canti 1997). Anthropogenic inclusions comprise both organic (e.g. charcoal) and biomineral (bone) and other inorganic components (e.g. ceramics, daub, ash, slag), which can be associated with particular activities or spaces.

Results and discussion

As noted above, some data were already available on Vatya houses prior to the more recent investigations of Százhalombatta-Földvár. Here, some results of the ongoing SAX project will be presented. Soil micromorphological samples from seven Vatya houses (floors and walls) were analysed to add details to construction techniques and material choices.

Floors

Two main floor types were documented previously, and both were identified at Százhalombatta-Földvár: the so-called earthen floors and the more obvious clay floors ('clay' here refers to a very fine grained, yellow soil/sediment that is used for construction, e.g. Kovács 1963; Bóna 1982; Poroszlai 2000c). According to our observations, clay floors appear more frequently at the site. In some cases, however, it became evident that earthen floors were constructed first, and later this practice was changed to preparing silty clay floors on top of an earlier earthen floor (e.g. houses ID 1818 and 3147).

Detection of silty clay floors during the excavation was much easier compared to earthen floors,

Table 13.1. *List of the samples analysed.*

Sample code		Stratigraphy/ Microlayers	Description	Archaeological context
MS9/2 2003	Floors and related silty clay	g	Silty clay floor layer; passive zone	House 3733
MS13/1 2002		a		House 127
		c		
		d		
MS27 2004		a, b, c, d		House 3136
MS29 2004		b, c		
MS34 2004		g		House 3181
MS35 2004		g		
MS32 2004		g		House 1818
MS43/1 2004		d	Earthen floor	
MS6 2004		b	Silty clay floor layer; passive zone	
		d	Earthen floor	
MS7/1 2002		c	Silty clay floor layer; passive zone	House 3147
		d	Earthen floor	
MS7/2 2002		b	Silty clay floor layers; passive zone	
		c	Silty clay matter as building material	
		d, e, f, g, h	Earthen floors	
MS5 2004		g	Silty clay floor layer; passive zone	
		h	Silty clay matter as building material	
		i, j	Earthen floor	
MS13 2004		f	Silty clay floor layer; passive zone	
		k, l	Earthen floor	
MS8/1 2003		b, c, d, e, f	Silty clay floor layers; passive zone; renewals of floor	House 3700
MS9/2 2003		d	Silty clay floor layers; passive zone	
3230	Daub and re-plasterings	-	Daub	Wall

simply due to their distinctive yellow colour. Samples of seven houses (IDs 127, 1818, 3136, 3147, 3181, 3700, 3733) were processed and analysed to observe differences and variations (Figs. 13.3 and 13.4). The very fine matrix of the silty clay floors consists mainly of mineral matter (clay, quartz, polycrystalline quartz, muscovite, biotite, glauconite and chlorite). Quartz and polycrystalline quartz occur with higher frequency (Fig. 13.5). The fabric (matrix) of such floors is very compact. Anthropogenic components (e.g. bone, ash, ceramic fragments) are only occasionally present (Fig. 13.5). It seems that silty clays used for flooring were not tempered with vegetal matter. Although phytoliths are present in small quantities, they may be part of the raw material. In some cases, larger amounts of organics are detectable (mainly in the form of pseudomorphic plant remain voids). However, organics appear locally in clusters, and this suggests that they entered the clay matter accidentally, maybe from the surroundings during application or use (e.g. MS7/2 2002 b in house 3147 or MS9/2 2003 g in house 3733; Fig. 13.4). Although the silty clay floors are very similar in composition, they are not from one source (Figs. 13.3 and 13.5; Table 13.2). The main difference is the amount of quartz/polycrystalline quartz in them. The rest of the components (other minerals, anthropogenic inclusions, organic materials) do not show a significant difference (Fig. 13.5). Based on these inclusions, two main types of silty clay floor material can be distinguished: a sandy silty clay floor and a less sandy one.

Various clay sources were easily accessible in the vicinity of the site that were likely used in the Bronze Age, as suggested by provenance analysis (Kalmár 2005). However, provenance analysis can be rather problematic as clay sources can be heterogenic and there is a great variety of potential sources. Mapping of clay sources and matching them with the ceramic material was tested previously (Kreiter 2007; Kreiter *et al*. 2007) but only a local origin could be established.

Table 13.2. *Summary of micromorphological observations.*

	Context	Micro-layer	Sample	Horizon thickness (cm)	Lower boundary	Structure		
						Coarse/fine ratio (cf 100 µm) (%)	Porosity (%)	Bioturbation
Floors	House 127	a (silty clay)	MS13/1 2002	1.2	sharp	35/65	15-25	slight/moderate
		c (silty clay)	MS13/1 2002	0.9	sharp	20/80	5-10	slight
		d (silty clay)	MS13/1 2002	1.2	sharp	15/85	5-10	no
	House 1818	g (silty clay)	MS32 2004	3.4	-	<5/>95	5-10	slight/moderate
		b (silty clay)	MS6 2004	2.6	sharp	40/60	5-15	moderate
		d (earthen)	MS6 2004	3.8	-	30/70	10-20	moderate
		d (earthen)	MS43/1 2004	1.6	-	10/90	20-30	slight/moderate
	House 3136	a (silty clay)	MS27 2004	2.5	sharp	5/95	5-10	no/slight
		b (silty clay)	MS27 2004	0.4	sharp	<5/>95	<5	no
		c (silty clay)	MS27 2004	0.5	sharp	5/95	<5	no
		d (silty clay)	MS27 2004	0.2	sharp	<5/>95	<5	no
		b (silty clay)	MS29 2004	1.2	sharp	5/95	5-10	moderate
		c (silty clay)	MS29 2004	3	sharp	20/80	20-30	moderate/high
	House 3147	d (earthen)	MS7/2 2002	1	sharp	5/95	5-15	slight/moderate
		e (earthen)	MS7/2 2002	0.7	sharp	5/95	10	slight
		f (earthen)	MS7/2 2002	0.8	sharp	5/95	10	no/slight
		g (earthen)	MS7/2 2002	0.8	sharp	5/95	5	no/slight–slight
		h (earthen)	MS7/2 2002	0.5	sharp	5/95	5-10	moderate
		d (earthen)	MS7/1 2002	0.5	-	5/95	10-20	slight
		i (earthen)	MS5 2004	1	sharp	15/85	10-20	moderate
		j (earthen)	MS5 2004	1	-	5/95	10-20	moderate/high
		k (earthen)	MS13 2004	1.5	sharp	10/90	10-15	high
		l (earthen)	MS13 2004	1.2	-	5/95	20-30	slight
		g (silty clay)	MS5 2004	3.3	sharp	15/85	10-20	slight
		h (silty clay, but not floor!)	MS5 2004	1.3	sharp	5/95	5-15	slight/moderate
		c (silty clay)	MS7/1 2002	2.7	sharp	5/95	10-20	slight
		f (silty clay)	MS13 2004	2.7	sharp	5/95	5-10	slight
	House 3181	g (silty clay)	MS34 2004	3.5	-	5/95	10-20	moderate
		g (silty clay)	MS35 2004	0.7	-	5/95	10-20	moderate
	House 3700	b (silty clay)	MS8/1 2003	2.5	sharp	5/95	5-10	no/slight
		c (silty clay)	MS8/1 2003	1.4	sharp	<5/>95	<5	no
		d (silty clay)	MS8/1 2003	1.6	sharp	10/90	5	no
		e (silty clay)	MS8/1 2003	1.6	sharp	30/70	5	no
		f (silty clay)	MS8/1 2003	1.4	sharp	5/95	5	no
		d (silty clay)	MS9/2 2003	2.7	sharp	5/95	5-15	slight/moderate
	House 3733	g (silty clay)	MS9/2 2003	2.1	-	30/70	15-25	slight
Walls	daub		ID 3230	4.4	-	5/95	25-30	slight
	daub		ID3280	2.5	sharp	5/95	30-35	slight
	re-plastering 1			0.15	sharp	5/95	5	no
	re-plastering 2			0.1	-	5/95	5-15	no
	daub		ID3294	2.5	-	20/80	30-40	slight
	daub		ID 3580	3.4	-	5/95	30-35	slight
	re-plastering 1		MS10 2004 a	0.1	sharp	0/100	5-10	no
	re-plastering 2			0.15	sharp	5/95	5-10	no
	re-plastering 3			0.1	sharp	0/100	5-10	no
	re-plastering 4			0.15	sharp	5/95	5-10	no
	re-plastering 1		MS43/2 2004 b	0.1	sharp	5/95	5	no
	re-plastering 2			0.05	sharp	5/95	<5	no
	re-plastering 3			2	sharp	5/95	5	no/slight
	re-plastering 4			0.05	sharp	10/90	5	no
	re-plastering 5			0.15	sharp	5/95	5-10	no/slight
	re-plastering 6			0.05	sharp	10/90	5-15	moderate
	re-plastering 7			0.15	sharp	5/95	5-15	no/slight
	daub		MS43/1 2004 e		-	10/90	5-10	no
	re-plastering 1			0.1	sharp	10/90	5-10	no
	re-plastering 2			0.05	sharp	10/90	5-10	no
	re-plastering 3			0.2	sharp	10/90	5-10	no
	re-plastering 4			0.3	sharp	10/90	5-10	no

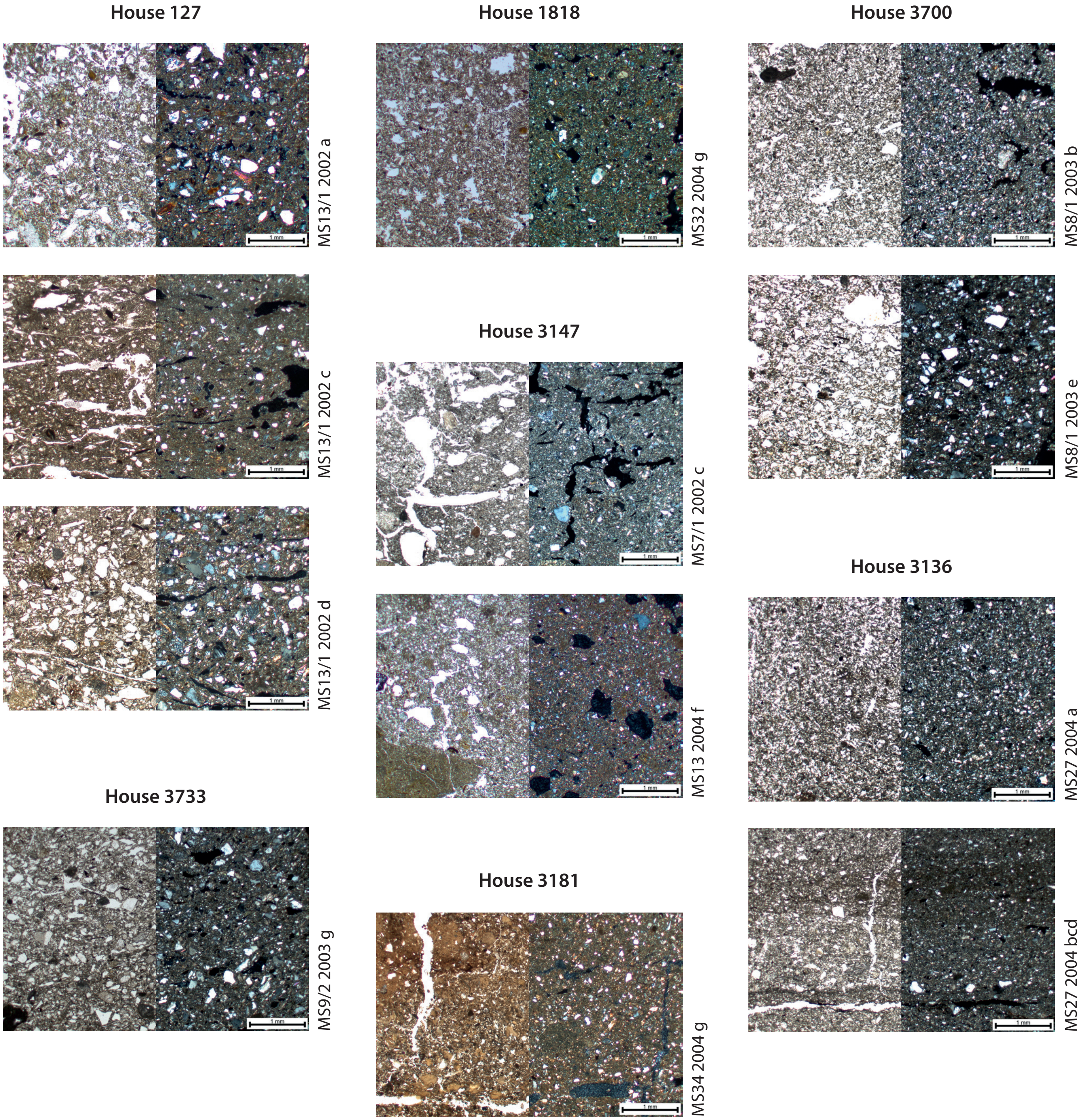
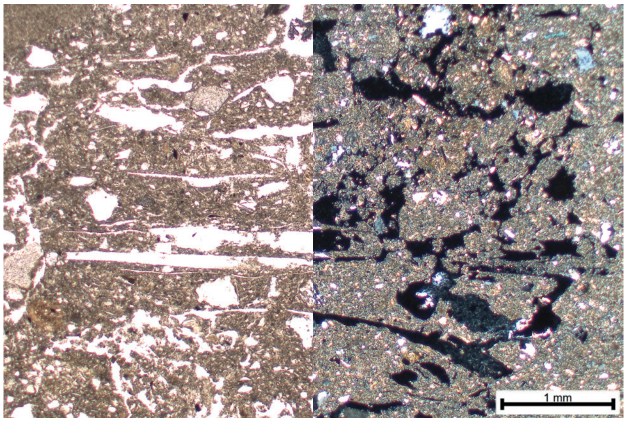
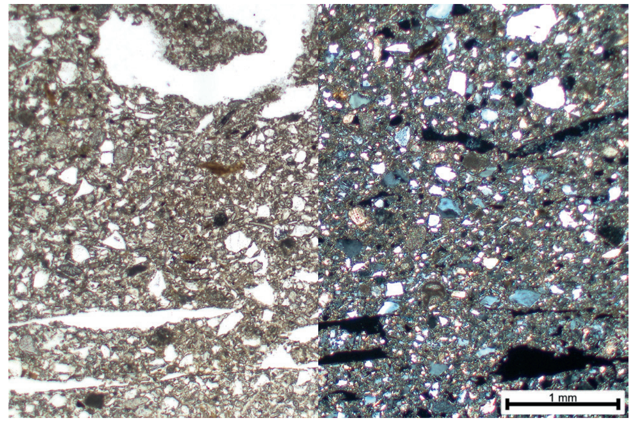


Figure 13.3. *Micrographs of silty clay floors (PPL/XPL). Images: authors.*

We assume that local clay was used for building, since it was naturally available locally in large quantities, and with different compositions. Although at this stage of research the exact relationship between the various clay sources and the end products cannot be established, at least two major construction silty clay materials can be differentiated. Houses ID 127, 1818 and 3181 were classified into the sandier category, while houses ID 3136, 3147, 3700 and 3733 were considered to belong to the less sandy category. In the case of those houses classified as sandier, all the floors (all the renovations) belonged to this category. This could indicate that one source was used for a long period by the inhabitants of the houses. Out of the silty clay floors of houses classified as less sandy, one of the five floors of ID 3700 house (MS8/1 2003



MS7/2 2002 b



MS9/2 2003 g

Figure 13.4. *Pseudomorphic plant voids (PPL/XPL). Images: authors.*

'e') was found to belong to the sandier type. A difference was found in the case of ID 3136 house as well (MS27 2004 *vs* MS29 2004, Fig. 13.5), but since it was not significant, the house was registered in the sandier category. Observed floor variations within the 'life' of a given house further confirm use of diverse clay sources, and could also indicate a time separation of the renewal activities.

The number of anthropogenic inclusions in the floor clays is low and does not show great variety (Fig. 13.5). This suggests that such elements got randomly incorporated into the material, during preparation or application, as opposed to deliberate placement.

The most evident result of the soil micromorphological analysis in relation to silty clay floor construction was the presence or absence of renewal. Renewal is

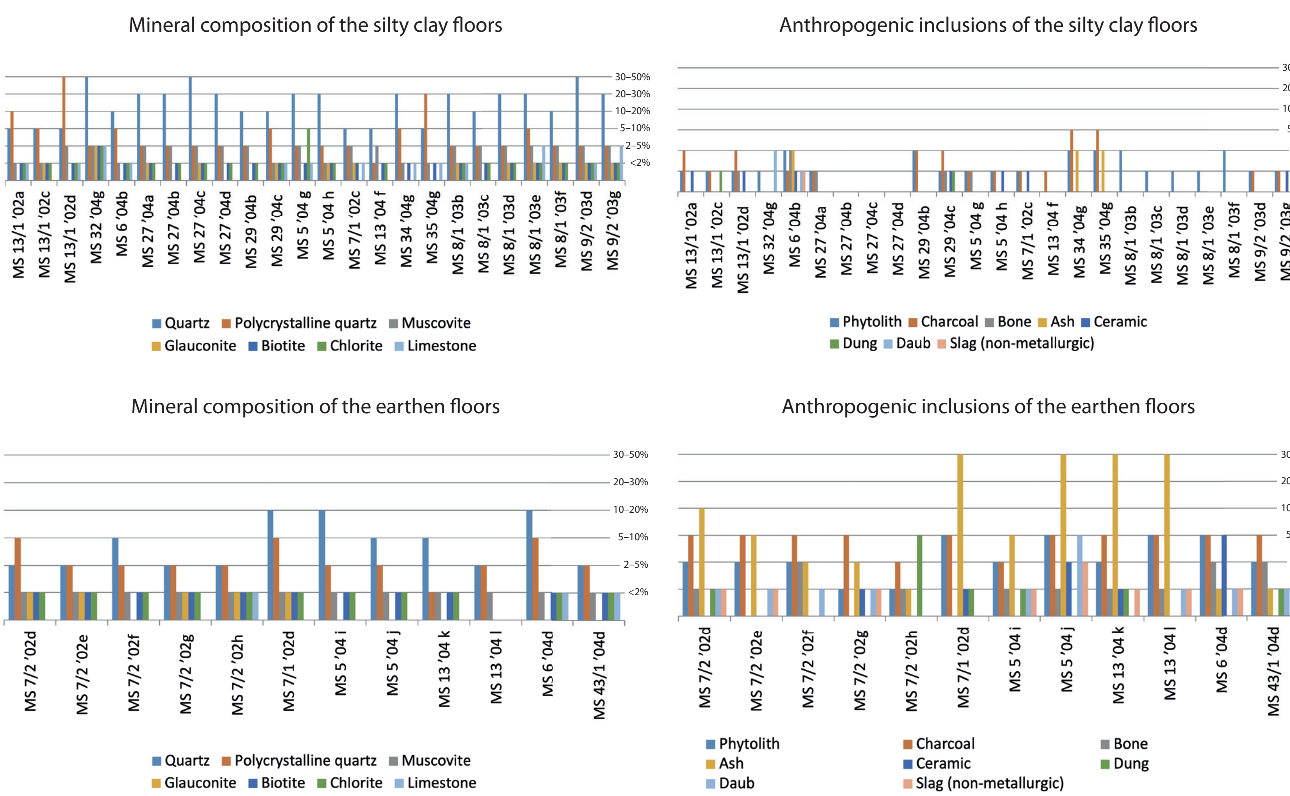


Figure 13.5. *Composition of the analysed silty clay and earthen floors. Images: authors.*

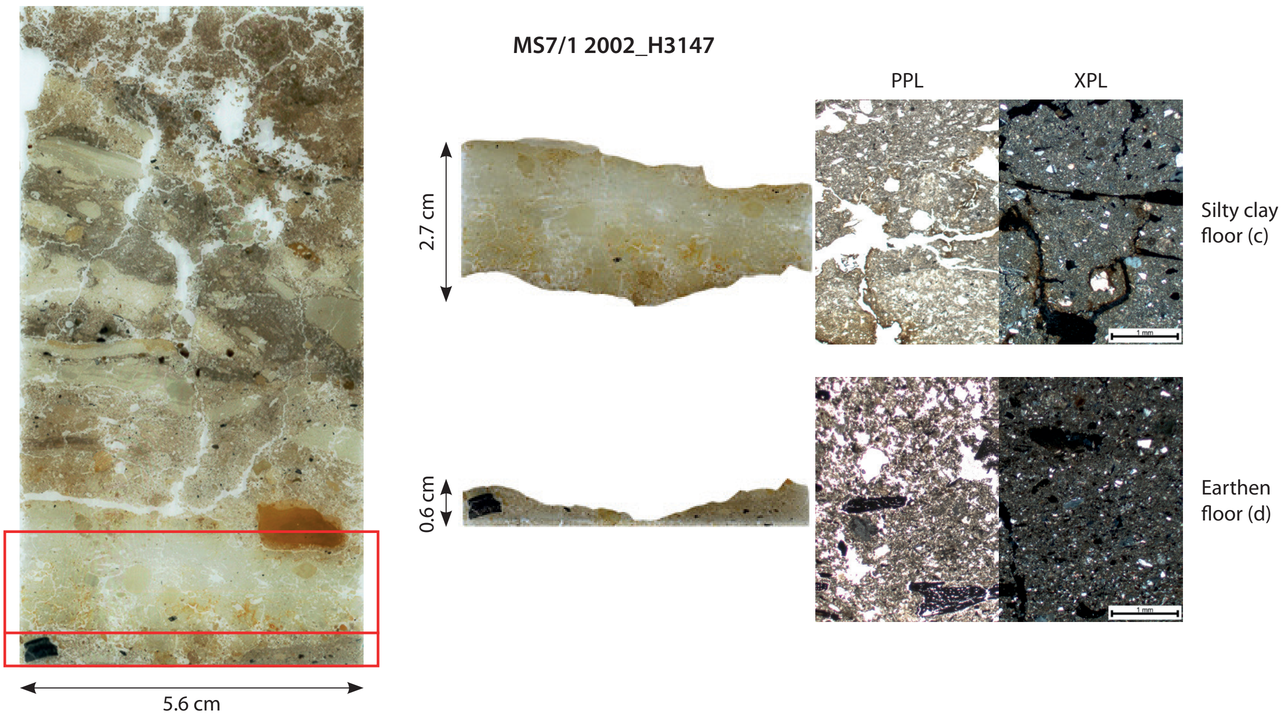


Figure 13.6. *Silty clay floor and the underlying earthen floor of house ID 3147. Images: authors.*

considered to be a major activity, when a larger area or the entire floor surface was re-plastered with silty clay, as opposed to renovation, when only specific areas (worn out or broken) were treated/fixed by silty clay. Houses ID 1818 and 3147 have no trace of silty clay floor renewal at all (Figs. 13.3, 13.6 and 13.12), while in other cases multiple renewals could be detected, e.g. houses ID 127, 3136 and 3700 (Figs 13.3 and 13.7). In two houses (ID 3181, 3733) the number of floor renewals could not be stated from thin section analysis, as only one floor was captured in the sample, which might not be the only one. Out of all the investigated houses, house ID 3700 shows the largest number of renewals: the initial silty clay floor was renewed four times, making five floors in total (Fig. 13.7). House ID 127 has two (three floors in total) while house ID 3136 shows only one renewal (two floors in total). In the case of the latter, the two analysed samples show a different picture. One of them contains only two silty clay horizons (the original floor and the renewal floor), while the other shows four clayey horizons (possible floor layers?) (Fig. 13.3). This might be explained by the character of the sampling locations and the position within the house. The sample exhibiting the four silty clay layers was taken near the pit of the house. At this location it seems that more renovation was necessary, to keep the pit in shape. In this case, we can see an example of local renovation as opposed to renewal.

In those cases where multiple floor renewals could be detected (houses ID 127, 3136 and 3700) the initial layers were thinner, and a relatively thick layer closed the series (e.g. Fig. 13.7). House ID 3136 is an exception, where the renewal horizon was thinner than the initial one. In those cases, where the initial thin clay layers were *c.* 0.5–1 cm in thickness, it is hard to believe that they would be appropriate for continuous use, therefore their appearance in this form raises questions. Further investigation of the samples also showed the lack of floor build-up between the floor horizons (Figs. 13.3 and 13.7). This does not reflect that the houses were uninhabited or kept immaculately clean during the Bronze Age. Everyday activities leave various traces. Microscopic findings can be trampled into the floor matter, food and waste residues can also remain on the floor surface even after regular cleaning. The surface also can be broken or worn out over time. These are all factors that can affect the efficiency of floor renewal. Taking all this into account, it seems that prior to floor renewal, the floor surface was scraped clean to get a proper surface for new flooring. This is further supported by the clear, sharp boundaries between the horizons. Unfortunately, this activity (construction process) destroyed those micro-findings that would help us to detect use of space. Nevertheless, it became evident that maintenance – to quite a high quality, based on these examples – was an important part of Bronze Age life.

Although soil micromorphology is unable to tell the time that passed between the preparation of the floor layers, the observations suggest that houses where multiple floor renewal was found must have been in use for longer time. Such a time-, energy- and raw material-consuming activity would not be necessary if they were only used for a short time. Good quality silty clay floors found at the site with a thickness of *c.* 3 cm are most likely able to last for years, so a lower frequency of floor renewal is proposed. The initial/older floors are almost always thinner than the youngest one of the series. Those floors that were not renewed are always thicker, similar to the latest renewals. This indicates that the 0.5–1 cm thick initial floors only represent part of the original floor and are most likely the end result of several cleaning/scraping events. It seems that there was a point when the floor thinned down to such an extent that it could not be further used properly, so renewal needed to take place. This variation in thickness (see, e.g., house ID 3700, Fig. 13.7) and the number of renewals not only show this practice but can be used to assess frequency of maintenance and lifespan of the house and, to some extent, use of space as well. Intensively used areas (floor surfaces), and areas where ongoing activity resulted in dirtiness or damage to the floor, must have been cleaned and maintained more frequently. To add a spatial aspect to this observation, various locales within the house would need to be sampled and analysed.

One of the samples of house ID 3147 showed another interesting building technique. In sample MS5 2004, two silty clay layers could be detected (Fig. 13.8), seemingly two floors. However, on-site observation did not confirm this, and only one floor horizon was present in the other samples of the same house (see, e.g., Fig. 13.6). The sample with two silty clay layers was taken right next to the north-eastern corner of the house. It was demonstrated before (house ID 3076; Kovács 2009) that walls were erected first and then the floor material was smoothed up to the wall in a

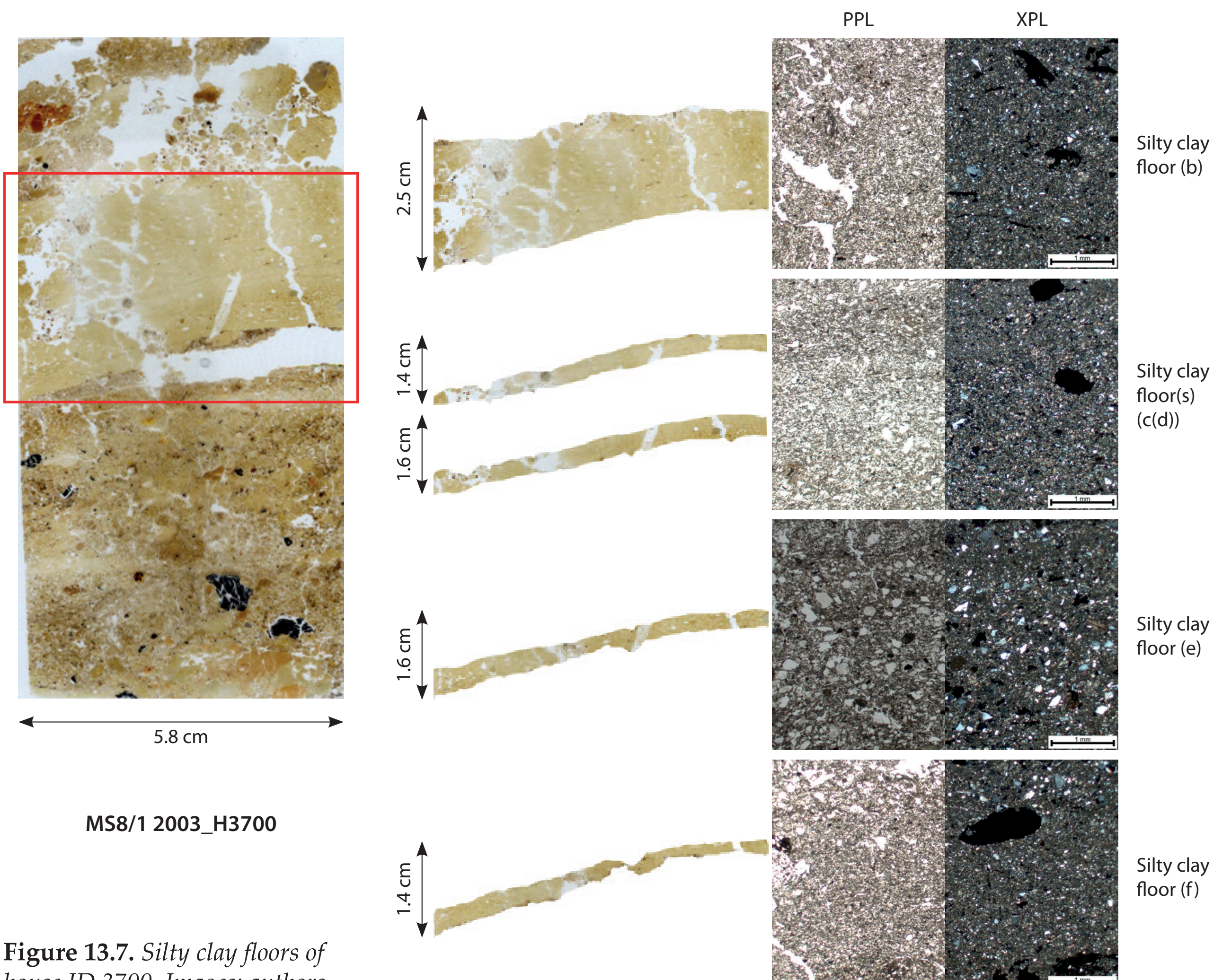


Figure 13.7. *Silty clay floors of house ID 3700. Images: authors.*

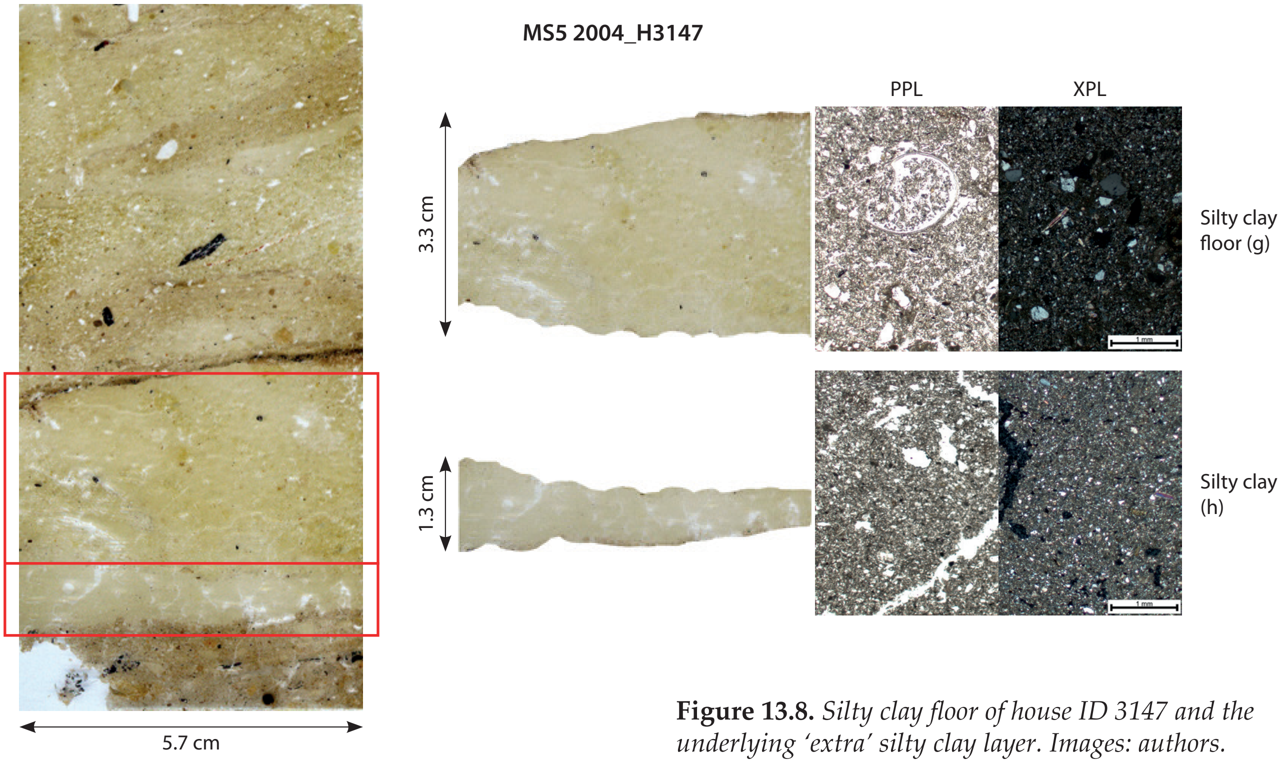


Figure 13.8. *Silty clay floor of house ID 3147 and the underlying 'extra' silty clay layer. Images: authors.*

slight rise, creating a 'bend' between the two structural elements. This extra silty clay layer seems to be some kind of a packing material underneath the 'bend' to avoid cracking. It served as a small foundation while joining the two parts. This kind of building technique would definitely be beneficial for sweeping, as the joint of the wall and floor was in a slight bend rather than a 'crack'. Refuse could not get stuck between the floor and wall this way. In sum, the silty clay here does not represent floor renewal, but is part of the building technique and maintenance custom.

At house ID 3147, another interesting phenomenon was observed. The earthen floor and an apparent 'renewal layer' (silty clay material) met along a slope (see Fig. 13.9). This layer might have served as some kind of a foundation before the first proper silty clay floor was laid. However, this does not seem to be the case, as only one sample exhibited this extra matter. It is more probable that an on-the-spot renovation was captured in the sample.

These examples let us have a glimpse into the everyday life, the construction and maintenance habits of the Vatya people at Százhalombatta. Proof of regular cleaning and maintenance, renovation and floor renewal preserve the ancient knowledge: Bronze Age technologies and know-how become visible under the microscope.

Recognition of earthen floors during excavation is not as easy as silty clay floors. The material of the earthen floors is quite similar to the general sediment of the site (greyish brown loam/sandy loam), so colour change is not so evident. The analysis of the thin sections enabled closer examination of the earthen floors. Surface compactness and surface finds are the most helpful indicators for detecting earthen floors during excavation. Some examples were already identified by traditional archaeological techniques (surface separation), which were further supported by thin section analysis (Fig. 13.10). The investigation of the earthen floors of houses ID 1818 and 3147 will let us have a look at this type of building technique.

Similar to the silty clay floors, the material of the earthen floors is very finely structured and compact (Table 13.2). Their mineral components are also similar: quartz, polycrystalline quartz, muscovite, biotite, glauconite and chlorite are present, out of which quartz and polycrystalline quartz dominate (Fig. 13.5). However, in the earthen floors these minerals occur with somewhat lower frequencies. Besides their colour and the mineral component differences, the main dissimilarity lies in the higher amounts and wider range of anthropogenic inclusions. In the earthen floors various quantities of bone/burnt bone, wood ash, charcoal, ceramic or daub/plaster fragments are always detectable in the samples. These inclusions are very small in size and randomly oriented, which suggests non-intentional deposition. The general sediment of the site was used to create the earthen floors, so micro-fragments of everyday

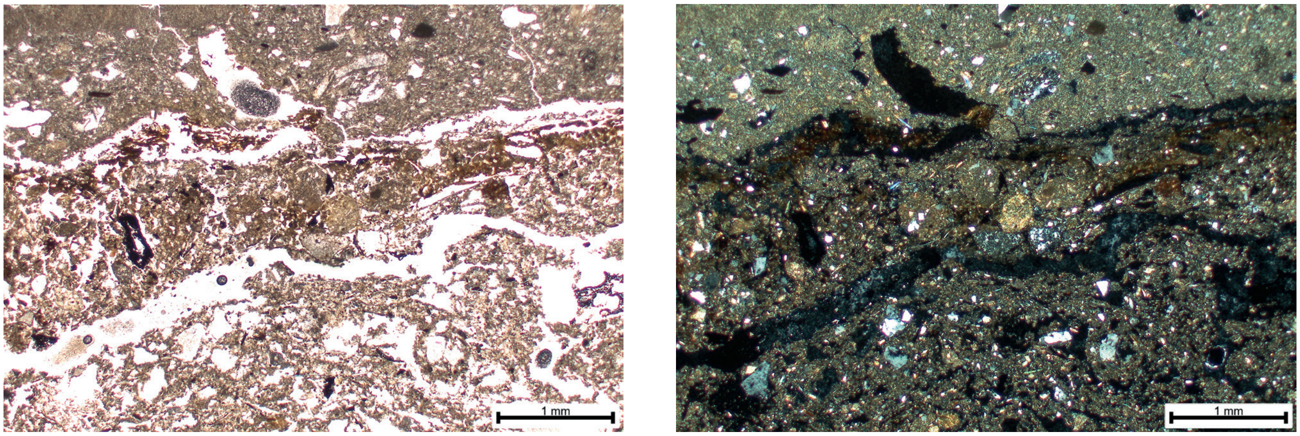


Figure 13.9. *Silty clay floor of house ID 3147 and its local renovation (PPL/XPL). Images: authors.*

life were obviously incorporated into the floor matter. The fine structure and the lack of macro-findings (e.g. ceramic sherds or larger bone fragments) show that some conscious treatment of the sediment took place prior to building. In our opinion, the raw material was pre-treated, 'sieved', inorganic and non-degraded organic materials were sorted out and then with some compression the floor was prepared.

A series of earthen floors could be observed in only one case: house ID 3147. This shows that the

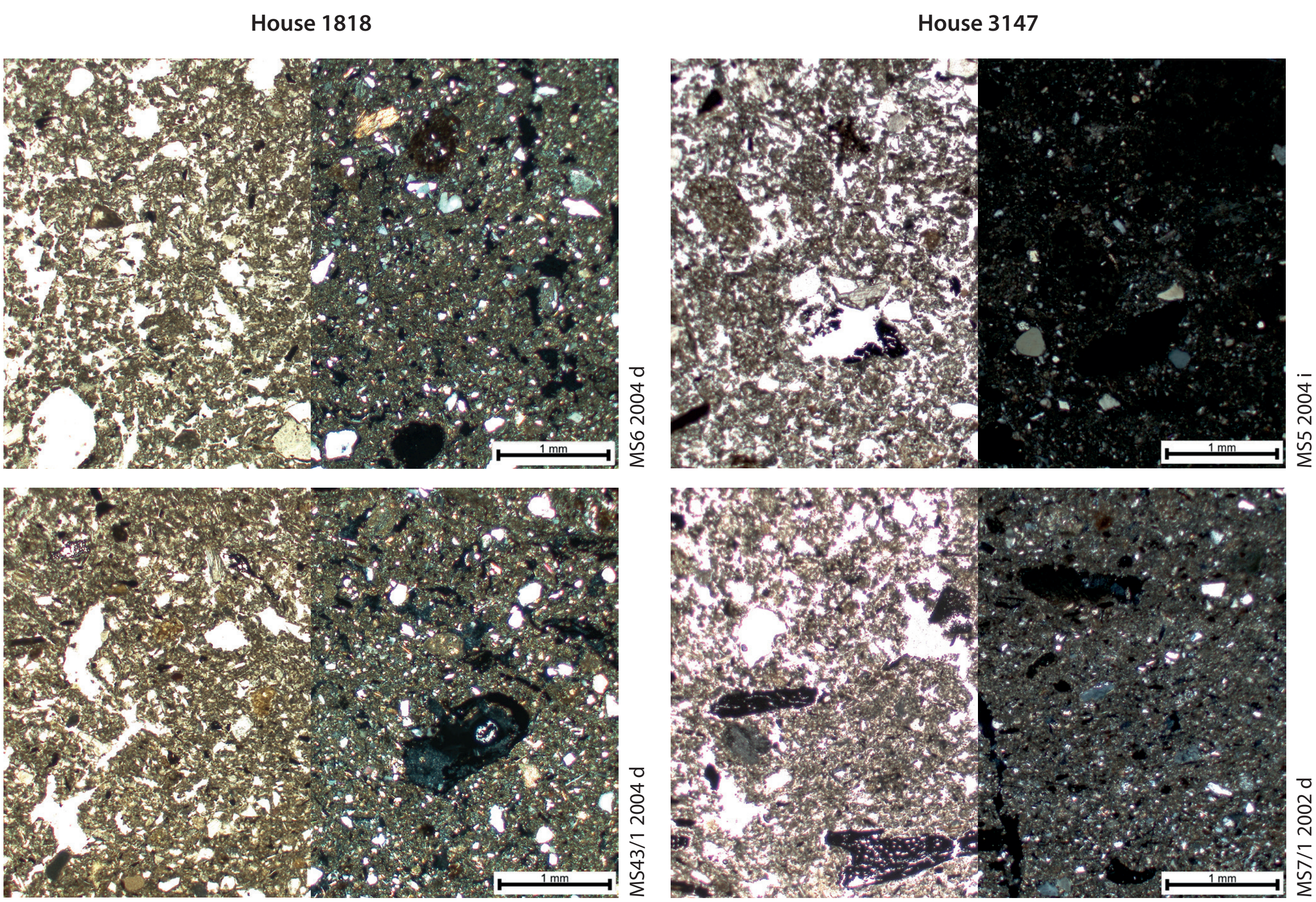


Figure 13.10. *Microphotographs of earthen floors (PPL/XPL). Images: authors.*

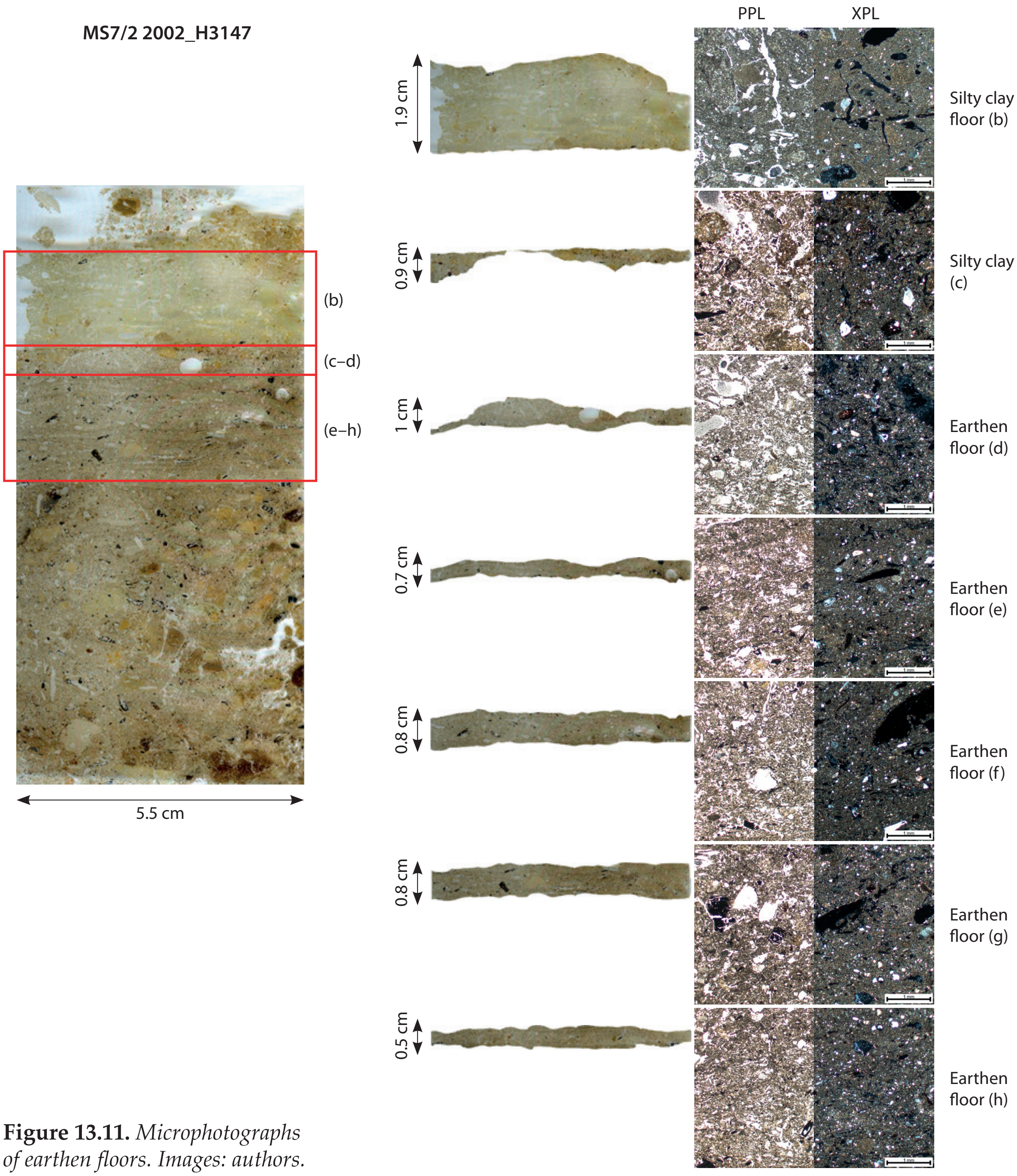


Figure 13.11. *Microphotographs of earthen floors. Images: authors.*

above-described building and maintenance technique (renewal of floors) was in practice regardless of floor type (silty clay and earthen floors). During excavation, the exact number of renewals could not be counted. Only the presence of a multi-layered surface could be documented. Five earthen floors could be identified in the prepared thin section (Fig. 13.11, 'd–h' micro-layers), which indicates that earthen floors were in use for a prolonged period. But for some reason this practice was stopped, and the entire floor was plastered with silty clay (Fig. 13.11, horizon 'b').

The sample of house ID 1818 shows a similar technique. The initial earthen floor (Fig. 13.12, horizon 'd') was changed for a silty clay one (Fig. 13.12, horizon 'b'). In this case, neither of the two floors was renewed. There is another difference to be noted here. On the surface of the initial earthen floor, floor build-up (a burnt horizon) could be detected. On top of this was the silty clay floor

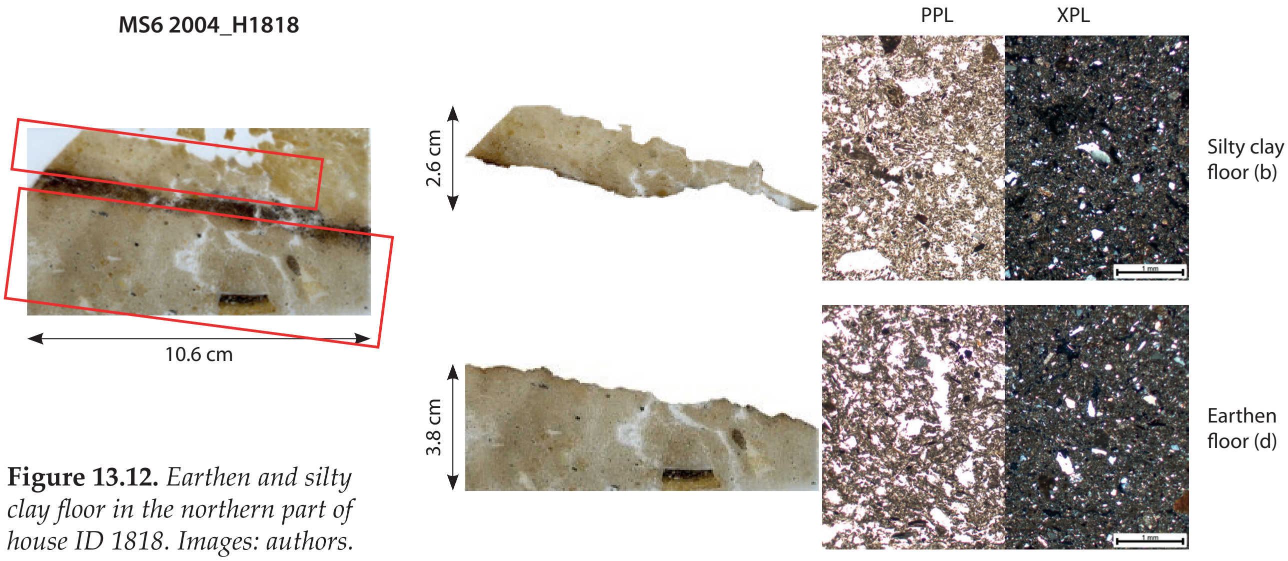


Figure 13.12. *Earthen and silty clay floor in the northern part of house ID 1818. Images: authors.*

prepared. This observation seems to be contrary to the findings of the silty clay floors, where cleaning and scraping of the surface was said to be a prerequisite for the adhesion of the new floor layer. This example shows that variation could occur. An explanation can only be guessed at this stage: individuality, necessity, or maybe an exception. Based on the results available so far, earthen floors always preceded silty clay ones.

Walls

At Százhalombatta, the majority of wall remains found are made of wattle and daub. Thin section analysis allows us to add details to existing knowledge. Wall and floor matter, and their building techniques, can be compared to trace similarities and differences.

As with floors, walls were mainly prepared from silty clay. However, differences can be instantly spotted when looking at the micrographs (Figs. 13.3 *vs* 13.13 and 13.5 *vs* 13.15; see also Fig. 13.14). Due to the added temper, a large amount of organic matter in the case of daub material can be identified. In thin section, this is shown by the large number of vegetal voids (pores left after the decay of organic matter) and phytoliths. Consequently, porosity is enhanced, as opposed to the compact nature of the silty clay floors. The addition of organic temper was only practised in the structural elements of the wall. Maintenance of walls was also observed in a series of fine plastering layers (Fig. 13.13) on the surface of the daub. Similar to the floors, these layers do not contain vegetal tempering (Fig. 13.15); their composition and structure are most similar to the silty clay floors. They are very fine grained, compact, and contain quartz, polycrystalline quartz, mica (muscovite), biotite and some chlorite. The number of anthropogenic inclusions is very low, and they do not show great variation.

Clay is very heavy, and without tempering it cannot be easily applied for wattle and daub construction. Since clay shows a high degree of shrinkage and expansion due to heat or water absorption/addition, temper needs to be added to reduce structural weaknesses, such as cracking. Heavy clay that needs to be applied vertically on a wooden frame can be more successful when it is lightened with some organics (such as plant matter and dung). With the added organics, clay becomes more plastic as well (Kruger 2014). When temper is mixed into the clay, air bubbles also get caught in the mixture. This not only lightens the material, but also enhances its insulating properties. Both the pseudomorphic plant remain voids and the air bubbles (pores in general) can be effectively studied under the microscope. The micrographs of the daub show that pores are randomly oriented, and they are parallel closer to the surface (Fig. 13.14). Their shape is also different: roundish on the inside while elongated towards the surface. This nicely shows the way of application. First, the mixture is applied in a lump (rounded voids) and only the surface is smoothed to create an even surface (elongated void shapes). The fine re-plasterings show the same kind of elongated void spaces, if there are any voids in them. Voids appear rather occasionally in them, as there is limited mixing in their case.

Although soil micromorphology cannot add time aspects to the re-plasterings, the number of them identified in thin section indicates relative frequency: the more re-plastering present, the more frequently maintenance took place. Based on the available data, multiple re-plasterings are present: two, four, and seven times in the analysed samples. The multiple renovations clearly indicate continuous and conscious

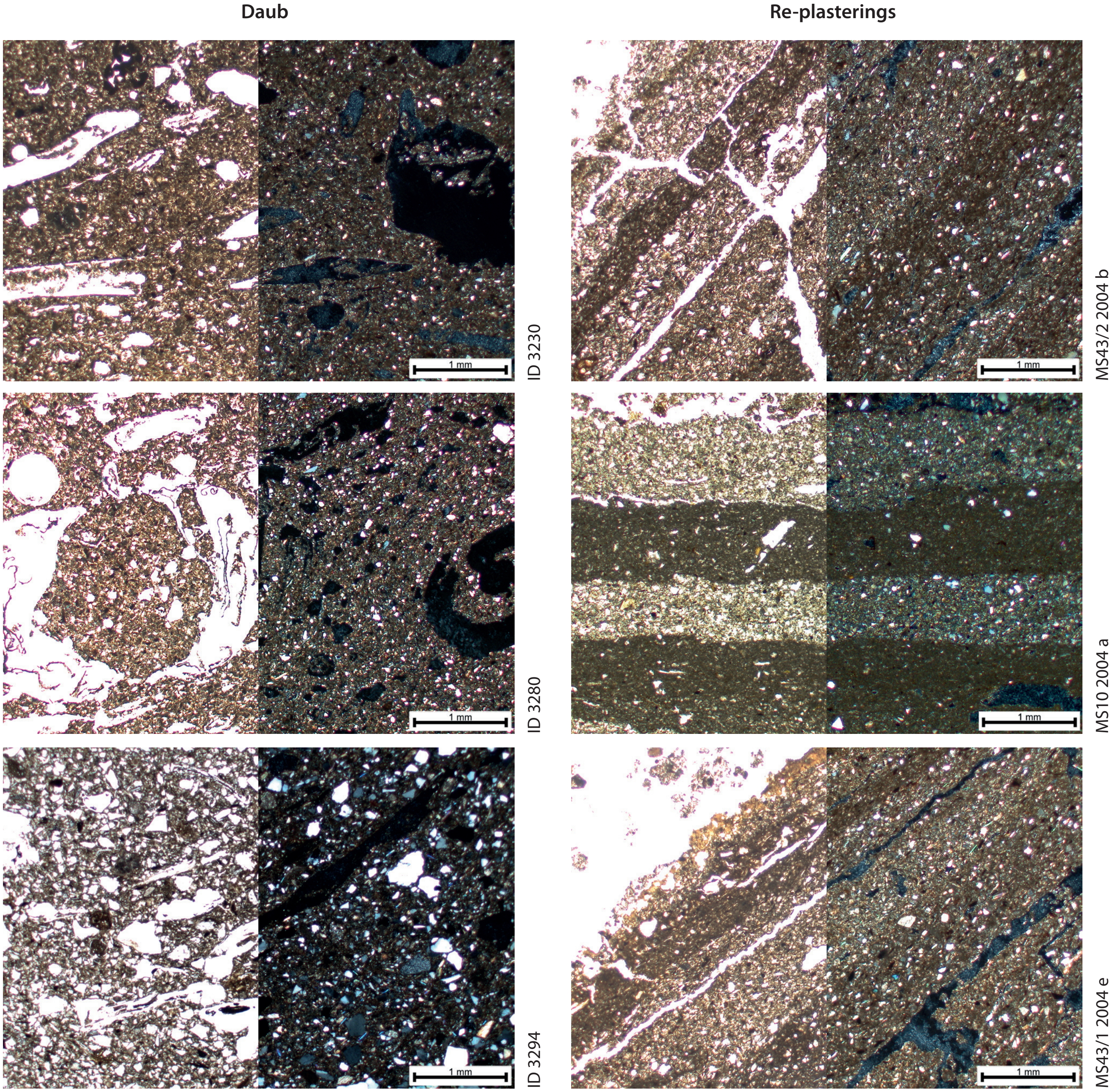


Figure 13.13. *Daub (left) and series of re-plastering layers (right) in thin section (PPL/XPL). Images: authors.*

maintenance, and might even be evidence of aesthetic need. Since no systematic analysis of wall plasters has so far been conducted from this site, in this study we can only highlight the existence of such a practice. The number of re-plasterings present in the analysed samples most likely under-represents the actual 'full' series, but even with these limited results it seems that walls were more frequently maintained (renewed or renovated) than floors. The practice of maintenance can thus be presented, and this can be broken down into practices in individual houses, and numerical data can also be added.

Conclusions

Clay was a very important material in the life of the Bronze Age Vatya people at Százhalombatta tell site, similar to what is seen at the tells of the Near East. Besides pottery production, clay was one of the major raw materials of construction. Soil micromorphological

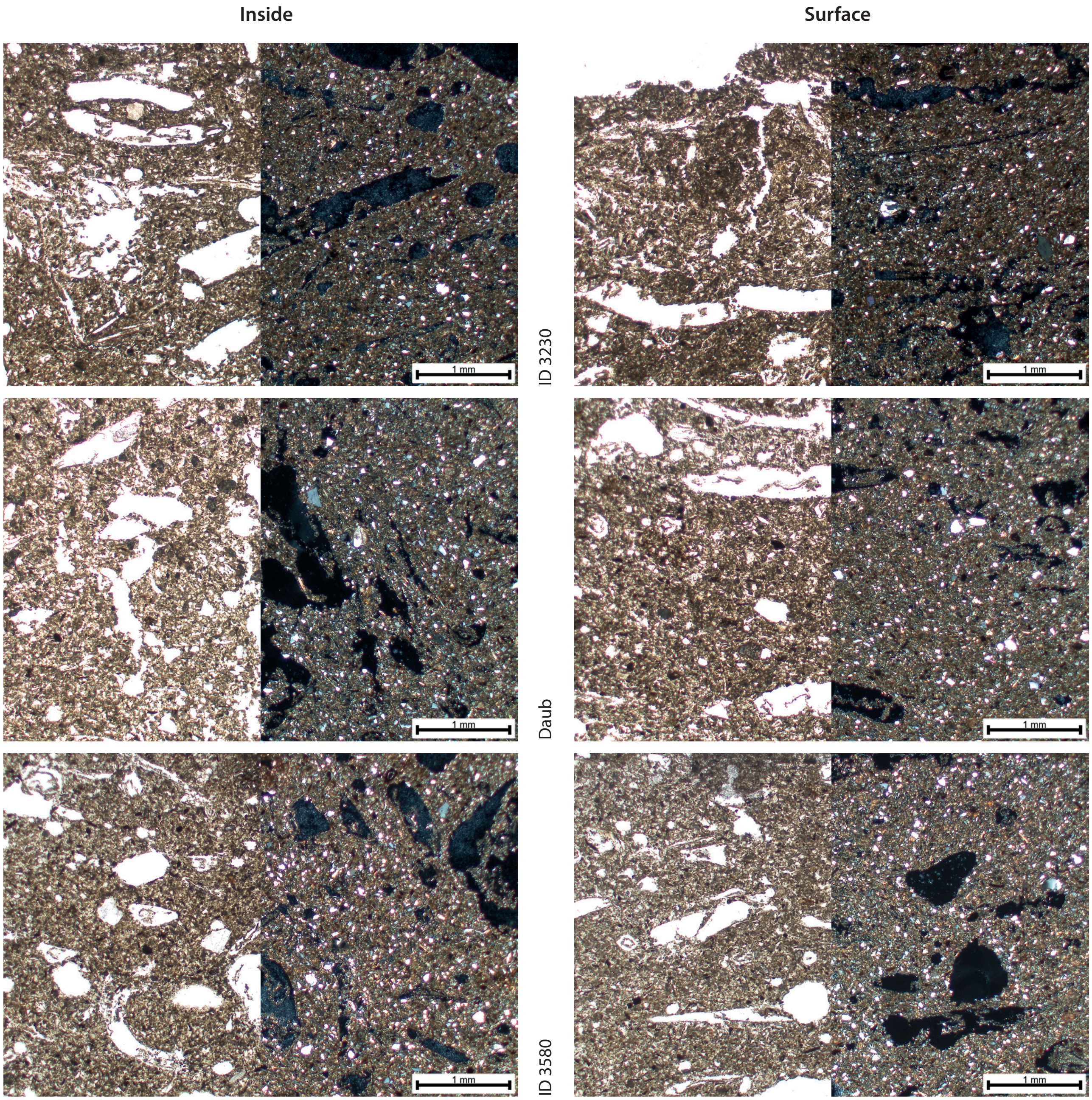


Figure 13.14. *Inner structure and surface of daub fragment in thin section (PPL/XPL). Images: authors.*

analysis of floors and walls provides insights into the building techniques and technical knowledge of Vatya settlers. Floors and walls prepared from silty clay have a very fine matrix, and only occasionally contain anthropogenic inclusions. Floor matter is highly compacted, while daub walls are highly porous in structure. The mineral composition of the silty clay raw material is very similar in floors and walls. Larger quantities of quartz, polycrystalline quartz, and small quantities of muscovite, glauconite, biotite, chlorite, limestone and snail/shell fragments were observed. The analysis showed that various clay sources were used: sandy and less sandy ones. Since the composition of the naturally occurring clay deposits is greatly varied, it is not possible to determine the exact locale of the clay sources used during the Bronze Age. However, it can be stated that clay sources of different characteristics were consciously used for production and construction purposes. In the case of floor and wall clays, the major difference observed was the addition of temper in walls. Various

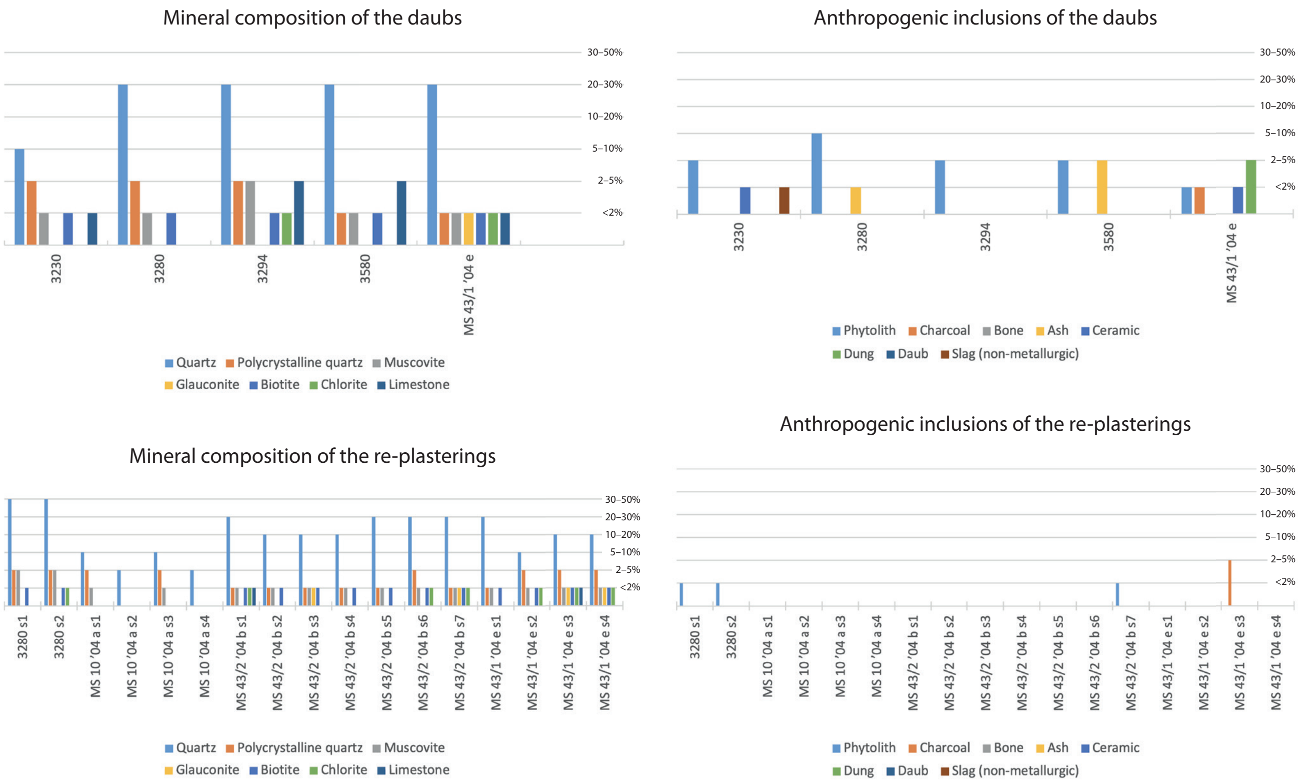


Figure 13.15. *Composition of daub and re-plastering. Images: authors.*

mixtures were prepared by adding mainly vegetal matter during wall construction, as opposed to floor building, where no temper was detected, as weight was not a concern. The mixture used for wall re-plastering also lacked tempering, and clay was applied to the daub surface as a thin clay mass. A solid thick silty clay layer (3–5 cm) was found to be appropriate for trampling as a floor. All this reflects that the members of the local Vatya community were aware of the properties of the clay raw material in their surroundings. They made thoughtful decisions in choosing the most appropriate clay source for specific activities. This selection of raw material was indicated by the observed differences in floor clay types (sandy *vs* less sandy floors). The repetitive use of the same kind of silty clay material during the life of a house is probably due to there being one source or similar sources. Thin section analysis showed that Vatya people had the routine knowledge of transforming raw material into applicable mixtures of varied purposes. This centuries-old knowledge of generations was shaped over many experiments and was well-known and adapted to local circumstances.

Furthermore, observations of various building techniques could be made through microscopic analysis. These are the repetitive wall plasterings, floor renovations and floor renewals, for example. It was demonstrated that some of the silty clay floors were scraped clean prior to renewal for better adhesion. As a consequence, indicators of use of space have been removed, so observations on this aspect cannot be made in these cases. Although thin section analyses are not suitable for time determination, they can indicate frequency. Floors were less often renewed or renovated compared to walls. Besides silty clay floors, earthen floors were identified, even a series of them in one of the houses. Earthen floors were later plastered with silty clay. We found that in cases where an earthen floor preceded a silty clay floor, no renewal of the silty clay floor occurred. Floor repair, scraping and renewal, and multiple wall re-plasterings do not only show the existence of technical construction knowledge, but reveal much more about the Bronze Age community. Maybe it is not an exaggeration to propose that the described repetitive activities (regular maintenance) signal needs for cleanliness even in prehistory. It would be hard to believe that such activities only indicate individual needs and not socially accepted norms. The results contribute several, new details to our understanding of Vatya domestic architecture, technology and lifestyle. The ongoing excavation and parallel micromorphological examinations will certainly further enrich our existing knowledge.

Inspired geoarchaeologies

Geoarchaeological research captures dimensions of the past at an unprecedented level of detail and multiple spatial and temporal scales. The record of the past held by soils and sediments is an archive for past environments, climate change, resource use, settlement lifeways, and societal development and resilience over time. When the McDonald Institute was established at Cambridge, geoarchaeology was one of the priority fields for a new research and teaching environment. An opportunity to develop the legacy of Charles McBurney was bestowed upon Charles French, whose 'geoarchaeology in action' approach has had an enormous impact in advancing knowledge, principles and practices across academic, teaching and professional sectors. Many journeys that began at Cambridge have since proliferated into dozens of inspired geoarchaeologies worldwide. This volume presents research and reflection from across the globe by colleagues in tribute to Charly, under whose leadership the Charles McBurney Laboratory became a beacon of geoarchaeology.

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