NEO-LITHICS 2/12

The Newsletter of Southwest Asian Neolithic Research

Contents

Editorial

The sky is falling, still. In his Introduction chapter of the 1998 book *The Prehistoric Archaeology of Jordan*, Don Henry noted that the number of publications in all venues pertaining to all periods of Jordanian prehistory had zoomed to an average of 14 per year between 1980-1986, noting that this was "a nearly four-fold increase … over the whole decade of the 1970's" (Henry 1998: 1). Over the past couple of decades the pace of research and publication for the entire Levant has started to reach unmanageable proportions for authors attempting to make sense of newly available information, and this is becoming particularly difficult in the case of projects dealing with the12th-4th millennia. Certainly we would all benefit from a constantly updated central repository of new publications, suitably tagged with keywords, but how such an institution could be developed and maintained is a daunting problem.
Geneviève Dollfus of Paléorient has foreseen these needs; in recent years, she has laid the foundations for such a data base, and we should think about supporting its implementation.

Gary O. Rollefson and Hans Georg K. Gebel

Henry D.
1998 The Prehistoric Archaeology of Jordan. BAR International Series 705. Oxford, Archaeopress.

Excavations at the Late Epipalaeolithic Site of Shubayqa 1: Preliminary Report on the First Season

Tobias Richter, Leslie Bode, Michael House, Rune Iversen, Amaia Arranz Otaegui, Ingeborg Saehle, Guenever Thaarup, Marie-Louise Tvede, and Lisa Yeomans

Introduction

Shubayqa 1 is a hitherto little known Natufian site situated in the northern Badia region of eastern Jordan (Fig. 1). The site was first identified during survey in 1993 (Betts 1993; 1998: 25-26) followed by a brief excavation in 1996. This initial test excavation revealed part of a structure with a paved floor, buried by *in situ* deposits teeming with lithic artefacts and faunal remains (Fig. 2). In October and November 2012 a team from the University of Copenhagen returned to Shubayqa 1 to carry out larger scale excavations as part of the Shubayqa Archaeological Project (see http://shubeika.ccrs.ku.dk/) and the Epipalaeolithic Foragers in Azraq Project.

One of the key aims of the Shubayqa Archaeological Projects is to investigate the relationship between the Younger Dryas event (*ca*. 12,800-11,500 BP) and cultural developments during the Late Epipalaeolithic occupation in the semi-arid to arid 'marginal zone' in the southern Levant. The cooler and drier conditions that marked the beginning of the Younger Dryas have been seen as an influential factor in the expansion of Natufian populations from the Mediterranean 'core zone' into the marginal, more arid fringe (Bar-Yosef 1995; Bar-Yosef and Belfer-Cohen 2000, 2002; Bar-Yosef and Meadow 1995; Byrd 2005; Moore and Hillman 1992). At the same time, it has been suggested that the Younger Dryas forced sedentary Natufian groups into the cultivation of cereals to compensate for the loss of wild stands in areas adjacent to existing settlements (Hillman 1996; Hillman *et al.* 1989, 2001; Moore 1991, 2000).

Fieldwork at Shubayqa 1 was conceptualized to test these ideas through the examination of a seemingly well preserved Natufian site situated in the semi-arid to arid

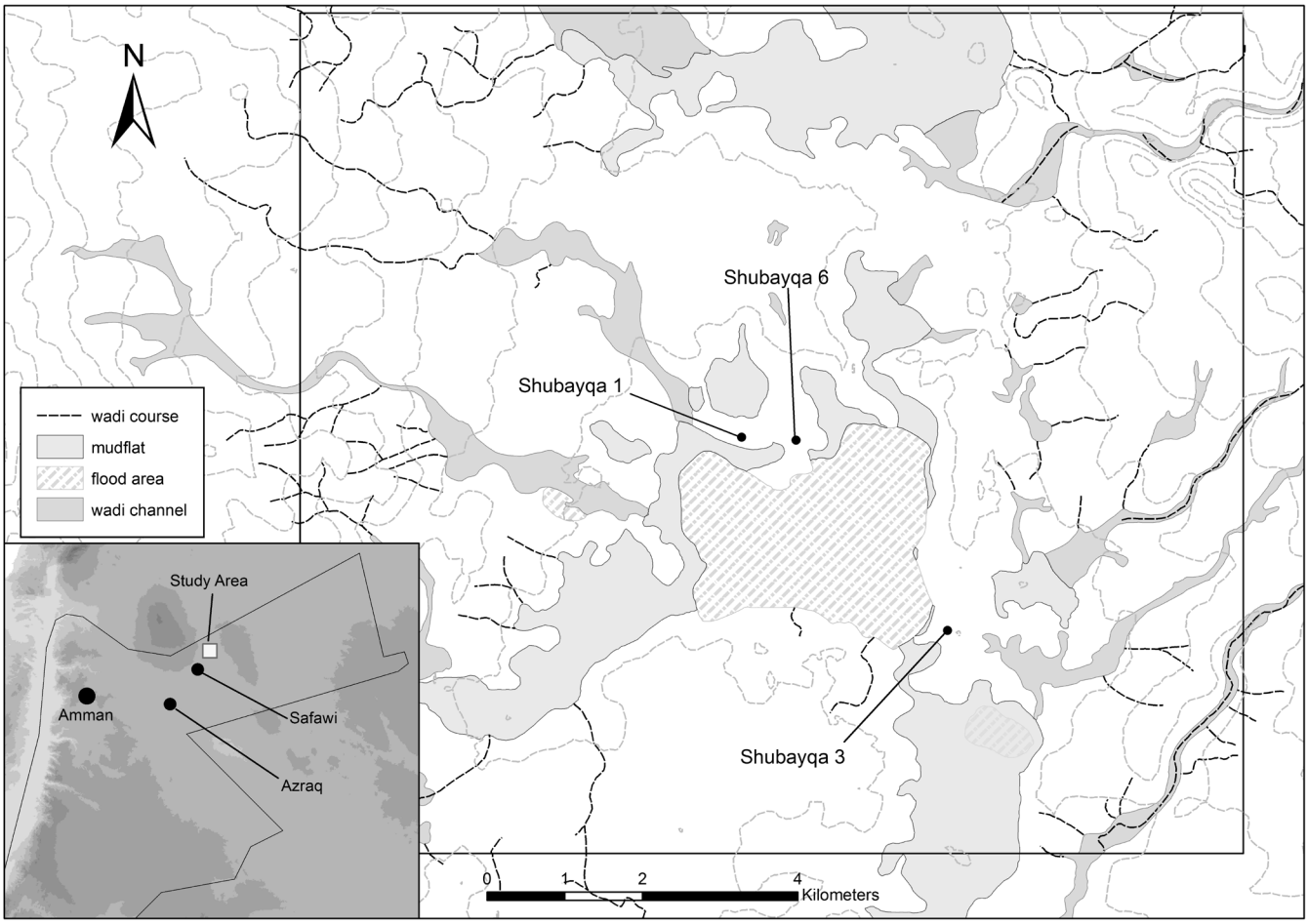

Fig. 1 Topographic map of the Qa' Shubayqa showing the locations of Shubayqa 1, 3 and 6.

Fig. 2 The 1996 trial trench at Shubayqa 1 showing part of a semi-circular wall and flagstone pavement (courtesy of L. Martin).

zone. Simultaneously, fieldwork at the site and in the wider Shubayqa area aims to provide a more detailed reconstruction of local environmental conditions during the Younger Dryas to better understand the effects of global climatic change on the local scale. Finally, Shubayqa 1 offers an opportunity to provide other evidence for the character of late Epipalaeolithic societies in the Azraq Basin that are known from only two excavated sites so far (Betts 1991, 1998; Garrard 1991).

Although the fieldwork carried out during this season focused primarily on Shubayqa 1, we also carried out a brief reconnaissance survey of the surrounding area to situate the site within its local landscape.

The Site

Shubayqa 1 is situated in the northwestern part of the Jordanian Badia. It lies to the immediate north of the Qa' Shubayqa, a 12 km^2 large dry lake fed by the Wadis Rajil and al-Burraqyeh from the west and the Wadis Salma, Ghaysan and al-Hamra al Shamali from the east. The temporary lake that forms during the rainfall season in the Qa' Shubayqa is a continuation of the Wadi Rajil that drains out of the Qa' Shubayqa in the southeast and continues to flow southward towards the Azraq Oasis. With its seasonal flooding the Qa' Shubayqa is still an attractive grazing area for Bedouin groups during the spring (according to local informants). It seems likely that the area may have been a more stable or even permanent body of water under more favourable climatic conditions. The availability of water in the area under past environmental conditions is an area of future research. Today the Shubayqa area is situated at the edge of the Irano-Turanian vegetation zone which rings Jebel Druze. Average mean annual rainfall is between 80-100 mm with most rainfall occurring in the winter.

The site of Shubayqa 1 sits in the southwestern corner of the abandoned Islamic village of Khirbet Shubayqa. It lies at an elevation of 740 meters above sea level and consists of a *ca*. 2000 m^2 roughly circular mound that rises 2.5-3 meters above the surrounding area (Figs. 3 and 4). Basalt blocks of various sizes are strewn across the surface and there are various historic walls and structures associated with the mound. An Islamic burial cairn was built on the summit of the mound (local informants have told us that this is *ca*. 70 years old). A north-south running field wall with a short east-west terminus that partially encloses the burial cairn was presumably constructed at the same time. To the southwest and west lie two rectangular, collapsed buildings, which probably form part of the main occupation phase of Khirbet Shubayqa. The surface of the mound is littered with chipped stone artefacts and small bone fragments. Six mortars – two double and four single mortars – made on large basalt mortars are the most obvious of a large number of ground stone

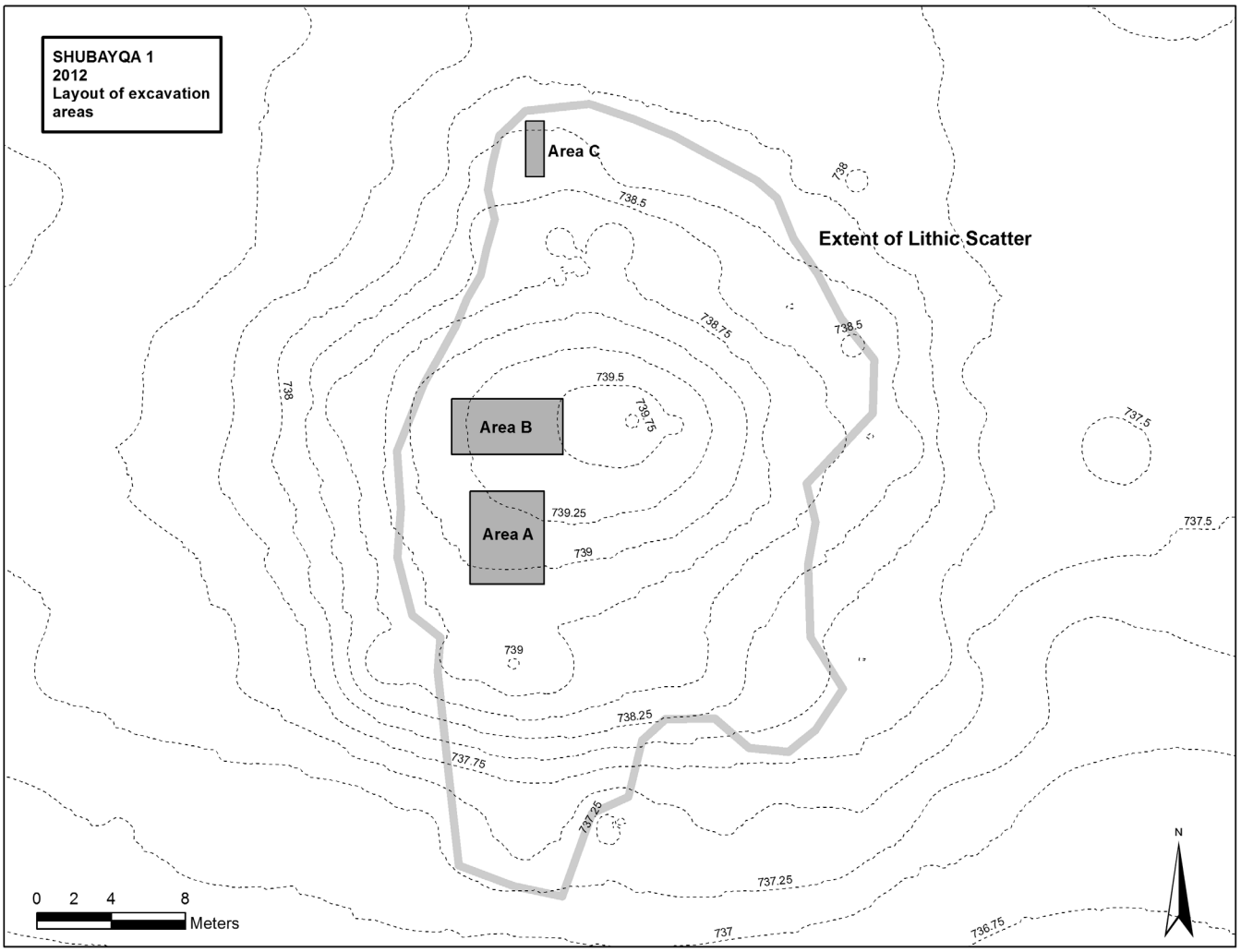

Fig. 3 Topographic plan of Shubayqa 1 showing the layout of excavation areas and extent of the lithic scatter.

artefacts spread across the same area (Fig. 5). Traces of possible buried, semi-circular walls can be seen on the surface in various locations.

Area A

The initial aim of the excavation was to relocate and delineate the 1996 excavation trench using archive photographs and observations on the ground. Using the photographs the old trench was easily identified and Area A laid out accordingly. The original trench had collapsed at some time in the past sixteen years. It was filled by a loose, soft deposit that contained abundant chipped stone, ground stone and faunal remains. We considered the material that filled the 1996 trench to be residual and therefore removed it relatively swiftly to establish the

Fig. 4 View of the Shubayqa 1 site looking southwest.

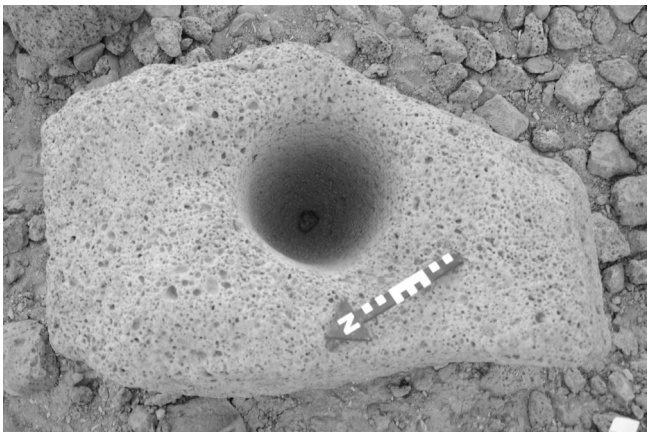

Fig. 5 One of the six surface ground stone mortars recorded at Shubayqa 1.

previous limits of excavation. The removal of the fill revealed features visible on the 1996 photographs: part of a semi-circular wall constructed of basalt uprights and a paved floor built using flat basalt flagstones (Figs. 2 and 6a). Since the end of the 1996 excavation and before the collapse of the trench, this pavement was partially disturbed. At least one large pavement stone had been pulled up and moved aside and remained at an inclined angle at the bottom of the trench (Fig. 6a bottom left).

Having delineated the 1996 limit of excavation the next task was to expand Area A to further reveal the remains of the semi-circular structure. This necessitated the removal of large quantities of loose basalt boulders to the east of the 1996 excavation trench, not only to allow for the continuation of excavation, but also to prevent them from collapsing into the deeper, old trench. Following the removal of these blocks a possible alignment of stones and some flat-lying basalt flagstones were encountered in K26-27 and L26-27. It was however unclear whether this represented a deflated stone structure or just a coincidental alignment of stones, given that the area exposed was quite small. Recording and removal of this structure allowed further excavation of *in situ* deposits. These consisted of a series of dark grayish brown deposits that contained abundant chipped stone, faunal remains and ground stone, as well as other items of material culture. Further excavations revealed the top of the return wall of the already partially exposed structure, indicating that some of these deposits fill the interior of a semi-circular building. This structure measures 4 m in diameter with walls constructed of upright-standing basalt stones (Fig. 6b).

A circular, stone-lined pit of as yet unknown function was exposed at the northern limit of excavation in squares J-K 26 (Fig. 6c). The fills contained many burnt stones at the top and abundant charred plant remains in an ash-rich sedimentary matrix throughout. The circular stone lining was rebuilt at least once in the same position, suggesting continuity of function. This would seem to rule out accidental burning of a storage pit, suggesting instead that burning was an integral part of the feature's function. While the feature could be a hearth, it is also possible that it may have been used as a roasting pit. Further work on the archaeobotanical material should provide us with a better idea of this feature's function.

Excavations in Area A concluded *ca*. 30 cm above the suspected floor level of the semi-circular structure. This will be the focus of renewed excavations in the next season.

Area B

This area was opened up to the north of Area A, separated from it by a 1 m wide baulk (Fig. 3). It initially measured 4 x 3 m and targeted *in situ* archaeological deposits. Surface artefacts, in particular chipped and ground stone, were encountered in large numbers already on the surface and in the topsoil. They were closely associated with three boulder-mortars situated in the vicinity of the excavation area. The first ten centimeters of topsoil contained occasional pieces of early Islamic ceramics, as well as some isolated early and late Neolithic projectile points. The majority of the lithic assemblage however had a distinct late Epipalaeolithic character. Chipped and ground stone artefacts, as well as animal bones, continued to be recovered in abundance as the area was further reduced. Beneath two midden deposits, 50 cm below modern surface, excavations revealed a flagstone paved area in J22-24 (Fig. 7a). This prompted the expansion of the excavation area by two meters to the east, enlarging the total area to 6 x 3 m. Eventually the stone pavement was exposed across the entire eastern half of the area (covering squares J-L 22-24). The pavement consisted of large basalt flagstones. One mortar and several grinding stones were incorporated into the pavement. A hearth was also exposed in K22 (Fig. 7d). Strewn across the pavement were numerous smaller ground stone artefacts and several pavement stones and worked ground stones showed traces of ochre pigment. In addition, three disarticulated sets of human remains were recovered. The first were the highly fragmented and isolated remains of an adult individual consisting of a fragmented upper segment of cranium, part of one clavicle and two broken parts of an ulna and radius, as well as other not yet identified elements (Fig. 7c). At the eastern edge of the excavation area the disarticulated remains of one infant and one adult were found concentrated in one area. A medium sized basalt slab had either been placed or dropped on top of these individuals. The infant remains include vertebrae, ribs, skull fragments, finger digits and teeth buds. The remains of the adult consist of skull fragments. Towards the end of the excavation season the articulated remains of another infant were found after cleaning the south section of the baulk between Area A and B (Fig. 7b). This necessitated the cutting back of the section to fully expose and recover these remains. The dentition suggests that these are the remains of a less than 6 month old infant, which lay on its right side in a crouched position. A lump of ochre was found in close association with the left hand. For an infant burial it appeared very well preserved with cranial fragments, ribs, vertebrae and most upper and lower limb elements present. The burial was found beneath a phase of pavement repair, suggesting that flagstones were lifted at times and burials placed beneath them. Indeed, this burial was cut into an earlier infant burial, which we were unable to excavate this season due to time constraints.

Area C

The presence of a suspected semi-circular wall visible on the surface in the northern part of the site prompted the opening of a small sondage here to investigate the full extent of the site. Excavations revealed a 50 cm deep sequence of deposits and showed that the align-

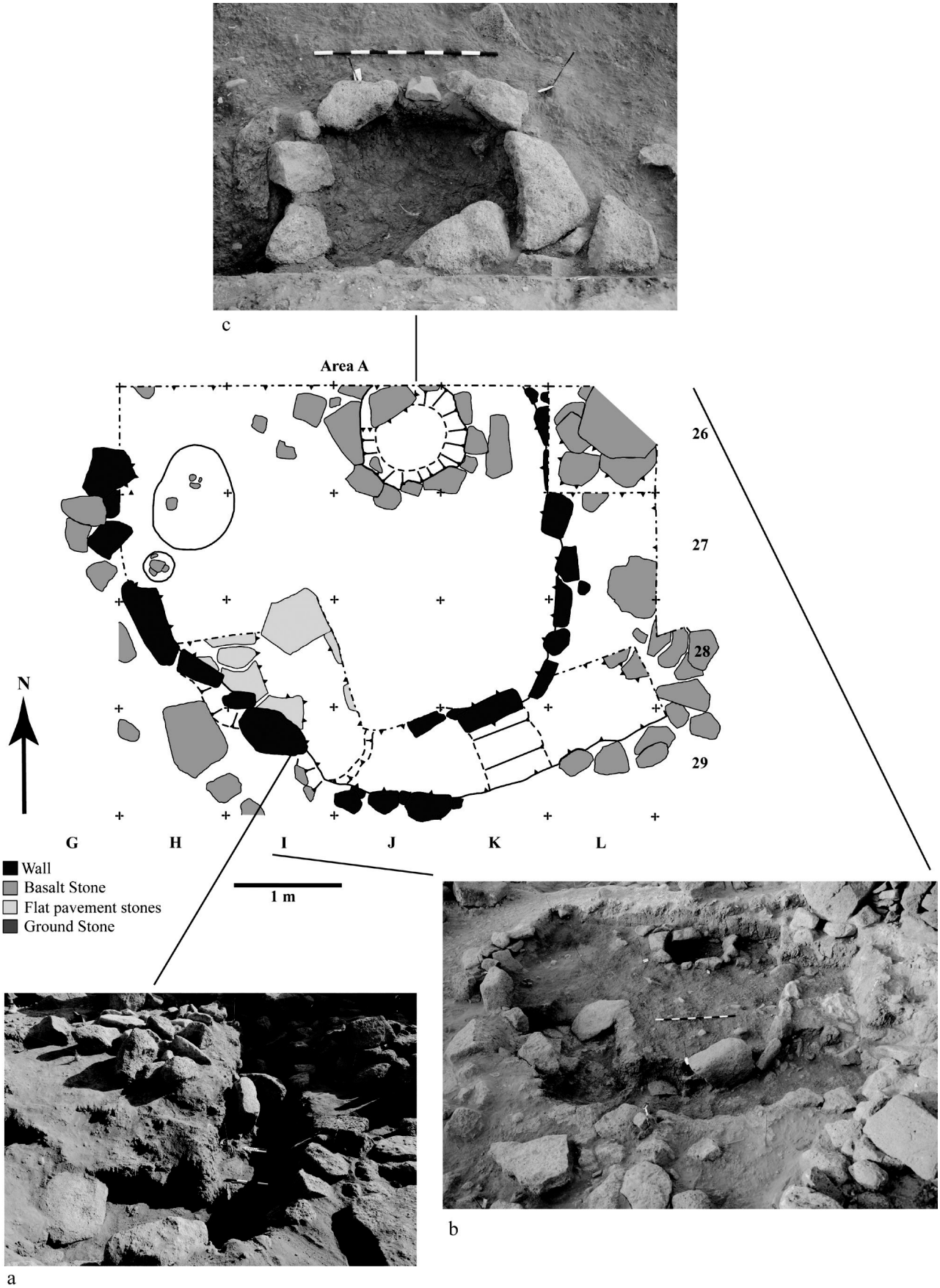

Fig. 6 Post-excavation plan of Area A: a) view of the re-excavated 1996 trench; b) end of season overview of Area A; c) stone-lined feature.

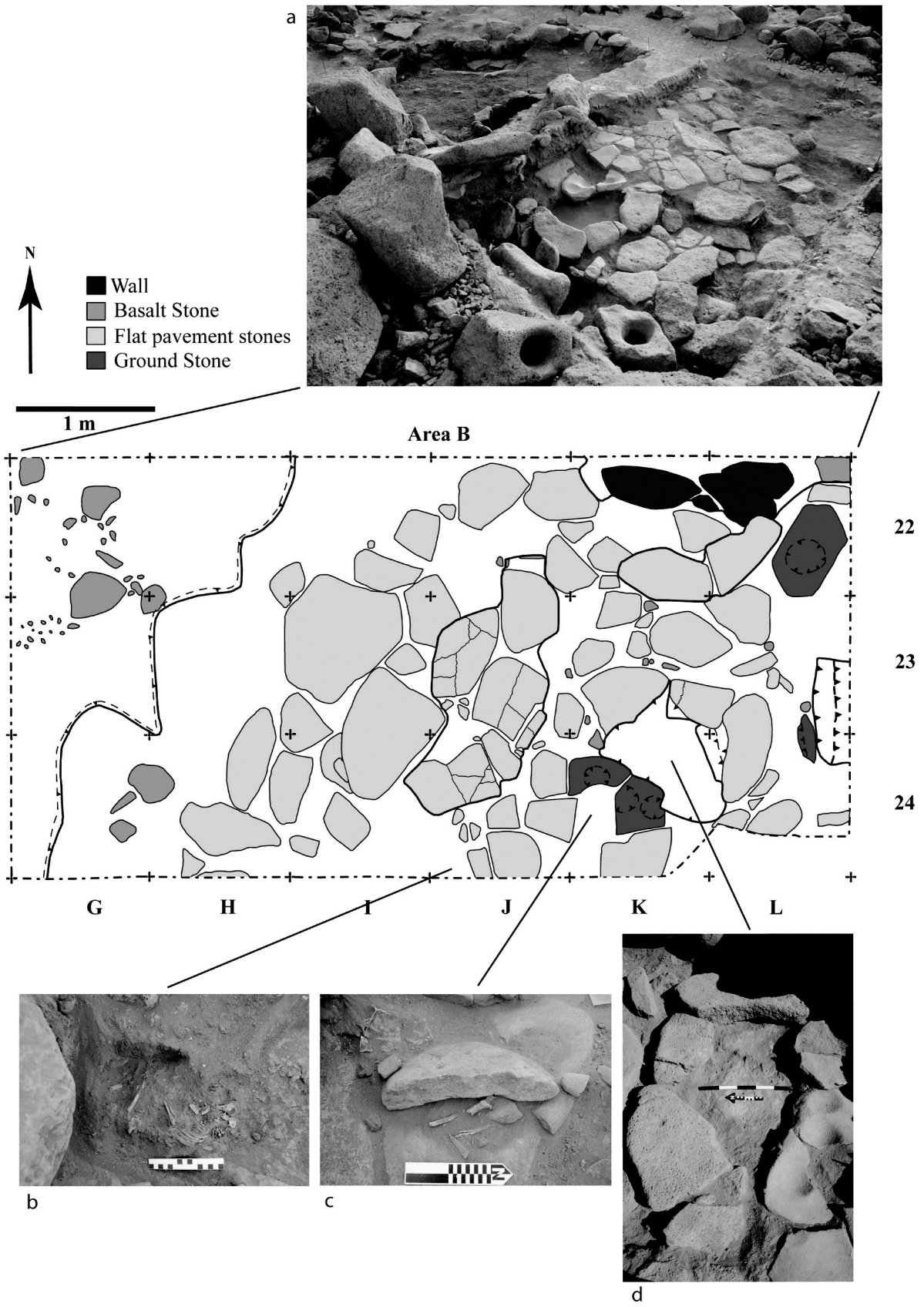

Fig. 7 Post-excavation plan of Area B: a) end of season overview looking southwest; b) infant burial; c) disarticulated human remains of an adult strewn over several ground stone artefacts; d) hearth with ground stone artefacts incorporated into the pavement.

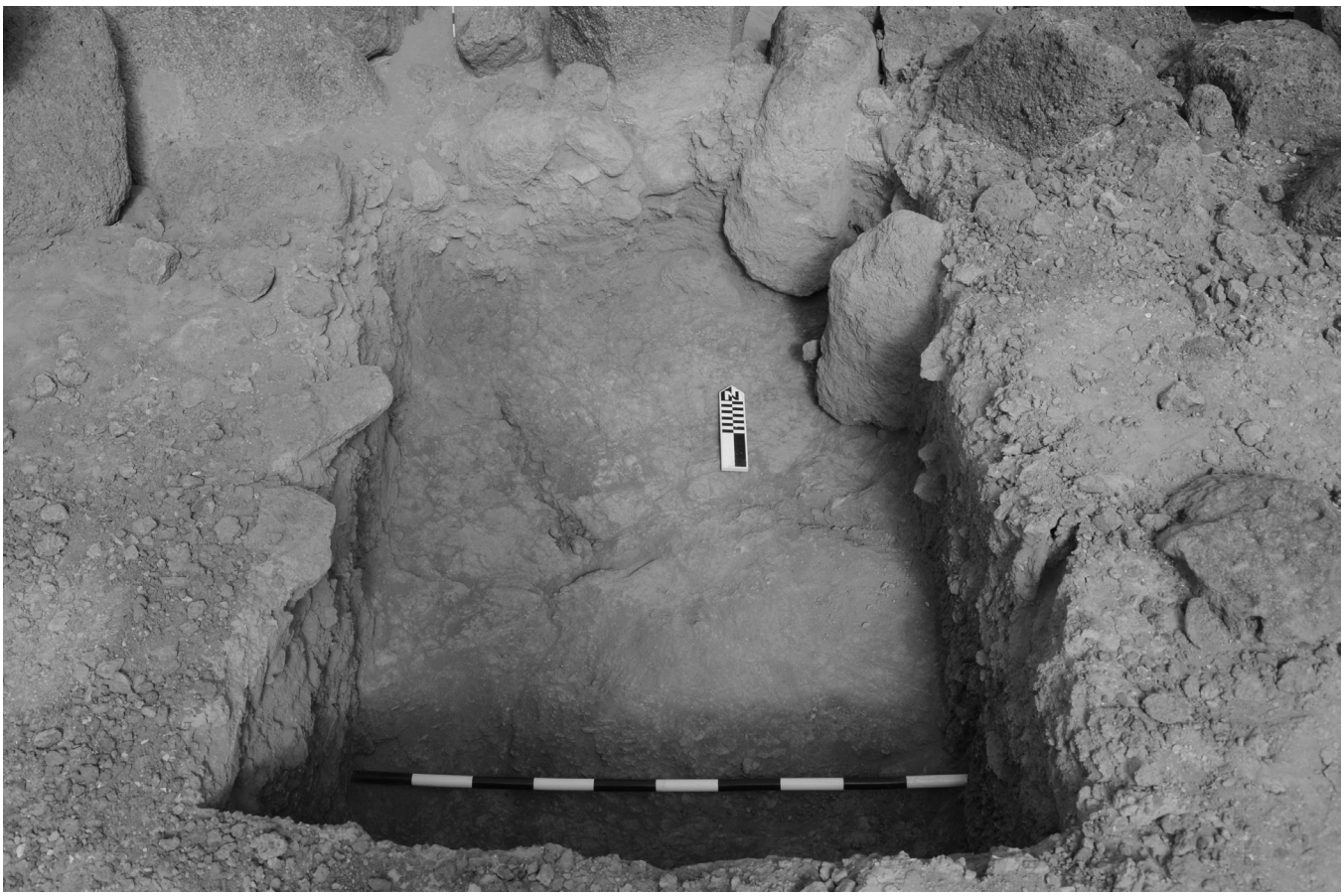

Fig. 8 Post-excavation overview of Area C.

ment of stones observed on the surface is indeed part of an as yet unidentified structure (Fig. 8). At the bottom of the sondage a compact earthen surface was exposed. This was covered by a soft brown silt (possibly aeolian), with rare finds. On top of this deposit was a finds-rich mid-brownish-grey midden deposit, which contained dense concentrations of charcoal. Chipped stone artefacts suggest that this area also forms part of the Natufian occupation. Two further leveling and compacted occupation deposits were situated above this midden deposit. Excavations in Area C showed that archaeological deposits and features are present in this area, warranting further investigations in this northern part of the site. The sondage also showed that Shubayqa 1 is considerably larger and potentially more complex than hitherto assumed, with occupation deposits and architecture extending this far to the north.

Finds

A wide range of material culture, fauna and botanical remains were recovered from the excavations (Fig. 9). Chipped stone and animal bones constitute the majority of the remains. The raw material used for chipping stone exhibits great variability. The majority of the assemblage consists of light to mid-grayish types of flint that are commonly found in the limestone areas of the Azraq Basin further south. There are also some red and pinkish varieties, which are known from sources to the south, southwest and west. A somewhat rarer category includes more translucent, fine-grained varieties of flint of unknown origin. There are also examples of chalcedony, sources of which exist to the east of the Azraq Oasis (Betts 1998: 34). No obsidian was found. The chipped stone appears to be a predominantly flake orientated industry. Few blades and bladelets were observed with many small flakes dominating the debitage. Microburins exist, but do not appear to be very common. Cores are very small and exhibit signs of extensive reduction. Bladelet cores appear to be rare. Burins and splintered pieces are common and can be miniature-sized. Primary pieces of debitage are very rare and there are few crested blades or other initial core preparation pieces that would suggest blade or bladelet production. Retouched artefacts include scrapers, backed bladelets, truncations, notches / denticulates and simple retouched flakes. As can be expected, geometric microliths are common and are dominated by lunates. Lunates are generally short – even very short – and are backed using abrupt, bipolar and Helwan retouch. The smallest variety of lunates appear to be usually backed using bipolar or abrupt retouch, but not Helwan. The lunates suggest a late Natufian date. Sickle-blades are rare. The Shubayqa 1 chipped stone assemblage appears to be comparable to the Khallat ‘Anaza material (Betts 1998: 16-19), where the microburin technique was also rare, flakes and bladelets were equally represented, and the toolkit was dominated by Helwan and abruptly / bipolar ba-

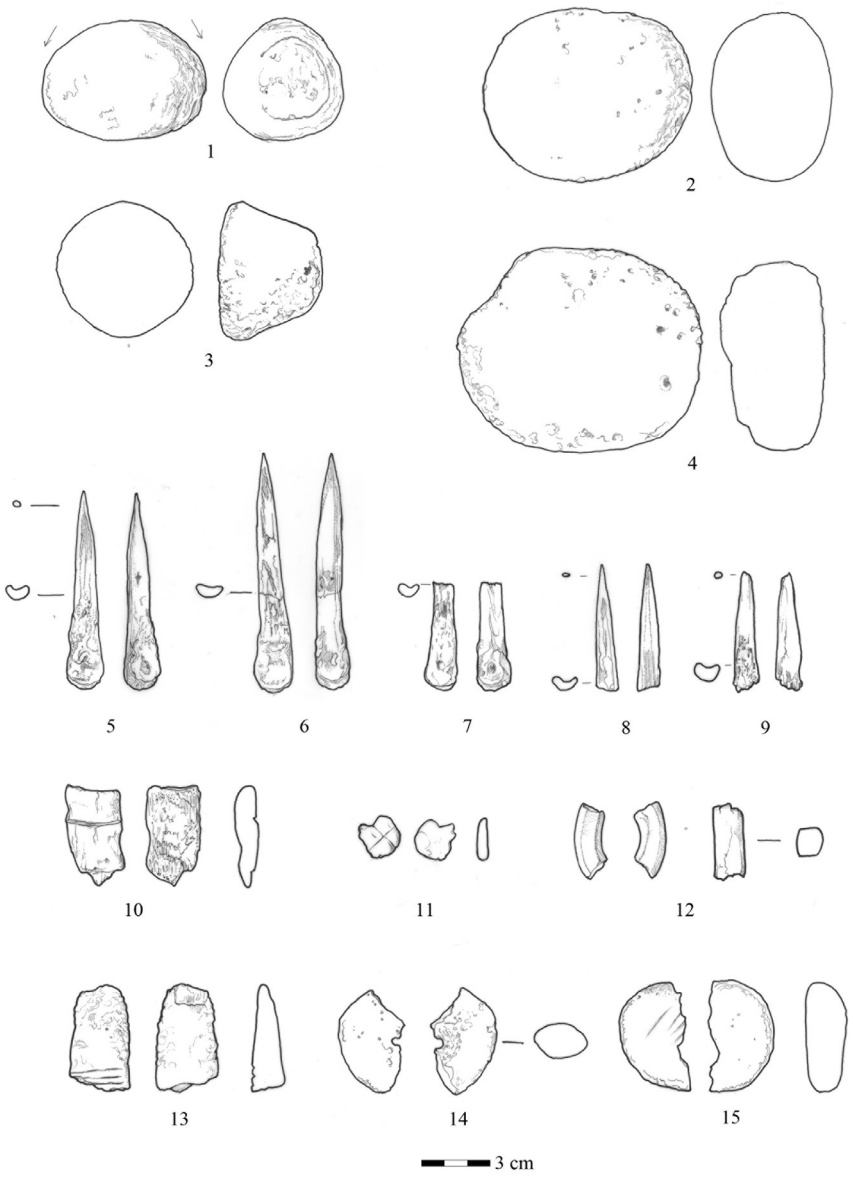

Fig. 9 Material culture from the excavations at Shubayqa 1. 1: Basalt Hammerstone with circular incision, 2, 4: Basalt handstones, 3: Basalt stone ‚plug', 5-9: Bone points, 10: Polished and incised bone, 11: Incised stone, 12: Limestone ring fragment, 13: Polished basalt stone with parallel incisions, 14: Basalt stone ring, 15: Basalt stone ring with parallel incisions.

cked, short lunates. The main difference appears to be in the cores, with Shubayqa 1 having more flake cores, splintered pieces and burins. Two key factors contributed to the character of the Shubayqa 1 assemblage. One is the distance between the site to the nearest raw material sources. The nearest flint raw material to Shubayqa 1 is located between 70-90 km to the south and southwest, while chalcedony can be found east of Azraq, 80 km south of Shubayqa. Transporting material over these considerable distances to the Qa' Shubayqa clearly affected the size and amounts of material that people were able to transport and resulted in maximal reuse of any available raw material. The second factor that influenced the character of the assemblage was settlement pattern. With architecture, burials and heavy-duty ground stone tools (see below) Shubayqa 1 appears to have been occupied intensively and for prolonged periods. The prolonged occupation of this one locality, coupled with the scarcity of locally available flint, would have demanded a high degree of exploiting whatever raw material was at hand. The Shubayqa 1 raw material economy therefore appears to be an interesting aspect that requires further careful investigation.

Ground stone was found in abundance at Shubayqa 1. In addition to seven basalt-boulder mortars the excavations recovered more than 300 individual pieces of worked basalt. The mortars, six of which were found on the surface, consist of two double mortars and five deep single mortars. The remainder of the ground stone assemblage consists of grinding slabs, slabs with cupholes, numerous vessel fragments, pestles, handstones, pounders, one grooved stone and various fragments and miscellaneous pieces (Fig. 9:

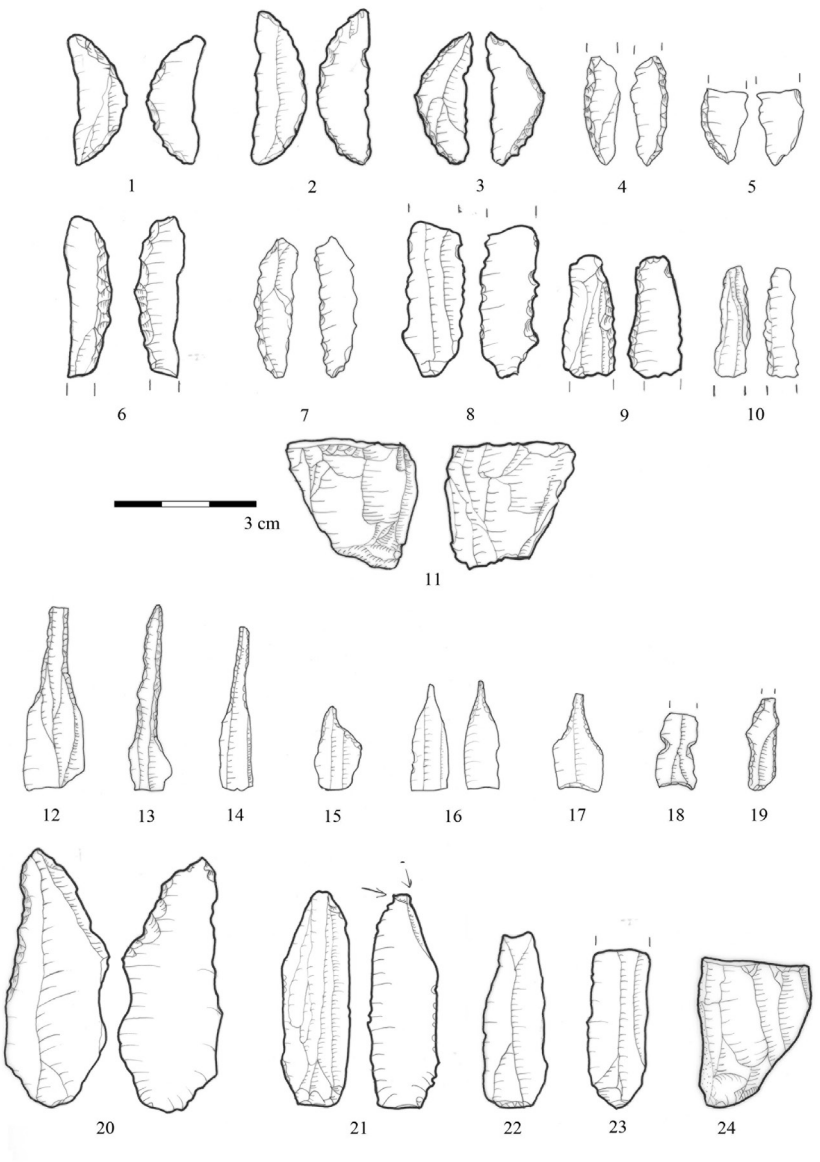

Fig. 10 Chipped stone from Shubayqa 3 (1-11) and Shubayqa 6 (12-24). 1-3: Helwan Lunates, 4-5: Broken Helwan Lunates, 6-7: Helwan retouched bladelets, 8: Retouched bladelet, 9-10: Backed bladelets, 11: Single platform core, 12-17: Drills, 18: Broken el-Khiam point, 19: Backed bladelet, 20: Retouched blade, 21: Burin, 22-23: Bladelets, 24: Single platform core.

1-4, 12-15). All the ground stone was made using basalt, which is hardly surprising given its abundance in the local environment. Instances of ochre staining were observed on some pieces, suggesting that some were used to process pigments. Similar to other sites it is likely that the ground stone was employed in many different tasks, ranging from hide working and mineral grinding to processing plant foods (Dubreuil 2004). Further, more intensive study of the assemblage is necessary to investigate the frequency of different uses.

There are several other worked stone objects, including stone rings (made from both basalt and limestone), as well as a number of incised objects (Fig. 9, 11-15). The latter include one polished pebble incised with two crossed lines and a hammerstone with a circular incision around one end. Other rare objects include a number of beads made from stone, bone and marine shell. All the shell beads recovered to date were made from *dentalium* shells, indicating that the site was linked into long-distance exchange networks. A small number of bone tools were also recovered. These include several points (Fig. 9: 5-10), as well as an incised piece of bone, possibly the fragment of a handle (Fig. 9: 10).

Faunal preservation is generally good and the assemblage is considerable in size, especially in comparison to other late Epipalaeolithic sites in the Azraq Basin. It consists of many small, highly fragmented pieces, suggesting intensive carcass processing for marrow and grease. The species identified to date include gazelle, caprines and small equids, hare, fox, tortoise and a wide range of birds. Gazelle is particularly abundant and dominates the assemblage. The presence of caprines is intriguing, as these have rarely

been documented in such early assemblages in eastern Jordan, having previously been thought to be introduced as domestic livestock during the early Neolithic (Garrard *et al.* 1996).

Charred plant remains were recovered from multiple contexts at the site. By far the densest concentration was found in the circular stone-lined feature in Area A, but other deposits also produced significant amounts. Both seeds and charred wood were found. The former include wild barley (*Hordeum spontaneum*) and sedges (Cyperaceae), while the latter include tamarisk (*Tamarix* sp.), Chenopodiaceae and ash (*Fraxinus* sp.). This assemblage, which is currently being analysed, represents the first substantial archaeobotanical assemblage from any Natufian site in eastern Jordan. It promises outstanding insights into the palaeoenvironment and plant economy of the Late Epipalaeolithic in the Badia and beyond.

Survey

In addition to excavations we carried out a brief reconnaissance survey in the area surrounding the site. This focused in particular on the early Islamic village of Khirbet Shubayqa. The preliminary results of the village survey will be reported elsewhere (Richter and Tarboush in preparation). Here we want to briefly draw attention to two additional prehistoric sites visited during the reconnaissance work.

Shubayqa 3 is a Natufian site situated on a low hill at the southeastern edge of the Qa' Shubayqa overlooking the dry lake. The site was first reported by Betts (1998) as a Late Natufian site. We successfully relocated this site during this season and carried out a brief surface collection. Shubayqa 3 consists of a surface scatter of chipped stone artefacts, faunal remains, and ground stone artefacts that spreads over an area of 5000-6000 m^2. To the west the site is delineated by later enclosures and two burial cairns (of which one was robbed recently) while the lithic scatter peters out gradually in all other directions. The site is slightly disturbed by modern tracks to the north, south and east. One possible circular structure was noted during the walkover. Surface material was collected from a single north-south transect, 80 meters long and 2 m wide. This resulted in a collection of 395 chipped stone artefacts (see Table 1, Fig. 10). Ground stone artefacts were also ubiquitous on the surface but were not collected at this stage. Although bladelets were numerous in this assemblage, flakes were represented in almost equal numbers. Both bladelet and flake cores were present. Betts (1998) suggested that the site was probably late Natufian, but this was based on a limited surface collection. The 2012 surface collection produced a number of long and wide Helwan lunates (Fig. 10: 1-5), which seem to suggest an early Natufian date for the occupation.

As part of the survey of Khirbet Shubayqa we also located a hitherto unknown prehistoric site. It is

Chips & Chunks	63	15,94%
Cores	13	3,29%
Debitage	144	36,45%
Retouched	175	44,3%
Total	**395**	
Retouched		
Scrapers	8	4,57%
Perforator	1	0,57%
Retouched Blade	9	5,14%
Denticulates	6	3,42%
Notched	20	11,42%
Truncations	4	6,28%
Retouched/backed bladelets	32	18,28%
Helwan Lunates	6	3,42%
Lunates	2	1,14%
Broken Lunates	2	1,14%
Retouched flakes	86	49,14%

Table 1 Chipped stone from Shubayqa 3.

Cores	3	1,22%
Chips & Chunks	31	17,70%
Debitage	113	46,31%
Retouched Pieces	97	39,75%
Total	**244**	100%
Retouched		
Scrapers	2	0,81%
Perforators	10	4,09%
Burins	10	4,09%
Notches	13	5,32%
Denticulates	2	0,81%
Retouched/ backed bladelets	39	15,98%
Projectile Points	1	0,40%
Microliths	1	0,40%
Splintered Pieces	2	0,81%
Retouched flakes	17	6,96%

Table 2 Chipped stone from Shubayqa 6.

situated at the southeastern corner of the abandoned early Islamic village on a low mound at the edge of the Qa' Shubayqa, *ca*. 1 km east of Shubayqa 1. It is comparable in size and appearance to Shubayqa 1. A rectangular building, probably dating to the early Islamic occupation, and a burial cairn were built on top of the mound. Chipped stone artefacts spread across an area of *ca*. 2000 m^2. In places it seems to be retained by a semi-circular stone alignment, which could represent part of a buried structure. Although one grinding stone was seen lying *ca*. 50 m to the west of the site, there was no ground stone visible on the surface of the mound itself. A surface collection at the site yielded 244 pieces of chipped stone (Table 2, Fig. 10) and 6 fragments of greenstone. The collection contained a significant number of bladelets and small flakes, but only few cores were found. Amongst the retouched pieces was one broken el-Khiam point (Fig. 10: 18)

and ten perforators (Fig. 10: 12-17), together with many notches, retouched flakes and retouched/backed bladelets. On the basis of the overall technology and the single el-Khiam point it can be tentatively suggested that this site may date to the PPNA. The presence of many drills and greenstone fragments suggests that greenstone bead production may have been important at this site. The nearest greenstone source is located *ca*. 150 km southwest of the Qa Shubayqa to the west of Wadi el-Jilat. Following on from Betts' (1993) survey of the Qa Shubayqa we have labeled this site Shubayqa 6. Further excavations at this site are necessary to confirm the initial assessment of age and function.

Conclusion

This inaugural fieldwork season of the Shubayqa Archaeological Project demonstrated that Shubayqa 1 is a site with interesting research potential. Excavations have shown that it is a multi-phased, complex Late Epipalaeolithic Natufian site. It combines many features that are more commonly associated with Natufian sites in the Mediterranean 'core zone', including architecture, heavy-duty ground stone tools, plant exploitation and human burials. Shubayqa 1 today sits at the edge of the Irano-Turanian vegetation zone and the 100 mm annual average annual precipitation boundary. Both Betts (1998) and Moore et al. (2000) have described the Jebel Druze as a Mediterranean zone 'island' poking out of sea of steppe and desert. Moore et al. (2000; Moore and Hillman 1992) have hypothesized how the climatic and environmental change of the Younger Dryas affected the size and distribution of these vegetation zones. Shubayqa 1 can shed further light on these issues and also help us to better understand the impact of the Younger Dryas climatic episode in relation to changing settlement patterns, subsistence practices and cultural dynamics of the terminal Pleistocene in southwest Asia.

The Younger Dryas has been seen by many scholars as a key climatic event that forced Late Epipalaeolithic societies to lower dense population numbers in the Mediterranean Zone by expanding into more arid and marginal areas, and by taking up the cultivation of cereals and other plants to compensate for the loss of natural habitats (Bar-Yosef 1995; Bar-Yosef and Belfer-Cohen 2000, 2002; Bar-Yosef and Meadow 1995; Moore and Hillman 1992; Moore 2000; Henry 1989, 1995). The presence of a possible early Natufian site (Shuabyqa 3) and a PPNA site (Shubayqa 6) affords us an opportunity to examine the transition from gathering and hunting to the early aceramic Neolithic in the Harra in much better detail. We hope that further surveys in the Qa Shubayqa area and excavations at all of the sites discovered so far will shed some new light on this crucial time frame.

Acknowledgements. We would like to thank the Department of Antiquities of Jordan for permission to carry out this project and their continued support. We are grateful to the assistance of our departmental representative Mr Hussein Askar al-Serhan. We would also like to acknowledge the kind help of the Royal Bedouin Police Safawi, the Badia Research and Development Centre and the British Institute in Amman. Lastly, we are grateful for the help provided by Mr Ali Shkreitir and our local workmen from Safawi. This project is funded by the Danish Council for Independent Research (Culture and Communication) grant #11-116136.

Tobias Richter
Department for Cross-Cultural and Regional Studies
University of Copenhagen
richter@hum.ku.dk (corresponding author)

Leslie Bode
Department of Archaeology
University of Nottingham

Michael House
Department for Cross-Cultural and Regional Studies
University of Copenhagen

Rune Iversen
SAXO Institute
University of Copenhagen

Amaia Arranz Otaegui
Universidad del País Vasco-Euskal Herriko
Unibertsitatea (UPV-EHU)
Departamento de Geografía, Prehistoria y Arqueología

Ingeborg Saehle
SAXO Institute
University of Copenhagen

Guenever Thaarup
Department for Cross-Cultural and Regional Studies
University of Copenhagen

Marie-Louise Tvede
SAXO Institute
University of Copenhagen

Lisa Yeomans
Department for Cross-Cultural and Regional Studies
University of Copenhagen

References

Bar-Yosef O.
1995 The role of climate in the interpretation of human movements and cultural transformations in western Asia. In E.S. Vrba (ed.), *Paleoclimate and evolution with emphasis on human origins*: 507-523 New Haven and London: Yale University Press.

Bar-Yosef O. and Belfer-Cohen A.
2000 Early sedenstism in the Near East: a bumby ride to village life. In I. Kujit (ed.), *Life in Neolithic farming communities. Social organization, identity, and differentiation*: 19-62. Fundamental Issues in Archaeology. New York: Kluwer Academic.
2002 Facing environmental crisis: societal and cultural changes at the transition from the Younger Dryas to the Holocene in the Levant. In R.T. Cappers and S. Bottema (eds.), *The Dawn of Farming in the Near East*: 55-66. Berlin: ex oriente.

Bar-Yosef O. and Meadow R.H.
1995 The origins of agriculture in the Near East. In T.D. Price and A. B. Gebauer (eds.), *Last hunters-first farmers: New perspectives on the prehistoric transition to agriculture:* 39-94. Santa Fe: School of American Research Press.

Betts A.V.G.
1991 The late Epipalaeolithic in the Black Desert, easter Jordan. In O. Bar-Yosef and F. R. Valla (eds.), *The Natufian Culture in the Levant*: 217-234.
1993 *Wadi al-'Ajib/ Shubeiqa Survey 1993*. Amman: Department of Antiquities of Jordan. Ann Arbor: International Monographs in Prehistory.
1998 *The Harra and the Hamad. Excavations and Surveys in Eastern Jordan, Volume 1*, Sheffield: Sheffield Academic Press.

Byrd B.F.
2005 Reassessing the emergence of village life in the Near East. *Journal of Archaeological Research* 13(3): 231-290.

Dubreuil L.
2004 Long-term trends in Natufian subsistence: a use-wear analysis of ground stone tools. *Journal of Archaeological Science* 31: 1613–1629.

Garrard A.N.
1991 Natufian settlement in the Azraq Basin, eastern Jordan. In O. Bar-Yosef and F.R. Valla (eds.), *The Natufian culture in the Levant*: 235–244. International Monographs in Prehistory. Ann Arbor.

Garrard A.N., Colledge S.M. and Martin L.
1996 The emergence of crop cultivation and caprine herding in the "marginal zone" of the southern Levant. In D. Harris (ed.), *The origins and spread of agriculture and pastoralism in Eurasia*: 204-226. London: University College London Press.

Henry D.O.
1989 *From foraging to agriculture: the Levant at the end of the Ice Age*, Philadelphia: Philadelphia University Press.
1995 *Prehistoric cultural ecology and evolution. Insights from southern Jordan.*, New York: Plenum Press.

Hillman G.
1996 Late Pleistocene changes in wild plant food available to hunter-gatherers of the northern Fertile Crescent: Possible preludes to cereal cultivation. In D. Harris (ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia*: 159-203. London: UCL Press.

Hillman G., Colledge S.M. and Harris D.R.
1989 Plant-food economy during the Epipalaeolithic period at Tell Abu Hureyra, Syria: dietary diversity, seasonality, and modes of exploitation. In D. R. Harris and G.C. Hillman (eds.), *Foraging and farming: the evolution of plant exploitation*: 240-268. London: University College London Press.

Hillman G., Hedges R., Moore A., Colledge S., Pettitt P.
2001 New evidence of Lateglacial cereal cultivation at Abu Hureyra on the Euphrates. *The Holocene*, 11(4): 383-393.

Moore A.M.T.
1991 Abu Hureyra 1 and the antecendants of agriculture on the Middle Euphrates. In O. Bar-Yosef and F.R. Valla (eds.), *The Natufian Culture in the Levant*: 277-294. Ann Arbor: International Monographs in Prehistory.
2000 *Village on the Euphrates: from foraging to farming at Abu Hureyra*. Oxford: Oxford Univesity Press.

Moore A.M.T. and Hillman G.C.
1992 The Pleistocene to Holocene transition and human economy in southwest Asia: the impact of the Younger Dryas. *American Antiquity* 57(3): 482-494.

Moore A.M.T., Hillman G. and Legge A.J.
2000 The Setting. In A.M.T. Moore, G. Hillman and A.J. Legge (eds.), *Village on the Euphrates. From Foraging to Farming at Abu Hueryra*: 43-91. Oxford: Oxford University Press.

Richter T. and Tarboush M.
in prep. Survey and Excavations in the Qa' Shubayqa: Report the First Season of Shubayqa Archaeological Project. *Annual of the Department of Antiquities of Jordan*.

Renewed Excavations at Monjukli Depe, Turkmenistan

Reinhard Bernbeck, Susan Pollock, and Birgül Öğüt

Monjukli Depe is a small site close to Altyn Depe in southern Turkmenistan a few kilometers north of the foot of the Kopet Dag. It dates to the Late Neolithic period through the early Aeneolithic (regional terminology for "Chalcolithic"). The site's uppermost level was broadly exposed in the early 1960s under the directorship of O.K. Berdiev (1972). Prior to this, A.A. Marushchenko had excavated a stratigraphic sounding in the center of the mound, which was unfortunately never published in detail. In 2010, we began renewed excavations at the site.[1]

Our work seeks to clarify the chronological sequence at the site and technological-cultural developments in the transition from the Neolithic to the Aeneolithic periods. Since 2010, we have conducted three seasons of work at Monjukli Depe. Although much of the analysis remains to be completed, preliminary results already point to some important new insights. Here, we briefly mention aspects of chronology, architecture, pottery technology, and subsistence.

Dating and Sequence

We encountered Neolithic levels only in a few places. They occur some 3.5 to 4.0 m below the present mound surface and are located not far below the earliest Aeneolithic architecture. Although we have only reached the upper part of the Neolithic occupation, we know from the Soviet investigations that the Neolithic layers have a depth of some three meters. Several radiocarbon dates firmly anchor these levels in the late 7th to early 6th millennium BCE, contemporary with Early Jeitun at the type site of Jeitun (Harris *et al.* 2010: 120-123). This runs counter to Berdiev's assumption of a Middle to Late Jeitun date for Neolithic Monjukli Depe (Berdiev 1972). It is too early to say whether and how these Neolithic materials differ from those from the site of Jeitun itself or from other Jeitun sites in the western ranges of the Kopet Dag foothills, such as Pessedjik, Bami or Novaja Nisa or sites in Iranian Khorassan (see Garazhian, this issue).

The Neolithic levels are separated by a *hiatus* of *ca*. 900 years from the Aeneolithic occupation. Our initial question about the nature of the transition from the Neolithic to the earliest Aeneolithic or "Anau IA" period has thus been answered simply: there was no transition. Absolute dates for the Aeneolithic occupation at Monjukli Depe also present us with a surprise: Berdiev already pointed out that the pottery from Aeneolithic Monjukli Depe bears motifs that are different from those of Anau North and the few other known Anau IA sites (*e.g*. Berdiev 1974: 35-36; Hiebert and Kurbansakhatov 2003: 75-77). He therefore claimed that Monjukli Depe's Anau IA layers were chronologically later than those at the other sites, including nearby Çakmakly Depe. Our results, however, reverse this sequence. Anau IA layers at Anau North have been dated to the second half of the 5th millennium by several absolute dates (Hiebert and Kurbansakhatov 2003: 55-56), while nearly all determinations from Aeneolithic Monjukli Depe fall into the first half of the 5th mill. cal. BCE (Pollock and Bernbeck *et al.* 2011: 183-184; Bernbeck *et al.* in press). Therefore, at least in the southeastern part of the Kopet Dag foothills, the current sequence of Early/Middle/Late Jeitun, followed after a lengthy *hiatus* by Anau IA has to be modified by inserting a chronological unit that we call the "Meana Horizon." The geographic extent of this horizon is presently unclear. Pottery motifs similar to those discovered at Monjukli Depe, the main element for an assessment of chronological and other parallels, have yet to be found. South of the border in Iranian Khorassan, the chalcolithic materials from Shir-e Shian or the Shahroud survey seem also to date later than Aeneolithic Monjukli Depe (*e.g.* Roustaie 2012: fig. 16). In terms of absolute dates, we can compare the Meana Horizon with the early "Transitional Chalcolithic" of the Tehran plain (Fazeli Nashli *et al.* 2004).

Aeneolithic Architecture

Our excavations have revealed extremely well preserved architecture from the Meana Horizon, with some walls standing to a height of 1.5 m or more (Fig. 1). The buildings very often underwent substantial modifications, particularly through the addition of internal partition walls. Berdiev (1972) described Aeneolithic architecture at Monjukli Depe as consisting of three house types: multi-roomed buildings consisting of small cellular entities, houses with functional installations (hearth, benches, *etc*.), and houses with lengthy "vestibules." From our work it is apparent that many of the complex, late-phase plans noted by Berdiev were originally one-room, squarish buildings divided in half by two opposing buttresses. Berdiev's "vestibule" and "functional installations" seem to refer to the fact that one half of the buildings served as both entry and space for bins, hearths and other such features, while the other half, the floors of which are 12-15 cm higher than the other, consisted of living quarters. The fundamental layout of these houses is quite similar to the standard house types

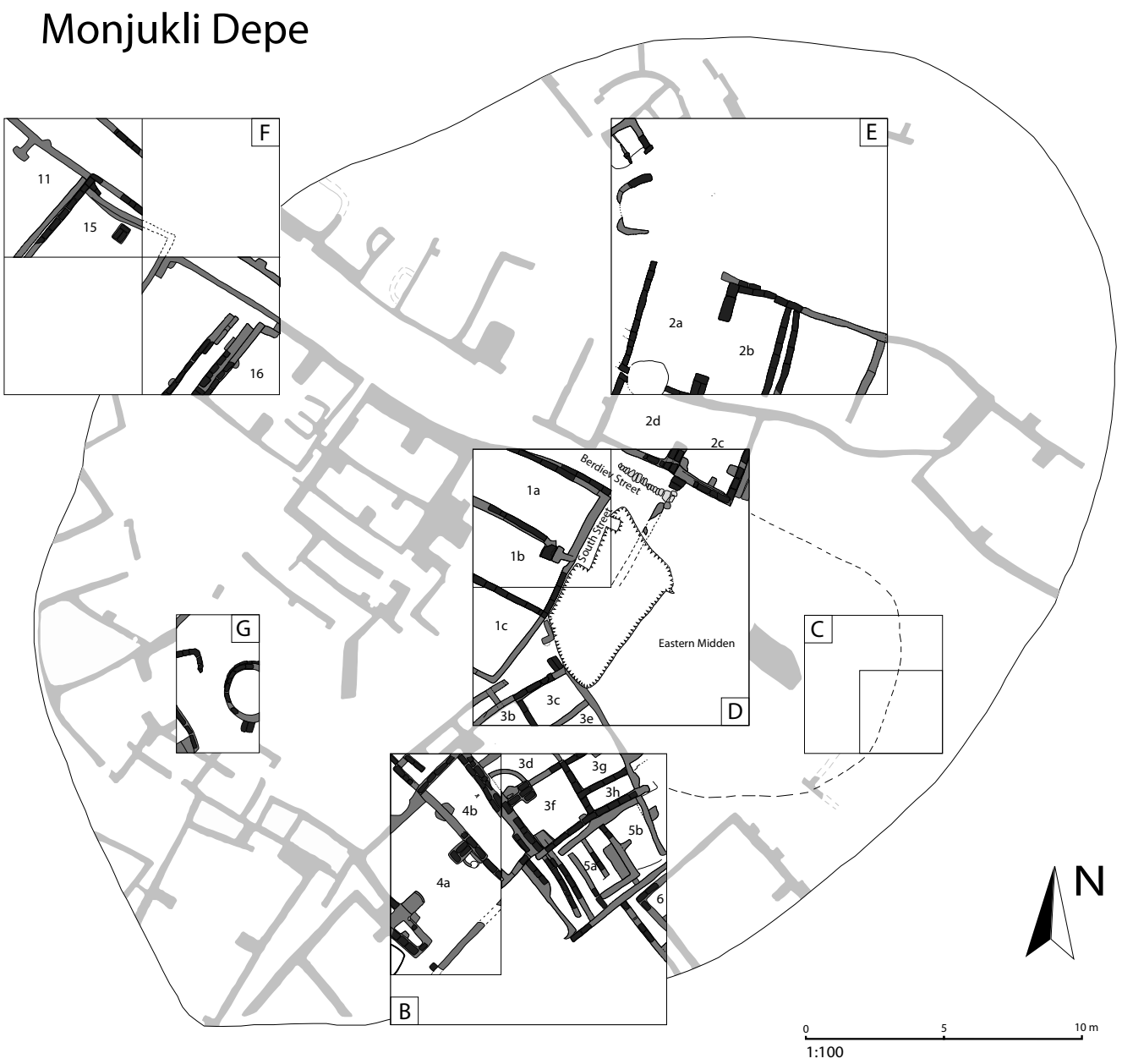

Fig. 1 Plan of Monjukli Depe Stratum II.

found at Early Jeitun sites such as Jeitun itself, but also at Çagylly Depe not far from Monjukli Depe, a site that is thought to date to the Late Jeitun period (Berdiev 1966).

The buttresses encountered in many houses come in two types: simple protrusions from walls that are one or two bricks wide; and T-shaped buttresses that extend one brick length from a wall and are then enlarged at the end (Fig. 2). Buttresses were especially well plastered, often several times and in different colors. They apparently had the primary function of supporting the roofs of the spacious rooms but seem also to have had a more symbolic function, the details of which still elude us.

Well known from other sites of the Aeneolithic period is also the habit of painting walls. In Monjukli Depe, we found both white and ocher-colored examples, in one case also traces of black paint. At any one time, however, each wall was monochrome: there was apparently no wall painting of the sort found at Neolithic Pessejik Depe (Müller-Karpe 1982: 18-19).

The village plan of Monjukli Depe contains a thoroughfare, thought by Berdiev to be similar to the one at Çakmakly Depe that cut the village in half. Our excavations exposed Berdiev's street but showed that some modifications of his ideas are necessary. At more or less the center of the mound, the straight street we call "Berdiev Street" (Fig. 1) that runs from the northwestern edge of the village is paved with a row of flat stones that lead up to a gate with door sockets and a large, incised limestone door jamb. It is clear that this gate could be closed. Behind it, we found an open area bordering a huge ash accumulation which we refer to as the "Eastern Midden." Here we discovered many well preserved animal bones, particularly skulls of cattle

Fig. 2 Monjukli Depe Building 9 with two opposed T-shaped buttresses.

and sheep. The exact derivation of the material in the Eastern Midden is unclear, but it seems to be related to communal feasting.

Shortly to the west of the gate, a smaller passageway turned off to the south ("South Street", Fig. 1), coming to an end between two houses. Taking together the insights from house architecture and village layout, we find more parallels to Jeitun-period Çagylly Depe than to Aeneolithic Çakmakly Depe, suggesting at least some elements of a continued tradition from Neolithic Çagylly to early Aeneolithic Monjukli Depe.

Pottery and Chronological Problems

The most surprising find in terms of pottery at Monjukli Depe is the abrupt drop in quantity from the Neolithic to the Aeneolithic period (Pollock and Bernbeck *et al.* 2011: Fig. 19). The range of Neolithic materials from Monjukli Depe is too small to investigate differences or commonalities with other sites of the Jeitun period and particularly with Jeitun itself. However, there is a notable difference between the bulk of the coarse chaff-tempered ware from the Neolithic levels and a small component of a fine chaff-tempered painted ware. Neolithic Coarse Chaff Ware has a thick flaky slip, as well as very thick, slightly S-shaped walls and simple rims. These characteristics, plus clear indications of sequential slab construction (Vandiver 1987), make this coarse ware a typical Late Neolithic product that can be connected to the technology of vessel production from the southwest Iranian lowlands to the Kopet Dag foothills.

Another, much finer chaff-tempered ware is "Fine Chaff Black-on-Red Ware." It has a thick, carefully burnished slip on both outside and inside and is equally carefully painted with abstract motifs in thin black lines. It can likely be dated to the time just before the

900-year *hiatus* between the Jeitun occupation and the Meana Horizon. The sherds are all small and heavily worn, and none of them has been found *in situ* (see Pollock and Bernbeck *et al.* 2011: Fig. 16 and Fig. 20, Groups A and B).

Ceramic vessels from the Aeneolithic levels at Monjukli Depe cannot be considered objects of daily life. Their rare occurrence likely made them akin to luxury items. Their general make-up is similar to that described by Hiebert (2002: 33) for the Anau IA "high-fired" ware at Anau North, where this material constitutes only 15 % of the full assemblage. Almost all Aeneolithic ceramic vessels from Monjukli Depe are thin-walled hemispherical bowls of various sizes with simple rims and dimpled bases with a very small diameter. Motifs consist of one band at the rim, often with a sloppily drawn cross-hatch motif or triangular patterns and four to six vertical lines that converge at the narrow base of the vessel (Pollock and Bernbeck *et al.* 2011: Figs. 17 and 18). Contrary to our macroscopic observations and the description of this ware in the literature as "high-fired" (*e.g.* Hiebert 2002), archaeometric analysis shows that firing temperatures were no higher than those of the Neolithic chaff-tempered pottery (Daszkiewicz in press). It may be of chronological importance that Monjukli Depe's Meana Horizon is almost completely devoid of chaff-tempered pottery and that the typical ware is essentially untempered. At least in the southeastern Kopet Dag piedmont, the chaff-tempered Neolithic pottery should not be linked to the equally coarse but much later Anau IB wares (see Berdiev 1974).

Subsistence Practices

Only a small portion of the faunal and floral remains recovered from Monjukli Depe has been analyzed. Nonetheless the initial results offer some pertinent information regarding subsistence at the site in comparison to other assemblages.

Miller (2011: 219-221) notes the presence of both glume and free-threshing wheat in the Aeneolithic levels at Monjukli, whereas in Anau IA levels at Anau itself only free-threshing wheat was present. The very few Neolithic samples from Monjukli Depe yielded only glume wheat, as did the type-site of Jeitun. Wheat seems to predominate over barley at Monjukli Depe, with six-row barley present in both Neolithic and Meana Horizon occupations. Both the macrobotanical and phytolith analyses indicate the use of irrigation, presumably a simple form using gravity-flow (Miller 2011: 220; Ryan 2011: 226; Miller and Ryan 2011: 227). Plant material from the Anau IA period at Anau North is also argued to imply irrigation (Miller 2003: 137-138), whereas at Neolithic Jeitun it remains uncertain whether irrigation was practiced or if farmers sought out places with high water table. Alternatively, a somewhat greater amount of precipitation may have enabled crops to be grown with rain-fed agriculture alone (Charles and Bogaard 2010).

Faunal remains at Monjukli Depe are heavily weighted toward domestic species, in particular sheep, goat and cattle. Gazelle and half-ass *(Equus hemionus)* are among the more commonly represented wild species (Benecke 2011). A rather different faunal spectrum is represented at Jeitun and Anau North. At Jeitun the only definitive domesticates are sheep and goat; wild game include gazelle but no equids or cattle (Dobney and Jaques 2010). At Anau North domesticates include sheep, cattle, and dog, with gazelle and onager the principal hunted animals (Moore *et al.* 2003).

Summary

Renewed excavations at Monjukli Depe have clarified some questions of chronological import in the relation between the Late Neolithic and the Early Aeneolithic of southern Turkmenistan. At the same time, they have raised many new questions. Some of them can be answered by continuing work at the site, others can be investigated by soundings at other sites, particularly Çagylly Depe, where Neolithic levels are easily accessible. However, only a much denser network of survey and excavation along the northern Kopet Dag foothills will enable us to clarify whether we are indeed in the presence of prehistoric cultures that are fairly homogeneous in a region that stretches across hundreds of kilometers, or whether we need to deconstruct "Jeitun", "Anau IA" and other such categories into smaller, more local traditions.

Endnote

[1] We thank Dr. Mukhammed Mamedov, Dr. Ruslan Muradov, Dr. Aydogdy Kurbanov, Prof. Dr. Natalja Solovieva and Mr. Ahmed Khalmuradov as well as others too numerous to name here who have supported our work at Monjukli Depe. The fieldwork was funded by the Excellence Cluster TOPOI (Free University of Berlin), the National Geographic Society, and the German Research Foundation (DFG).

Reinhard Bernbeck
Free University of Berlin
Institute of Near Eastern Archaeology
rbernbec@zedat.fu-berlin.de

Susan Pollock
Free University of Berlin
Institute of Near Eastern Archaeology
spollock@zedat.fu-berlin.de

Birgül Öğüt
Free University of Berlin
Institute of Near Eastern Archaeology
ogut@zedat.fu-berlin.de

References

Benecke N.
2011 Archaeozoological investigations. In: S. Pollock, R. Bernbeck *et al*., Excavations at Monjukli Depe, Meana-Čaača Region, Turkmenistan, 2010. *Archäologische Mitteilungen aus Iran und Turan* 43: 210-213.

Berdiev O.K.
1966 Чагыллы Депе, Новый Памятник Неолитической Джейтунской Культуры. In: H.A. Кисляков and M.Г. Воробьева (eds), *Материальная Культура Народов Средней Азии и Казахстана*: 3-28. Москва.
1972 *Мончукли Депе* – многослоиное поселение неолита й раннего енеолита в южном Туркменистанею Каракумские Древносьти 4: 11-34.
1974 Керамика времеи Ануа I A, In: B.M. Массон (eds.), *Материальная культура Туркменистана, Выпуск 2*: 5-38, Ашхабад: Ылым

Bernbeck R., Pollock S., Öğüt B., Sturm P., Schönicke J. with contributions by Daskiewicz M., Eger J., Keßeler A., Rogasch J., Teuwsen K.
In press The second season of excavations at Monjukli Depe, Turkmenistan, 2011. *Archäologische Mitteilungen aus Iran und Turan.*

Charles M. and Bogaard A.
2010 Charred plant macro-remains from Jeitun: implications for early cultivation and herding practices in Western Central Asia. In: D.R. Harris, *Origins of Agriculture in Western Central Asia: An Environmental-Archaeological Study*: 150-165. Philadelphia: University Museum.

Daszkiewicz M.
In press Archaeometric analysis of a sample of pottery from Monjukli Depe, in: R. Bernbeck *et al*., The second season of excavations at Monjukli Depe, Turkmenistan, 2011. *Archäologische Mitteilungen aus Iran und Turan.*

Dobney K. and Jaques D.
2010 The vertebrate assemblage from excavations at Jeitun, 1993 and 1994, In D.R. Harris, *Origins of Agriculture in Western Central Asia: An Environmental-Archaeological Study*: 172-179. Philadelphia: University Museum.

Fazeli Nashli H., Coningham R.A.E., and Batt C.M.
2004 Cheshme 'Ali revisited: towards an absolute dating of the Late Neolithic and Chalcolithic of Iran's Tehran Plain. *Iran* 42: 13-24.

Harris D.R. with Gosden C. and Meadows J.
2010 Dating the site: radiocarbon chronology. D.R. Harris (ed.), *Origins of Agriculture in Western Central Asia: An Environmental-Archaeological Study*: 119-124. Philadelphia: University Museum.

Hiebert F.T.
2002 The Kopet Dag sequence of early villages in Central Asia. *Paléorient* 28 (2): 25-42.

Hiebert F.T. and Kurbansakhatov K. (eds.)
2003 *A Central Asian Village at the Dawn of Civilization. Excavations at Anau, Turkmenistan*. Philadelphia: University Museum.

Miller N.
2003 The use of plants at Anau North. In: F.T. Hiebert and K. Kurbansakhatov (eds.), *A Central Asian Village at the Dawn of Civilization. Excavations at Anau, Turkmenistan*: 127-138. Philadelphia: University Museum.
2011 Preliminary archaeobotanical results. In: S. Pollock and R. Bernbeck *et al*., Excavations at Monjukli Depe, Meana-Čaača Region, Turkmenistan, 2010. *Archäologische Mitteilungen aus Iran und Turan* 43: 213-221.

Miller N. and Ryan P.
2011 Comparison of charred macroremains and phytoliths from Monjukli Depe. In: S. Pollock and R. Bernbeck *et al*., Excavations at Monjukli Depe, Meana-Čaača Region, Turkmenistan, 2010. *Archäologische Mitteilungen aus Iran und Turan* 43: 227.

Moore K.M., Ermolova N.M., and Forsten A.
2003 Animal herding, hunting, and the history of animal domestication at Anau depe. In: F.T. Hiebert and K. Kurbansakhatov (eds.), *A Central Asian Village at the Dawn of Civilization. Excavations at Anau, Turkmenistan*: 154-159. Philadelphia: University Museum.

Müller-Karpe H.
1982 *Neolithische Siedlungen der Dzejtun-Kultur in Süd-Turkmenistan*. München: C.H. Beck.

Pollock S. and Bernbeck R. with contributions by Benecke N., Castro Gessner G., Daszkiewicz M., Eger J., Keßeler A., Miller N., Pope M., Ryan P., and Sturm P.
2011 Excavations at Monjukli Depe, Meana-Čaača Region, Turkmenistan, 2010. *Archäologische Mitteilungen aus Iran und Turan 4*3: 169-237.

Rouataie K.
2012 Archaeological Survey in the Shahroud Area, northeast Iran: a Landscape Approach. Archaeologische Mitteilungen aus Iran und Turan 44: 191-220.

Ryan P.
2011 Phytolith analysis. In: S. Pollock and R. Bernbeck *et al*., Excavations at Monjukli Depe, Meana-Čaača Region, Turkmenistan, 2010. *Archäologische Mitteilungen aus Iran und Turan 43*: 221-227.

Vandiver P.
1987 Sequential slab construction: a conservative southwest Asiatic ceramic tradition, ca. 7000-3000 B.C., *Paléorient* 13 (2): 9-35.

Recent Excavations at Tapeh Baluch (Baluch Mound): a Neolithic Site in Neyshabur Plain, NE Iran

Omran Garazhian

Introduction

Tapeh Baluch is located in the western part of Neyshabur Plain. Yousef Abad, 4 km from Tapeh Baluch, is another prehistoric site located in Neyshabur Plain which was excavated by the American expedition of Metropolitan Museum between 1935-40 and 1947 (Hiebert and Dyson 2002; Garazhian 2008a). After the 1940s, the plain was surveyed and re-visited several times by different expeditions and archaeologists (Garazhian 2012a; Etemadi 1999; Tohidi 1977). No Neolithic sites were reported from these surveys; even the team that had located Tapeh Baluch conservatively called it a prehistoric site (Garazhian 2012b).

Although prehistoric research in the Neyshabur Plain dates back to about 100 years ago, there are still certain obstacles and problems that need to be mentioned:

1. Neolithic sites are not easily accessible in the modern occupations of Western Khorassan (Garazhian 2008b: figs.1, 2).
2. The features and diagnostics of the Neolithic cultures in Khorassan are so far unknown (Garazhian 2012b, 2008a; Malek Shahmirzadi 2003; Hiebert and Dyson 2002; Talai 2000; Kohl *et al.*1984; Ricciardi 1980; Kohl and Heskel 1980), and the surveys and site visits have been either conducted mostly non-systematically or by the non-prehistorians.
3. Neolithic site formation processes and the sedimentary environments of the Neolithic make it difficult to identify them in the landscape (Garazhian 2008b).
4. Cultural and natural processes and impacts in the plain made our access to Neolithic sites difficult or impossible. This last problem has in fact caused the archaeology of Western Khorassan to concentrate on the Islamic periods of the plain (Garazhian 2012b).

Since Mellaart's times (Mellaart 1975), Neolithic research started to understand the Neolithic less as a "cultural period" than as a process of neolithization (Watkins 2006; Simmons 2011). It stresses the role of animal and plant domestication and sedentism (Braidwood 1983). Neolithic sites are generally considered as early villages of food producers. The problem of surveying is that it simply classifies material as Neolithic without knowing the Neolithic characteristics of

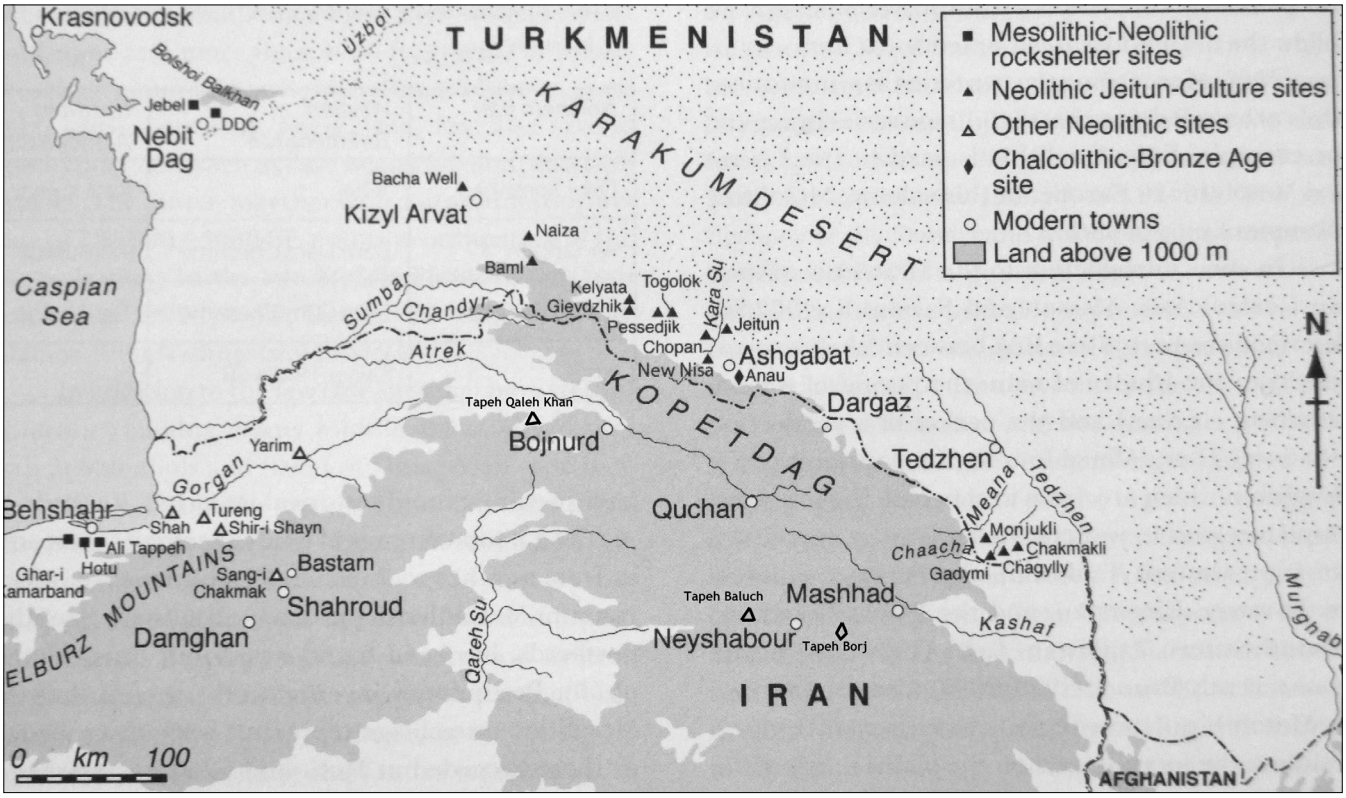

Fig. 1 General map of the North Eastern Iran and South Turkmenistan Neolithic sites (modified after Harris 2010).

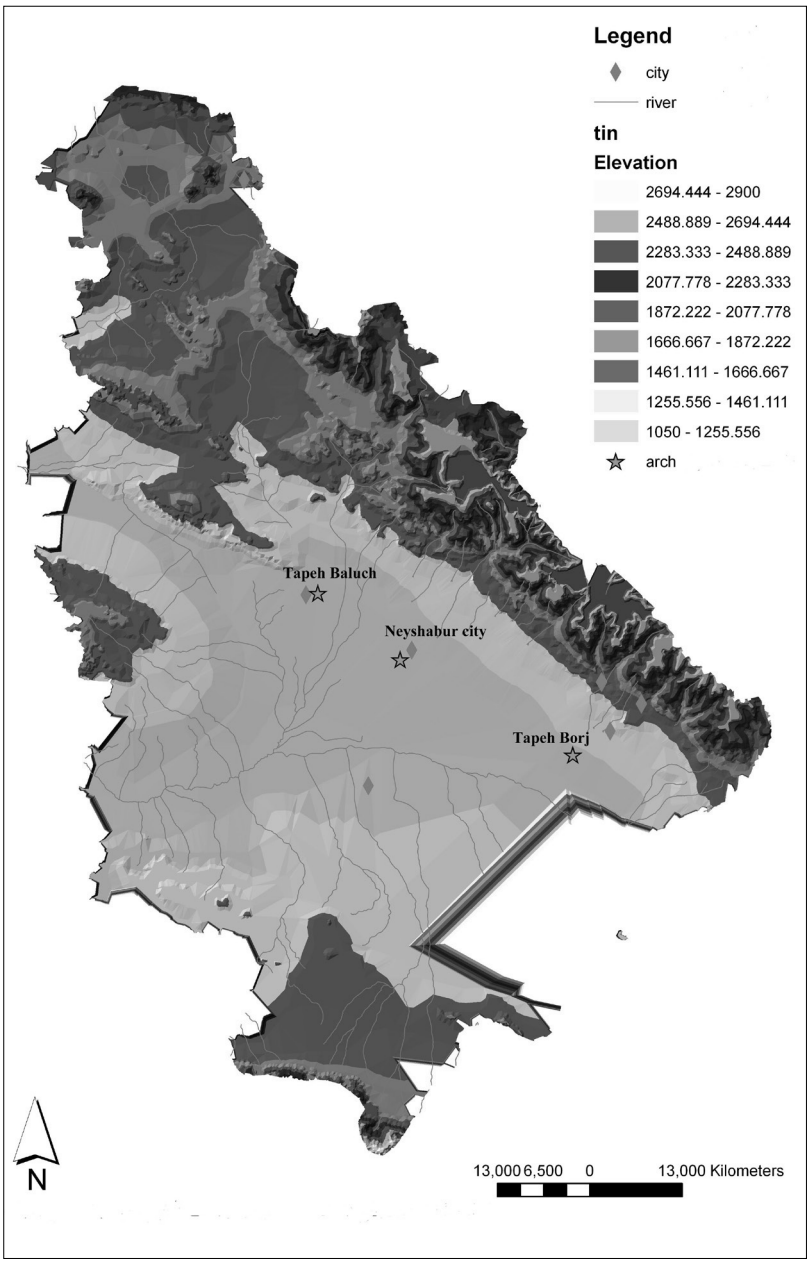

Fig. 2 The map of Neyshabur plain topography and the prehistoric sites.

the site and its past ecologic and landscape background. Instead, knowledge of tangible *in situ* archaeological layers are imperative to assign the term Neolithic to surface material.

The existence of the archaeological visibilities and sites is itself an issue, and the possibility to access them in modern era is another one. Therefore, the quality and the quantity of the archaeological visibilities and sites are important. The evidence of Upper Paleolithic material in Western Khorassan's surface assemblages remains unstudied, and identifying the distribution patterns of the Neolithic sites in comparison with those of Paleolithic ones would be sketchy. The few Neolithic cultures (or features) of the region were defined by cross-regional comparison: The most "similar" sites in other areas include Sang-e Chaxmaq (central North Iran, Roustaie 2009) and Jeitun (SW Turkmenistan, see Bernbeck *et al.* this issue), Neolithic cultures from which we have only limited information (*cf.* Marshall 2012; Harris 2010).

Tapeh Baluch excavations started just after three site visits in order to train archaeology students. Excavations conducted in limited areas showed the special formation of the site's Neolithic deposits (see Figs. 3-8). This article concentrates on the Neolithic layers and their material. It should be stressed that the mound was excavated only during a short season; further excavations are being planned. The Tapeh Baluch excavations were done in spring and summer 2011 under the auspices of Neyshabur University.

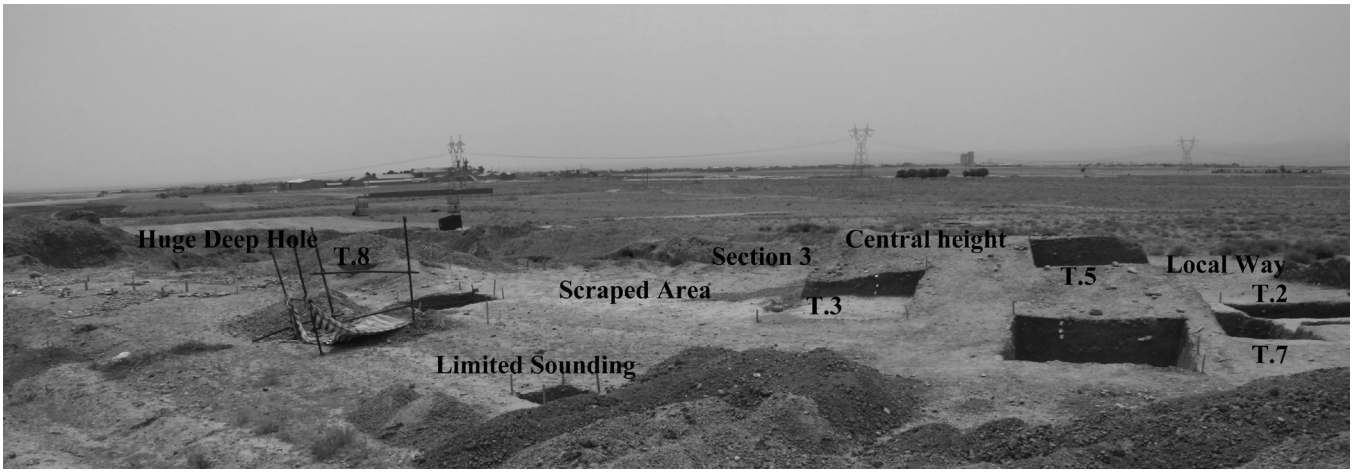

Fig. 3 General view of Tapeh Baluch, north eastern view.

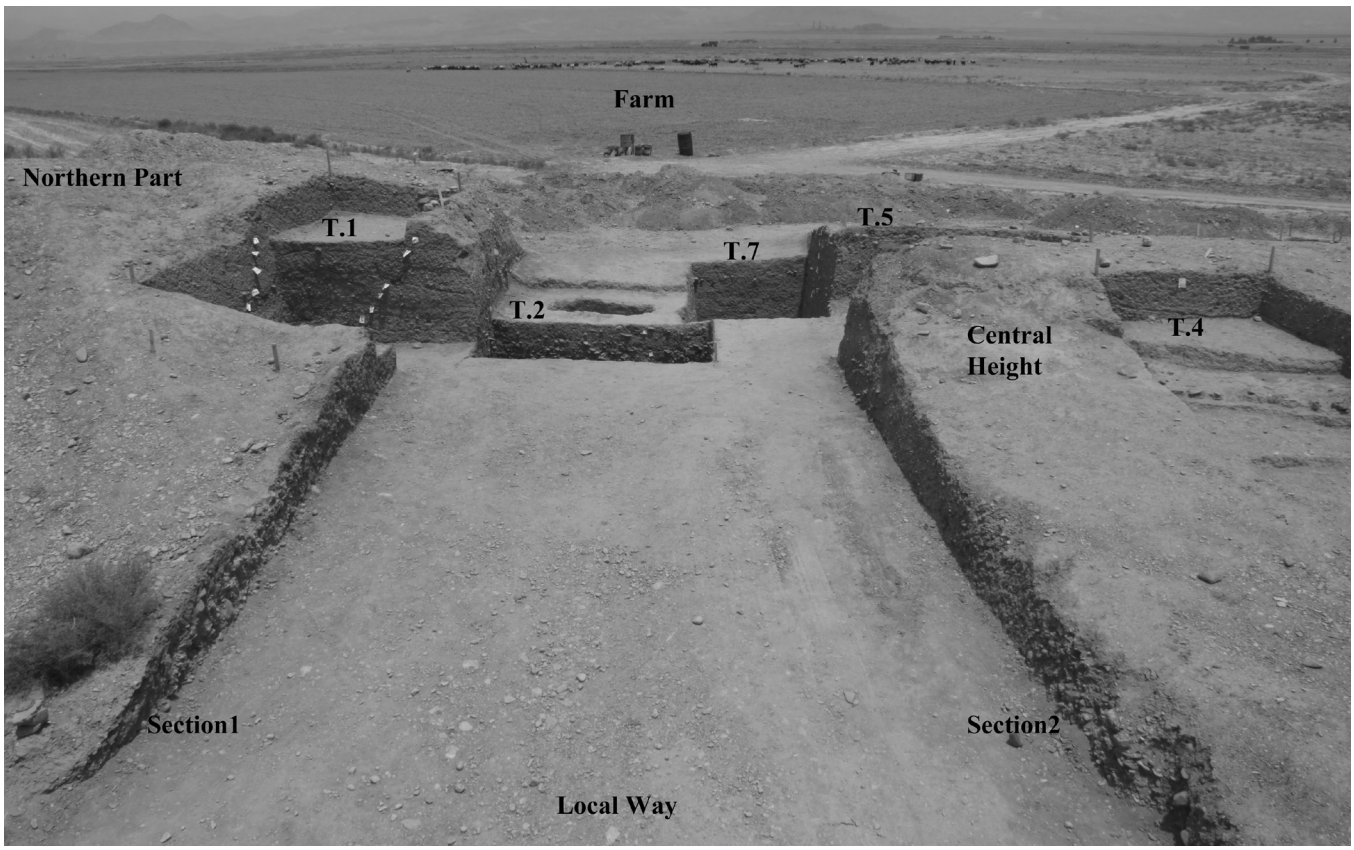

Fig. 4 General view of Tapeh Baluch, western view.

Neyshabur Plain: Ecology and Landscape

Neyshabur is an inter-mountainous plain in Central Khorassan. The Binalud Mountains are located along its northern and eastern sides (Fig. 2) while Kuh-e Sorkh surrounds the southern and western parts of the plain. The plain is separated from the deserts of the Central Iranian Plateau by these mountain ranges (Fig. 1-2). Kal-e Shor River and its branches flow into the Neyshabur Plain; the main branch of the

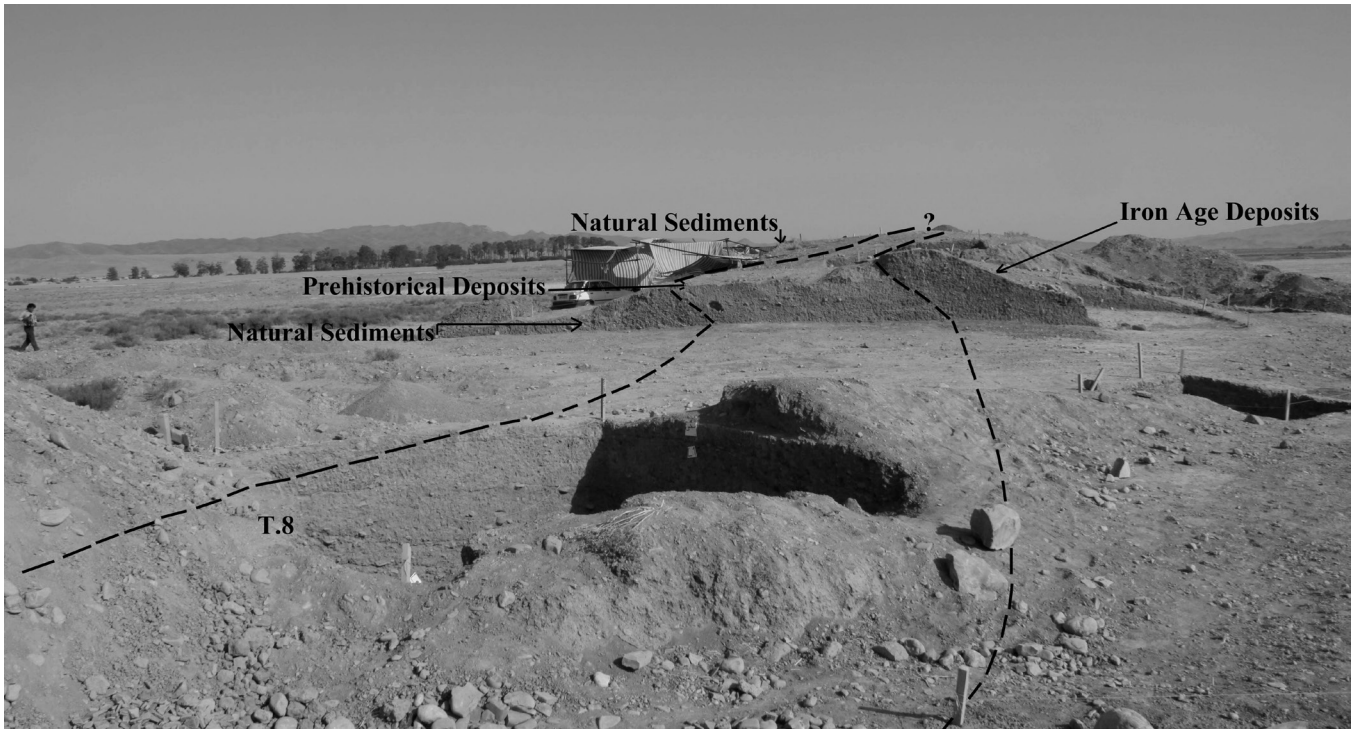

Fig. 5 General view of Tapeh Baluch, natural and archaeological deposits, southern view.

river crosses through the lowest part of the plain. Ecological and climatic conditions divide the Neyshabur Plain into two zones: a drier western part and a more humid eastern part in which the modern city center is located (Fig. 2).

In terms of geomorphology, the row of natural mounds parallel to the Binalud range in the central Neyshabur Plain is important. These mounds are located in different surroundings; Neolithic and Chalcolithic material/ villages are attested on all these natural mounds (Fig. 5). Tapeh Borj (see Fig. 2) is one of these sites, located in the eastern part of Neyshabur Plain (Garazhian 2008b, 2012a, 2012b, Garazhian *et al.* n.d.) while Tapeh Baluch is located in its western part (Fig. 2).

Site Conditions and Excavations

Tapeh Baluch is some 17 km linear distance from Neyshabur. The name of this site has been taken from Baluch families (immigrating from Sistan and Baluchestan provinces located in SE Iran) who camped seasonally on the site less than fifty years ago. There are extensive farms around Tapeh Baluch, and a huge deep hole exists in the southern part of the mound (Fig. 3). This depression resulted from extracting a great amount of sand used for construction. The northern parts of Tapeh Baluch were cut in order to construct a local road for the farmers (Fig. 4). It should be noticed that this is the location in which we opened trenches and reached the Neolithic layers (Figs. 3-8).

The site itself consists of a natural mound or mounds located in the center of western parts of Neyshabur Plain. The mound's eastern edge is located along a river (one of the Kal-e Shor upper tributaries). Its central apex was cut by the farmer‘s road, and they scraped the natural and archaeological layers. Cleaning the cut, we named it "Section 3" (Fig. 3). A bit to the north of this section, the construction of another local road created Sections 1 and 2 (Fig. 4). The cleaning of the three long sections was the first action of our field work. The cleaning allowed for the following observation: the high parts of the mounds comprised two different types of sediments and deposits. In general, the western parts represented natural deposits and the eastern parts contained the prehistoric layers (Fig. 5).

Stratigraphic excavations were conducted in eight trenches. Neolithic layers were recognized in four of them. An appropriate stratigraphic approach was reached by connecting two trenches, the one located on the top and the other in the middle part of the mound (at the surface of the local road). The cleaned sections were situated between two trenches. Around the farmer's road we excavated in four trenches: T.1 and T.2, both connected to each other and located in the northern part of the top of Tapeh Baluch. The sequence starts from Layer I at the top to Layer 17 at the bottom (strati-

Fig. 6 Layers of T.1 and T.2, Tapeh Baluch, northern view.

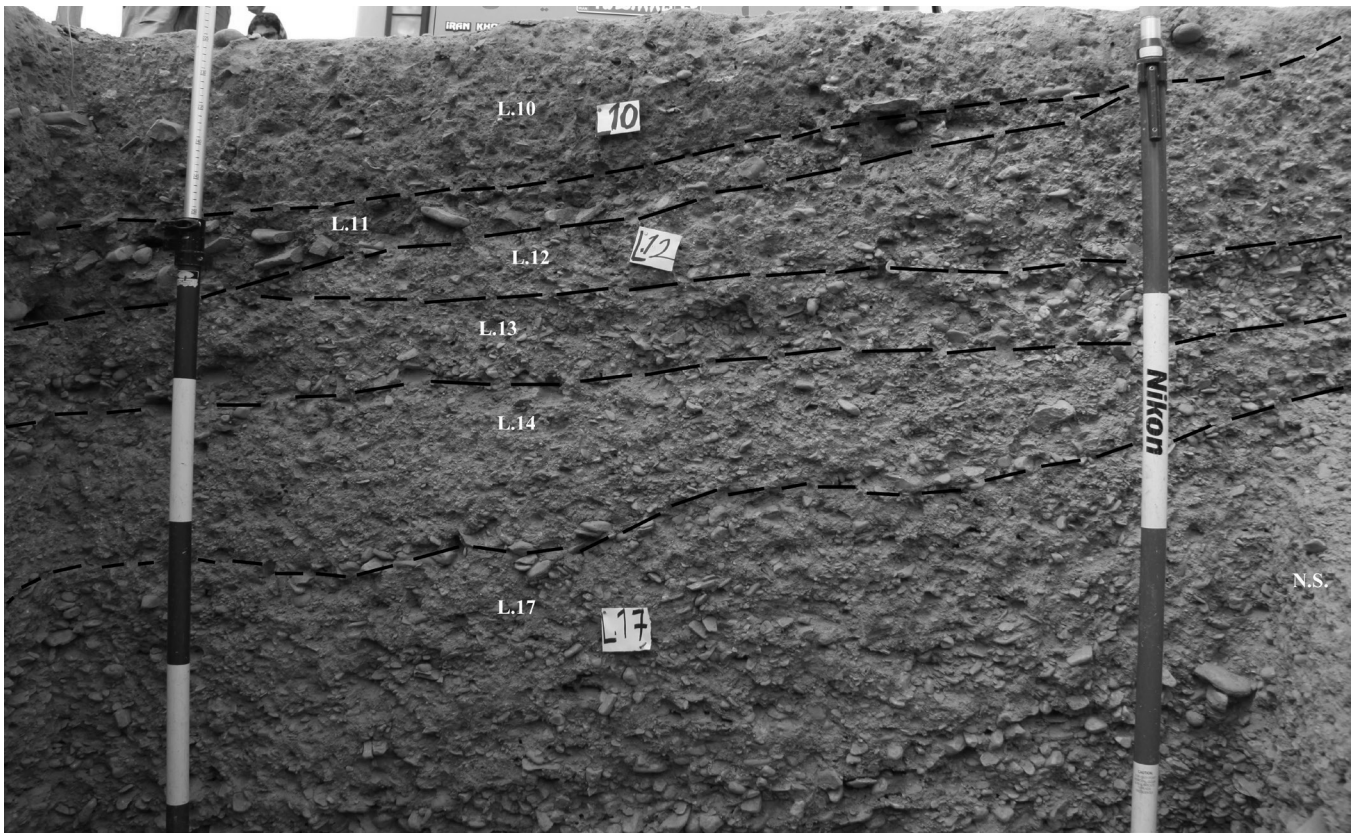

Fig. 7 Complement layers of T.1 and T.2, western section of T.2.

Fig. 8 Layers of T.5 and T.7, Tapeh Baluch, central part.

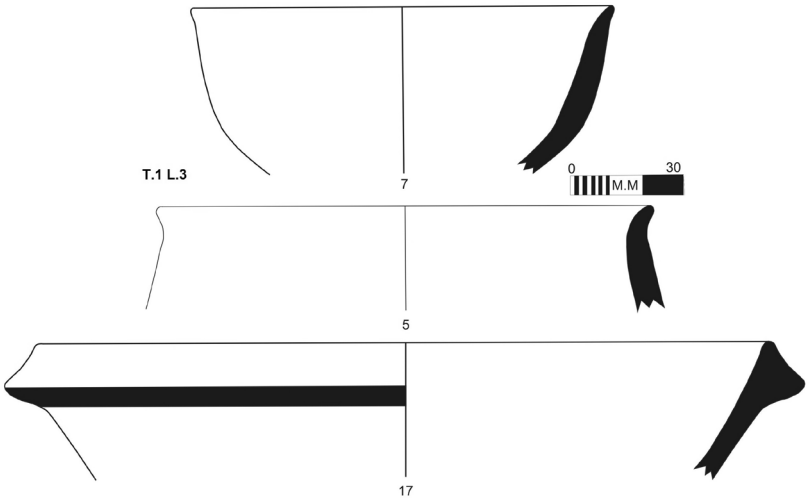

Fig. 9 T.1, Layer 3, pottery forms.

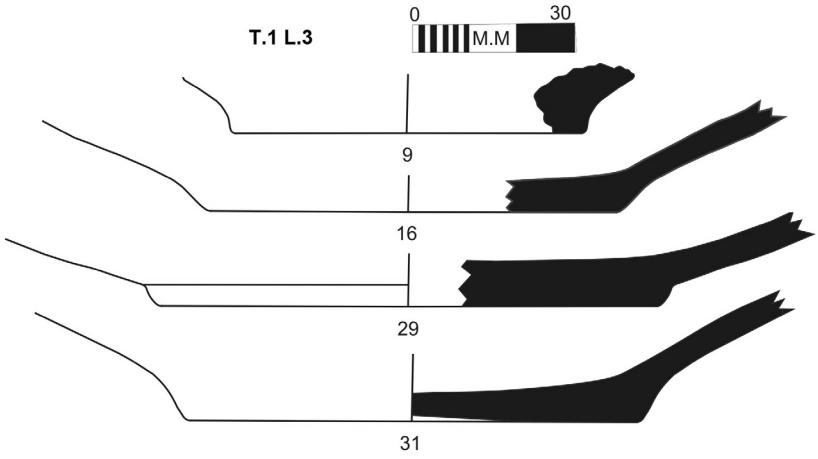

Fig. 10 T.1, Layer 3, pottery forms, bases samples.

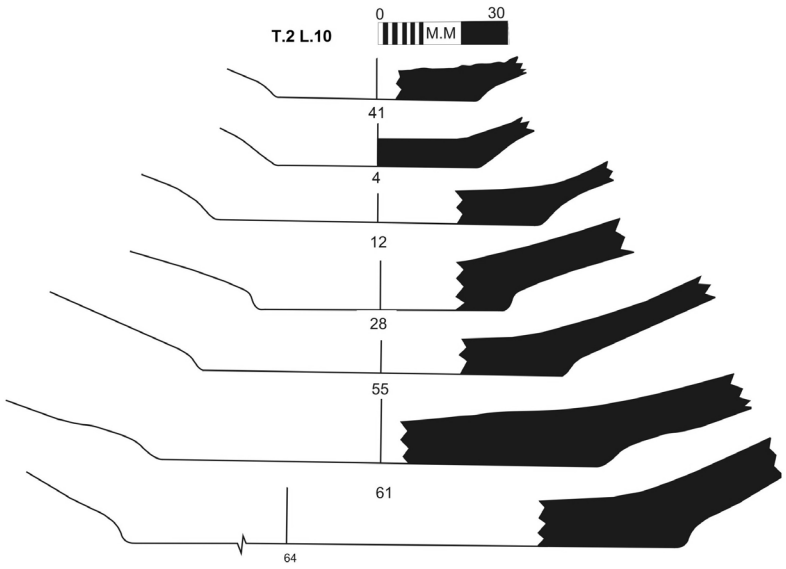

Fig. 11 T.2, Layer 10, pottery forms, bases samples.

graphy of the northern height, *cf.* Figs. 6-7). Trenches 5 and 7 (T.5 and T.7) are located in the central part of the top of Tapeh Baluch (Fig. 4, 8) and presented another sequence from top Layer 1 to bottom Layer 9 (Fig. 8). The deepest layers (Layers 15 and 9) in both excavation units reached the gravels of an ancient river bed (Fig. 7). The thickness of the archaeological deposits towards the south remains unknown. T.8 was opened on the southern parts of Tapeh Baluch and also revealed Neolithic layers (Fig. 5).

Surface surveys of the surrounding areas helped us recognize the highly specialized groundstone technology of Tapeh Baluch. Surface survey also proved that archaeological deposits are present in the eastern half of the mound (Fig. 5), confirmed by sampling and 14 limited soundings (*cf.* Fig. 3).

Trenches 1 and 2

The excavation of T.1 was started from the top of the site in north and continued to the surface of the farm road. This trench had a 3×3 m extension. Section1 made it clear that the layers were formed in a declivity shape (Fig. 6); consequently, in order to locate higher layers we had to expand the trench eastward. A 2× 2 m extension exposed three more recent layers on the top of the site (surface layer and layers 1 and 2, *cf.* Fig. 5). The deepest layer of T.1 (L.9) is the uppermost layer of T.2. Layers 1 and 2 did not contain prehistoric material, but Layers 3 to 8 belonged to the Late Neolithic and continued down to Layer 17 in T.2 (Figs. 6-7).

T.2 was established in a 4×3 m area, on the farm road. Coming down on an oval structure (S1 in Fig. 6) in the eastern part, the trench extension was reduced to 2×3m. On the northwestern corner of T.2 natural sediments lay under an upper layer which was identified in the T.1 stratigraphy. T.2 excavation was continued not only to ancient riverbed sediments in Layer 15, but also in Layers 16 and 17 (Fig. 6). The above-mentioned layers had scarce archaeological material mixed with natural sediments in eastern parts of T.2. More extensive excavations in the future may encounter pre-pottery layers, perhaps at the interaction border between the ancient riverbed and natural sediments (Fig. 8).

Stratigraphic excavations of T.1 and T.2 revealed a seventeen-layered sequence. Layers 1 and 2 at the top of T.1 can be attributed to late Iron Age and the Achaemenid

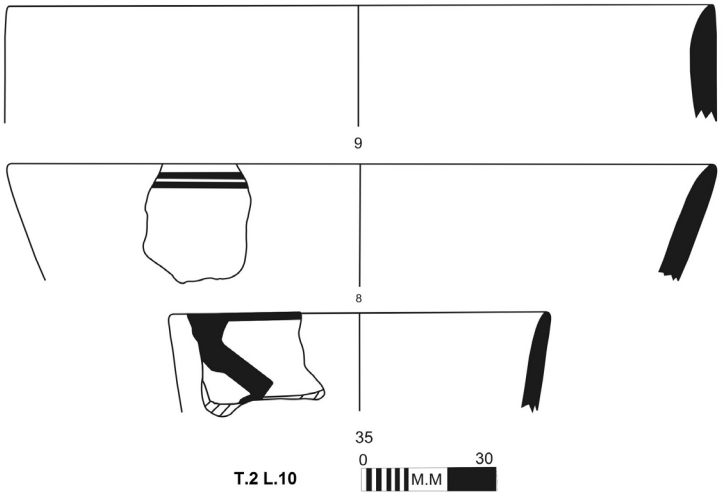

Fig. 12 T.2, Layer 10, pottery forms.

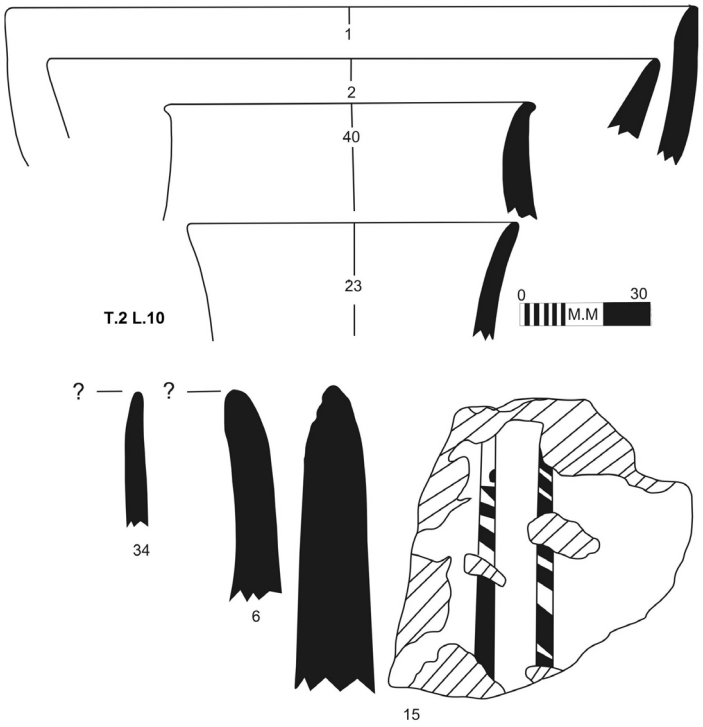

Fig. 13 T.2, Layer 10, pottery forms.

period (?), while Layers three to seven have relatively limited finds (Fig. 9). These layers are proposed to be related to the early Chalcolithic – late Neolithic horizons (Garazhian 2012b). In a general view, the layers were mixed with natural sediments. For example, all T.1 layers and Layer17 in T.2 provided limited archaeological evidence. Layers 8 to 17 are related to Neolithic horizons. In this sequence (Fig. 6) Layers 9 to 14 had more *in situ* material than the older and younger ones.

Layer 10 in T.2 is a thick layer recognized in the eastern parts of the trench (Fig. 7). The upper part of this layer was heavily damaged in the course of road construction. Studies based on classification of pottery assemblages presented a wide range of forms (Fig. 11). Generally, painted and unpainted pottery types represented variations in decorations (Fig. 11). The root of this process can be followed in Layer 13, which is comprised of natural sediments (Figs. 6, 8). According to comparative studies (Coolidge 2005; Askarpur and Garazhian 2011; Harris 2010; Roustaie 2009) the pottery decorations (Figs. 12, 13) and forms found in this layer confirm its attribution to the early- middle Pottery Neolithic horizon. A specific handle that has a vertical shape has been identified in this layer (Fig. 16; *cf.* Khan *et al.* 2010). A little bit older, it appears that Layer 14 has the same varieties (Fig. 17). A unique motif representing two or three human bodies was identified in Layer 14 (Fig. 18). Layers 14 to 16 are assumed to be early Pottery Neolithic.

Trenches 5 and 7

Located just opposite to T.1 and T.2, T.5 (Section 2 in Fig. 8) was opened (3×3m) from the upper central part of Tapeh Baluch. The trench was excavated down from the road's surface, while T.7 was continued from the road to the ancient riverbed sediments (Fig. 8). T.7 had a 2 × 4 m area and was extended 4 m to the east. T.5 and T.7 layers over-

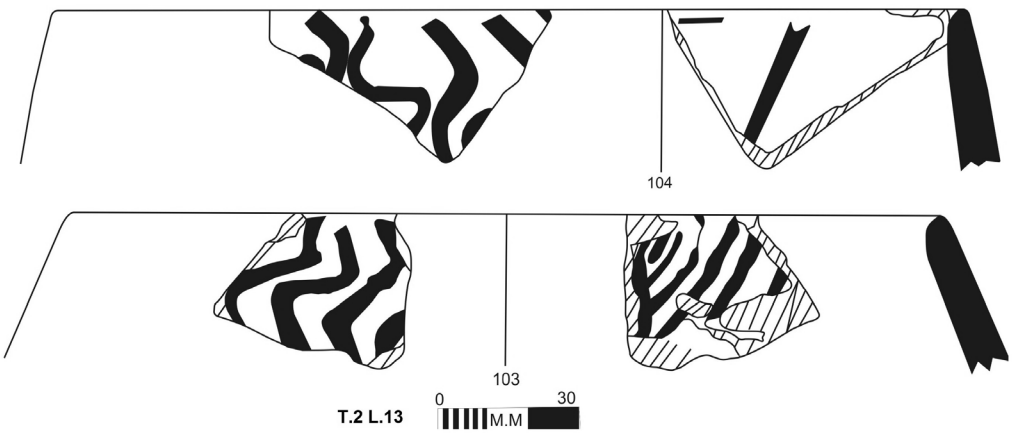

Fig. 14 T.2, Layer 13, painted samples.

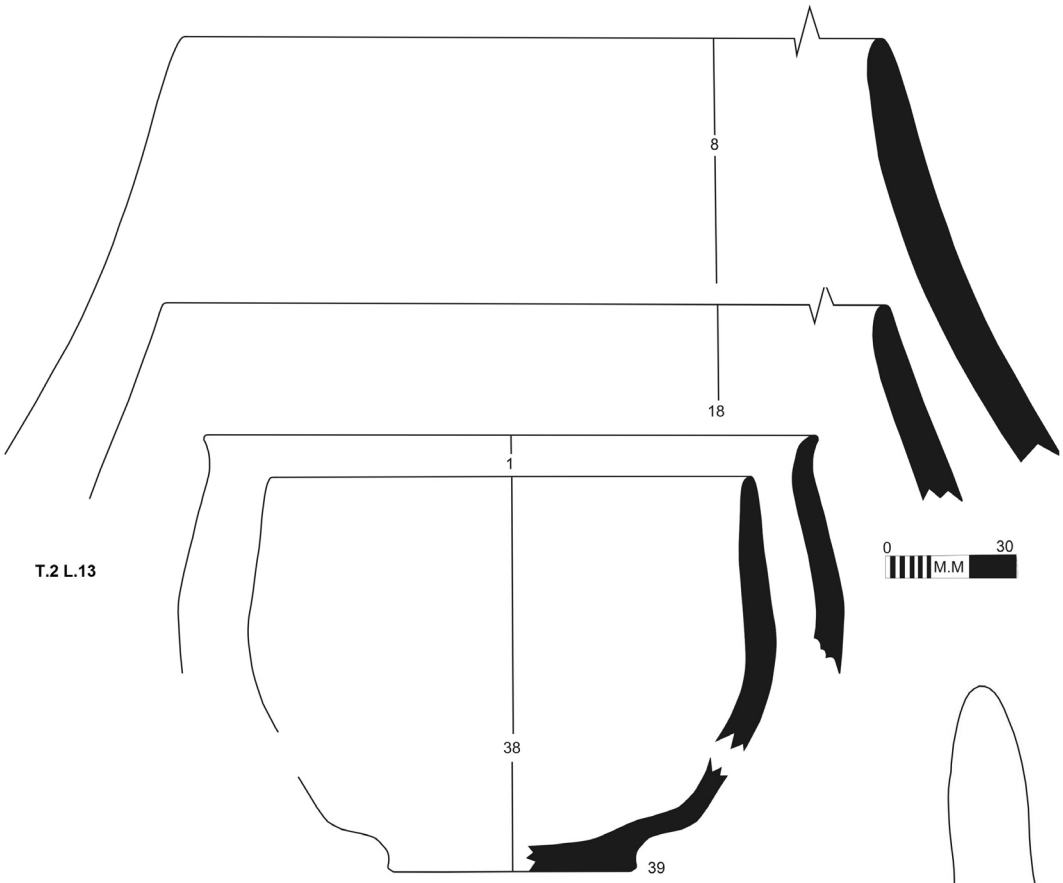

Fig. 15 T.2, Layer 13, pottery forms.

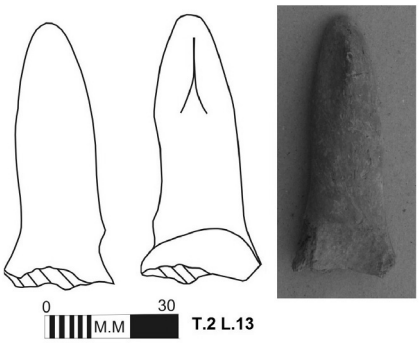

Fig. 16 Vertical handle of a pottery sherd.

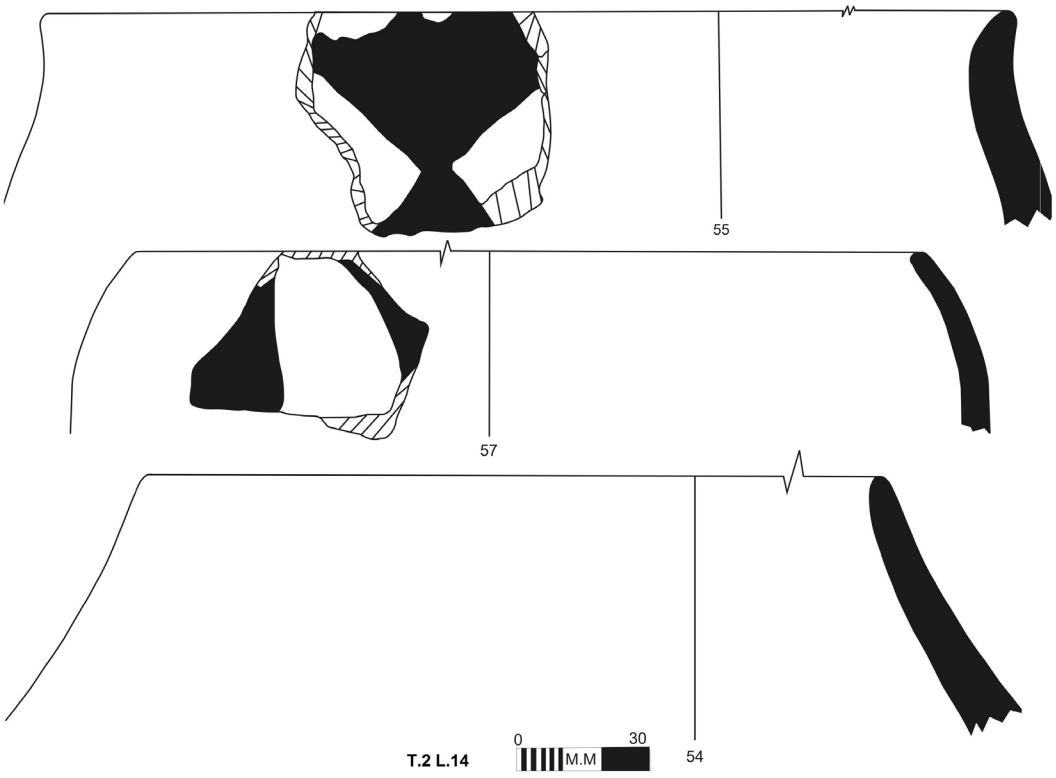

Fig. 17 T.2, Layer 14, pottery forms.

lapped each other. The first five layers exposed in T.5 could be attributed to historical periods and Iron Age horizons (Fig. 8). Layers 6 to 9 in T.7 showed Neolithic indicators (Fig. 8). These layers are in the same horizon in T.2 (Layers 11to14) where depositional connections could be observed (Figs. 6, 8). Furthermore, the comparisons between pottery collections confirmed the relative chronology, depositional formation, and horizontality. In should be noted that the pottery forms are not very limited in these layers.

Trench 8

T.8 (3×3 m) was situated in the far southeastern part of Tapeh Baluch (Fig. 5). The main reason to establish the trench was to locate the limits of archaeological deposits. This trench was located less than ten meters from the Section 3. T.8 was opened in a place which was scraped before (Fig. 3). Having excavated the trench, seven layers were recognized. Layers 1 to 3 extended horizontally, but Layers 4 to 7 were formed in a downhill manner. Layer 1 was attributed to the Iron Age and Layers 2 to 7 to the Neolithic. These layers were comparable with Layers 10 to 15 in T.2. Layer 4 contains more material culture than the others. Pottery forms have wide ranges of variation (Fig. 17), similar to Layer 12 in T.2. Comparable to Layer 14 in T.2, Layer 6 contained both painted and unpainted ceramics (Fig. 19). Neolithic material of T.8 is a little different from the ones of T.1, T.2 and T.7. Noticeably, in absence of C14 dating we cannot precisely establish chronological relationships, but according to depositional formation process , all the deepest Neolithic layers (L.15 in T.2, L.9 in T.7, L.7 in T.8) were formed on natural sediments of an ancient river bed.

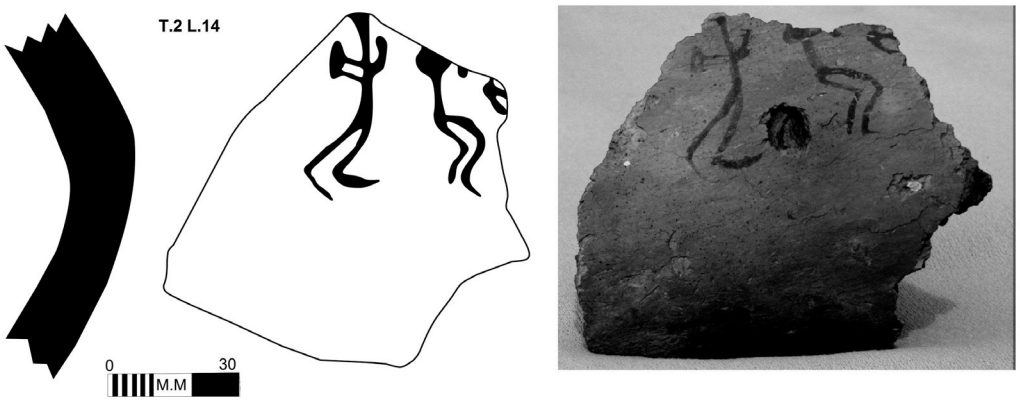

Fig. 18 T.2, Layer 14, a painted sample of pottery with human motif.

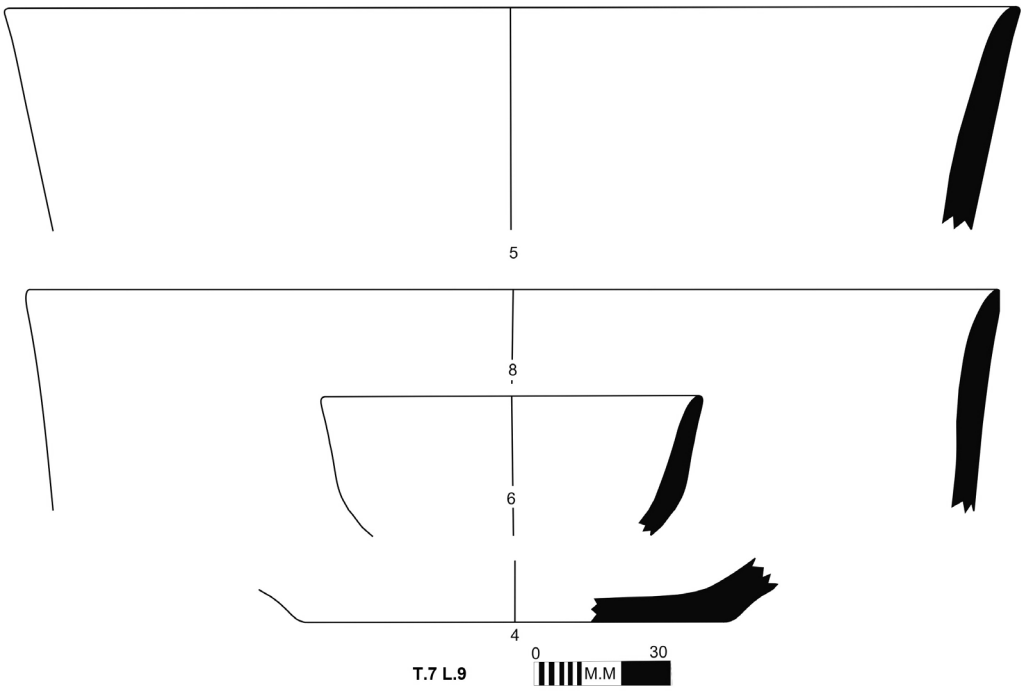

Fig. 19 T.7, Layer 9, some different samples.

Fig. 20 Selected lithic artifacts from Tapeh Baluch.1) cortical flake, 2) bladelet, 3) notched proximal segment of a blade, 4) proximal blade segment, 5-6) utilized proximal blade segments, 7, 9-12) trapezoids, 8) lunate, 13) distal end of a retouched blade.

Fig. 21 T.2 layer 14, *in situ* horns of hunted mammals.

Discussion

Neolithic sites have been rarely reported from Western Khorassan. For example, James Mellaart (1975) reported only one site from the Mashhad Plain. Despite being surveyed several times, no one knew of any Neolithic site in Neyshabur Plain before 2012 (Garazhian 2008a). Baluch is the first known Neolithic site in all Western Khorassan.

From a site scale, the site location can be discussed from ecological and formational process viewpoints. According to the excavations and surveys, it could be proposed that the site had been formed on the eastern slopes of small natural mounds (Garazhian 2012b) while natural river sediments identified in three trenches represent the north-south direction of a permanent or seasonal river that flowed along the side side of the natural mounds in the center of the plain (Figs. 5, 6, 8). Evidence from the region and local residents indicate that there was a recent river that has dried up and been filled in during the last twenty years. Ecologically, the location of the archaeological site was dependent on the river and the natural mounds. The interactions between site and the river allow us to hypothesize that some amount of archaeological remains have been removed by river floods during a long-term process.

The proposed site chronology is based on comparisons of archaeological collections and contexts. The density of burned stones mixed with Neolithic ceramics indicates that the materials and deposits were in situ. In addition, lithics (Fig. 20) and the skulls of hunted mammals (wild sheep or goats) all represented Neolithic indicators. Four rows of small bones were found on cobbles beside the natural river sediments of Layer 15 (T.2) and deeper than the mammal skulls (Fig. 21); scattered pieces of bones were found which might belonged to human hands. Based on these materials,

we propose that the mammal skulls and human bones in the deeper position are together related to the same grave. It can be hypothesized that the other parts of the skeleton were removed by floods.

Ceramics are the main indicators for the Neolithic culture of Tapeh Baluch. Analysis demonstrates that less than 5% of the ceramics were painted. Nevertheless, some of the painted ceramics are unique, such as the one with human motifs. Groundstone artifacts are significant in comparison with other Neolithic sites of eastern Iran; approximately 90% of the stones identified in different layers were in the form of small pieces and reused, often to construct ovens. The lithics found in the archaeological survey in the surrounding areas of the site and at sites located in other regions of Khorassan reflect a local tradition of Neolithic and Chalcolithic cultures (Garazhian 2008a).

On an ecological basis, Tapeh Baluch is currently not surrounded by fertile lands, which might explain why very few seed remains were found in flotation. In different Neolithic layers we have not found any architectural structures, only the accumulation of stones with ovens and ashes. The archaeological material and contexts indicate in situ Neolithic deposits. Referring to the quality and quantity of natural resources, it seems that the site was a seasonally occupied one.

In terms of future surveys, it appears that the preserved archaeological sites are in locations associated with the natural mounds that parallel the Binalud Mountains in the central zones of the Neyshabur Plain. The slopes are located around the plain and the alluvial fans. Regarding natural resources, different kinds of zones had different capacities and potentials appropriated by Neolithic cultures. While geomorphologic instability and erosion during a long term process have made archaeological deposits sink under tons of alluvial sediments. Hence, the accessible number of Neolithic sites and archaeological visibilities are very limited in the Neyshabur Plain. However, there are methods that can be proposed for future archaeological activities such as following environmental-ecological circumstances that could be useful in archaeological surveys. Furthermore, one of the most important ways can be utilizing the experiences of local educated groups and expeditions by Cultural Heritage Organization (CHTHO), while another method could be to develop an archaeological database and sharing data by publishing material.

Acknowledgements: The Tapeh Baluch excavations were supported by Neyshabur University. I would like to thank the financial and transport support provided by the university. The permits were issued by the Cultural Heritage, Tourism and Handicrafts Organization, Khorassan Razvai Province Branch, and permission was granted by the Iranian Center for Archaeological Research. I appreciate all these administrative colleagues, especially M. Tughrai as the representative of CHTHO and my colleagues Dr. L. Papoli yazdi, Dr. M. Dezhamkhoy, Kh. Judi and H. Fakhr-e Ghaemi who helped effectively in field work. Additionally , I'd like to thank all of the archaeology students who attended in this season's field work. All the pictures were taken by A. Mohebali, E. Rigi, and M. Najmi.

Omran Garazhian
University of Neyshabur,
Department of Archaeology, Neyshabur, Iran
and
Guest Fellow, Institute of Near Eastern Archaeology
Free University of Berlin,
Hüttenweg 7, 14195 Berlin, Germany
omrangarazhian@gmail.com
garazhian@zedat.fu-berlin.de

References

Askarpur V. and Garazhian O.
2011 Trends in Evolution of Pottery in Qaleh Khan, Bojnurd. *Journal of Archaeological Studies* 1/3: 107-131 (in Persian).

Braidwood L.
1983 *Prehistoric archeology along the Zagros Flanks*. Chicago: University of Chicago Press.

Coolidge J.
2005 *Southern Turkmenistan in the Neolithic (petrography case study).* Oxford: BAR International Series 1423.

Etemadi E.
1999 The archaeological survey of Neyshabur Archaeological sites, Iranian cultural heritage organization report, Tehran (unpublished, in Persian).

Garazhian O.
2008a T*he transitional Process between the Chalcolithic and Bronze Age Cultures in Northeastern Iran*. Doctoral dissertation, Prehistoric Archaeology, Tehran University.
2008b Stratigraphy in Neyshabur Tapeh Borj Sounding one, an interpretive approach. *Payme Bastanshenasi (Archaeological Note)* 6: 1-21(in Persian).
2012a Changes Pattern during Transitional Process from Chalcolithic Cultures to Bronze Age in Northern East of Iran, Based on Pottery studies. In H. Fahimi and K. Alizadeh (eds.), *Namvarnameh: a volume in honor of Dr.Masud Azarnosh:* 597-609. Tehran: Ganjinh-e Honar.
2012b Neyshabor before Shapur, an introduction to Persian translation. In C.K. Wilkinson, *Nishapur. Some early Islamic Buildings and Their Decoration:* 17-22, translated into Persian by H. Bakaeian. Mashad: Marandiz publications.

Garazhian O., Papoli L. and Dana M.
n.d. Stratigraphy of Tapeh Borj, Neyshabour. *Iranian Journal of Archaeology and History* 50 (in press, in Persian).

Harris D. (ed.)
2010 Origins of Agriculture in Western Central Asia, an Environmental Archaeological Study. Philadelphia: University of Pennsylvania.

Harris D. and Coolidge J.
2010 Prehistoric Archaeology. In D.Harris (ed.), Origins of Agriculture in Western Central Asia, an Environmental Archaeological Study: 43-53. Philadelphia: University of Pennsylvania.

Hiebert F. and Dyson R.
2002 Prehistoric Nishapur and the frontier between central Asia and Iran. *Iranica Antiqua* 37: 113-149.

Khan F., Knox J.R. and Thomas K.D.
2010 *Sheri Khan Tatakai and Early Village Life in the Borderland of North- West Pakistan: Bannu Archaeological Project Surveys and Excavations 1985-2001.* Bannu Archaeological Project Monographs No. 1. Oxford: Oxbow Books.

Kohl P., Frankfort H.P. and Gardin J.C.
1984 *Central Asia Paleolithic Beginnings to the Iron Age*. Paris: Editions Recherche sur les Civilisations.

Kohl P. and Heskel D.
1980 Archaeological Reconnaissance in the Darreh Gaz Plain: A Short Report. *Iran* 17: 160-169.

Marshall J.
2012 *Missing Links: Demic Diffusion and the Development of Agriculture on the Central Iranian Plateau.* Durham theses, Durham University, Available at Durham E-Theses Online: http:// etheses.dur.ac.uk/3547/

Malek Shahmirzadi S.
2003 *The Prehistory of Iran*. Tehran: Cultural Heritage Organization Publications (in Persian).

Mellaart J.
1975 *Neolithic of the Near East.* London: Thames and Hudson.

Ricciardi V.
1980 Archaeological survey in the upper Atrak Valley (Khorassan, Iran), preliminary report. *Mesopotamia* 15: 51-72.

Roustaie K.
2009 Masuda and Sang-I Chakhmaq: a review of Japanese excavations in Sang-I Chakhmaq. *Bastan Pazhuhi* 8: 119-128 (in Persian).

Simmons A.H.
2011 *The Neolithic Revolution in the Near East: Transforming the Human Landscape*. Tucson: University of Arizona Press.

Talai H.
2000 *The archaeology and art of Iran in the first Millennium B.C.* Tehran: SAMT (in Persian)
2011 *Eight Thousand years of Iran Pottery.* Tehran: SAMT (in Persian).

Tohidi F.
1977 *Archaeological survey of Khorassan*. Tehran: Iranian Cultural Heritage Organization (in Persian).

Watkins, T.
2006 Neolithisation in Southwest Asia: the Path to modernity. *Documenta Praehistorica* 33: 71-88.

‘Ain Ghazal Revisited: Rescue Excavations October and December-January, 2011-2012

Zeidan Kafafi, Gary Rollefson, Khaled Douglas, and Ahmad Lash

Introduction

In July 2011 the Ministry of Education began bulldozing operations as a preliminary stage of constructing a new school building in the center of ‘Ain Ghazal. After several days of destruction, which affected more than two hectares of the site (Figs. 1 and 2), bulldozing was brought to a halt through the efforts of the authors, the Department of Antiquities, and the Ministry of Tourism and Antiquities.

In October 2011 Kafafi, Douglas, Lash, and colleagues spent three weeks to clean several areas of the bulldozer sections in order to determine the stratigraphy of the destroyed layers of architecture and sediments. It was determined that more extensive investigations be undertaken during the months of December and January (2011 and 2012) when volunteers could be assembled to excavate probes into the sections to recover as much information as time allowed.

Based on the October work on the bulldozer sections, several promising areas were selected for excavation. Field work resumed on 21 December 2011 and lasted until 10 January 2012. A brief summary of those probes is provided below:

I.1 (Lower Terrace)

One of the most imposing revelations in the bulldozer sections was a wall constructed of massive limestone and flint blocks arranged on end; some of the large stones were more than 80 cm in length and up to 45 cm in width (Wall 1 in Fig. 3). Through more than three meters of sediment accumulation, there were as many as nine floors and surfaces identified in the sequence, including the surface on which the large wall was erected. The wall was evidently built during the Late PPNB or the PPNC period, for Yarmoukian pottery did not appear until well above the bottom of the wall. However, the wall apparently was used during Yarmoukian times based on the appearance of at least two later phases associated with pottery-bearing layers (Fig. 3). The wall ran into the section, and both faces of the wall had been cleared over a length of about a meter and a half in October. We intended to continue the exposure of the wall during the December-January efforts, but on Friday, 23 December, while we were not present, the exposed portion of the wall collapsed, perhaps due to the drying of the sediments supporting it before any drawings could be made. Nevertheless, we managed to reveal an additional 1.5 m back into the section afterwards (Fig. 4).

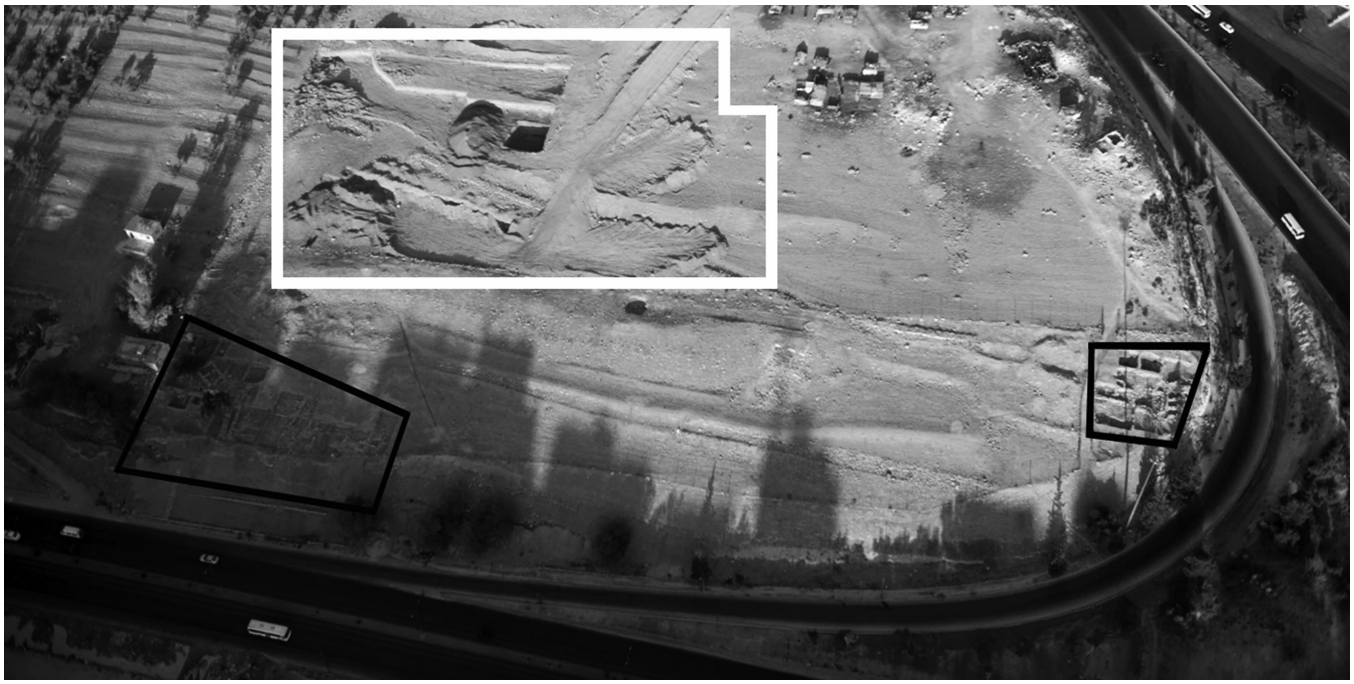

Fig. 1 Aerial view of the upper West Field of ‘Ain Ghazal showing the extent of bulldozing during the summer of 2011 (in the white frame). Areas inside the black frames indicate locations of excavation trenches in the 1980s and 1990s (photo by Matthew Dalton, APAAME, with permission by David Kennedy).

To the south a second wall (Wall 2 in Fig. 3) was oriented in the same direction, but being built of much smaller stones, its character suggests it was not associated with Wall 1 even though they were built on the same surface. In the bulldozer scree to the north of I.1 there are more enormous stones, so a companion to Wall 1 might be located several meters outside of our trench. Artifacts from the trench were not particularly numerous, nor was there any indication of what the function of the wall may have served.

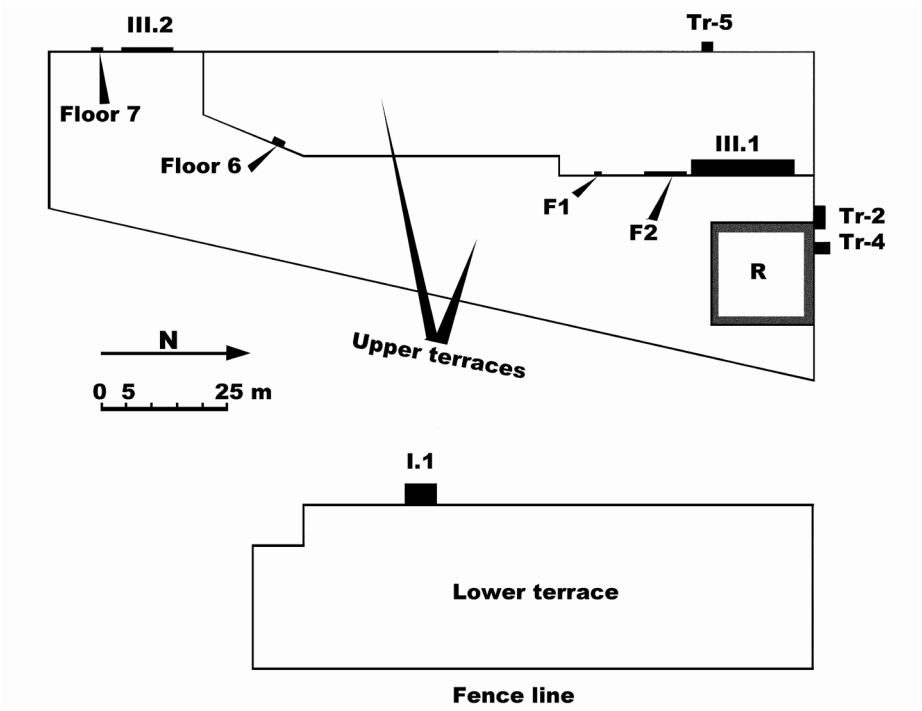

Fig. 2 Schematic map of the bulldozed area showing the location of Sections I.1 (lower terrace), III.1 (Upper terrace, north), and III.2 (Upper terrace, south) as well as Feature 1 (F1), Feature 2 (F2), and several sampled floors in the bulldozer sections. R represents the deep trench intended to be a reservoir for water for the school (drawing: G. Rollefson).

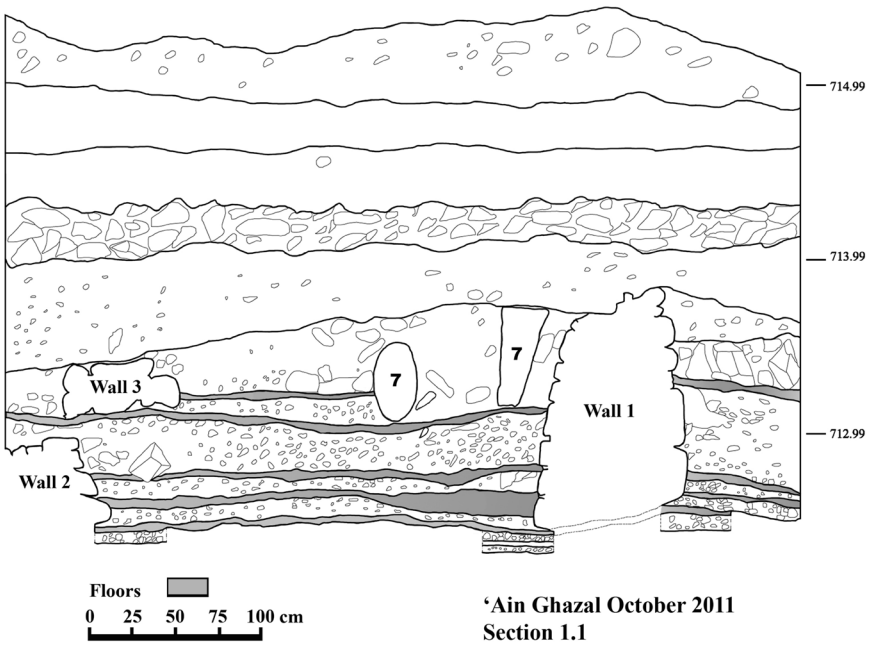

Fig. 3 Stratigraphy in Section I.1, looking west, showing several Yarmoukian floors and walls. Locus 7 represents an installation associated with a late use of Wall 1 (drawing: K. Douglas, modified by G. Rollefson).

III.1 (Middle Terrace)

This section had been partially cleaned and drawn by Ahmad Lash in October, but there had been considerable collapse of architectural elements in the time since then. There were clearly two periods of occupation visible in the section: an upper wall just below the modern surface dating to the Yarmoukian period, as well as a complete N-S section of the interior of a PPNC house less than a meter below the Yarmoukian structure (Fig. 5).

Excavations were intended to expose the earlier house as much as a meter into the section, but soon after excavations began here, a burial was encountered inside the Yarmoukian building in the SE corner of the room, slowing downward progress considerably (Figs. 6 and 7). Nevertheless, it is the first Yarmoukian burial we have found at ʿAin Ghazal, and only the second one known in Jordan (the other from Wadi Shu'ayb in 1989). When a British volunteer arrived halfway through the season, work was extended towards the south of this section with the intention of determining if the Yarmoukian wall visible in the section continued southwards; we left a ca. 1.5 m gap between the two probes, but it appears that the eastern wall of the structure did indeed continue to the south, extending the length of the wall for a total of at least four meters (although the southern end of the wall appears to have been destroyed in Neolithic times).

Despite the slow progress of excavations from the top of section III.1, work was also undertaken in the lower part of the exposure to get a clearer idea of the stratigraphy. The floor of the lower house was made of chalk (probably ground to a powder, then mixed with water and some additives) and was brilliant white against the sterile reddish basal clay beneath the floor and the collapsed fill inside the structure (Fig. 5). In con-trast to the

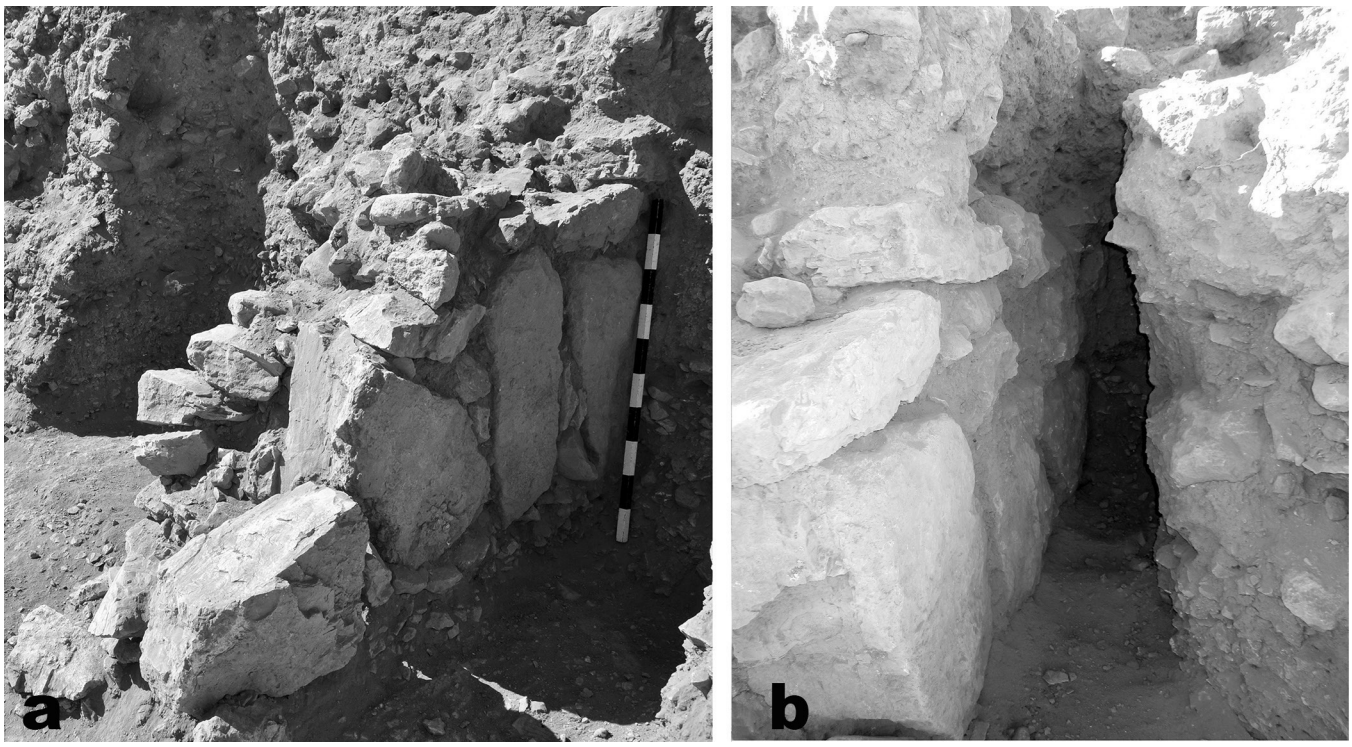

Fig. 4 a: Wall 1 constructed of standing stones as exposed in October 2011 (photo: K. Douglas); b: Extension of wall 1.5 m into the western section in January 2012 (photo: G. Rollefson).

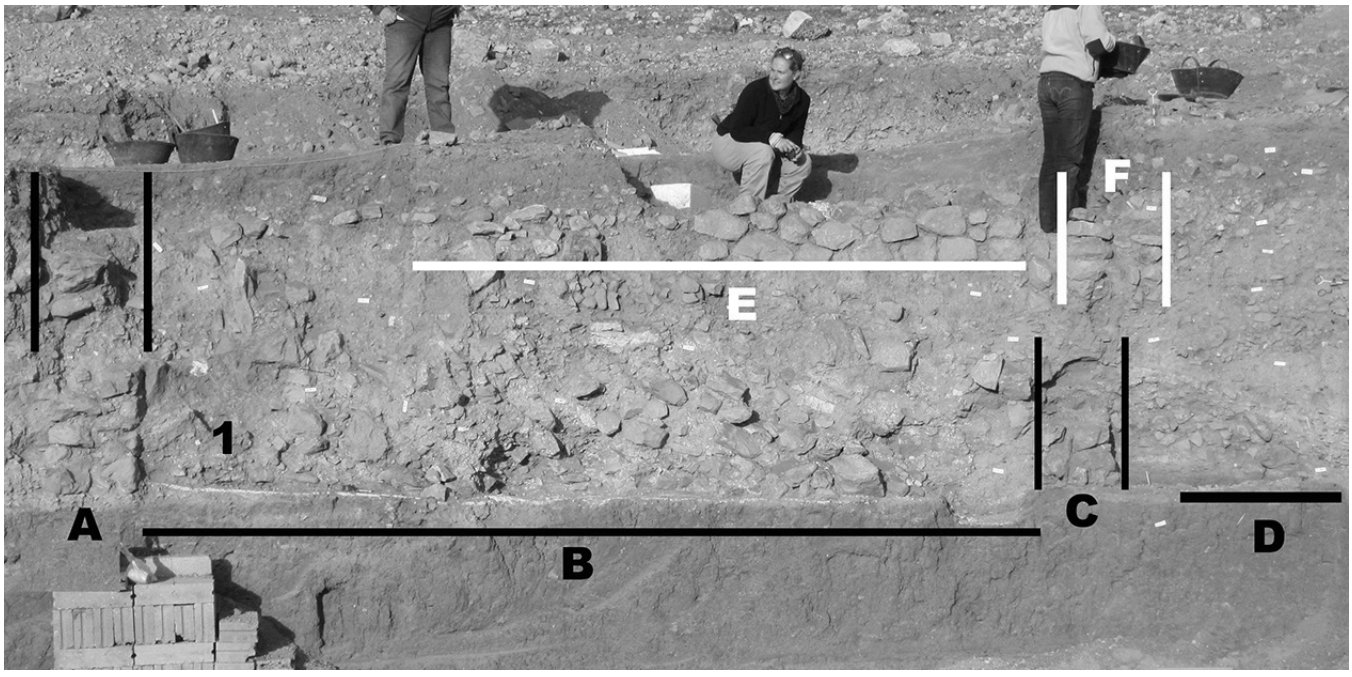

Fig. 5 Domestic structures exposed in Section III.1, view to the west. A and C are E-W walls at either end of a red-painted *huwwar* plaster floor (B), and D is an exterior surface. 1 indicates the location of a clay storage feature (see Fig. 6). E is a N-S Yarmoukian wall, and F is an E-W Yarmoukian wall of a different structure (photo: G. Rollefson).

sophisticated lime plaster floor construction during the Middle and Late PPNB at ‘Ain Ghazal, the PPNC floor was laid directly atop the clay soil, which degraded the structural integrity of the surface; additionally, there was no evidence that the floor was painted red, which was a virtual requirement during the earlier PPNB periods. The southern wall of the lower building was set on top of a PPNC rubble layer (*cf*. Zielhofer *et al.* 2012: 433-434), adding to the certainty that this was a PPNC building. The floor was clearly angled downwards towards the north, and this appears to have been intentional. The floor dipped suddenly into a *ca*. 25 cm wide “channel” at the northern wall. This “channel” appears to have run the length of the northern wall into the bulldozer section, but why the channel was there is not at all clear.

Cleaning of the section revealed a sun-dried clay

Fig. 6 View to east of the SE corner of the Yarmoukian structure; the burial is at the pointed end of the 35 cm scale. At the top of the photo is the deep reservoir excavation (photo: G. Rollefson).

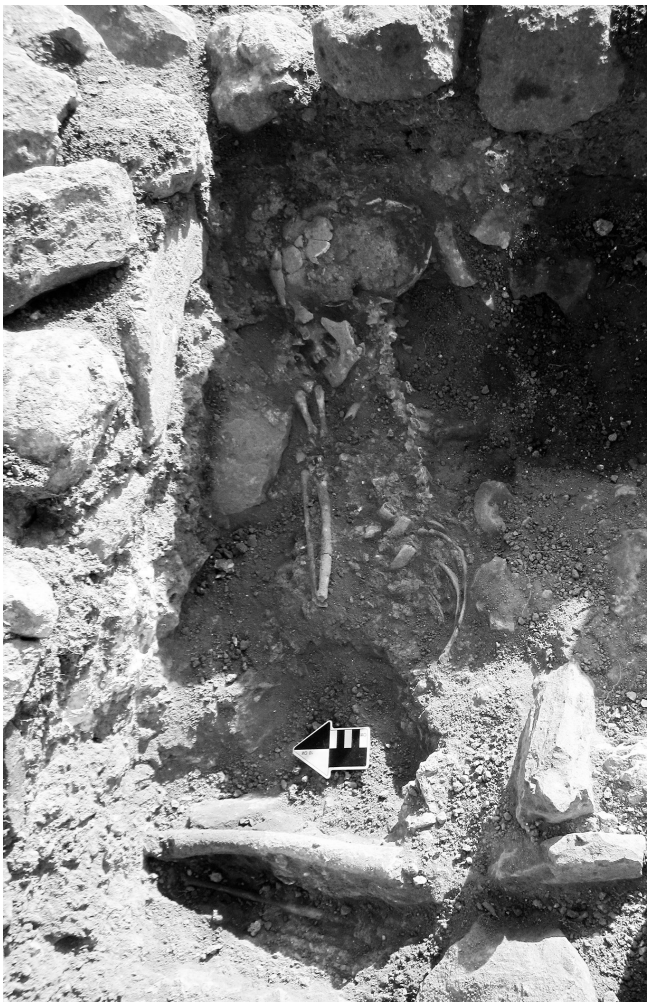

Fig. 7 Burial in the corner of the Yarmoukian building in Fig. 6 (photo: G. Rollefson).

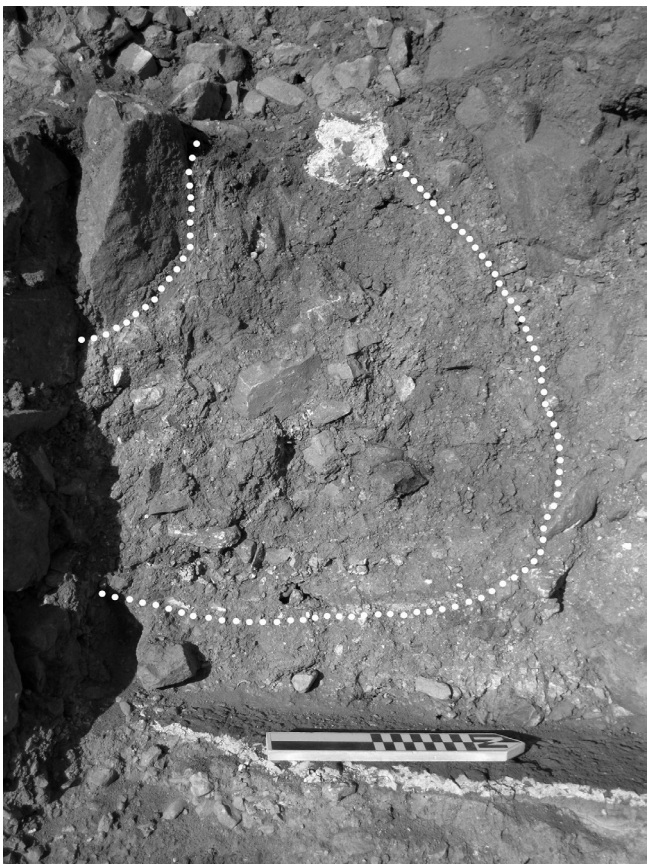

Fig. 8 The white dotted line indicates the exterior of a clay storage vessel at the southern end of floor B (1) in Fig. 5 (photo: G. Rollefson).

storage facility against the southern wall of the PPNC house. Curiously, the clay is 10YR 6/6-7/6 yellow to brownish-yellow, which is markedly different from the local basal clay; where this clay came from, and why it was selected instead of the local soil, is unclear. The bell-shaped feature (Fig. 8) was plastered at the base, and in the fill of the feature there was a considerable amount of chalk fragments in addition to stones that had fallen from the wall after abandonment. The rest of the house was filled with collapsed wall stones amid a rough sedimentary mix of chalky fragments (and, inexplicably, rare small pieces of red-painted lime plaster fragments).

Feature 1

Feature 1 (F1 in Fig. 2) is a small lime (?) plaster basin excavated into the sterile *terra rossa* soil about 9 m south of the southern wall of the PPNC house. There is no clear association of this basin with any other architectural feature, and its function remains obscure. It is clearly PPNB in age (most likely Late PPNB, in the latter half of the 8th millennium) based on its stratigraphic relationship with Feature 2 (below). The construction of the basin, which consisted of two phases, was relatively crude, utilizing hand-sized stones as part of the matrix (Fig. 9b). We collected the entire contents of the basin for later analysis. The dimensions of F1 are 50 cm in diameter, 25 cm deep, and with a wall that varied from 7-11 in thickness.

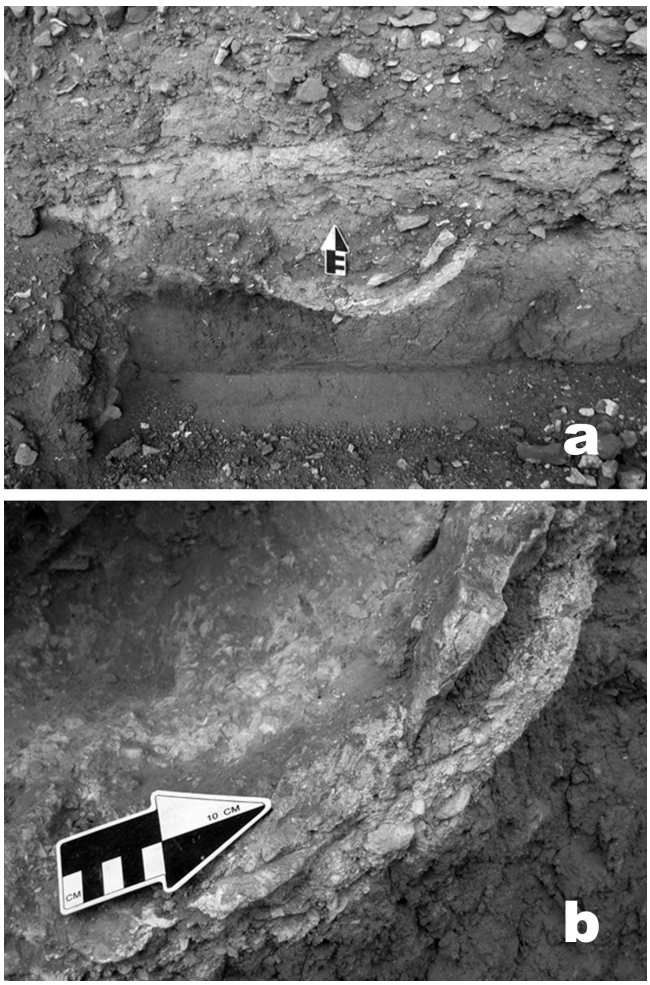

Fig. 9 a: The plastered basin cut into sterile basal clay; note the heavy burning to the lower left of the basin. b: Close-up of the basin showing burning on the interior. Scale is 10 cm, and north is to the right in both images (photos: G. Rollefson).

Notably, the *terra rossa* soil has been heavily burned just beneath the southern edge of the basin (Fig. 9a), an event that might also be related to the yellowish-pink color of the interior of the plaster basin.

Feature 2

Feature 2 (F2 in Fig. 2) is immediately south of the PPNC house, but lower absolutely by approximately 30 cm. It is a 10-15 m lens, 15-30 cm thick, of very powdery light gray ash that extends over a 4 m length directly atop sterile *terra rossa* (Fig. 10a). Once again, there are no indications of structural associations with this feature, which appears to be an open-air dump. However, near the center of the feature was a dense Late PPNB chipping station, with hundreds and hundreds of large and small flakes that resulted from the preparation of at least one (if not more) naviform blade cores, the hallmark of the Middle and Late PPNB periods. We took a sizeable collection of artifacts from this feature, as well as a sample of the ash for later analysis. A radiocarbon sample (AA98396) produced a date of 6891 ± 112 calBC, at the very end of the LPPNB period.

Trench 2 and Trench 4

Two successive white floors were visible high above the bottom of the 4-m deep reservoir excavation ("R" in Fig. 2), and we decided to obtain samples of the floors for comparison with the floor in the PPNC house as well as floors in Yarmoukian structures in other parts of the site. Normally, Yarmoukian and PPNC floors were of beaten earth, but in this part of the site

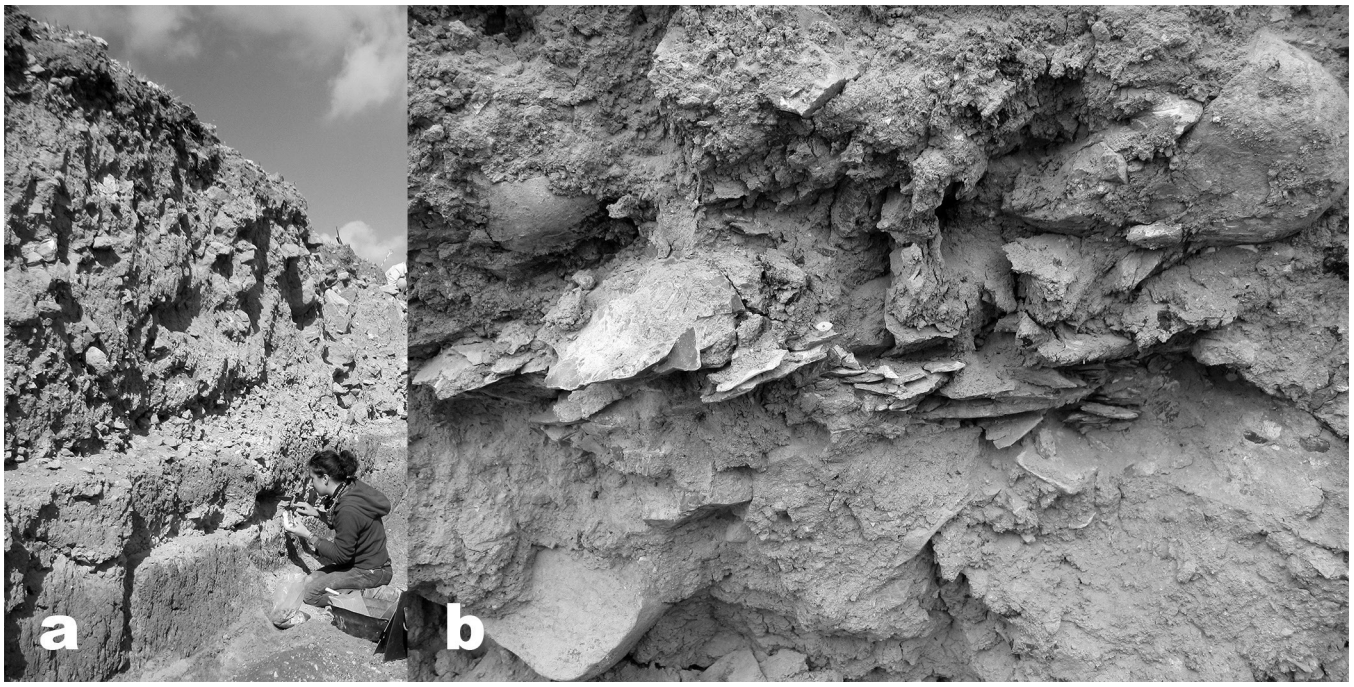

Fig. 10 a: excavation of Feature 2, which lies on sterile basal clay. b: Close-up showing the density of naviform debitage on and in the fine ash (photos: G. Rollefson).

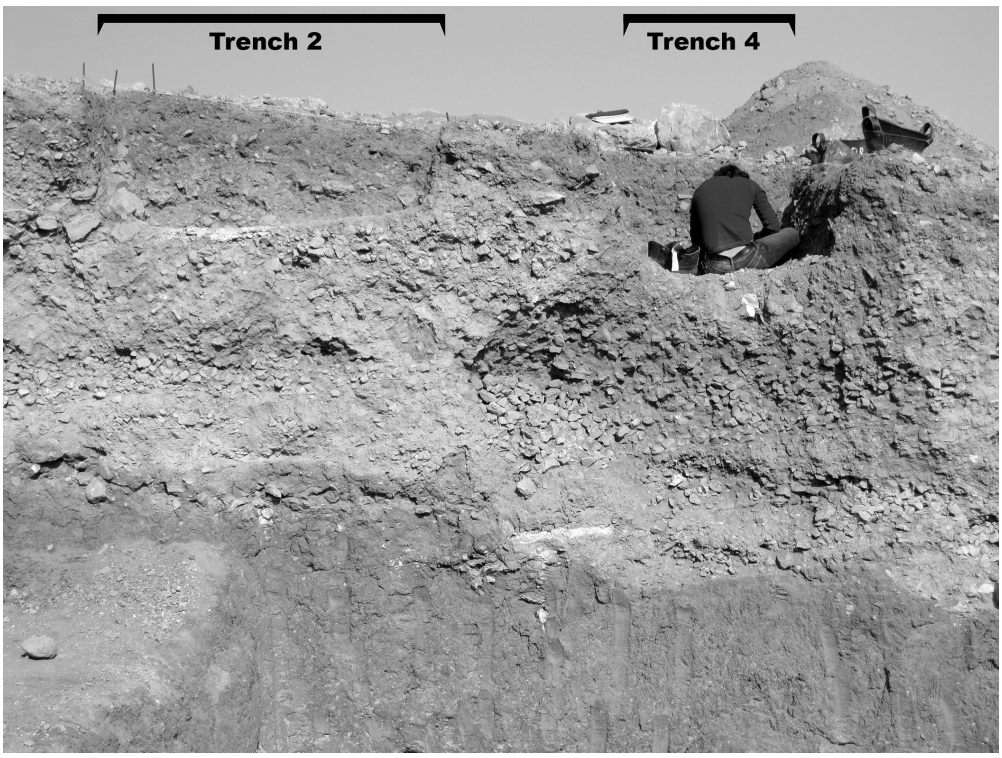

Fig. 11 Trench 2 (left) and Trench 4 in the north section. Note the ashy rubble layers (photos: G. Rollefson).

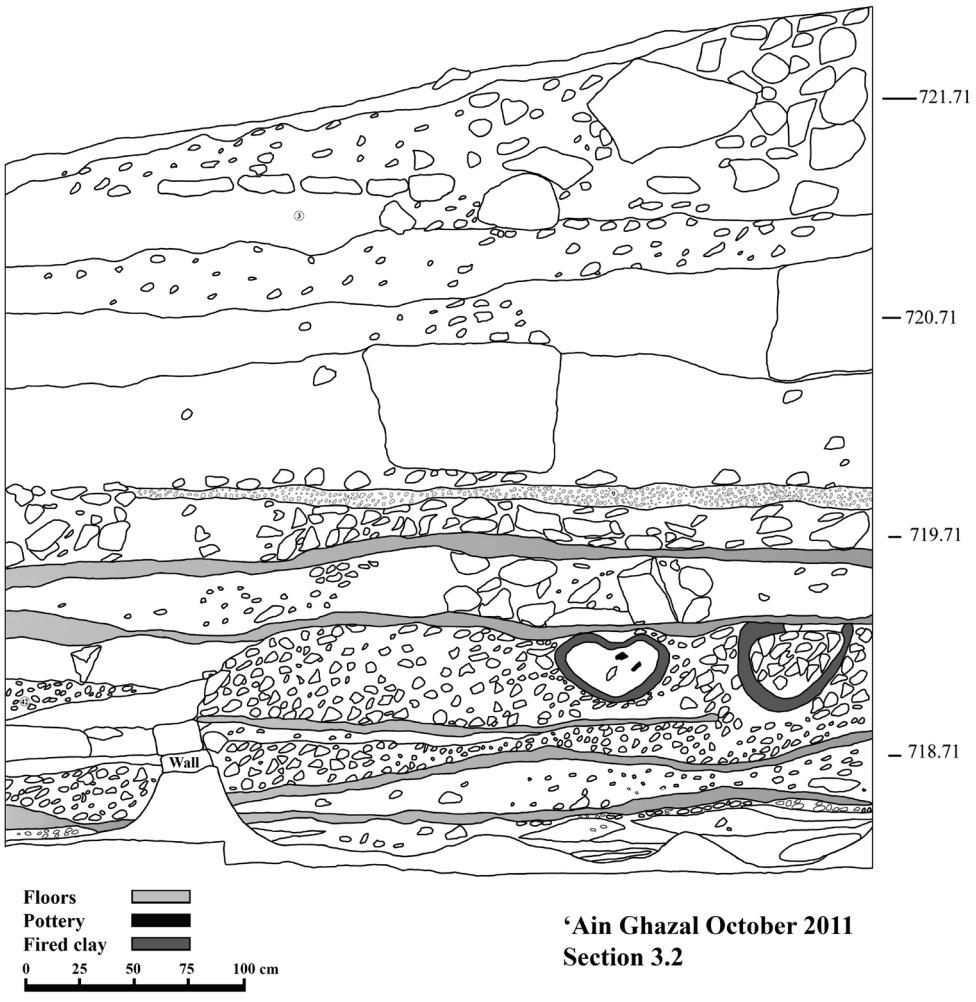

Fig. 12 Stratigraphy revealed in Section III.2 (view to west). Of particular interest are the two fired clay "vessels" near the lower right part of the section (drawing: K. Douglas, modified by G. Rollefson).

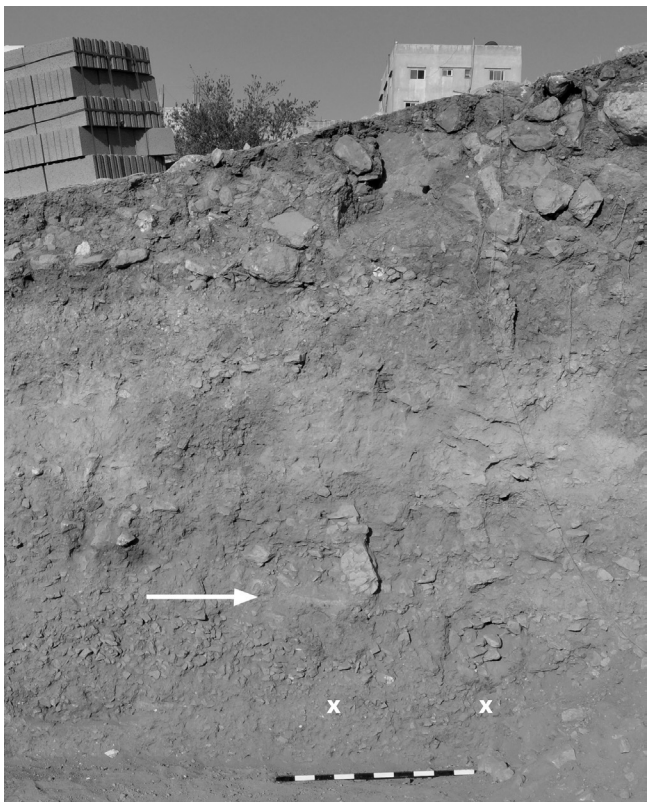

Fig. 13 Location of the clay vessels ("X") *ca*. 3 m below the modern surface. The white arrow indicates the huwwar floor that sealed the vessels (photo: G. Rollefson).

white chalky floors were common (*e.g.*, in Trench 2 at the left, Fig. 11). The two Trench 2 superimposed floors were made of *huwwar* (ground-up chalk mixed with mud) and were in a poor state of preservation. In Trench-4 we sampled a dense accumulation of angular rubble and dark gray ash (to the right in Fig. 11). The presence of angular rubble throughout the PPNC and Yarmoukian layers at 'Ain Ghazal remains an impenetrable mystery so far, and these samples might help to elucidate the reasons for their presence.

Section III.2

To the extreme southwest of the bulldozer excavation of the middle and upper terraces is a section that reveals a sequence of several floors and surfaces mostly associated with Yarmoukian rubble layers (Fig. 12). Of particular note in this area are two sub-spherical bag-like features made of burned reddish clay (Figs. 13 and 14). Both are beneath a *huwwar* floor and predate the structure above them. The feature (Locus 015) on the left in Fig. 14 is 47 cm in diameter and approximately 30 cm high. The other feature (Locus 017) is 43 cm in diameter and 40 cm high with walls about 5-7 cm thick. Both were filled with ashy soil and fist-sized stones as well as a few Yarmoukian potsherds. The contents of both features were collected for later analysis. A radiocarbon sample from Locus 017 (AA98395) yielded a date of 5772 ± 64 calBC, our first Yarmoukian ^{14}C date from the site.

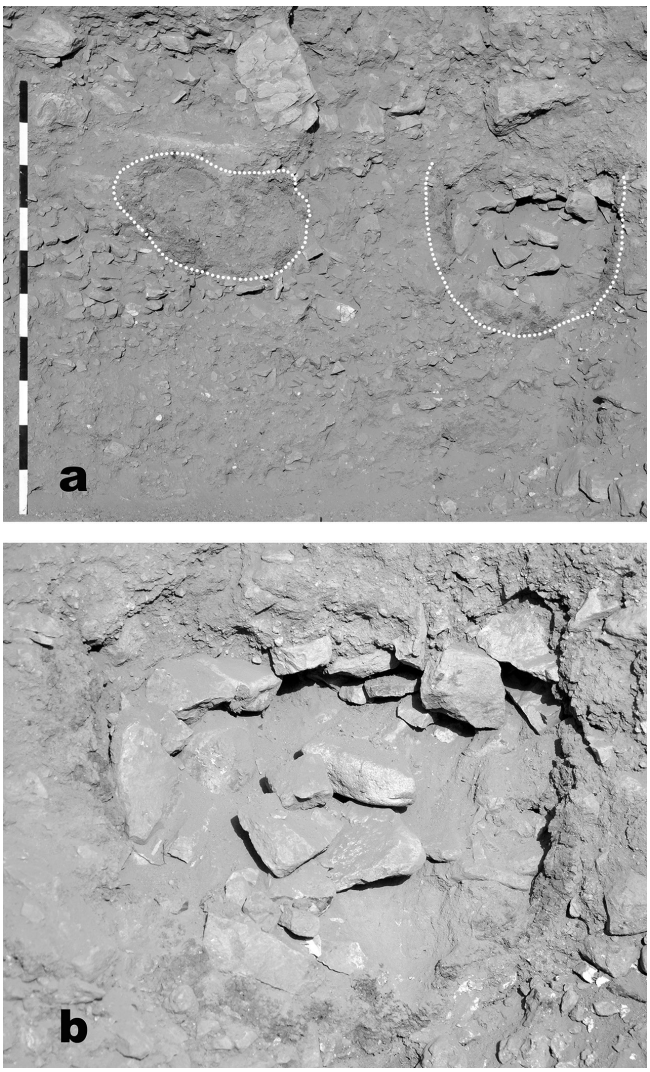

Fig. 14 a: White dotted lines outline the fired clay vessels in Fig. 10 b: Close-up of the vessel to the right (photos: G. Rollefson).

Tr-5, Floor 6, and Floor 7

Small probes reached what are Yarmoukian floors one to two meters below the modern surface in the uppermost terrace. Floors 6 and 7 (both *ca*. 5 cm thick) are characteristically chalky, with little structural integrity, but the floor in Tr-5 is yellower in color and may be a kind of *huwwar*. Yarmoukian sherds were present just above all three floors.

Square 3073

One of the principal aims of the 2011-12 season was to see if there were one or more burials under the MPPNB house floor in Square 3073, a trench that was excavated in 1982-1984 (Rollefson and Simmons 1984, 1985, 1986). Two depressions in the otherwise flat floor suggested that they may have resulted from the decay of human burials beneath the floor; subfloor burials were characteristic of the MPPNB period (*ca*. 8,300-7,500 calBC).

Fig. 15 Composite photo of the eastern (left) and southern bulldozer sections of the "reservoir" excavation. Note the walls and floors in the eastern section, and the rubble-filled pits and rubble layers in the southern section (photos: G. Rollefson).

Excavating through the floor in the northeast corner of the floor hearth room resulted in exposing an earlier outdoor fireplace, but there was no burial in this area. The section through the floor demonstrated that there was indeed a reflooring episode, a typical feature of the process of interring someone beneath the house floor. Furthermore, there was only the most recent flooring episode above the depression, which would be expected if a burial had been placed there, since the original floor would have been removed while excavating the grave. But as it turned out, we were wrong to expect a depression from human decay since the body would have been exposed when the grave was reopened to extract the skull, and the grave would have been refilled with no subsequent contraction. Nevertheless, there is at least one burial somewhere beneath this floor, but we didn't have the time to search for it.

Discussion

Architectural density for the PPNC appears to remain very low, based on what we can see in the bulldozer sections, but the case for the Yarmoukian period contradicts our earlier surmise about the area of ʿAin Ghazal after the LPPNB megasite collapse at the beginning of the 7th millennium. Drought clearly played a part in the dramatic reduction of the PPNC presence at ʿAin Ghazal, but some amelioration is likely to have spurred a regrowth (albeit still very non-intensive) in the latter half of the 7th millennium.

The western (uphill) part of ʿAin Ghazal appears to have witnessed a period during the PPNC and earlier Yarmoukian periods that involved the almost industrial scale of producing rubble, both associated with burning and without the use of fire (Figs. 11 and 15). What activities were involved remain frustratingly unclear, although based on the interdigitation of floors, walls, and rubble, they don't appear to have excluded residential presence in the midst of them.

Artifact recovery was moderate, partly due to the decision to sieve excavated dirt only at a 25 % scale. Even so, there was still an appreciable amount of flint and groundstone artifacts as well as a sizeable amount of animal bone. We were not able to conduct any detailed analysis of the recovered material, but there are certainly tools that indicate a continued dependence on hunting and farming. Small finds were very rare (a single example consisting of a broken small pendant of mother-of-pearl).

Certainly there is an urgency to resume large-scale excavations at ʿAin Ghazal, especially before the vertical bulldozer sections succumb to gravity and erosional forces. But raising funds for such an endeavor is a major challenge, and the environment for obtaining moneys is weaker than ever before. Nevertheless, efforts to this end will be made by the authors.

Acknowledgements. The work undertaken during October 2011 was supported by Yarmouk University and the Hashemite University of Jordan. We also thank Dr. Bilal Khraisat and Dr. Fouad Hourani for their contributions to the project. The mitigation during the 2011-12 phase was made possible by a generous donation from the American Center of Oriental Research (ACOR) and by funding from Whitman College. The Department of Antiquities was also very supportive in terms of providing workmen and advice. Dr. Barbara Porter (ACOR Director) and the ACOR staff gave unstintingly in their services and advice, for which we are all very grateful. Volunteers Kathleen Bennallack, Hana Bani Ata, Janaki Phillips, Elizabeth Hambleton, Issa Abu Dayyeh, and

Helaine Wyatt worked ceaselessly under trying weather conditions, but with a dedication that ensured quality results.

Zeidan Kafafi
Faculty of Archaeology and Anthropology,
Yarmouk University and
Hashemite University, Jordan
zeidan.kafafi@gmail.com

Gary Rollefson
Department of Anthropology,
Whitman College
rollefgo@whitman.edu

Khaled Douglas
Hashemite University, Jordan
khaleddouglas@hotmail.com

Ahmad Lash
Department of Antiquities of Jordan
ahmadlash@yahoo.com

References

Rollefson G. and Simmons A.
1984 Neolithic ‘Ain Ghazal (Jordan): Interim Report on the First Two Seasons (1982-1983). *Journal of Field Archaeology* 11: 387-395.
1985 The Early Neolithic Village of ‘Ain Ghazal, Jordan: Preliminary Report on the 1983 Season. *Bulletin of the American Schools of Oriental Research Supplement* 23: 35-52.
1986 The Neolithic Village of ‘Ain Ghazal, Jordan: Preliminary Report on the 1984 Season. *Bulletin of the American Schools of Oriental Research Supplement* 24: 147-164.

Zielhofer C., Lee Clare L., Rollefson G., Wächter S., Hoffmeister D., Bareth G., Roettig C., Bullmann H., Schneider B., Berke H. and Weninger B.
2012 The decline of the early Neolithic population center of ʿAin Ghazal and corresponding earth-surface processes, Jordan Rift Valley. *Quaternary Research* 78: 427–441.

Stage 3 Manufacturing Traces of the Ba'ja LPPNB Sandstone Rings

Tristan Michiels, Amer Salah Abdo al-Souliman, and Hans Georg K. Gebel

Prologue: We present our study in a more unconventional manner. When we started work on the specific morphology of the manufacturing traces, we did not want to be "burdened" with sorts of experimental/ replicative perspectives before having reached a decent archaeological understanding of the traces. Only by discussing these we were able to understand the imperative of replicative work. Thus, the development of our analytical understanding is reflected by the two perspectives and parts this contribution has which we wanted to present separately for the sake of their integrity and to document our "learning process": the archaeological sight on manufacturing traces, and how they have to be reconsidered after making a simple and preliminary replicative test. Or: how a merely archaeological interpretation of such technological subjects can go astray without a replicative approach …

Subject, Aims and Methods

The sandstone rings represent a much-attested category of artefacts in LPPNB Ba'ja. Contextually, they occur in the room fills and in primary contexts (*e.g.* Gebel and Hermansen 1999, 2000; Purschwitz and Kinzel 2007), and were found in high numbers in a dump placed in one of the site's access areas (Gebel and Hermansen 1999: 20). Interpretations of this find class suggested that they were used as bracelets or pendants (Starck 1988), sewn-on objects (Gebel n.d.), or most recent as commodity coupons (Gebel 2010: 45, 71ff); other publications refer to the production of the sandstone rings (Gebel and Bienert 1997 *et al.*; Hintzman 2011[1]).

A generalized *chaîne opératoire* of 6 production stages provided a preliminary understanding of the blanks, waste and finished product types, as well as ideas on the manufacturing and kind of tools used (Gebel and Bienert 1997: 252-258, Gebel and Hermansen 1999: 20; Table 1). It is this article's aim to present a qualitative understanding of the most enigmatic part of the manufacturing process, the crucial production Stage 3: It comprises the traces leading to the separation of the raw ring from the interior disk. Thus we included in our qualitative study objects of production Stage 4a-b: They are direct results of Stage 3 and show its significant manufacturing traces (Plate 2.a-b). In addition, Stage 2 disks were included since initial Stage 3 manufacturing traces already can be identified on them.

This traceological study aims to assist a future modelling of the rings' *chaîne opératoire* beyond the generalized succession of work stages. It should include the alternative, corrective and recycling[2] processes during production (*cf.* Endnote 2), supported by a replicative system analysis as well as a statistical and contextual evaluation. Here we will also briefly describe the petrographic parameters and specific workability (Table 4) of the various sandstone raw materials used and their local geological contexts (*cf.* section: Raw Materials Sources and Qualities by Amer al-Souliman). Then we focus on the traces of manufacturing to properly describe these, and to approach the difficult question of which tools/ actions might have been used to extract the interior disk.

Traces were studied macroscopically, by microscope and by conventional scans[3], after the artefacts were cleaned with water and a soft brush; calcareous crusts remained on the pieces. So far we have not identified any residue of tools in the traces of non-cleaned products; depending on the tools used such remains cannot be excluded.

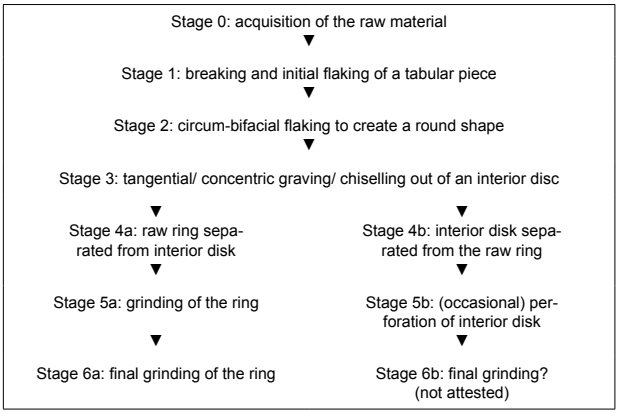

Table 1 Reconstructed stages of sandstone ring production after Gebel and Bienert *et al.* 1997.

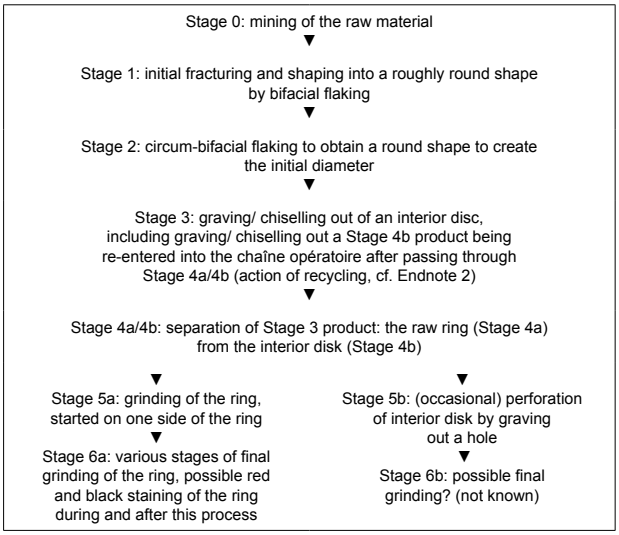

Table 2 Revised understanding of the stages of sandstone ring production (T. Michiels).

Raw Material Sources and Qualities

Geological Setting of Neolithic Ba'ja

The LPPNB village of Ba'ja is located in the southern highlands *ca*. 10 km north of Petra, 5 km north of Beidha, at an altitude of about 1160 m a.s.l. The highlands rest between the arid plains of Wadi Araba in the W and the desert steppes of the Arabian Plateau in the E.

The site's geological location is part of the thick sandstone formations which cover the Precambrian granites and volcanoclastics (Bender 1974). It rests in the Cambrian Umm Ishrin Sandstone Formation; the upper Ordovician Disi Sandstone Formation is to be found southeast of the site (Barjous 1995) in one of the Petra region's joints, as a result of tectonic activity. The location is a very attractive combination of valleys, broad plateaus and deep gorges. The Ba'ja joint (Siq al-Ba'ja) is filled with a thin layer of gravels and weathered sediments (Gebel *et al.* 1997). M. Andresen's unpublished MA-Thesis (Andresen 2007) on the mineral raw materials of LPPNB Ba'ja presented a classification of four sandstone raw material groups (SRMG 1-4) that were observed in Ba'ja[4].

Objectives and Methods of Mineralogical Study

The study aims to 1) characterize the mineralogical character of the most used variety of sandstone in ring production, 2) to describe its mechanical resistance and compare it with samples taken from geological contexts of the site's vicinity, and 3) to comment on observations made on the latter during a test. For this, our limited mineralogical research asks the following questions: What are the mineralogical and chemical compositions of the most used sandstone raw material? What are the geological contexts of this raw material? What are its mechanical specifics?

Thin section analysis was carried out to characterize the commonly used sandstone variety (identification of the mineralogical composition), using Optical Microscopy (OM). It is checked with the raw material classes for sandstones so far used by the archaeologists (Stark 1988, Gebel and Bienert *et al.* 1997, Andresen 2007) and the classification of Heinrichs (2008). Two sandstone samples from the Umm Ishrin formation and one characteristic from the Ba'ja sandstone rings production were macroscopically investigated. For the Umm Ishrin clayey-silty sandstone sample from Siq al-Ba'ja a XRF analysis was undertaken (Table 3).

Petrograhic Analysis

Selected microscopic photos are chosen to petrographically describe the samples.

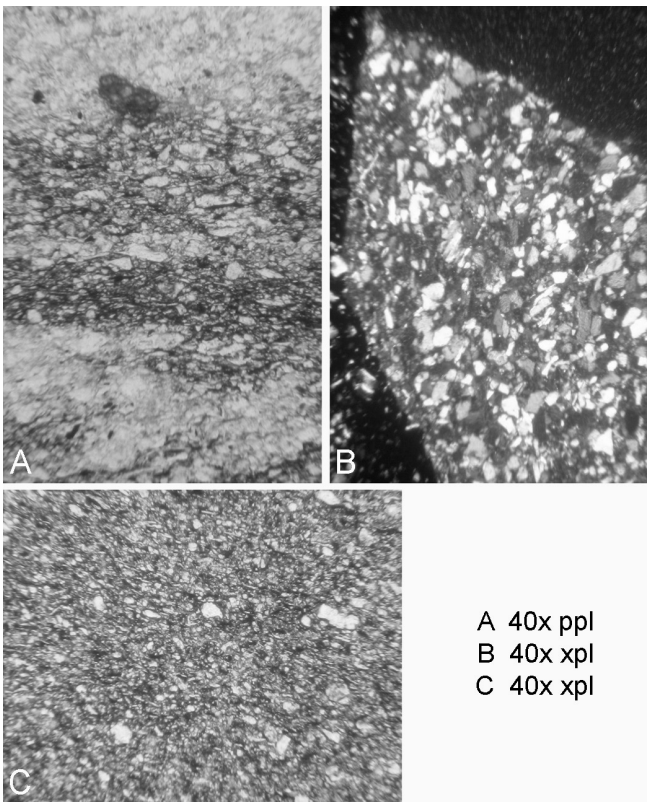

Fig. 1 Selected thin sections of petrographic analysis. A-B from al-Ba'ja (A: banding; B: with rock fragment). C from Sample 2 of a LPPNB sandstone ring (general view). (photos: Souliman)

Sample 1 represents the Umm Ishrin clayey-silty sandstone from Siq al-Ba'ja at UTM 36 R x0736023, y3367060; under the microscope it is showing rock fragments (Fig. 1.B), iron oxides, muscovite (maica), feldspar, quartz and calcite. The banding (Fig. 1.A) is between ferruginous and less ferruginous.

Sample 2 is from a LPPNB sandstone ring fragment; petrographically it is similar to Sample 1, but its grains are finer and it shows no banding (Fig. 1.C): Neolithic people obviously preferred for sandstone rings the more homogenous sandstone varieties with compact layers. The rock contains clay minerals and iron oxides as cement between the quartz grains; it appears brown to black in plane - polarized light.

The XRF testing of the Umm Ishrin clayey-silty sandstone sample from Siq al-Ba'ja shows a high amount of quartz and clay, Al_2O_3, Fe_2O_3, and MgO (Table 3).

Material's Hardness

The mechanical specifics of the sandstone quality preferably used to manufacture the rings are shown in Table 2, as compared to the ferruginous and Ordovician sandstone qualities.

Item	S.ID.	Fe_2O_3 Wt.%	MnO Wt.%	TiO_2 Wt.%	CaO Wt.%	K_2O Wt.%	P_2O_5 Wt.%	SiO_2 Wt.%	Al_2O_3 Wt.%	MgO Wt.%	Na_2O Wt.%	L.O.I Wt.%
1	**KA**	4.26	0.006	0.95	2.61	0.54	0.24	61.70	18.00	1.37	0.045	9.50

Table 3 XRF analysis for Umm Ishrin clayey-silty sandstone Sample 1 from the Siq al-Ba'ja. (provided by the Natural Resources Authority, Amman).

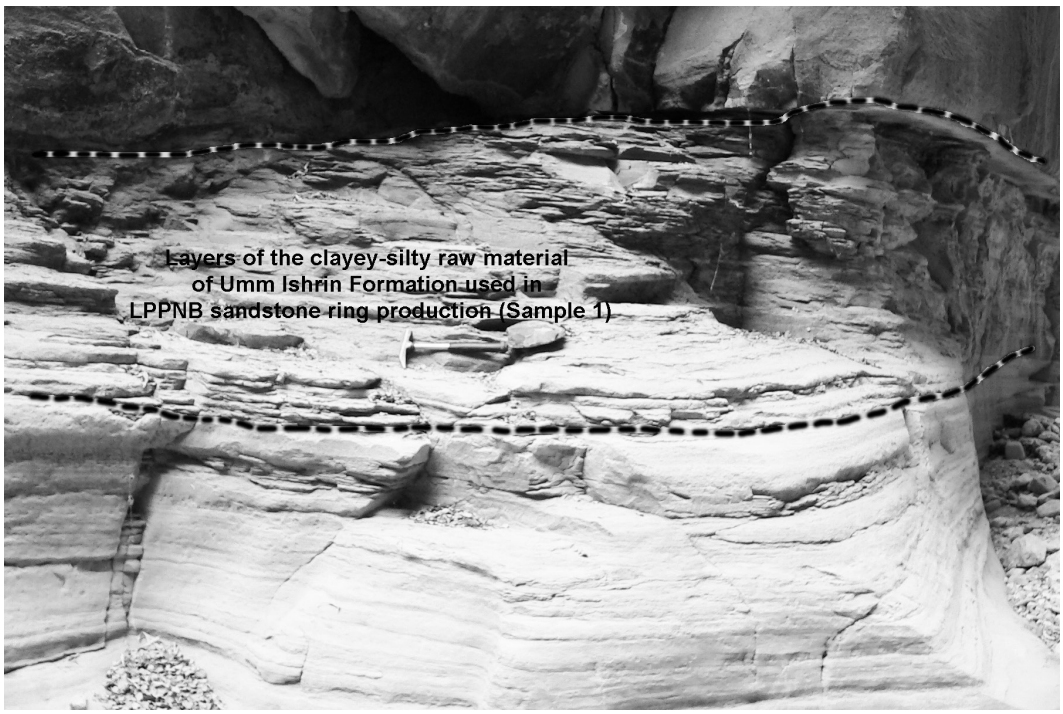

Fig. 2 Stratigraphical location of the preferred sandstone ring raw material in the Umm Ishrin formation in Siq al-Ba'ja. (photo: Souliman)

Discussion of Results

Cursory visual inspection suggests that the sandstone rings were made by using locally available Umm Ishrin sandstone qualities; the raw material is *e.g.* available in the Siq al-Ba'ja, the gorge by which the site is accessed. The characteristic concordance between the raw material sample from the *siq* (Sample 1) and the LPPNB sandstone ring Sample 2 indicated that the sandstone rings raw materials were taken from the thin rippled beds and laminations of the sandy/ clayey components of the Umm Ishrin sandstone formation (Fig. 2). Since the clay content of the preferred raw material (*cf.* also Andresen 2007: SRMG 2) is almost 30%, it reacts soft and resilient to carving. This is supported by its physical characteristics, like the compactness of its clay minerals and the very fine-grained quality of the stone, and the chemical composition as well as the crystallization. Although it is easier to carve the soaked raw material, it is possible to carve it in its dry state (*cf.* below). However, this raw material has a tendency to easily fracture. Aside from its overall availability in the area, it is the ideal material for this type of manufacturing (*cf.* The Test).

The raw material is similar to Heinrichs' class VIIIb (Heinrichs 2008: 654), the violet, clayey, hard, and very fine-grained sandstone. Heinrichs found that the drilling hardness in dry condition for this class is at 10–25 (medium in this system) which is good for carving while not being either too hard or too fragile.

Aside of its good workability (Table 4), the raw material must have also been attractive for its shiny (from the quartz component) and colourful (from the iron and aluminum oxides Fe_2O_3 and Al_2O_3, *cf.* the XRF data in Table 3) appearance which other local rocks - *e.g.* the limestones – do not provide.

Raw material/				
Sample	Hardness of dry sample	Hardness of after soaking in water for 5 and 10 minutes	Hardness after soaking in water for 20 minutes	Remarks *after Andresen 2007
ferruginious sandstone (SRMG 1*)	very hard to carve	very hard to carve	very hard to carve	No change in resistance by increasing the period of soaking.
clayey-silty sandstone (SRMG 2*) = Sample 1 and 2 of this analysis	easy to carve	easy to carve	easy to carve	Workability/ carving became easier/ more invasive by increasing the period of the soaking in water; after soaking for one hour the raw material became too fragile/ risky to be worked.
Ordovician sandstone (SRMG 4*)	fracturing/ fragile	fracturing/ fragile	fracturing/ fragile	Too coarse and strong to carve

Table 4 Hardness/ resistivity of the various sandstone raw materials.

Stage 3 Traceology

For this analysis, 28 diagnostic pieces[5] were selected from various contexts and seasons, serving as sample for the attribute analysis (Table 5).

	Stage 2 (<bifacially worked> round disk)	Stage 3 (raw ring still attached to interior disk)	Stage 4a (raw ring)	Stage 4b (interior disk)
Trace A	present	present	present	present
Trace B	absent	present	present	no information
Trace C	not applicable	no information	present	non-present

Table 5 Traces as attested with working stages.

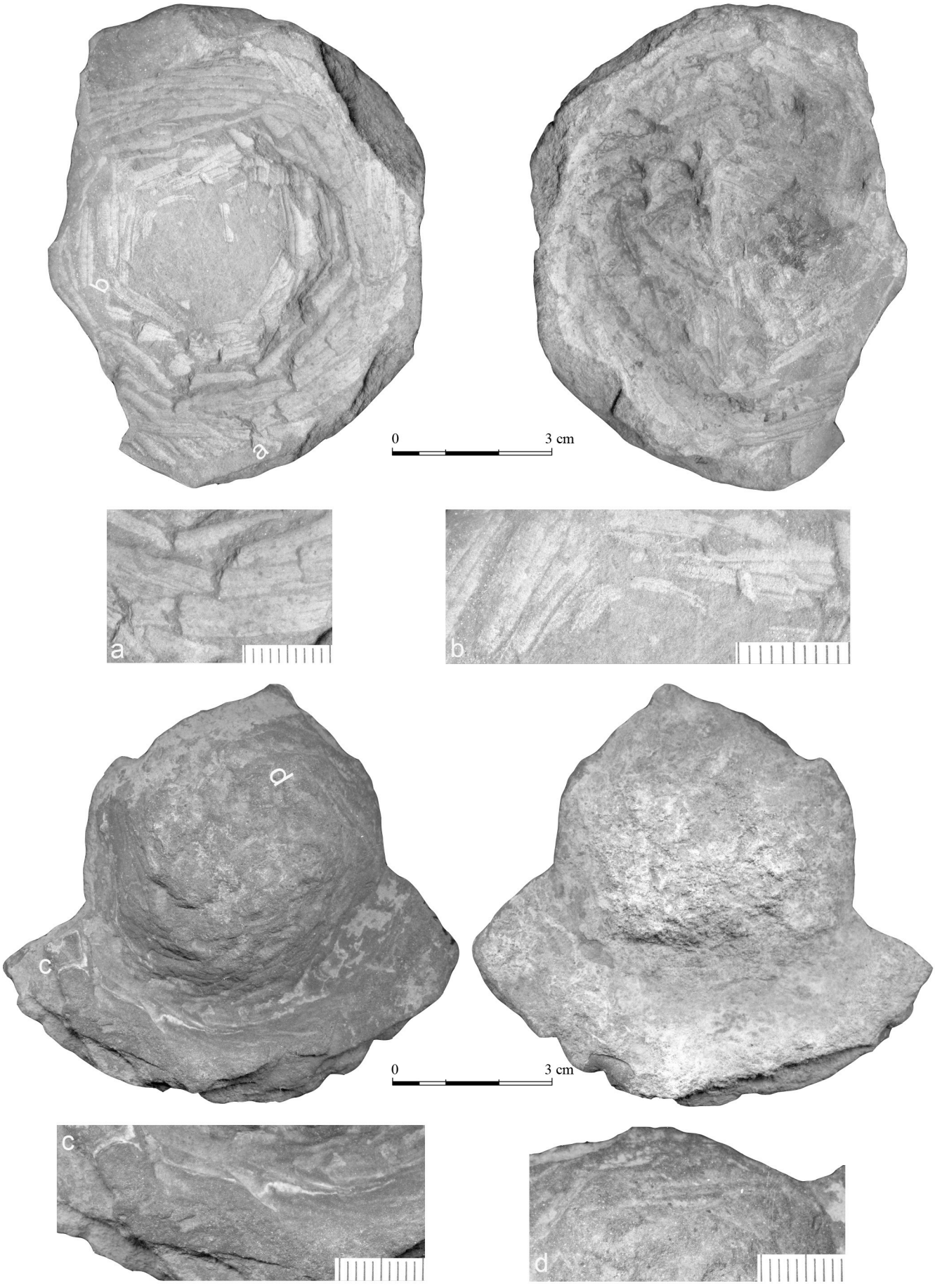

Plate 1 *a-b* fragment (01288.1) of Stage 3 with major parts of interior disk and outer ring: *a-b* close-ups of Trace A – *c-d* fragment (11287) of Stage 3 with interior disk and part of outer ring; upper right thick calcareous crust on manufacturing traces of "reverse": *c-d* close-up of Trace A. (scans/ plate: Gebel/ Michiels/ Purschwitz)

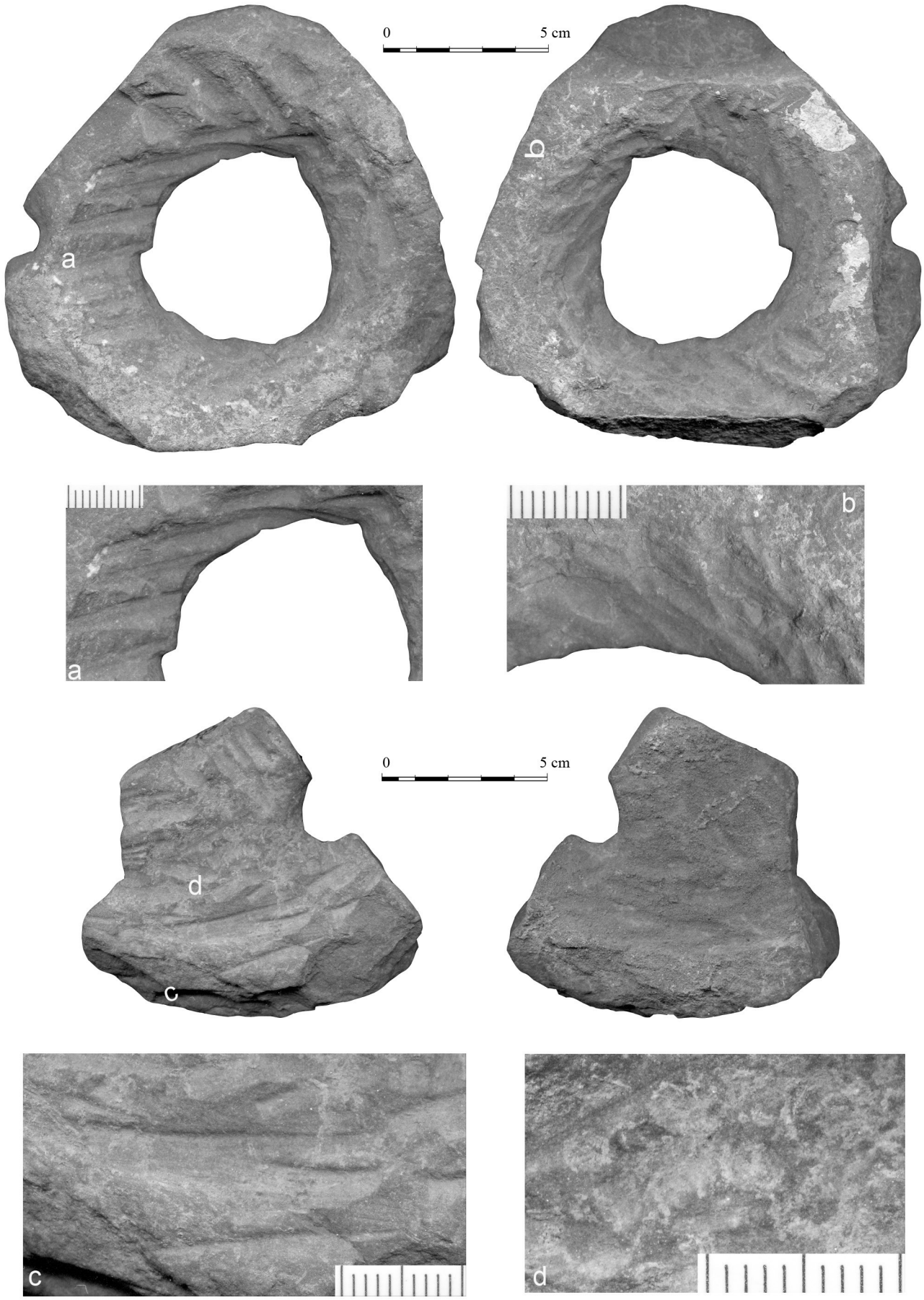

Plate 2 *a-b* exterior raw ring (21362) Stage 4a with Traces C on both sides of the interior edge: *a-b* close-ups of Trace C – *c-d* fragment (21245.2) of Stage 3 with part of interior disk and outer ring, with type of perforation in the area between outer ring and interior disk; upper right thin calcareous crust on manufacturing traces of "reverse": *c* close-up of Trace A, *d* close-up of shallow circular negatives with c. 2,5 mm diameters. (scans/ plate: Gebel/ Michiels/ Purschwitz)

Basically, we distinguish three kinds of manufacturing traces[6] related to Stage 3 working. The tracks' position is presented with the trace descriptions since they are influential for the expression of the traces, respectively the holding of the raw form and operational mode of the tool (the discussion of the positions *cf.* the technical interpretation). In fact, it might be correct to assume that all traces derive from the same type of tool type which only was used differently in terms motion direction, tool handling as related to the position in which the semi-finished product was hold, which had different working edge morphologies/ widths, and possibly from applying different force/ pressure.

Traces A (Plate 1.a-b, 2.c): Show a 2-5 mm wide working edge of a tool continuously proceeding in the sandstone, leaving 5-15 mm long removal tracks with rectangular profiles. In the – often slightly curved – direction of the track the tool leaves fine parallel striations (running parallel in the track's direction); the track may show slight internal steps towards its end. The ends of the tracks show clear steps; the depths of the tracks are approximately 0,5-0,8 mm and many times slightly increasing towards the stepped end. Tracks of Traces A are generally placed tangentially, and concentric from the outer (intended) raw ring to the interior disk. Quite distinctive but rare are short, broad tracks with deep pronounced steps, observed on the surface of interior disks (F.no. 01209.6, 21284.1 and 21245.3). This track type apparently relates to a regularizing of the interior disk's surface.[7] In traceological terms, it belongs to Trace A, representing a short action with a broader working edge.

Traces B (Plate 1.c-d): Represent narrow (<1,0 mm) tracks with V-shaped profiles and similar lengths and continuities like Traces A. The striations of A are missing, as do the internal steps. Tracks of Traces B are generally also placed tangentially and concentric from the outer (intended) raw ring to the interior disk, but the tool must have been operated with its narrow edge and mainly on the interior of the later raw ring and less in perimeter areas of the interior disk. The tangential application of the tool and the use of its narrow side allowed deeper tracks/ removals.

Traces C (Plate 2.a-b): Their tracks are quite similar to those of Traces A, measuring in average 5 mm in width, 5-15mm in length and 1,5 mm in depth. They start at upper parts of the outer raw ring' inside and go steeply down in a more acute tangential angle. These tracks are applied at the end of Stage 3, aiming to do the final separation of the interior disk from the outer ring. We distinguish these (uncommon) traces from the Traces A and B since this movement of the tool left specific tracks.

Aside from these trace classes, other work traces seem to occur on the intermediate products. *E.g.*, shallow circular negatives with c. 2,5 mm diameters occur on an interior disk close to the groove between the interior disk and the outer ring (F.no. 21245.2), looking very much like a applying a short drilling pressure (Plate 2.d).

Stage 3 Technical Discussion, Interpretation

All discussion and interpretation of the Stage 3 traces must be clarified before attempting a replicative (experimental) approach to the materials, and their proper statistical and contextual evaluation.

On the basis of the LPPNB traces, and without a designed replication study, we hesitate to decide about a certain tool that left the traces. Before discussing this, a remark needs to be made on the presence of Stage 3 and Stage 4 products: While Stage 4 is the central operation in the production process and probably the one most likely to fail, there are not many Stage 4 fragments (interior disk with fragment of outer ring still attached (Plate 1) attested, in contrast to the many Stage 4a-b to 6 waste products.[8] The seemingly low number of Stage 4 failure products possibly is due to the likely re-use of larger interior discs for another Stage 3 operation (Table 2) which would result in a ring with a smaller diameter (failure/ effort management *sensu* Gebel and Hermansen 1999: 20 and Endnote 2).

We accept the notion of a specialized sandstone ring production using a standardized design of succeeding operational acts (Gebel 2010). We see a strong probability that a chisel-like tool was used, operated with a sort of hammer, and that the working actions were executed on a semi-resistant support (*cf.* also Gebel and Bienert *et al.* 1997: 254). The continuous tracks show the smoothly proceeding movement of a tool with a constantly applied energy in the sandstone material, respectively testify a little mechanical resistivity of the raw material.

When it comes to the notion that burins or burin-like flint tools were used to execute the Stage 3 works (Gebel and Wilke, pers. comm.) it has to be stated that the Ba'ja flint assemblages hardly contain burins, which is also true for the contexts of the sandstone ring workshops (Gebel and Purschwitz, pers. comm.). If not a burin/ burin-like tool, any other "compact" hafted flint tool with a narrow and acute working edge is possible; the traces then could be described as the result of a "burinating" or carving action[9], an interpretation favoured here.

The major part of the used raw materials is the layered and coarse- to fine-grained reddish, clayish silty sandstone, with medium mechanical resistivity. We assume that the sandstone was soaked in water not only to increase its workability but also to test the raw material prior to selection for the solidity of its layers: Weak layers would separate when soaked, and chunks would be chosen which have the needed thickness.

"The Test"

After the archaeological description and discussion of the traces, we designed a small test to investigate the workability of the sandstone commonly selected for the stone rings production.[10] By intention, we did not rework the previous sections of this contribution after gaining basic insights from our test on the rings working

Fig. 3 Carving acting in the test, tool's motion and orientation. (photo: Michiels)

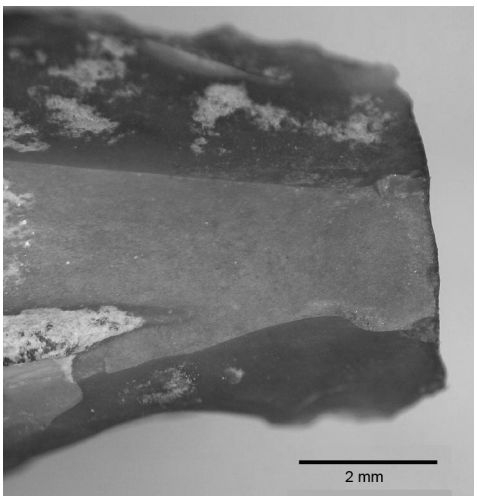

Fig. 4 Close-up of use traces on the tool resulting from all carving actions of the test. (photo: Purschwitz)

traces[11]. As explained in the Prologue, we explicitly want to document how a mere archaeological description and interpretation may ignore, misinterpret or overemphasize aspects if not controlled by a replicative approach. Thus, in this section we comment our archaeological results by the tests' insights, after presenting the tests' design and results.

The test aimed to reproduce the rings' Stage 3 manufacturing traces by using a hafted flint tool on the sandstone raw material commonly selected for the ring production: Chunks of SRMG 2/ Sample 1 sandstone were extracted from the bedrock in Siq al-Ba'ja were it is easily accessible. As a tool, Hans Gebel hafted the terminal part of a truncated blade which' width he laterally reduced by steep retouches while keeping its strongest part at the two central parallel ridges. The trapezoidal section of its tip had a thickness of 1,95-2,15 mm at its very end and a width of 5,50 mm at its ventral side; the width between the two dorsal ridges was 2,45 mm (Figs. 3-4).

As raw material, we soaked a large chunk of the Sample 1 sandstone (Umm Ishrin clayey-silty sandstone, respectively of the SRMG 2) for 30 minutes in water, before we executed 2 tracks by using the dorsal side of the tip entering the sandstone (ventral side of tip was upside: Fig. 3). In a first action, we produced a track of c. 20 mm by two succeeding continuous moves by hand-pressured carving in the same track (Track I, depth: c. 0,2-0,3 mm; Fig. 5); the following action was chiselling a track of c. 25 mm length (Track II, depth: 0,4-0,5 mm; Fig. 5) with a hard hammer in one continuous move.[12] The same actions were repeated after having soaked the sandstone in water for another 30 minutes (Track III: 20 mm in length, two continuous moves, hand-pressured carving, depth: c. 0,4-0,5 mm <Fig. 5>; Track IV: c. 25 mm in length, one continuous move, chiselling with hard hammer, depth: c. 0,6-0,8 mm <Fig. 5>[13]). Tracks 5 and 6 on Fig. 5 represent two subsequent single moves by hand pressure in raw material soaked for one hour. In all cases the same tool was used by its dorsal ridge; from all 8 moves it received the traces/ tracks documented in Fig. 5.

The test proved the following:

1) Carving and chiselling this sandstone variety in the way described is not difficult at all. A (hafted) flint tool with a narrow and truncated tip passes – unexpectedly – softly through the material when soaked.
2) Neither the traces/ tracks nor the action need a sophisticated explanation, or can be called enigmatic.
3) Most likely the differences or types of Traces A-C are archaeologically "overemphasized", and simply represent only different tip morphologies used with different standard motions in the material when hold in certain but changing ways. Traces A-C may result from the same or similar actions; the test proved that both chiselling and hand-pressured carving was used, and paved the way to the understanding that a replicative system analysis will allow to distinguish both traces. A stepped end of a track more indicates a hard-hammer technique, a fading out track more indicates hand pressure actions. Tiny steps are characteristic for a chiselled track but may slightly express also by hand pressed motion.
4) We see it evident that flint tools were used. The internal striations in the tracks direction result from the dorsal ridges of a flint tool.
5) We doubt that a special tool type was used for carving and chiselling at Stages 2-3, *e.g.* a dihedral burin. The work can be executed with any formal or non-formal hafted flint tool which has a strong tip with a squared section and a steep front.
6) While the tracks' widths on the archaeological material show some width standards with tools' tips, the broad track type apparently relates to an regularization/ evening out of the interior disk's surface (*cf.* above, *Traces A*: "representing a short action with a broader working edge"), and were created by much broader tips.

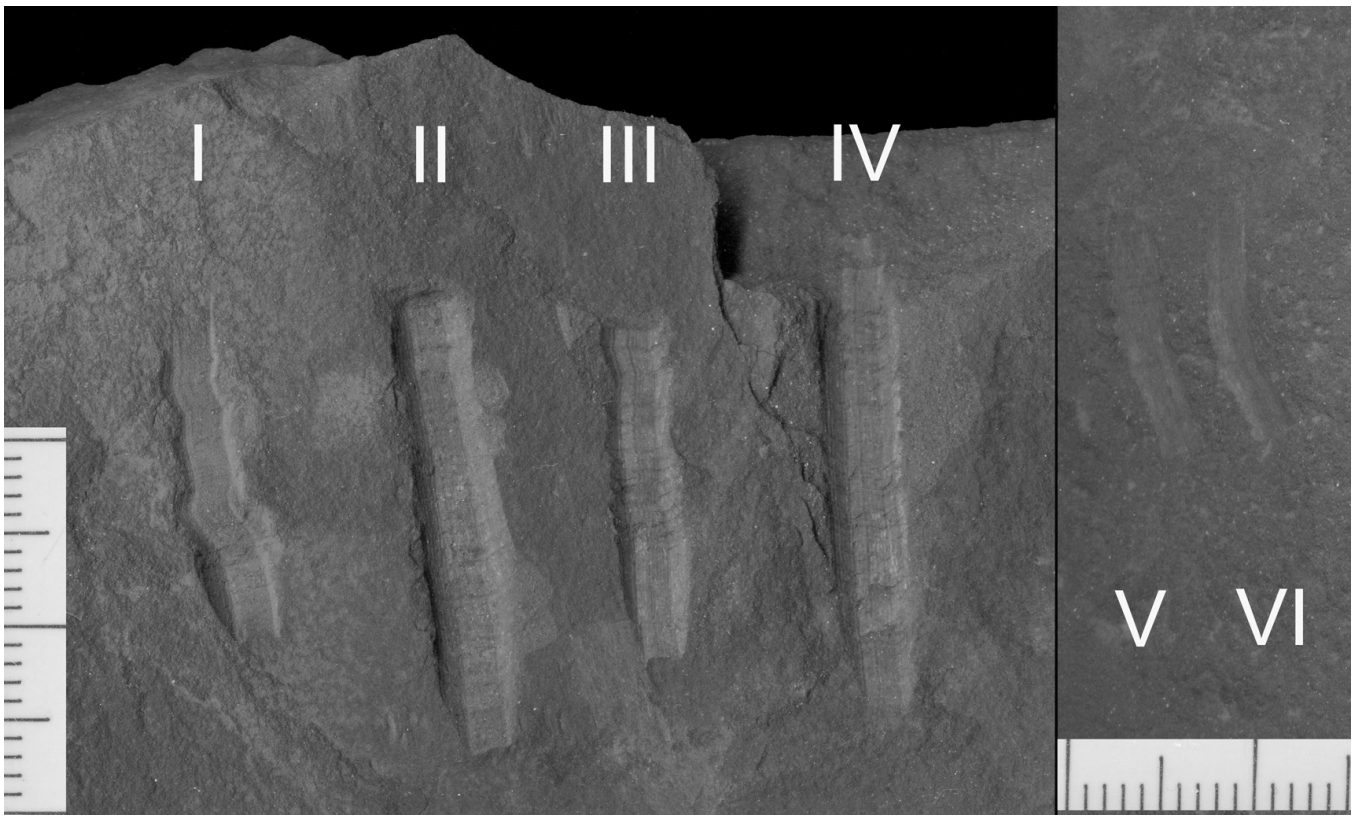

Fig. 5 Tracks I-VI of the test, representing the various carving actions on Umm Ishrin clayey-silty sandstone (SRMG 2) soaked for 30' and 60' in water. For the actions/ tracks *cf*. the text. (photo: Gebel)

Results and Further Stone Ring Research

Our traceological study on the Stage 3 manufacturing traces resulted in two perspectives which we wanted to present separately:

1) We provided an archaeological description of three classes of traces observed for the central Stage 3 of the *chaîne opératoire* of the sandstone ring production at LPPNB Ba'ja, based on a small qualitative sample: Trace classes A, B and C.

2) Because we described the traces as being the result of the tool application and specific executed actions, we decided to make a test. This broadened our understanding in two more ways: firstly, the workability of the SRMG 2 sandstone increases greatly when soaked with water. Secondly, all previously described traces are likely the result of one sort of a flint working tip which may have a slightly variable width and was set in a haft. The traces' variability and "ontology" which originally influenced the (archaeological) identification and description of three trace classes are probably nothing else than different combinations of handgrips, tool-blank angles, energy application, tool tips, and manufacturer's skills. These combinations resulted in just different expressions of what basically is one kind of trace. In other words: The traces rather are the result of a sequence of lively actions than a matter of archaeological classification. Thus, instead of classifying traces archaeological research should more respect the manufacturing biography of artefacts by reconstructing executed actions and related contexts by empirically designed replicative means.

By studying this specific part of the *chaîne opératoire* it became clear that detailed studies on failure management and the re-use of certain parts of the sandstone rings can increase our understanding of these culturally still enigmatic objects (Gebel 2010: commodity coupons?). This should be supported by a quantitative approach and contextual analysis. A replicative system analysis, for which we laid a basis with this contribution, became a must to gain insights in the full aspects of the Ba'ja sandstone ring production.

Acknowledgements: This study is a result of the 10th season of the Ba'ja Neolithic Project in Jordan. A part was done as an internship under guidance of H.G.K. Gebel by Tristan Michiels in Beidha, Jordan. The authors thank Phil Wilke and Leslie Quintero for sharing their ideas about the possible tools used for the sandstone ring production. Tristan Michiels and Amer Souliman thank Hans Georg K. Gebel for advice and focusing their ideas on the manufacturing of the sandstone rings. We also thank Christoph Purschwitz for valued comments, and the use of his computer. Sincere thanks also go to Khalid Moumani (Natural Resources Authority, Amman) for his advice and support of this study.

Endnotes

[1] Hintzman's idea that a reamer was used for the production of stone rings may well apply to rings made of marble, limestone and other raw materials, but definitely contradicts the traceology of the Ba'ja and Basta sandstone rings. We do not exclude the use of a reamer for grinding the ring's interior section, although the weight of the reamer may add a high breakage risk to the production process. Marble, limestone and other raw materials, but definitely contradicts the traceology of the Ba'ja and Basta sandstone rings.

[2] *e.g.*, that Stage 4b products, the interior disks, were recycled as Stage 2-3 products, raw rough discs: Some Stage 4b- pieces were big enough to be re-entered in the Stage 3 manufacturing process, showing the traces of their previous Stage 3.

[3] For the scans of the objects an Epson Perfection V100 was used on 1200 dpi. The microscope used was DNT DigiMicro Profi with 10x magnification.

[4] We reproduce here in English the Ba'ja sandstone raw material characterization by Andresen 2007:
SRMG 1: ferruginous sandstone of high mechanical resistivity
SRMG 2: clayey-silty sandstone of medium mechanical resistivity
SRMG 3: feldsparic (arcosic) sandstone of low mechanical resistivity
SRMG 4: white-ish brittle types of sandstones with little mechanical resistivity
SRMG 1-3: schisty-tabular qualities of the reddish Cambrian sandstone (IN, Umm Ishrin sandstones): reddish-yellow-violet (different contents iron oxides), high share of binders (carbonates, clay, iron oxides), clefts may occur, fractures steep-sided
SRMG 4: Ordovician sandstone, resting geologically above Cambrian sandstone (DI, Disi sandstones): whitish, with fossils, low share of binder material, brittle, fractures/ weathers roundish
An earlier classification of the sandstone raw materials was published by J.M. Starck (Starck 1988: 138).
Here, it should be noted that another mineral raw material was used for stone rings in Basta, described as „plaster-like" in earlier preliminary reports. Actually this raw material is a bitumen-rich carbonatic marl (Affonso and Pernicka 2004:158-165; Gebel, n.d.), possibly requiring a different manufacturing method. No production waste was found for these in Basta.

[5] Disk Stage 2 is represented by 4 items, Stage 3 objects by 12, raw ring Stage 4a by 6, and interior disk Stage 4b is represented by 6 items.

[6] In addition to the traces of the manufacturing process, traces resulting from using the finished object can be present. Thirdly, we can observe traces resulting from post-depositional processes and erosion. The study of the use-wear traces might deliver interesting results for the (finished) sandstone rings. We observed wear/gloss from using it as a pendant or a kind of „pocket gloss".

[7] The evening out of the (interior) raw disk's surfaces can occur with both Stages 2 and 3, a subject not explicitly addressed in Gebel and Bienert *et al.* 1997: 254-256.

[8] For quantitative aspects *cf.* Table 4 and Fig. 15 in Gebel and Bienert *et al.*1997, and information in the contextual study of Purschwitz and Kinzel 2007.

[9] The use of a tool made from antler or teeth was meanwhile dismissed by H.G.K. Gebel (pers. comm.), originally thinking that the parallel striations in the tracks could result from the lamellar structure of teeth. But teeth material would have quickly got worn ...

[10] Also Phil Wilke encouraged us to do so: „You have to try it to take it from the realm of speculation to that of science", and „... more likely, I would think, would be a chisel made in the fashion of a dihedral burin, perhaps a heavy-duty one made on something like a blade core platform spall. ... Or maybe these could be made on crested blades, or any thick blade, especially a large percussion blade." (in emails by 19/9/2012)

[11] This test was only a trail run to examine how a water-soaked sandstone would behave when chiselled and/ or carved by a hafted flint tool with a narrow working edge. This definitely does not represent a designed experimental or replicative approach albeit the test followed a fixed agenda.

[12] Comment on the carving/ chiselling issue by Phil Wilke, after reading the draft of this contribution: "I think the small steps you see in the experimental grooves, and the ones in the failed specimens at Ba'ja, result from the tool crossing minute layers of alternating hard, and then soft, material. ... The layering reminds me of carving across the grain of some woods on an angle, where the tool briefly follows a hard growth ring, and then cuts through it and drops suddenly through a softer ring, to again follow a hard one, and so on."

[13] Track IV caused the flaking of the chunks edge, a damage which is avoided in the archaeological material by obliquely set tracks to edges.

Tristan Michiels
Leuven University,
Department of Archaeology
tristan.michiels@gmail.com

Amer Salah Abdo al-Souliman
Hashemiye University
Queen Rania Institute, Zarqa
amer_asuliman@hotmail.com

Hans Georg K. Gebel
Free University of Berlin
Institute of Near Eastern Archaeology
hggebel@zedat.fu-berlin.de

References

Andresen M.
2007 *Abiotische Rohstoffe in der frühneolithischen Siedlung Ba'ja (Jordanien)*. Heidelberg University: unpublished M.A. thesis.

Barjous M.O.
1995 *Supplement Text to the Geological Map of Petra and Wadi Al-Lahyana (Sheet: 3050I/3050IV, 1:50000).* Amman, Natural Resources Authority.

Bender F.
1974 *Geology of Jordan*. Contributions to the Regional Geology of the Earth. Supplementary Edition 7. Berlin/ Stuttgart, Gebrüder Borntraeger.

Crepaldi Affonso M.T. and Pernicka E.
2004 Mineralogical Analysis of Late PPNB Rings. In: H.J. Nissen, M. Muheisen and H.G.K. Gebel (eds.), *Basta I. The Human Ecology*: 155-167. Berlin: ex oriente.

Gebel H.G.K.
2010 Commodification and the Formation of Early Neolithic Social Identity. The Issues Seen From the Southern Jordanian Highlands. In M. Benz (ed.), *The Principle of Sharing. Segregation and Construction of Social Identities at the Transition from Foraging to Farming.* Studies in Early Near Eastern Production, Subsistence, and Environment 14: 31-80. Berlin, ex oriente.
n.d. The Stone Rings. In: B. Dahl Hermansen, H.G.K. Gebel, and D.S. Reese, *Basta IV.1. The Small Finds and Ornament Industries*. bibliotheca neolithica Asiae meridionalis et occidentalis and Yarmouk University, Monograph of the Faculty of Archaeology and Anthropology. Unpublished Ms.

Gebel H.G.K. and Hermansen B. Dahl
1999 Ba'ja Neolithic Project 1999: Short Report on Architectural Findings. *Neo-Lithics* 3/99: 18-21.
2000 The 2000 Season at Late PPN Ba'ja. *Neo-Lithics* 2-3/00: 20-22.

Gebel H.G.K. and Bienert H.D. with contributions of Krämer T., Neef R., Müller-Neuhof B., Timm J. and Wright K.I.
1997 Ba'ja hidden in the Petra Mountains. Preliminary results of the 1997 investigations. In: H.G.K. Gebel, Z. Kafafi and G.O. Rollefson (eds.), *The Prehistory of Jordan,* II. *Perspectives from 1997.* Studies in Early Near Eastern Production, Subsistence, and Environment 4: 221-262. Berlin: ex oriente.

Heinrichs K.
2008 Diagnosis of Weathering Damage on Rock-cut Monuments in Petra, Jordan. *Environmental Geology* 56: 643–675.

Hintzmann M.W.
2011 Stone Ring Production in the Neolithic of the Near East, and Anologies From the American West. In: E. Healey, S. Champbell, and Osamu Maeda (eds.), *The State of Stone. Terminologies, Continuities and Contexts in Near Eastern Lithics.* Studies in Early Near Eastern Production, Subsistence, and Environment 13: 125-134. Berlin: ex oriente.

Purschwitz C. and Kinzel M.
2007 Ba'ja 2007. Two Room and Ground Floor Fills: Reconstructed House-life Scenarios. *Neo-Lithics* 2/07: 22-35.

Starck J.M.
1988 Comparative Analysis of Stone Ring Artefacts From Ba'ja and Basta. In A. Garrard and H. G. K. Gebel (eds.), *The Prehistory of Jordan. The State of Research in 1986*. British Archaeolgical Reports – Intern. Series 396: 137–174. Oxford, B.A.R.

Wadi Hammeh 27: an Early Natufian settlement at Pella in Jordan, by Phillip C. Edwards (ed.)

Culture and History of the Ancient Near East, Volume 59. Brill, Leiden.
ISSN: 1566-2055; ISBN13: 9789004236097; hardback, Pages: xxvi, 410 pp.

http://www.brill.com/wadi-hammeh-27-early-natufian-settlement-pella-jordan

Wadi Hammeh 27, an Early Natufian Settlement at Pella in Jordan is a detailed report on one of the most important Natufian sites to have emerged in the past thirty years and an integrated analysis and interpretation of subsistence strategies, settlement patterns and ritual life in one of the world's earliest village communities. The 14,000-year-old settlement of Wadi Hammeh 27 is one of the most spectacular sites of its kind, featuring one of the largest, most complex pre-Neolithic buildings yet discovered in the Middle East, an unparalleled series of artefact caches and activity areas, and a rich corpus of late Ice Age art pieces.

Contents

Submissions NEO-LITHICS, Dörte Rokitta-Krumnow/Dr. Hans Georg K. Gebel,
ex oriente, c/o Free University of Berlin, Hüttenweg 7, 14195 Berlin, Germany,
Emails: d.rokitta-krumnow@gmx.de · hggebel@zedat.fu-berlin.de, Fax 0049 30 98 311 246.
NEO-LITHICS, Prof. Dr. Gary O. Rollefson, Department of Anthropology,
Whitman College, Walla Walla, WA 99362, USA, Email: rollefgo@whitman.edu.

Orders (New Subscriptions, Payment of Subscription Renewal, Back Issues)
New subscriptions: via https://www.exoriente.org/bookshop/
Payment of Subscription Renewal: via https://www.exoriente.org/bookshop/ (please, mention the invoice number under Message to ex oriente Bookshop from Customer in the shopping basket) or send credit card details (card type -Visa or Master-, cardholder name, credit card number, expiry date, CVV number) to ex oriente Fax 0049 30 98311246 or by letter to ex oriente, c/o Institute for Near Eastern Archaeology, Hüttenweg 7, 14195 Berlin, Germany.
Back Issues before 2008: can be downloaded from www.exoriente.org/downloads/neolithics.php

Subscription
Minimum of three years subscription requested = 6 issues, c. 40-50 pages each, 66 Euro for 6 issues/ minimum subscription period (postage included); back issues available; members of ex oriente receive Neo-Lithics free of charge (included in the annual membership fee: 40 Euro for employed members, 15 Euro for students/ unemployed members).

Deadlines twice a year: 15th of May and 15th of November

Submission Guidelines
Text formats: in Word without formatting; for the general style of text, bibliography, and captions consult this or a recent issue of Neo-Lithics - Illustration formats: individual EPS, TIFF- files or JPEG in high resolutions; illustrations should not be embedded in the Word file. Please, sent a hard copy of the manuscript in case of complex contributions; keep bibliographic references to the utmost minimum. Authors are obliged to present with their submissions formal letters of agreement by copyright owners if they use illustrations, texts, materials, or ideas from oral presentations obtained from sources not their own. Captions of photo and graphic illustrations must mention the author(s) of the photo or graph, even if rights for these are in the hands of the institution providing these materials for publication.
ex oriente respects UN resolutions as well as the project permits of antiquities departments and or the ethics of funding institutions. ex oriente does not publish data obtained in occupied territories or assists the publication of field data not covered by a permit.

Subscription Information
In the upper right part of the address field (envelope) you will find the issue mentioned until which (included) you paid your subscription. If you find an invoice with this issue, a renewal of subscription is necessary for the next three years / 6 issues. If an invoice is not paid after two months it is understood that a prolongation of the subscription is not desired, and no further issues will be send.

Copyright Note

Neo-Lithics is published and distributed by ex oriente, Berlin.
Printing House: dbusiness, Berlin - © ex oriente e.V., Berlin - ISSN 1434-6990