Central Zagros Archaeological Project

Excavations at Bestansur, Sulaimaniyah Province, Kurdistan Regional Government, Republic of Iraq

17th March – 24th April 2012

Archive Report

The mound of Bestansur, from the southwest.

Preface

A first season of excavations at the site of Bestansur took place in spring 2012 as part of the Central Zagros Archaeological Project, co-directed by Roger Matthews, Kamal Rasheed Raheem and Wendy Matthews. The project operates under a Memorandum of Understanding issued by the Sulaimaniyah and Erbil Directorates of Antiquities and Heritage, with agreement from the State Board of Antiquities and Heritage, Baghdad, and is funded by a grant from the UK Arts and Humanities Research Council with the project title 'Sedentism and Resource Management in the Neolithic of the Central Zagros'.

We are extremely grateful to all our colleagues at Sulaimaniyah Directorate of Antiquities and Heritage, in particular its Director Kamal Rasheed Raheem, who made the project possible and provided vital support at every stage, as well as all the support staff and drivers. We also thank our colleagues at Erbil Directorate of Antiquities and Heritage, in particular its Director, Abubakir O. Zainadin (Mala Awat), for their ongoing support. We are very appreciative also of the considerable assistance provided by the staff of Sulaimaniyah Museum, led by its Director, Hashim Hama. Our two government representatives, Sabr Ahmed and Kamal Aziz gave support and advice in a great many ways as well as serving as key team members. We also thank the villagers of Bestansur who worked with us on site and looked after us in the Expedition House. We thank Ahmed Rasheed Raheem for expertly producing a contour plan of the mound (Fig. 2.1).

The spring 2012 team comprised:

Roger Matthews	University of Reading	Project Co-Director, lithics, excavation
Wendy Matthews	University of Reading	Co-Director, micromorphology, excavation
Kamal Rasheed Raheem	Sulaimaniyah Antiquities	Co-Director
Sabr Ahmed	Sulaimaniyah Antiquities	Representative, excavation, ceramics
Kamal Aziz	Sulaimaniyah Antiquities	Representative, excavation, ceramics
Hero	Sulaimaniyah Antiquities	Excavation
Zuhair Rijib	University of Baghdad	Ceramics
Robin Bendrey	University of Reading	Archaeozoology, excavation
Amy Richardson	University of Reading	Finds, data-base, excavation, pXRF analyses
Sarah Elliott	University of Reading	Micromorphology, excavation, pXRF
Jade Whitlam	University of Reading	Archaeobotany
Chris Beckman	University of Reading	Photography, excavation
Ingrid Iversen	University of Reading	Micro-archaeology, excavation
Nick Harper	University of Reading	Excavation, molluscs
David Mudd	University of Reading	Ground-stone, excavation
Mike Charles	University of Sheffield	Archaeobotany
Gemma Martin	University of Sheffield	Botany
Lisa Cooper	University of British Columbia	Ceramics, excavation

The following report is a preliminary, provisional account of the results from the spring 2012 season, produced for distribution to the Sulaimaniyah, Erbil and Baghdad Directorates of Antiquities and Heritage, and is not intended for publication.

Contents

Chapter One: Research Issues, Strategy, Methods

Roger Matthews, Wendy Matthews, Kamal Rasheed Raheem

Sedentism and resource management in the Neolithic of the Central Zagros

One of the most significant transformations in history took place after the last Ice Age, from *ca*. 14,000 BC (all dates calibrated BC), when human communities began to settle down in villages and to exploit intensively the resources around them, including plants and animals (Zeder 2009). In time people changed from being mobile hunter-foragers to settled farmers and stock-keepers, with domesticated crops and animals. Often called the Neolithic transformation, this fundamental development in the human condition steadily spread across much of the world and led ultimately, through surplus accumulation and social differentiation, to the emergence of towns, cities, and empires, thus shaping the modern world.

One region where these developments occurred early is Southwest Asia. In recent decades there has been much work on Neolithic developments in this region through excavations in Turkey, northern plains of Iraq, Syria, Jordan, and the Levant, which have demonstrated the great variability in local trajectories of development from hunter-forager to village-farmer. One area that has not been investigated since the 1970s is the Zagros Mountain region and hilly flanks of western Iran and eastern Iraq. Earlier work in this region was of key importance in exploring the Neolithic transformation, with excavations at sites such as Jarmo, Asiab, Sarab, Ali Kosh, and Ganj Dareh in the 1950s-70s (Braidwood and Howe 1960; Smith 1976). These researches indicated that Neolithic communities changed to sedentary lifestyles and began using fired ceramics, the earliest in Southwest Asia, by *ca*. 7900 BC. Study of the plant and animal remains suggested that communities favoured use of lentils, peas, and nuts over cereals and that wild goat were intensively hunted. There was arguable evidence for domestication of goat by *ca*. 7900 BC.

Since 1979 there has been almost no fieldwork concerning the Neolithic of this area and the evidence is now decades out of date compared to the rest of Southwest Asia and beyond. The Central Zagros Archaeological Project (CZAP) is a collaborative programme, focusing on the Neolithic period, run by the University of Reading and Sulaimaniyah Antiquities Directorate, Iraq. The objectives are to investigate research questions within the Early Neolithic of the central Zagros. How did early sedentism take place and did it develop from temporary and seasonal to permanent and year-round? How was architecture constructed and how was early village space used and socialised? What was the role of ritual and human burial in social cohesion at this time? What modes of animal husbandry were employed, including intensive hunting, herding, and domestication of goats, native in the wild to the Zagros? What plant resources were exploited and how? What is the absolute chronology of development in the Zagros Neolithic? These questions will be addressed through excavation at the sites of Bestansur and Shimshara.

Results from this research will be of value in situating the Central Zagros within the Neolithic transformation in Southwest Asia, and will serve as a model for the application of inter-disciplinary approaches to archaeological questions. The research will assist in placing our own species within a rich context of ecological and social change that characterised the Neolithic transformation following the end of the last Ice Age, one of the most impactful episodes in human history.

Aims, objectives, issues

The aims and objectives of the project are:

1. To investigate issues in the transition from hunter-forager to villager-farmer in the central Zagros region by the application of a full range of modern scientific and humanities-based approaches to Early Neolithic societies of the eastern Fertile Crescent.

2. To address the imbalance in our knowledge and understanding of the Neolithic transition in Southwest Asia through fieldwork and research in the eastern Fertile Crescent, and through widespread dissemination of results and interpretations within academe and beyond.

3. In collaboration with colleagues, to produce high-quality outputs that maximise the outreach and impact of the project's achievements.

The project research questions are:

1. Sedentism, society and ritual
Did early settlements develop from seasonal and temporary to year-round and permanent?
How were these early settlements constructed and socialised?
How significant was ritual in social transformations in the Zagros Neolithic?

2. Resource management
What were Early Neolithic economic practices and do they suggest a 'broad spectrum revolution'?
How best do we investigate hunting, management, and domestication of wild goat?

3. Chronology of change
What is the chronology of change in the Zagros Neolithic? How does high-resolution evidence develop our understanding of sedentism and resource management in Southwest Asia?

Methods

The main approach is three seasons of excavation at the Neolithic sites of Bestansur and Shimshara, to investigate socio-economic and cultural strategies through the Early Neolithic. Recording and processing are managed through the web-based Integrated Archaeological Data-Base (IADB). Excavation is being conducted, employing trenches for diachronic investigation and open-area trenches to examine buildings, external areas, middens and streets/corridors. Excavated deposits are quantified, sieved, floated, sampled, and processed for recovery of lithics, ground-stone, clay tokens, figurines, faunal and botanical remains (macro and micro), phytoliths, molluscs, and architectural materials.

Additionally, intensive field survey will be conducted during 2013 in the vicinity of Zarzi cave, in the Iraqi Central Zagros, in order to investigate the Neolithic settlement of this fertile region.

Chapter Two: Excavations in Trenches 1-10

Roger Matthews, Wendy Matthews, Sabr Ahmed, Kamal Aziz, Hero, Sarah Elliott, Robin Bendrey, Amy Richardson, Nick Harper, Lisa Cooper and Chris Beckman

Introduction

Roger Matthews and Wendy Matthews

Surface walking and artefact collection of the mound at Bestansur and the fields surrounding the mound in September 2011 and January 2012 suggested that intact Neolithic levels could be excavated in the fields on the west, south and east sides of the main mound, in particular, on the basis of finds of significant quantities of chert and obsidian stone tools and debitage. Surface collection on the mound itself indicated later periods of occupation overlying any Neolithic evidence, attested by ceramic sherds (Chapter Thirteen). On the basis of the surface finds and the mound's topography we decided to position and excavate 10 small trenches, each 2 x 2m in area, located on the lower slopes of the mound and in the surrounding fields (Fig. 2.1).

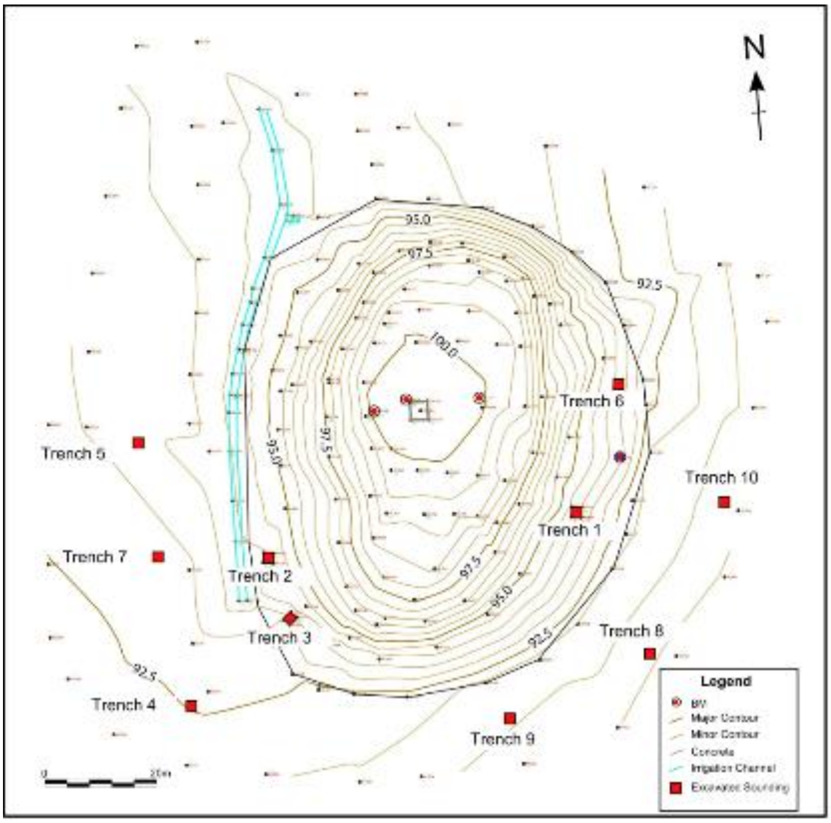


Figure 2.1. Contour plan of Bestansur mound, showing location of Trenches 1-10.

As excavation proceeded it became clear that intact Neolithic deposits do survive below the modern plough soil at almost all locations and they are accessible for further excavation. Considering the overall picture from all 10 trenches, intact Neolithic deposits are preserved across an excavated area of more than 50m north-south and 100m east-west, in fields either side of the archaeological mound. If contiguous and contemporary, this spread of occupation indicates a Neolithic site of at least 0.5 hectares, but the precise limits of the surface lithic spread have yet to be defined and it is likely that the Neolithic site is significantly larger than 1.0 hectare. The modern surface in the fields slopes gently down from northwest to southeast. Neolithic levels are currently preserved at *ca.* 30-50cm below the modern topsoil and an erosion horizon. They were encountered at *ca*. 93-92m above site datum in the west (Fig. 2.2; Trenches 4, 5, 7) and at *ca.* 91.2-90.7m in the east (Fig. 2.3; Trenches 8, 9, 10).

Figure 2.2. View from mound's summit facing west-southwest, with Trenches 4, 2, 7 and 5 from left to right.

Figure 2.3. View from mound's summit facing southeast, with Trenches 10, 1 and 8 from left to right.

Probable Neolithic deposits were also revealed in the base of the mound itself, in Trenches 1 and 2, in the form of deposits with Neolithic lithics and without later pottery. These basal levels without pottery, moreover, are similar in absolute height to intact Neolithic levels in the adjacent fields, further suggesting that they are Neolithic in date, at *ca*. 93m above site datum in the west in Trench 2, and at 92.13-92.05m above site datum in the east in Trench 1. This similarity in absolute levels suggests the Neolithic site at Bestansur may have been relatively flat with a gentle northwest-southeast slope. This apparent flatness may be due to erosion and activities at the site since the Neolithic, including possible levelling for construction in later periods and modern ploughing. There could be a small Neolithic raised mound in the *ca*. 52m distance between Trenches 1 and 2, below the top of the current mound, which sits 7-10m above Neolithic Levels. Much of this raised mound, however, is likely to be Neo-Assyrian and later in date, as there is abundant pottery from these periods at the site (Chapter Thirteen), and intact post-Neolithic levels with preserved architecture were encountered in the base of the mound at *ca.* 93m above site datum, in Trenches 1, 3 and 6. Further excavations on the mound will continue to investigate the nature and date of occupation levels on the mound.

Methods of investigation

Roger Matthews and Wendy Matthews

A consistent methodology was applied in the excavation of all 10 trenches. Excavations began by removal of topsoil and upper eroded and wash deposits by large pick and shovels. Intact Neolithic deposits were encountered at depths of *ca*. 30-50cm below the modern field and mound surfaces and excavation of these deposits proceeded with small pick and trowel with occasional use of large tools. We employed standard CZAP sampling procedures, collecting 250g archive samples and 50l whole-earth flotation samples from every context, where the deposits provided sufficient material. Additional samples were taken as required for a range of specialist purposes. Dry-sieving with 4mm mesh was conducted on deposits once samples had been collected, except in cases where the heavy clay content of deposits made dry-sieving unfeasible. In these cases a sample of the deposit was processed through dry-sieving and the remainder was shovelled into wheel-barrows and checked by hand before disposal on the spoil-heap, with a tally of buckets and barrows being maintained for each context. The local workmen proved highly adept at hand recovery of the smallest fragments of cultural material from broken soil on the ground and in the wheel-barrow. Construction of tripod-mounted 4mm sieves towards the end of the season will allow for greater sieving capability in the future. All excavation and sampling activities were recorded on a range of forms for entry into the Integrated Archaeological Data-Base. At the end of the season all trenches were lined with organic sacking and back-filled with the original excavated material.

Excavations in Trench 1

Sarah Elliott and Robin Bendrey

Introduction

Trench 1 is located on the lower slopes of the eastern side of the mound, approximately 10m from the field-edge (Fig. 2.1). It is one of two trenches positioned on this side of the mound aimed at exploring the depth and nature of the lower sequences of the mound (Fig. 2.4). The uppermost layers in the centre of the mound were of a later date, attested by surface finds collected during field walking, and so the lower slopes were targeted for excavation in order to access the lowest levels in the time available.

Figure 2.4. View from the north showing location of Trench 1 in relation to lower slope of the mound and field-edge.

Sequence of structures, deposits and features

The following account describes Trench 1 deposits from the earliest stratigraphic levels upwards. The matrix of these deposits showing their relationship to each other is laid out in Fig. 2.5.

Probable Aceramic Neolithic contexts

The earliest feature identified in the lowest excavated levels of Trench 1 was a mud/pisé wall (C1099) running in a northwest-southeast alignment. This wall was identified by the presence of a linear reddish-orange deposit (*ca*. 50cm long) interpreted as the internal plaster face of the wall (Fig. 2.6).

The earliest deposits excavated consisted of a series of fills (C1107, C1105, C1103, C1102 and C1100) contained by the mud/pisé wall (to the northeast), and a series of arbitrary spits (C1106, C1104 and C1101) to the southwest of the wall (Fig. 2.7).

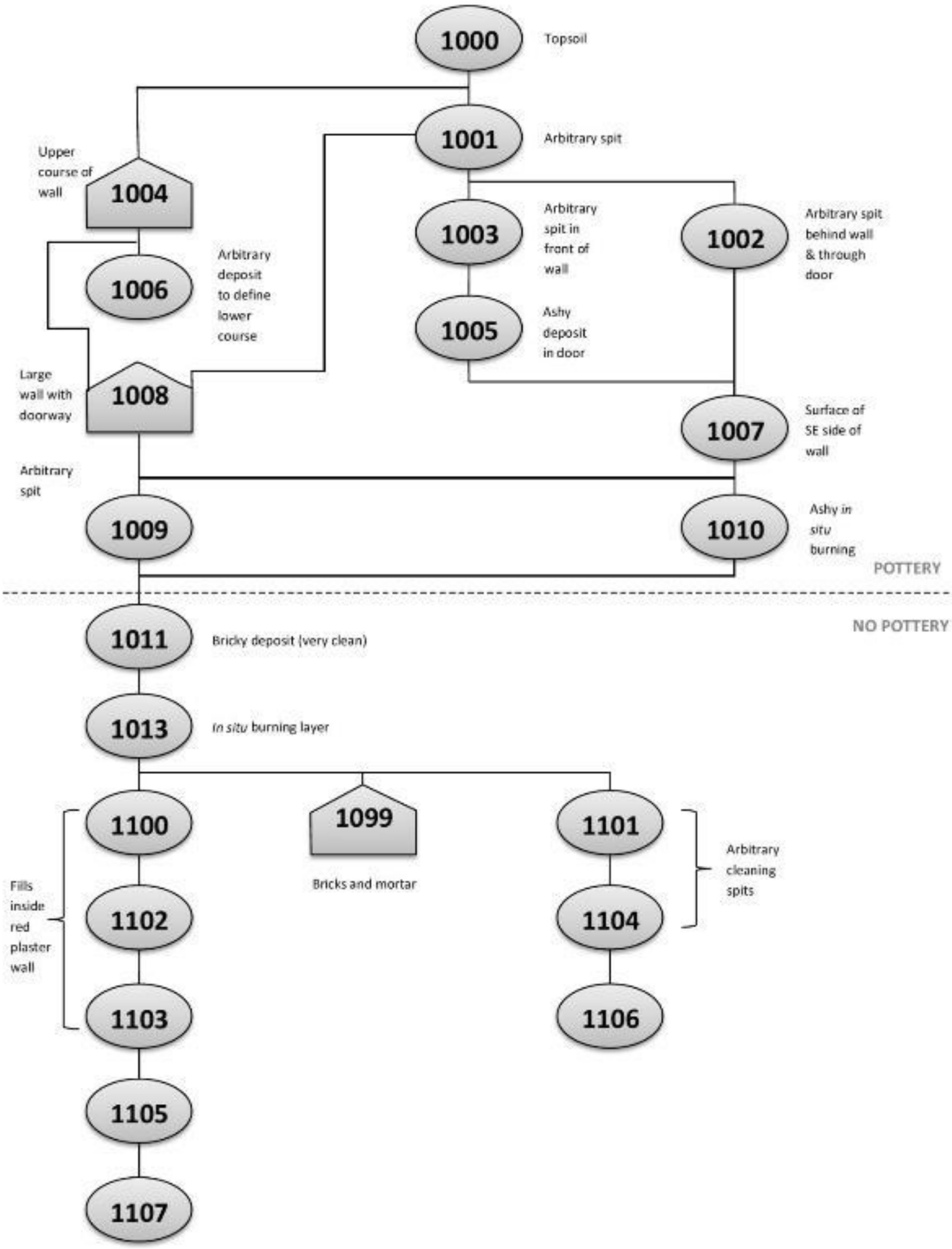


Figure 2.5. Matrix of contexts in Trench 1.

Figure 2.6. Left: linear reddish-orange plastered face as revealed during excavation. Right: reddish-orange plastered face during excavation (*ca*. 10cm revealed), looking southwest.

Figure 2.7. Trench 1, looking north, after excavation of fills to the northeast of the mud/pisé wall and arbitrary spits to the southwest.

During excavation of the fills to the northeast of C1099, we identified a possible return of the wall (running southwest-northeast) at a right-angle to the reddish orange plaster surface of wall C1099. This return exhibited some red patches of possible plaster material, although it was less clear than the northwest-southeast alignment. The earliest excavated deposit inside this wall was a *ca*. 50 x 50cm arbitrary square removed in the south corner (C1107), at the possible return of the wall, with the aim of determining the relationship between the fills and the wall. Unfortunately, due to time restraints, this relationship was never fully determined. The red plaster face appeared to finish, but the relationship with the underlying fills was not fully determined. This issue may be answered by analysis of a micromorphology block (S452) taken through wall C1099 (Chapter Three)

Stratigraphically above C1107, northeast of wall C1099, lay contexts C1105, C1103, C1102 and C1100. The lowest three (C1105, C1103 and C1102) were a series of fills containing flat stones (Fig. 2.8). Superimposing plans 7, 8 and 10, it appears that these three contexts could have originally been one stone feature. In this interpretation, the flat stones appear to have constituted a single contiguous surface covering an area of *ca*. 59 x 54cm. The uppermost fill, C1100, was excavated down onto C1102 and the lower limits were defined by the first stone layer.

Figure 2.8. Trench 1, looking north: flat stones in deposit C1102.

The area southwest of wall C1099 contained no distinct features or deposits, therefore arbitrary spits were excavated with the aim of revealing further features in this area. C1106 was the lowest stratigraphic arbitrary spit, followed by C1104, then by C1101. Stratigraphically overlying wall C1099 and fill C1100 was an area of possible *in-situ* burning represented by a concentration of charred material (C1013). To determine the extent of this deposit it was half-sectioned, then completely removed for flotation. The precise extent of the burning was uncertain, as some charred flecks appeared to be dispersed across the area of Trench 1.

The subsequent deposit, above C1013, consisted of an anthropogenically clean bricky-like deposit *ca.* 20cm thick (C1011). Due to the lack of finds from this context it was considered a potential natural sediment during excavation. Half of the deposit was removed, revealing C1013. On the confirmation that it was not natural material, the rest of C1011 was removed.

All the contexts described above were devoid of pottery and are considered to be of probable Aceramic Neolithic date. The chipped stone from these contexts is typical of the broader assemblage from the other probable Aceramic Neolithic deposits across the site (Chapter Nine).

Later contexts with ceramics

Above the bricky layer (C1011), a small ashy deposit (C1010) was identified in the southeast corner of Trench 1. There were no identifiable features across the rest of the trench at this level, which was removed as a single arbitrary spit (C1009). The subsequent feature above C1009 and C1010 consisted of a stone wall (C1008) running *ca*. 2.39m from the southwest corner of the trench to the northeast (Fig. 2.9). It was *ca*. 0.96m in height and *ca*. 0.84m in width. The wall breaks, for a distance of *ca*. 0.58m, approximately half-way along its length in what is interpreted as an entrance/doorway.

Figure 2.9. Trench 1, looking north: stone wall (C1008).

The areas to either side of the wall were excavated as separate units: with C1002 to the northwest and C1007, C1005 and C1003 southeast. The earliest deposit to the southeast of the wall (C1007) covered the extent of the trench. Stratigraphically above C1007 was a defined ashy deposit dumped in the entrance of the wall spreading towards the southeast. Above this C1003 was removed, again covering the extent of the trench to the southeast of the wall. The northwest part was numbered and sampled separately as C1002.

Above wall C1008, at its northern extent, an arbitrary deposit, C1006, was removed to define the extent of wall C1008. Stratigraphically above C1006 lay an upper course of the wall, C1004. Finally, two arbitrary spits of topsoil were removed (C1001 and C1000). C1001 was removed around C1004 to establish whether the stones were part of a feature. C1000 was the uppermost deposit (turf and topsoil), the lower limit of which was defined by the top of wall (C1004).

Trench extensions

For safety and access reasons, once a depth of 1.2m had been reached in Trench 1, the four sides of the trench were stepped (i.e. to the north, south, east and west) (Fig. 2.10). Each step consisted of an area of 2 x 2m taken down *ca*. 1-1.5m depending on the slope of the mound. The deposits in these extensions were not numbered and recorded in the same detail. All finds from each extension were bagged up with one context number:

northern extension finds – C1015
eastern extension finds – C1017
southern extension finds – C1016
western extension finds – C1018

Figure 2.10. Trench 1, looking west, showing north, south, east and west extensions, with wall C1012 visible in the northern extension (right).

The continuation of wall C1008 was identified in the northern extension. While it was not excavated or recorded it was allocated a context number (C1012) due to the discovery of a small find (SF9) which was stratigraphically below the wall. This find was protruding from beneath the wall. As the find was a bronze scabbard tip (Fig. 2.11), it was deemed better to remove this find for conservation and dating than to leave it *in situ*.

Figure 2.11. Bronze scabbard tip (SF9) from below wall C1012 in northern extension of Trench 1.

Trench 1 discussion and interpretation

The excavated levels in Trench 1 can be divided into at least two main periods of activity. Of most interest, for the project aims, are the levels below C1010 (Fig. 2.5). The finds in these deposits, based on the lithic assemblage and the absence of pottery, suggest an Aceramic Neolithic date. Particularly important is the architectural evidence in the form of the mud/pisé wall and red plaster facing (Figs 2.6-2.7). Although only limited in extent, the evidence identified helps to establish the extent and type of activities across the site as a whole, and hints at variations in architecture when compared to that recovered from Trenches 7 and 8 (Chapter Three).

The bulk of the mound is of much later date, as attested by the ceramics (Chapter Thirteen). Within Trench 1, pottery and other later finds were recorded from contexts 1010 and above suggesting that all these deposits date to the Iron Age and later.

Excavations in Trench 2

Nick Harper

Introduction

Trench 2 is located on the southwest side of the mound at Bestansur, above the field where Trenches 4, 5 and 7 were excavated in the field west of the mound, and close to Trench 3 (Figs 2.1-2.2, 2.12). The 2 x 2m trench was situated here in order to explore the depth of the Neolithic underlying more recent levels. Most of the excavated deposits in Trench 2 were much later and we excavated to a depth of *ca*. 2m before we arriving at probable Neolithic deposits. The artefacts found in the trench were well preserved and the range of items discovered indicates human activity in this part of the site over a long period of time.

Figure 2.12. Opening of Trench 2 (left), with Trench 3 on the right, looking southeast.

The size of the trench at the start was 2 x 2m but by C1034, around 1.24m deep, we narrowed the trench to 1 x 2m. For the final few contexts we narrowed the trench again to 1 x 1m. Probable Neolithic layers appeared at a depth of 1.88m (C1037) (Figs 2.13-2.15).

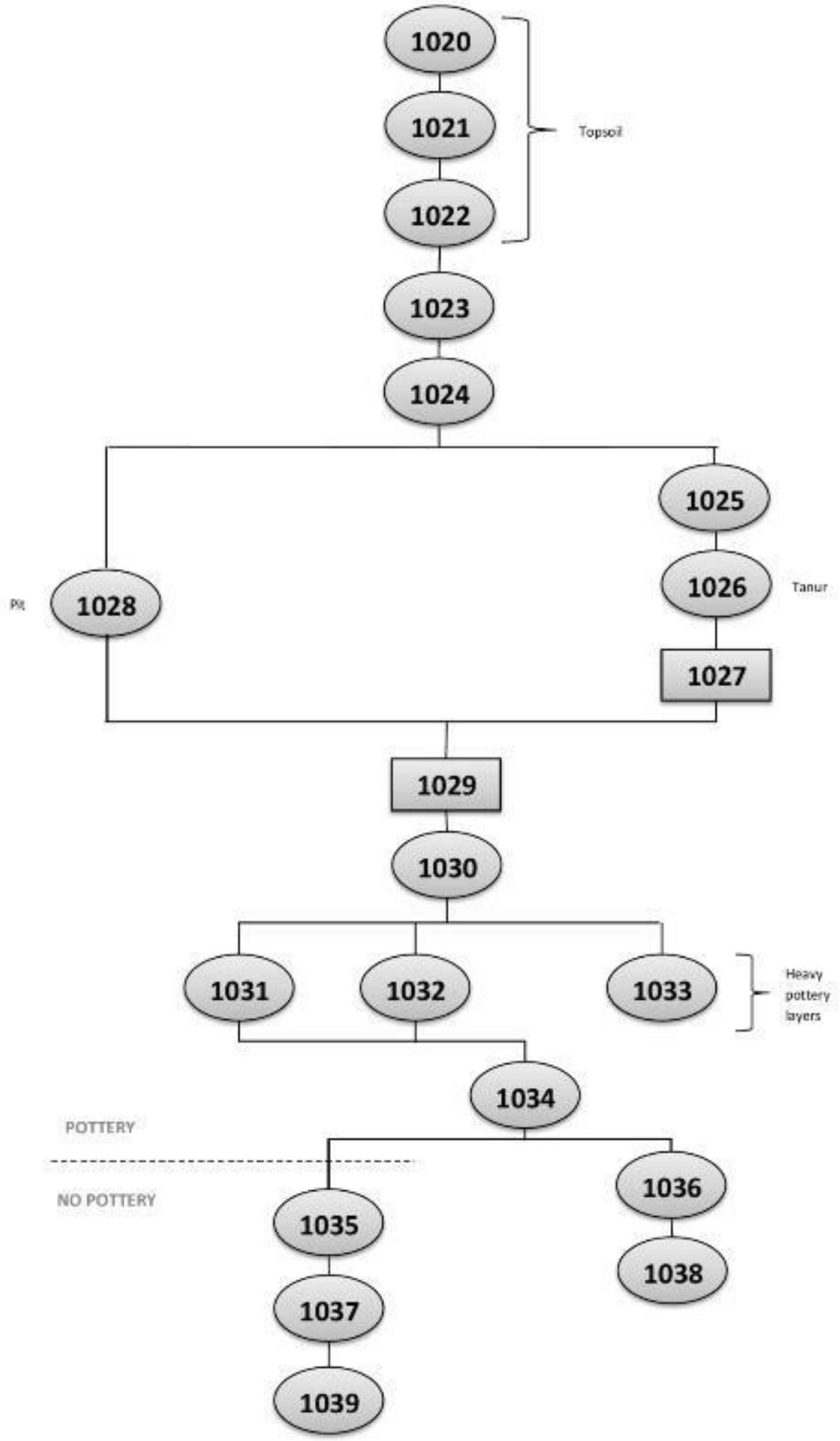


Figure 2.13. Matrix of contexts in Trench 2.

Figure 2.14. Trench 2, looking south, to show depth of excavation.

Sequence of structures, deposits and features

In the lowermost layers of Trench 2 we reached probable Aceramic Neolithic levels. Shells, bones and flints were found randomly in these deposits. Above them we excavated a floor of flat stones (C1036), which appeared to mark the transition between the Aceramic Neolithic and the later periods (Fig. 2.15). From then upwards we encountered layers rich in pottery from mixed periods (Chapter Thirteen), animal bones and flints in large quantities. These pottery-rich layers continued until C1030, with less pottery in subsequent layers. C1033 was a post-Neolithic pit which was not excavated. C1028 was also a pit which produced a human mandible, one of the few human remains so far discovered at the site.

Figure 2.15. Trench 2, C1038, probable Neolithic deposits at base of trench (left) with later stone paving (C1036, right), looking south.

The most interesting feature from this trench was the small oven or tannour (C1025-C1027; Fig. 2.16). The fire installation was discovered in the northwest corner of the trench at *ca*. 67cm below the surface. The oven's diameter was 46cm to the outside of the walls, and 36cm on the inside. The remainder of the deposits in Trench 2 were again a mix of pottery, bone, shell and flint, which occurred randomly across the trench. Due to the depth to which we had to excavate in order to reach the Neolithic, steps were cut into the west-facing wall, and contexts from here had no connection to the deposits within the trench.

Figure 2.16. Trench 2, oven/tannour C1025-C1027, looking west.

Trench 2 discussion and interpretation

Trench 2 produced some of the largest quantities of materials at the site, with a large proportion of it being pottery. Unfortunately there seems to be very little pattern to distribution of the materials, probably due to the fact that most of the excavated deposits were slope wash from higher up the mound. The oven, however, shows that there was activity at the bottom of the mound and one of those activities was cooking or heating. We do not know whether this cooking installation was inside a building or outside. In the earlier periods it could be argued that this area was a disposal area for unused pottery and other debris, which would explain the masses of pottery found in C1031-C1034. Under C1036, a flat stone surface, we probably reached the Neolithic period. No more features were found underneath this context but the quantity of artefacts indicates that activities were taking place in this area. It is likely that Aceramic Neolithic deposits exist below the lowermost excavated levels in Trench 2 but there is significant difficulty in accessing them below at least 2m of slope wash and later materials.

Excavations in Trench 3

Wendy Matthews and Sabr Ahmed

Location of trench

In order to obtain a rapid insight into nature and date of deposits at the base of the mound at Bestansur, a small trench was located at the edge of a recent irrigation cut at the southwest of the mound, Trench 3, 2 x 1.5m (Fig. 2.17).

Figure 2.17. Location of Trench 3 at southwest edge of the base of the mound. Base of C1042. Looking northwest, scale = 50cm.

Excavation and sampling methods
Deposits were excavated principally with a large pick, shovel and trowel. A small pick was used where stone walls and features were exposed. All deposits were recorded using the CZAP recording forms and system, and sampled according to established CZAP methodology for combined wet-screening and flotation and archive samples (see Trench 4). As no Neolithic deposits or intact floors of any date were revealed in this trench, deposits were not dry-sieved.

Excavation strategy
The objective in this small trench was to clean up the existing section and to expose *in-situ* archaeological deposits below colluvium. Topsoil was excavated as contexts C1040 and C1042, each *ca*. 25-30cm thick. Below this mixed fill deposits were excavated as C1043, 10cm thick, which overlay a layer of stones with pottery and bone fragments 10cm thick, excavated as C1044 (Figs 2.18-2.19).

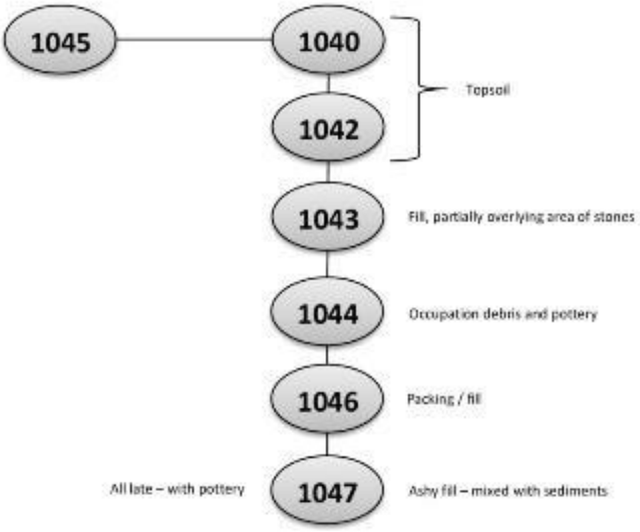


Figure 2.18. Matrix of contexts in Trench 3.

Figure 2.19. Layer of stones, pottery and bone C1044, Trench 3. Looking northeast, scale = 50cm.

As deposits in the southern half of this trench were less well-preserved and potentially disturbed, excavations were stepped down. Disturbed topsoil deposits were excavated as C1145, 30cm thick. Undisturbed bricky fill-like deposits were then excavated as C1046 across the whole trench, in a unit 15-20cm thick. At the base of this, distinct ashy deposits were detected and excavated as C1047 in the north of the trench (Fig. 2.20) associated with an irregular line of stones along the western section profile (Fig. 2.21). Excavations were terminated at this point as they had had reached the objective of revealing deposits at the level of the base of the mound and the modern plain and established that they were still post-Neolithic in date with late pottery lying on this surface and incorporated into the stone wall along with rectilinear baked brick. Deposits below this were being excavated in nearby trench Trench 2. A new trench, Trench 4, was opened in the adjacent fields where there is potential for more open area excavation and deeper trenches, if fruitful.

Sequence of deposits, features and structures

No intact Neolithic deposits were reached in this 1.20m-deep trench. All deposits are late in date associated with pottery and occasional rectilinear baked brick fragments. The earliest feature is a linear stone wall/feature associated with late pottery, ash lenses (C1047) and a grindstone, probably on a floor surface (Fig. 2.21). Overlying deposits comprise: bricky building fill C1046; an overlying layer of stone, pottery and bone C1044, and topsoil deposits C1045, C1042, C1040.

Trench 3 discussion and interpretation

That the base of excavation here is still late in date (Chapter Thirteen), but at the base of the mound and level with the modern plain suggests either that there was little or no mound at Bestansur in the Neolithic or that late deposits may be terraced onto a small Neolithic mound, as discussed further in Chapter Three.

Figure 2.20. Lenses of ash associated with a linear stone feature/wall (Fig. 2.20), excavated as C1047 in the north of Trench 3. Looking northeast, scale = 50cm with 10cm increments.

Figure 2.21. Base of excavation of C1047, showing linear stone feature and grindstone on floor in southeast corner of the trench. Trench 3, looking northeast, scale = 50cm.

Excavations in Trench 4

Wendy Matthews and Sabr Ahmed

Selection of location

This trench was selected to investigate the depth and nature of Neolithic activity in the flat area to the southwest of the mound, close to where several Neolithic bullet cores were found by surface survey in January and March 2012 (Fig. 2.22).

Excavation methods

The uppermost deposits were excavated with a large pick and shovel to remove the topsoil which was 35-40cm thick. Neolithic deposits without pottery were uncovered immediately below topsoil, at 92.27m above site datum (OD), and excavated with judicious use of large pick as this enables close checking of the fresh faces of intact clods of deposits and thereby the structure and composition of deposits, as well as use of a small pick and trowel. All section faces were straightened using a small pick in diagonal strokes and cleaned using a trowel and an artist's palette knife whilst still fresh and moist during and at the end of excavation of each context. The base of each excavation unit was marked by a tag nailed into the section profile with the context number written onto it to enable reflexive comparison of excavated units with the strata visible in section profiles and samples collected for micromorphological and other geochemical and phytolith analyses. Excavated surfaces were cleaned by trowel for photography. The north, south and west sections were drawn at the end of the season.

Figure 2.22. Excavation and section cleaning, Trench 4, looking northeast.

Recovery of finds

Artefacts, lithics, bone, shell and other finds were recovered from topsoil deposits by careful hand-picking in the trench and from each shovelful in the wheel barrow. A sample of the Neolithic deposits was dry-sieved to ensure recovery of materials >3mm.

Sampling
Samples of 250-500g of deposit were collected from all contexts for sub-sampling for geochemical and phytolith analyses and as an archive.

Whole-earth samples of *ca.* 50 litres, or less where contexts were smaller than this, were collected from all confirmed Neolithic contexts, 35cm below the modern surface, from contexts C1063-C1086. Neither materials nor deposits were removed from these whole-earth samples in the field. These samples were collected for combined wet-sieving and flotation, which was conducted at the dig house, in order to analyse the nature, abundance, size and preservation of macro and micro-artefacts and bioarchaeological remains in each context and thereby indicators of activity areas, diet and ecology (Chapters Four, Six and Seven).

Micromorphological samples were collected from natural (C1088-1087, SA447) and sequences of surfaces and deposits including C1082-1081 (SA352) and C1064-1063 (SA353) (Chapters Three and Five).

Excavation strategy
Topsoil
With permission from the farmer, the young crop was removed by hand. The dark topsoil, C1060, 25-30cm thick, and underlying slightly paler topsoil C1061, 25cm thick, were excavated across the 2 x 2m trench with a large pick, shovel and trowel.

Upper surfaces and deposits in 2 x 2m trench
As possible Neolithic activity surfaces were detected below topsoil, at the base of C1061, a 60cm strip of deposits was left intact in the east of the trench to investigate whether these possible surfaces more clearly identifiable and better preserved in lower deposits and in the section profiles (Fig. 2.22). These surfaces were represented by discontinuous lenses of shell, pale patches of clay and sparse Neolithic lithics and did not contain any pottery. The other 2 x 1.4m area in the centre and west of the trench was excavated as context C1062, 12cm thick. Although there were still large sections of roots, >3cm thick and 60cm long across the trench, distinct lenses of shell were detectable within this deposit and in a more extensive spread across the base of this context, with occasional lithics and bones lying flat, which suggest that this was an activity surface. A similar sequence of discontinuous surfaces below this was excavated as C1063, onto surface C1064 which also had shells, bone and lithics lying flat on it. The western 60cm strip of deposits was subsequently excavated down to this surface, across the 2 x 2m trench, as two corresponding contexts C1065 (=C1062), and C1066 (=C1063). Surface C1064, 3-4cm thick, was excavated to reveal a discontinuous surface, C1067. C1067 was excavated to a slightly arbitrary depth of *ca*. 7cm, where a discontinuous surface with a human bone lying horizontal was uncovered (Fig. 2.23).

Figure 2.23. Human femur section on a surface at the base of C1067, Trench 4, by the northern section profile.

Lower surfaces and deposits in 2 x 1m trench

As surfaces were proving difficult to detect and the aim was to investigate the nature, continuity and depth of deposits in this area of the site, the trench was divided in half, and a 2 x 1m trench excavated in order to speed up investigations, provide a profile view of deposits and leave a sequence for future sampling. A sequence of clearer surfaces with lenses of shell, sparse stones, burnt aggregates and lithics and bone lying flat were excavated as contexts C1068, C1069, C1080, C1081 and C1082, each with underlying deposits and discontinuous lenses 5-8cm thick.

Transition to natural deposits

At 1m below the modern surface, 91.59 m OD, deposits became lighter in colour and only contained sparse anthropogenic inclusions. Excavation of these continued in the 2 x 1m trench in more arbitrary spits *ca.* 7cm thick as contexts C1083 and C1084 (Fig. 2.24). In order to investigate more rapidly whether these pale deposits were natural and to step the trench for safety, the excavated area was reduced to a 1 x 1m trench. A series of arbitrary spits through natural deposits were excavated to a depth of 1.9m below the modern surface, 90.69 m OD, as contexts C1085-C1088).

Figure 2.24. Natural deposits in west of Trench 4 and overlying sequence of Neolithic surfaces and deposits and topsoil, looking west.

Sequence of deposits, features and structures

This report discusses deposits, features and structures in Trench 4 in their stratigraphic order of deposition from the base of excavations to the topsoil and modern surface.

Natural deposits

The lowermost natural deposits excavated are pale brown (7.5YR 6/4 light brown) and more than 45cm thick. At the base of these, 90.69m OD, the abundance of white aggregates appeared to increase. At 91.15m OD there was a gradual change to more reddish orange brownish deposits (7.5YR 5/4 brown), *ca.* 43cm thick. The transition from natural to deposits with traces of human activity with lithics and increasing charred flecks is gradual, affected in part by bioturbation which has mixed areas of the boundary between these, at *ca.* 91.59m OD, 1m below the modern surface, at the base of C1083. In the field, texture by feel analysis suggested that the particle size of these natural deposits was silty clay (Hodgson 1976). Particle size determination using laser granulometry indicates that they are of silty clay loam (Chapter Three).

The samples collected from natural include:

SA457: lowermost natural deposits (bulk)
SA447: transition between C1088 and C1087 (micromorphology; Chapter Three)
SA193: upper natural deposits C1086 (bulk)

Neolithic deposits

Earliest traces of activity

The first clear Neolithic activity surfaces with discontinuous linear lenses of mollusc shells, bone and chipped stone, ash, charred plant remains and burnt aggregates were detected at 95cm below the modern surface, at 91.67m OD, and were excavated as C1082, and sampled in micromorphology block SA352 to study their composition, deposition and activities represented (Fig. 2.25; Chapter Five).

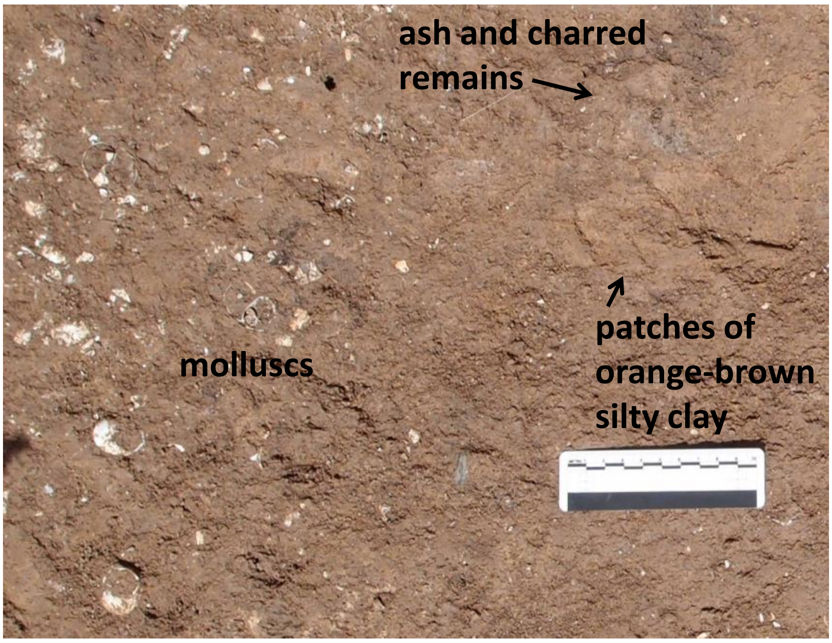


Figure 2.25. Surface at base of C1081, with molluscs, lithics and bone lying flat and patches of ash and charred remains and of orange-brown silty clay, Trench 4.

Repeated traces of activities

The Neolithic sequence in this trench comprises a series of surfaces and accumulated deposits *ca.* 68cm thick, from 91.59-92.27m OD, which are generally 10YR 4/3 dark brown in colour and fine grained silty clay (loam). At least seven clear surfaces were identified during excavation and in section profile, marked by discontinuous linear distributions of mollusc shells, some bone fragments and lithics lying flat and occasional patches of ash, charred flecks and burnt aggregates particularly in contexts C1082 and C1064 (Fig. 2.26). Each mollusc lens is 1-2cm thick and more than 0.3 to 2m in extent, and predominantly comprises *Helix Salamonica*. These mollusc lenses recur at 4-10cm intervals. Molluscs were most abundant on surfaces C1069 and C1062 (Fig. 2.26). Of particular note is the presence of a section of human femur at the base of C1067 (Fig. 2.23) and an obsidian blade #374 in C1069 which appears to be from a different source than the majority of the assemblage analysed by pXRF (Chapter Nine).

Topsoil

These Neolithic surfaces and deposits lay immediately below *ca.* 35cm of topsoil, which graded from 10YR 3/3 dark brown - 10 YR3/2 very dark greyish brown, and is being partially truncated by modern ploughing and cultivation (Fig. 2.27).

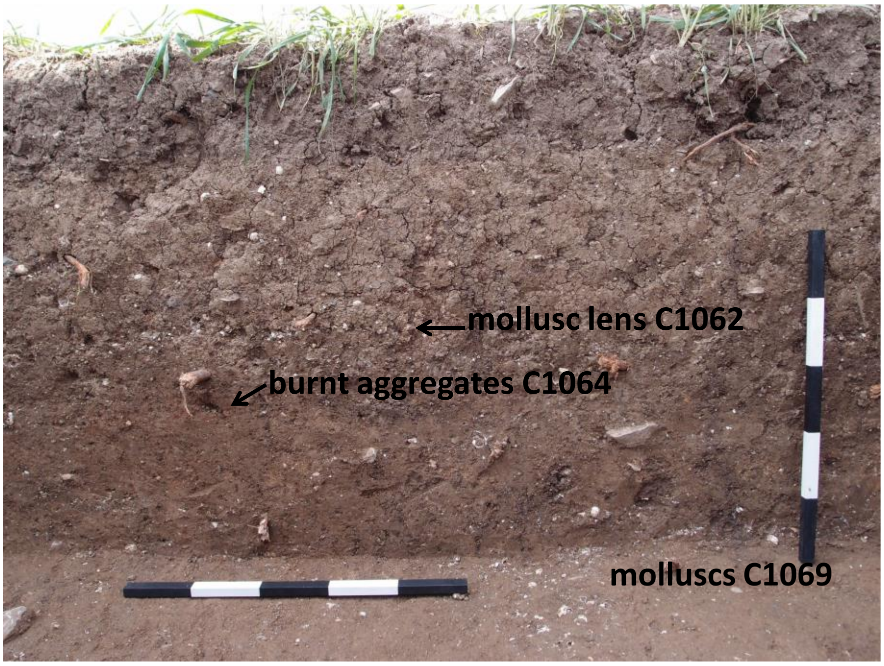


Figure 2.26. View of contexts C1069, C1064, C1062.

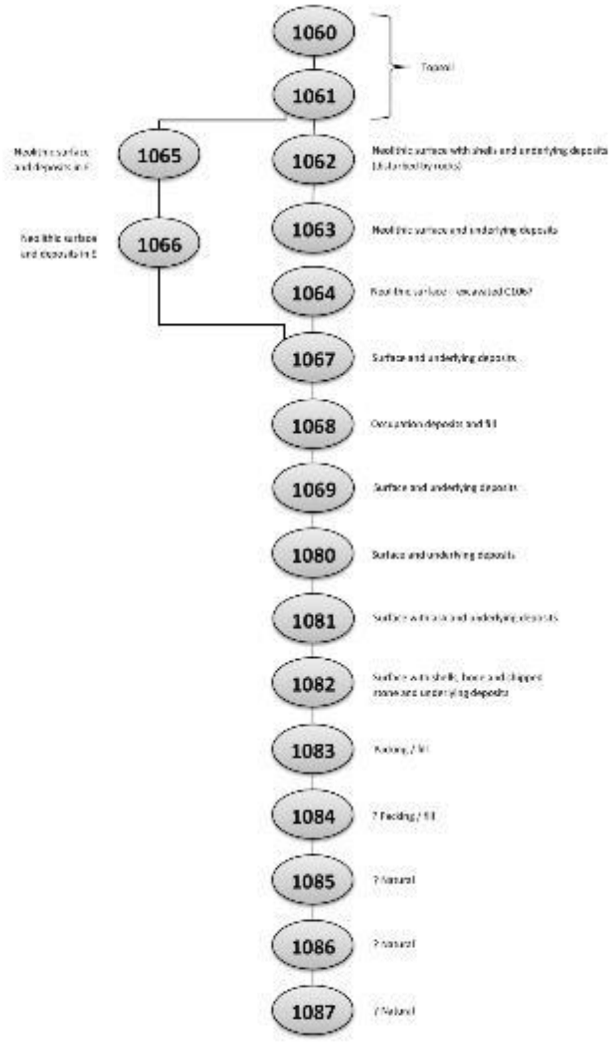


Figure 2.27. Matrix of contexts in Trench 4.

Trench 4 discussion and interpretation

No traces of *in-situ* architecture were detected in this trench. Deposits appear to represent a sequence of accumulated trampled surfaces, probably in an open area. There was, however, remarkable consistency in the types of accumulated deposits and materials, which suggests considerable repetition and long term continuity in the types of activities in this area of the site (Fig. 2.24).

Many of the activities in this area were associated with deposition of mollusc shells, some lithics and bone, and occasional patches of ash and burnt aggregates. These materials suggest activities associated with processing of molluscs perhaps for food as they predominantly comprise *Helix Salamonica* which is edible (Reed 1962) and are currently being investigated by Nick Harper (Chapter Twelve), as well as activities associated with use of fire, lithic tools and some bone fragments. One obsidian blade, #374 in C1069, is from a different source area to the other 44 tools analysed to date (Chapter Nine, Fig. 9.15), and suggests access to a different network of resources by an individual or group engaged in activities in this area. Preliminary analyses by Amy Richardson suggest the majority of tools may be from Eastern Anatolian sources, whilst tool #374 may be from Central Anatolian sources.

The presence of a part of human femur in C1067 and flecks of ochre in C1080 suggest some of the activities in this area may have included possible ritual, symbolic or marked activities (Bradley 2005; Keane 2010).

Of significance also is the presence of traces of dung spherulites in spot samples of the ashy patches from C1081-1082 (Chapter Five). The presence of dung suggests there may have been a close proximity between humans and animals, and perhaps management of animals and/or use of dung as fuel early in the history of activities in this area of the site, which is currently being investigated in PhD research by Sarah Elliott (Chapter Five).

Excavations in Trench 5

Amy Richardson and Kamal Aziz

Introduction

Trench 5 was located in the field to the west of the mound at Bestansur (Fig. 2.1). A preliminary surface survey conducted in January 2012 yielded several chert bullet cores and possible very early ceramics, which were recorded and plotted with GPS. Trench 5 was situated on the basis of the location of these artefacts and in line with the centre of the mound, amidst concentrated artefact scatters. The aim in this trench was to establish the extent of the spread of material directly to the west of the mound and to explore activities in this area of the site, including the possibility of flint knapping.

Trench 5 was located in a field of cereal crops (Fig. 2.28), which were removed from the 2 x 2m square and the spoil heap located on the mound-side of the trench. A narrow path between trench and field edge was forged to maintain accessibility with minimal damage to the farmer's crop.

Figure 2.28. Laying out Trench 5, looking east towards the mound.

Initial spits of topsoil were removed across the full extent of the trench, through the topsoil and subsoil. Once it became apparent that the eastern and western sides of the trench were displaying markedly different artefact patterns, the trench was taken down in 1 x 2m stages until features could be discerned (see matrix Fig. 2.29). Features, including a mollusc midden and deep pit, were defined and excavated separately.

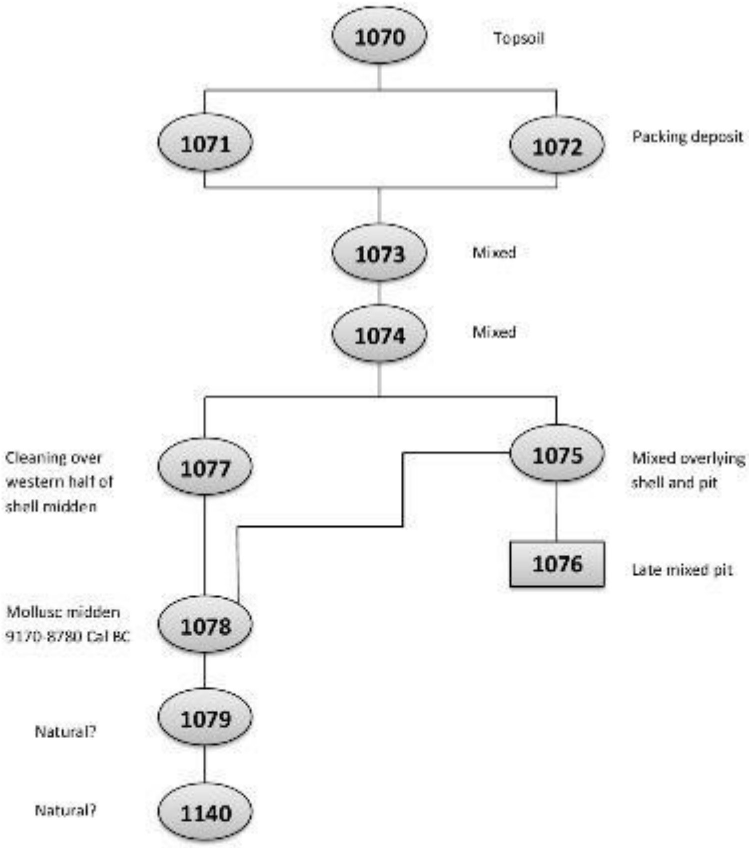


Figure 2.29. Matrix of contexts for Trench 5.

The dense mollusc deposit was identified, defined, planned and sampled in accordance with procedures recommended by Martin Bell. The deposit was column-sampled at its maximum depth. The half-section across the eastern trench was excavated until the base of the deposit was visible and a clean edge accessible. A further quarter-section in the southwest quadrant was removed and a 50l sample sent for flotation (SA121). A 50cm column sample was taken from the deposit, comprising two 4cm spits in the southeast corner of the northwest quadrant (SA122 and SA 123; see Fig. 2.30). A sub-sample of 150 shells from each spit has been exported to the University of Reading, for study by Nick Harper (Chapter Twelve). In addition, the soil retrieved from each spit of the column was retained for archive (SA124 and SA 125) and the remainder of the quadrant archived for future analyses (SA126).

Figure 2.30. Trench 5 after the removal of the 50cm column sample (SA 122 and SA123) from the mollusc deposit (C1078), with later pit (C1076) in the southeast corner.

The deposits beneath the mollusc midden were investigated and excavations continued until evidence for human activity was no longer present. Excavations in the eastern half-section were resumed, in a bid to find the maximum extent of the pit (C1076; Fig. 2.30) and to ensure no earlier phases could be discerned beneath the mollusc layer. Although an inward slope of the pit walls was visible, it was not possible to reach the bottom.

Sequence of structures, deposits and features

The lowermost deposits reached in Trench 5 appear to be natural accumulations, with no artefacts or evidence for human activity (C1140). The earliest activities are represented by isolated chert and obsidian blades (C1079), which are immediately overlaid by the substantial mollusc deposit (C1078). The appearance of the midden suggests accumulation onto a flat surface, creating a heap, clipped by the western and northern edges of Trench 5. The full extent of the midden beyond the excavation limits is, as yet, unknown. Within the mollusc deposits, artefacts including obsidian and chert blades and animal bone, were retrieved. A sample of one animal bone was sent for radiocarbon dating, but found to have no separable collagen suitable for dating. An obsidian blade was recovered from between the two spits of the column sample (SF13, located between SA122 and SA123; Fig. 2.31). The material that covered the mollusc midden was dense with lithics and bone, as seen in the cleaning spit (C1077).

Figure 2.31. Obsidian blade (SF13), recovered between SA122 and SA123 spits of the mollusc column sample (C1078).

Above C1077, the deposits were distinctively more mixed (C1075) including chert, abundant obsidian, small quantities of pottery and a piece of slag, indicating some disturbance of the integrity of the context. C1074 was more mixed again, containing abundant pottery, animal bone, shell from the midden below, smaller quantities of lithics, and two halves of cylindrical red beads.

On the east side of Trench 5, the pit fill (C1076; Fig. 2.30) was packed with mixed deposits of pottery, stone, lithics and shells visibly tumbling down the pit walls from the mollusc midden (C1078), through which it cuts. This pit was capped with stone and brick packing material (Fig. 2.32), which was dense with pottery, lithics and bone (C1073). The packing included an articulated dog skeleton, charcoal and more shell. Ploughing of the field and human activity appears to have substantially disturbed the upper deposits. Further remnants of the dog skeleton appear in C1072, alongside large quantities of pottery, more lithics and glass. Contexts C1071 and C1070 (subsoil and topsoil) are entirely mixed deposits, which contain material from all periods, both churned from the contexts below and spread by wash from the mound and modern ploughing.

Trench 5 discussion and interpretation

Trench 5 represents an intersection of Neolithic and later activities. Early activity is attested by the presence of worked stone tools, including chert and obsidian blades. Intensive activity is first seen in the accumulation or deposition of a midden of mollusc shells, comprising predominantly land snails, but with occasional freshwater molluscs. The frequent association of blades with this substantial deposit suggests preparation and, most likely, consumption of molluscs in the immediate vicinity. The seasonality of mollusc activity in the region and the cohesive nature of the deposit suggest that the deposit represents a single event or season of consumption. The consumption of molluscs is well attested at other Neolithic sites throughout the region (Reed 1962; Lubell 2004). This site and in particular the deposit in Trench 5 have the potential to provide the first in-depth, comprehensive analyses of these deposits in the Central Zagros, through quantitative analysis, radiocarbon dating and isotopic analysis.

A ^{14}C date has been obtained on one shell sample from deposit C1078 which gives a conventional radiocarbon age of 9570±40 BP (Beta-326883). This date calibrates with 95% probability at 2 Sigma to 9160-8780 cal BC. While some allowance must be made for the use of shell in radiometric dating, this relatively early date does suggest that occupation at Bestansur took place at least during the early 9th millennium cal BC, and possibly earlier. Many more dates are needed before we can speak with confidence about the site's absolute chronology and its wider significance.

Overlying the molluscs are abundant lithics, more snails and bones, possibly indicating continued use, although no particular features indicative of specialised activities are present.

Figure 2.32. C1073 stone and brick packing material capping the deep pit in Trench 5.

Cutting through these deposits, a deep pit was clipped by the edge of Trench 5 (C1076, Fig. 2.30). This pit, potentially a well, if deep enough to meet the water table, was later filled with debris and material from the mound and surrounding land, with a mix of material from all periods of occupation, from Neolithic to Iron Age. The well/pit was finally capped with bulky material, such as stone and slabs of fired clay (Fig. 2.32).

Excavations in Trench 6

Lisa Cooper, Sarah Elliott and Robin Bendrey

Introduction

Trench 6 was located on the lower slopes of the eastern side of the mound (Fig. 2.1). It comprises a section placed on the western side of a recent gulley, running approximately north-south, cut into the eastern side of the mound. Trench 6 is one of two trenches positioned on this side of the mound aimed at exploring the depth and nature of the lower sequences of the mound.

Figure 2.33. View looking northwest showing Trench 6 and recent gulley leading off to the right (filled with spoil).

The location of Trench 6 took advantage of a previously cut gulley (Fig. 2.33). The aim of this section was to quickly determine the depth and type of archaeological deposits on this side of the mound. An area 2m wide and following the slope by 3m up the western side of the gulley was targeted for rapid removal. Much of the upper 2m was slope wash, disturbed and bioturbated material (Fig. 2.34). The aim was to provide a rapid assessment of stratigraphy, and as a result finds were collected, but it was deemed unnecessary to sample consistently for flotation.

Figure 2.34. View looking northwest showing Trench 6 during excavation, including slope wash, disturbance by animal burrow (with animal, inset) in the northern extent of the trench.

Sequence of deposits and features

The following brief account describes Trench 6 deposits from the earliest stratigraphic levels upwards. The matrix of these deposits showing their relationship to each other is laid out in Fig. 2.35. The lower deposits were excavated in a northern and southern section (Fig. 2.36).

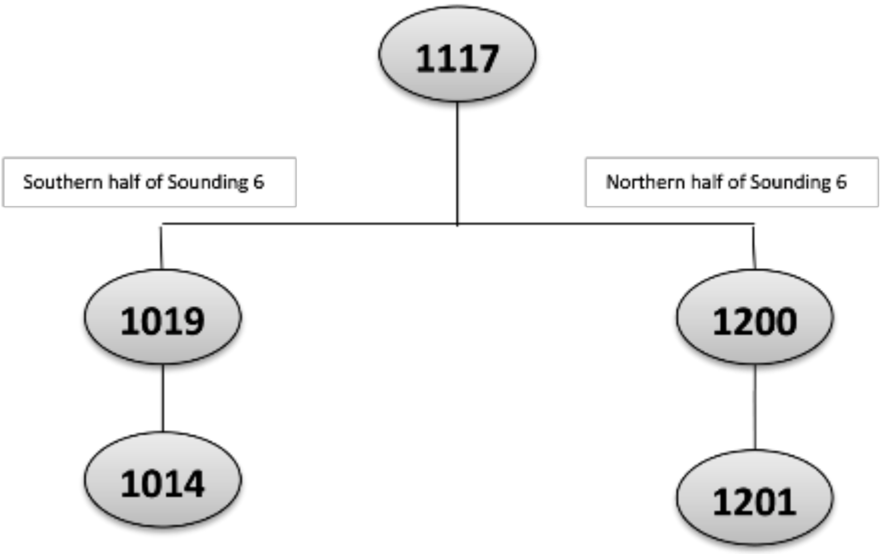


Figure 2.35. Matrix of contexts in Trench 6.

Figure 2.36. View looking west showing the southern half-section excavated to a slightly lower depth than the northern half-section.

C1117, the upper part of C1019 in the southern half of the trench, and C1200 in the northern half of the trench, appeared to consist of a thick layer (10-20cm) of wash from the slope of the tell above. Further down, at least two dark horizontal layers of ash, in between which were lenses consisting of burned chunks of broken bricks, additional discrete clusters of ash and clusters of a white-yellowish powdery substance, were encountered. As with the layers of slope wash above, these ashy strata were much disturbed by plant roots and animal burrows, but it was suspected that they could represent a series of ancient surfaces (floors?) which had been burned, with destruction debris lying above, in at least two closely dated episodes. Near the base of C1019, in the southern extent of the trench, fire installation C1014 was revealed. Due to the discrete nature of this deposit (Fig. 2.37) a sample was collected for flotation (S80). Although this fire installation is difficult to relate stratigraphically to C1200 since it was part of an operation carried out earlier in the season, it seems to have been situated at the same level as one of the lower ashy layers in C1200, and thus may have sat in or on top of one of the presumed surfaces.

C1201 was encountered in the northern half of the trench and represents a layer of grey, clayey soil that was uniformly encountered under the ashy deposits of C1200. It appears that the lower part of C1201 in the southern half of the trench also penetrated into this layer. Seven flat-lying stones, lying in a cluster near the north section of the trench were found in C1201 and could possibly represent the remains of a surface. C1201, which penetrated below the level of the flat stones in several areas of the northern half of the trench, and further cleaning at the bottom of C1019 in the southern half of the trench, revealed a distinct change in soil colour from grey to brown. Scraping on the southeast side of the trench indicated that the very top of the Neolithic horizon of the tell had been reached in this brown soil layer. No pottery sherds were encountered at this depth.

Figure 2.37. Close-up of fire installation C1014.

Above C1014, C1019 was allocated to all finds in the southern half of Trench 6. Above C1019, and the contexts in the northern half (C1200 and C1201), all topsoil finds were allocated to C1117.

Trench 6 discussion and interpretation

Artefact assemblages indicate that the deposits briefly assessed in Trench 6 are all later than the Aceramic Neolithic. Much of the upper deposits were slope wash, and much of the sequence appeared disturbed and bioturbated (Fig. 2.34). Nevertheless, further down, the presence of possible burned surfaces and associated overlying destruction debris, a fire installation, and still further down, a cluster of flat-lying stones, suggest that some intact archaeological deposits existed in the lower sequence. Very few diagnostic pottery forms were collected from Trench 6, but those encountered in the lower ashy layers appear to be Sasanian in date (Chapter Thirteen).

Excavations in Trench 7

Roger Matthews

Introduction

Trench 7 is located *ca*. 15m west of the southwest edge of the mound at Bestansur, one of three trenches (Trenches 4, 5, and 7) excavated in the large field situated to the west and southwest of the mound (Figs 2.1.-2.2). This field was under cereal cultivation during the excavation and care was taken to cause minimum disruption to the crop, with the farmer's co-operation throughout.

All three 2 x 2m trenches in this field were positioned on the basis of surface finds of Neolithic lithics from intensive field-walking around the mound. Deposits and features in Trench 7 were in general accessible and well-preserved, with clear remains of architecture and evidence for a wide range of human activity. We plan to expand Trench 7 into broader open-area excavation in the summer 2012 season.

The uppermost deposits (C1090-C1091) were excavated across the 2 x 2m trench, followed by excavation of deposits in the north half of the trench (C1092-C1098; C1170-C1172), and finally excavation of deposits in the south half of the trench (C1173-C1179; C1191-C1199). We excavated intact architectural spaces and associated features in the lowermost level of the trench in the form of a 50cm grid, with deposits being recovered for micro-archaeological processing (Fig. 2.38; Chapter Four). Excavation was halted at this stage, without removal of the walls, in view of the potential for open-area excavation of these structures in future seasons. A matrix of Trench 7 contexts is shown in Fig. 2.39. We used standard CZAP recording procedures throughout. At the end of the season, as with all trenches, Trench 7 was covered in sacking and back-filled with excavated soil.

Figure 2.38. View of excavation in 50cm grid, looking north.

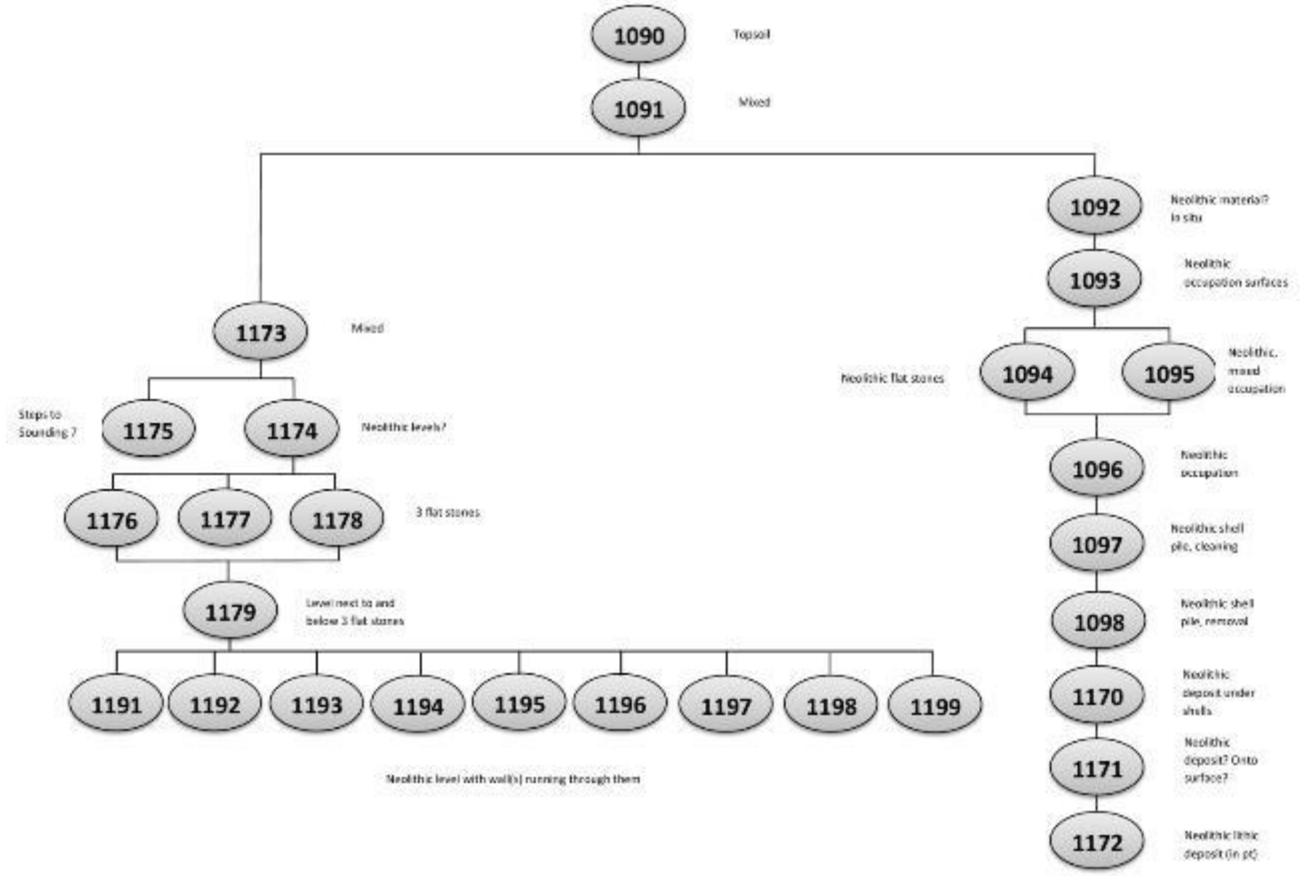


Figure 2.39. Matrix of contexts in Trench 7.

Sequence of structures, deposits and features

The following account considers Trench 7 deposits from the earliest levels upwards, in their true sequence of deposition (in reverse order to their sequence of excavation). The earliest features uncovered, though not excavated, in Trench 7 were the walls of the Neolithic building illustrated in Figs 2.40-2.41. These walls were difficult to trace, largely due to their composition of unshaped blocks of clay, with no clear bricks. There were no traces of wall plaster but in places the wall edges were clear, and flecks of white chalky material occurred within the wall material but not outside the walls. The walls are heavily truncated as floor surfaces were exposed at a depth of <10cm below the surviving height of the walls. Earlier floors and surfaces may exist below the excavated uppermost surfaces. The walls delineate three distinct spaces or rooms, two of which appear to be small internal rooms, while there is also a larger, possibly open, area. The architecture is clearly rectilinear in form.

Micro-archaeological excavation and sampling across a 50cm grid was carried out onto the floor surfaces accessible in the south half of Trench 7, which included portions of all three spaces (Chapter Four). *In-situ* quern-stones (Chapter Ten) in two rooms provided a useful guide to the location of the floor surfaces, which were otherwise difficult to define. Systematic pXRF analysis across the deposits was also carried out, with significantly higher levels of phosphorous in the open area, suggesting an interpretation of this space as used for animal penning amongst other activities (Chapter Five).

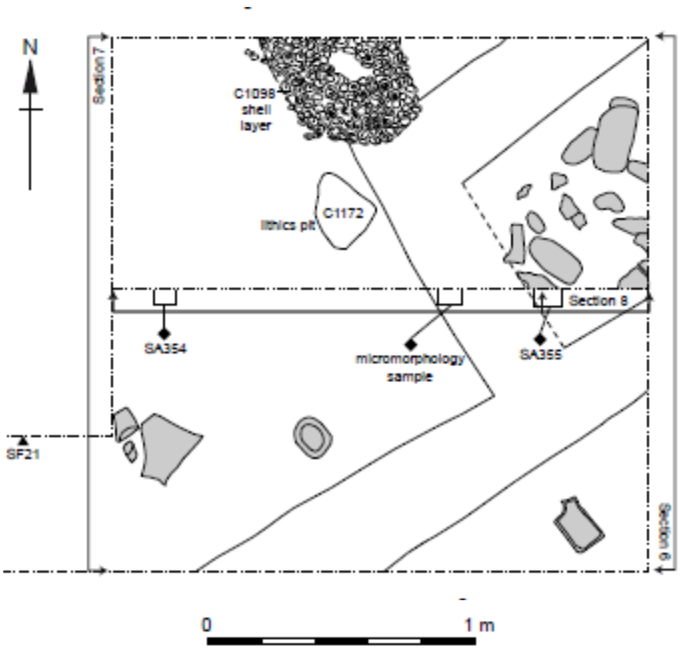


Figure 2.40. Composite plan of Neolithic structures and features in Trench 7.

Figure 2.41. Neolithic rectilinear building with *in-situ* quern-stones, looking south.

In the north half of the trench, the earliest features are the unexcavated walls. Within the open area the earliest detected feature is the deposition of a discrete cache of lithic debitage (C1172; Fig. 2.42). This cache, which contained 797 fragments of chert including one core (Chapter Nine), may have been deposited in a pit under a fugitive surface contemporary with the surface(s) exposed in the south half of the trench, but during excavation the putative surface and pit were not visible. The lithics were discretely concentrated in an area 30 x 20 x 5-8cm in dimension.

Figure 2.42. Context 1172, deposit of lithic debitage.

A subsequent phase of activity in the north half of the trench is attested by two discrete deposits. A clearly defined concentration of edible snail shells (C1098) covered an area of 30 x 35 x 10cm (Fig. 2.43), slightly overlapping the western corner of the adjacent wall. Underlying the shells was a spread of reddened earth (C1170), perhaps from a fire for cooking the shells.

Figure 2.43. C1098, deposit of edible snail shells, looking north.

A second discrete deposit within this phase is of flat, plate-like stones (C1094; Fig. 2.44; Chapter Ten). At present it is not possible to determine whether the stones lay within the walls of the small room as the stones occur at a higher level than the detected walls of that room. It is possible that the walls did extend higher than originally detected in excavation. Future excavation of adjacent deposits should answer this question.

Figure 2.44. C1094, deposit of flat, plate-like stones, looking east.

Overlying both phases described above were deposits characterised by fugitive surfaces, with small lenses of ash and burning and occasional pieces of bone or lithics lying flat on probable surfaces (C1092-C1096 in north half of trench; C1173-C1179, C1191-C1199 in south half of trench). All these deposits appear to represent intact Neolithic occupation, with no evidence for significant intrusion from later occupation and without pottery, but lacking clear traces of architecture. No pottery was recovered from any deposit underlying C1091. As in other trenches at Bestansur, intact Neolithic deposits occur at a depth of 50-60cm below the modern field surface. In excavation of deposits to create an access step at the southwest corner of the trench an alabaster mace-head (SF21) was recovered (C1175; Fig. 2.45), without clear association to any context within the trench.

Figure 2.45. C1175, SF21, alabaster mace-head in place of discovery, looking west.

Trench 7 discussion and interpretation

The excavated levels in Trench 7 provide insights into a range of human activities undertaken at the site in the Early Neolithic period. In the lower phase the exposure and micro-archaeological investigation of three distinct spaces provides scope for comparative analysis room by room (Chapter Four). At the macro level, the presence of *in-situ* quern-stones and a chopping tool in two rooms indicates processing of probably foodstuffs such as legumes and nuts within these spaces (Chapter Ten).

The deposit of lithic debitage (C1172) is evidence for onsite chert knapping in the probable open area. The chert worker used 4-5 different nodules of chert, working them down to very fine cores, one of which was discarded along with the mass of debitage, all of it very fine in dimensions. We can envisage the knapper squatting or sitting with their back against the adjacent wall, facing into the courtyard, with a cloth or fleece across their lap to collect the debitage and protect their skin. A possible retouching tool of alabaster (SF16) was found in C1092 in Trench 7. On completion of the knapping the chert-worker carefully gathered up the debitage and placed it in a small pit cut into the floor surface before covering the deposit over with soil. The presence of multiple tiny fragments of chert in the cache suggests that the knapping took place not far from the place of deposition.

Later activity in this area is attested by the discrete shell deposit (C1098), which lies on a fugitive burnt surface (C1170). We interpret this deposit, along with similar ones from Neolithic levels elsewhere at the site, as discarded remains from cooking and eating of edible snails by the occupants of the site (Chapter Twelve). The deposit of flat stones (C1094) may represent tool blanks or stones from flooring (Chapter Ten).

We thus have a wide range of spatially-situated human tasks and activities richly attested in the 2 x 2m exposure in Trench 7, which augers well for future recovery, analysis and interpretation of excavated materials and deposits in open-area excavation of Neolithic levels at Bestansur.

Excavations in Trench 8

Wendy Matthews, Sabr Ahmed, Kamal Aziz and Hero

Introduction

This 2 x 2m trench was selected in order to investigate the nature of the site to the southeast of the mound in an area with a concentration of lithics on the surface of the field (Figs 2.1, 2.3, 2.46).

Excavation and sampling methods

We employed standard CZAP excavation and sampling procedures for every context. We collected 250g archive samples and 50l whole-earth samples from which nothing was removed for combined wet-sieving and flotation to study the abundance and size of artefactual and bioarchaeological remains in each context (Chapters Four, Six, Seven and Nine). Where contexts were less than 50l, the entire deposit was sent for combined wet-screening and flotation. Samples for specialist analyses were collected from a range of contexts as appropriate, including in Trench 8 for phytolith, micromorphological and geochemical analyses (Chapters Three and Five). Portable XRF readings were taken of ash surfaces C1182 and walls of the underlying building (Chapter Five). All Neolithic deposits were dry-sieved using a 4mm mesh. The volume of dry-sieved deposits was recorded and all artefacts and bioarchaeological remains collected for specialist analyses.

Figure 2.46. Trench 8 in field at the southeast edge of the mound, looking southeast.

Excavation strategy

The uppermost deposits were excavated with a large pick and shovel to remove the topsoil which was *ca.* 30cm thick in two contexts C1130-C1131. An extensive layer of unoriented stones, lithics, and abraded pottery was uncovered across the trench below colluvium C1133 at a depth of 35cm, 90.79m OD (Fig. 2.47). As this was a horizon of mixed, abraded and eroded pottery and lithics, this deposit was excavated as a single unit C1134, 10-15cm thick, with a large pick and shovel.

Figure 2.47. Layer of abraded stones, pottery and lithics below topsoil C1134, looking west.

Neolithic deposits without pottery were uncovered immediately below this layer and excavated with small pick, trowel, and on occasion judicious use of large pick as this enables close checking of the fresh faces of intact clods of deposits and thereby the structure and composition of deposits. These deposits comprised fairly homogenous pale brown deposits (5YR 4/4 reddish brown – 7.5YR 4/4 brown) with 5% white flecks, which were excavated as two contexts C1135-1136 over a depth of 20-25cm. These deposits were without pottery and had few finds and sparse burnt aggregates and charred flecks.

In order to provide a rapid evaluation of whether Neolithic deposits were preserved on this lower, eastern side of the mound, as these deposits were below the height of natural on the western side of the mound and contained little anthropogenic material, the trench was reduced in size in the south of this trench, as the workmen increasingly suggested that these deposits resembled natural in the area, based on their experience as both local farmers as well as excavators on other archaeological projects. Homogenous brown silty clay deposits, 10YR 4/6 strong brown with little anthropogenic material were excavated in two spits as C1137, first in a 2 x 1m area for *ca*. 10cm, then for a further 10cm in a 1 x 1m trench, in the southeast corner (Fig. 2.48). A further spit was excavated as C1138, also 10cm thick.

Figure 2.48. 1 x 1m trench in southeast corner, looking southeast.

At a depth of *ca.* 1.17m below the modern surface, 89.96m OD, a grey ashy deposit with Neolithic lithics was encountered and excavation strategy immediately altered to use of small pick and trowel. This ash layer, 5-8cm thick, was excavated as C1180 and sampled for whole-earth wet-sieving and flotation to examine the nature and preservation of Neolithic materials in the east of the site (SA254). Plastic canvas sacks were pinned to the section and placed over the ash deposits in order to protect these deposits during excavation in the rest of the trench and to retain moisture, as with increasing heat, deposits were drying out more quickly once exposed (Fig. 2.49).

Figure 2.49. Protection of sections and surfaces in 1 x 1m trench during excavation. Base of excavation of C1181.

The small step in the northwest corner was enlarged beyond the trench to enable access to renewed excavation in the north of the trench. A small plinth of deposits in this northwest corner containing molluscs that had not been cut by the eroded and braded layer of stones, *ca*. 60 x 70cm, was then excavated as C1139 down to the same level as the base of C1136.

Deposits below C1136 in this northern half of the trench were excavated to a depth of 5-8cm as C1181, which is contemporary with C1137 in the south of the trench. As deposits in C1181 were more heterogeneous than those of C1136, separate whole earth samples were collected from deposits with ashy lenses in the northwest corner (SA256), and pale brown deposits in the northeast corner (SA272). Deposits immediately below C1181 were increasingly varied. In the northeast, an area of dark deposits rich in charred plant remains, *ca*. 60 x 80cm, 2-3cm thick, was excavated and sampled as C1182 and analysed using pXRF in the field (Fig. 2.50; Chapter Five). Underlying brown silty clay deposits, 7.5YR 5/4 brown, C1183, were excavated across the extant three-quarters of the trench to a depth of 5cm.

Figure 2.50. Charred deposits in northeast corner, C1182.

On cleaning across the trench below C1183, at 90.21m OD, clear wall lines were revealed, marked by the slightly more reddish brown colour and white carbonate inclusions of the wall make-up. Surface scraping with a hoe proved particularly effective in revealing the wall lines, which were on the same northeast-southwest alignment as a rectilinear patch of green silty clay in the west of the trench (Fig. 2.51). The fact that much of C1137-C1138 resembled natural deposits and had few Neolithic finds can, with hindsight, be explained as their composition of wall material constructed from natural. These wall-lines could be traced in the edge of the section profile of the 1 x 1m trench in the southeast of the trench, excavated as C1138.

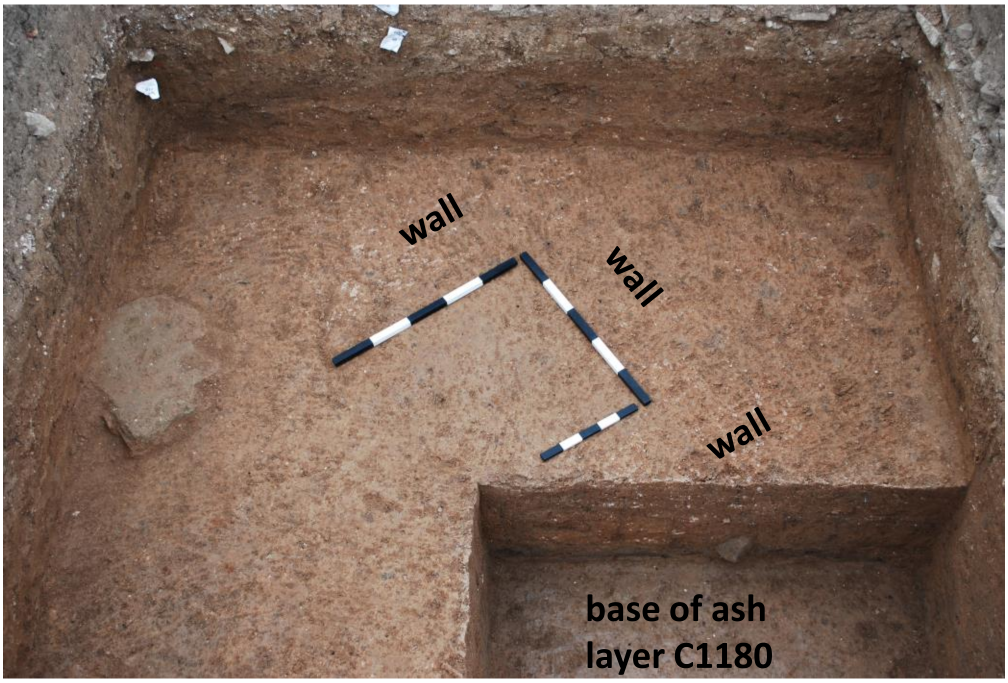


Figure 2.51. Wall lines visible at the base of C1183 in the north of Trench 8.

The room fill was excavated as C1184. Interior wall edges were defined using a picking action with the trowel. An ephemeral surface below C1184 was excavated as C1185 where it was preserved in the northeast corner of the room. Excavations were left at this stage as further excavation would require a larger exposure to make sense of the wall alignments and interior and exterior spaces, and there was no more time available this season (Fig. 2.52).

Figure 2.52. End of excavation and sampling for micromorphology, looking northwest, scale = 25cm.

Sequence of deposits, features and structures

The sequence of deposits in this trench is discussed from the earliest to the latest, from the base-up, with reference to the matrix for this trench at the end of this section (Fig. 2.59). Natural sediments were not reached in this trench.

Earliest phase: grey ashy deposits C1180

The earliest deposits excavated in this trench lie *ca.* 1.25m below the modern surface, at 89.88m OD. These comprise a layer of ashy deposits, 10YR 5/2 greyish brown, with burnt aggregates and charred plant remains (Figs 2.51, 2.53-2.55; Flotation and wet-sieving sample SA254; micromorphology sample SA350). Speculatively, the small 1 x 1m exposure and western section suggest this ash may abut a wall line or feature to the south constructed from orange brown silty clay (Fig. 2.54).

Figure 2.53. Charred plant remains and burnt aggregates in grey ash C1180, looking north. Scale = 25cm.

Figure 2.54. Charred plant remains and burnt aggregates in grey ash C1180, looking west. Scale = 25cm.

This ash layer C1180 underlies the walls of a later phase of activity in this area associated with a pisé-walled building, as illustrated in the northern section profile of the small 1 x 1m trench in the southeast quadrant of Trench 8 (Fig. 2.55).

Figure 2.55. Northern section profile of 1 x 1m trench in southeast, showing ash layer C1180, overlain by pisé -walled building, looking north, scale = 25cm.

Pisé-walled building

A pisé-walled building was constructed on top of ash layer C1180 and a *ca.* 3-6cm thick layer of orange brown silty clay, as illustrated in Figs 2.52 and 2.55. The walls were constructed from slightly reddish brown silty clay loam pisé (*tauf*) with white calcareous aggregates, and aligned northeast-southwest. The walls survive to an extant height of *ca.* 25cm. The wall materials were sampled in SA350 (micromorphology) and SA455 (bulk geoarchaeological analyses) to study their source materials and architectural properties and technology (Chapters Three and Five).

The floor was prepared by laying a thick packing with some stones, as revealed in the cut for micromorphology block SA450, currently being analysed (Chapter Three). Only the upper floor and occupation deposits were excavated and are best preserved in the northeast of this room. They comprise mixed deposits with ash, charred plant remains, burnt aggregates and possible flecks of ochre, with a lithic lying flat (Lithic C1185 #1) C1185-4 (Fig. 2.56), sampled for micromorphological analyses (SA451).

Figure 2.56. Mixed deposits on floor of pisé-walled building containing ash, charred plant remains and burnt aggregates, with a lithic lying flat (Lithic C1185 #1) C1185-4.

The overlying layer C1183, is a mixed silty clay loam 7.5YR brown in colour. On top of this there was a discrete accumulation of dark deposits (7.5YR 3/2 dark brown) rich in charred plant remains (>10%) and burnt aggregates C1182 (Figs 2.50, 2.57). The western edge of these deposits is on a similar alignment to the underlying walls (Figs 2.50-2.51). It is possible that these deposits represent a late accumulation of deposits in a room/area which continues to the northeast of this trench and may be associated with the pisé-walled building. These deposits were sampled for a range of micromorphological (SA360) and geoarchaeological analyses (Chapters Three and Five).

Figure 2.57. Mixed deposits on surface in northeast corner of Trench 8, possibly associated with a late phase of the pisé-walled building. This deposit, C1182, includes charred plant remains (>10%) and diverse burnt aggregates.

Overlying strata C1181, C1139 and C1136, comprise mixed fill/deposits with occasional traces of surfaces e.g. at the interface between C1181 and C1136 and C1139, which includes burnt aggregates and sparse traces of ash (Fig. 2.58). The plinth of deposits in the northwest of this trench proved to contain better preserved Neolithic deposits than areas covered by stones and abraded pottery C1134, as it was further upslope than the rest of the trench and was covered by more colluvium. This plinth of deposits, C1139, included lenses of shell (Fig. 2.58) and a large well-preserved red deer bone (Chapter Six).

The upper 45-50cm of deposits in this trench, from 90.74m OD, do not represent *in-situ* Neolithic deposits, and comprise in sequence from the base up colluviums: a thick layer of abraded pottery and stones C1134, further colluvium C1135 and topsoil C1133, C1131-1130. The thick layer of stones with abraded pottery and lithics, C1134 may be: a packed surface from post-Neolithic occupation; erosion or deflation – which is supported by abrasion of pottery; or perhaps as a stone line from soil forming processes including bioturbation (Birkeland 1999, 27, 126). If the stones are of natural origin and widespread across the site, where they do not occur, they may relate to subsequent disturbance and redistribution by ploughing of the topsoil (Evans and O'Connor 1999).

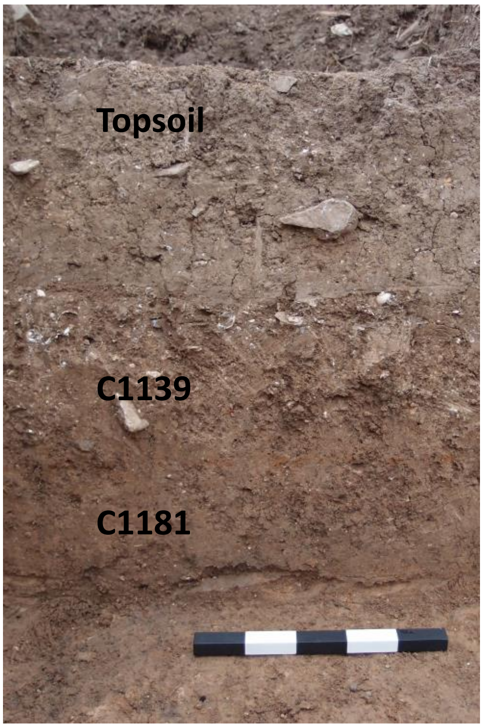


Figure 2.58. Neolithic surfaces and deposits in the northwest corner which include lenses of molluscs C1139, burnt aggregates and ash at the top of C1181. Scale = 25cm.

Trench 8 discussion and interpretation

Preservation

Many deposit boundaries, both horizontally between strata as well as vertically along wall edges were fairly clearly identifiable in the field, once the excavator is familiar with their characteristics and properties. There has been some reworking by bioturbation, as common, although not always fully recognised on archaeological sites. It is possible that the walls of the pisé-walled building may have stood higher, perhaps partially eroded, as visible in the northern section profile, there are some white carbonate flecks visible higher up in the sequence, and some lenses such as C1182 and the burnt aggregates on the boundary between C1181 and C1139 to the west and C1136 to the east, are discontinuous and may respect a wall face that is now difficult to detect. Wider area exposure will help with definition of wall lines and deposit boundaries.

Architecture, activity areas and phasing

Of particular significance in this trench is the long sequence of occupation, which continues below the current limit of excavation at 1.25m below the modern surface, 89.88m OD. There are at least two major phases of activity in this area of the site. The earliest is represented by a well-preserved grey ash layer C1180 which may be associated with walls or features at the base of the 1 x 1m trench in the southeast. The second is an overlying pisé-walled building with a small room *ca*. 65cm x >1m in the centre of the trench and other spaces detectable, beyond this, including probably the charred layer C1182 to the northeast later in its history. The deposits on the floors of this building are mixed and include ash, charred plant remains, lithics and flecks of ochre, attesting a range of activities associated with burning. A wide range of ongoing bioarchaeological, geoarchaeological, and macro- and micro-artefactual analyses will help to define the nature of activities in this area through time, as reported throughout this volume.

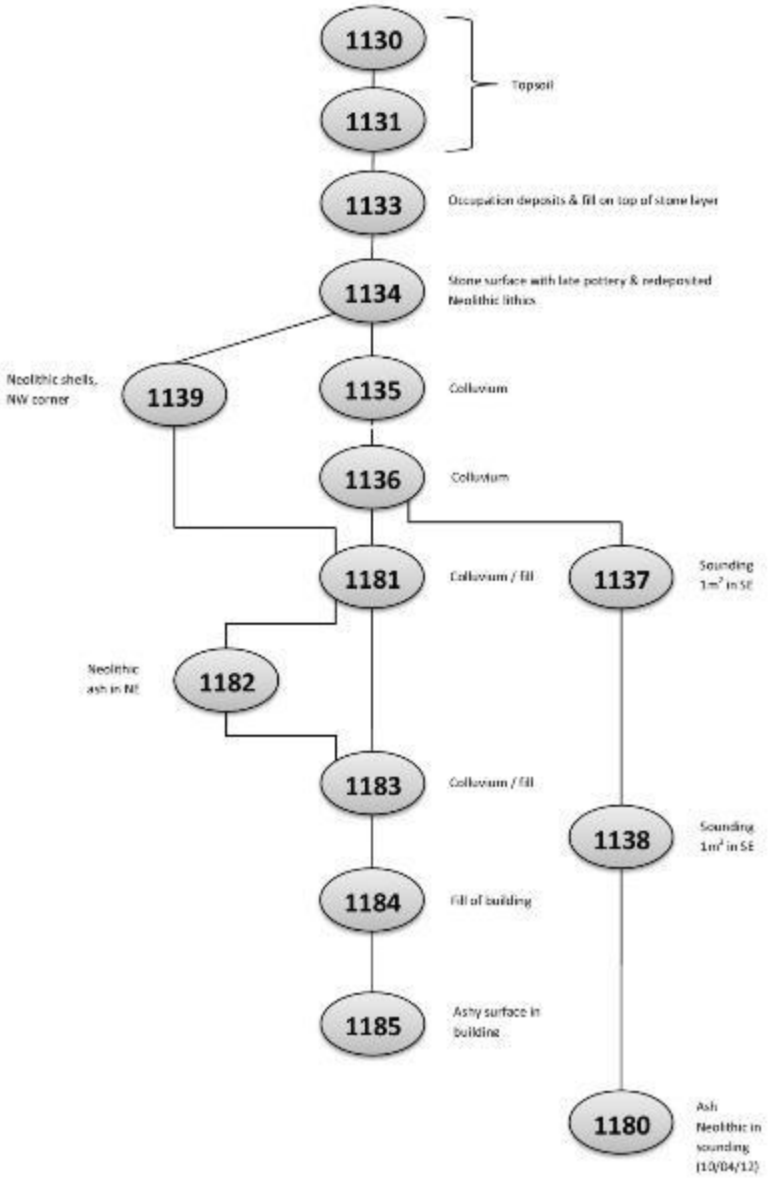


Figure 2.59. Matrix of contexts for Trench 8.

Excavations in Trench 9

Amy Richardson, Sarah Elliott and Nick Harper

Introduction

Trench 9 is located *ca.* 7m south of the southern edge of the mound at Bestansur, one of three trenches (Trenches 8, 9 and 10) excavated in the fields to the south-southeast of the mound (Fig. 2.1). This field was under cereal cultivation during the excavation and care was taken to cause minimum disruption to the crop, with the farmer's co-operation throughout. It is one of the three trenches positioned in the fields on this side of the mound aimed at exploring the extent of archaeological deposits beyond the slopes of the mound itself.

Sequence of structures, deposits and features

The following account describes Trench 9 deposits from the earliest stratigraphic levels upwards. The matrix of these deposits showing their relationship to each other is laid out in Fig. 2.60.

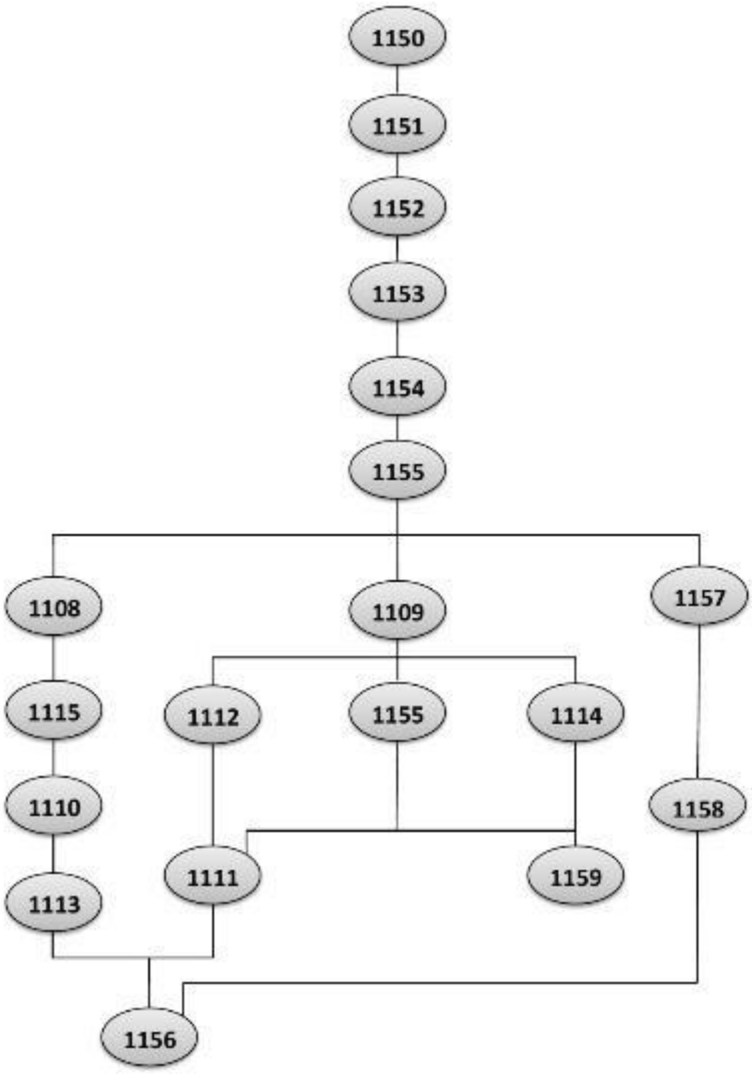


Figure 2.60. Matrix of contexts in Trench 9.

The earliest features identified in the lowest excavated levels of Trench 9 were a series of three hearths. During excavation of Trench 9 these were left on a pedestal for sampling and recording in detail. The earliest deposit (C1156) in Trench 9 was removed as an arbitrary spit in the eastern half section of Trench 9 which is situated around this pedestal. Stratigraphically above C1156 was the hearth base or make up of two, possibly three, hearths (Fig. 2.61). Prior to excavation all hearths and associated deposits were tested using portable X-Ray Fluorescence.

The make-up of the northern hearth was C1113, situated below C1110. These contexts were excavated and sampled separately due to differences in colour and texture of the sediments. The centre and southern hearths were sat on top of hearth make-up C1111 (Figs 2.62-2.63). There was no difference in this deposit either beneath the hearths or stratigraphically (unlike the differences in C1113 and C1110).

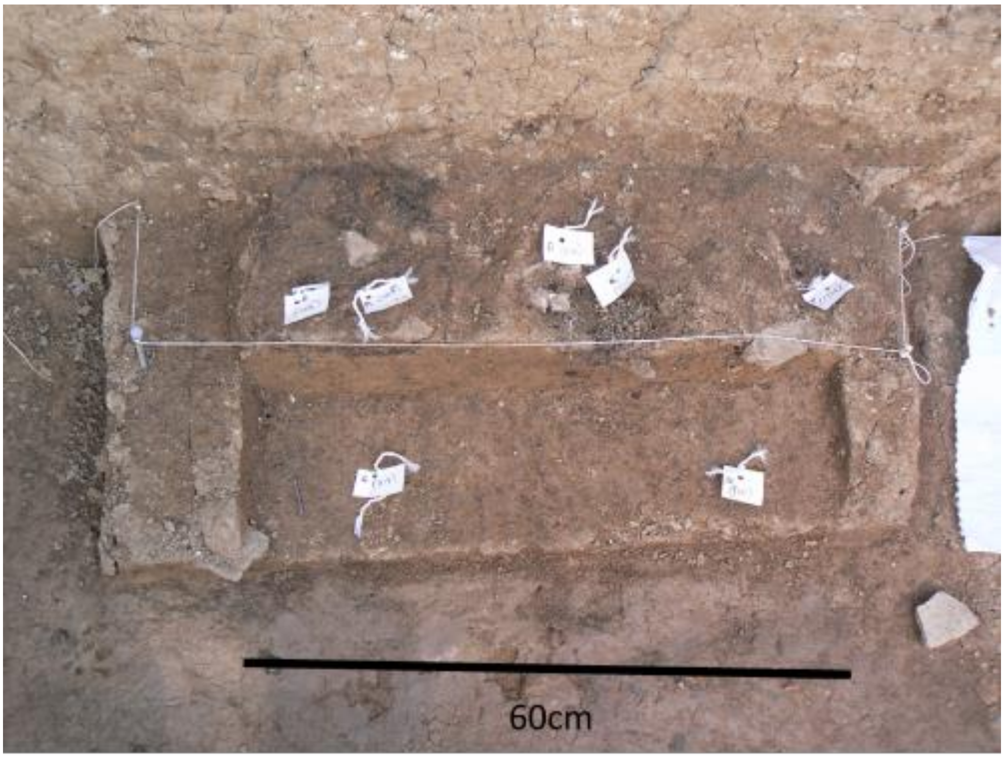


Figure 2.61. View looking east, showing three hearths (C1115, C1112/C1155 and C1114) in Trench 9. Three tags on the left represent deposits associated with the northern hearth (C1115), two tags in the centre represent deposits associated with the central hearth (C1112/C1155) and the two tags on the right represent deposits associated with the southern hearth (C1114).

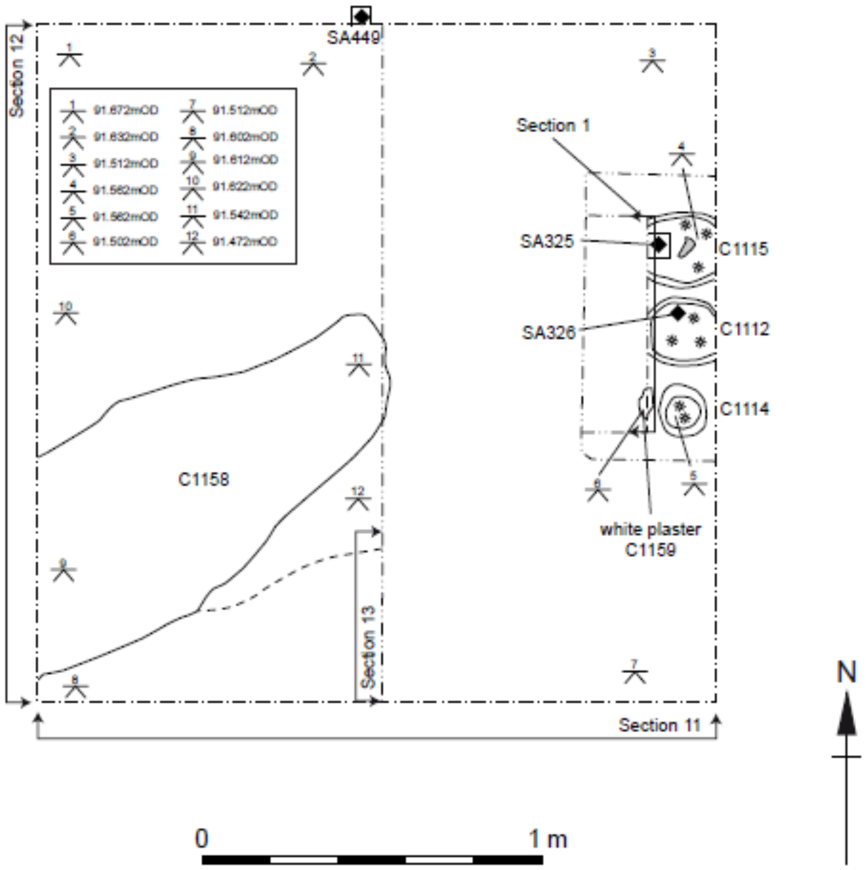


Figure 2.62. Trench 9 plan.

The three hearths were removed simultaneously; the larger of the two, the northern (C1115), and central hearth (C1112/C1155) were sampled for both micromorphology and flotation (Fig. 2.63). The southern hearth (C1114), which was much smaller, was sampled only for flotation.

The contexts excavated above these hearth deposits were cleaning contexts. The purpose of these cleaning contexts was to remove any contamination in order to get accurate readings of chemical elements using the pXRF on the hearth deposits. A 1cm cleaning context C1108 was removed above the northern hearth (C1115) and a 1cm cleaning context (C1109) was removed above the central and southern hearths (C1112/C1155 and C1114).

The presence of the hearths was initially identified during the excavation of C1155, a half-section of the eastern side of the trench. Containing chert, shell and bone, with small lime deposits scattered throughout, the half-section included a spread of charred deposits, concentrated above the red-ringed hearth (C1115). Overlaying this charring was a deep (15cm) deposit with minimal evidence for human activity (C1154), likely alluvial wash, which was sandwiched between the charring in C1155 and later evidence for *in-situ* burning in C1153.

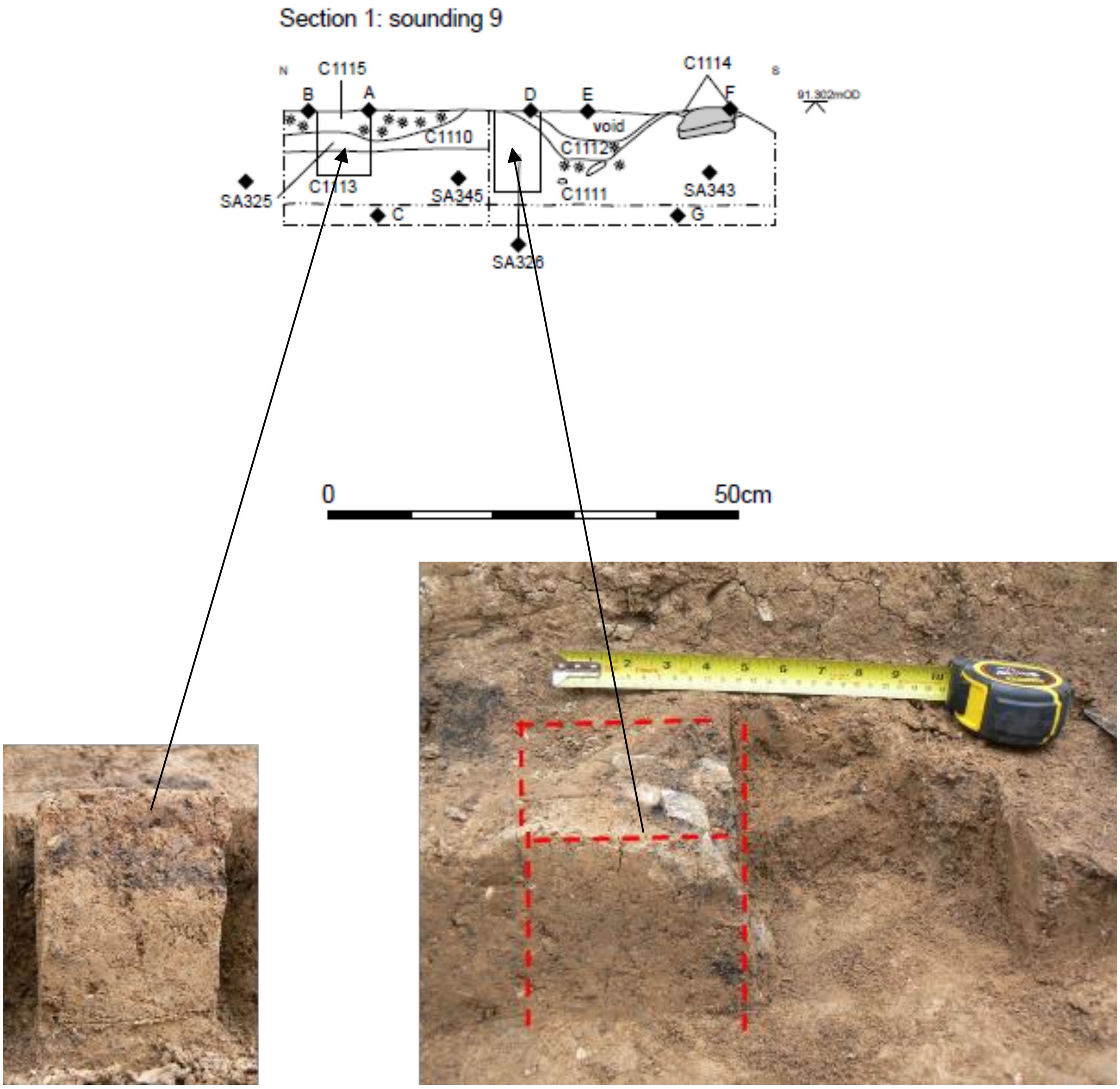


Figure 2.63. Top: Section 1 showing three hearths (C1115, C1112/C1155 and C1114) in Trench 9. Bottom left: sample <325>, arrow indicating location on section. Right: red lines indicate location of sample <326> in the hearth deposit, arrow indicating location in section.

The later episode of burning in C1153 presented a broad spread of charred material in the eastern side of Trench 9, *ca.* 4cm deep, with a large amount of chert and shell, a few sherds of pottery (possibly intrusive) and lime deposits throughout. No pottery was recovered beneath this context. The eastern and western sides of the trench were extensively sampled for flotation and geoarchaeology. Fourteen pXRF readings and spot samples were taken at 1m intervals across the trench and at strategic points across the grid, focussing on areas of burning and lime deposits (Fig. 2.64). Above this layer of intense activity, a thin cleaning spit was removed (C1152), which was packed with flint and shell, bone, including sheep and crab claw, and small pieces of fired clay, including a tiny clay bead in a fine, soft, lightly fired fabric (SF18). The latest deposits excavated (C1151 subsoil and C1150 topsoil), demonstrated a dense mix of materials, likely disturbed by root and ploughing activity.

Figure 2.64. Locations of pXRF readings taken in C1153, Trench 9.

Trench 9 discussion and interpretation

The lowermost deposits of Trench 9 attest intensive burning activity in the form of three adjacent fire installations or hearths. We are as yet uncertain as to their exact function but the contextual and material attributes all point to a Neolithic date for these features.

Excavations in Trench 10

Sabr Ahmed and Chris Beckman

Introduction

Trench 10 is located *ca*. 15m east of the southeast edge of the mound at Bestansur (Figs 2.1, 2.3). It is the northernmost of three trenches (Trenches 8, 9, and 10) excavated in the large field situated to the east and southeast of the mound. As with all the trenches excavated in fields where cereal cultivation was ongoing, care was taken to cause minimum disruption to the crop.

Sequence of structures, deposits and features

The lowermost deposits in Trench 10 included many lithics, including chert cores, and no pottery sherds, and are probably of Aceramic Neolithic date but no architectural features were encountered (Fig. 2.65). Overlying these deposits were spreads of stones and sherds (such as C1162, Fig. 2.66), typical of post-Neolithic occupation at Bestansur and probably dating to the Neo-Assyrian period and later.

Figure 2.65. Trench 10, C1164, looking south.

Figure 2.66. Trench 10, base of C1162, looking east.

Trench 10 discussion and interpretation

The excavated levels in Trench 10 match well with those excavated in other trenches at Bestansur, with probable Aceramic Neolithic levels situated 40-50cm below the modern field surface. Overlying these deposits there is evidence for paving or disposal of significant quantities of sherds and stones from much later periods (Fig. 2.67).

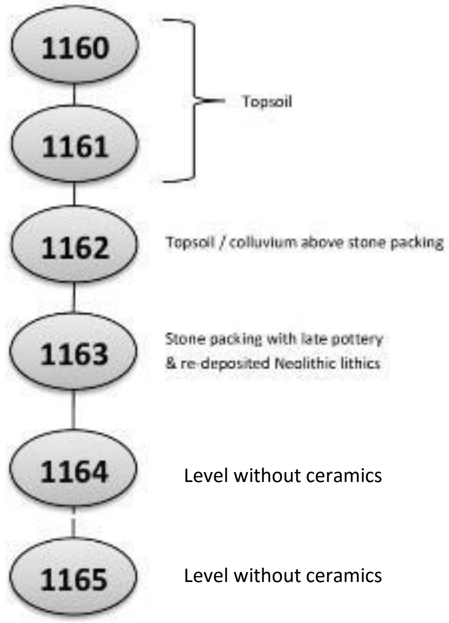


Figure 2.67. Matrix of contexts in Trench 10.

Summary of results from excavations in Trenches 1-10

Roger Matthews and Wendy Matthews

Excavations in Trenches 1-10 have achieved our principal aim in establishing the existence and locations of intact Early Neolithic deposits at Bestansur. In all trenches, except 3 and 6, *in-situ* Neolithic deposits were certainly or probably reached, and in three trenches (1, 7 and 8) intact Neolithic architecture was excavated. These results promise well for future open-area excavation of at least one part of the site. It is clear that any excavation of Neolithic levels within the topography of the mound itself will need to remove at least 1.5-2m of later layers and slope wash before reaching Neolithic deposits. In the fields surrounding the mound, by contrast, our excavations in Trenches 4-5 and 7-10 demonstrate that Neolithic deposits are there to be excavated at depths of 30-50cm below the modern surface. These upper deposits of plough soil and wash can be rapidly removed in future as they lack contextual integrity.

The Neolithic deposits excavated in the fields around Bestansur all appear to date to the Aceramic Neolithic as no definitely identifiable sherds of Neolithic pottery were recovered in excavation. The site appears to have been abandoned for a long time at some stage after the Aceramic Neolithic, with a resumption of human presence at the site only in the Iron Age several millennia later. No Chalcolithic or Bronze Age materials were found at Bestansur. The existence of Chalcolithic and Bronze Age sites in the vicinity of Bestansur shows that the abandonment was local and not part of a regional episode. Such shifts in precise settlement locations may have been connected with episodic movements of the major spring at Bestansur or of the river flowing from it. Future geomorphological and palaeo-environmental research in the area will address this and other related questions.

Chapter Three: Architecture, Activities and Site-Formation Processes: Geoarchaeological Approaches and Observations

Wendy Matthews

Geoarchaeological approaches and key research themes

A range of geoarchaeological techniques are being applied at Bestansur to characterise sediment and soil sequences on and off-site. The specific aims are to study continuity and change in Early Holocene climate and environment and in Neolithic ecological and social lifeways. To achieve this we are analysing multi-proxy indicators of palaeoclimate and environment, source materials and technological choices, and micro-traces of the nature, organisation and timing of activities. We also aim to investigate the context, taphonomy and preservation of artefactual and bioarchaeological remains by study of burial conditions and site formation processes.

This report begins with a review of key research problems and questions that we aim to address in these geoarchaeological analyses with regard to the Neolithic more widely as well as the Central Zagros in Iraqi Kurdistan in particular. It then examines the geoarchaeological techniques that we are applying, followed by a discussion of each of these key themes and emerging data from Bestansur. Although this current report is largely based on field observations, as many of these analyses are ongoing, preliminary results from initial micromorphological and bulk geoarchaeological analyses are discussed in each section to inform on excavation and sampling strategies and highlight ways in which these are contributing to key themes.

Climate and environment

The importance of climate and environment has been re-emphasised in recent research on the Neolithic more widely - as significant factors in spatial and temporal variability in biomes and thereby in the viability and histories of early sedentism and the inter-relationships between humans, plants and animal (Zeder 2009). There is increasing evidence for local and regional variation in plants and animals and in human inter-relationships with them. Soils, sediments, minerals and water sources are also central to human, plant and animal life and the choices that strategies that are made (Rosen and Roberts 2009).

Was the climate colder and drier in the early Holocene, as current interpretations of Lake Zeribar lake cores 45km to the east suggest (Hole 1999; Stevens *et al*. 2001; Wasylikowa *et al*. 2008)? How did society respond to climate change in the Early Holocene? What sediments and soils surround the site of Bestansur, and how were they utilised? Are there any indications of climate and environment within the built settlement and in the resources that the inhabitants were selecting?

Ecological strategies and pathways

There is increasing evidence of local and regional variation in environment and ecological strategies and pathways in the development of agriculture across Southwest Asia as well as globally (Willcox 2005). Which strategies and choices were made at Bestansur? Is there evidence of diversification and/or specialisation in the use of local and wider resources at Bestansur in the Early Holocene (Flannery 1969; Stiner *et al*. 2000; Savard *et al*. 2006)? Are there any traces of past agricultural practices in off-site sediment and soil profiles, and/or in the micro-biological residues on-site, such as early plant and animal management including penning (see also Chapters Five-Eight)?

Sedentism

How did communities become more sedentary? Were initial activities at Bestansur associated with periodic hunting/gathering or were they from year-round settlement? Was there periodic fission and fusion of populations in order to obtain resources and socialise, as increasingly evident at other sites in Southwest Asia (Rosen and Roberts 2009)? What high-resolution microstratigraphic and microarchaeological evidence is there for the nature, seasonality and periodicity of depositional sequences and specific biomarkers at Bestansur (Monks 1981; Fairbairn *et al*. 2005; Chapters Five, Seven and Twelve)?

Social roles and relations

How were society and activities organised across the community and within individual social units? Was the household a key social unit, as many studies of Neolithic sites have suggested (Kuijt 2000; Bloch 2010)? Or, is there evidence of other social units and networks as emerging at a number of sites, such as Çatalhöyük (Pilloud and Larsen 2011)? How was space, structured and organised at short and longer term timescales? What indicators are there of social actions, roles and interaction and exclusion during the life-cycle of individual features, spaces and buildings across the community and generations, at the scale of single deposits, sequences, site levels and the history of the settlement?

Technological choices

What and how were technological choices and innovations made during Neolithic transformations? There is considerable evidence for considerable shared knowledge of materials and technology across Southwest Asia as well as local and regional variations (Özdoğan 2002). What and how were such choices made at Bestansur and what was the site's role in innovation more widely?

Symbolism and ritual

Are there any traces of ritual and activities such as feasting, which are argued to have played a key role in Neolithic society and lifeways (Hodder 2010)?

Geoarchaeological techniques

The geoarchaeological techniques applied to examine these questions and materials include detailed field descriptions and lab analyses of deposits to study indicators of: climate and environment; the nature, spatial organisation and frequency of traces of activities; the composition and technology of architectural materials; as well as indicators of site formation and burial conditions. These analyses include:

In the field:

- detailed field descriptions and handling of deposits to study composition, structure, properties, boundaries and inclusions of deposits, adapting methods developed in soils science (Hodgson 1976) and archaeology (Courty *et al*. 1989; McAnany and Hodder 2009);
- Portable X-ray fluorescence (pXRF) to analyse elemental composition of materials (Emery and Morgenstein 2007; Speakman 2011; see also Chapters Five and Nine).

In the laboratory:

- micromorphology - microscopic study of sediments and micro-artefactual and microbioarchaeological remains in resin-impregnated thin-sections, 14 x 7cm, 25-30µm thick, to analyse the precise depositional context, associations and post-depositional alterations of components and materials in archaeological deposits and contexts and thereby their ecological and social significance. These thin-sections are prepared using a Brot grinder polisher and epoxy resin, and analysed in plane-polarised light, cross-polarised light, oblique incident light and fluorescent light, following internationally standardised methodology (Bullock *et al*. 1985; Courty *et al.* 1989; Matthews 1995; Stoops 2003; Goldberg and Macphail 2006):

- spot and bulk X-ray diffraction (XRD) to study the mineralogy of clays, sediments and architectural materials and potential source materials and preservation environment;
- particle size analysis to study the properties of sediments, soils, depositional and post-depositional environments and architectural materials;
- pH to study acidity and alkalinity of sediments, materials and burial environment (Schiffer 1987; Goldberg and Macphail 2006).

Nine block samples were collected for micromorphological analysis of architecture and activity areas in spring 2012 and the thin-sections have recently been manufactured from these. Additional micromorphological samples are being studied by Sarah Elliott with regard to early animal management and related ecological and sociocultural studies (Chapter Five). Ten bulk sediment samples have been analysed for: particle size determination (Blott 2008), pH (ministry and mineralogy, pending). Preliminary results from these micromorphological and bulk geoarchaeological analyses are briefly discussed below to inform on excavation and sampling strategies and highlight ways in which these are contributing to key themes.

Laboratory analyses

Ten samples from natural, wall and floor materials, and ashy occupation deposits have been analysed for bulk pH and particle size determination and identification of their mineralogy through Quaternary Scientific (QUEST), School of Human and Environmental Sciences, University of Reading. The results are reviewed briefly below.

pH determination

The pH value was determined in water (Ministry of Agriculture, Fisheries and Food) and by adding calcium chloride (Avery and Bascombe 1974). Initial results are discussed below in the section on preservation and post-depositional alterations.

Particle size determination

The particle size of loose material in bulk sediment sample bags was analysed by laser granulometry and the statistical programme GRADISTAT (Blott 2008). Results indicate that all deposits analysed are fine grained with >20-38% clay, >60-75% silt and <0-5.5% sand, including natural, wall and floor materials, and ashy occupation deposits.

Nine out of ten of these can be classified as 'silty clay loam' according to Hodgson (1976) or 'fine silt' according to Blott (2008) who developed the programme GRADISTAT. One deposit is finer grained and can be classified as silty clay (Hodgson 1976) with >35% clay at 38.2% clay and 0% sand, C1202, used for wall construction in Trench 7.

Climate, environment and resources

Geology

Bestansur is located in the Shahrizor basin at an altitude of 553m above sea level, at 35˚22'36.69" N, 45˚38'44.14" E. The location selected for the site of Bestansur in the Neolithic is at the boundary of three geological zones and thereby close to a range of different ecozones and a major spring. These geological zones run northwest-southeast through Sulaimaniyah province due to uplifting and folding by the collision between the Arabian and Iranian plates. The three geological zones in the region of Bestansur comprise from west to east (Saeed Ali 2008, 72-77, fig. 3.2 after Sissakian 2000):

- alternating thin beds of shale and marl

- blueish white marl and marly limestone
- white or grey pelagic limestone.

There are mountain ranges to the west, which rise from foothills 10km away to peaks >1600m at Qaradagh, 30km distant. To the northeast a series of ridges start at just 2.3km from the site and rise to a height of 1500m within 10km of the site. The mountains on the border with Iran, 35km away, are over 2000m high. The Shahrizor basin and fields around the site are covered by alluvial and fan deposits, which today provide rich agricultural soils.

The current spring 400m north of the site at Bestansur is large and perennial and is likely to have existed in the Neolithic as the area is underlain by impervious marl and is at the juncture of several geological zones. This spring feeds a small river that runs into the Tanjero river currently 2.6-4km away, which leads to the Diyala river, a major tributary of Tigris river. Both the spring by Bestansur and the river that leads from it today host rich riparian vegetation, including reeds and trees. The bed of the river adjacent to the site is covered in large cobbles, which were probably a source of at least some of the groundstone from Neolithic levels at the site which is being studied by David Mudd (Chapter Ten).

Chert of red, grey, yellow, brown and white colour is recorded as present in the Qulqula Radiolarian formation (Saeed Ali 2008, 73).

A major aim of the second season at Bestansur is to collate existing studies of the geology in the region of the site and to investigate the availability of local and regional resources and palaeoenvironment (see also Chapter Eight). Key objectives are to study buried soils in the environs of the site as indicators of palaeoenvironment and any agricultural practices as well as cave speleothems as indicators of palaeoclimate.

Lake Zeribar, 45km to the east of Bestansur, is one of the longest and best studied lake core sequences in Southwest Asia (Van Zeist and Bottema 1977; Wasylikowa *et al*. 2008). A range of multi-proxy palaeoenvironmental records, however, are urgently needed as climate and environment in this region varies considerably locally. Lake Zeribar is at a significantly higher altitude than Bestansur, at 1300m above sea level, and there are a number of outstanding discrepancies in current data from Zeribar (Wasylikowa *et al.* 2008; W Matthews in press).

Natural sediments at the base of the mound

In the field natural sediments were exposed at the base of Trenches 4 and 5 (Chapter Two). In Trench 4 a *ca*. 90cm thick sequence of natural deposits was excavated in a 1 x 1m trench down to 90.69m OD. The lowermost natural deposits are pale brown (7.5YR 6/4 light brown) with carbonate inclusions and more than 45cm thick. At 91.15m OD there was a gradual change to more reddish orange brownish deposits (7.5YR 5/4 brown), *ca.* 43cm thick. In the field texture by feel analysis suggested that the particle size of these natural deposits was silty clay (after Hodgson 1976). Particle size determination by laser granulometry characterises these as 'silty clay loam'.

Natural sediments: Trench 4 SA447

SA447 was collected to examine the boundary between pale brown (7.5YR 6/4 light brown) and slightly more reddish orange brown (7.5YR 5/4 brown) natural deposits, at 91.15mOD, and the nature of any differences between these two deposits (Fig. 3.1). Initial analysis suggests that there are more carbonate inclusions in the lower paler deposits and reddish orange clays in the upper deposits (Fig. 3.1), which partly explains the slightly coarser particle size results from laser granulometry results, when compared to wall and floor materials.

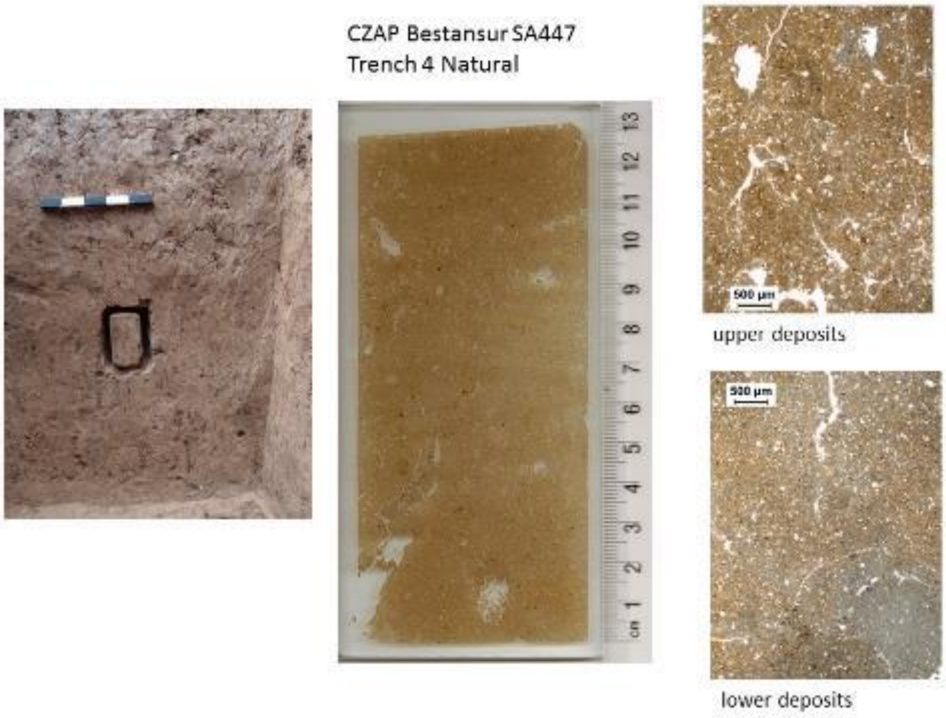


Figure. 3.1. Micromorphology sample SA447, Trench 4.

Preservation and post-depositional alteration of deposits and materials

The burial environment at Bestansur is oxidising (aerobic) and moist, with no macroscopically preserved water-logged nor desiccated materials. We are currently analysing the pH, clay mineralogy, particle size and micromorphology of deposits on site, below the mound, and off-site to investigate burial environment and preservation conditions.

Neolithic and Post-Neolithic deposits at Bestansur have been subject to a range of post-depositional alterations by anthropogenic and pedogenic agencies and processes that need to be considered in evaluation of all artefactual and bioarchaeological remains and contexts. The conditions, agencies and processes currently observed and being investigated are briefly reviewed here.

pH, acidity and alkalinity is a major factor in post-depositional alterations of deposits and materials. pH is of particular relevance to studies of two key indicators of plant and animal related activities currently being investigated: plant silica phytoliths, which dissolve in highly alkaline environments, with a pH > ~ 8.2 (Tsartsidou *et al*. 2007; Matthews 2010); and calcareous spherulites, which dissolve in a pH of < ~<6 (Canti 1999). Both of these indicators have been detected in microscopic analysis of spot samples and micromorphological thin-sections of sediments from Bestansur (Chapter Five), suggesting that in at least some contexts the pH is approximately neutral.

Initial bulk pH resultsuggest that the soil water is slightly alkaline and the sediments, when combined with calcium chloride, more neutral. The pH value in water from all samples is close to and above the limit for preservation of silica plant phytoliths at 8.15-8.58. The pH value after adding calcium chloride, however, is lower and more neutral ranging from 7.37-7.57.

Soil and sediment properties and burial environment

Shrink-swell of clays and alternate wetting, drying, heating and freezing of materials can affect the structure, preservation and movement of organic and inorganic material in soils (Schiffer 1987). The Shahrizor plain is currently subject to marked seasonal variation in climate and burial environment, with freezing conditions in winter, heavy rains in spring and periodically in other seasons, and dry conditions and high temperatures >40-50˚C in summer. We are currently analysing the abundance and mineralogy of clays at Bestansur by particle size analysis and XRD, to evaluate their shrink swell properties, as well as to investigate their properties and likely sources.

Deposits were moist during excavations in spring 2012 (March-April), but dried and cracked quickly when exposed, particularly to the sun. We used new woven plastic sacks to cover deposits and section faces daily to retain moisture. This successfully reduced drying and cracking of deposits, and thereby helped to retain their colour, visibility and depositional structure. Future excavations, particularly in the summer, will need to manage moisture retention by using shelters and excavation covers.

Carbonate nodules are present in a range of deposits at Bestansur, particularly those selected for construction of pisé walls, as discussed below. We are currently investigating whether these were a constituent part of the materials brought to the site for construction, and/or whether the carbonate nodules have formed in-situ and are indicative of climate and burial environment.

Biological and anthropogenic agencies and processes

Evidence of a range of post-depositional biological and anthropogenic agencies and processes was observed during excavation at Bestansur, both as active agents as well as relic indicators of these. The nature and extent of these post-depositional alterations is being assessed in the current laboratory investigations.

Relic burrows from past plant and soil faunal activity and bioturbation were identified during excavation of all contexts, as channels in-filled often with dark greyish brown fine sediments, particularly in section profiles.

Ploughing and crop planting currently affects deposits to a depth of *ca.* 30-45cm, and is creating a mixed and reworked organic rich topsoil (Ap horizon).

Plant roots affected all horizons excavated, even natural deposits 1-1.9m below the modern surface. The dwarf shrub and fodder crop *Prosopis* (local name *khanook* (sp.)) currently grows by the side of the fields in which the excavation trenches are located. This shrub has a particularly deep and active root system that extends below the limit of excavation. These roots are thick, at up to 3cm in diameter, and were particularly dense and long (*ca*. 70cm) in some trenches, notably Trench 4, close to the road where they are growing. Current cereal and weed roots are also present in topsoil.

Soil fauna are active and include large earthworms and ants, active today. We expect to encounter earthworm granules in micromorphological thin-sections, which may be several microns to >2mm in size (Canti 2003, 144).

Mollusc shells were observed in many Neolithic deposits across the site. The predominant species is *Helix Salomonica* (Chapter Twelve). These shells were often present as discontinuous lenses across entire excavated surfaces, as in Trench 4, as well as occasional in large extensive deposits greater than 2 x 1.8m, and 8cm thick, notably in Trench 5 C1078. As these are associated with surfaces and artefacts and bones lying flat, at least some of these distributions are likely to be from human processing, consumption and discard of these molluscs. *Helix Salomonica* is common on many Late Pleistocene and Early Holocene sites, and may have been consumed as one component of a 'broad spectrum diet' (Chapter Twelve; Reed 1962; Flannery 1969). Some molluscan species burrow or occupy relic burrows. The molluscan assemblage at Bestansur and its environmental, ecological and socio-economic significance is currently being studied by Nick Harper (Chapter Twelve).

<u>Small burrowing mammals</u> were observed in the fields, and are likely to have created some of the burrows observed on site.

In-situ Neolithic deposits

Intact Neolithic deposits were reached in eight out of the ten trenches excavated, and are preserved in an area of more than 50m north-south and 100m east-west in the fields either side of the archaeological mound at Bestansur. This currently known extent is similar to that of many Neolithic sites (Baird 2005). The site could be larger than this as surface survey suggests that Neolithic lithics are scattered over an area of more than 250m diameter around the site of Bestansur. The extent of the site will be investigated in by geophysical survey in summer 2012 and by further surface survey.

The modern surface in these fields above and around the site slopes gently northwest-southeast. Neolithic levels are currently preserved at *ca.* 30-50cm below the modern topsoil and a stone horizon which is present in many trenches. Neolithic deposits were encountered at *ca*. 92.25-92.50m above site datum (m OD) in the west (Trenches 4, 5, 7) and *ca.* 90.75-91.5m OD in the east (Trenches 8 and 9). Deposits that are probably Neolithic in date were also revealed in the base of the mound itself, in Trenches 1 and 2, as they contain Neolithic lithics but no later pottery. These basal levels without pottery are similar in height to intact Neolithic levels in the adjacent fields, further supporting a date in the Neolithic, at 92m OD above site datum in Trench 1 on the eastern edge of the mound. The lowermost Neolithic levels excavated to date are in Trench 8 at 89.88m OD.

This similarity in levels suggests that the site at Bestansur may have been relatively flat without a raised central mound with a gentle northwest-southeast slope in the Neolithic. This apparent flatness, however, may be due to erosion and activities at the site since the Neolithic, including possibly levelling for construction in later periods and modern ploughing. There could still have been a small Neolithic raised mound in the *ca*. 52m distance between Trenches 1 and 2, below the top of the current mound, which currently lies 7-10m above Neolithic Levels. Much of this raised mound, however, is likely to be Neo-Assyrian and later in date, as there is abundant pottery from these periods at the site (Chapter Thirteen), and intact post-Neolithic levels with preserved architecture were excavated in the base of the mound as low as *ca.* 93m OD, in Trenches 1, 3 and 6. Some of these buildings, however, could have been terraced into an earlier, underlying Neolithic mound. Further excavations on the mound, therefore, will continue to investigate the nature and date of occupation levels on the mound and the extent and height of Neolithic occupation (Chapter Two and Thirteen

Architecture

This research is investigating how buildings and surfaces may have been used to create settings and boundaries for particular fields of action and social roles and relations, as the selection and placement of specific materials is not only functional, but also a medium for social representation (Carsten and Hugh-Jones 1995; Fisher 2009; Bloch 2010; Robb 2010).

Study of surfaces and the residues on them, can provide avenues for investigation of continuity and change in ecological and social actions, strategies, roles and relations at high-resolution timescales in the order of seasonal, annual, life-cycle and longer-term cycles (Kramer 1979; Matthews 2005; Matthews in press).

Methodology

We are currently analysing the materials and technology of the walls, as outlined in the introduction, using:

- field observations and recording to examine macroscopic and structural properties of materials
- portable XRF analysis to study elemental composition;
- XRD to characterise bulk and clay mineralogy;
- Laser granulometry to determine particle size;
- Micromorphology in large thin-sections to study composition, structure and post-depositional alterations;
- pH to analyse alkalinity and acidity of materials and the burial environment.

Results from field observations are examined here, with reference to preliminary results from laboratory analyses.

Buildings

The Neolithic architecture in both the west and east of the site in Trenches 7 and 8 is rectilinear and encloses small rooms and spaces in Trench 7 and 8. In both of these areas it is oriented northeast-southwest, with the wall corners not the wall faces aligned to the cardinal points. The probable Neolithic architecture in Trench 1 is also rectilinear and similarly oriented. This orientation is common in much later architecture in Mesopotamia, and has a range of environmental and social benefits, due in part to differences in light and temperature (Shepperson 2009). All of these walls were constructed from compacted mud – pisé/tauf.

In Trench 7 the walls are 31-37cm thick with an extant height >25cm (Fig. 3.2). The southeast wall is more than 2m in length. The walls demarcate at least three spaces in this 2 x 2m trench. These comprise a small probably roofed room, with inner dimensions of 72-76cm (northwest-southeast) x >88 cm (northeast-southwest). From the current exposure of only 2 x 2m it is not yet fully certain whether the other spaces are roofed or unroofed nor whether they are exterior. The northern space may be exterior or an unroofed courtyard. The south-eastern space is >1.2m long >0.58 m wide. The placement of two grindstones in the northern and south-eastern spaces and burial of a lithic cache (C1172) suggest that this area of the site was a focus for a range of activities including grinding and knapping (see also Chapters Two and Ten).

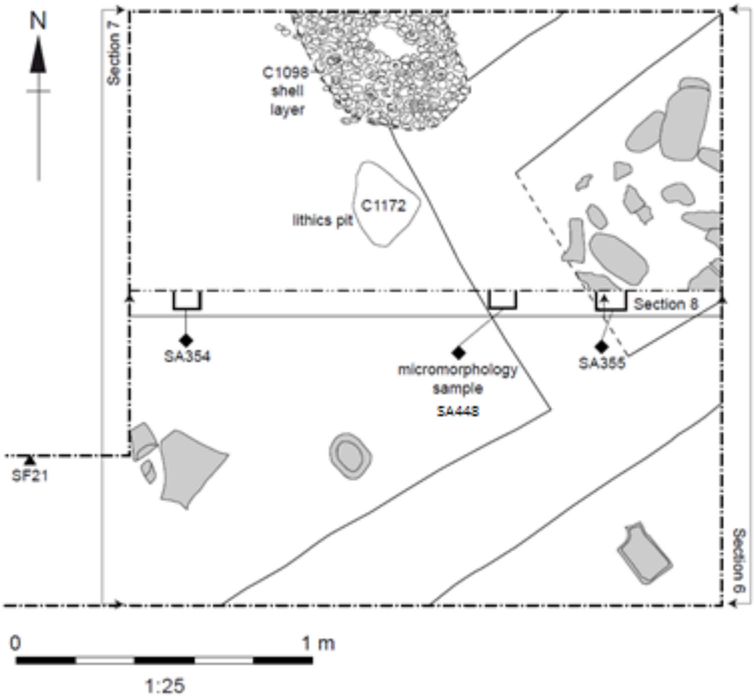


Figure 3.2. Composite plan of Trench 7.

In Trench 8 the walls enclosed a small room *ca.* 0.65 x >1m (Chapter Two). The residues on the floor of this small interior room suggest that it was associated with activities related to burning, lithics, and possibly flecks of ochre, pending results from all specialist analyses. The thickness of the walls in Trench 8 needs to be confirmed by further excavation. The surviving walls are 32-37cm thick.

The only other probably Neolithic wall encountered in the 10 trenches was in Trench 1, in the northeast corner. It is also oriented northeast-southwest. The absence of pottery in associated deposits and the absolute height of the base of the wall to date, at 92m OD, suggest this wall may be Neolithic. The inner northeast and northwest wall faces were well preserved and possibly plastered/scorched in places making identification in the field very clear, pending full micromorphological analysis of SA452. The fill of this probable internal room included sparse scorched/red aggregates similar to the northwest wall face. The southwest and southeast wall faces were more difficult to identify as the fill was of similar composition to the wall. The architecture exposed comprises corner of probable room >1.0 x 0.95m. The floor or a feature in the southwest corner was covered/lined with flat stones C1102, C1103 and C 1105.

Other architectural features

Hearths

Other architectural features include the hearth settings in Trench 9. These were constructed from pisé and moulded to form two adjacent small circular hearths *ca*. 20cm in diameter in the north of the setting (C1112 and C1115) and another small circular feature 16cm across (C1114). Traces of white plaster below this small southern feature suggest it may perhaps have been a basin early in the history of the use of this composite installation. These installations were aligned due north-south, in contrast to the architecture in Trenches 7 and 8 which were aligned northeast-southwest. Pending further excavation, it is not known whether these installations abut a wall which was either free-standing or part of a building/courtyard, as this setting is at the very eastern edge of the trench. Lenses of charred plant remains and burnt and non-burnt aggregates on a possible floor surface were partially exposed at the base of this trench in the south and west sections and examined in micromorphological SA449, discussed below, which may be contemporary with the early use of these features. An extensive layer of sloping ash C1158 may be contemporary with the latest use of the composite setting of hearths. Micromorphological analysis indicates that this ash is from relatively high temperature burning (SA286, discussed below), however, and may therefore be from larger hearths/areas of burning.

Stone settings
A stone setting was partially uncovered in the northwest corner of Trench 7: flat stones 8-22cm in size, were laid in a sloping area *ca.* >52 x 60cm (Chapter Two). Its context and use is currently uncertain pending further excavation.

Architectural materials and technological choices
Wall construction
Field and particle size analyses have established that walls were principally constructed from compacted pisé/tauf made from slightly reddish brown silty clay (Trench 7) to silty clay loam (Trench 8) with white calcareous aggregates.

Other materials observed in the field include a greenish silty clay brick/feature in Trench 8, exposed below C1181. This is being analysed by pXRF and for mineralogy.

Preliminary micromorphological analyses have also been conducted, and the results from thin-section analysis are summarised here.

<u>Wall materials and architectural technology: Trench 7 SA448</u>
Micromorphology sample SA448 was selected to examine the materials and technology of the Neolithic pisé walls in Trench 7 (Fig. 3.3). The walls were constructed from a slightly reddish orange brown silty clay with carbonate inclusions <50 microns to >5mm in size. There are sparse fine linear impressions and brown staining from plant inclusions that may have acted as sparse vegetal temper to provide tensile strength and flexibility and reduce cracking (Fig. 3.3; Houben and Guillaud 1989).

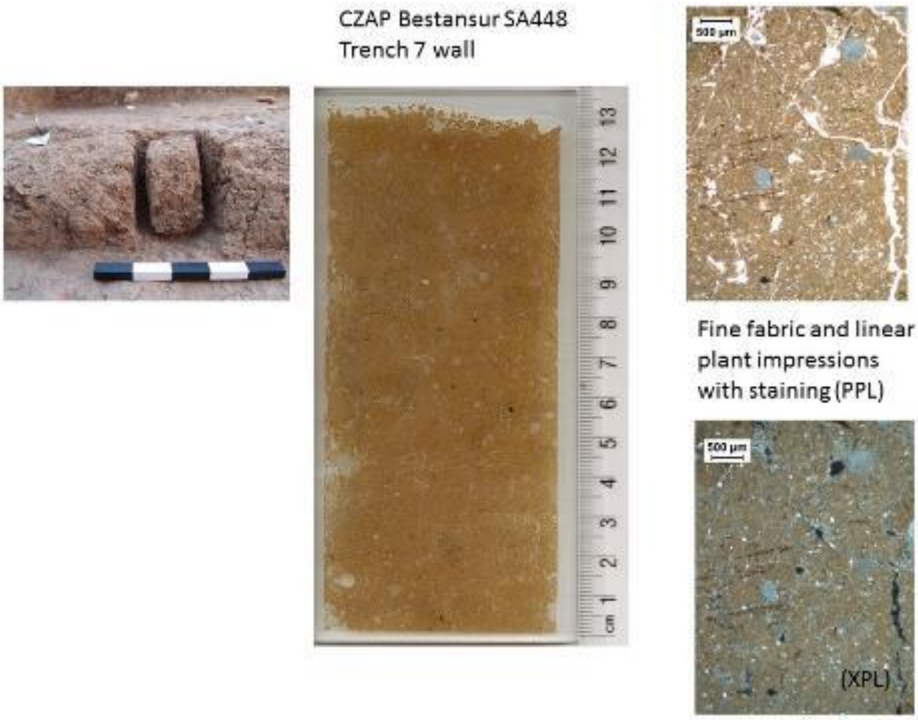


Figure. 3.3. Micromorphology sample SA448, Trench 7.

Wall materials and architectural technology: Trench 1 SA452
Micromorphology sample SA452 was studied to characterise the materials and technology of the pisé walls at the base of Trench 1, which are probably Neolithic in date as not pottery was recovered from these levels (Fig. 3.4). The reddish slightly sloping wall face probably continues below the current level of excavations, as indicated at the base of the sample block (Fig. 3.4). The outer ~1.4cm of the wall face is more red in colour than the wall interior. One key question is whether this reddish colouration is due to burning after construction of the building, as fragments of architectural materials in the fill suggest, or due to the application of a plaster render. Initial micromorphological analyses suggest that the boundary between the face and the interior of the brick is gradual due to post-construction burning, although root disturbance along the wall face compounds this interpretation (Fig. 3.4). More detailed analyses are ongoing and will include infra-red microscopy to determine whether there are any alterations of the mineralogy by burning (Weiner 2010).

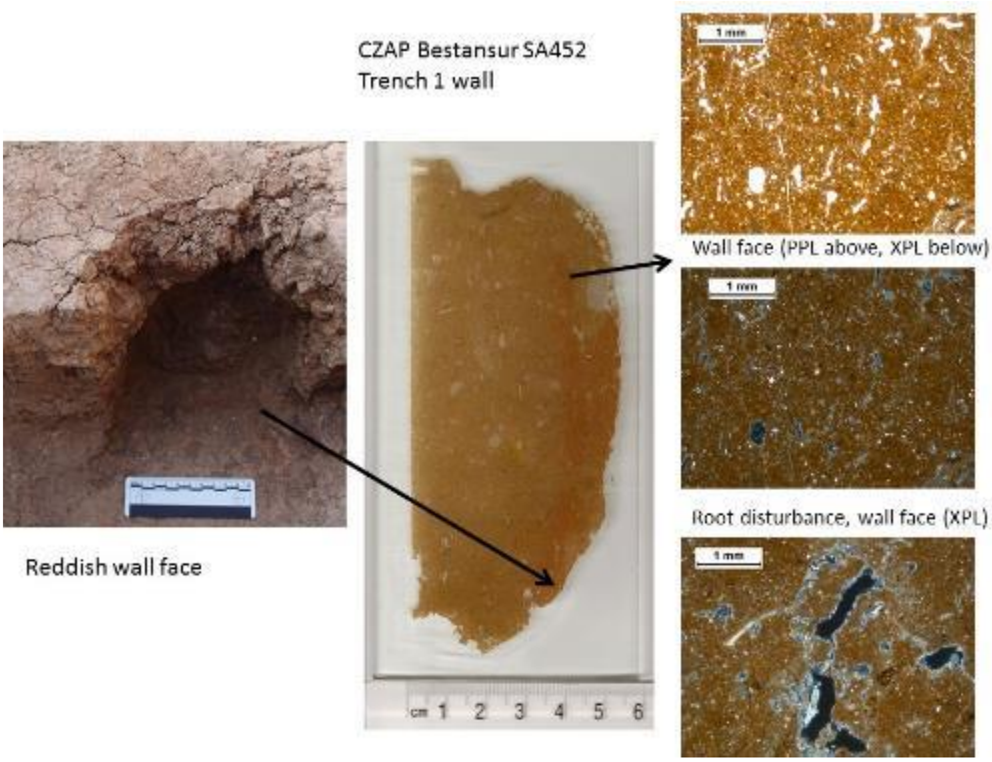


Figure 3.4. Micromorphology sample SA452, Trench 1.

Surfaces
A range of Neolithic surfaces have been observed in the field (Chapter Two) including:

Thick packing with stones (Trench 8, thin-section SA450 below);
Stone-paving from flat stones in Trench 1 (C1102, C1103 and C 1105);
Silty clay packing/surfaces in a range of excavation trenches;
Thin-white plaster lining a partially excavated ?basin, Trench 6;
Lenses of white aggregates which may be from possible relic surfaces made from materials similar to the pisé walls but difficult to detect due either to trampling in antiquity or to post-depositional bioturbation. These lenses are evident in a range of section profiles including those in Trench 9.

Activity foci and distinct field of action and roles: spatial and temporal variation

Field observations suggest there were a range of foci of activities as summarised here. Corresponding micromorphology samples numbers where collected are given in square brackets, those in *italics* are briefly discussed at the end of this section, those in plain text are being analysed largely by Sarah Elliott. These foci include:

- Possible mollusc processing, consumption and discard:
    - Repeated lenses in Trench 4 [SA352];
    - Dense concentration Trench 5 C1078 [*SA284*];
    - Shell clusters in Trench 7 C1098, although we cannot currently rule out that this is a natural accumulation, possibly in a relic burrow left by a mammal.

- Burnt spreads from activities or discard related to burning:
    - Charred plant remains spreads: Trench 9 C1153, Trench 8 C1182 [SA360];
    - Ash from higher temperature burning:
        - Concentrations: Trench 9 unexcavated ash lens on a surface[*SA449*] and an extensive sloping spread of ash C1158 >1.40 x 0.6cm, 5-8cm thick [*SA350*];
        - Scattered patches e.g. Trench 4 C1082 [SA352];
    - Burnt aggregates: associated with scorched surface Trench 4 C1064 [S357]; Trench 5 above shell layer [*SA284*]; Trench 8 C1181 with patches of ash.

- Constructed hearths: Trench 9 C1115 [SA325], C1112, C1114.

- Possible basin: integrated use with hearths Trench 9, unexcavated white plaster below C1114.

- Grindstones: notably in two spaces in Trench 7 [SA354].

- Lithics cache: Trench 7 C1172.

- Flat stone settings/surfaces/artefacts:
    - Trench 1 C1102, C1103 and C 1105;
    - Trench 7 [SA355].

- Possible red pigment, perhaps ochre: e.g. Trench 9 [*SA285*].

- Stone layers with abraded post-Neolithic pottery and Neolithic lithics may be indicators of relic post-Neolithic activity surfaces but are perhaps of natural origin (see discussion on post-depositional alterations above, and Chapter Thirteen), including:
    - Trench 2 C1038;
    - Trench 5;
    - Trench 8 C1134.

- Rooms: small:
    - Trench 7 [SA355];
    - Trench 8 [*SA450-451*].

The wider context of these and future foci will be analysed in larger area excavations in summer 2012.

Micromorphological observations of floor materials and occupation deposits

Samples from a range of internal and external floor sequences were collected to study how floors surfaces were used to construct settings for particular actions, roles and relations, and whether accumulated micro-residues on surfaces may indicate the history of use of these places and provide evidence of ecology and society.

Floor materials and accumulated deposits: Trench 8 SA450 and SA451

SA450 and SA451 were collected to study the lower and upper floor sequences in a small internal room *ca*. 0.65 x >1m in size (Figs 3.5-3.6). The floor surface was prepared from a thick silty clay loam packing with some stone hard core (Fig. 3.5). Although there were traces of ash and burnt aggregates on the latest floors (C1184-C1185 Chapter Two), the deposits in micromorphological samples SA450 and SA451 were comparatively clean, with sparse charred plant remains. Of interest to reconstruction of the environs, deposits in SA451 included aggregates of oxidised water-laid clay.

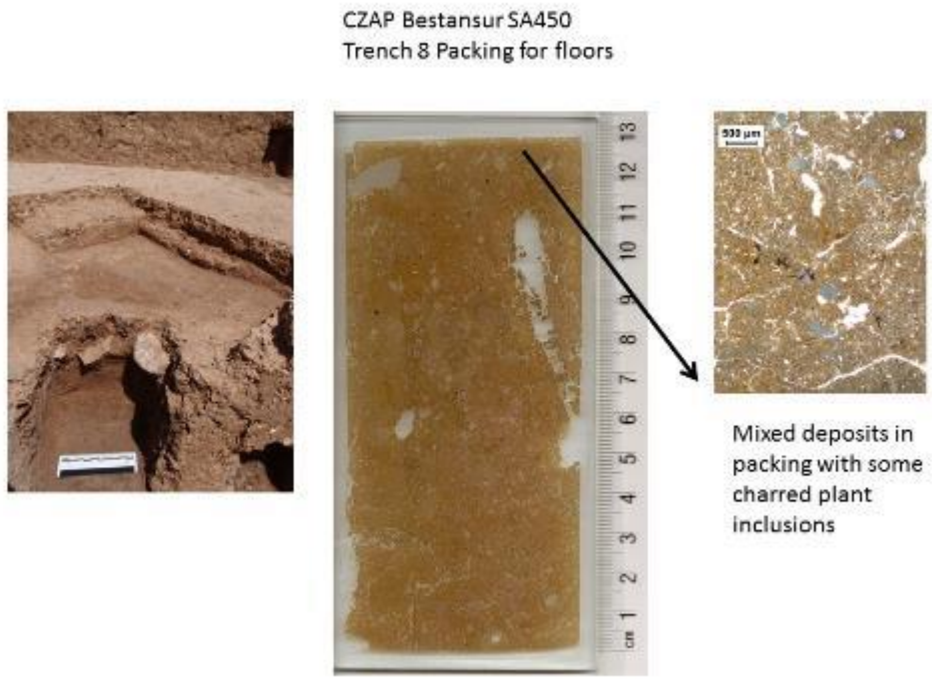


Figure 3.5. Micromorphology sample SA450, Trench 8.

Figure 3.6. Micromorphology sample SA451, Trench 8.

Floor materials and accumulated deposits: Trench 9 SA449 (lowermost unexcavated deposits)
It is currently uncertain whether the features in Trench 9 are within an interior or exterior space, as no walls were encountered during excavation. The basal deposits in SA449 include a basal pale brown silty clay surface, overlain by *ca*. 2cm thick sequence of trampled/swept mineral aggregates, some of which are burnt dark brown, and partially charred occupation debris (Fig. 3.7). More detailed analyses of these micro-residues are currently being conducted including analysis of traces of amorphous organic remains and phytoliths in optical and fluorescent light. Of interest to reconstruction of the environs, the uppermost deposits included aggregates of whitish water-laid carbonate rich clays/silty clays.

Figure 3.7. Micromorphology sample SA449, Trench 9.

Floor materials and accumulated deposits: Trench 9 SA449 (lowermost excavated deposits C1158)

SA286 was collected to examine what activities, fuel and ecological indicators may be present in the extensive sloping layer of ash in the lowermost deposits excavated in Trench 9, C1158. In thin-section these deposits proved to be the best preserved and most plant rich deposits sampled to date (Fig. 3.8). These deposits represent relatively high temperature burning >*ca*. 750°C as they predominantly comprise calcitic ash crystals with few charred plant remains, as carbon tends to be burnt off at temperatures greater than 500°C and many plant materials are calcified at >750°C (Canti 2003; Matthews 2010). A range of well preserved and articulated plant silica phytoliths are also present, including examples of grasses, reeds and probably dicotyledons from trees/shrubs and are currently being analysed. Some of the ashes and plant remains may be derived from animal dung burnt as fuel, as calcareous dung spherulites which form in the guts of animals have been identified (Canti 1999; Matthews 2010). This has important implications for study of early animal management, diet and ecology, which is being studied by Sarah Elliott (Chapter Five). Other micro-archaeological residues including abundant burnt aggregates are also being studied.

Figure 3.8. Micromorphology sample SA 286, Trench 9.

Floor materials and accumulated deposits: Trench 9 SA285 (upper deposits)

SA285 was sampled to analyse the diverse lenses of anthropogenic deposits later in the history of Neolithic activity in this area of the site. These deposits in the field and in thin-section (Fig. 3.9) include, from the base up:

- Deposits with white aggregates, red flecks, perhaps ochre, burnt aggregates, as well as bone;
- *ca*. 2.5cm thick accumulation of ash with burnt bone, burnt aggregates – some with well-preserved plant impressions from moulded materials and charred plant remains.

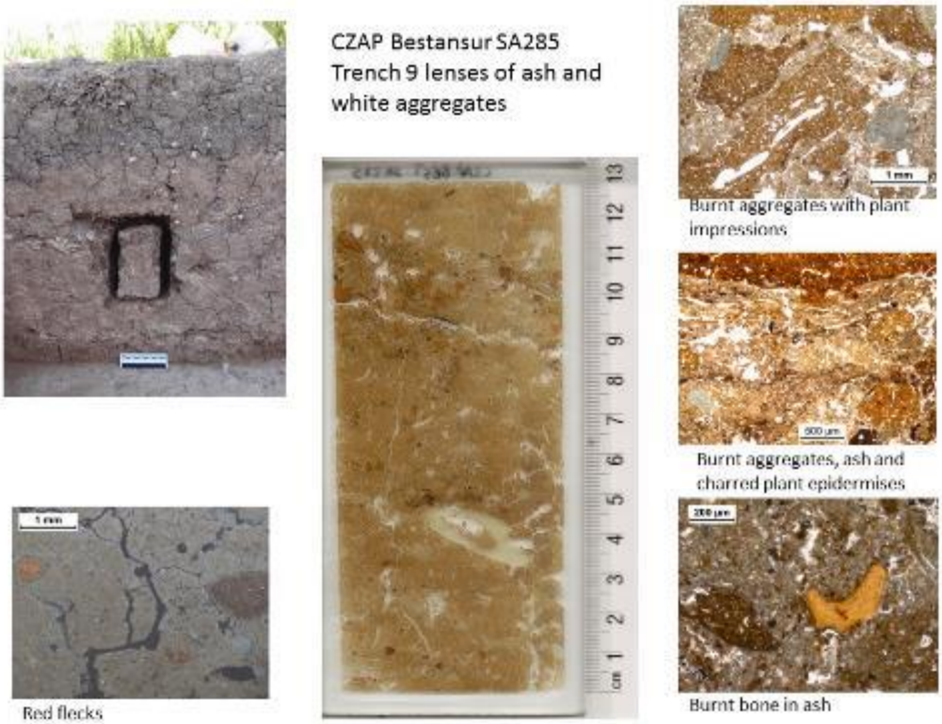


Figure 3.9. Micromorphology sample SA 285, Trench 9.

Floor materials and accumulated deposits rich in molluscs: Trench 5 SA284, C1078

Sample SA 284 was collected to study the deposition and context of an extensive layer of molluscs in Trench 5, C1078 (Fig. 3.10). These molluscs principally comprise *Helix Salomonica,* which is edible (Reed 1962). In thin-section the surrounding deposits largely comprise brown silty clay loam with sparse amorphous organic staining. There is little trace of ash nor charred plant remains from any proximate burning. The growth bands within the mollusc shells are well-preserved and clearly visible in both plane and cross polarised light (Fig. 3.10), and coupled with isotope analysis can provide considerable insight into climate and seasonality (Chapter Twelve). Overlying deposits include some burnt aggregates, but few traces of burnt plant remains.

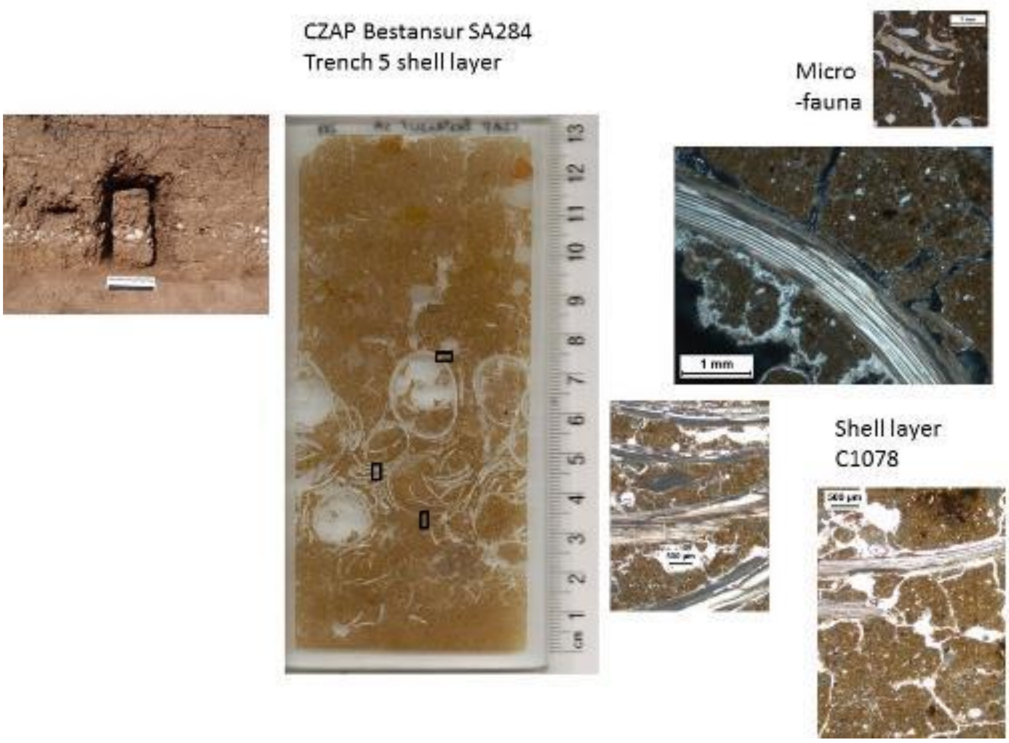


Figure 3.10. Micromorphology sample SA 284, Trench 5.

Micromorphological conclusions

All of these micromorphological samples are currently being studied in more detail, following internationally standardised procedures as discussed above. The pilot samples analysed here indicate the presence of relatively well-preserved microstratigraphic sequences and a diverse range of sediments and micro-archaeological residues for ongoing study of the surrounding environment and Neolithic ecology and society. Of particular note are the well-preserved ashes and phytoliths in SA286, Trench 9.

Comparanda

It is perhaps too early to discuss architectural comparanda as the trenches were only 2 x 2m to establish the nature, depth and extent of Neolithic activity across the site in the first season. Forthcoming area excavations in summer 2012 will focus on larger area excavations to provide a wider context with which to understand the range of activity areas and whether these are interior or exterior and how they were articulated in time and space.

That the architecture is rectilinear suggests it is PPNB in date (Zeder 2009). Where rooms are identifiable, these are small, at less than 0.65-88m in width, but *ca*. 1m or larger length. Small rooms have often been interpreted as storage rooms based on their small size and limited movement. At the PPNB site of Ganj Dareh D, *ca*. 8000 cal BC, however, a wide range of features and artefacts were found on floors of many small rooms, less than *ca.* 1.2 x 1.8m in size including grindstones, pottery, a ritual setting of sheep skulls set into a wall, sub-floor burials, in addition to identifiable storage bins (Smith 1990; Matthews in press). Residues on the floor of the small room in Trench 8 include charred plant remains, burnt aggregates, lithics and possible ochre (Chapter Two). Small as well as larger rooms and spaces were constructed at Jarmo, which is 65km northwest of Bestansur. The layout and sequence of buildings, features and activity foci will be closely compared to the architecture at these and other Neolithic sites in the Zagros and wider Southwest Asia. When excavating Jarmo Braidwood *et al*. (1983, 10) argued that, as at many sites "we have no really good evidence that might specify the use to which the various rooms in the house were out', as few artefacts were left on floors. We hope that this report demonstrates some of the emerging ways in which new interdisciplinary and microarchaeological approaches can provide high-resolution forensic scale evidence on continuity and change in the ecological and social lifeways and strategies of the Neolithic occupants at Bestansur.

Chapter Four: Microarchaeology

Ingrid Iversen

Introduction

Microarchaeology has the potential to produce new and different data as well as testing findings and interpretations from other excavation methods. The nature of the data, its abundance and scale, lends itself to understanding spatial patterns in finer resolution than is typically the case using macroartefacts, architecture and features. The excavations at Bestansur included a comprehensive programme of sampling, processing and recording of microarchaeological material. The overall results are summarised here after first discussing the methods used.

Methods and protocols

Sampling strategy

Sampling was based on a scheme of systematic random sampling and strategic sampling in discussion with excavators and other specialists, and was fully integrated with the flotation procedures. A whole-earth sample of 50 litres was collected by the excavator from each context. Contexts with features, such as architecture or ground stone, or evidence for activity, such as concentrations of artefacts or debris (e.g. flint debitage, burning) were subject to the collection of the complete context – a strategic sample. In some cases sub-samples were taken to ensure a finer spatial resolution, e.g. areas around fixtures and next to walls, and open areas are also sometimes sampled using a grid (Fig. 4.1). Floor surfaces are given particular emphasis as the most likely to retain micro-traces of the activities which took place there.

Figure 4.1. Sampling in Sounding 7: Area marked for microarchaeology sampling with 50 x 50cm grid and spots for portable XRF sampling.

Close cooperation in sampling decisions with all team members is important as each stage produces its own information. Observations by the excavators are a key input into the decision to take a sample. The samples collected are used both for archaeobotanical study and for analysis of activities and this is reflected in the sampling strategy but it is expected that most samples will be of interest to both.

Processing (Figs 4.2-4.3)

The sample to be analysed is first floated, which removes loose soil and allows the collection of plants and other light material – the *light fraction.* The samples are then dried before the *heavy residue* is sieved through a 1cm sieve. This removes all the large items, including stones. At this stage any artefacts are picked out by hand and recorded as bulk finds.

Floating Drying

Figure 4.2. Floating and drying of sample.

The remaining residue is put through a nest of sieves which sorts it by size: <1cm>4mm, 4mm-2mm and 2mm-1mm.The size fractions are then sorted by type of material, such as pottery, bone, shell, lithics etc. The sorted material is weighed and counted and these data recorded.

Sieving by size Sorting by material

Figure 4.3. Sieving and sorting of material.

Preliminary results

Sampling

In total, 3653 litres of sediment was floated and 116 samples were processed. The total weight of heavy residue was 192kg with an average sample weight of 1.65kg, ranging from over 8kg to around 5g (Fig. 4.4, Table 4.1). The size of strategic samples varied according to context, presence of a grid and deposit thickness. Small areas obviously produce smaller sample sizes. The 116 samples were taken in 9 different trenches and came from 94 contexts.

The heaviest samples typically included large items such as stones or a large proportion of molluscs and so the material to be sorted after the larger than 1cm items were handpicked, was much less. Once the heavy residue was sieved through a 1cm sieve the total heavy residue to be sorted weighed 113kg

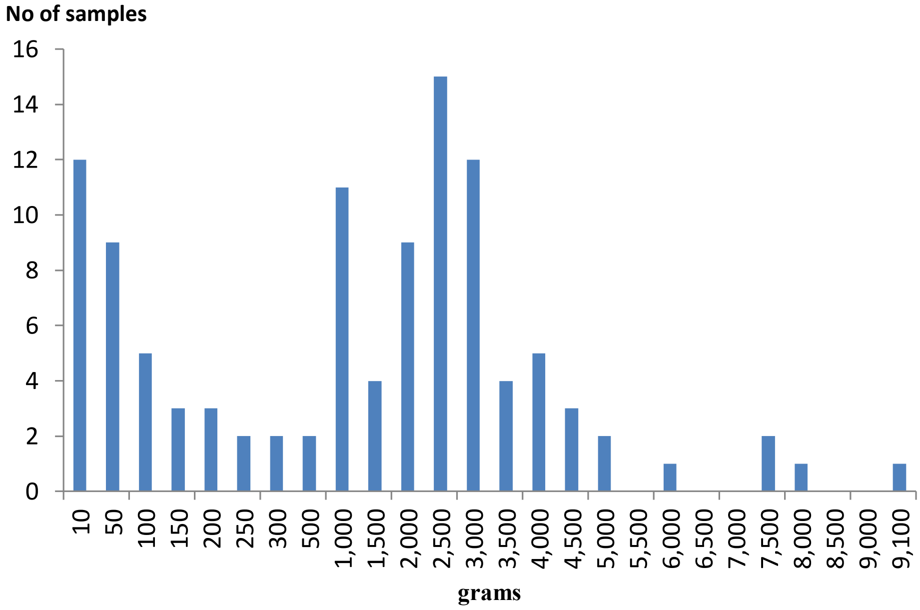


Figure 4.4. Distribution of sample weight.

A majority of heavy residue samples were between 1kg and 3kg and were the result of random sampling (53 samples). The other cluster of samples shown in Fig. 4.4 weighed between 10g and 200g and comprised samples chosen strategically (32 samples). In total, based on the size of the samples it is estimated that around two-thirds were the result of random sampling and one-third were strategic samples.

Samples processed	116
Volume of sediment (litres)	3653
Heavy residue (kg)	192
By size	
<1cm>4mm	46
2mm-4mm	45
1mm-2mm	22

Table 4.1. Heavy residue processed.

Sounding	**Samples**	**Contexts**	**Volume floated**	**Weight**	**Samples sorted**		**% sorted**
					by size	**by material**	
	#		(l)	(g)	#	#	
1	20	17	860.5	47,450	20	17	30
2	9	9	235	27,041	9	3	50
3	1	1	53	7570	1	1	28
4	11	10	540	26,820	11	10	25
5	13	10	554.75	33,330	10	10	23
6	1	1	1	280	1	1	100
7	32	22	388.75	10,732	28	26	100
8	11	9	496	22,519	11	7	50
9	18	15	478	16,754	18	16	25
10	1	1	46				0
Totals	**116**	**94**	**3653**	**192,496**	**109**	**91**	

Table 4.2. Samples by trench.

Sorting
Most of the samples were sorted by size (109 of 116) and material (91of 116) (see Table 4.2). The unsorted samples, primarily topsoil, have been stored alongside the residue from the partially sorted samples.

Once the residue had been sieved into different size fractions a decision was made on the proportion to be sorted by material as there was not the time to sort all samples in their entirety. A number of factors were taken into account: the size of the sample and the context of the sample, and whether the excavator had indicated it as a priority or being of potential special interest, being the key considerations. While around 25% of the total weight of residue was sorted by material well over 50% of all samples were fully sorted. This reflects the complete sorting of all the smaller, and typically strategically chosen, samples.

Material
Shell dominated the sorted material on all measures. It accounted for 71% of the total weight of the heavy residue sorted and was the most ubiquitous, being present in around 75% of all samples (see Figure 4.5, Table 4.3, Table 4.4). The density of shell is also on average much greater than all other types of material (see Table 4.5).

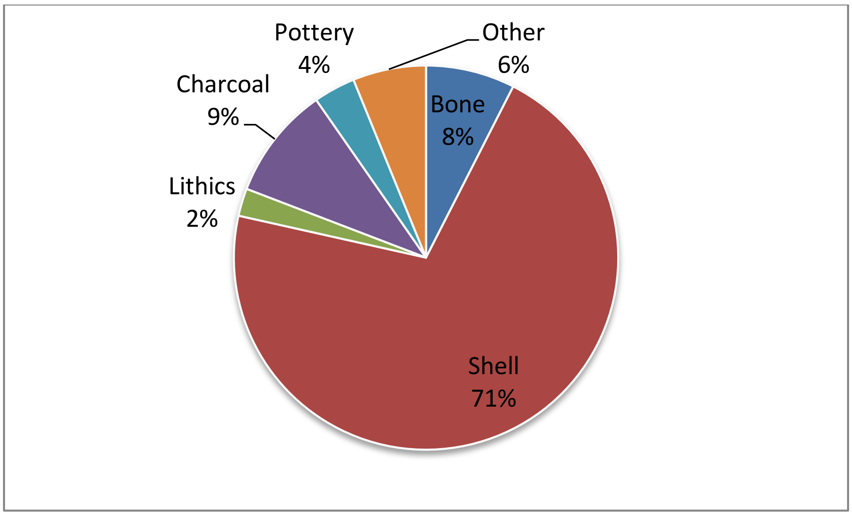


Figure 4.5. Material distribution by weight.

Bone and charcoal were found in 43% and 52% of samples respectively, with other materials less common: lithics in 18% of the samples and pottery in just 6.5%, in 4 trenches (see Table 4.6). The category 'other' includes fired clay, plaster and brick.

Sounding (g)	Bone	Shell	Lithics	Charcoal	Pottery	Other	Total
1	49	293	19	88	26	110	585
2	20	63	4	11	59	0	156
3	2	91	4	1	0	0	99
4	29	949	19	62	0	10	1069
5	43	495	9	35	31	17	629
6	1	3	0	3	1	0	8
7	28	137	9	28	0	2	203
8	43	154	1	38	0	41	277
9	35	177	12	50	0	25	299
Total	**249**	**2362**	**77**	**316**	**117**	**205**	**3326**

Table 4.3. Total weight of material recovered from heavy residue by trench.

There was a great variation of material by trench (Table 4.3) but a much clearer picture of the variation can be seen in the average density of material as this makes the data more comparable having removed the influence of the size and number of samples (Tables 4.4-4.5).

Sounding	Bone	Shell	Lithics	Charcoal	Pottery	Other
	(g per 100g)					
1	0.54	3.39	0.16	1.37	0.33	0.82
2	2.72	17.58	0.33	1.72	4.05	
3	0.80	22.99	1.12	1.15		
4	0.45	17.62	0.13	2.12		0.20
5	1.21	19.55	0.31	2.26	0.38	0.22
6	0.41	1.00		0.88	0.49	
7	1.69	16.60	0.45	3.15		0.20
8	1.25	5.23	0.04	2.24		0.49
9	1.60	7.19	0.31	4.17		1.08
Average	**1.18**	**12.35**	**0.36**	**2.12**	**1.31**	**0.50**

Table 4.4. Density of material by trench.

The data in Table 4.5 are the simple averages of samples processed for each trench as the density measure already takes account different sample sizes. The average for all samples is again a simple average. The microartefacts were also counted and those data will be added to the analyses.
The average density of the different material by trench provides pointers to investigation of individual contexts; e.g. are the higher concentrations of shell indicative of shell mounds/middens or is the higher than average bone density in Trench 2 linked to one or more contexts and so on. The data for the presence and density of material overall provides an average against which individual context findings can be assessed.

	Weight (g)	Samples containing	Average density (g per 100g)
Bone	249	43.2%	1.18
Shell	2362	76.6%	12.35
Lithics	77	18.3%	0.36
Charcoal	316	51.6%	2.12
Pottery	117	6.6%	1.31
Other	205	14.3%	0.50

Table 4.5. Summary by material.

Discussion

The sampling protocol is working well and is producing roughly equivalent samples with the size reflecting the type of sample, i.e. strategic or random. This allows comparison between samples. A number of the smallest samples (those less than 10g) produced data that looks very skewed both where there was a complete absence of material or where a very few microartefacts suggest a high density of material. In this case it is possibly better to look at the number of items per sample.
The dominance of shell, both in the absolute amount found and in its presence in the majority of samples, is primarily a reflection of the large quantities of molluscs present in many contexts. While in some cases they may be occurring naturally there is strong evidence that they were being eaten and so reflect past activities (Chapter Twelve). The highest concentrations of shell were found in contexts related to deposits or middens of molluscs.

There are other factors which contributed to the high density of shell, such as the visibility within heavy residue. The colour (white, cream, light brown) and texture (smooth and sometimes shiny) enhances visibility during sorting. In addition, shell breaks easily and often into small pieces which may have happened *in situ* and being hard to clean away remained, or in the process of flotation and sieving. Further analysis of the density of shell, in conjunction with other finds, by context may help to give a more nuanced picture, including distinguishing what is 'background noise'. To gain a complete picture of all material, the microartefact distributions should be looked at alongside the handpicked macroartefacts . A strategy of collecting whole earth samples helps in producing the most accurate picture.

The sampling, processing and recording of microartefacts provides the basis for further analysis. The results reported here are aggregated by trench and so give averages against which single samples and contexts can be measured. The detailed analysis will need to combine the microarchaeological data with other information on the context and other finds in order to achieve the best possible interpretation of activity and use of space.

Chapter Five: Portable X-Ray Fluorescence, Spot-Sampling and Micromorphology Sampling: Investigating Early Animal Management, Diet and Ecology

Sarah Elliott

Introduction

An integrated field methodology was applied at Bestansur during the spring 2012 field season. This methodology was developed with the primary aim to identify archaeological dung deposits to study early animal management, diet and ecology. The detection of dung deposits enables investigation of animal management practices through independent markers by the identification of animal penning and secondary use of animal dung (e.g. as a fuel or a constituent of construction material). The study of animal dung is of major significance for archaeological research, as it provides important links between plant and animal ecology, management and use, and contributes to the study of the surrounding vegetation at that time. Dung remains bridge the gap between archaeozoology and archaeobotany (Shahack-Gross 2011, 214) and enable us to contribute to and examine new markers of animal management practices (Zeder 2009).

Strategic approach (Fig. 5.1)

Dung is difficult to identify in bulk or spot soil samples. In addition, there is no single standardised definitive protocol or set of criteria for the identification of animal dung. There is considerable need and scope for developing an integrated field and laboratory approach (Shillito *et al.* 2011; Shahack-Gross 2011). The methodology applied at Bestansur was devised in order to locate, identify and sample dung deposits using a range of analyses. Field methods comprised portable x-ray fluorescence (pXRF), spot-sampling/smear slide analysis and micromorphology sampling. The aim in using pXRF was to locate phosphorus rich deposits which may be indicative of dung which could then be spot-sampled for microscope analysis in the field. The aim of the field microscopic analysis was to identify calcareous spherulites from smear sides which were produced from the spot samples. Calcareous spherulites are formed in the gut of animals during digestion and pass through the digestive system into the dung and can be identified under cross polarised light at high magnification (Canti 1999). The objective in the collection of micromorphology block samples in areas where dung had been successfully identified was to be able to carry out a range of analysis on the dung deposits back in the laboratory at the University of Reading. The analysis of micromorphological thin sections enables me to identify and analyse dung deposits *in situ*. Micro sub-samples taken from these deposits could then be selected from specific dung layers for further detailed analysis.

Figure 5.1. Portable x-ray fluorescence readings being taken at Bestansur with a Niton XL3t GOLDD+ Left and Middle photographs: smear slides being made-up for microscope analysis and identification of calcareous spherulites. Right photograph and diagram: calcareous spherulites; Micromorphology blocks being taken at Bestansur.

Sampling

Portable x-ray fluorescence

In total 130 pXRF readings were taken on archaeological sediments at Bestansur during the spring 2012 field season. The results for the phosphorus readings range from values below the limit of detection to 4698 ppm (parts per million). The phosphorus values for confirmed dung contexts are 1078-4698 ppm. Fig. 5.2 shows phosphorus readings taken from Trench 7 presented here as a case study.

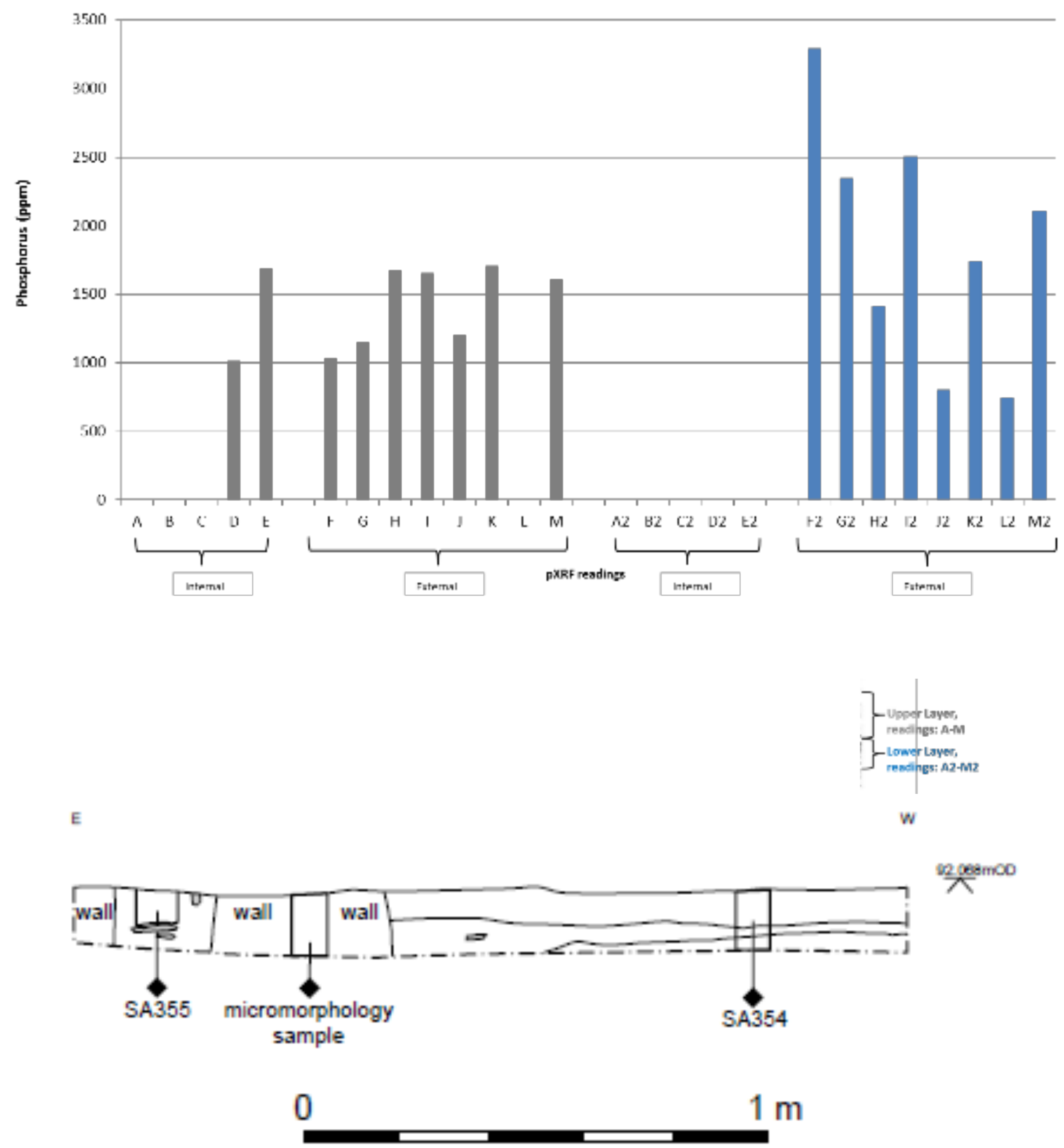


Figure 5.2. Upper: graph showing Phosphorus readings, Trench 7, from five internal and eight external locations. Left hand side (grey A-M) taken from upper stratigraphic layer and right hand side (blue A2-M2) taken from lower stratigraphic layer.
Lower: Section 8, in Trench 7 showing the upper and lower layers from which the readings were taken

Spot-sampling and smear slide analysis

Small spot samples were taken in targeted locations across the trenches where pXRF readings were taken. In total 130 samples were taken for field and further laboratory analysis. A range of these samples were analysed in the field and calcareous spherulites and phytoliths identified in some of the samples. Table 5.1 shows the presence and absence of spherulites and observed phytoliths from a range of probable Neolithic contexts.

	<102>	(1181)	<98>	<265>	<97>	<258>	<267>	<103>	<351>	(1155)	<96>	(1107)	<95>	(1081)	<491>	(1011)
Spherulites	*				*		*	*		*	*	*	*	*	*	*
Keystone		*														
Smooth elongate			*					*	*				*			
Bulliform	*		*		*	*										
Sinuate elongate			*			*			*							
Trichome/hair			*	*												
Rondel							*		*							
Elongate Dendritic	*								*							
Bilobe									*							
Multicell Husk									*							
Block	*	*													*	
Platey	*				*	*		*	*	*	*	*	*	*	*	*
Sheet	*		*								*					
Smooth spheroid		*														
Silica aggregate	*															
Tracheid	*															

Table 5.1. Spot sample smear slide observations Bestansur April 2012, to identity presence and absence of spherulites and key phytolith types.
* Indicating the presence of spherulites and a range of observed phytoliths in a range of contexts () and samples <> from probable Neolithic contexts.

Micromorphology sampling programme

Specific locations were selected for sampling of micromorphology block samples after consideration and analysis of the pXRF and spot sample results (Fig. 5.3). Locations with high phosphorus, spherulite and phytolith content were targeted for further sampling. In addition to this other contexts were targeted for analysis of architectural materials and technology, natural sediments and activity areas (Chapter Three). Eleven block samples were taken from areas identified on site as containing dung deposits (Table 5.2) and a further nine samples were taken from other locations (Table 5.3).

Sample No.	Trench No.	Description
325	9	Hearth from section 1
326	9	Hearth from section 1
350	8	Wall and ash deposit
352	4	Ash with spherulites
353	4	Red brickey burnt aggregates, high phosphorus
354	7	External area fills section 8
355	7	Internal area fills section 8
356	1	Brickey construction material with spherulites
358	1	Fill inside wall (1099)
359	1	Fill inside wall (1099)
360	8	Ash section 10

Table 5.2. Micromorphology block samples taken for the analysis of dung deposits.

Sample No.	Trench No.	Description
284	6	Shell layer
285	9	Activity surfaces, lenses of ash and flecks of ochre
286	9	Lower ash layer
447	4	Natural
448	7	Wall sample (mud)
449	9	Floor surface (mud) and ash
450	8	Floors and packing (mud)
451	8	Upper floors (mud)
452	1	Wall material and plaster (mud)

Table 5.3. Micromorphology block samples taken for other analyses (Chapter Three).

Figure 5.3. Left: Trench 1, locations of samples <356> (left) and <358> (right)
Middle: Trench 7, sample <354>
Right: Trench 9, taking sample <325>.

Discussion

The pXRF results from the case study presented here, Trench 7, indicate that overall the phosphorus readings are higher in the area interpreted as being external in comparison to the areas interpreted as internal. In addition to this the lower stratigraphic layer clearly has higher phosphorus readings. Dung has been identified in the external areas in Trench 7, and further spot samples and micromorphology blocks have been taken from Trench 7 which are currently undergoing further analysis. The presence of dung in the external area could suggest this is a possible area for gathering or penning of animals, but further analysis is required in order to investigate this interpretation.

Dung deposits have successfully been identified in some of the archaeological deposits at Bestansur from in-field microscopic analysis of the spot samples taken from areas of high phosphorus. The presence of calcareous spherulites provides irrefutable evidence of the presence of ancient animal dung. The micromorphology blocks collected at Bestansur have been exported to the University of Reading and are currently undergoing preparation in the laboratory for further detailed analysis.

Chapter Six: Preliminary Assessment of the Zooarchaeological Assemblage

Robin Bendrey

Introduction

This chapter briefly assesses the animal bone assemblages recovered from the CZAP excavations at Bestansur in spring 2012. The phasing of the excavated contexts is still at a provisional stage and the material has been divided below into that which is considered to be stratified Aceramic Neolithic contexts and that attributed to post-Aceramic Neolithic. However, as analyses and dating of the site stratigraphy proceeds (including radiocarbon dating and artefact analyses) the final phasing of the excavation contexts will vary from that given here. This zooarchaeological assessment does not include consideration of the material recovered from the top soil.

Academic context and research aims

The shift from reliance upon hunted wild populations to the control and exploitation of domestic animals is one of the great step changes in the human past (Harris 1996; Barker 2006). It is now argued that the early domestication of sheep, goat, pig and cattle, in possibly multiple centres of the Fertile Crescent in Southwest Asia, appears to have developed as a gradual process, evolving from hunting strategies and the intensification of relationships between humans and wild animals into the management of, at first, morphologically unchanged animals, generally within their natural habitat (Zeder 2005; 2009; Conolly *et al*. 2011; Vigne *et al*. 2011). These evolving human-animal relationships were connected with a range of fundamental economic, social, and ritual transformations – especially those related to mobility, sedentarisation, and animal and plant use (Barker 2006; Vigne 2011).

The aims of the CZAP research programme at Bestansur, and the other sites within the Central Zagros (see Matthews *et al*. in press), will contribute data and interpretations to a range of overlapping research themes, including:

processes of animal domestication
human diet, economy and society
wild animal resources
ecology and environments
sedentism and territorial use
animal husbandry

Zooarchaeological analyses will be fully integrated with a range of research methods being applied by the CZAP team to investigate animal diet and management from GC/MS, micromorphological, phytoliths and archaeobotanical analyses (Chapters Three, Five and Seven).

Caprine domestication in the Taurus-Zagros Arc

Current evidence indicates that initial goat domestication, possibly occurring multiple times, arose between around 8700 and 7900 BC in the region stretching from the Zagros Mountains, in the eastern Fertile Crescent, to the highlands of southeastern Anatolia (Peters *et al*. 2005; Zeder 2008; Pereira and Amorim 2010). The Central Zagros region lies within the natural habitat of wild goats, and is a region of particular interest in the early history of goat management and domestication (Zeder 2005; Pereira and Amorim 2010). The earliest archaeological evidence for the presence of domestic goats from this region comes from Ganj Dareh, where the demographic profile indicates a managed population of goats dating to *ca*. 7900 BC that are morphologically unaltered from wild animals (Hesse 1978; Zeder and Hesse 2000; Zeder 2005; 2008) [see Peters *et al*. (2005) and Vigne *et al.* (2011) for early evidence from other regions]. Current evidence indicates that domestic sheep, however, appear in the Central Zagros only from *ca*. 7000 BC (Zeder 2008), whereas initial sheep domestication may have occurred in southeastern Anatolia during the 9th millennium BC (Peters *et al*. 2005). Predating the latter, evidence for the intensive exploitation of wild sheep, as at Körtik Tepe, Turkey, (10th millennium BC), may represent a highly selective hunting that was perhaps a precursor to strategies of herd management in the region (Arbuckle and Özkaya 2006). In the lower Zagros region, both domestic sheep and goat are present in the Ceramic Neolithic assemblage at Jarmo (Stampfli 1983; Zeder 2008).

Identification and recording

The recording system for the Bestansur zooarchaeological assemblage was based on the protocols used at Çatalhöyük by Russell and Martin (2005, 34-38). The bones were identified with the aid of standard published protocols (Boessneck 1969; Schmidt 1972; Prummel and Frisch 1986; Halstead and Collins 2002; Zeder and Lapham 2010; Zeder and Pilaar 2010). Bones not identified to species have been awarded an animal-size category, or labelled indeterminate. In this report bones are quantified by the number of identified fragments (NISP) and by bone weight (grams). Some material that could not be identified in the field has been exported to Reading for checking against modern osteological reference collections. Identifications reported in this assessment are provisional – some of these will change as further work is undertaken and specimens are compared to more comprehensive osteological reference collections (including the Natural History Museum collections in London and Tring).

Recovery methods

Animal bones were collected by three different methods: hand-picking during excavation; dry sieving of the excavated sediments using a 4mm mesh; and wet sieving using a 1mm mesh. Only those bones recovered by hand-picking and dry sieving were recorded in the field, due to time constraints (Table 6.1).

Material recovered from the integrated wet sieving and flotation programme (typically, 50 litres of deposit per context was processed by machine assisted water flotation; Chapters Four and Six) has not yet been analysed, except for two bones hand-picked from the flotation process (Table 6.1). The bones recovered by wet sieving have been quantified by weight (see Chapter Four; also Tables 6.2 and 6.3): 249 grams of bone fragments were recovered. Consideration of the distribution of this material relative to the volume of sediment floated indicates that bone was consistently recovered at relatively low densities across the trenches (0.1g/litre) (Table 6.3). The exception to this is that recovered from Trench 6 (1.0g/litre) – however this material was derived from a single, discrete feature (the fire installation – see Chapter Two, Trench 6). During the course of the next field season, all bone fragments from the wet sieving will be counted and weighed, and diagnostic elements recorded (see Russell and Martin 2005, 34-35). This will allow the analysis of taphonomic variables, provide controls on recovery, and the analysis of small vertebrate bones that may contribute to the study of small dietary taxa (birds and fish) and wild/commensal micro-vertebrates that will allow assessment of local ecology, environments and resource use.

All hand-recovered and dry-sieved bones were recorded in the field, during April 2012 (Table 6.1). This consists of 1890 fragments of hand-picked bones, weighing 6544 grams, and 123 fragments of bone weighing 249 grams from the dry-sieving. Volumes of dry-sieved soils/sediments, and that neither dry-sieved nor floated, have not yet been calculated for the individual trenches, so it has not yet been possible to calculate the densities of fragments per litre sieved/excavated. This will be completed when all data are available on the IADB.

For the purposes of this assessment the dry-sieved and hand-picked bones are considered together (Tables 6.4-6.6). The hand-recovery of all materials by the local workmen was to an excellent standard (Chapter Two). This is further supported by a comparison by maximum bone fragment lengths between those fragments recovered by hand and those by dry-sieving: the fragment length distributions can be seen to be very similar, indicating that hand-picking is recovering a similar size-range of material (although there is some variation) (Fig. 6.1). Hand-picked and dry-sieved fragments are considered together during the rest of this assessment.

Preservation and taphonomy

The assemblage was scored for general conditions of preservation (excellent, good, fair, and poor) and broad taphonomic characteristics (battered, rounded, spikey, and variable) (O'Connor 1991, 234-235). The latter was assessed in order to distinguish between those contexts where bone fragments retained sharply angular margins to old breaks, those that exhibited a rolled/abraded appearance, and those that exhibited impact pitting/battering. Generally, the assemblage is well preserved – most material exhibiting a good quality of preservation and a 'spikey' appearance (Table 6.4). The good quality of preservation bodes well for achieving project goals, many of which are based on the recovery of identifiable remains (see above).

Preliminary results

Quantification and distribution of recovered remains: Aceramic Neolithic contexts

The zooarchaeological assemblage analysed to date (the hand-picked and dry-sieved material) from those contexts classed as Aceramic Neolithic is presented in Table 6.5. The following taxa have been recorded in the assemblage: cattle, wild bovid (probably *Bos primigenius*), red deer, sheep, goat, roe deer, wild boar, large canid, human, micromammal, bird and tortoise. Although this is a small assemblage, it presents a range of taxa consistent with that witnessed from other broadly contemporary sites in the region (e.g. Bendrey *et al*. in press; Bökönyi 1977; Hesse 1978; Stampfli 1983).

The size of the recovered sample is currently too small reliably to assess the relative proportions of sheep and goat bones in the assemblage (Table 6.5). At other Aceramic Neolithic sites in the Zagros, goat bones dominate relative to sheep (Fig. 6.5). However, goats adapt better to higher, harsher, or more arid environments than sheep do (Silanikove 2000; Bendrey 2011) and ethnographic data indicates that, elsewhere in the mountains of Asia, goats tend to increase relative to sheep at higher altitudes within domestic herds (Krader 1955). In this respect, it will be interesting to establish, following further excavation, the relative proportions of sheep and goat bones at the site of Bestansur, lying as it does on the edge of the Shahrizor plain and the lower slopes of the Zagros.

Detailed studies of age, sex and size of the animals have not been undertaken for this preliminary report, as the size of the assemblage (Tables 6.5 and 6.6) mean that only limited interpretations could be drawn. These studies will form a key part of future reports as greater quantities of data are recovered from further excavations. It is aimed that this will be achievable following the August/September season. Although the analysis of the metrical data recorded from the zooarchaeological assemblage has not been undertaken for this assessment, it is clear from visual assessment of the size of specimens that both wild boar (Trench 5; C1074) and wild bovid (Trench 7; C1095) are present in the assemblage. Although the latter most probably derives from wild cattle (*Bos primigenius*), bison (*Bison bonasus*) is also a possibility as it was present in the region during later prehistory (Stampfli 1983, 440-442). The bone is a mid-shaft fragment of tibia and does not retain the morphological zones needed to identify it to species (e.g. Gee 1993).

Trench 7 also produced evidence for a specific activity in the form of a worked goat metatarsal (Fig. 6.2). This shows a circular groove around the shaft, with broken internal cortical bone, and is indicative of bone-bead production as identified at Neolithic Jeitun, Turkmenistan (Harris 2010, fig. 9.24; Dobney and Jacques 2010, 178-179).

Radiocarbon dating

Three bones from Neolithic levels were selected and submitted for radiocarbon dating to Beta Analytic which included:

Human femur (Trench 4, C1067; sample weight = 3.1g)
Sheep metacarpal (Trench 7, C1096; sample weight = 3.3g)
Indeterminate mammal (Trench 5, C1078; sample weight = 1.7g)

Sections of cortical bone were taken from the human using a hand-held Dremmel rotating saw. The complete indeterminate bone fragment from C1078 was submitted for sampling. Unfortunately none of the samples yielded separable collagen and so could not be dated. In the absence of collagen, future radiocarbon determinations may need to focus on apatite in shell and burnt bone (Lanting *et al*. 2001; Saliège *et al*. 2005).

Quantification and distribution of recovered remains: post-Aceramic Neolithic contexts

The zooarchaeological assemblage from those contexts provisionally classed as post-Aceramic Neolithic is presented in Table 6.6. This is a larger assemblage than that assigned to Neolithic features, amongst which there are a number of notable bone groups:

A range of wild taxa are positively identified, including roe deer, fox and wild boar (Fig. 6.3)
The large assemblage from Trench 2 (associated with pottery dating to the Iron II period (Chapter Thirteen)) contains at least two types of equid: one smaller, cf. donkey (*Equus asinus*), and one larger species or hybrid. A partially articulating equid spine was noted as possessing pathological markers (e.g. Fig. 6.4) suggestive of riding (see Levine *et al*. 2005). A partial dog skeleton was recovered from Trench 5, C1072.

Preliminary conclusions and prospects

Zooarchaeological assemblage

Although the Aceramic Neolithic assemblage analysed to date is small (Table 6.5), it does demonstrate significant future potential to contribute to project aims:

the material recovered from the these levels is well preserved;
more extensive open area excavation in future seasons will produce larger, statistically viable, assemblages;

assessment of the lithic assemblage suggests an 8th millennium BC date for the Aceramic Neolithic levels (Chapter Nine), possibly with material even earlier than this as indicated by a radiocarbon determination on a mollusc shell from Trench 5 (Chapter Two).

The dates indicated by the radiocarbon determination, the assessment of the lithic assemblage and the absence of pottery point towards the material being earlier than the Ceramic Neolithic zooarchaeological assemblage from Jarmo (Stampfli 1983; Zeder 2008). This would mean that, with the recovery of larger assemblages, we will be able to contribute essential new data to filling in the chronological and geographical gaps in our knowledge on the slow and gradual processes of animal domestication and the transitions to herding and human sedentarisation in the Zagros region (Bendrey *et al.* in press a; Zeder 2008). Further work has the potential to contribute to all project research aims discussed above.

The next stage of zooarchaeological analysis will undertake the following:

analysis of all bones recovered via wet sieving and flotation (see above);
verification/refinement of taxonomic identifications through comparison to comprehensive, regional-specific, osteological reference collections (e.g. those at the Natural History Museum, London);
refinement of stratigraphic data and phasing of contexts;
further investigation into collagen survival in the material (in collaboration with Gundula Müldner). The absence of separable collagen from the three bones submitted for radiocarbon dating is a potentially significant challenge to biomolecular work on the collections.

Stable isotope ecology of caprine husbandry

Some of the challenges in understanding transitions from hunting to herding and the forms of early animal management lie in the fact that conventional zooarchaeological techniques struggle to identify subtle changes in the ecology and management of individuals and populations, for example morphological changes to the skeletons of animals are not a leading-edge marker of domestication, but can be delayed by a significant length of time (Zeder 2008). In recent decades, advances in applications of isotope geochemistry to archaeological research have presented a number of powerful techniques with which questions relating to animal management and mobility can be explicitly tested and explored.

It is aimed that isotopic analyses on serial samples taken from archaeological caprine tooth enamel from Bestansur will be used to reconstruct aspects of the animals' diet and management, seasonality and environment, and mobility and territorial use (as has been explored, for example, for later prehistoric nomadic pastoral groups in the Altai mountains [Bendrey *et al*. in press b]). It is aimed that this will begin in autumn 2012 if we can recover appropriate samples during excavation. To achieve this, the archaeological data will be contextualized and interpreted within modern isotopic control data from the site and region (Chapter Eight).

Acknowledgements

Thanks to Louise Martin (UCL) for kind support and digital resources/databases.

Trench	1	2	3	4	5	6	7	8	9	10	Total
Hand-picked	61	901	42	44	269	39	90	132	20	292	1890
4mm dry sieve	4	7	-	48	-	-	-	64	-	-	123
Hand-picked from flotation	-	-	-	-	2	-	-	-	-	-	2
Total	65	908	42	92	271	39	90	196	20	292	2015

Table 6.1. Distribution of animal bone recovered by the different methods, by number of fragments (NISP), excluding wet sieved material (to be analysed).

Trench	1	2	3	4	5	6	7	8	9	10	Total
Hand-picked	119.3	3093.5	95.2	194.4	881.7	75.9	492.9	444.5	84	1062.9	6544.3
4mm dry sieve	2.1	2.4	-	118.8	-		-	125.9	-	-	249.2
Hand-picked from flotation	-	-	-	-	12.1	-	-	-	-	-	12.1
Wet sieve	49	20	2	29	43	1	28	43	35	-	249
Total	170.4	3115.9	97.2	342.2	936.8	76.9	520.9	613.4	119	1062.9	7054.6

Table 6.2. Distribution of animal bone recovered by the different methods, by bone weight (g) (wet sieve bone data from Chapter Four).

Trench	Volume floated (l)	Bone weight (g)	Bone density (grams per litre)
1	860.5	49	0.1
2	235	20	0.1
3	53	2	0.0
4	540	29	0.1
5	554.75	43	0.1
6	1	1	1.0
7	388.75	28	0.1
8	496	43	0.1
9	478	35	0.1
10	46	-	0.0
Totals	3653	249	0.1

Table 6.3. Bone recovered through the wet sieving programme (data recorded by Ingrid Iversen, see Chapter Four).

	Excellent	Good	Fair	Poor	Variable	Total
Battered	-	2	-	-	-	2
Rounded	-	3	-	-	2	5
Spikey	-	36	18	4	10	68
Variable	-	6	4	-	1	11
Total	-	47	22	4	13	86

Table 6.4. Assessment of preservation and taphonomy of the bone assemblage (by number of bone-producing contexts).

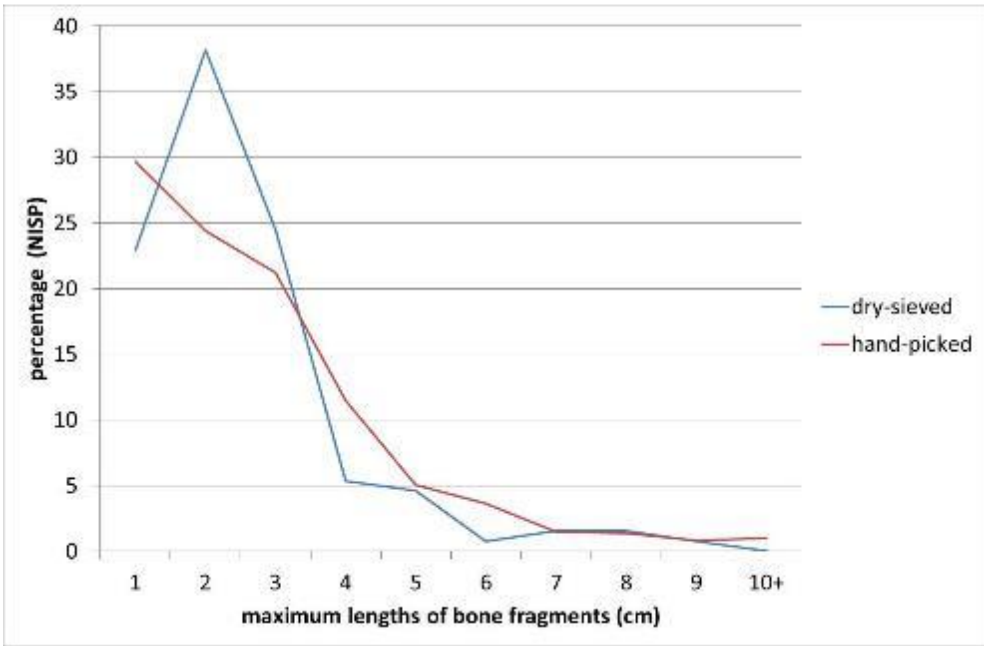


Figure 6.1. Comparison of the distribution of maximum bone lengths between those fragments collected by hand and those collected by dry-sieving (% NISP).

	trench	1	2	4	5	7	8	9	10	total
Large-sized	*Bos*	-	5	-	-	3	1	-	-	9
mammals	Large bovid	-	-	-	-	1		-	-	1
	Cervus elaphus	-	1	-	-	1	1	-	-	3
	large-sized indet.	1	13	7	3	8	5	11	6	54
Medium-sized	*Ovis/Capra*	-	2	6	-	6	1	-	2	17
mammals	*Ovis*	-	1	-	-	3	1	-	-	5
	Capra	-	-	-	-	4	2	-	-	6
	Capreolus capreolus	-	-	-	-	-	-	-	1	1
	Sus scrofa	-	4	1	-	-	-	-	2	7
	Large canid	-	2	-	-	-	-	-	-	2
	Human	-	-	2	-	-	-	-	-	2
	Medium-sized indet.	6	11	51	4	24	13	5	16	130
Small-sized mamm.	Small-sized indet.	-	-	-	-	1	-	-	-	1
Micro-mammals	Microfauna	1	-	-	1	-	-	-	-	2
Birds	Bird indet.	-	-	1	-	1	-	1	-	3
Reptiles	Tortoise	-	1	1	-	-	-	-	-	2
Indeterminate	Indeterminate	4	70	23	5	29	33	3	5	172
	total	12	110	92	13	81	57	20	32	417

Table 6.5. Quantification of animal bone from Aceramic Neolithic contexts, by number of fragments (NISP).

Figure 6.2. Bone working off-cut from artefact manufacture (proximal goat metatarsal) (Trench 7; C1092). This shows a circular groove around the shaft, with broken internal cortical bone, and is indicative of bone-bead production as identified at Neolithic Jeitun, Turkmenistan (Harris 2010, fig. 9.24; Dobney and Jacques 2010, 178-179).

	Trench	1	2	3	5	6	7	8	10	total
Large-sized mammals	*Bos*	1	20	1	6	-	-	2	7	37
	Large bovid	1	-	-	-	-	-	-	-	1
	Cervus elaphus	-	-	-	-	-	-	1	2	3
	Large equid	-	-	-	-	1	-	1	-	2
	Large-sized indet.	3	241	4	30	2	1	40	42	363
Medium-sized mammals	Small-medium equid	-	8	-	-	-	-	-	1	9
	Ovis	-	3	-	4	-	-	1	3	11
	Capra	1	11	-	3	-	-	-	2	17
	Ovis/Capra	6	21	1	6	1	1	7	21	64
	Capreolus capreolus	-	-	-	-	-	-	-	2	2
	Small cervid	-	-	-	-	-	-	-	1	1
	Sus scrofa	-	25	-	4	-	-	2	7	38
	Human	-	2	-	-	-	-	-	-	2
	Medium-sized indet.	11	109	15	62	19	2	32	93	342
Small-sized mammals	Small carnivore	-	1	-	-	-	-	-	-	1
	Medium carnivore	-	-	-	5	-	-	-	-	5
	Canis familiaris	-	1	-	39	-	-	-	-	40
	Vulpes vulpes	-	1	-	-	-	-	-	-	1
	Small-sized indet.	-	-	-	-	1	-	-	-	1
Micro-mammals	Microfauna indet.	1	1	-	2	2	-	-	-	6
Birds	Bird indet.	-	-	-	1	1	-	-	-	2
Reptiles	Tortoise	-	-	-	9	-	-	-	-	9
Crustacea	Land crab	-	-	-	1	-	-	-	-	1
Indeterminate	Indeterminate	29	354	21	86	12	5	53	79	639
	total	53	798	42	258	39	9	139	260	1598

Table 6.6. Quantification of animal bone from post-Aceramic Neolithic contexts, by number of fragments (NISP).

Figure 6.3. Wild boar radius and ulna (fused) (Trench 5; C1074).

Figure 6.4. Two equid vertebral fragments exhibiting impinging dorsal spinous processes (Trench 2; C1038).

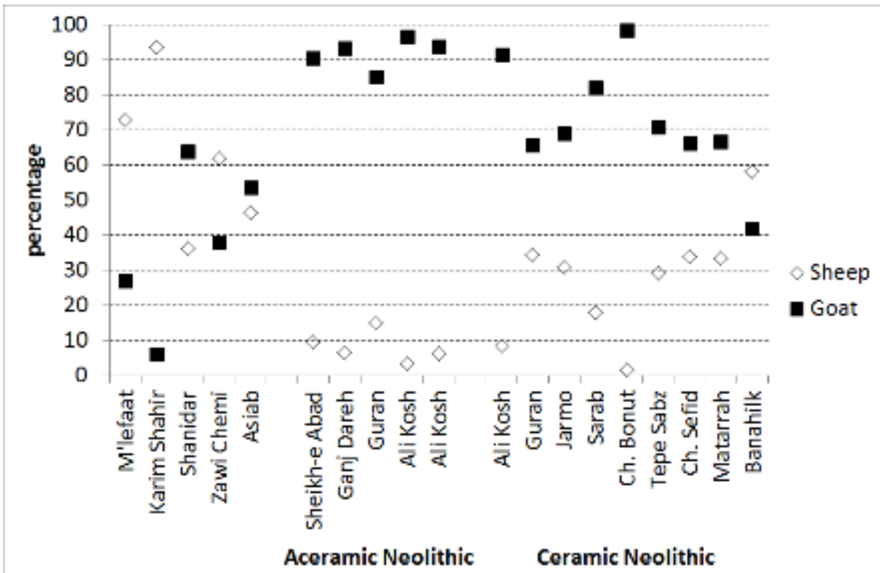


Figure 6.5. Comparison of the percentage representations of the bones of goats and sheep (relative to the total number of sheep plus goat bones) at sites in approximate chronological order from left to right (data from Zeder 2008, table 4; figure from Bendrey *et al*. in press a).

Chapter Seven: Archaeobotany

Jade Whitlam

Introduction

A programme of systematic sampling and flotation of soil samples was undertaken for the recovery of plant remains during the field season. The archaeobotany team consisted of Jade Whitlam, Gemma Martin and Nick Harper. Mike Charles assisted with the design and initial set-up of the flotation machine and provided advice and guidance for the duration. Two local workers from Bestansur village were employed to work on the flotation tanks throughout the season and were central to its success.

Sampling and methods

The aim of sampling was to collect systematically 50 litres of deposit from each context (bar topsoil removal); contexts of less than 50 litres were sampled in their entirety. Samples were collected from all context areas and types, including midden and open area deposits, areas of *in-situ* burning and hearths, floors and fill within rooms. Sampling decisions were made in communication with the excavation team and other specialists.

Soil samples were processed by machine assisted water flotation (Fig. 7.1). The flotation machine was powered by an electric pump and worked on a recycling system to conserve water. Due to the concreted/aggregated nature of sediments at Bestansur, a number of samples were soaked in water and mixed by hand to help disaggregate the soils prior to processing. Light flots (the floating material) were collected in a chiffon mesh with *ca*. 250µm aperture, attached to a bucket hung from the flotation machine spout while heavy residues (non-floating material) were collected in a 1mm mesh attached to the interior of the tank. Light flots were air-dried in the shade before being weighed and bagged for scanning and export. Heavy residues were sent to the heavy residue team for further processing (Chapter Four). To maximise the number of samples processed soil samples of <5 litres were routinely processed by bucket flotation.

A total of 116 soil samples (*ca.* 3653 litres) were submitted for flotation from Trenches 1-10 during the season. Ninety-five samples (*ca.* 3640 litres) were processed by machine flotation and 21 samples (*ca.* 12.8 litres) were processed by bucket flotation. Table 7.1 illustrates the breakdown by trench of soil samples processed.

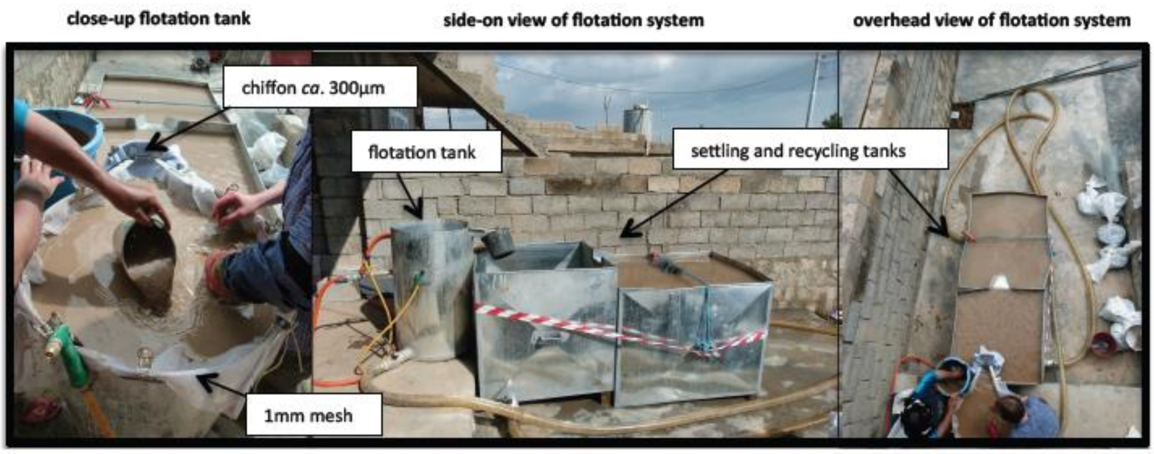


Figure 7.1. The machine flotation system at Bestansur.

Sounding	No. of samples	No. of contexts	Volume of soil (litres)
1	21	18	860.5
2	9	9	235
3	1	1	53
4	10	10	540
5	12	10	554.75
6	1	1	1
7	31	23	388.75
8	12	10	496
9	18	15	478.3
10	1	1	46
Total	116	98	3653.3

Table 7.1. Distribution by trench of soil samples processed.

Post excavation processing

When dry, the light flot was sieved at 4mm, 2mm, 1mm and 0.3mm. Coarse flots (>1mm) were 100% sorted under a stereoscopic microscope to record and remove identifiable botanical material: wood charcoal as well as plant macrofossils including caryopses, chaff and pericarp fragments. Fine flots (0.3mm – 1mm) were sub-sampled using a riffle box where necessary to produce a volume of sample *ca.* 5ml. This was sorted and botanical material identified to major category (e.g. glume bases, cereal grain, grass grain, nutshell/fruit). The remainder of the 0.3mm flot was retained for potential future study, as were the <0.3mm fractions. Although several samples were initially scanned in the field to assess the necessity of further soil sampling, the main bulk of the analysis is currently being undertaken in the UK at the University of Reading and School of Archaeology, University of Oxford.

It is not possible at this early stage of analysis to present preliminary results except to say that charred plant material (including cereal grain, grass grain, glume bases and charcoal) has been identified as present in several samples. Continued analysis will provide a clearer picture of the extent and distribution of plant material across the excavated trenches and help direct further sampling in subsequent field seasons.

Chapter Eight: Modern Landscape Transect Sampling Programme

Robin Bendrey, Jade Whitlam, Sarah Elliott and Gemma Martin

Introduction

Articulating with the archaeological research at Bestansur, integrated programmes studying multiple environmental variables and ethnographic research into human-animal-plant interactions are being undertaken. During the spring 2012 season at Bestansur we began a programme of modern sampling to define environmental and geological parameters with which to contextualise and interpret a range of studies relevant to the broader project aims. This research will contribute to a number of key research themes/aims:

Given the influence of environmental parameters (e.g. precipitation, temperature, ecology and topography) on early farming economies (Bendrey 2011; Conolly *et al*. 2012), understanding the interplay of these factors at a local and regional level are key for developing our understanding of animal and plant use and economies at and around the site of Bestansur.

Given the potential exploitation of different altitudinal/ecological zones for grazing by early pastoral groups, we need to be able to assess such patterns of exploitation from the archaeological record. It is possible to study these through isotopic analyses of archaeological tooth enamel linked into understanding of variation in available isotopes across the (modern) landscape (e.g. Bendrey *et al*. in press; see Chapter Six).

Modern variation in plants in the region (Chapter Seven): to inform on variation in modern plant ecology and develop modern reference material to aid identification of the archaeological macrobotanical remains.

Modern variation in geology in the region (Chapters Three and Five). On-going geochemical and geomorphological analyses of anthropogenic deposits at the site of Bestansur need a geological background value to provide a control and comparison. Generally, specific activity areas can be characterised by higher or lower concentrations of individual elements against the background value (Middleton *et al*. 2005).

We began a sampling programme while in the field in spring 2012. This will be continued and expanded in later field seasons and will also be combined with focussed ethnographic research on animal and plant use.

Landscape transect sampling at Bestansur

A landscape transect was selected for analysis which covered a number of modern ecological, altitudinal, geological, and functional domains (Fig. 8.1). A range of samples were collected in April 2012 during field work at Bestansur. Digital photographs and GPS readings were obtained for each collection.

A major aim of this initial research stage was to collect modern plant samples with which to characterise biosphere $^{87}Sr/^{86}Sr$ values for the region around the site of Bestansur, focussing on three domains: the river catchment area, the farmed alluvium of the Shahrizor plain, and the lower slopes of the Zagros Mountains (Fig. 8.1).

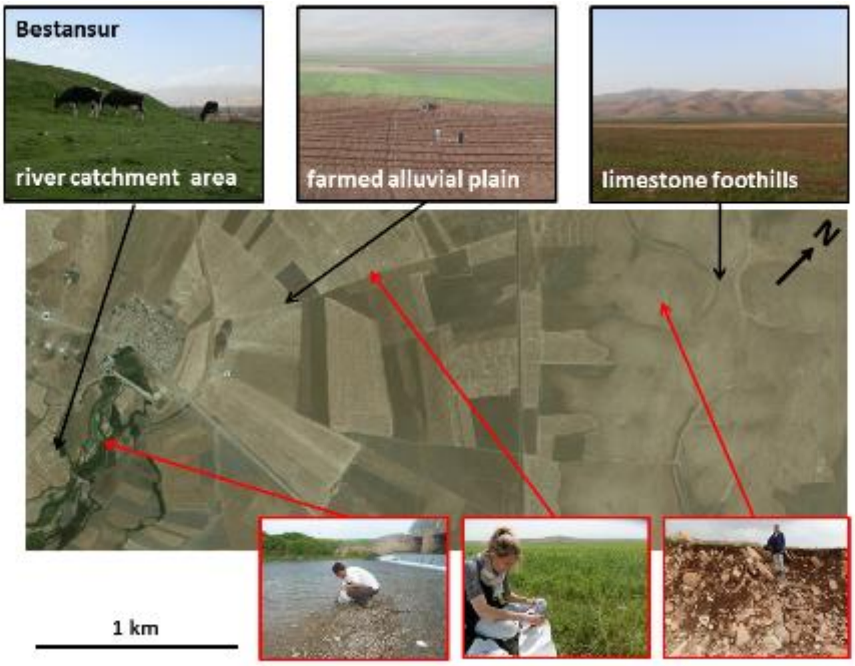


Figure 8.1. Modern landscape domains (based on altitudinal, ecological, geological and functional attributes) around the Neolithic site of Bestansur (black boxes); sampling of local plants, water and soils (red boxes).

Figure 8.2. Natural spring and river adjacent to Bestansur mound, looking northeast.

Water sampling
Water sample collection was undertaken with the main aim to identify modern seasonal variation in oxygen isotope composition. Both river and local precipitation (rain) water were sampled for analysis. Samples were stored in the freezer following collection. The local river originates at a spring below the modern village of Bestansur (Fig 8. 2). It will be necessary to take further precipitation and river samples from different seasons throughout the year with which to identify seasonal fluctuations in the modern values.

Plant sampling
Plant collection was undertaken with two main aims:

To provide leaf material for isotopic analyses as part of the proposed strontium isotope ratio study;

To obtain appropriate specimens for identification, informing both isotope studies and archaeobotanical research.

Species were selected from the wild flora growing on the lower edges of Bestansur mound (Fig. 8.3), at the margins of fields and on the stony slopes of the lower foothills, all of which were observed as being grazed by modern livestock.

Figure 8.3. Collection of flora on slopes of Bestansur mound.

Multiple specimens were obtained for each collection with individuals selected that represented as many features of the complete plant as possible including flowers and/or fruits. The whole of each specimen was removed and a small hoe employed to assist digging out of the plant. Excess soil was shaken off and specimens were carefully wrapped in kitchen towel and stored in sample bags while in the field. All collections were labelled with tags bearing a collection number and description corresponding to the information recorded in the collecting book. Digital photographs and GPS readings were obtained for each collection. Plants were pressed and dried over several days with the straps being tightened periodically as the plant material shrunk. Plant presses where then exported to the UK.

In total 19 collections were obtained in the field. Identifications were made at the Herbarium, University of Reading by Stephen Jury and Ronald Rutherford. To date 11 taxa have been identified, listed below. The outstanding collections are grass/cereal taxa and require further expertise for precise identification.

Adonis microcarpa DC.
Ononis biflora Desf.
Onobrychis crista-galli Lam./*O. caput-galli* (L.) Lam.
Centaurea hyalolepis Boiss.
Medicago coranata L.
Scorpirus muricatus L.
Lathyrus pseudocicera Pamp./*L. marmoratus* Boiss & Blanche
Trifolium dasyurum C.Presl
Trifolium resupinatum L.
Anagallis arvensis (subsp. *femina*) L.
Brassicaceae/Cruciferae (cf. *Sinapsis alba* L.)

Geology sampling

Geological sample collection was undertaken with two main aims:

As a 'natural' geology control dataset for geochemical analyses of anthropogenic deposits at the site of Bestansur. Increased elemental concentrations can be indicators of specific human activity, but elemental values need to be related to regional geological variability in order to accurately interpret elemental signatures (Chapter Five);

Soil profiles were recorded and samples of natural earth were taken at selected plant collection sites in order to assist interpretation of isotopic results from these samples.

Assessment of local sediments and geology will be achieved via analysis of the samples of natural earth using standard laboratory protocols; x-ray diffraction (XRD), x-ray fluorescence (XRF), magnetic susceptibility and particle size determination.

Animal sampling

Sampling of animal tissues and products was not undertaken in spring 2012 due to time constraints. This is to begin in autumn 2012, and will include teeth and dung.

Future prospects

Strontium isotope values will be analysed for selected plant leaf samples from across the three defined modern landscape domains (Fig. 8.1). Identified variation in the biosphere $^{87}Sr/^{86}Sr$ values from the plant samples will be interpreted in the context of the plant biology of the species collected and the assessment of the local geology.

This research will be developed in scope in future seasons. Initial assessment of underlying geology will be undertaken using regional geological maps, followed by sample collection from identified areas.

An ethnoarchaeological programme will be linked to this research focussing on modern animal and plant use in the region (Fig. 8.4). Ethnoarchaeology provides the reference data to reinforce and augment the inferences that formulate archaeological interpretation (Roux 2007).

Figure 8.4. Modern herd of goats feeding at the base of the mound at Bestansur.

Chapter Nine: Chipped Stone Tools and Debitage

Roger Matthews and Amy Richardson

Introduction

The site of Bestansur was first identified as having a significant Neolithic component on the basis of surface finds of chert and obsidian artefacts, and the spring 2012 season of excavations has richly confirmed that identification. Tools and debitage of chert and obsidian occur in almost every excavated context in all ten trenches and are concentrated in the fields to the west, south and east of the mound and, less so, on the mound itself. Lithic materials constitute one of the most prevalent and significant forms of material culture in the Pre-Pottery Neolithic levels at Bestansur, providing evidence for resource use, long-distance interactions, stone technology, and the spatial distribution of activity within the site.

This report provides a preliminary outline account of the lithic assemblage recovered in the 2012 spring season at Bestansur, with sections on methods of recovery and processing, distribution of lithic materials and types across the excavated trenches, tool typology and tool use, and potential flint and obsidian sources, including pXRF analysis. Throughout this report the term ‘chert’ is used to describe “all sedimentary rocks composed primarily of microcrystalline quartz, including flint, chalcedony, agate, jasper, hornstone, novaculite, and several varieties of semiprecious gems” (Luedtke 1992, 5).

Recovery and processing methodology

Lithics were recovered from almost all excavated contexts during the spring 2012 season at Bestansur. Where volume permitted, 50l of each context was collected in sacks for flotation as a whole-earth sample with no artefacts removed. The remainder of each excavated context was either dry-sieved at 4mm or hand-picked to recover all visible artefacts. Lithics were thus recovered both in the trench as excavations proceeded and at the laboratory from sorting of heavy residues following flotation (Chapter Four). Both streams of recovery were integrated in the lithics recording process, enabling study of the full range of lithic material in all contexts.

Lithics were recorded by excavated context. For each context an initial division of the lithics into tools and debitage was undertaken, with debitage defined as all waste pieces removed from a nodule or block of chert or obsidian in order to create a desired tool. All debitage was then sorted into chert or obsidian types, as defined by colour and inclusions, counted and weighed in their colour groups within each context, labelled and bagged. All details were entered into an Excel lithic debitage spreadsheet. Tools were divided into material type within contexts and recorded individually, weighed, measured in three dimensions, labelled and bagged. Details on degree and type of retouch, on platforms and bulbs of percussion, and any other relevant comments were also entered into a dedicated Excel lithic tools spreadsheet. Many tools were also drawn and photographed.

The manner of recording for the Bestansur lithics enables a detailed level of analysis of aspects such as the absolute and relative counts and weights of chert and obsidian within individual contexts, within individual trenches and across the site as a whole. It also facilitates analysis of the distribution of tool types within and across the stratigraphic sequences excavated through the season and across their spatial distribution within archaeological levels. Future analysis of the Bestansur lithics will take such studies further than is feasible in this preliminary archive report.

During the season all lithics from Trenches 1-9 were fully processed while those from Trench 10 remain to be completed. Excavation in Trenches 3 and 6 did not reach *in situ* Neolithic levels and so lithics from those trenches do not feature in most of the following analyses. The current report focuses on lithics from Trenches 1-2, 4-5 and 7-9.

Distribution of lithic materials and types across the excavated trenches

In total, 2523 pieces of chert and obsidian were recovered and recorded during the season from Trenches 1-9. As illustrated in Figs 9.1-9.2, the weight of the total site lithic assemblage is distributed at approximately 85% chert and 15% obsidian while the quantity distribution is 69% chert and 31% obsidian. These percentages are significantly affected by the finding of a cache of 797 chert bladelets and debitage in Trench 7, C1172, which alone accounts for 45.75% by quantity of all chert recovered during the season from all trenches.

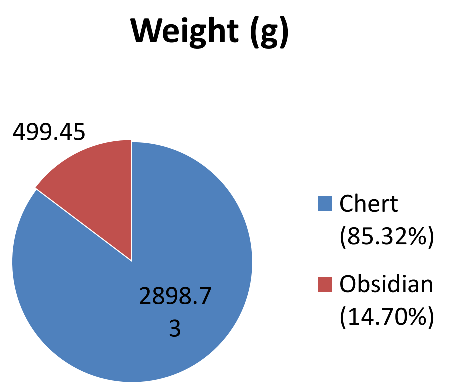


Figure 9.1. Weight (g) of lithic materials from all contexts, Trenches 1-9 combined.

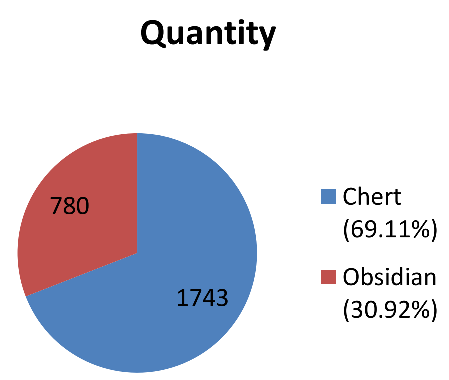


Figure 9.2. Quantity of lithic materials from all contexts, Trenches 1-9 combined.

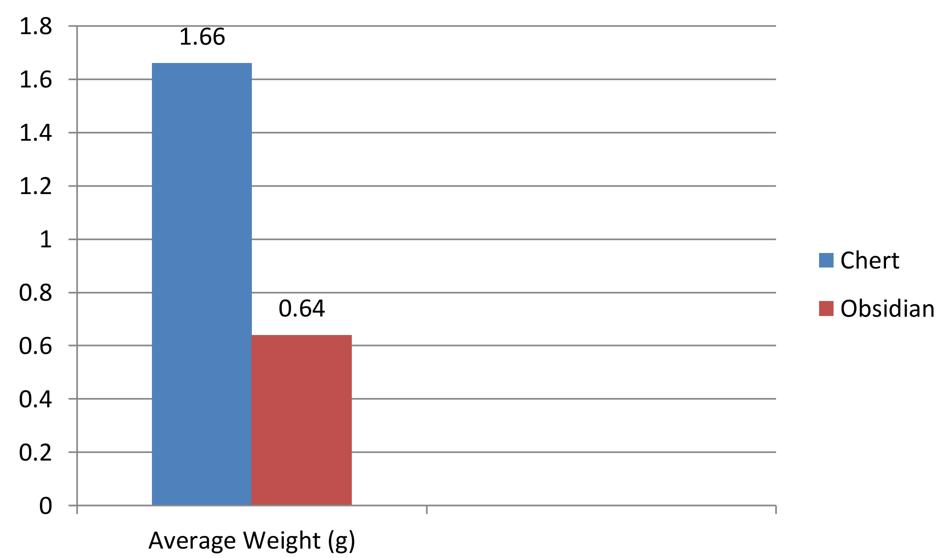


Figure 9.3. Average weights for chert and obsidian pieces, all contexts combined.

The average weight of pieces of chert, at 1.66g, is significantly higher than that for pieces of obsidian, at 0.64g, indicating more careful curation and reworking of cherished obsidian materials by the site's inhabitants (Fig. 9.3). Chert will have been more easily available within the site's locality, while obsidian reached the site after a journey of not less than 250km. Figs 9.4-9.5 show the distribution of chert vs obsidian across the trenches, demonstrating the relatively high proportions of obsidian, by quantity not by weight, present across the site. The distribution across Trenches 1-9 of the lithic assemblage by material and by tool vs debitage is illustrated in Fig. 9.6.

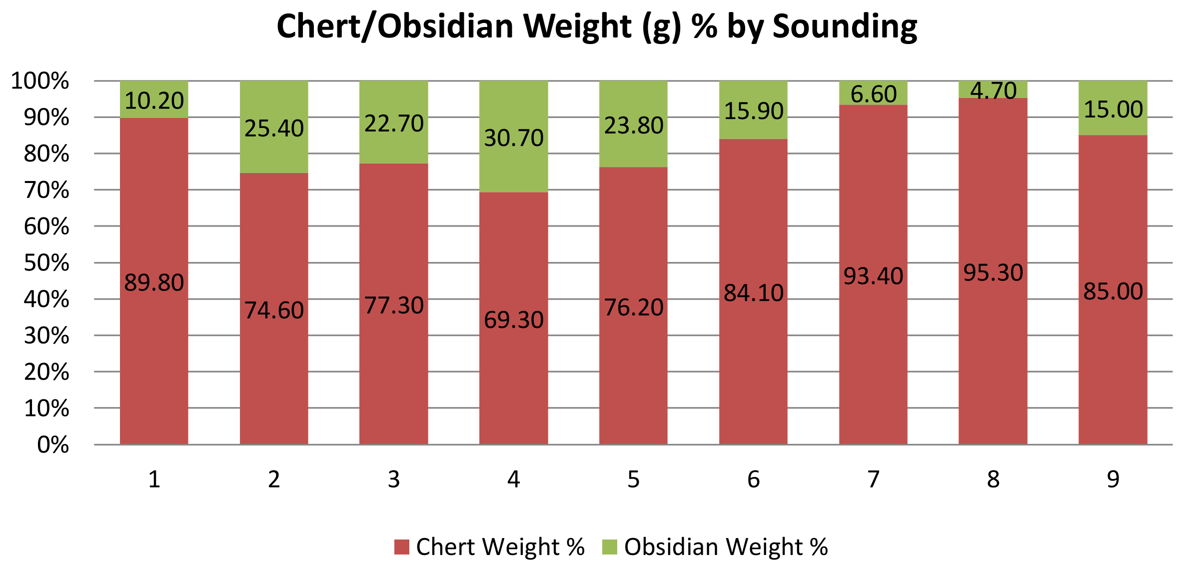


Figure 9.4. Percentages of lithic materials, tools plus debitage, across Trenches 1-9, by weight (g).

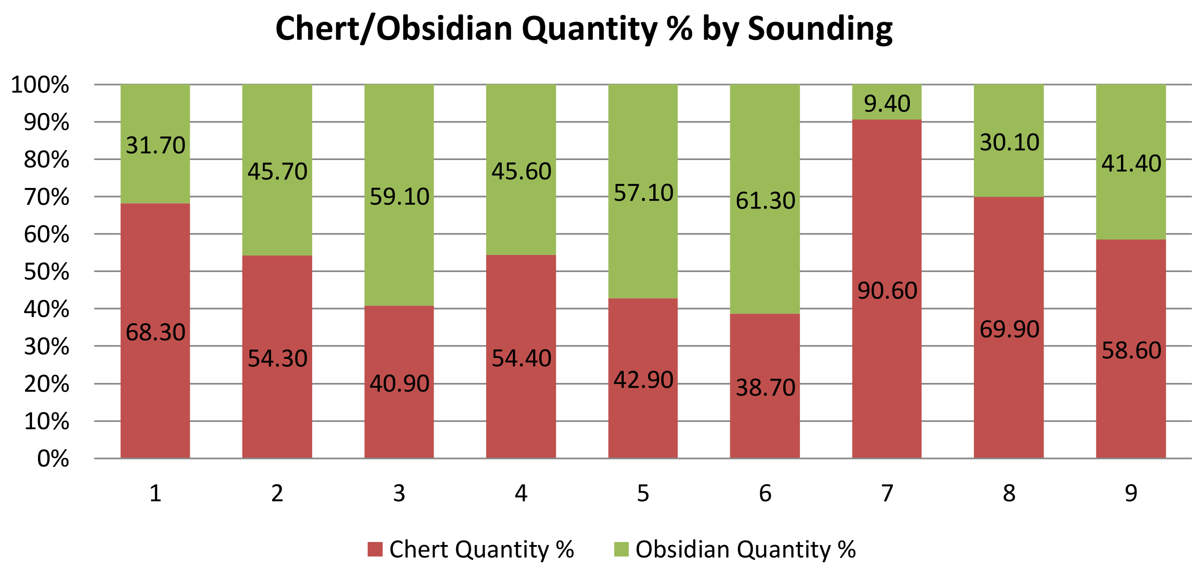


Figure 9.5. Percentages of lithic materials, tools plus debitage, across Trenches 1-9, by quantity.

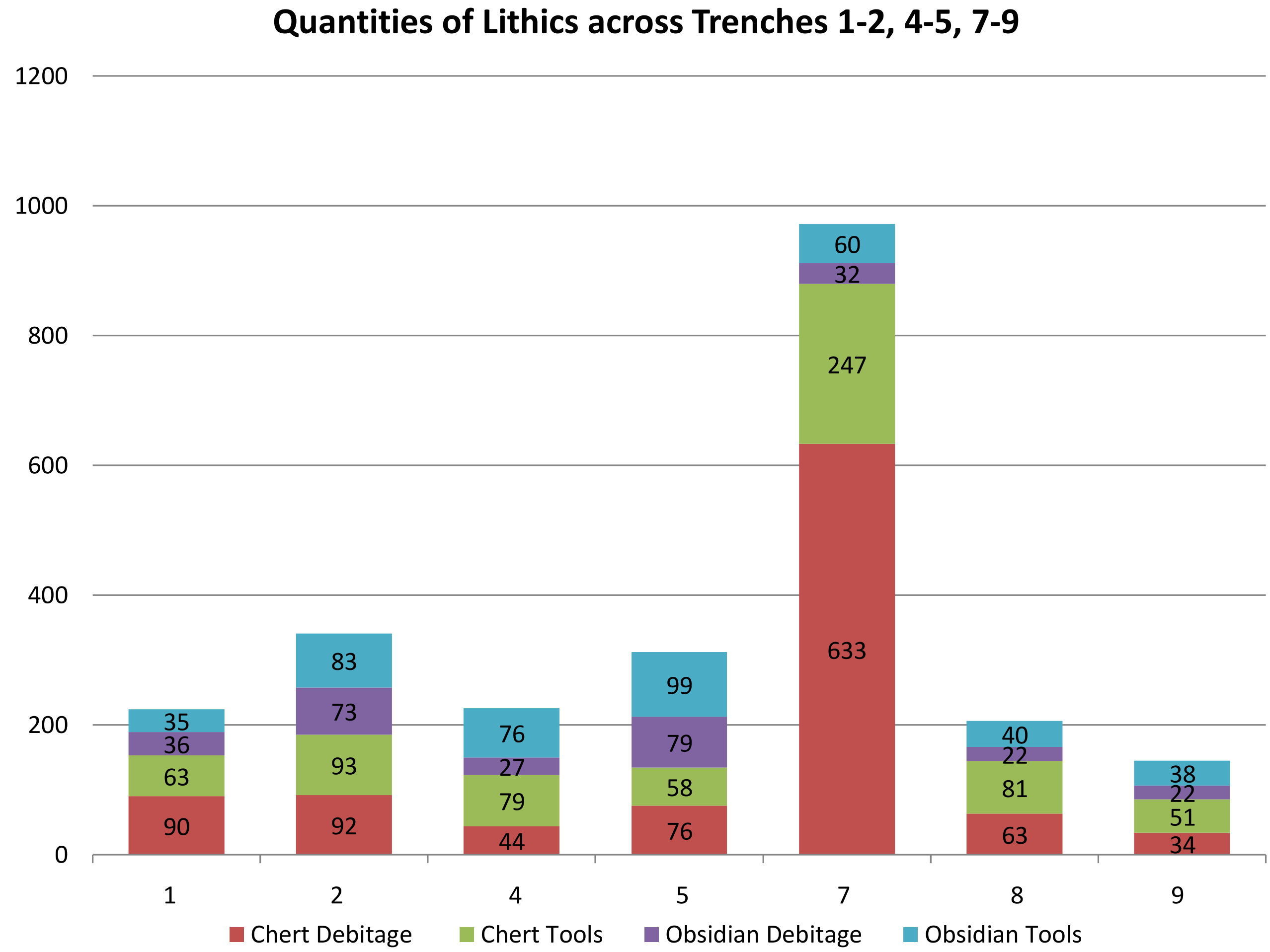


Figure 9.6. Quantities of lithics across Trenches 1-2, 4-5, 7-9.

The relative frequency of obsidian and chert at Neolithic sites in the eastern Fertile Crescent can be a tentative indicator of chronology as well as of proximity to available obsidian sources. The earliest Neolithic sites of the upper Zagros, such as Sheikh-e Abad, Ganj Dareh, Abdul Hosein and Asiab (Smith 1976, 17; Pullar 1990, 113; Kozlwoski 1999; 64; Vahdati Nasab *et al*. in press), have either no obsidian at all or frequencies of less than 1% by quantity. The Pre-Pottery Neolithic levels at Jarmo in the lower Zagros have 23-33% obsidian by quantity (Hole 1983, 257), while lower levels at Shimshara have *ca*. 85% obsidian by quantity (Mortensen 1970, 27-28). At Çayönü in the Pre-Pottery Neolithic period obsidian increases from *ca*. 20% in the earliest phases to *ca*. 60% in later phases (Caneva *et al*. 1994, 263). The chert/obsidian quantity proportions recovered at Bestansur appear to sit between those recorded for Pre-Pottery Neolithic levels at Jarmo, 70km to the west, and at Shimshara, 110km to the northwest.

Tool typology and tool use

Chert and obsidian tools are defined as artefacts created by the removal of debitage. They are the intended (usually) products of knapping. Cores and core fragments, whether reused or not, are also included in the category of tools. Tools are frequently distinguished from debitage on the basis of retouch along their edges or points, and the intensity and type of retouch were recorded in the tools spreadsheet. The major area of uncertainty centres on the use of unretouched blades as potential tools. Clearly a blade without retouch can serve as a cutting or slicing tool, especially if made from obsidian. We took the decision to define all unretouched blades as potential tools for the purpose of this analysis, which means that the tool assemblage for the site and for each trench is dominated by blades. In many cases it may be that unretouched blades were not the intended product of knapping but rather its debitage. Rather than make a value judgement in each case, we have defined all blades as tools, even in the case of the cache of chert debitage in C1172 where it is likely that all the blades in this deposit should be treated as unwanted debitage. In any case it is straightforward to remove unretouched blades from the figures in studying the tool assemblages.

The tool assemblage attested in all trenches at Bestansur can be broadly characterised as Mlefatian as defined by Kozlowski (1999, 51-75), with an emphasis on blades and production of a limited repertoire of tool types on locally available cherts with varying usage of imported obsidian (Fig. 9.7). Blades occur in large numbers in all Trenches (Fig. 9.8), and the vast majority of them are broken at either one or both ends. It is not clear if breakage occurred during manufacture or use of the blades, or both. All blade tools may have been used for a wide variety of cutting and slicing activities. Apart from blades and tools made on blades, other tool types include scrapers, drills, and borers (Fig. 9.9). There are very rare occurrences of microliths in the form of trapezes and crescents. As Kozlowski (1999, 71) argues for a late Pre-Pottery Neolithic date for the introduction of geometric microliths in the eastern Fertile Crescent, it may be that their scarcity in the Bestansur assemblages suggests a relatively early Pre-Pottery Neolithic B date for the sequence here.

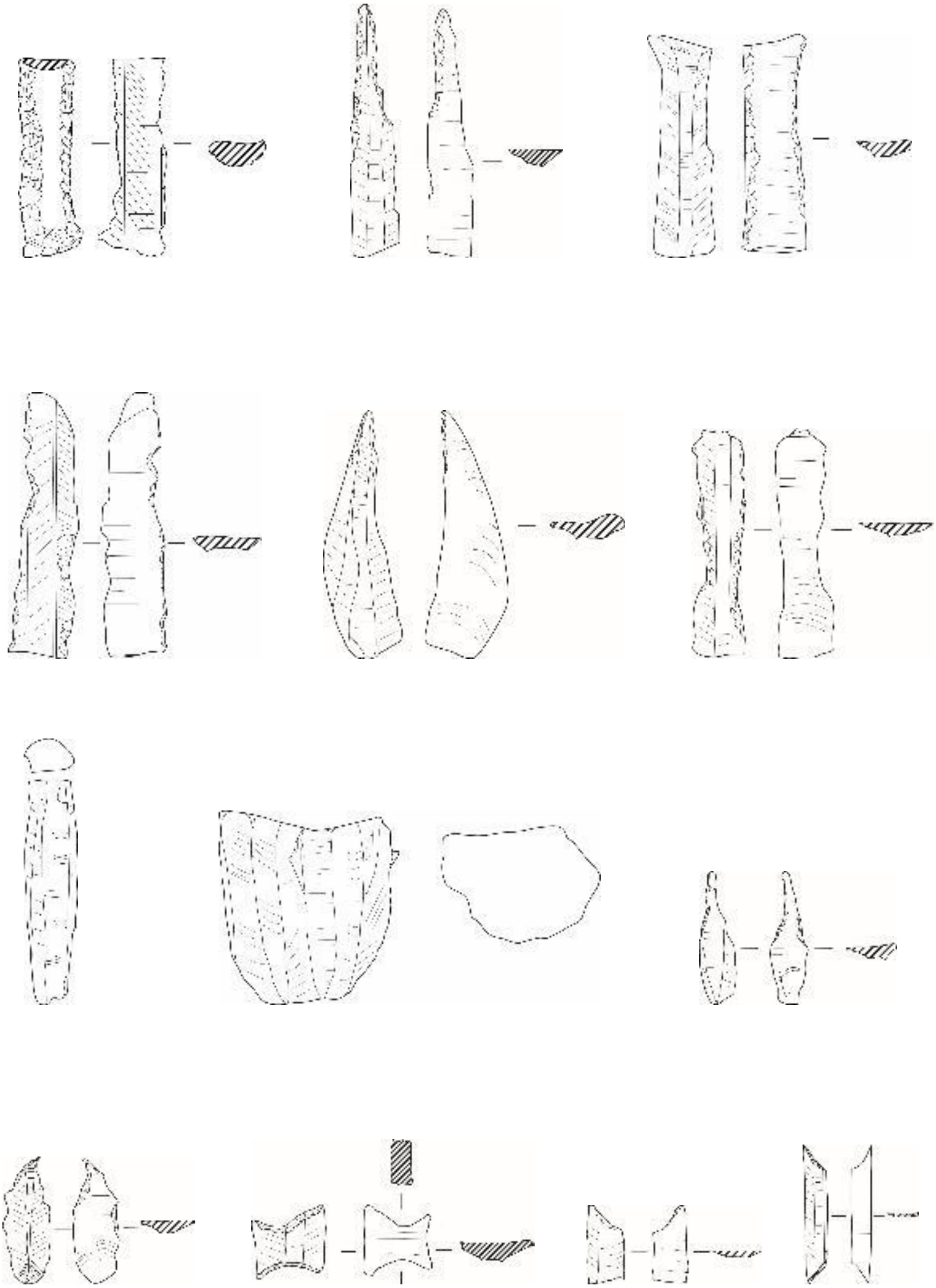


Figure 9.7. Tools from Bestansur. Scale 1:1.

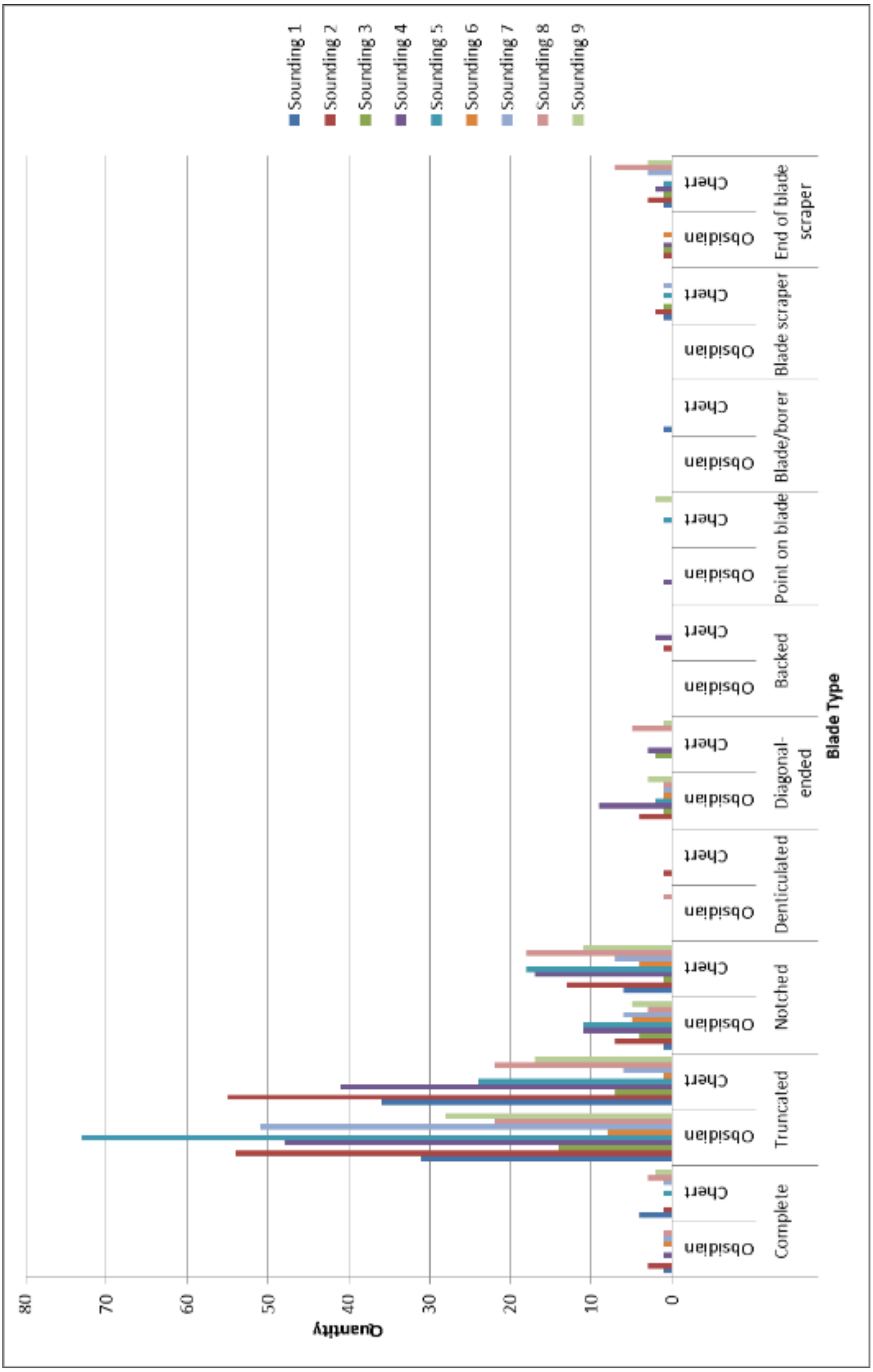


Figure 9.8. Distribution of blade types across Trenches 1-9, omitting all blades from Trench 7 C1172.

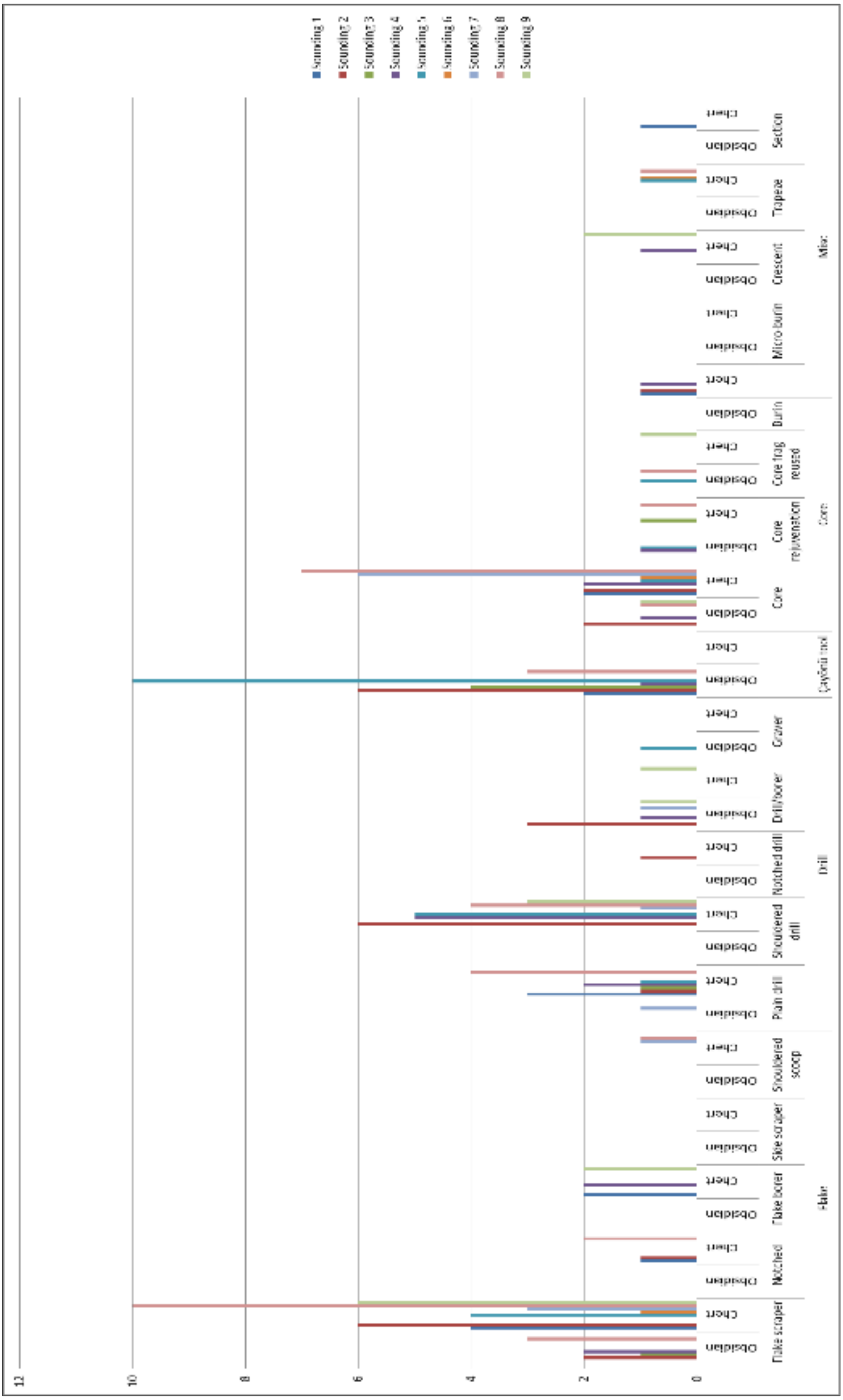


Figure 9.9. Distribution of non-blade tool types across Trenches 1-9.

Figure 9.10. Çayönü tool (Tool 153, C1030, Trench 2).

Figure 9.11. Çayönü tool (Tool 199, C1034, Trench 2).

One of the most diagnostic tool types found at Bestansur is the so-called Çayönü tool, occurring in six of the nine excavated trenches (Figs 9.10-9.11). These tools have a distinctive morphology, with thick blades showing steep, dense retouch on both edges, and often with a flaring or hooked end. In cross-section they are frequently angular and rhomboid. On their flat obverse faces they often show clear use-wear traces in the form of radial lines etched into the obsidian, interpreted by Anderson (1994) as evidence for their use in final finishing or decorating of stone objects such as marble bracelets and limestone plaques or bowls. Such finished objects have yet to be found at Bestansur. Çayönü tools appear in a broad band of territory spanning southeast Anatolia, upper Mesopotamia and the central Zagros, and are dated to the later 8th and 7th millennia calibrated BC (Kozlowski and Aurenche 2005, 143). At Çayönü itself these tools are associated in particular with the Cell Building and subsequent sub-phases (Caneva *et al*. 1994, 263), from *ca*. 7600 calibrated BC onwards.

	Total Quantity	Cores %	Debitage %	Blades %	Tools %
Trench 1	224	0.9	56.3	36.6	6.3
Trench 2	341	1.2	48.4	42.5	7.9
Trench 4	226	1.8	31.4	60.2	6.6
Trench 5	312	1.0	49.7	42.3	7.1
Trench 7	972	0.6	68.4	30.4	0.7
Trench 8	206	4.9	41.3	40.3	13.6
Trench 9	145	1.4	38.6	49.7	10.3
Bestansur Total	2426	1.3	54.5	41.1	5.3

Table 9.1. Overall technological structure of Bestansur assemblages for Trenches 1-2, 4-5 and 7-9, and for site overall (excluding Trenches 3 and 6).

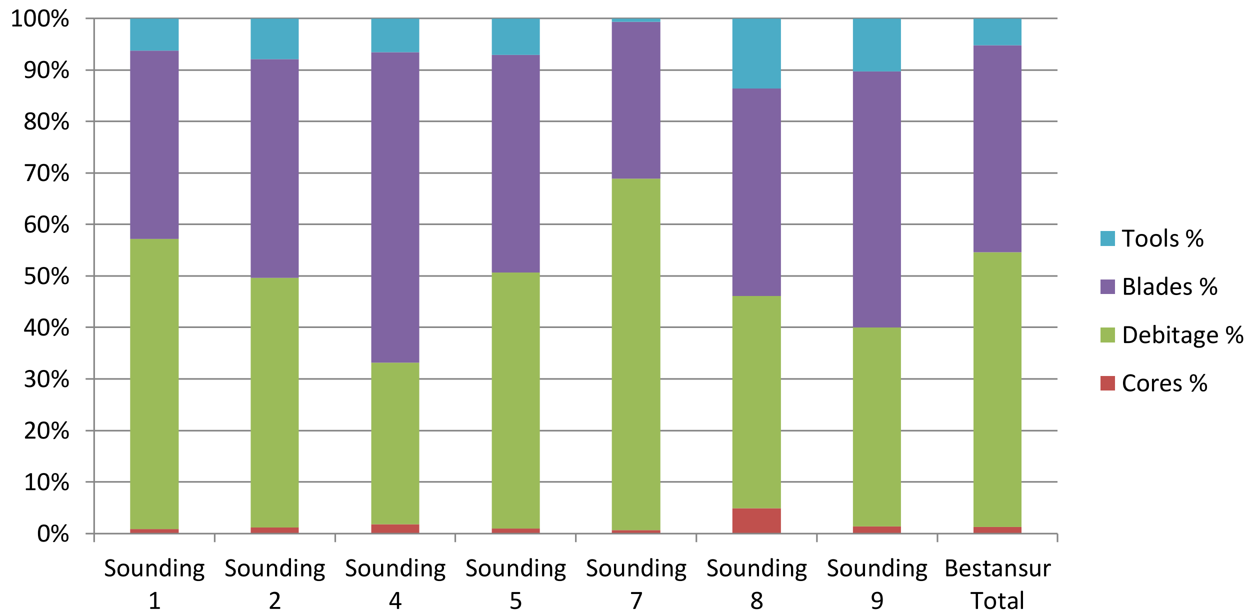


Figure 9.12. Graphic display of Table 9.1.

In sum, the overall structure of the Bestansur assemblages from Trenches 1-2, 4-5 and 7-9 is highly comparable to that described by Kozlowski (1999, table 9) for Mlefatian assemblages from a range of sites in the central and south Zagros. In Tables 9.1-9.2 and Figs 9.12-9.13, we show the technological structure of the assemblages firstly across the trenches at Bestansur and secondly *en masse* against the site figures compiled in Kozlowski's table (note that there is a question over the recovery methods regarding the egregiously low debitage count at Shimshara). The graph, Fig. 9.13, clearly demonstrates the structural similarity of the Bestansur site assemblage to those recorded from other sites of the Neolithic Zagros such as Jarmo, Abdul Hosein and Ali Kosh in particular.

	Total Quantity	Cores %	Debitage %	Blades %	Tools %
Abdul Hosein	12,657	3.8	46.6	45.2	8.9
Shimshara	876	1.0	8.4	39.7	50.8
Chogha Sefid	37,281	2.0	62.5	22.9	12.6
M'lefaat	2229	2.4	62.3	27.9	7.4
Sarab	43,674	0.9	67.0	25.5	6.6
Ali Kosh	87,281	1.0	52.9	40.9	5.3
Jarmo	105,826	0.4	48.7	45.5	8.3
Genil	588	1.5	51.9	31.1	15.5
Tamerkhan	323	6.5	11.1	26.6	56.3
Bestansur	2426	1.3	38.6	41.1	5.3

Table 9.2. Technological structure of Bestansur assemblage (excluding Trenches 3 and 6) compared to structure of assemblages from sites in central and south Zagros (figures from Kozlowski 1999, table 9).

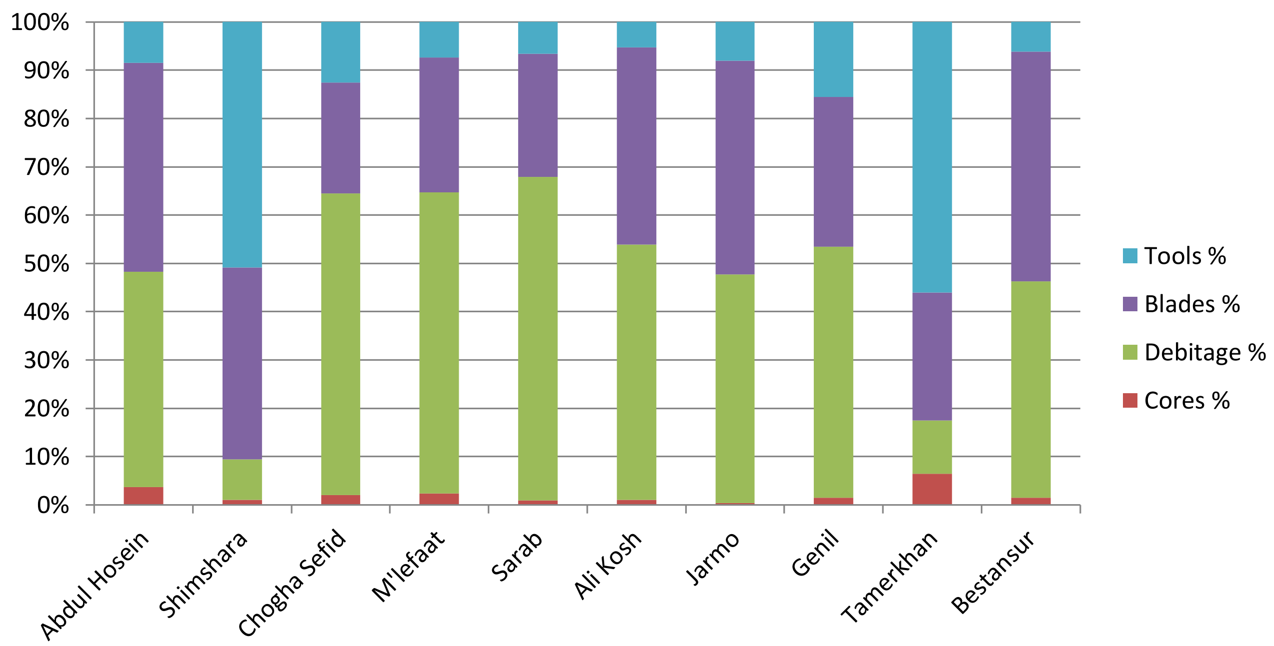


Figure 9.13. Graphic display of Table 9.2.

Kozlowski (1999, 65) interprets this overall structure, with its high debitage and blade proportion and low non-blade tool proportion, as indicative of *in-situ* lithic production over extended periods of time in permanently settled locales largely using locally available raw materials, a scenario that is likely to fit the Bestansur material rather well.

Materials analysis of obsidian and chert

The abundant chipped stone assemblage from Bestansur has the potential to provide a great wealth of information regarding resource utilisation and Neolithic networks. In addition to typological and technological analyses, it is possible to make inferences based on the chemical composition of the materials, through portable x-ray fluorescence analysis. Research in Southwest Asia in recent years has illustrated the potential for these approaches, particularly in Turkey and Syria, using techniques such EDXRF and ICPMS (see, for example, Carter and Shackley 2007; Khalidi *et al.* 2009; Poupeau *et al.* 2010), and more recently Iran.

Methodology

Portable x-ray fluorescence (pXRF) was conducted in the field using a Niton XL3t GOLDD+. Chert and obsidian were analysed in the Niton tungsten-lined stand, following the University of Reading local rules, with radiation monitored throughout. All readings were taken in 'Mining' mode, running at 20 seconds for each of the high, low and main filters, with 60 seconds operating time for the light elements. All readings are in parts per million (ppm). On start-up, a system check was performed to ensure the stability of the instrument under field laboratory conditions, and two standards with known values were run to check for precision. In addition, analysis was performed on these standards at the end of each operation, to measure for drift.

Prior to analysis, all artefacts were washed in water and residues removed where possible. Each piece was placed centrally to the analysis window (Fig. 9.14), covering the total area where possible. The results used in this document refer to the readings taken on the ventral side of the flint and obsidian blades (where available), or flat surfaces without concretions.

Figure 9.14. Placement of artefact over analyser window in tungsten-lined portable stand (pXRF below).

During the analysis, the following details were recorded in hard copy and later digitised:

Date
Reading number
Tool number
Trench number
Context
Material
Colour
Description
Location on tool of analysis
Further comments

Following each lab session, all readings were downloaded and backed up on a separate hard-drive. All readings are stored in a Microsoft Access database. For the purposes of preliminary analysis, results have been analysed in Microsoft Excel. Future analyses will utilise a refined methodology and multivariate statistical analysis for the characterisation of the cherts and obsidians. Photographs were taken of each analysed tool.

Preliminary analysis of obsidian

All obsidian cores and Çayönü tools were selected for analysis. The remaining obsidian tools were selected from the 471 in the excavated obsidian assemblage, based on sufficient size and variation in colour, from a range of contexts and across a range of tool types (Table 9.3). This selection process was intended to ensure that all tool types and all variations on appearance were sampled. All tools were classified according to type and colour.

Tool #	Type	Trench #	Context #	Weight (g)	Colour
16	Çayönü tool	1	1000	0.65	Dark grey
21	Çayönü tool	1	1001	0.16	Black
124	Çayönü tool	2	1029	2.11	Black
125	Çayönü tool	2	1029	1.82	Black
153	Çayönü tool	2	1030	1.80	Black
162	Core	2	1031	3.51	Black
163	Core	2	1031	2.05	Black
174	Çayönü tool	2	1031	0.10	Black
173	Microburin	2	1031	0.49	Dark grey
188	Flake scraper	2	1034	28.45	Black
198	Çayönü tool	2	1034	6.17	Black
199	Çayönü tool	2	1034	2.83	Black
219	Blade, notched	2	1036	3.11	Dark grey
252	Blade, notched	2	1038	4.94	Black
276	Blade, truncated	3	1045	2.07	Black
291	Çayönü tool	3	1045	0.87	Black
292	Çayönü tool	3	1045	0.66	Black
293	Çayönü tool	3	1045	0.49	Black
298	Çayönü tool	3	1046	1.98	Black
331	Core	4	1065	21.35	Black
334	Diagonal-ended blade	4	1065	0.70	Mid-grey
374	Blade, truncated	4	1069	1.91	Clear translucent
360	Çayönü tool	4	1067	1.28	Black
373	Diagonal-ended blade	4	1069	1.15	Dark grey
403	Çayönü tool	5	1070	1.20	Black
439	Core rejuvenation flake	5	1073	1.91	Black
Tool #	Type	Trench #	Context #	Weight (g)	Colour
440	Çayönü tool	5	1073	1.04	Black
441	Çayönü tool	5	1073	1.19	Black
442	Çayönü tool	5	1073	0.49	Black
495	Core used as scraper	5	1074	2.48	Black
504	Çayönü tool	5	1074	2.61	Black
505	Çayönü tool	5	1074	2.44	Black
502	Graver	5	1074	1.71	Dark grey
520	Çayönü tool	5	1075	1.53	Black
534	Çayönü tool	5	1076	0.69	Black
548	Çayönü tool	5	1078	0.15	Black
550	Çayönü tool	5	1078	0.32	Black
581	Drill / Borer	7	1092	0.58	Mid-grey
600	Blade, truncated	7	1093	1.16	Pale grey
661	Blade, notched	7	1175	1.03	Pale grey translucent
682	Core used as scraper	8	1130	0.51	Black
683	Çayönü tool	8	1130	0.15	Black
684	Flake scraper	8	1130	0.69	Black
700	Çayönü tool	8	1131	0.19	Black
702	Çayönü tool	8	1133	0.32	Dark grey

Table 9.3. Obsidian tools selected for pXRF analysis.

A total of 45 obsidian artefacts, from 25 contexts throughout Trenches 1-8 were selected for analysis, including:

3 obsidian cores, plus 2 used as scrapers and 1 rejuvenation flake
26 Çayönü tools
8 blades

1 drill/borer
2 flake scrapers
1 graver
1 microburin

Due to time constraints, it was not possible to analyse all obsidian, nor material from all contexts (i.e. Trenches 9 and 10), in the field laboratory. The material has been deposited with the Sulaimaniyah Directorate of Antiquities and Heritage, and may be re-explored in future.

Preliminary analysis reveals a clear polarisation of the data, indicating a likely single source for 44 of the 45 artefacts analysed. A simple scatter-plot comparing the relative values of Rubidium (Rb) and Zirconium (Zr) highlights the marked isolation of Tool #374 from the standard chemical composition of the remaining readings (Fig. 9.15). The same pattern of distinction between Tool #374 and the other 44 obsidian artefacts can be illustrated comparing almost any two elements shared by their compositions.

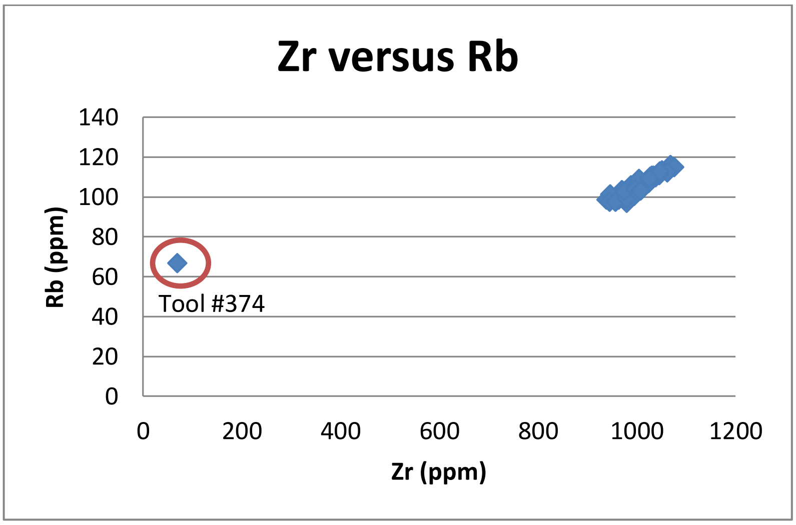


Figure 9.15. Scatterplot comparing Zr and Rb (ppm) for the obsidian tools from Bestansur.

Thus far, the data from the 44 dominant artefacts appear to share similarities with the samples from the sources at Nemrut Dağ and Bingöl A, situated close to Lake Van (Fig. 9.16), in Eastern Turkey, and in the region of the headwaters of the Euphrates and the Tigris. The sources in this area appear to have provided much of the obsidian recovered from the western central Zagros Neolithic sites (Forster and Grave 2012).

Figure 9.16. Map of sites mentioned in the text, including obsidian sources.

At this stage, it is not possible to commit the data to a named source, but with further calibration and comparison, it may well prove that the majority of the obsidian was sourced from Eastern Anatolian sources, centred around Lake Van, whereas Tool #374 could potentially derive from Central Anatolian sources (see Fig. 9.17).

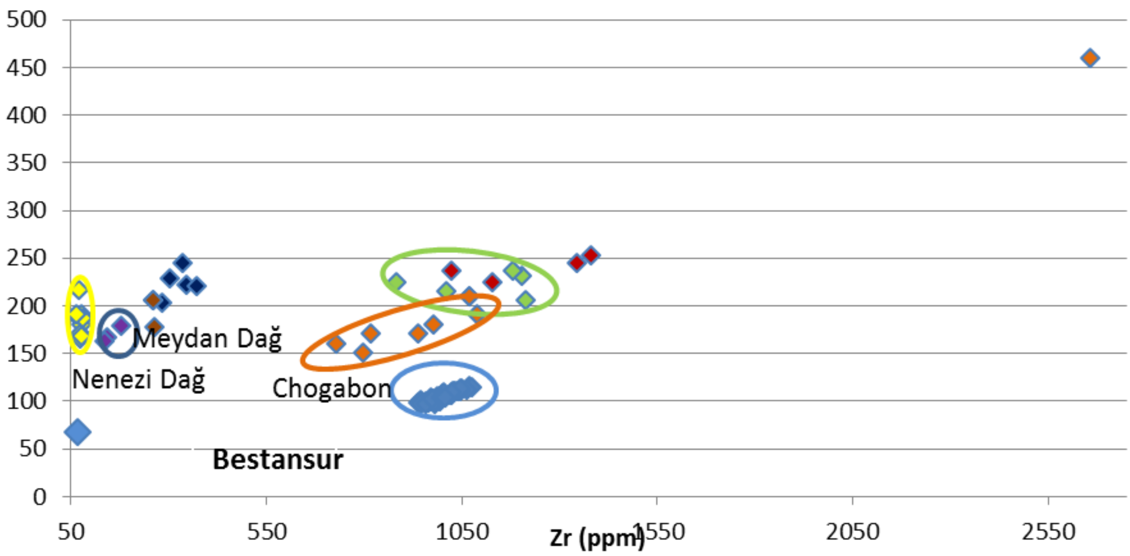


Figure 9.17. Comparison of Rb/Zr in Bestansur obsidian tools with known sources in Central and Eastern Anatolia.

Where the simple Rb/Zr analysis (Fig. 9.15) and breakdown of the major elemental composition (Fig. 9.18) represent considerable uniformity, with the exception of Tool #374, further examination of the minor and trace elements reveals a more heterogeneous and dynamic assemblage of obsidians (Figs 9.19-9..20).

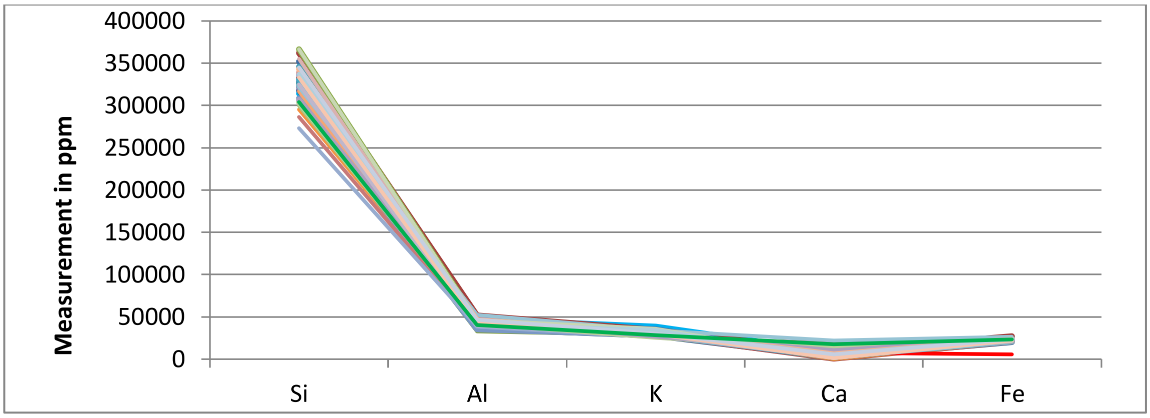


Figure 9.18. Comparison of major elements across 45 obsidian tools from Bestansur.

A sharp peak in phosphorus occurs only in a single tool (Tool #41), a Çayönü tool from a mixed context in Trench 5 (Fig. 9.19). The other tools tested in this context (C1073) do not feature the same peak and it is likely that this is an exception related to either surface residue or inclusion in the obsidian itself. Likewise, analysis of a single drill/borer from Trench 1 shows elevated chlorine and titanium levels (Tool #21, C1001). One Çayönü tool from Trench 8 (Tool #702, C1133) revealed higher proportions of sulphur and chlorine than seen in the standard minor elements profile for the Bestansur obsidian tools.

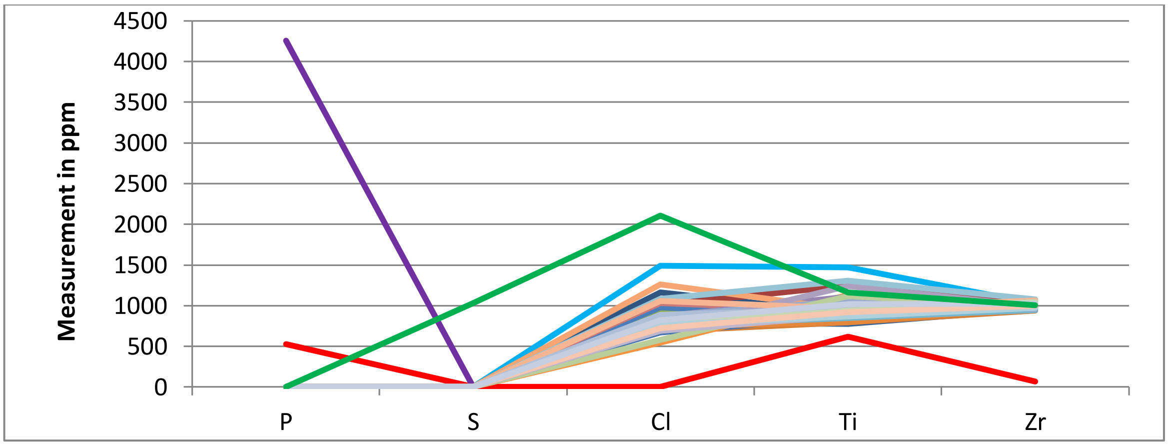


Figure 9.19. Comparison of minor elements across 45 obsidian tools from Bestansur.

Furthermore, Tool #702 (represented in bright green) and Tool #21 (in bright blue) both show deviation from the trace elements profile seen in the majority of obsidian tools at Bestansur (Fig. 9.20). In the former, this is characterised by low manganese and barium levels, in the latter by low barium and a unique peak in tungsten. This may relate to natural variation in elemental composition at source, residues on and impurities in the obsidian, or potentially chemically very similar, but differing sources in the Eastern Anatolian group around Lake Van. In order to answer these questions, further investigation and a larger data set is required for further comparative analysis.

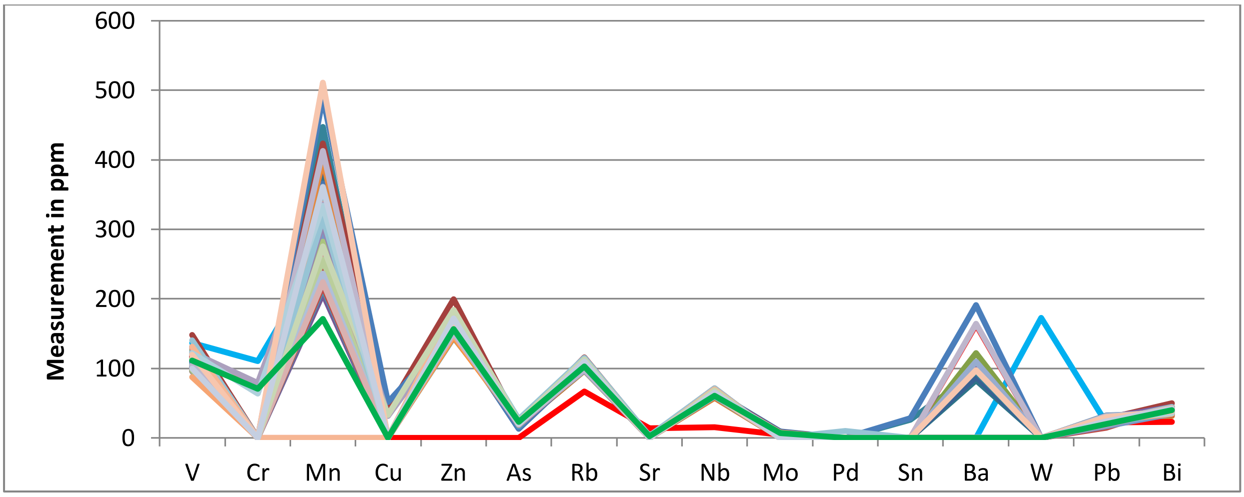


Figure 9.20. Comparison of trace elements across 45 obsidian tools from Bestansur.

Preliminary analysis of chert

The natural wealth of variability in chert sources renders the analysis complex, in the absence of local geology samples. Principally composed of quartz crystals, it is the impurities (i.e. other minerals present) that define the characteristics of chert, including colour and hardness (Luedtke 1992, 10). Nonetheless, it is possible to make a few observations on the basis of the pXRF analysis thus far. A total of 11 chert cores from the 15 excavated at Bestansur were analysed in the field laboratory (Table 9.4). These were selected for their colour and size, in order to analyse a cross-section of the chipped stone worked on site. This preliminary analysis intends to establish a foundation for further field analysis of the cherts in future seasons, including an examination of the relationship between the artefacts and the chert sources available locally.

Tool #	Trench #	Context #	Colour	Weight (g)
90	1	1102	Mid-grey	6.44
210	2	1036	Pale blue/grey	35.01
229	2	1038	Dark brown	12.55
362	4	1067	Mid-grey	3.95
388	4	1080	Pale grey/white	2.52
447	5	1074	Grey/green	11.96
564	7	1091	Pale grey with dark mottling	25.62
609	7	1094	Pale pink/grey	31.73
624	7	1172	Pale grey with dark mottling	6.59
656	7	1174	Pale grey/white	40.17
690	8	1131	Pale grey/brown with dark grey streaks and mottle	37.54

Table 9.4. Chert cores selected for pXRF analysis.

The most commonly occurring colour is grey, which forms the foundation for the majority of the cherts, with variations based on additional impurities in the matrix. Two primary groups may be characterised, including the plain pale grey cherts (sometimes tinged) and the pale grey with mottling. These groupings are clearly illustrated by the major elements present, in which the mottling appears to be determined by the presence of calcium in the chert (Fig. 9.21). Tools #564, #624 and #690 all demonstrate higher calcium values (>30k ppm) than their pale grey counterparts (<10k ppm).

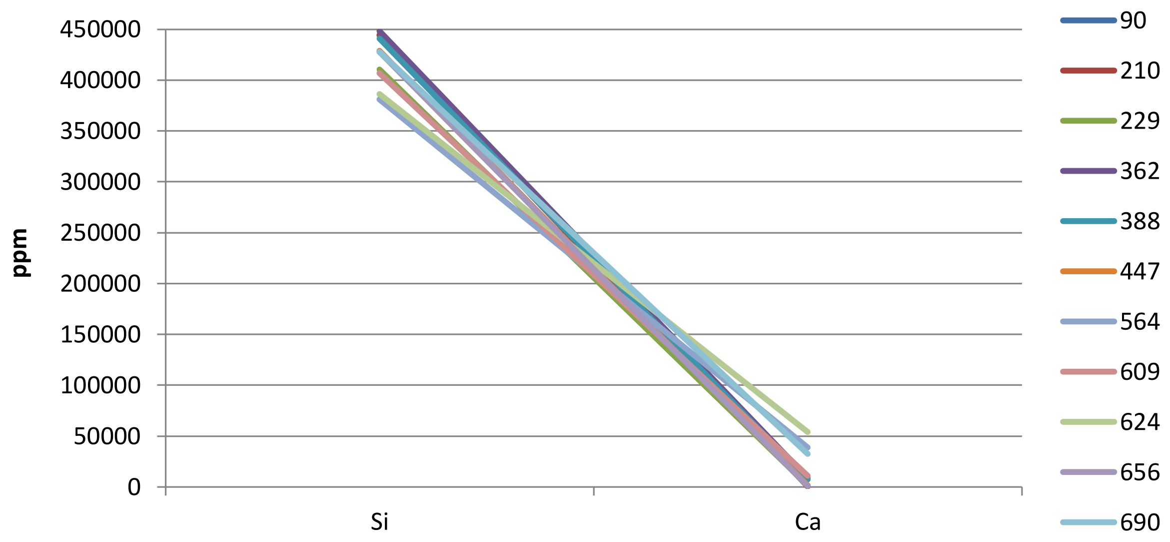


Figure 9.21. Comparison of major elements across 11 chert cores from Bestansur.

The minor elements elucidate greater complexity within the cherts (Fig. 9.22). Tool #624 has high levels of phosphorus, which require further investigation to establish whether these are consistent throughout the whole tool, or whether the reading is the result of surface residues or an isolated inclusion in the chert. Tool #447, although otherwise consistent with the pale grey group, has a high level of aluminium (>7k ppm), which may contribute to the green tinge to the grey of the chert.

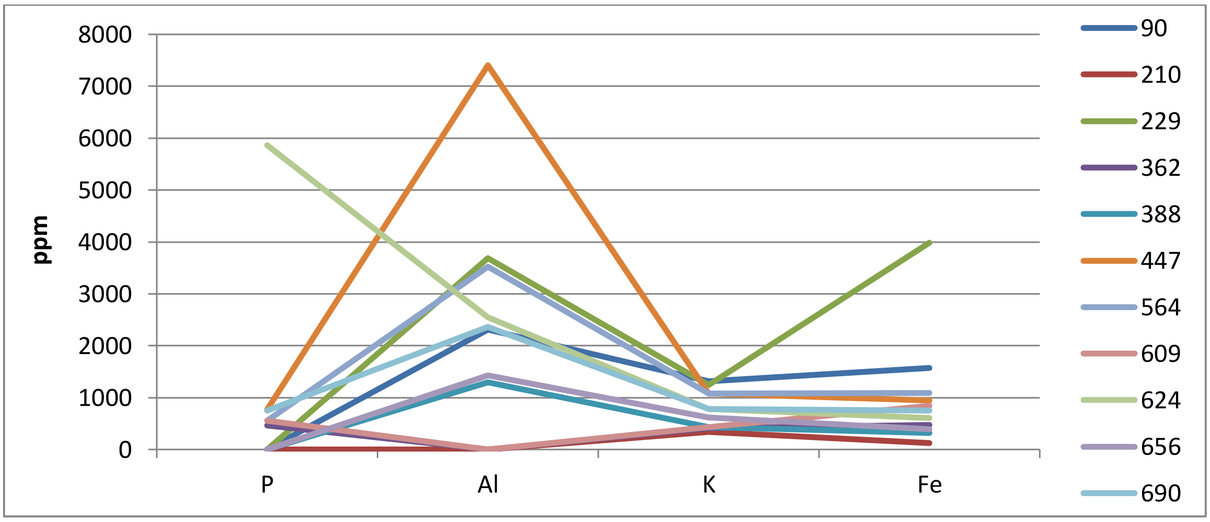


Figure 9.22. Comparison of minor elements across 11 chert cores from Bestansur.

Uniquely, Tool #229, a dark brown blade core with 14 facets, has proportionally high levels of iron and titanium (see Figs 9.22-9.23). This is the only brown-coloured core found at the site, with fewer than 30 brown tools catalogued over the course of the season ranging from mid-to-dark browns. Thus far, the indications are that this particular chert was less commonly used at Bestansur than cherts in grey hues, possibly due to either the practical or aesthetic values of the material, or the availability of this resource in the locality. It is well established that obsidian was travelling into this area, and Tool #229 was recovered from Trench 2, from a context (C1038) in which 12 obsidian tools were also found. Further analysis of less frequently occurring cherts such as this may be able to elucidate some of the local and regional networks that operated and facilitated resource exchange and movement. The trace elements reveal further fine-grained detail, including the presence of manganese and barium in the mottled grey cherts (Tool #90, #624 and #690; Fig. 9.23).

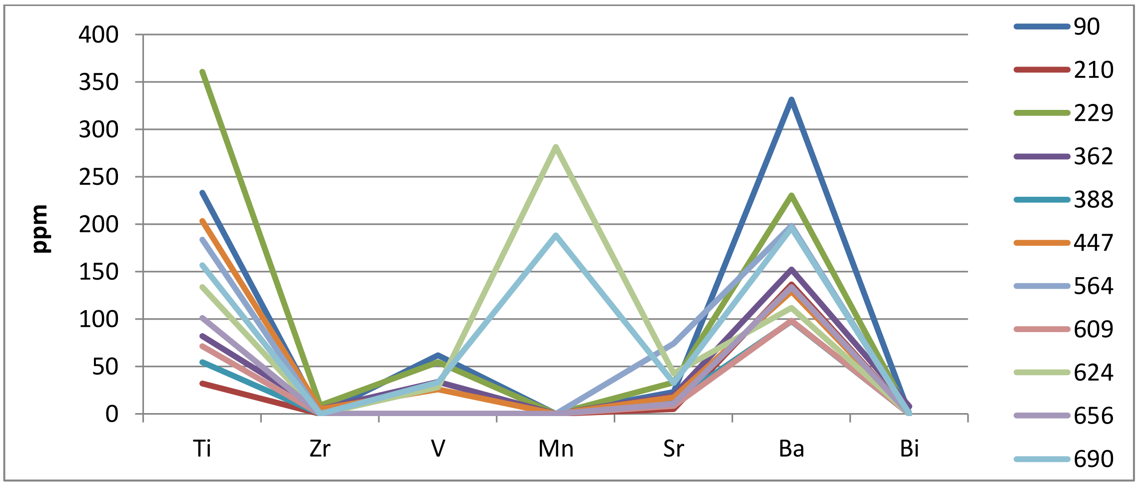


Figure 9.23: Comparison of trace elements across 11 chert cores from Bestansur.

The limited range of elements present in the 11 cherts analysed (far fewer than were detected in the obsidian) and the remarkable homogeneity of the values from most of the tools analysed, illustrates the likelihood that chipped stone tools were, for the most part, crafted from locally available chert sources, with occasional exceptions.

In order to expand and refine these results, it is necessary to integrate new data into this dataset, from further seasons of fieldwork at Bestansur. Concurrently, the local geology must be investigated, in order to establish local chert sources potentially utilised by inhabitants of the site. Cherts collected from future seasons of field survey around Zarzi and from the section at Shimshara will be analysed in a similar manner; comparisons will be drawn between the cherts, and between the chert assemblages. These analyses may operate in conjunction with analysis of less commonly occurring cherts and particularly those which contain rare elements, where applicable, in order to examine networks in the landscape.

Chapter Ten: The Ground Stone Assemblage

David Mudd

Introduction

This report is a preliminary description of the ground stone items excavated from trenches at Bestansur. The report is based on a catalogue of the items (Bestansur Ground Stone Catalogue v2.0.xlsx). The catalogue covers the morphology and classification of the items, and suggests comparable items from other sites. It does not include detailed studies of use-wear. The report will be expanded to reflect stratigraphic context and other data when this information has been consolidated in the IADB, together with an assessment of the significance of the assemblage. The report gives a high-level overview of the assemblage, but a full statistical or spatial analysis of the items would not be useful at this early stage in the excavation of the site. It concludes with a discussion and proposals for future work.

Examination and recording

A total of 148 pieces were recovered from 10 2m x 2m trenches, excavated to a depth of up to 1.60-2m. The majority were handpicked, with a few being recovered from flotation samples. 43 groups of items were recorded as Bulk Finds, and 12 individual items as Small Finds. The context of Bulk Finds was recorded, but not their exact spatial coordinates. To catalogue the items and compile this report, every piece was examined. Individual pieces were identified separately in the catalogue where they appeared to be worked or were otherwise of interest (thus for example BF635 consists of three stones, BF635.01, .02 and .03). Dimensions, weight and physical description were recorded. Items were examined with a hand lens, magnification x30, but not with a microscope.

The majority of worked stone items were photographed to aid recognition. Raw material has been identified with the aid of a reference book (Pellant 2000). The items are currently stored in the dig house in Bestansur. The individual stones in a Bulk Find bag are not separately labelled, but can be identified easily from the dimensions and description in the catalogue.

Scope

Neolithic assemblages of non-chipped stone are customarily referred to as 'ground stone'. As the report shows, the Bestansur assemblage is broader than this. Not all the items were reduced by grinding or pecking. A number are 'utilised cobbles' – stones of a convenient shape and weight which were used without first being modified (Moholy-Nagy 1983, 291). Some stones do not show any signs of use. They may have been tool blanks, or have had an architectural purpose such as floor surfaces or hearth linings. Some are fragments which may have been debris from stone tool manufacture or curation. A few are clay or mud rather than stone. For the sake of simplicity, however, the report uses the term 'ground stone'. It is worth noting that all the excavated stone items were stratigraphically above the Neolithic surfaces of the site and must therefore have been introduced to the site, even if they appear to be natural. They are all of potential archaeological interest.

The catalogue and this report cover all excavated ground stone items. Further work, based on ^{14}C dating, stratigraphy and analysis of material culture, is needed to define the nature and dating of excavated contexts and levels.

Local geology and raw material sources

The great majority of the items are likely to be local stone. Most are limestone, and a few are sandstone and shale. The geology of the Shahrizor Valley consists of Quaternary alluvial fan deposits (boulder, gravel, sand, silt and clay) overlying Cretaceous limestone (Karim 2011). There is a spring-fed river some 100m from the excavation site, and it is assumed that this was present at the time the Neolithic site was occupied. Many of the items are river pebbles/cobbles, showing signs of water wear and smoothing. Their source is presumed to be the river: similar stones are visible in the river and on its banks. There is a low hill between the two parts of Bestansur village, some 300-500m west of the dig site. The hill has outcrops of pale grey, honey-coloured, and dark limestone in bedding planes 20-40cm thick. Similar outcrops can be seen on hills 1-2km distant. The river and the limestone outcrops are likely to be the sources of most items in the assemblage.

Classification

Several published sources have been used to identify and classify the ground stone items. Two are overviews: Wright's classification of ground stone tools from the prehistoric Levant (Wright 1992), and Mazurowski's catalogue of items from Nemrik 9 and other sites from the eastern wing of the Fertile Crescent (Mazurowski 1990). Kozlowski and Aurenche took a regional overview of cultural materials in the Neolithic Near East (Kozlowski and Aurenche 2005). Their work includes ground stone artefacts, but they focus on items which are diagnostic of different cultural groups rather than attempting a comprehensive classification. Reports on the ground stone from Jarmo (Moholy-Nagy 1983), Çayönü (Davis 1982) and Jericho (Dorrell 1983) have also been used for comparison. These are sites from the eastern, northern and western zones of the Fertile Crescent, of comparable date, and with substantial ground stone assemblages.

These classification systems are based on artefact morphology. This is problematic for some of the Bestansur stone for the following reasons. Firstly, many items are too fragmentary to envisage their shape when complete, and I have therefore inferred their function from manufacture and use-wear evidence. Secondly, some items are 'utilised stones' which do not have the standard morphology for a particular tool, but their method of use (e.g. percussion, grinding, rubbing) is reasonably clear. They were presumably selected opportunistically because they were convenient for a particular purpose and did not need initial modification. Some commentators (for example Moholy-Nagy 1983) treat them as a separate category. I have included these with the appropriate functional category on the basis that how they were used is more helpful to the interpretation of the site than whether or not they conform to a morphological taxonomy.

Thirdly, one group show signs of more than one mode of use – abrasion and percussion marks on the same flat disc, for example. It is not clear whether this is sequential re-use or simultaneous multi-functionality. The published classifications tend to assume single, rather than multiple, functions, but I suspect that this is open to question. Fourthly, still others are unidentified, although I have tried to keep this group as small as possible.

Finally, I have grouped the items into broad functional categories in order to simplify the analysis of the assemblage. My categories are derived from those used by other commentators. My use of traditional terminology, however, should not be taken as a definitive indicator of how an artefact was actually used.

Analysis and results

With these explanations and caveats in mind, I move on to the results of the analysis.

Spatial analysis

The 148 items are shown by category and location in Table 10.1:

Category/Trench	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Surface**	**Total**
1 Pestles	1						4	1			1	7
2 Percussion tools	3				2		4	2		1	1	13
3 Celts & axes		1										1
4 Spheres		1					1	1		1		4
5 Mortars		1										1
6 Grinding slabs	2											2
7 Quernstones				1			4					5
8 Handstones		2					2	1		1	1	7
9 Rubbers & polishers	1	2				1	4			1		9
10 Chopping tools		1					1					2
11 Slingstones		1						1				2
12 Containers						1						1
13 Maceheads					1							1
14 Retouching tools					1		1			1		3
15 Stone working raw material/debris	18						15	1				34
16 Miscellaneous	2	6						1				9
17 Unmodified stone	1	4			3		24	2		1		35
18 Unidentified	2	2					2			1	1	8
Intrusions		1					2	1				4
Total	**30**	**22**	**-**	**1**	**7**	**2**	**64**	**11**	**-**	**7**	**4**	**148**

Table 10.1. Trench location of ground stone items.

Some trenches yielded none, or very few ground stone items, whilst others had relatively large numbers. There are several possible reasons for this disparity:

some trenches may not have reached the full depth of Neolithic occupation;
there may be spatial differentiation in the distribution of ground stone on the site ;
some trenches were outside the boundary of Neolithic occupation.

Further excavation will answer this question.

Categories of Bestansur ground stone

Pestles

4 complete, 3 incomplete; limestone and granite; 23-1960 g.

These items have different forms. Two (BF460.02 [C1091], SF44 [surface]) are clearly pestles, relying on their weight to pulverise materials. They are cylindrical, with rounded tips. BF460.01 [C1091] and BF750.01 [C1173, presumed Neolithic] are naturally long heavy stones, not modified, but with percussion damage at the ends: the opportunistic use of a convenient stone. The material selected for two items, granite, suggests they were used for grinding as well as crushing. Three of the complete pestles are from Trench 7.

Figure 10.1. Ground stone pestle BF460.02.

Figure 10.2. Pestle BF460.01 (top) - opportunistic use of a convenient stone?

Percussion tools

2 complete, 11 incomplete; all limestone; 9-180 g.

This category of stones, mostly from Trenches 7 and 8, does not rely on weight for their effect, but they show signs of percussion. In all cases this is on the perimeter or edge of the stone rather than on a flat surface, so they are unlikely to be anvils. Several of these tools are segments (usually a quadrant) of a flat or plano-convex river cobble, snapped to the required shape. Others are unworked stones, used opportunistically.

Celts/axes

1 incomplete; limestone; 305 g

The cutting edge or bit is absent from this stone tool (BF499.02 [C1038, presumed Neolithic]), but it has the clear symmetry, longitudinally and in transverse section, of a Pre-Pottery Neolithic celt (Wright 1992, 71-73; Mazurowski 1990, 57-67; Kozlowski and Aurenche 2005, 163). It is ground and polished, is widest at the midpoint of its length, and shows percussion traces on the butt. Assuming the cutting edge to have been 5cm (equal to the butt width) it would have had a cutting weight of *ca*. 60-70 g per cm, mid-range for this type (Davis 1982).

Spheres

4 complete; limestone and sandstone; 120-429 g

Spherical stone balls with percussion damage are a common feature of Southwest Asian ground stone assemblages from the Natufian onwards, disappearing in the 5th millennium BC. Commentators classify them in different ways. Wright (1992, 70) calls them pounders, used for battering. Mazurowksi's label is 'ball/bolas' (1990, 19-24). He argues that the battering marks are in fact abrasion of crushing or flaking negatives, and were made in the manufacturing process, not in subsequent use. He cites palaeoethnographic evidence that the balls were used as bolas stones, tied in linked leather sacks and thrown to bring down wild animals, to be killed, or captured for domestication. Spherical stones are noted at Jarmo and labelled as hammerstones. However, Moholy-Nagy acknowledges that they may have been slingstones (1983, 292). Kozlowski and Aurenche (2005) treat spheroidal handstones (with facets) and stone balls as two separate categories.

Several of the Bestansur examples were flaked and/or abraded, and the facets were then pecked. It is difficult to see why pecking should have been necessary for the surface of a bolas stone. I take the view that their use was as a hand tool for battering and pounding, not as a bolas ball.

Mortars

1 incomplete; limestone; 477 g

BF499.01 [C1038, presumed Neolithic] is a quadrant of a bowl mortar, of characteristically Pre-Pottery Neolithic style. It has a thick, flat base, sloping internal surface and a well-formed rim. The internal surface has some striations, and no pigment is visible. The mortar is less well-formed than similar items from Jarmo, but better-formed than Nemrik Group 4 examples. It seems unlikely that such a solid artefact would break into a neat quadrant accidentally, suggesting that it was deliberately broken. The presence of punch marks at the centre of the bowl supports this interpretation.

Grinding slabs

1 complete, 1 incomplete; limestone; 447-1017 g

These two flat rectangular stones (BF205.01 and BF 205.02 [C1009]) were found together. Their flat surfaces do not show signs of abrasion or striation, but their overall shape matches Wright's definition of a block grinding slab (Type 2). Mazurowski describes a range of similar items from sites across the Fertile Crescent, showing that there is considerable diversity in morphology, raw materials and function (1990, 69-76).

Figure 10.3. Grinding slabs BF205.01 (top) and BF205.02 (middle).

Quernstones

4 complete 1 incomplete; limestone; 400-3380 g

The excavation has yielded some fine examples of Early Neolithic quernstones, found in a range of forms across the whole Fertile Crescent. The complete examples, all from Trench 7, seem most similar to querns from Shimshara and PPN Jarmo with relatively flat working surfaces, slightly concave longitudinal axes and flat or slightly convex short axes. All are well-formed by grinding and pecking, with smooth working surfaces, regular perimeters and flat bases. Two (BF460.04 [C1091] and SF28 [C1177, presumed Neolithic]) have circular depressions ground into their working surfaces, almost certainly by deliberate manufacture rather than use-wear. SF28 has a further small circular dip set into the main depression.

What were the quernstones used for? Adams (2002) argues from experimental and ethnographic evidence that different-shaped mortars would have been used to process different materials. A saddle-shaped quernstone is good for crushing and would have let unwanted material (nut shells and grain husks) fall away, whilst a basin-shaped stone would have ensured that powdery material such as flour or ground seeds or nuts remained on the processing surface. Although cereal processing tends to be a primary focus for Neolithic research, Dubreuil (2004), citing the work of Savard and colleagues at M'lefaat (2003), suggests that we may be under-estimating the proportion of legume processing at Natufian and early PPN sites. It seems reasonable that chopping rather than grinding tools might be used to process nuts, legumes and coarse vegetable matter, and indeed, a chopping tool BF802.01 was found next to a quernstone SF27 [C1176, presumed Neolithic].

Three of the querns (SF27, SF28 and SF29) were found close together in a presumed Neolithic level in Trench 7 (Fig. 10.4), resting on the same surface, with the chopping tool BF802.01 and a fragment of stone with a smooth concave surface, possibly a further quern fragment (BF802.02). The juxtaposition of this set of tools with complementary functions is interesting. None of the quernstones is worn or damaged beyond repair, so they appear to have been deliberately deposited rather than discarded.

Figure 10.4. A kitchen set *in situ*? Left to right: Quernstones SF29, SF28 & SF27 with chopping tool BF802.01 and possible quern fragment BF802.02. Scale 50cm.

Handstones

4 complete, 3 incomplete; limestone and shale; 14-900 g

Handstones are generally defined as the upper (hand-held) stone used with a quernstone or grinding slab in order to grind material. They are distinguished by use-surfaces which are worn by abrasion not percussion. This group of Bestansur stones is a mixed bag, with few conforming to recognised types, and few showing strong evidence of abrasion or striation. Those which do are ground stone artefacts BF752.03 [C1164, presumed Neolithic](Unifacial Rectilinear, Wright Type 61) and BF460.03 [C1091] & BF708 [C1773, presumed Neolithic] (Bifacial Discoidal Flat, Wright Type 28).

Rubbers and polishers

7 complete, 2 incomplete; limestone; 61-280g

This is another diverse group. Most of the stones are fragments, though they may have been complete as tools. Few show significant marks of rubbing or striation, suggesting that they may have been used to polish soft material such as hide. None shows pigment traces suggestive of use to harden leather (Dubreuil and Grossman, 2009). Dubreuil's experimental reconstruction of Natufian ground stone processes (2004) showed that some implements previously assumed to be grindstones had in fact been used for hide working, not for grinding. Microscopic examination of this group of stones is proposed, to get a clearer indication of the material processed by the stones.

Chopping tools

2 complete; shale; 506-781 g

Chopping tools on Neolithic sites look like leftovers from the Middle Palaeolithic (and Mazurowski 1990 argues that they may indeed be so). They are heavy naturally round stones which fit the hand, and which have had large flakes struck off to leave sharp edges. Two such tools have come from Bestansur. The association of chopping tool BF802.01 with a quernstone in C1176, presumed Neolithic, has already been mentioned, the other is BF499.03 [C1038, presumed Neolithic]. Both are made from a hard black stone, probably shale but possibly basalt.

Figure 10.5. Chopping tool BF499.03.

Slingstones

2 complete; limestone; weights not available

These two small spherical balls are too small to be percussion tools, and not smooth enough to be rubber/polishers.

Containers

1 incomplete; limestone; 131 g

BF895 [C1200] is a fragment of a bowl-like vessel, with a flat base, well-made wall and smooth internal surface. Kozlowski and Aurenche note that this style is common in the Zagros from the second half of the 8th millennium BC, and further west into the 7th(Kozlowski and Aurenche 2005, 168, Type 3.1.2).

Maceheads

1 complete; alabaster; 363 g

This very well-made stone SF21 [C1175] is interesting. The type is generally known as a macehead, although the basis for this interpretation is unclear. It contrasts sharply with the spherical balls described as 6.2.4 above. The item is carefully and symmetrically ground, with the circumference being circular to within 1mm. It has been polished to a sheen. The top and base are slightly flattened, and a conical hole has been bored into the centre of the stone. It shows some staining, but it is not clear whether this is pigment or post-depositional. From the bottom of this hole, a second, narrower, hole has been bored through to the other side of the stone. It tapers from the centre of the ball to the circumference, unlike other published examples which are bored biconically from the surface of the sphere. The top 10mm of this second hole are quite shiny, consistent with stringing, and there is slight chafing at the bottom edge. The circumference of the ball has slight percussion damage.

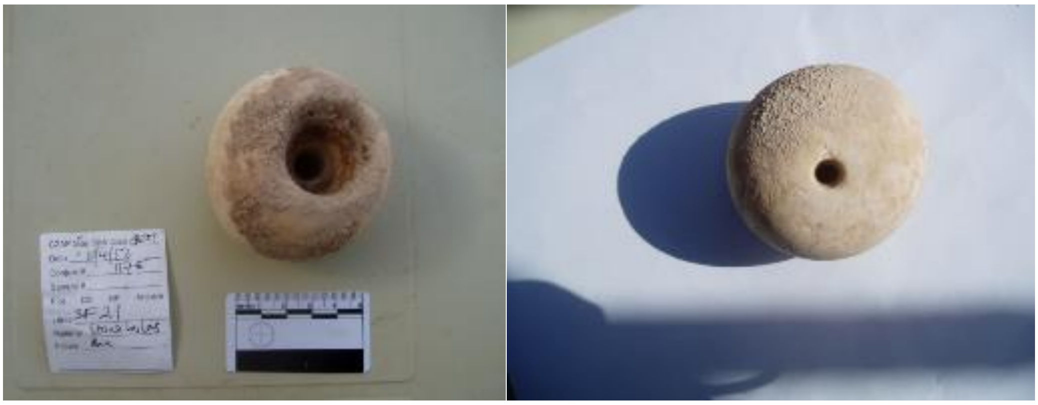


Figure 10.6. Macehead SF21 - top and bottom.

Mazurowski (1990) examined 108 of these objects (his ‘Group X’). The surfaces of some are rough and unfinished, but he notes that examples from Nemrik, Jarmo and Tell Maghzaliya are meticulously finished by polishing to a sheen: ‘a high degree of elegance’. Some of the Jarmo maceheads were grave goods, intentionally broken in two. He notes that these artefacts appeared in northern Iraq from the middle of the 9th millennium BC (at Zawi Chemi Shanidar), and were most common in the PPNB. He believes that they may have been strung as personal weapons, and dismisses the functions of digging-stick weights or door sockets. Moholy-Nagy (1983) examined examples from Jarmo. She ascribed their percussion marks and occasional ochre staining to use as grinding tools, but admitted that this did not explain their carefully shaped and polished surfaces. Several of the Jericho maceheads are of alabaster and other white stone, although these are later (Early Bronze Age) and a different shape (Holland 1983). There is a similar stone on display in the Sulaymaniyah Museum, labelled only as a Neolithic stone ball. Whatever SF21’s original function, the selection of alabaster, an unusual and distinctive stone, hints at a differentiated social status for its manufacturer or user.

Retouching tools
2 complete, 1 blank; alabaster; 0.5–8 g

These are two small conical alabaster tools (SF16 [C1092, presumed Neolithic] and SF25 [C1164, presumed Neolithic]), and an irregular blank of the same material (BF236.01 [C1070]). They have finger and thumb grip facets, and the tips show slight pressure or percussion damage. Their likely use is for retouching chipped stone tools.

Stone working raw material/debris
34 pieces; limestone and sandstone

34 irregular fragments of stone are assumed to be material associated with stone tool manufacture, curation or reworking. None are worked, and none show evidence of use-wear. Some very crumbly fragments of sandstone, may be for use as an abrasive for grinding other stones.

Miscellaneous objects
5 pieces

This group includes a fishing net weight (BF531 [C1132]), a thermally fractured cooking stone or pot-boiler (BF04.1 [C1020]), and two pieces of attractively coloured stone. One is a grain of translucent pinkish-mauve stone, as yet unidentified (BF065.02 [C1003]). pXRF analysis showed high levels of arsenic, silicon and lead.

Unmodified stone
35 pieces; limestone and sandstone; total c 3000 g

Several of the trenches, particularly Trench 7, contained quantities of whole and fragmented flat river cobbles, about the size and shape of a pitta bread. They were all unworked and had no use-wear, although many had a plano-convex section and very smooth surfaces. Several of the percussion tools were made from similar stones. The stones may be tool blanks, or possibly stones for flooring (as at Jarmo) or hearth lining (as at Gird Ali Agha) (Braidwood and Howe 1960, pl. 13 A-B).

Unidentified objects
8 incomplete; limestone and sandstone; 15-122 g

Intrusions
4 pieces

This group, from Trenches 7 and 8, includes a mud brick (well-formed and well-preserved but not Neolithic) a small lump of iron slag, and 2 triangular pieces of suspiciously symmetrical sandstone, possibly tile. Although found in a context which is presumed Neolithic [C1094], their presence may be an indication of more recent soil disturbance.

Discussion

The assemblage contains many examples of artefacts which are characteristic of the early aceramic Neolithic in the Zagros region. A few are known from the Natufian, and some from the Pottery Neolithic, but overall it is clear that this is a Pre-Pottery Neolithic assemblage. Many of the artefacts have comparanda from Nemrik, Jarmo, M'lefaat, as well as more distant sites such as Çayönü, and Jericho. It is too early to say whether the ground stone industry changed over the site's Neolithic occupation phase.

The assemblage contains artefacts associated with processing foodstuffs and hides, with stoneworking and possibly with hunting. Again, these are typical of early Neolithic lifeways and strategies. Some typical PPN artefacts are absent – grooved stones ("shaft straighteners"), personal ornaments such as beads, pendants and bracelets, and decorated stone. However, the trenches have only investigated a small proportion of the anticipated area of the site. A few items are exotic or unusual, and this may be an indication of differential social status within the settlement. Some items seem to have been deliberately broken or deposited, suggesting formal discard processes.

The great majority of the raw material is local stone, so this is not in itself an indication of trade, exchange or contact across longer distances. Many of the artefacts are purposefully and carefully made, involving an investment of labour and skill. It is too early to identify craft specialisation, however. On the other hand, a large proportion of the artefacts are 'good enough': pieces of convenient stone taken from the riverbed and given the minimum preparation necessary to serve the required purpose.

There are differences between the trenches in the quantities and types of ground stone artefacts excavated. This may be sampling bias, or it may be an indication of genuine spatial differentiation across the site. Broadly, if 20m^2 of trenches yielded 150 items, then a future 10m x 10m trench might contain 500-1000.

Future work

The differences in yield between the trenches should be a factor in determining the excavation strategy for the site. The catalogue and this report should be reviewed when the results of the project's environmental and other studies are available, and taking into account stratigraphic data.

Microscopic study of use-wear on tool types likely to be associated with processing food and animal products should be conducted, to give a clearer indication of their actual use, in order to complement the project's palaeoenvironmental research objectives. The possible survival of surface residues should not be ruled out. Dubreuil's methodology (2001; 2004) is a good basis for such studies, and includes the experimental reconstruction of tool manufacture and use. Further work is needed to validate identification of rock types and sources.

Chapter Eleven: Small Finds Analysis

Amy Richardson

Introduction

A total of 41 small finds (SF) were recorded during the course of the spring 2012 excavations at Bestansur, from nine of the ten trenches. Represented in this small assemblage is a varied mix of artefacts from all periods. A summary of each small find is presented in Table 11.1. These artefacts were cleaned, photographed, recorded and drawn, before packing for archiving and transportation to the Sulaimaniyah Museum, for storage with the Directorate of Antiquities and Heritage.

Methods of investigation

The objects were recorded in a Small Finds Register, assigned a number, and a Small Finds Form initiated by the excavator, before passing the find to the author for processing. Where appropriate, the excavator logged the 3D co-ordinates of the find. Artefacts recorded as small finds included those made from metal, adornments such as beads, clay artefacts not including pottery, glass, cores from obsidian and chert working, and all unusual finds of individual note.

Analysis

The most abundant contexts for small finds were in Trenches 1 and 7, located to the east, and Trench 10 to the west of the mound at Bestansur (see Fig. 2.1).

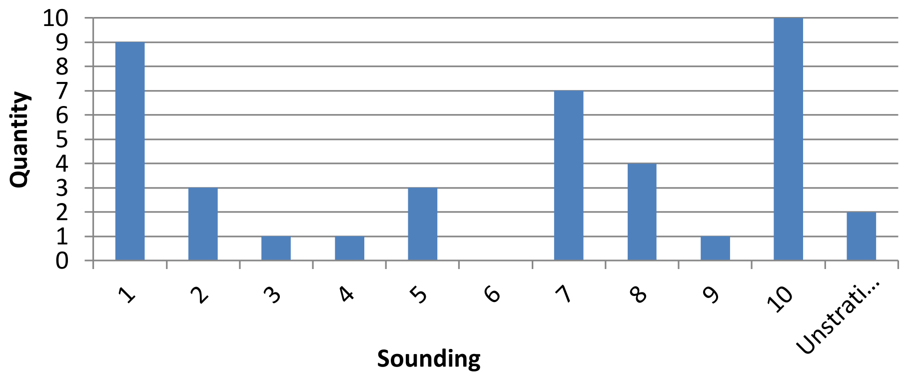


Figure 11.1. Quantity of small finds recovered per trench.

Four pale, cream-coloured stone artefacts were recovered from Trenches 7, 8 and 10 (Fig. 11.2). These objects occurred in the latest potentially Neolithic contexts in Trench 7 (SF16, C1092 and SF21, C1175), and in mixed deposits in Trench 8 (SF33, C1134) and in Trench 10 (SF25, C1164). Analysis with the Niton XL3t GOLDD+ portable X-ray fluorescence instrument has elucidated the elemental composition of these artefacts (Fig. 11.3; see Chapter Nine for methodology).

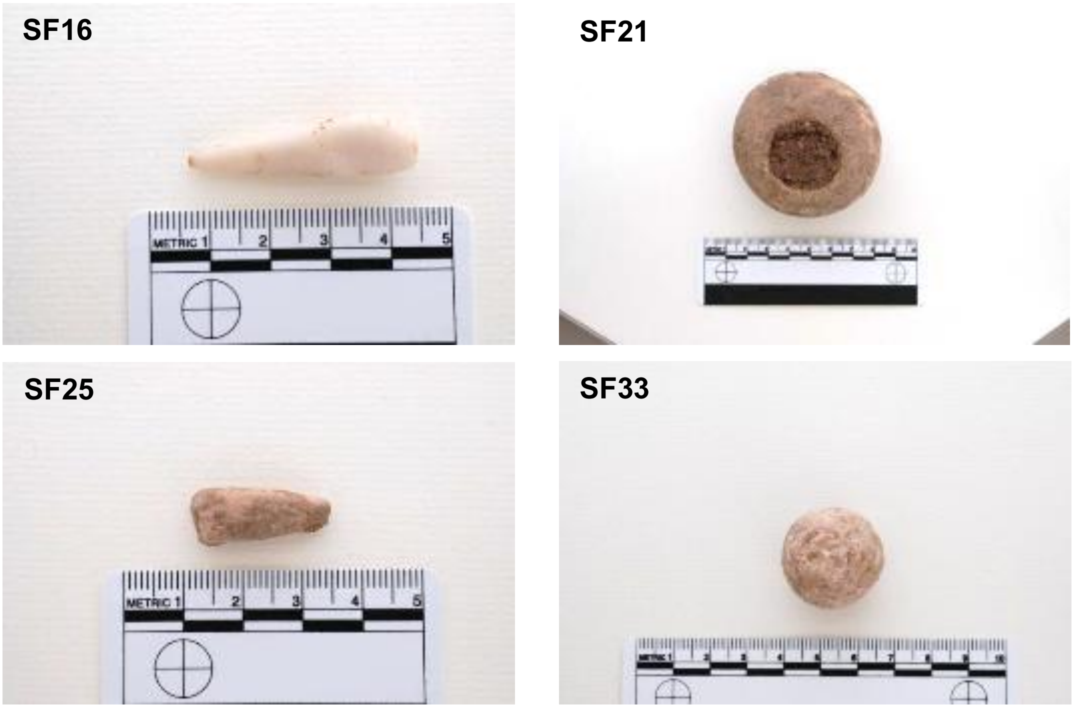


Figure 11.2. Alabaster artefacts.

High calcium concentrations and substantial silicon (*ca*. 50k ppm) indicate that the stone used in all four artefacts is a gypsum alabaster. SF16 and SF25 may relate to leather working or stone tool retouching (Chapters Nine and Ten). SF21 may be comparable with mortars found at Jarmo, and SF33 shows surface wear related to usage. A stone tool (SF8), possibly a bolas, was located in the same context as the latter (C1134) and also shows scarring. Three sub-rectangular limestone grinding stones were excavated in Trench 7 (SF27, SF28 and SF29). Further analysis of larger alabaster artefacts (SF21, SF33 and SF35) and the grinding stones is discussed in the ground-stone section (Chapter Ten).

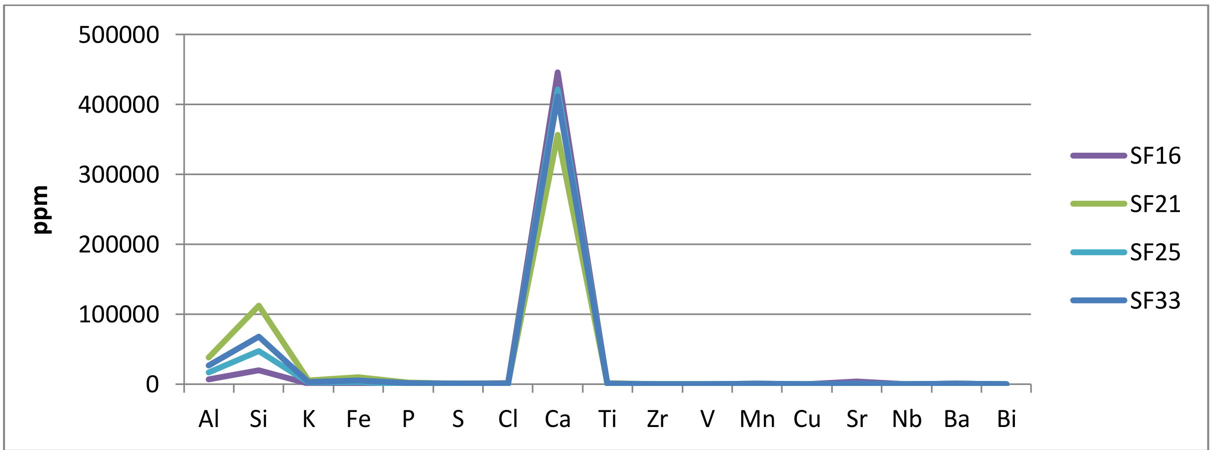


Figure 11.3. pXRF analysis of cream-coloured stone artefacts, using Niton XL3t GOLDD+ analyser, with major, minor and trace elements displayed.

A total of ten stratified clay artefacts were recorded as small finds at Bestansur (Fig. 11.4). Amongst the earliest is a simple, hand-formed, low-fired coarse rim sherd, from Trench 4 (SF23, C1081). This was located in an ashy layer immediately above the shell deposit in C1082. A single clay ball (SF15), possibly a token, was recovered in the lower levels of Trench 1, C1100, from the fill inside the red plaster wall. The blackened surface indicates the ball has been burned, though not necessarily intentionally. Trench 7 yielded two shaped-clay objects from Neolithic levels, including a very small unfired pellet (SF20, C1092) and a curved cylinder with narrow central hole, possibly a bead (SF30, C1171; Fig. 11.5).

An orange, circular, flat bead (SF18) was retrieved from the cleaning spit (C1152) above the dense burning deposits in Trench 9. This tiny, circular bead was made from very fine, powdery material (Fig. 11.5). Three further small ground stone polished beads were recorded during the excavations (SF8 and SF12): two red half-beads were located in a deposit of mixed material in Trench 5, C1074, and a complete orange stone example (SF19) came from Trench 1, C1011, alongside a crudely knapped chert core (SF11), in the earliest context to contain pottery.

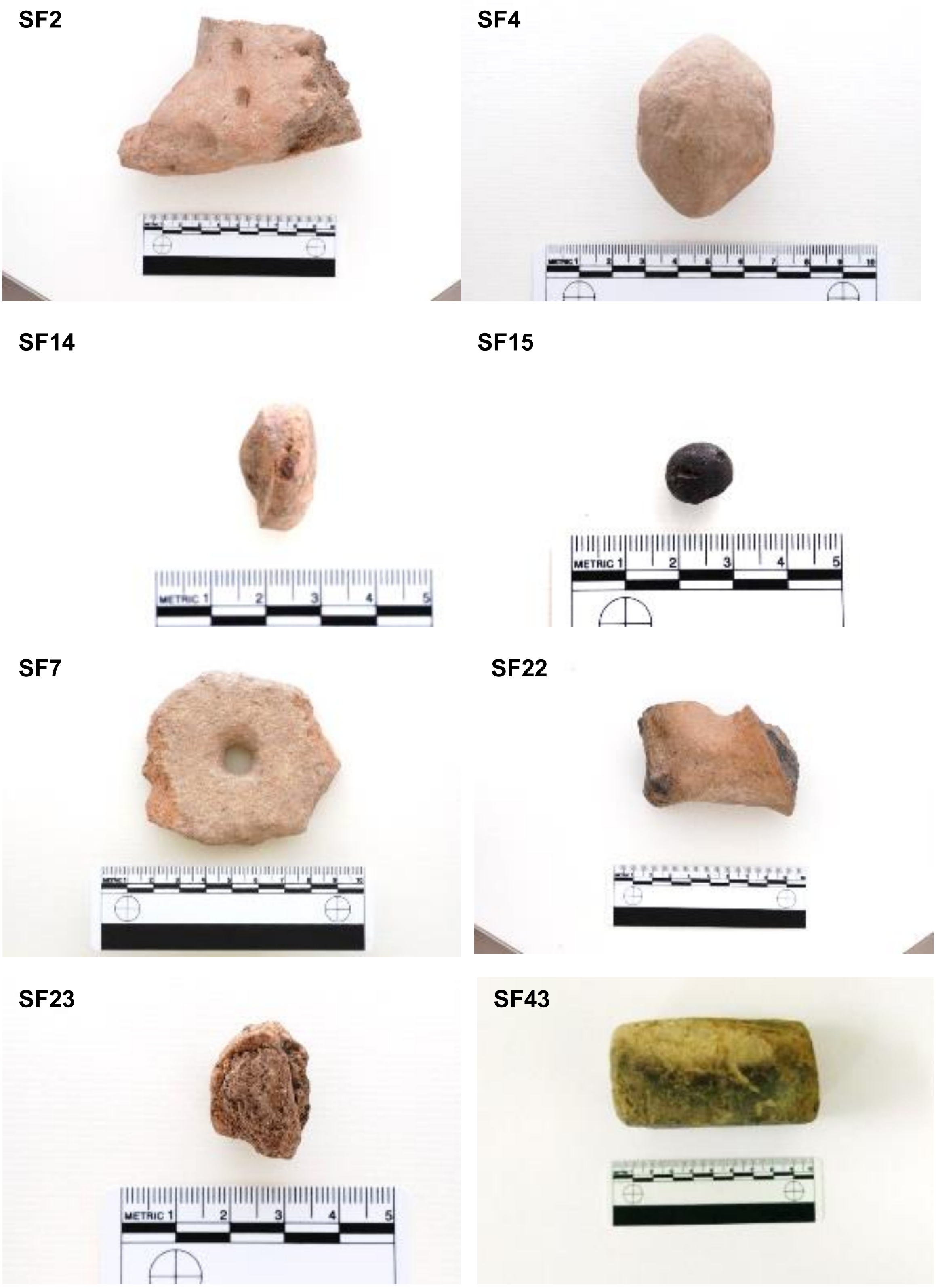


Figure 11.4. Clay artefacts.

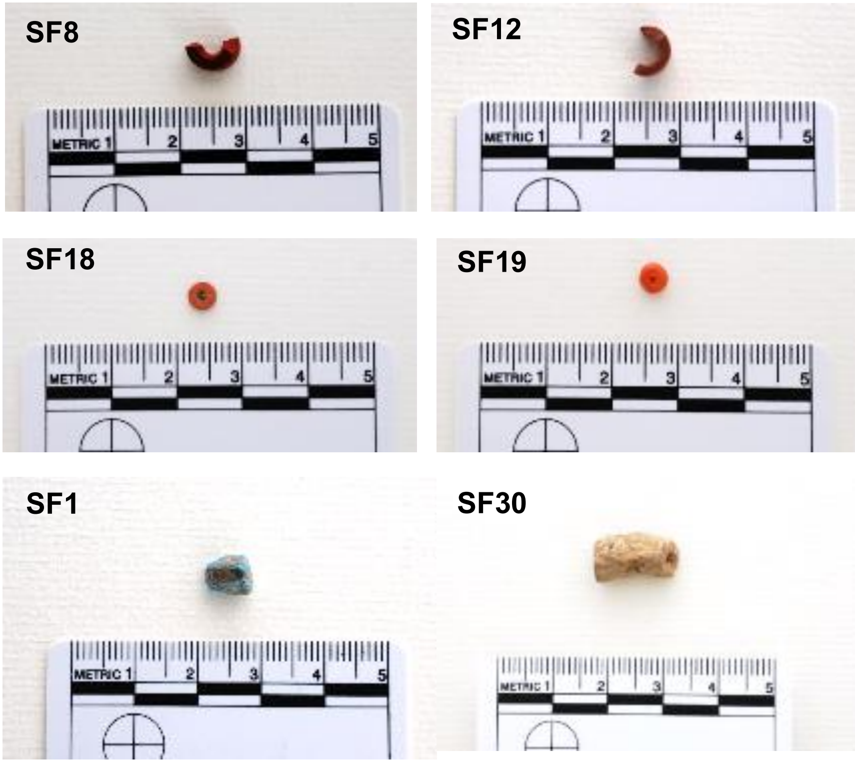


Figure 11.5. Beads recovered from Trenches 1-10.

Preliminary pXRF analysis on the red and orange stone beads has revealed that they are produced from at least two different types of stone (Fig. 11.6). Their similarity indicates that these may belong to the same adornment, possibly part of a necklace. SF18, however, appears to have been formed from very fine, iron-rich clay, which has been lightly fired. The chemical composition of this clay is similar to that of the local natural soils and its deviation from these may be considered a result of both the selection and refinement processes. The fourth of these beads, which is distinctly orange in colour (SF19), demonstrates significant differences in chemical composition from the others, being composed primarily from calcium, indicating that this is a simple orange calcite.

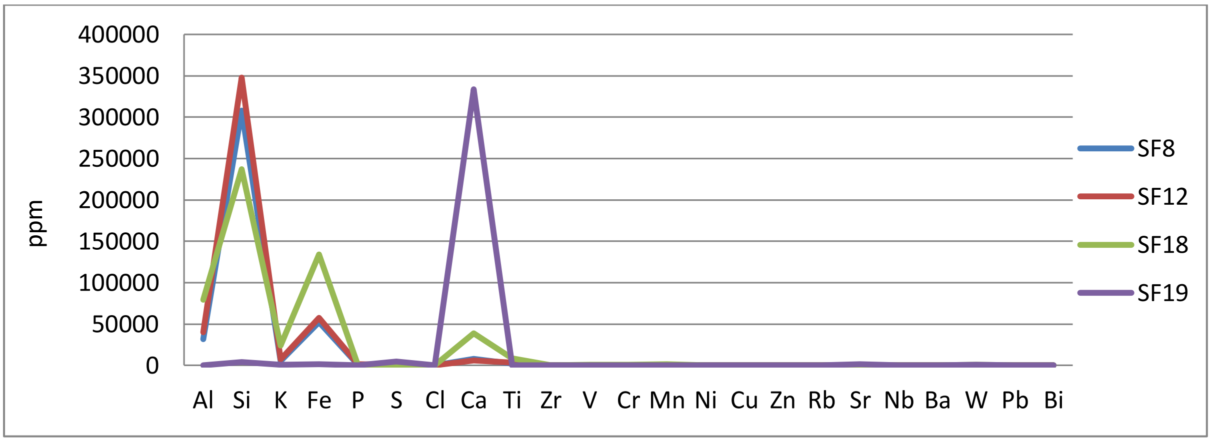


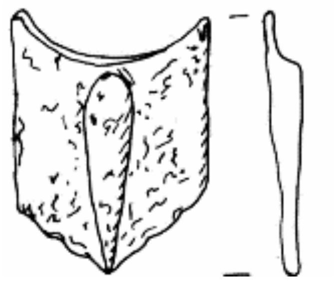
Figure 11.6. pXRF analysis of red and orange coloured beads, using Niton XL3t GOLDD+ analyser, with major, minor and trace elements displayed.

In the cutting of steps for Trench 1, an unstratified bronze object, possibly a scabbard-tip, was unearthed (Fig. 11.7). A single bronze hairpin (SF10), with simple impressed decorative line details was recovered from Trench 2, C1034. In subsequent deposits, a clay object of uncertain function (SF14, C1036) and a large clay loom weight (SF17, C1038) were recovered, in some of the earliest layers containing pottery within that trench.

Only two pieces of bone were recorded as small finds, one of which had been worked (SF6, C1007) and one very small chip which may have assumed its blue colouration through proximity to copper alloy artefacts (SF34, C1134). Both fragments were located in pottery-rich layers.

In Trench 10, two chert cores were recovered (SF24 and SF26), in a mixed context that included pottery (C1164). Glass sherds (SF37, SF39, SF41), a bronze arrowhead (SF38) and an elegant bronze bracelet (SF40), all from the upper levels of Trench 10, amongst and immediately above stone packing in mixed contexts containing later pottery and re-deposited lithics (C1162, C1163). These levels represent some of the latest archaeological deposits excavated at the site. In the plough soil above these levels, a simple fired-clay oblong, possibly a brick, was recorded (SF43), and an unmodified stone tool (SF36) located in the topsoil (C1160).

SF9



SF10

SF38

SF40

Figure 11.7. Bronze artefacts.

A single faience bead (SF1, C1001; Fig. 11.5), along with bronze and iron nails (SF3, C1002, and SF5, C1003), were recovered from the topsoil spits removed from Trench 1. These contexts contained clay artefacts also, including a biconical spindle whorl (SF4, C1003). Above this, in C1001 there was a large piece of shaped clay that is possibly representative of a foot or boot (SF2), broken at the heel and ankle, with deep, roughly circular gouges in regular arrangement running vertically.

Two modern plastic objects were recorded from the surface and topsoil over Trenches 3 and 8, including a small vessel sherd (SF32) and a blue bead (SF31). One clay animal figurine (SF22; Fig. 11.4) was discovered on the surface of the upper levels of the mound. The artefact comprises the front limbs and torso of an unidentified mammal, broken at base of neck and flared haunches.

Discussion and interpretation

The small finds represent millennia of occupation at the multi-period site of Bestansur. The Neolithic is stratigraphically well attested, through the lithics and ground stone artefacts, such as the quernstones (SF27, SF28 and SF29). Early ceramic usage can be seen in simple unfired and lightly fired clay artefacts. The possibility of a clay token (SF15; Fig. 11.4) raises some issues. Commonly found across Neolithic sites in the Central Zagros and throughout the Fertile Crescent, their absence thus far at Bestansur may potentially be indicative of preservation issues at the site. Unfired clay artefacts have not been readily observed at the site and this single clay ball, seemingly unintentionally burned and therefore preserved, could represent a category of material that is otherwise not surviving in the archaeological record.

Beads and stone tools for working leather or lithics demonstrate an active community involved in craft and utilising stone resources. Alabaster and obsidian on the site indicate that early communities were tapped into networks of exchange and resource management, requiring further investigation.

Later activity at the site indicates substantial use of bronze, with the quantity of iron finds underestimating the quantity of slag indicative of ironworking at Bestansur. The metalwork has occurred in contexts containing glass, with a curvature indicative that glass vessels were in usage. In conjunction with the decorated bronze bracelet, bronze hairpin and bronze arrowhead, distorted by impact, the Trenches excavated in spring 2012 begin to elucidate a picture of a later complex and sophisticated society that occupied the site.

SF	Context	Trench	Item	Length (mm)	Description	Fig.
1	1001	1	Bead	7	Broken blue-green faïence bead (25%) with visible shaft and abraded exterior surface. Biconical with lower-body protrusion. Three parallel grooves faintly visible along circumference.	11.5
2	1001	1	Clay object	120	Large, shaped-clay object, possibly representative of a foot/boot, broken at heel and ankle. Underside is uneven, rough and slightly rounded. Upper has four deep, roughly circular gouges in regular arrangement, paired running vertically, with traces of possibly further gouged decoration. Function is unknown, but detailing appears decorative.	11.4

SF	Context	Trench	Item	Length (mm)	Description	Fig.
3	1002	1	Copper alloy nail	25	Copper alloy nail, with wider head tapering towards tip (missing, shaft is bent). Section is roughly circular. Green patina visible beneath corrosion.	
4	1003	1	Clay spindle whorl	54	Biconical, hand-formed, clay spindle whorl with irregular, roughly central shaft. Some abrasion and concretions adhering to surface. Clay is orange-pink to light brown, unevenly coloured, hard-fired with gritty inclusions.	11.4
5	1003	1	Iron nail	70	Long, thin ferrous nail, tapering from head towards broken tip. Appears roughly circular in section with squaring at the head, although ferrous material is heavily corroded. Possibly modern/intrusive.	
6	1007	1	Worked bone	16	Small piece of burnt bone. Ends are broken with possible cut marks. Bone may be polished; burnt umber to dark brown.	
8	1074	5	Stone bead	6	Half of small, cylindrical bead, in red-brown soft stone. Awl marks visible from drilling of the shaft from both sides.	11.5
9		1	Scabbard tip	48	Copper alloy object with lower scalloped edge leading to point, upper crescent edge and spinal dagger. Sides are bent at right angles to reverse of object for affixing. Possibly a scabbard or belt tip. Very little corrosion, though some concretions.	11.7
10	1034	2	Hair pin	92	Corroded copper alloy hair pin, tapering from squared head to narrow tip with circular section. Decorative incised lines on upper 20mm, visible beneath corrosion, including horizontal bands alternated with two crossed diagonals.	11.7
11	1011	1	Chert core	26	Rough, multifaceted flint core, crudely knapped from purple-grey stone with indigo veins. Very sharp, indicating limited post-depositional disturbance. See lithics catalogue for further details.	
12	1074	5	Stone bead	6	Half of small, cylindrical bead, in red-brown soft stone. Awl marks visible from drilling of the shaft from both sides.	11.5
13	1078	5	Obsidian blade	46	Obsidian blade – see lithics catalogue for further details.	
14	1036	2	Clay object	23	Clay object of uncertain function, possibly originally rounded cylindrical shape. Now broken with uneven surface. Clay is very fine, powdery and buff-pink.	11.4
15	1100	1	Clay ball	12	Small clay ball, with flattened underside, as though deliberately manipulated. Some abrasions on the surface. Clay is quite fine and heavily burned, with colour varying from dark brown to black. Possibly a token.	11.4
16	1092	7	Alabaster tool	37	Stone tool in calcium-rich stone, possibly alabaster. Pointed tool has flattened upper, for attaching to haft. Some evidence for wear at the tip. Possibly for flint or hide working. pXRF and ground stone analysis performed.	11.2

SF	Context	Trench	Item	Length (mm)	Description	Fig.
17	1038	2	Loom weight	79	Clay loom weight with central hole and abraded edges, probably originally circular or polygonal. Pink clay is lightly fired.	11.4
18	1152	9	Clay bead	5	Very small, simple circular bead with very narrow central shaft. Fabricated from soft, powdery stone. Two pieces.	11.5
19	1011	1	Orange (calcite) bead	5	Small, orange stone barrel bead, possibly calcite, with narrow central shaft.	11.5
20	1092	7	Clay pellet	5	Very small, light brown clay pellet. Likely deliberately formed. Function uncertain.	
21	1175	7	Alabaster mortar	66	Hard cream stone (possibly alabaster) mortar, bolas or macehead. Preservation is good. Some concretions on surface. Off-centre shaft narrows from 32mm to 10mm. Soil in shaft is sampled for further analysis (SA391). pXRF analysis and ground stone analysis performed. Comparable with mortars from Jarmo.	11.2
22			Clay figurine	79	Zoomorphic figurine, hand-formed from fired clay. Front limbs and torso remaining; broken at base of neck and haunches (markedly flared). Clay is buff to very dark grey on exterior, with blackened core.	11.4
23	1081	4	Pottery sherd	27	Sherd of coarse, low-fired pottery, possibly a simple rim. Sherd has buff exterior and blackened interior.	11.4
24	1164	10	Chert core	36	Pink and grey mottled chert bullet core, with c. 14 bade facets and 1 flake/chunk removed. Concretions adhering to surface.	
25	1164	10	Alabaster tool	32	Cream stone tool, likely alabaster. Thickened end has hole worked, extending 3mm into centre of artefact, for affixing. Tip is broken. Similar to SF16, possibly for working leather or retouching flint tools.	11.2
26	1164	10	Chert core	41	Rough chert core with c.12 blade facets, fractured towards base. See lithics catalogue for further details	
27	1176	7	Quernstone	230	Sub-rectangular limestone grinding stone. Concave along length and across breadth: use surface. Opposite surface convex, irregular – not a use surface. Use surface is very smooth.	
28	1177	7	Quernstone	180	Sub-rectangular limestone grinding stone. Circular depression 10mm deep, 110mm in diameter, ground to form use surface. Within this, there is another depression 3mm deep, 45mm diameter, formed by use-wear: circular grinding.	
29	1178	7	Quernstone	205	Sub-rectangular limestone grinding stone. One use surface, ground to concave longitudinally and convex transversely (hence 'saddle'). Use surface very smooth, other surface not worked, though base may have been made flat by pecking.	
30	1171	7	Clay bead	24	Roughly cylindrical, curved object, with very narrow central hole. Possibly a clay bead. Exterior is abraded, with concretions. Clay is variable in colour and hardness across surface.	11.4

SF	Context	Trench	Item	Length (mm)	Description	Fig.
31	1131	8	Plastic bead	5	Modern small blue plastic bead. Round with central hole. Band around circumference from mould.	
32	1044	3	Plastic sherd	23	Sherd of plastic with slight wall curvature and band of foil or paper on exterior.	
33	1134	8	Alabaster ball	27	Pale, uneven stone ball, coated in concretions. Chips and cuts to stone are visible. See ground stone catalogue for further details.	11.2
34	1134	8	Bone chip	5	Tiny chip of blue bone, possibly taken on colour of adjacent metal artefacts (i.e. copper alloys).	
35	1134	8	Stone bolas	53	Dense, dark grey stone tool, possibly a bolas. Some scarring visible from impacts. One side completely coated in concretions.	
36	1160	10	Stone tool	190	Unmodified stone tool, possibly utilised for pounding – some regular ridging on long edge.	
37	1162	10	Glass sherd	39	Sherd of glass, or possibly faience. Wall has irregular curvature, suggesting either irregular vessel shape or other form.	
38	1162	10	Bronze arrowhead	37	Complete copper alloy arrowhead in good condition. Triple-winged, with buckled edge from impact. Shaft intact. Light corrosion.	11.7
39	1162	10	Two glass sherds	50	Two sherds of glass – flaking and abrading. Beneath corrosion, fragments appear green. Glass is thick-walled and irregularly shaped.	
40	1163	10	Bronze bracelet	58	50% of a copper alloy bracelet. Thin band of copper alloy has quadrate section and cuboid details at two pints on recovered segment. Light corrosion. One point of modern abrasion reveals material.	11.7
41	1163	10	Glass sherd	49	Sherd of glass, thinner-walled than SF37 and SF39. Curvature is regular and suggests a fine, open vessel with parallel lines running around vessel wall. Probably lower body sherd. Glass is flaking and abraded. Pitting of air bubbles visible in break.	
43	1161	10	Clay block	89	Fired clay oblong, possibly a brick. Clay is pink-buff on one side and burned black on the other. One corner abraded to reveal coarse clay with varied tempers. Block is formed with clean angles and smooth sides.	11.5

Table 11.1. All small finds from Bestansur season spring 2012.

Chapter Twelve: Molluscs

Nick Harper

Introduction

During the spring season of 2012 significant mollusc deposits of Neolithic date were discovered at the site of Bestansur. We collected nine mollusc samples from the excavated assemblages and exported them to Reading for further identification and analysis, with the kind permission of the Sulaimaniyah Directorate of Antiquities and Heritage. Recording and analysis of the molluscs is still very much in progress and this short report provides some initial discussion.

Excavation

All ten excavated trenches across the site contained quantities of shell belonging to snails (Table 12.1), the species of which is yet to be identified. The most substantial deposits recovered were in Neolithic contexts. Both Trench 5 and 7 produced large quantities of molluscs, including part of a midden from Trench 5 composed of a large number of mollusc shells (see Chapter Two for excavation and sampling procedures). Very few molluscs were recovered from Trench 10, where the Neolithic deposits have not yet been fully excavated. The largest deposits are predominantly from the trenches excavated to the west of the mound (Trenches 2, 3, 4 and 5), although this may not be statistically significant. Trench 7 yielded comparatively little weight of mollusc shell, in contrast with Trenches 4 and 5 (to its South and North respectively), although the Neolithic levels indicate that this Trench included internal space and external space used for activities probably unrelated to the mollusc depositions (see Chapter Two). Small quantities of river mollusc, possibly freshwater clams, were also recovered amongst the deposits, indicating that these were deliberate depositions, related to consumption, rather than natural accumulations of burrowing mollusc.

	Bulk Find Record Count	Weight (g)
Trench 1	64	1549
Trench 2	23	2481.4
Trench 3	10	2979.6
Trench 4	46	5689.1
Trench 5	41	5114.4
Trench 6	3	151
Trench 7	56	710.3
Trench 8	33	927.3
Trench 9	52	1167
Trench 10	4	486.3

Table 12.1. Summary of the count and weight of shell recorded as Bulk Finds from each trench.

In order to facilitate analysis and our understanding of the role of molluscs in the diets of the Neolithic inhabitants of Bestansur, collection and recording procedures will be further refined, in order to ensure consistent recovery strategies. All shell occurring in the dry-sieving and heavy residue will be returned as bulk finds. More substantial deposits, such as those in Trenches 5 and 7, will be sampled according to CZAP procedures, taking a hand-picked column sample in the instance of deep midden deposits (Chapter Two).

Samples for further analysis

Nine mollusc samples were exported for further analysis (see Table 12.2). The samples brought back were of varying size, dependent on the quantity retrieved and retained as bulk finds. Selection of samples was based on size of sample, preservation of shells for identification purposes, security of context as Neolithic and trench distribution, in order to get as wide a spread as possible across the site.

Trench No.	Context No.	Sample No.	Description	Weight (g)
1	C1011	-	BF310 - Bag of mollusc shells for quantification and analysis	600g
2	C1034	-	BF348 - Bag of mollusc shells for quantification and analysis	860g
2	C1039	-	BF759 - Bag of mollusc shells for quantification and analysis	215g
4	C1062	-	BF878 - Bag of mollusc shells for quantification and analysis	766g
5	C1074	-	BF354 - Bag of mollusc shells for quantification and analysis	1400g
5	C1077	SA116	BF359 - Bag of mollusc shells for quantification and analysis	340g
5	C1078	SA122	Bag of mollusc shells for quantification and analysis	1050g
5	C1078	SA123	Bag of mollusc shells for quantification and analysis	1035g
8	C1139	-	BF888 - Bag of mollusc shells for quantification and analysis	124g

Table 12.2. Samples exported for further analysis.

Six of the samples were taken directly from the bulk finds archive and three were selected as samples for further study (SA116, SA122 and SA123), all from the Trench 5 shell midden deposit. SA 116 is from the cleaning directly above the deposit, clipping its uppermost edges. The sub-sample of SA122 exported to Reading for further analysis (*ca*.150 shells) is taken from the first 50 x 50cm square spit of the column sample. SA123 is a subsample from the second spit directly beneath SA122.

One of the first tasks when the molluscs arrived back in Reading was to freeze them. This killed any small animals or insects that might have been in the shells or soil deposits. After they were frozen the soil had to be removed from both the inside and outside of the shell, which took two weeks as it proved difficult to break down the organic material inside the shell. After submerging them in water for a week, we added hydrogen peroxide to two samples and calgon to the remainder, in order to break down the organic material. To clean the shells we used brushes to remove organic material.

Future research

I will be using two main methods in studying the molluscs. The first comprises recording and examining the species of mollusc, establishing whether they are edible or not, and whether they are land based or fresh water types. The second will be to examine the size of the snails. Is there a range of sizes, and therefore ages, or is there a bias towards one or more sizes of snail? These methods will enable the project to explore issues of the potential consumption of snails by humans at the site. We can then examine artefacts and features associated with the snails, such as lithic tools and hearths, as potential indicators of snail use. We are also considering using isotope analysis to further examine the seasonal environments the molluscs inhabited.

Chapter Thirteen: Neo-Assyrian and Sasanian Pottery

Lisa Cooper, Zuhair Rijib and Sabr Ahmed

Introduction

Pottery was found in considerable quantities at the site of Bestansur in 2012 from every trench that was excavated. None of this pottery, however, was found *in situ*; rather, it was derived from various secondary deposits as well as eroded soil that had washed down the slope of the tell, carrying pottery from higher contexts and depositing the sherds further down the slope or at the base of the tell. The levels in which the pottery sherds were excavated overlie all of the Neolithic levels thus far investigated, indicating that the Neolithic occupation at Bestansur was pre-pottery in date.

Much of the ceramic material was found worn and abraded, and sometimes heavily concreted, due in large part to the secondary and tertiary contexts from which the pottery was obtained and the fact that it has been subjected to centuries of erosion and weathering. In general, the sherds were also very fragmentary and small. No whole vessels were encountered, nor were entire profiles obtained for any of the pottery forms. Nevertheless, enough diagnostic pottery sherds (rims, bases and decorated body sherds) were collected such that it was possible to ascertain the general date of the occupations from which they originally derived. The excavations appear to have revealed two main phases of occupation: the Iron Age II, coinciding with the end of the Neo-Assyrian period (*ca*. 7th century BC), and a later phase dated to the Sasanian period (*ca*. 3rd-7th centuries AD).

Iron II pottery

Pottery dating to the Iron II period was derived from several trenches on the tell, often in surface or sub-surface collections (e.g. Trench 1, Contexts 1000 and 1001; Trench 3, Contexts 1040, 1042 and 1045; and Trench 5, Contexts 1070 and 1072). Other quantities of pottery were found in deeper contexts (e.g. Trench 1, Contexts 1008 and 1009), and in fairly abundant quantities from fill contexts below Context 1029 in Trench 2: 1030, 1031, 1032, 1034, 1036 and 1038. These latter contexts in Trench 2 appear to be the most well-stratified and un-mixed, and so consequently much of the sherds' classification and subsequent attempts to establish dates through comparisons with other sites' ceramic material were formulated on the basis of this corpus.

The Iron II pottery is generally composed of a fine to medium ware, characterized by silt to coarse sand-sized mineral particles occurring sparsely or moderately in the clay matrix. Overall, there were few indications of vegetable inclusions in any of the sherds investigated. The pottery was moderately fired, achieving mainly a reddish-brown, red-pink or pale orange colour surface colour, and a pink or red-brown core colour. All of the pottery was found unpainted and unslipped, save for one body sherd, which had traces of red painted bands (from Context 1034, Trench 2), and an incised body sherd with a thin cream-coloured surface slip (from Context 1031, Trench 2; fig. 2:13).

Some cooking vessels were identified, and they appear to have been fired to a grey-brown or red-brown colour. They comprise dense grey or white coarse sand-sized mineral inclusions, and often bear traces of smoke-staining on their surfaces. Macroscopic observations of the production technology of the pottery suggests that the majority of Iron II vessels were shaped and finished on the wheel, although further fine-grained studies will need to be carried out to determine any further technological particulars. Future scientific investigations such as petrographic analysis may also assist in understanding further aspects of the ceramic production technology and the provenance of the vessels' raw materials.

The diagnostic pottery sherds indicate that the Iron II was characterized by a wide range of open-bowl forms, cups, small jars, medium to large closed jars, medium to large open pots, and a wide range of hole-mouthed pots, the majority of which were probably used as cooking vessels.
The Iron II date of the pottery corpus at Bestansur has been determined by fairly good comparisons to vessel forms occurring at other sites with Iron II, or Neo-Assyrian period occupations. Many of these comparisons can be made with pottery from Neo-Assyrian sites located to the west in the Tigris Valley, such as Assur, Nimrud, Nineveh, while other comparanda can be sought to the east and southeast in the central western Zagros regions of Iran.

Simple bowls with plain rims (Fig. 13.1.1) can be compared with similar bowls from Neo-Assyrian contexts at Nineveh (Lumsden 1999, fig. 41). Similar simple bowls have also been found in Iron Age contexts at Bestansur's near neighbour in Iraqi Kurdistan, Bakr Awa (Miglus *et a*l. 2011, Taf. 1: d-e). A cup with a slightly tapering rim (Fig. 13.1.2) finds a good parallel with cup forms from the late Neo-Assyrian occupation at Kar-Tukulti-Ninurta (Schmidt 1999, Abb. 6a: 39-40). Small bowls with out-turned, downward drooping rims (Figs 13.1.3-13.1.4) are best compared to those found in Neo-Assyrian contexts at Nineveh, Assur and Nimrud (Lumsden 1999, fig. 4:7; Hausleiter 2010, Taf. 53: SF 9.1, 9.2), while another small bowl form with out-turned, horizontally-level rim (Fig. 13.1.5) perhaps compares most favourably with the small bowl forms from the level I occupation at Baba Jan (dated to the 7th or 6th centuries BC) or those from Period II contexts at Godin Tepe in Iran to the east (dated to the 9th-7th centuries BC)(Goff 1985, 5, fig. 2:12; Gopnik 2011, fig. 7.57: 95).

Bowls with ribbed rims (Fig. 13.1.7) are very diagnostic of the Neo-Assyrian period in the Tigris Valley of northern Iraq, having been found at sites such as Nineveh, Nimrud, Assur, Kar-Tukulti-Ninurta and Khirbet Qasrij (Lumsden 1999, fig. 5:12; Oates 1959, pl. XXXV:13-14, 25; Haller 1954, Taf. 6: ac; Schmidt 1999, Abb. 6a: 5; Curtis 1989a, fig. 27: 67-69; see also Hausleiter 2010, Taf. 62 for several examples).

A large bowl with thickened, out-turned rim (Fig. 13.1.8) compares well to similar bowls found at Khirbet Qasrij, a site on the Tigris River near Eski Mosul, and probably dated to the 7th century BC of the Neo-Assyrian period, as well as the Iron II occupation at Khirbet Karhasan, also in the Eski Mosul region (Curtis 1989a, fig. 28: 86; see Green's comments on the Neo-Assyrian vs Post-Assyrian date of the Khirbet Qasrij material, 1999, 115, and fig. 8:4). A large carinated bowl with everted rim (Fig. 13.1.9) is perhaps the most diagnostic of the Neo-Assyrian period at Bestansur, and finds excellent parallels to those commonly found elsewhere in the Assyrian heartland to the west (Curtis 1989a, 47 and fig. 24:26; Hausleiter 2010, Taf. 63: SF 27.5).

The closest sherd bearing a resemblance to a "Palace Ware" bowl is the fine flaring rim (Fig. 13.1.10). Its diameter and rim form compare best to some of the fine wide-rim flaring bowls found at Nimrud (Hausleiter 2010, Taf. 75: SD 4.1), although admittedly the Bestansur rim is far too small to be certain of its overall form.

A number of necked jar forms have been found at Bestansur, many of which are characterised with everted rims (Fig. 13.1.16-13.1.17). These may be akin to medium-sized jars with everted rims and round bodies that taper to a base that have been identified, for example, in Neo-Assyrian contexts at Khirbet Khatuniyeh (Curtis and Green 1997, fig. 39: 168). The Bestansur examples, however, seem to possess somewhat shorter, less restricted necks, and may be more similar to medium jar forms from the east, such as those found in Period II at Godin Tepe (Gopnik 2011, fig. 7.53: 4). The bases of such jars may often comprise flat bases, but it is also conceivable that they were distinguished by tapered or narrow cylindrical bases, a few of which have been excavated (Fig. 13.2.14-13.2.15). Such bases are common at sites with Neo-Assyrian period occupation, such as Khirbet Khatuniyeh, Nimrud and

Kar-Tukulti-Ninurta (Curtis and Green 1997, fig. 43: 197; Hausleiter 2010, Taf. 104: FG 4.2, 105: FG 4.4; Schmidt 1999, Abb. 6b: 40).

Several cooking pot forms were found at Bestansur, the majority comprising a distinctive hole-mouth form with some type of thickened rim, either on the interior or exterior (Fig. 13.2.6-13.2.10). Some parallels to Neo-Assyrian or post-Assyrian period cooking vessels can be sought in the west in the Tigris Valley (Curtis and Green 1997, fig. 53: 312, 58: 392; Schmidt 1999, Abb. 4: 25; Curtis 1989a, fig. 36: 226), although on the whole these western forms do not appear as prolifically as they do at Bestansur.

A bodysherd, light reddish brown in colour throughout, with fine silt mineral particles, was covered on the surface with a thin layer of cream-coloured slip (Fig. 13.2.13). Moreover, its surface was lightly incised with a plant design. No good parallels can be found for this sherd at present, although judging by its context (C1031 from Trench 2), it does seem to be Neo-Assyrian in date. The majority of parallels from elsewhere seem to come from 7th century BC contexts, and thus it would appear that Bestansur's Iron II assemblage best fits within a late Neo-Assyrian date.

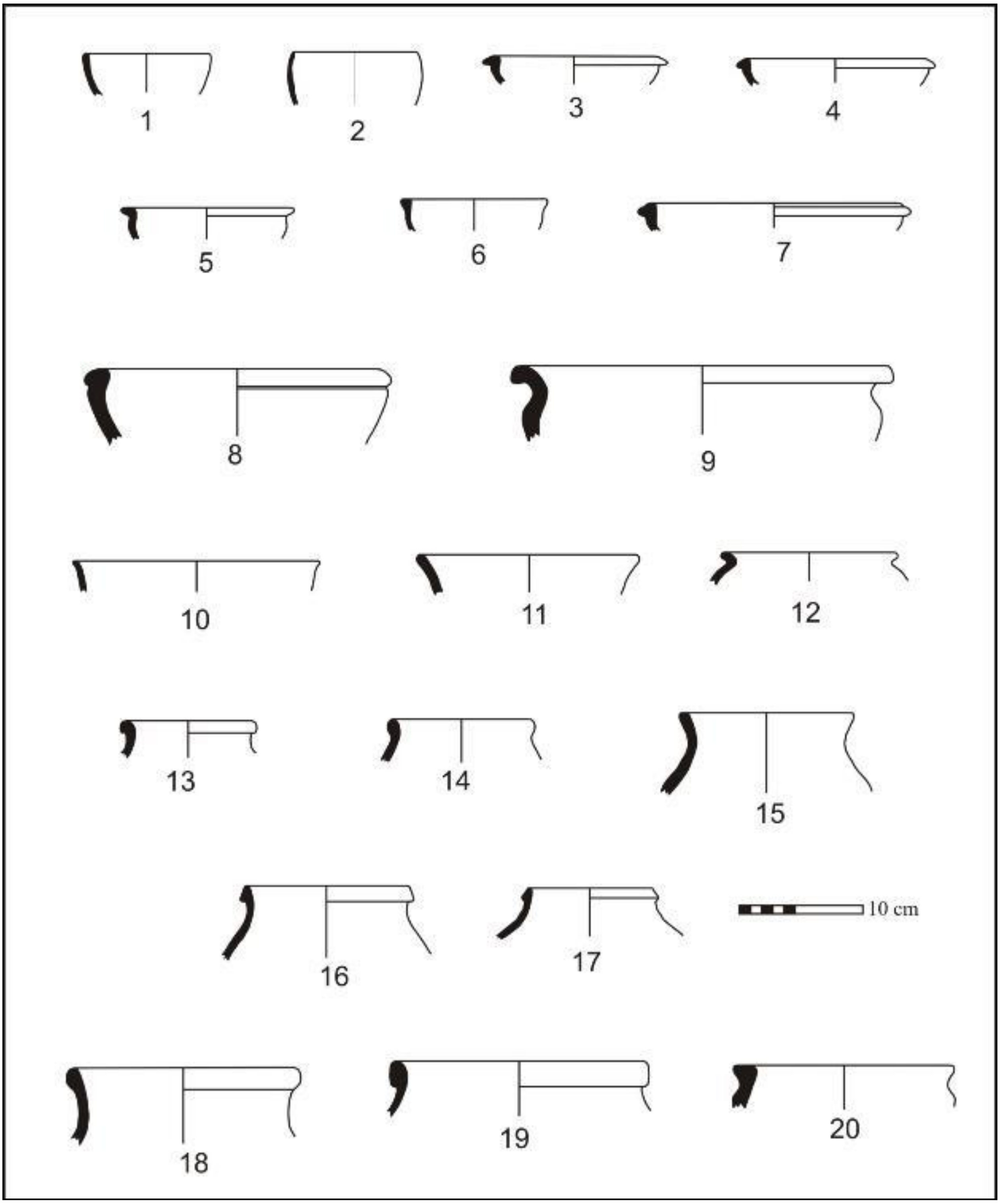


Figure 13.1. Iron II pottery.

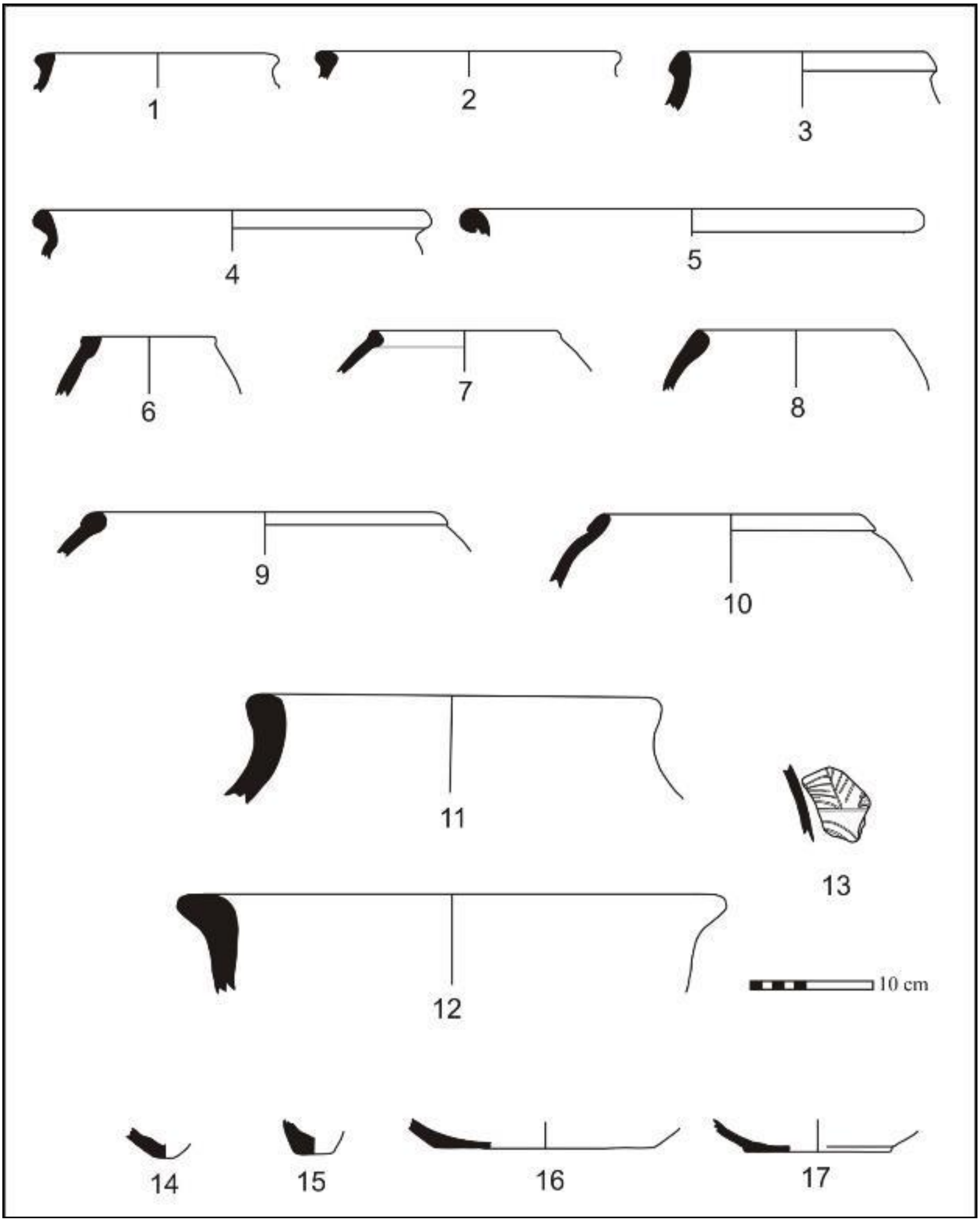


Figure 13.2. Iron II pottery.

Sasanian pottery

Pottery of this later date was collected mainly from surface and sub-surface levels of Trenches 1 and 2, 8 and 10, while further, numerous examples derived from deeper, fill contexts in Trenches 8 (Contexts 1133, and 1134) and 10 (Contexts 1163 and 1164). The pottery fragments of this assemblage tend to be slightly larger in size than those from the Iron II occupations, although most of the sherds were generally just as concreted and abraded as those from the earlier period. The pottery vessels are generally medium to coarse, characterized by silt to coarse sand-sized mineral particles occurring sparsely, moderately and densely in the clay matrix. Some of the sherds were also found to contain a mixture of vegetable and mineral inclusions. The pottery was moderately to well fired, with orange, red-pink, pale yellow and grey surface colours, and orange, red-brown, dark brown and grey core colours. One fabric stood out in particular among the Sasanian corpus because it characterised numerous sherds: it had an orange colour throughout, and comprised a dense abundance of coarse sand-sized soft white mineral particles (some type of carbonate?), and sometimes also coarse sand-sized grey minerals (chert?). Further fine-grained analysis will be able to determine with certainty the identity of these minerals and perhaps even the location of the production centre from which this distinctive fabric came.

The precise date of this pottery corpus has not yet been fully formulated and requires further study. So far, the assemblage that best compares to Bestansur is that collected principally at Qal'eh Yazdigird, a site located in the Kurdistan region of Western Iran, near the Sasanian site of Qasr-i Shirin. In particular, Bestansur's best affinities are with the collections of pottery sherds that were collected on the surface of the area of Tepe Rash at Qal'eh Yazdigird, this having been the place of a Sasanian village (Keall 1977, 3-4) . If the comparanda with the Tepe Rash sherds are correct, the date of the pottery from Bestansur would range between the 3^{rd} to the 7^{th} centuries AD, and fall within the Sasanian period.

Some of the parallels between the Bestansur and Qal'eh Yazdigird pottery are listed as follows:

Fig. 13.3.1 – Keall and Keall 1981, fig. 13:9 (Qal'eh Yazdigird: Zendan) and 13:10 (Qal'eh Yazdigird: Tepe Rash)
Fig. 13.3.4 – Keall and Keall 1981, fig. 20:8 (Qal'eh Yazdigird: Tepe Rash)
Fig. 13.3.12 – Keall and Keall 1981, fig. 9:22 (Qal'eh Yazdigird: Tepe Rash)
Fig. 13.3.13 – Keall and Keall 1981, fig. 10:12 (Qal'eh Yazdigird: Tepe Rash)
Fig. 13.3.14 – Keall and Keall 1981, fig. 9:3 (Qal'eh Yazdigird: Tepe Rash)
Fig. 13.3.15 – Keall and Keall 1981, fig. 10:21 (Dastagird; also a Sasanian site in the Diyala Region of Iraq)
Fig. 13.3.17 (comb-incised ware) – Keall and Keall 1981, fig. 21:3-4 (Qal'eh Yazdigird: Tepe Rash).

One other noteworthy sherd from Bestansur was a body sherd that bears parts of two circular stamped designs on its outer surface (Fig. 13.4, from Trench 8, Context 1134). The stamped impression appears to be that of a four-legged animal, and compares favourably to the stamped images of animals found on a vessel from Borsippa in Mesopotamia, and currently housed in the British Museum (Curtis 1989b, 68, fig. 81). This form of stamped decoration is also known from other Mesopotamian sites to the north, and is characteristic of the late Sasanian period, *ca*. 6^{th} century AD.

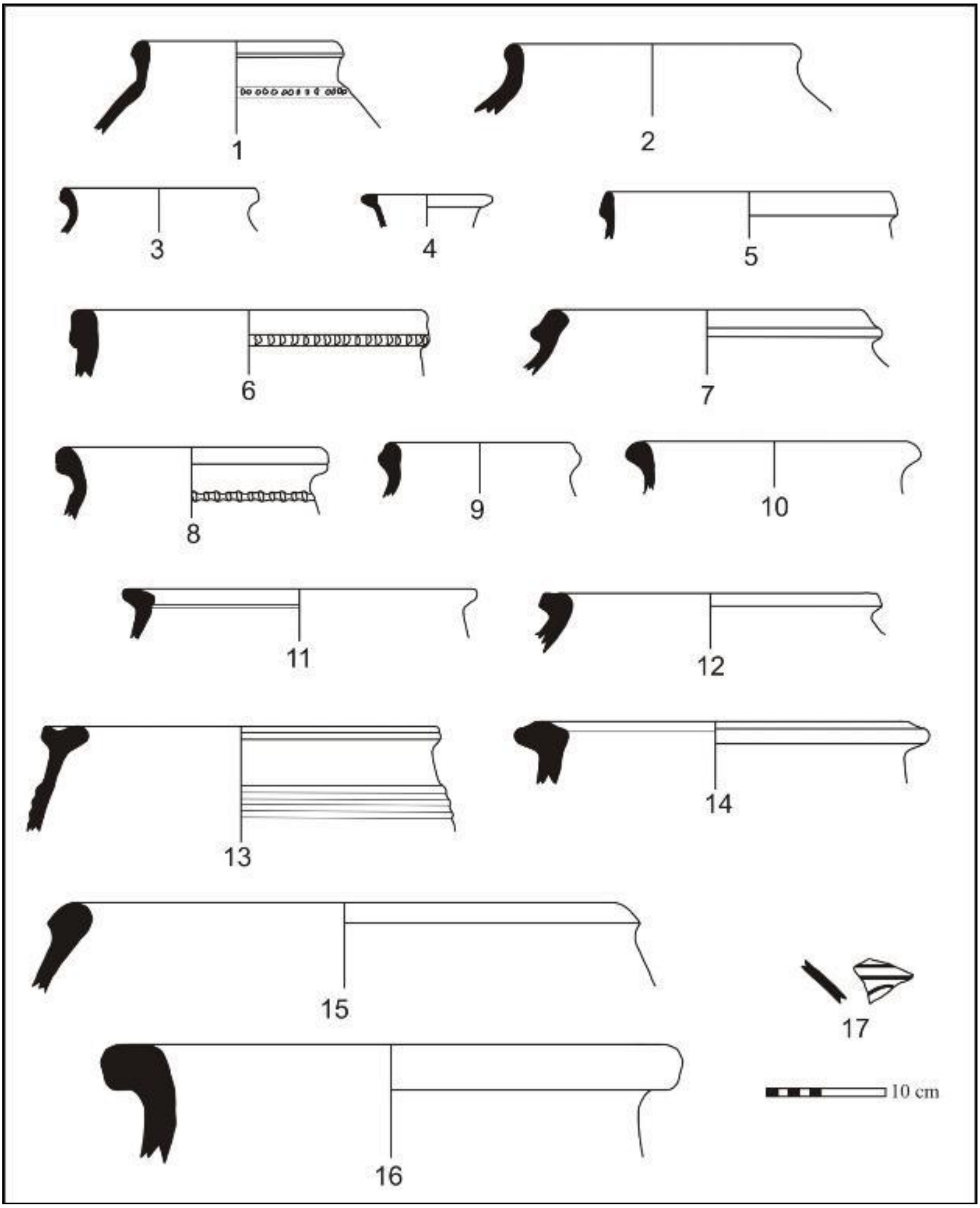


Figure 13.3. Sasanian pottery.

Figure 13.4. Stamped Sasanian sherd.

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