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Soil Micromorphological Investigation of Trampled Floors at Early Natufian site Wādī Ḥammeh 27, Jordan

Introduction

The Early Natufian period witnessed intensified settlement persistence compared to previous periods. Closely associated with this is an increase in frequency and variety of material culture, including dwellings of stone, a high frequency of ground stone artefacts, burials, *objets d'art*, and personal ornamentation such as shell beads and pendants of stone and bone (Richter *et al.* 2017). The explosion of material culture in this period indicates nuanced activities were undertaken on a daily basis, unintentionally leaving archaeological remains such as architecture and artefacts, as well as microscopic residues, within the sediment for us to identify and interpret; making a 'social interpretation of sedimentation . . . just as necessary as a social view of the artefacts contained [with]in the soil' (Gosden 1994: 193). More frequently, sediments are investigated as an additional type of material culture, 'which are shaping and being shaped by human behaviour' (Matthews 2010: 109).

Sediments are an archive constantly capturing residues of past human activities and can be viewed as artefacts in and of themselves. Activities repeated on a daily basis, and more ephemeral activities or those rarely practiced, can subsequently be identified, analysed, and interpreted using geoarchaeological techniques to investigate archaeological sediments. Techniques allowing us to view mesoscale and microscale components simultaneously with sediment structures are best suited to these tasks. The aim of this research is to apply high-resolution analysis of microstratigraphic sequences to evaluate macroscale identifications of floors at Wādī Ḥammeh 27. Excavations at Wādī Ḥammeh 27 were renewed for three seasons beginning in 2014 and finishing in 2016 under the "Ice Age Villagers of the Levant: Sedentism and Social Connections in the Natufian

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Period" (IAV) project. The directors include Phillip Edwards (La Trobe University), Louise Shewan (Monash University/ University of Warwick), and John Webb (La Trobe University). Geoarchaeological sampling was undertaken during November of the 2016 field season. Archaeological micromorphology was applied to investigate and characterise the sediments and microstratigraphy to identify whether microscopic floor and trampling characteristics were present.

Archaeological micromorphology provides microscale descriptions of archaeological sediments and microstratigraphy and is undertaken with the aim of reconstructing both depositional and post-depositional processes and archaeological events (Courty *et al.* 1989; Stoops 2003; Goldberg and Macphail 2006; Mallol *et al.* 2007; Ayala *et al.* 2007; Stoops *et al.* 2010). The technique involves the observation of *in situ* samples where texture, orientation, vertical, and horizontal relationships of constituents on thin section slides are described and interpreted (Courty *et al.* 1989). Detailed analysis of primary and secondary formation processes of each micro-stratum is important to provide a holistic understanding of site formation (Goldberg and Macphail 2006). More generally, micromorphological investigations of floors and occupation surfaces have provided important information on human behaviour (Courty *et al.* 1989; Gé *et al.* 1993; Matthews and Postgate 1994; Matthews 1995; Matthews *et al.* 1996, 1997; Boivin 2000; Tsatskin and Nadel 2003; Wattez 2012; Stahlschmidt *et al.* 2017; Tsatskin *et al.* 2017; Maher 2018).

Occupation surfaces can either be specifically constructed as floors or develop as unconstructed surfaces, that is to say, as trampled surfaces developed over culturally accumulated deposits and/or bodies of natural sedimentation (Gé *et al.* 1993). Different human behaviours produce each surface type. Trampled occupation surfaces and floors have received significant attention in the literature because micromorphology permits high-resolution examination of activities and traces preserved on ancient surfaces. On the microscale, trampling and human activity causes redistribution and parallel orientation of longer or elongated components—*i.e.*, the orientation and inclination of components are realigned by repetitive movement (Schiffer 1985).

Trampled surfaces in moist sediments are frequently identified in thin section using a series of structures including compaction; parallel bedding of larger micro-components with the underlying surface; sub-horizontal fissures; an embedded related distribution; vertical patterns in variety, size, and frequency of micro-fragments of cultural material; pressure fractured cultural components; and unsorted deposits with random orientation of components resembling a gravity flow deposit (Davidson *et al.* 1992; Gé *et al.* 1993; Matthews *et al.* 1997; Macphail and Goldberg 2010, 2018; Rentzel *et al.* 2017; Karkanas and Goldberg 2019). Conversely, well-expressed porous microstructure comprised of pellet-shaped aggregates separated by especially wide pores has been attributed to trampling of sediments in dry conditions (Stahlschmidt *et al.* 2017; Weinstein-Evron *et al.* 2018). However, compaction and a pelletal microstructure could also be indicative of bioturbation. Secure identifications of trampled surfaces require the presence of several of the above criteria to be present in the one feature. Differentiating between trampled surfaces and the later bioturbation of a deposit is complex and much additional work is required to investigate this issue.

Very few archaeological micromorphological studies of Natufian sites and features have been published to date (Goldberg 1979; Goring-Morris *et al.* 1999; Weinstein-Evron *et al.* 2007, 2018; Nadel *et al.* 2008, 2013; Colleuille 2012; Wattez 2012; Stahlschmidt *et al.* 2017; Tsatskin *et al.* 2017). The majority of these have largely concentrated on caves, rockshelters, and sites located upon terrace landforms outside cavemouths, rather than open-air encampments. A targeted micromorphological investigation of surfaces at Saflulim is the one published exception (Goring-Morris *et al.* 1999). Wādī Ḥammeh 27 is now the first such settlement located in the Mediterranean zone of the southern Levant to undergo such an enquiry. Micromorphology is applied as a microscale yardstick for the characteristics of the three specific trampled surfaces identified during excavation of the XX F Sondage (Floors 2.5, 2.6=2.7, 2.8; Table 1; see Fig. 3: 1), and indeed investigate whether further occupation surfaces exist, which might not have been readily visible during excavation. The present study corroborates field identification of occupation deposits and two (Floors 2.6 and 2.8) of the three trampled floors (Floors 2.5, 2.6=2.7, 2.8) identified within the eastern profile of Plot XXF by applying archaeological micromorphological analysis to reconstruct depositional history.

Background

There were four distinct occupation phases at Wādī Ḥammeh 27, an Early Natufian base-camp site in northwest Jordan dating to 12,500 to 12,000 years cal BC. Each phase was constructed upon the location of the previous one, demonstrating considerable intergenerational memory within the 500-year occupation period and the importance of place at Wādī Ḥammeh 27 to Early Natufian cultural groups (Edwards 1989). After three construction phases, overlying the fourth and earliest burial phase, Natufian occupation at Wādī Ḥammeh 27 ceased. Early Natufian archaeological deposits at Wādī Ḥammeh 27 have not been disturbed by subsequent human occupation of the site, making it essential to studies of both the Early Natufian period and the origins of sedentism in the Levant.

During excavation and subsequent analysis, Hardy-Smith and Edwards (2004) identified six trampled surfaces within the stratigraphy of Wādī Ḥammeh 27. These were identified using seven macro-scale characteristics including: sediment compaction, sediment colour, architectural features resting upon surfaces, artefact clusters resting on surfaces, bedded artefacts parallel with the surface, increase in artefact diversity, and an increase in artefact frequency. Floors identified within Plot XXF Sondage include the Occupation Phase 1 floor (Floor 2.3), Occupation Phase 2 floor (Floor 2.5), Occupation Phase 3 floor (Floor 2.6=2.7), and Phase 4 (Floor 2.8).

Edwards (2013) described the Phase 2 floor (Floor 2.5) as a grey clay deposit of variable hardness which was more compacted than the Phase 1 floor (Floor 2.3). Heavy artefacts were also scattered atop the surface of Floor 2.5. The Phase 3 floor (Floor 2.6) was bedded immediately underneath the Phase 2 Floor. It was located in the northern part of the sondage only and is synonymous with Floor 2.7. Floor 2.6 was comprised of a dry, grey crumbly deposit produced from weathered travertine rock combined with trampled sediments. The travertine surface was uneven; clay deposits and detritus infilled depressions and provided a relatively even surface. The Phase 3 surface (Occupation Surface 2.7=5.2)—located in the southern part of the sondage—comprised dark humic clays. Numerous stones and boulders including stone rings (Features 12 and 13) were on the surface. Floor 2.8 is the Phase 4 travertine bedrock at the base of Wādī Ḥammeh 27.

Constructed floors of limestone gravel, rudimentary lime plaster, and imported orange silty clay have been identified using micromorphology at Early and Late Natufian sites. Both gravel and rudimentary plaster floors were identified at El Wad

Table 1. Wadī Ḥammih 27 micromorphological (thin section) sample data and preliminary interpretations of Floors 2.5, 2.6=2.7, and Floor 2.8.

Phase / Locus (Context)	**Thin section (relative depth); preliminary interpretation**	**Inside/ Outside**
Phase 2 Floor 2.5	XXF10.1 0–7/18 mm: thin layer of redeposited sandy sheet wash.	Inside Structure 1
	XXF10.2 7/18–75 mm: Calcareous silty clay supporting flint, shell, bone, charcoal, geogenic calcareous components, and basalt fragments. Occupation deposit resembling a gravity flow deposit with some horizontal bedding of larger flint fragments. Larger flint fragments.	
	XXF11 0–75 mm: Very heavily bioturbated (floral and meso-faunal) occupation deposit. Calcareous silty clay supporting flint, shell, charcoal, geogenic calcareous components, and bone fragments. Green autofluorescence possibly indicates flavins or phosphorous in the sediment. Smaller archaeological components.	
	XXF12 0–75 mm: Heavily bioturbated (floral and meso-faunal) occupation deposit. Calcareous silty clay supporting flint, shell, charcoal, geogenic calcareous components, and bone fragments.	
	XXF13 0–75 mm: Very heavily bioturbated (floral and meso-faunal) occupation deposit. Calcareous silty clay supporting flint, shell, charcoal, geogenic calcareous components, and bone fragments. Larger archaeological components lacking bedding.	
Phase 3 Floor 2.6=2.7	XXF14.1 0–25 mm: Calcareous silty clay supporting flint, shell, charcoal, geogenic calcareous components, and bone fragments. Occupation deposit resembling a gravity flow deposit with some horizontal bedding of larger flint fragments. Bedded, large flint fragment.	Outside Structure 3
	XXF14.2 25–50 mm: Granular micro-structured (trampled?), calcareous silty clay supporting flint, shell, charcoal, geogenic calcareous components, and bone fragments.	
	XXF14.3 50–75 mm: Calcareous silty clay supporting flint, shell, charcoal, geogenic calcareous components, and bone fragments. Occupation deposit resembling a gravity flow deposit with some horizontal bedding of larger flint fragments. Bedded, calcareous boulder (referred parallel with base of micro-stratum and bedded flint in XXF14.1 – Floor?).	
Phase 4 Floor 2.8	XXF18.1 0–59 mm: Very heavily bioturbated (floral and meso-faunal) occupation deposit. Calcareous silty clay supporting flint, shell, charcoal, geogenic calcareous components, and bone fragments. Larger archaeological components frequently horizontally bedded.	Outside Structure 3
	XXF18.2 59–75 mm: Travertine bedrock. Micrite cemented packstone – Trampled, natural bedrock floor surface.	
	XXF18.3 59–75 mm: Compacted, calcareous silty clay supporting silt sized flint and bone fragments and geogenic calcareous sand. Organic residues trampled into the surface and dusty coatings atop the surface – Floor.	

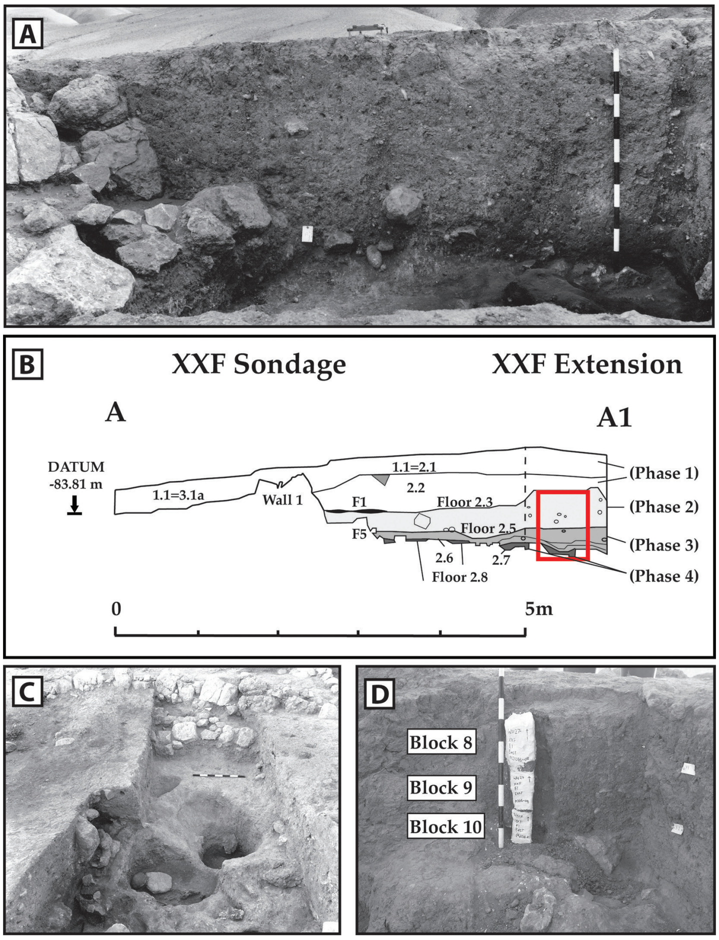
Terrace (Tsatskin *et al.* 2017; Weinstein-Evron *et al.* 2018). Phosphatic crusts on the underside of gravels from Early Natufian sediments were used to identify the floor (Tsatskin *et al.* 2017). A very disintegrated "dirty" calcareous material, preserved within post depositional infilling of microsparite and sparite, in Square N6 of Unit 2 (also an Early Natufian deposit) was identified as rudimentary plaster (Weinstein-Evron *et al.* 2018: 27). People during the Early Natufian period had knowledge of the process of producing quick lime for plaster. A hearth structure within Hayonim Cave contained a ". . . 20 cm thick-layer of white porous material" and was interpreted as a lime burning kiln during excavation (Kingery *et al.* 1988: 223). Saflulim, a Late Natufian base camp, provides another example of a constructed plaster floor. Sample SF L20a 175 contained quartz and calcareous silts with a lower proportion of coarse and fine charcoal and bone fragments are absent. The material was denser than the occupation deposit, containing little porosity and was identified as a rudimentary plaster floor, one of the earliest plaster floors in the region (Goldberg and Goren in Goring-Morris *et al.* 1999: 58–60). At Baaz rockshelter, (a Late Natufian site in Syria), an example of intact constructed floors within unit GH 3b.2- showed little sign of bioturbation or other post-depositional alteration and were composed of imported orange silty clay (Stahlschmidt *et al.* 2017). These examples provide increasing insight into the complexity of construction activities undertaken during the Natufian period.

These Natufian constructed floors can be juxtaposed with a sequence of overlying and non-constructed trampled surfaces at Late Natufian Hayonim Terrace (Wattez 2012) and within Early Natufian Hayonim Cave (Goldberg 1979). Cyclical couplets of occupation sediments containing general refuse, and either immediate (no post-depositional alteration) or delayed (indicated by significant meso-faunal burrowing) trampling of these sediments dominate microstratigraphy at Hayonim Terrace (Wattez 2012). It would be interesting to see if the microstratigraphy within Wādī Ḥammeh 27 shares similarities with that within Hayonim Terrace. However, due to infrequent micromorphological investigations of Natufian sediments, a somewhat restricted pattern of occupation habits only hints at geographical differences. Additional micromorphological investigations are required to provide a more complete interpretation of patterns in Natufian floor construction and trampled occupation surfaces. By applying archaeological micromorphological analysis to reconstruct depositional history, this study investigates field identifications of a series of trampled occupation floors at Early Natufian Wādī Ḥammeh 27.

Samples and Method

In order to to evaluate field identifications of trampled floors (Edwards 2013), geoarchaeological sampling was undertaken at the eastern profile of the Plot XXF Sondage during the 2016 field season (see Fig. 3:2). To clarify, this sampling location was originally excavated during the 1980s and was subsequently reported upon by Edwards (2013), unrelated to the sediments from the 2014–2016 excavations described in Edwards (this volume). The eastern profile of the Plot XXF Sondage was chosen as the sampling location because it was the only place where the site was excavated to bedrock, so it contains a full sequence of layers and phases (Phases 2, 3, and 4, below the previously excavated Phase 1), including the series of trampled, occupation floors (Floors 2.5, 2.6=2.7 and the travertine surface: Floor 2.8). Edwards and colleagues (2018) provide a more detailed account of the geoarchaeological sampling methods applied at Wādī Ḥammeh 27.

A total of nine thin sections, measuring 55 × 75 millimetres, were prepared from three oriented blocks (Blocks 8, 9, and 10) extracted from the eastern profile of the Plot XXF Sondage (Table 1 and Fig. 1). Thin sections were scanned in plane polarised (PPL) and crossed polarised light (XPL) using an Epson v700 'Photo-scanner'

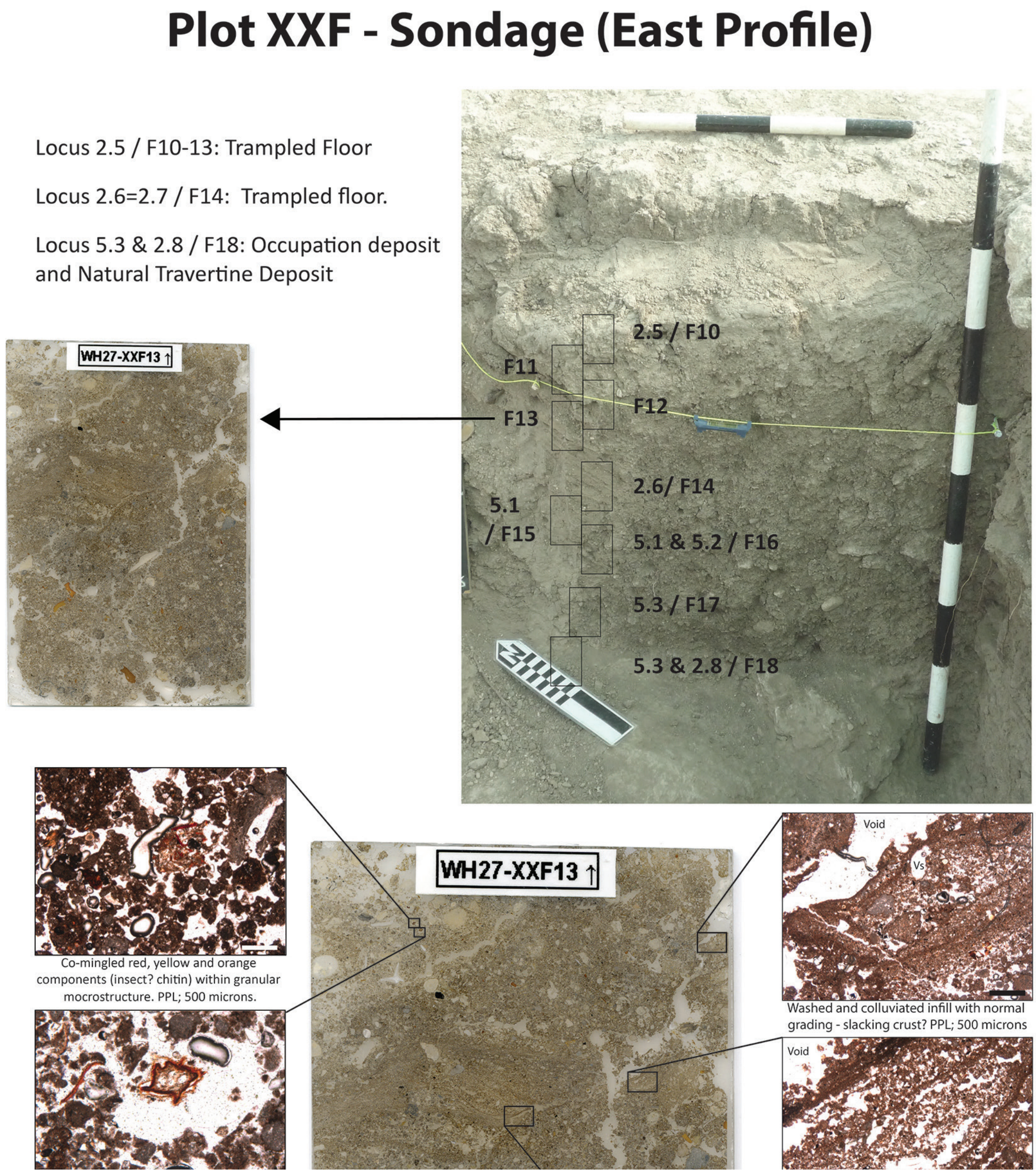


1. a) Eastern profile of Plot XXF sondage after the 1980s excavation (used with permission Edwards 2013b: 48 fig. 3.19), b) Stratigraphy of east profile of the Plot XXF – Sondage with the sampling location marked in red (redrawn from Edwards 2013b: 48), c) Used with permission Edwards 2013b: 53 fig. 3.30, and d) Eastern profile during geoarchaeological sampling of Blocks 8–10.

(Arpin *et al.* 2002) and were examined with both Olympus CX31 and Zeiss A1 Scope. The microscopes were set at magnifications between × 20–400 under Plane-Polarised Light (PPL), Crossed-Polarised Light (XPL), ultraviolet (UV), and Ordinary Incident Light (OIL). Micromorphological features were photographed using a mounted AutoCam MRc5 camera. Thin sections were described, ascribed microstratigraphic units (MSUs) and deposit types (DTs), and counted using established methods (Bullock *et al.* 1985; Courty *et al.* 1989; Stoops 2003; Goldberg and Macphail 2006).

Results

Even though a full profile of thin section samples was taken (samples XXF10 to XXF18), only those pertaining to the investigation of the floors identified during excavations will be reported upon here (samples XXF10 to XXF14 and XXF18). In the eastern profile, four trampled floor surfaces were identified on the macroscale



2. Location of samples from Floor 2.5, eastern profile of the Plot XXF Sondage, Wadī Ḥammih 27. Floral and meso-faunal turbation is presented within the microphotograms. A slacking crust infills a prominent channel void.

which were associated with Occupation Phases 2, 3, and 4 (Fig. 1).

Using sediment micromorphology, the trampled travertine surface (Floor 2.8, associated with the Lower Phase 3 occupation) was securely identified. The Phase 2 (Floor 2.5) and Phase 3 (Floor 2.6=2.7) were not securely identified on the microscale. Floor 2.3 was not relocated in thin section as Phase 1 occupation deposits were excavated away during the 1980s. Deposits within the eastern profile of Plot

XXF have undergone significant secondary mixing by occupation, reoccupation, and subsequent floralturbation and meso-faunalturbation as well as seasonal shrink swell processes. Significant transportation of sediment down through chamber and channel void systems is also observed and is concentrated within the top 470 millimetres of the eastern profile. The following results are initial results only and selected results are presented in Table 1.

Plot XXF—Sondage, Eastern Profile, Floor 2.5 (Samples XXF10, XXF11, XXF12 and XXF13; MSUs XXF10.1, XXF10.2, XXF12.1, and XXF13.1)

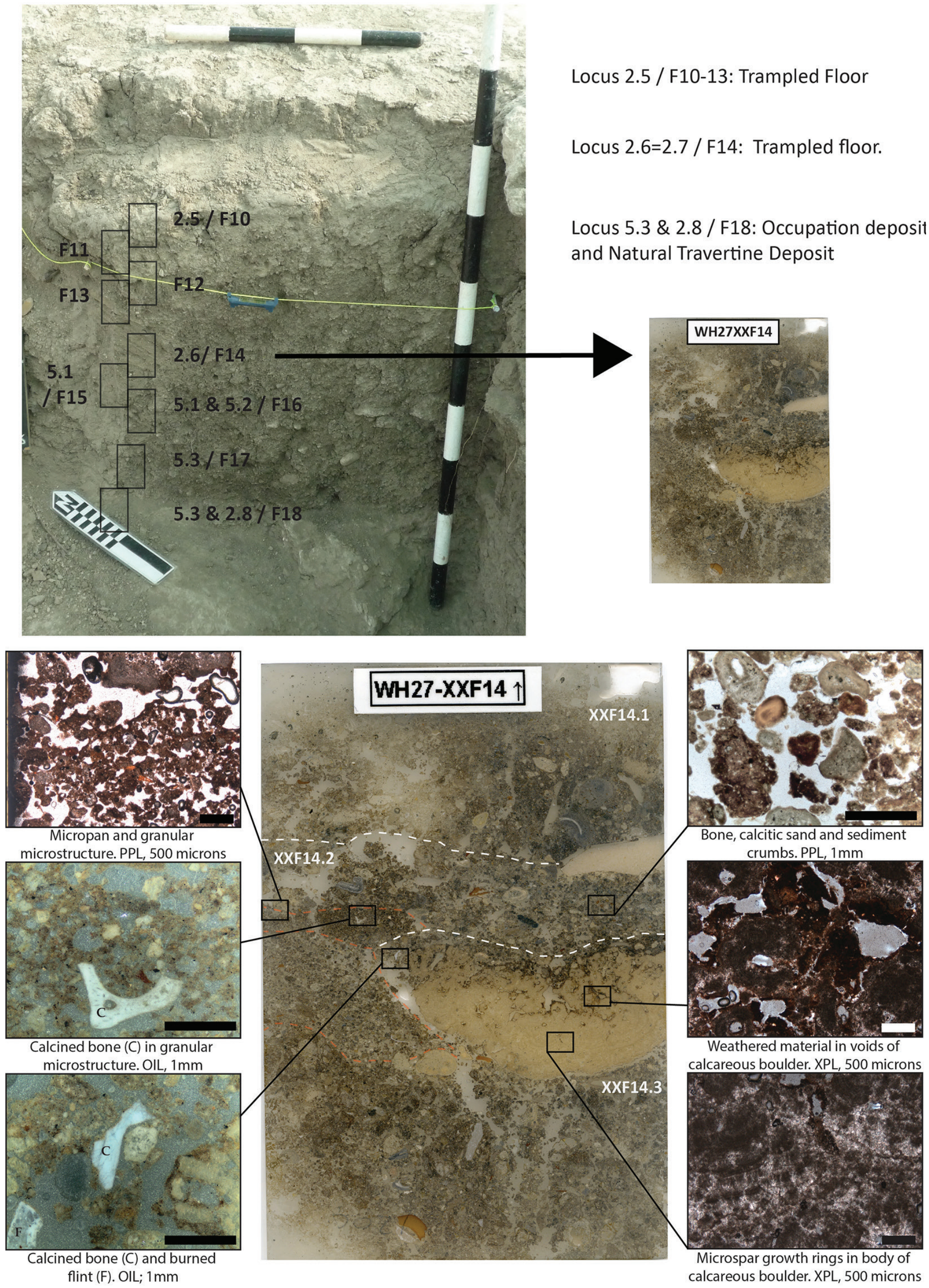
Samples XXF10, XXF11, XXF12, and XXF13 were taken from Floor 2.5 (Fig. 2). These samples revealed complex micro-stratigraphy heavily altered by post depositional processes, including floral-turbation, meso-faunalturbation, and seasonal shrink-swell processes, and water has transported silts down through the profile creating slacking crusts and coatings on void walls. Floor 2.5 is characterised by calcitic pebbles and sands as well as archaeological material embedded with calcitic silty clays. Archaeological material includes fragments of flint, shell, bone, charcoal, and fine igneous rock—basalt (exotic to the area and a fragment of a grindstone). Microstratigraphy within Floor 2.5 is comprised of four units (MSUs XXF10.1, XXF10.2, XXF12.1, and XXF13.1). Each microstratigraphic unit has a different microstructure; however, granular and crumb structures are present throughout. A thin, recent sheet wash deposit overlies the archaeological site and is comprised of redeposited calcitic sands (MSU XXF10.1).

A distinct pattern in artefact size is observed within the microstratigraphy of Floor 2.5. Micro-fragments of archae-ological material are larger in the lowest microstratigraphic units (XXF12.1 and XXF13.1). Increased size of artefacts is indicative of more intense occupation. Archaeological material decreases in size moving upwards through MSU XXF11.1 and increase in size again in MSU XXF10.2. Due to plant rooting, meso-faunal burrowing and shrink/swell processes, archaeological material has mixed orientations and is mostly referred parallel with voids; very few flint and bone components are referred parallel with the underlying contact with Floor 2.6. A trampled surface was not securely identified within the microstratigraphy. Even though the microstratigraphy with-in Floor 2.5 has an embedded related distribution (is matrix supported); vertical patterns in size, variety, and frequency of archaeological components are observed; and some components are referred parallel with the underlying contact with Floor 2.6. Other important indicators of trampling—such as sub-horizontal fissures and dusty crusts—were absent. This is probably due to the significant post-depositional alteration to the deposit. Microstratigraphic evidence does not securely support the field identification of Floor 2.5.

Plot XXF—Sondage, Eastern Profile, Floor 2.6=2.7 (Sample XXF14; MSUs XXF14.1, XXF14.2, and XXF14.3)

Sample XXF14 was taken from Floor 2.6 (Fig. 3). The microstratigraphy within this sample illustrated moderate to significant post-depositional alterations including floralturbation and transported calcitic sandy sediments downward through the profile, infilling channel voids. Floor 2.6 is characterised by calcitic pebbles, a single boulder (using the Wentworth scale: between 4096 and 256 mm in length) and sands as well as archaeological material embedded with calcitic silty clays. Archaeological material includes burnt and unburnt fragments of flint, shell, bone (both burnt and calcined), and rare charcoal. Components are poorly to moderately

Plot XXF - Sondage (East Profile)



3. Location of sample XXF14 from Floor 2.6=2.7, eastern profile of the Plot XXF Sondage, Wadī Ḥammih 27. Post depositional alteration to Floor 2.6=2.7 includes micropans, granular structure within void infill. A weathered surface of the calcareous boulder is illustrated and internal growth rings within the component. Calcined bone and blackened calcareous components are present.

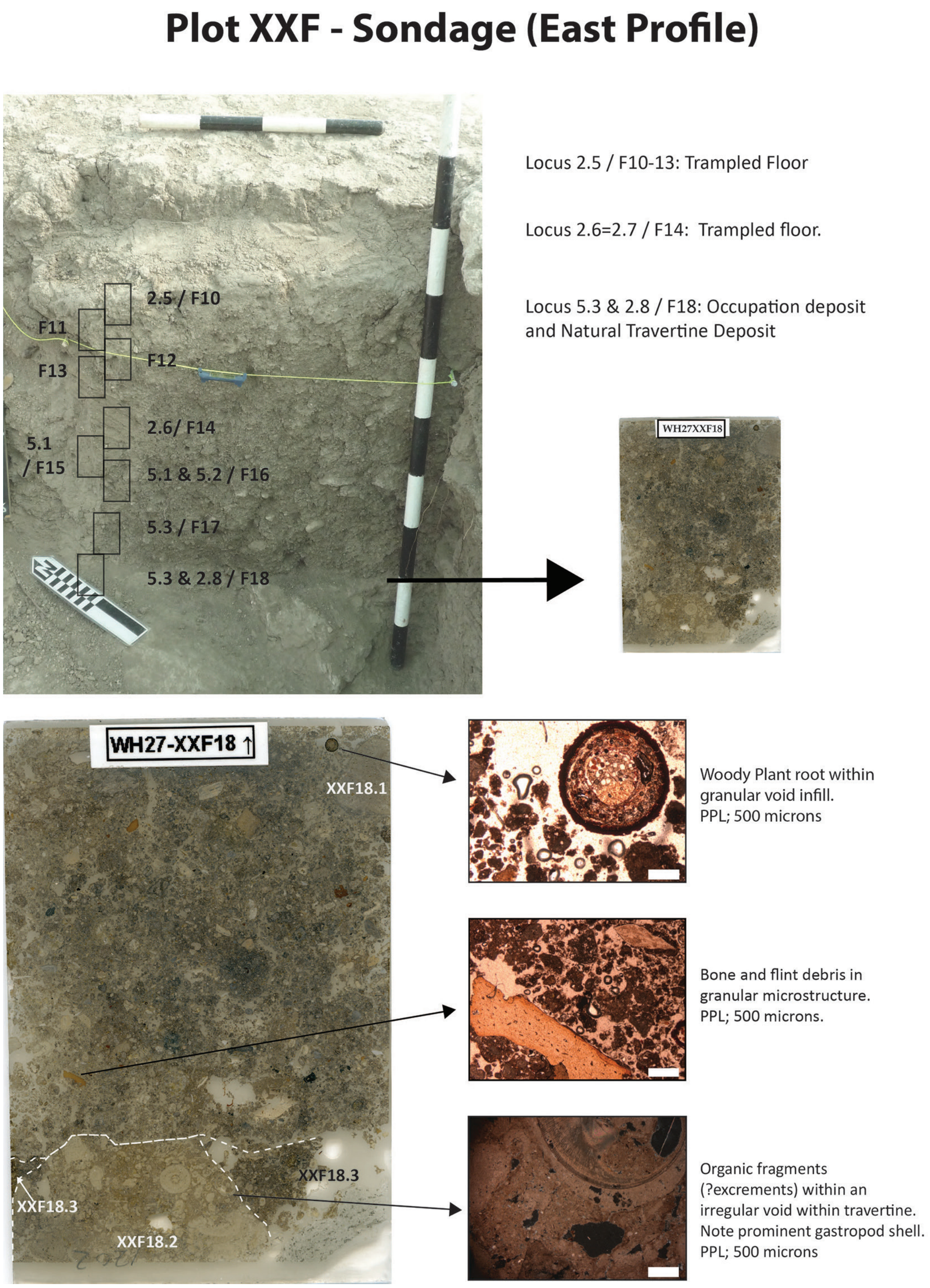
sorted within Floor 2.6. Microstratigraphy within Floor 2.6 is comprised of three units (MSUs XXF14.1, XXF14.2, and XXF14.3). Microstratigraphic units XXF14.1 and XXF14.2 are occupation deposits atop XXF14.3. The microstructure of the microstratigraphic units within Floor 2.6 are complex and composed of granular, crumb, and compound packing microstructures. The probable trampled surface of Floor 2.6 (MSU XXF14.3) is indicated by a prominent, horizontally bedded, limestone boulder. The upper surface of the boulder is weathered, and darker brown, compacted silty clay immediately overlies the boulder (MSU XXF14.2). This is, in turn, overlain by a horizontally oriented and bedded flint micro-fragment—the largest within this profile (within MSU XXF14.1).

Microstratigraphic unit XXF14.3—the bottom of Floor 2.6—was earmarked as a possible trampled floor based upon the presence of microscale characteristics including referred parallel bedding of large components and parallel bedding of these large components with the underlying contact with Locus 5.1 (MSU XXF15.1). Increased size and frequency of flint fragments within the overlying microstratigraphic unit (MSU XXF14.1) and the weathered upper surface of the limestone boulder were also taken into consideration. Floor 2.6 has a complex, open microstructure dominated by crumb and granular structures separated by compound packing voids. Stahlschmidt *et al.* (2017) used the open and aggregated microstructure at Baaz Rockshelter as a characteristic of trampling. The granular microstructure within Floor 2.6 is restricted to void infill. Sub-horizontal fissures (often used to identify trampling) are absent. Floor 2.6 has been subject to significant microscale post-depositional alteration. Hence, the more indicative characteristics of trampled surfaces (*i.e.*, crusting, organic residues trampled into the surface, and sub-horizontal fissures) are absent or microscale homogenization of Floor 2.6 has removed them. In this instance, micromorphology could not securely support the field identification of Floor 2.6.

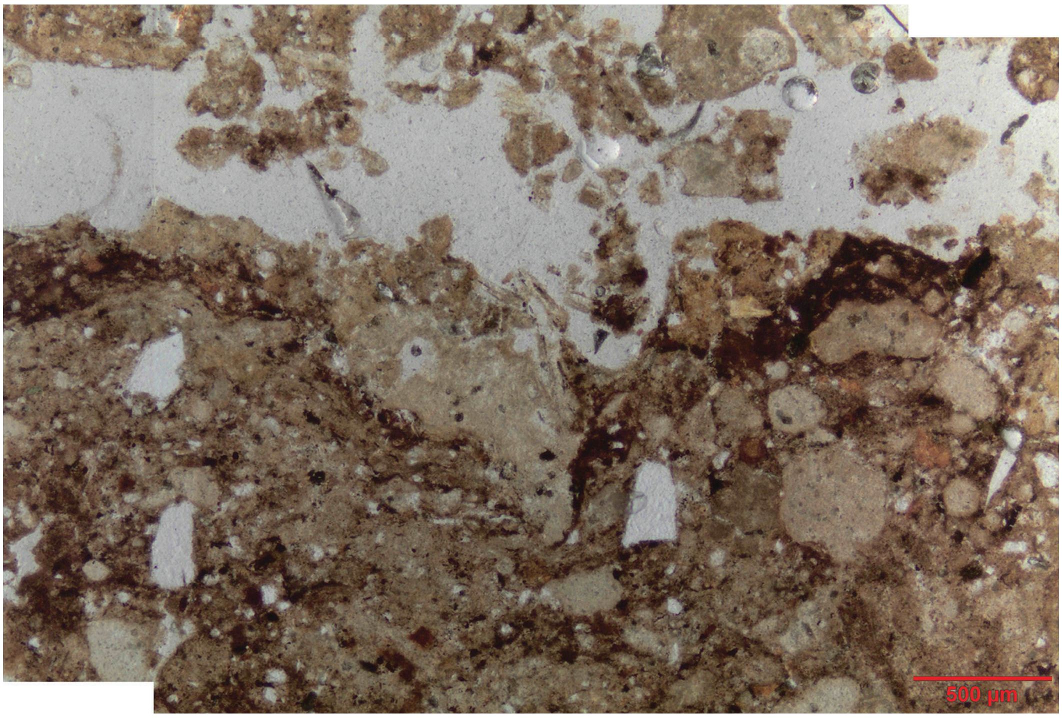
Plot XXF—Sondage, Eastern Profile, Floor 2.8 (Sample XXF18; MSUs XXF18.2, and XXF18.3)

Sample XXF18 was taken from Floor 2.8 (Fig. 4). The surface of the travertine within Floor 2.8 is undulating on both the macroscale and microscale. Undulations are filled with compacted Natufian grey clays, creating a level surface. The Natufian grey clay within these undulations was allotted microstratigraphic unit number XXF18.3. The travertine was assigned microstratigraphic unit number XXF18.2. These two microstratigraphic units are contiguous with one another at the bottom of the profile. Incipient iron hypo-coating on voids within the travertine (MSU XXF14.2) is present within millimetres of this trampled surface. Meso-faunal burrowing and excrements are observed close to the surface of the travertine (MSU XXF18.2). The structure of travertine within MSU XXF18.2 is a grain supported packstone comprised of calcitic granules and sand-sized components as well as gastropod shells all embedded within a micritic mud. Layered silt-sized flint and bone fragments and calcareous sand are embedded within compacted Natufian Grey Clay indicative of aeolian deposition. Sediment within Locus 5.3, immediately overlying Floor 2.8, peels away easily from the compacted surface visible in Sample XXF18 (Fig. 5). Microscopic black organic residues and thin dusty coatings are referred parallel with the surface of Floor 2.8 (within microstratigraphic unit XXF14.3).

Several microscale indicators of trampling are present within the surface of Floor 2.8. These include dusty crusts, referred parallel bedding of blackened organic



4. Location of sample XXF18 from Floor 2.8, eastern profile of the Plot XXF Sondage, Wadī Ḥammih 27. Natural Travertine rock and trampled occupation floor. Microstratigraphic units (MSU) are labelled on thin section XXF18.



5. Thin section sample XXF18, MSU XXF18.3. Detail of the trampled surface with blackened organic residues, dusty crusting and the upper deposit (Locus 5.3) lifted away from the compacted surface (PPL).

material, compaction—the overlying occupation deposit (Locus 5.3) peels away—and layered deposits infilling undulations (Fig. 5). Based upon the presence of these more telling characteristics of trampling, the identification of Floor 2.8 as a floor during excavation was corroborated by microscale evidence. During the 2014–2016 excavations, it became clear that the thin section samples taken from the eastern profile of the Plot XXF sondage are from outside the Phase 3 Structure 3 but inside Phase 2 Structure 1. The sediment samples did not have the same protection from weather and natural post-depositional processes.

Trampled Living Floors

Matthews *et al.* (1997) used criteria including embedded related distributions (matrix supported deposits), horizontal bedding and parallel distribution with the underlying deposit base to identify occupation deposits on floors in three Bronze Age tell sites in Southwest Asia. The majority of microstratigraphic units within the eastern profile of the Plot XXF sondage have embedded related distributions, weak to moderate parallel bedding with the base of deposits, and have linear distribution. Micro-artefacts are also present within most microstratigraphic units overlying the travertine (MSU XXF18.2). These structural criteria were applied here to identify MSU XXF10.2, XXF11.1, XXF12.1, XXF14.1, and XXF14.2 as occupation deposits. Components within these microstratigraphic units are unsorted and randomly distributed, resembling a gravity flow deposit. Karkanas and Goldberg

(2019) identified that occupation deposits and trampled living floors resemble these natural deposits. Trampling and human activity caused redistribution and parallel orientation of longer or elongated components—*i.e.*, the orientation and inclination of components were realigned by repetitive movement (Schiffer, 1985). Larger components (flint, bone, a calcareous boulder, and granules) within XXF14.1 and XXF14.3 have horizontal orientation and parallel bedding due to trampling (Rentzel *et al.* 2017).

Occupation surfaces should demonstrate characteristics of trampling and intensified accumulation of artefacts and other vestiges of human origin upon them (Karkanas and Goldberg 2019). Vertical patterns in variety, size, orientation, bedding, and frequency are evident in the eastern profile of the Plot XXF excavation trench. Intensified accumulations of microscale archaeological components were identified within Floor 2.5 (MSU XXF10.2, XXF11.1, XXF12.1) and Floor 2.6=2.7 (MSU XXF14.1). Microstratigraphic units (XXF10.2, XXF11.1, and XXF12.1) within Floor 2.5 have the relative highest variety (basalt, flint, bone, and shell), frequency and generally larger micro-artefacts. Microscopic archaeological material within Floor 2.5 (MSU XXF10.2, XXF11.1, and XXF12.1) are strongly referred parallel with voids and are rarely horizontally or sub-horizontally oriented, signifying post-depositional alteration. A more restricted variety (bone, shell, and flint) and smaller archaeological material is present within the bottom of trampled Floor 2.5 (MSU XXF13.1) and the middle of Floor 2.6=2.7 (MSU XXF14.2). The largest flint fragment within this profile is within trampled Floor 2.6 (MSU XXF14.3). Therefore, fragments of flint, bone, shell, and charcoal are larger, more frequent, horizontal to sub-horizontally oriented immediately overlying trampled occupation surfaces. They reduce in variety, size and frequency moving upwards, away from trampled surfaces.

Three trampled occupation floors (Floor 2.5, 2.6=2.7, and Floor 2.8) were identified during excavation in the 1980s and subsequent analysis (Edwards 2013a). Identifications were made based upon sediment compaction, sediment colour, architectural features resting upon surfaces, artefact clusters resting on surfaces, bedded artefacts parallel with the surface, increase in artefact diversity, and an increase in artefact frequency. These macroscale patterns were reflected on the microscale. Micromorphological investigation of samples from Floors 2.5, 2.6=2.7, and 2.8 securely identified one floor (Floor 2.8). A trampled surface within Floor 2.6=2.7 was suggested based upon parallel bedding of flint and other smaller burned micro-fragments with the base of the deposit and a calcareous boulder trampled into the surface (Fig. 3). The trampled surface within Floor 2.8 (MSU XXF18.2 and XXF18.3) is composed of localised, organic residues with referred parallel bedding with the base of the deposit (Fig. 5).

Trampled living floors in unprotected, natural environments are predisposed to post-depositional alteration, impeding identification. Therefore, identification is reliant upon patterning of lithics and other micro-artefacts or single hearth constructions and other features (Machado *et al.* 2013). Although there was architecture at Wādī Ḥammeh 27, the lower deposits within the eastern profile of Plot XXF were undoubtedly located outside Structure 3. Evidence of trampling within the profile includes compaction and horizontally or sub-horizontally oriented and bedded flint, bone and shell micro-fragments, and geogenic components. Sub-horizontal fissures, regularly used to identify trampling (Davidson *et al.* 1992; Gé *et al.* 1993), are absent. This is probably due to macroscale and microscale post-depositional alterations to the deposits. Trampled surfaces have been heavily bioturbated leaving parallel bedding of micro-artefacts, variety, size, and frequency as the main criteria for their identification within the east profile of Plot XXF.

During trampling experiments, Rentzel and Narten (2000), found effects of trampling on dry substrates is constrained to within a few millimetres underlying the activity surface—although in wet sediments—indications of trampling (including bedded artefacts and sub-horizontal fissures) can be observed to a depth of three centimetres. Additionally, compaction appears to be more pronounced in damp conditions (Karkanas and Goldberg 2019). Microstratigraphic units within the eastern profile of Plot XXF do not preserve sub-horizontal fissures due to post-depositional alteration and the friable nature of the sediment. However, the most obvious evidence for trampling during wet conditions—though heavily altered subsequent to deposition—is within Floor 2.6=2.7 (MSU XXF14.3). A calcareous boulder has probably been trampled up to 10mm into the surface and is underlying the largest, referred parallel bedded flint micro-fragment (within MSU XXF14.1). According to the findings of Rentzel and Narten (2000), in order for this pebble to have been trampled into the underlying deposit, the sediment must have been wet.

Suspected reworked, constructed trampled floors in addition to the original four identified within the east profile of Plot XXF by Edwards (2013a), and construction materials within the eastern and southern profile of Plot XXF are currently under investigation and will be reported at a later date.

Post-Depositional Processes

Post-depositional alterations to the deposits are very dominant and have impacted upon microstructure and the orientation of micro-artefacts. Coarse textural post-depositional alterations to the upper 470 mm of the eastern baulk of Plot XXF provide signals of a semi-arid environment. Colluvially and fluvially washed void infills were deposited via turbulent water under conditions where ground cover was absent (lacking vegetation; Courty *et al.* 1989). These coarse pedo-features disappear within Floor 2.6=2.7 (MSU XXF14.3) because turbulent water loses velocity as it moves downwards through the profile. The vertical location of these pedo-features implies a more recent series of infilling events. Further, currently vegetation is absent upon the ground surface overlying Wādī Ḥammeh 27 during summer months and at the beginning of the wet season. Meaning, coarse textural void infills were deposited since aridification of the area around the site. Furthermore, some of these infills contain yellow or reddish-brown plant root remains and stable meso-faunal excrements indicating more recent bioturbation.

Based upon the semi-arid climatic signal given by coarse textural post-depositional processes, recent floral turbation (yellow, red, pink colours) and dense pellets of micro-faunal excrements, at least some post-depositional alteration has occurred since the 1980s excavation. The profile has probably been altered, to at least some degree, from both above and within loose backfilled sediments. To avoid this situation, it is recommended that geoarchaeological testing takes place in tandem with initial excavations so additional samples can be taken in different locations and features within Natufian sites for a wider investigation of activities, activity areas, and occupation habits.

Conclusion

The application of archaeological micromorphology to sediments within the eastern baulk of Plot XXF revealed microscale signatures of Natufian activities and trampled occupation floors. Even though sediments from this profile are significantly altered by post-depositional processes, patterns in variety, size, frequency, bedding, and orientation of fragments of flint, shell, bone, charcoal, and basalt were utilised to identify Natufian activities, occupation deposits, and reworked, trampled surfaces. Based upon microscale evidence presented in this chapter, the activities undertaken by Natufian people at Wādī Ḥammeh 27 included flint knapping (early reduction sequence chips are present), heat treating flint, burning or cooking bone and shell, curation of adornments, and grinding resources with basalt mortars and pestles.

Several of the criteria for identifying trampled floors are present within features in the eastern profile of Plot XXF. These include weathered surfaces (Floor 2.6=2.7), parallel bedding, a pellet-shaped aggregate open microstructure and larger fragments of material culture, and geogenic components directly overlying features in Floor 2.6=2.7 (MSU XXF13.1 and XXF14.2; Fig. 3). *In situ* pressure breaks, sub-horizontal fissures, also used to identify trampling (Gé *et al.* 1993), are absent and compaction is restricted to sediment within aggregates. This could be due to post-depositional alterations overprinting these structures. Based on the paleoclimate at Wādī Ḥammeh 27, trampling of dry sediment possibly resulted in an open, pellet-shaped structure containing aggregates lacking sub-horizontal fissures. This microstructure is also indicative of bioturbated deposits and in concert with compaction could indicate meso-faunal burrowing rather than trampled surfaces. Meso-faunal galleries and floral channel voids (Figs. 2 and 4) are present throughout the eastern profile, especially within Floors 2.6=2.7 and Floor 2.8. Plant roots and meso-faunal burrowing have caused heavy bioturbation, generally leaving parallel bedding of micro-artefacts, variety, size, and frequency as the main criteria for identification of trampled floors. This evidence alone is not enough to identify trampled floors. A trampled floor was securely identified within the contiguous MSU's XXF18.2 and XXF18.3 at the base of the eastern profile of Plot XXF sand is consistent with the macroscale identification of Floor 2.8.

Micromorphological investigations of sediments from Wādī Ḥammeh 27 are ongoing and the results presented here are preliminary. Additional ancillary geo-archaeological analyses have also been undertaken in tandem with this investigation which will enable a clearer understanding of human activities and occupation behaviour at Wādī Ḥammeh 27.

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