Thin Sections from the High Mound of Titris Höyük: Preliminary Report
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Introduction

This report consists of preliminary descriptions and interpretations of fifteen thin sections taken from the High Mound at the site of Titris Höyük in southeastern Turkey during the 1994 field season. These samples constitute a discontinuous column sample from c. 2 m of stratified deposits exposed in Trench 43-61 (fig. 1). These deposits date from the mid-late Early Bronze Age to the early second millennium BCE (T. Matney, pers. comm. 2007).

Figure 1. West profile of Unit 43-61, with samples locations shown. Note that sample numbers have been grouped to correspond with the basic stratigraphic phasing suggested by both excavation and the results of micromorphological analysis presented here (see also fig. 2).
Phase 5.
Loose, highly bioturbated fill of decayed mud brick and mixed occupation debris.

Phase 4.
Package of plaster floors and stabling deposits.

Phase 3.
Compacted fill.

Phase 2.
Loose, highly bioturbated fill of decayed mud brick and mixed occupation debris.

Phase 1.
Intact mud brick.

Figure 2. Overview of the stratigraphic sequence with representative thin sections and brief description of each phase.
Common constituents

The sediments found in these thin sections share a number of characteristics in common, particularly with regard to their constituent materials. These are typical tell sediments in that they are made up almost entirely of decayed building materials and reworked occupation deposits. It is very clear that much of the clay matrix is derived from decayed mud bricks and it is very likely that a significant percentage of the coarse fraction is inherited from the mud brick as well. In order to avoid repeating descriptions of the same constituents for every sample described below, I will begin by describing those elements that are found throughout. Several of these components are illustrated below in figs. 3-5, others will be pointed out in figures throughout the text.

**Coarse Fraction.** The coarse fraction typically makes up from 10% to 30% of the total sediment in a given sample and is characterized by a great degree of heterogeneity within each sample and homogeneity between samples.

- At the larger end of the scale are abundant soil fragments (burnt and unburnt) and fossiliferous limestone or chalk lithoclasts. These tend to be well rounded but poorly sorted, ranging in size from very fine sand to medium pebble.
- These clasts are accompanied by a variety of more rare anthropogenic materials that include daub, plaster, and ceramics, also well rounded and poorly sorted.
- Bone and charcoal are common constituents, though the coarse examples of these tend to be sub-rounded to angular.
- Basalt lithoclasts and disorthic soil carbonate nodules appear occasionally.
- At the smaller end, there is ubiquitous well-sorted coarse quartz silt, ultimately aeolian in origin (though it is present in the mud brick as well, so it may also be inherited) and discrete fossil foraminifera that have been weathered out of a less resistant local rock and now comprise a fine to medium carbonate sand.

**Fine Fraction.** The fine fraction is characterized as anything smaller than medium silt (< 8 microns). The vast majority of the matrix is made up of calcareous clay, often with finely comminuted organic matter, charcoal, and phytoliths.

As mentioned above, these same constituents are observable in essentially every thin section, but there are significant differences in their organization and microstructure. These differences provide the basis for description and discussion below. Where relevant, any divergence in coarse or fine fraction from the above outline will be addressed,
whether locally within a sample or between samples. Description and discussion are grouped into five stratigraphic phases based on both field observations of the profile and common attributes of the thin sections themselves (figs. 1 and 2).

Figure 3. Typical amalgam of common constituents, including burnt and unburnt soil fragments (zones of reddened or blackened sediment), coarse charcoal (lower left), rounded limestone lithoclast (upper left) and fossiliferous limestone (right center). Plane polarized light (PPL), width of view = 4.7mm.

Figure 4. Same as left in crossed polarized light (XPL). The calcareous nature of the clay matrix is apparent here, and the ubiquitous aeolian quartz silt is visible as small light specks scattered throughout.

Figure 5. Large fragment of burnt bone. PPL, width of view = 4.7mm.
Phase 1 (TH94-22A and B)

The basal unit of the sequence (Sample 22B; fig. 6) is made up of intact mud brick, which provides a useful point of reference in comparing overlying examples of partially decayed mud brick. The pore space here is c. 20%, largely made up of the characteristic pseudomorphs left by straw temper used to make the bricks. These voids are expressed as sharp, elongate or circular chambers (depending on cross-sectional view), creating a spongy, almost vesicular structure. The clear contact running diagonally across the bottom of the slide may be the juncture of two bricks. The mud brick in the bottom third of Sample 22A shows some faunal disturbance (passage features) but is otherwise largely intact and clearly differentiated from the overlying deposit.

This upper portion of Sample 22B consists of the same heterogeneous, poorly sorted, well-rounded mix of coarse fraction constituents seen within the mud brick itself,
but with a slight increase in anthropogenic input over the underlying mud brick. For example, charcoal here appears not only as comminuted fine fraction, but also in larger, intact fragments that could not have been inherited. The matrix is also more calcitic and marginally less clayey than the pure mud brick. The overall structure here is best described as angular blocky as it is dominated by long cracks and consists generally of discrete, massive aggregates interspersed by sandier domains. Intrapedal voids are largely pseudomorphs and vesicles, while the intervening sediment owes its looser fabric to bioturbation and often contains pockets of mite faecal pellets.

At least one horizontally oriented lamina of sand-sized material (c. 800 microns thick) is underlain by a thin, compact silty clay layer (c. 400 microns thick), suggesting a possible floor surface. A large (c. 5 mm) fragment of plaster in the upper corner also contains stringers reminiscent of prepared flooring.

Both of these samples include fine silt coatings (or siltans) on pseudomorphic and faunally-derived voids (figs. 10, 11). The coatings sometimes contain finely comminuted charcoal, organic matter, and phyoliths and, in the upper portion of 22A, may be as thick as 200 microns.
Discussion. The material at the bottom of the profile suggests fill that was not exposed for a long period of time. The underlying mud brick appears to be in almost pristine condition and the possibility of recognizable floor or flooring material in the immediate overburden also indicates rapid burial without significant reworking. The siltans may be a result of fine material being translocated down from the thick overlying deposit of collapsed or dumped material. As we will describe below, this overlying deposit shows significant evidence of breakdown and dissolution as a result of faunal activity and weathering, and it must have been exposed for some period of time to allow leaching to take place.
**Phase 2 (TH94-21, -20, -19, and -18)**

Figures 12, 13. The samples above illustrate the chaotic organization of constituents and zones of altered mud brick, for example that seen in the upper-central third of Sample 19.

The four samples that constitute the next phase were taken from a deposit of decayed mud brick roughly 0.50 m thick. The microstructure of the stratum is generally determined by varying degrees of mud brick preservation and the extent of bioturbation. On the one hand, we see pseudomorphic structure similar to that in the intact mud brick described above, though here occurring not always in discrete, well-bounded zones, but often fading into areas of greater disaggregation (figs. 14, 15). The mud brick here also differs in that the form of many of the plant temper voids themselves has been altered by weathering processes, such as the passage of down-leaching water.

Where these domains of decayed mud brick end, the structure is generally characterized by much looser, disaggregated or reworked material. These zones are dominated by extensive bioturbation and often composed of coalesced faecal pellets derived from soil fauna. The resulting open, spongy structure will hereafter be referred to as Microfabric 1 (figs. 16, 17). Sample 18 presents a slight departure from this organization, revealing instead massive sub-angular granule-sized aggregates. These are
separated by zones of an open, crumby configuration of faecal pellets that have not been fused to the same degree as those in the lower samples. Worm casts and channels are also present.

Figure 14. Sample 19. Note juxtaposition of mud brick microstructure with clear pseudomorphs on left and spongy, bioturbated domain consisting of fused faecal pellets on the right. PPL, width = 4.7mm.

Figure 15. Same as left in XPL.

Figure 16. Heavily bioturbated sediment characteristic of Microfabric 1. Here faunal pellets have coalesced, resulting in closed voids and spongy, vesicular structure, similar to that visible on the right in figures above. PPL, width of view = 2.65mm.

Figure 17. Another example of Microfabric 1 in which small aggregates remain largely distinct, resulting in slightly more open, granular structure. PPL, width of view = 4.7mm.

Discussion. These samples suggest a chaotic amalgamation of dumped or collapsed building material, probably already degraded prior to deposition and continually reworked by soil fauna thereafter. The upper contact of this stratum was identified in the field as a layer of angular cobbles. This stratigraphic division is further reinforced by the drastic differences in microstructure between these samples and those of Phase 3, described below.
**Phase 3 (TH94-17, -16, -15, and -14)**

Figures 17, 18. These samples demonstrate the clear differences between this phase and those from the underlying Phase 2. Voids here are mostly long-running cracks and fissures, while the rest of the sediment is largely massive.

As a unit, these four samples present a striking deviation from the underlying sediments. The structure of all four is best described as angular to sub-angular blocky, expressed to varying degrees but without any clear trend from top to bottom. In Sample 17 (fig. 17), the dominant fissures run vertically, giving the impression of an almost columnar organization. In other samples, however, the peds are much more equant and better expressed. The discontinuous, arcuate pattern of voids present in Sample 14 shows most clearly that the structure of the entire deposit has been largely determined by the relict passage features of earthworm activity. Many of these have apparently been compacted and lost some of their continuous form, but persist in the curved, lunate shape of the cracks. There are also some fresh passage features and these contain mite faecal pellets.
Intrapedally, however, the aggregates are compact and massive, without any significant evidence of bioturbation (fig. 20). Porosity is c. 5% or less and voids tend to be small vughs and circular chambers.

![Figure 20](image1.png)  
**Figure 20.** Massive intrapedal structure from Sample 14. Matrix here is typical calcitic clay. Note also characteristic rounded soil fragment in lower right. PPL, width = 4.7 mm.

![Figure 21](image2.png)  
**Figure 21.** Same as left in XPL. Quartz silt of ultimately aeolian origin is also plainly visible here as bright specks throughout.

**Discussion.** The compaction of the sediment in this deposit suggests intentional tamping or ramming of the earth. It is evident that this is not a natural, ongoing process because although the majority of earthworm passage features have been squeezed and altered, some remain perfectly fresh, indicating that they were excavated after the rest of deposit had been compressed. It seems entirely likely that this may represent preparation for the construction of a building, the evidence of which comes from the intact floor deposits immediately above this layer.
Phase 4 (TH94-12A, -12B, and -11)

Figures 21, 22. The sequence of floors and floor deposits appear here as discrete laminae of varying thickness and color, visible at the top of Sample 12B and throughout Sample 12A.

The three samples taken from this phase constitute a complex sequence of prepared plaster floors and floor deposits. Rather than a complete microstratigraphic analysis, I will provide an initial description of the sequence and characterization of selected deposits within that sequence.

Beginning at the bottom, the lower half of sample 12B consists of massive, characteristically heterogeneous anthropogenic sediments. The upper contact of this unit is sharp and gives way to a looser, more chaotic combination of structures, including the open, bioturbated Microfabric 1 and local domains of decayed mud brick with intact pseudomorphs that present a general horizontal orientation. Within this, across the central portion of the sample, are stringers of dense, oriented plant matter, with concentrations of phosphate and herbivore coprolites indicative of stabling deposits (fig. 24) (Courty et al 1989: 114). This impression is confirmed by the presence of spherulites under cross-polarized light (fig. 25).
Spherulites are crystal aggregates composed of calcium carbonate that appear roughly circular under cross polarized light with a permanent cross extinction (fig. 23). They are formed in the stomachs of ruminants, especially sheep (though commonly in goats and cattle as well) and are generally thought to be the result of grazing on carbonaceous soils (Canti 1998, 1999). As such, spherulites are generally accepted as evidence of herbivore stabling, especially when they appear in abundance in conjunction with dense plant matter suggesting bedding or fodder.

Figure 23. A cluster of spherulites running diagonally from upper left to lower right. Individual spherulites are visible as small bright circles divided into four sections by their characteristic cross extinction. (This figure does not in fact come from any of the samples under discussion here, but because these spherulites are unusually large they allow for a more meaningful illustration). XPL, width of view = 2.35mm.

Figure 24. Stabling deposit from Sample 12B. Note dense concentration of horizontally oriented plant silica matter dominating the center of the image and herbivore coprolite in lower right (arrow). PPL, width of view = 4.7mm.

Figure 25. Same as left in XPL. The upper portion of deposit that appears darker here has particularly dense concentration of spherulites.

Above this open area of discontinuous stable deposits are several thin laminae (< 600 micron) of compact silty clay particularly rich in fine charcoal and horizontally oriented phytoliths, indicative of trampled floor horizons. Above these is a massive clay-rich plaster floor deposit, c. 2 mm thick. This floor, and those above it in sample 12A, has
developed a characteristic pattern of angular cracks, sometimes resulting in a discrete band of prismatic structure (figs. 26-29). On the upper surface of this plaster layer lie more trample horizons or floor deposits, similar in nature to those described above (fig. 26).

Sample 12A continues with a full sequence of alternating plaster floors, trample horizons, and stabling events. Figures 23 and 24 show some of the variability in floor composition, the difference here being one of clay content, and both also show the characteristic blocky structure. Figures 25 through 28 illustrate other laminae of plant matter, ash, and dung.

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Figure 26. Upper surface of plaster floor in Sample 12B. Overlying trample horizons are indicated by arrows. PPL, width of view = 4.7mm.

Figure 27. Same as left in XPL. Here the overlying floor deposits are clearer in the general horizontal orientation of round vesicles.

Figure 28. Plaster floor, Sample 12A. Note the well expressed perpendicular pattern of cracks. PPL, width of view = 4.7mm.

Figure 29. Clay-rich plaster floor from Sample 12A. PPL, width of view = 4.7mm.
Figure 30. Two laminae from sample 12A (arrows). The lower, thicker one is composed of plant matter and ash (calcite); the thinner, upper one contains phytoliths, spherulites and phosphate. PPL, width of view = 4.7mm.

Figure 31. Same as left in XPL.

Figure 32. Close-up of the thin, upper laminae in figs. 30-31, showing dense concentration of oriented phytoliths and characteristic yellow phosphate accumulation. PPL, width of view = 0.94mm.

Figure 33. Same as left in XPL. Bright spots within the dark band of the lamina are spherulites.

Sample 11 completes the sequence, though here the plaster floors are generally less well preserved than those lying below (fig. 34). The bottom half of the sample is composed largely of discontinuous fragments of plaster and partial floors and the intervening spongy sediment is richer in ash than in previous layers. Across the center of the slide a lies massive plaster floor, c. 4 mm thick. Smeared into the top of the plaster surface is a thick floor deposit, identical in composition and structure to the trample horizons described previously: massive silty clay, rich in both charcoal and plant silicates, with flowing, horizontal orientation (fig. 35).
In the material overlying this uppermost floor we see a return to the disaggregated, spongy structure dominated by soil fauna disturbance.

**Discussion.** This sequence of intact occupation surfaces provides the greatest potential for further study. The combination of finely plastered floors and intervening animal dung deposits seems rather incongruent and raises questions regarding local use of space. Were humans and livestock cohabiting or did structures undergo cycles of changing function? Furthermore, closer study of the floors may provide information regarding techniques of construction and building maintenance, and potentially the duration of occupation during this phase, while the stabling deposits could shed light on animal husbandry practices.
The uppermost samples in the sequence are both characterized again by complete faunal reorganization as in Microfabric 1, with the structure composed largely of faecal pellets and worm casts (fig. 37). The matrix here is more calcareous than anything below.
Conclusion

By way of summary, the sequence from Trench 43-61 appears to preserve at least two distinct phases of construction, occupation, and abandonment in the immediate vicinity. The first of these is represented by the intact mud brick at the base of the profile and the unconsolidated overburden of collapsed brick and building materials (Samples 23B-18). The second phase is initiated by the layer of cobbles and condensed sediment described in Samples 17-14, which apparently provided a hard-packed foundation for overlying structures. The occupation of these structures by both humans and livestock is attested by the package of plaster floors and stabling deposits (Samples 12B-11). These layers are in turn buried by further collapse and decay of the mud brick superstructure (Samples 10-9).

The ramifications of micromorphological analysis in this instance are several: in the first place the general trend of site formation and accumulation of anthropogenic sediments is illuminated, and we are able to validate and build on field observations of the stratified sequence. Furthermore, study of the occupation deposits preserved in Samples 12B, 12A, and 11 provides greater detail in describing the nature of built human environments at a major urban center in the EBA. In this case, the door is opened for a comprehensive analysis of the microstratigraphic sequence in order to address issues relating to domestic activity and the maintenance of interior spaces, human-animal relations, and changes in the use of space over time. Such a study would certainly benefit greatly from the integration of other data sources, including field observations of the sediments under excavation, finds analyses, and botanical reports.

Works cited