TP Area, midden sequence: A contribution to our understanding of open areas and formation processes at Çatalhöyük, using micromorphology and X-Ray fluorescence - Georgia Koromila, MSc Geoarchaeology, University of Reading.

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Introduction

In studying ecological and social practices, open areas and middens are important because they consist of deposits rich in cultural and bioarchaeological material and they represent particular types of meaningful deposition and space use (Martin and Russel 2000; Shillito above), and complement studies of the 'cleaner' surfaces and floors within and, presumably, on top of buildings.

What follows is a short presentation of the results of micromorphological and geochemical analyses conducted on two undisturbed sediment blocks from a sloping midden sequence in the TP Area, Unit (8932) (Figure 122) (Czerniak and Marciniak 2004), as part of an MSc Geoarchaeology Dissertation (2009-10). Chronologically, it is placed at the end of Late Neolithic / beginning of Early Chalcolithic.

The research questions addressed here can be summarized as follows:
What can we infer from the pre-depositional histories of the sediment components regarding past activities? What processes and/or practices are associated with the choice of both the materials and the place of discard? Was the deposition repetitive or discontinuous and in what time-scales? Was it disturbed, and how did this relate to living practices?

Figure 122. Çatalhöyük TP Area, Unit (8932), South profile.

Methods

Micromorphology was employed to identify microscopically the components comprising each specific layer and to infer their pre-depositional pathways, the character of their deposition and any post-depositional alterations, in order to reconstruct use of space and sedimentation processes.

The sediment blocks were oven dried at 40oC, then impregnated under vacuum and cut, ground and polished until thin sections 7x14cm were produced c. 30µm thick. These were studied using a Leica DMEP standard optical polarising microscope under x40, x100, and x400 magnifications, and described according to standardized atlases (Bullock et al. 1985; Courty et al. 1989; Stoops 2003).

X-Ray Fluorescence (XRF) was used to combine the microscopic observations for each layer with its geochemical composition, in order to assess the sensitivity of geochemistry and its potential in such sediments for activity-specific interpretations. The results were analysed using SPSS Statistics 17.0.

XRF was applied to sub-samples taken from the sediment blocks before impregnation and ground and pressed into powder pellets. These were analyzed using a Philips PW 1480 X-Ray fluorescence spectrometer, with a dual anode Sc/Mo 100kV 3kW X-Ray tube. The spectrometer is calibrated and the unknown samples were measured using Philips X40 analytical software.

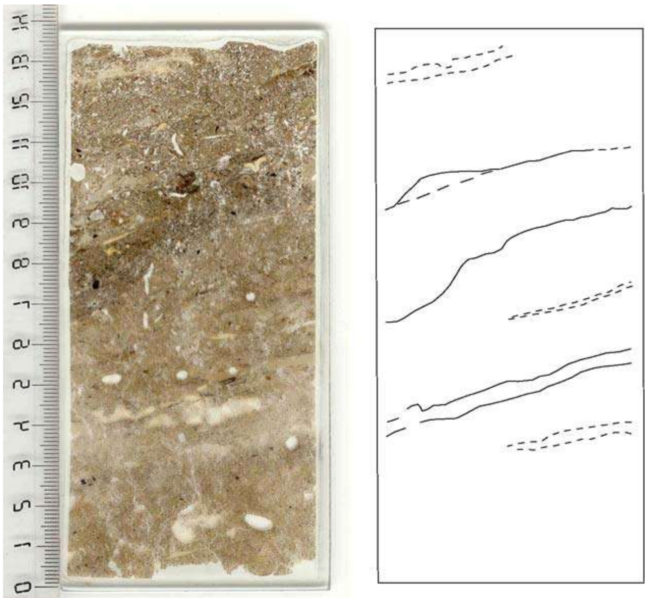

Figure 123. Thin section scan of sample C8 (upper part of the sequence) and drawing showing the designated microstratigraphic units

Results and interpretation

a. Micromorphology

The identified microstratigraphic units (Figures 123-124) were categorized into two broad types according to attributes, which present the highest degree of variation: unit thickness and related distribution, diversity, fragmentation, orientation and distribution of components.

In both types of units, the range of sedimentary and bio-archaeological material is very wide, including calcitic ashes, phytoliths, charred plant remains, decayed plant impressions, sediment aggregates, burnt and unburnt bone fragments, shell fragments, herbivore and omnivore dung, igneous and sedimentary rock fragments, single mineral grains.

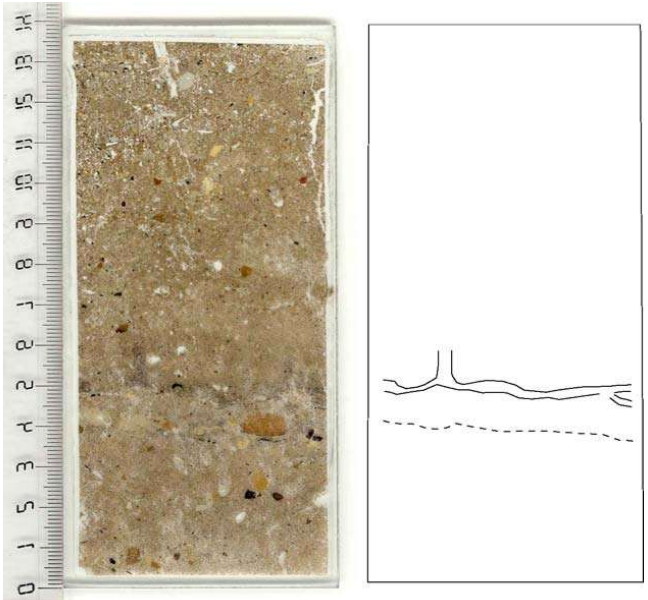

Figure 124. Thin section scan of sample C2 (lower part of the sequence) and drawing showing the designated microstratigraphic units

It is the configuration and the contextual relationships of these components that allow us to distinguish between unit types. The first group of deposits (Type A) (Figure 125) is characterized by a thickness range of c. 30 mm to over 85 mm, embedded related distributions, random or weak orientation, random distribution, and high diversity and mixing of components. In contrast, the second unit-group (Type B) (Figure 126) is comprised mostly of thin bands (c. 1-10 mm) with embedded to intergrain aggregate related distributions, moderate to strong orientation and clustered or in lines distribution of inclusions. This group are usually richer in organic than minerogenic material, and include specific classes e.g. large omnivore dung aggregates with bone fragments or clusters of phytolith and charred plant material.

[These differences are of major significance for understanding the pre-depositional, depositional and post-depositional agencies responsible for the formation of the sequence.

The inclusions in Type A units seem to have long and complex pre-depositional histories, as their high degree of fragmentation and roundness indicate extensive mechanical weathering. The diversity and mixing of burnt and unburnt material attest multiple primary sources. In the case of Type B units, heterogeneous, burnt and unburnt components, suggest multiple primary contexts, but here the components are not as thoroughly mixed, and are distributed in clusters and large aggregates within which the components maintain their original contextual associations. In sum, the evidence suggests that Type A units consist of material long exposed, mixed and reworked before its final deposition, having lost its original associations, while in Type B units inclusions were not as extensively and long exposed as to completely disaggregate.

Turning to the stage of deposition, evidence is not very clear. Type A units are unlikely to represent single depositional events; within these thick, uniform, unsorted and unoriented assemblages there are some instances of almost horizontally laid material, e.g. omnivore dung bands or long articulated phytoliths, which seem to have been deposited on an active surface. Some of these have been separately described as distinct sub-units and classified as Type B, but, regardless, it is important that they represent discontinuous breaks in these undifferentiated units, where they definitely define surfaces, thus suggesting that Type A deposits are most likely the result of a gradual and continuous accumulation process in an open area, perhaps encapsulating a multitude of singular events that have been masked by post-depositional mixing. Type B units, by contrast, with intergrain aggregate, less compacted, related distributions, and strong orientation and clustering of components, represent more distinct episodes of deposition, preserved during the accumulation of the sequence.

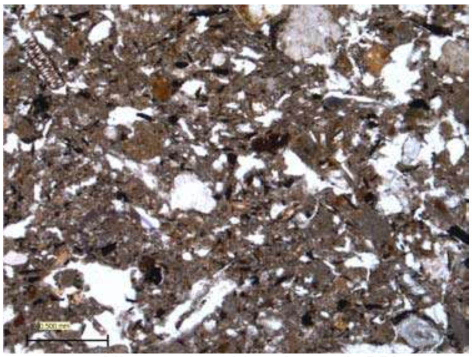

Figure 125. Microstratigraphic unit type A, PPL, bar=500 µm. Mixed ashy matrix with randomly oriented inclusions, among which charred plant remains, rock fragments, bone (bottom left), a reed phytolith (top left)

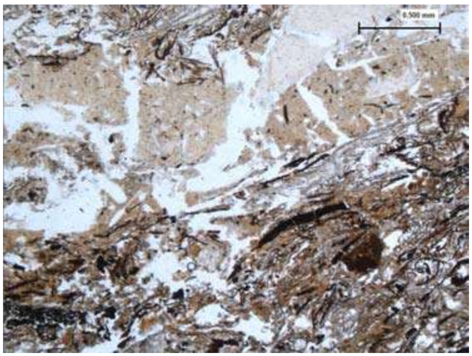

Figure 126. Microstratigraphic unit type B, PPL, bar=500 µm. Concentrated phytoliths and charred plant remains in parallel orientation, along with a large omnivore dung aggregate (upper half).

Throughout the sequence there are traces of alteration after deposition, including bioturbation and gypsum crystallization, particularly in voids. Apart from these processes, some disturbance may be attributed to mechanical reworking, perhaps due to surface trampling of sediments, especially for type A deposits, as this is in accordance with the homogenous distribution of material and the uneven degrees of compaction, although trampling features are not thus far well understood (Matthews 2010: 102; Matthews et al. 1997: 291). Post-depositional disturbances are detectable but less abundant in the, perhaps quickly covered, Type B units, where non random patterns of distribution and orientation are retained.

Based on this understanding of formation processes it is possible to comment on activities and use of space. The accumulated material in the sediments under study relates to activities that took place elsewhere. Calcitic ashes with charred flecks and phytoliths, but no identifiable dung derived calcareous spherulites (Canti 1997; 1999) attest burning activities with plant derived fuel, from various wood and grass types. Faecal material identified in some units indicates the presence of herbivore species, and omnivore species whose diet included bone. The rock fragments present represent allochthonous material, brought to the site, intentionally or not, by procurement activities reaching beyond the alluvial plain. Some of the sediment aggregates could be derived from constructional materials. Finally, discard itself should be perceived as a continuous succession of dumping events of diverse material. This together, with possible indications of trampling suggest a picture of an active open space frequented by humans and/or animals.

b. Elemental analysis

The XRF results exhibit correlations that reveal which groups of elements are co-dependent, and likely to have the same source(s) of input. Out of the three groups identified, two comprise elements considered to be strong anthropogenic indicators (Oonk et al. 2009: 38), namely P, Si, Cu, Zn and Na forming one group and Ca, Sr and V another. Interestingly, these elemental groups are negatively correlated with each other, as markedly expressed in the concentrations of Ca and P (Figure 127).

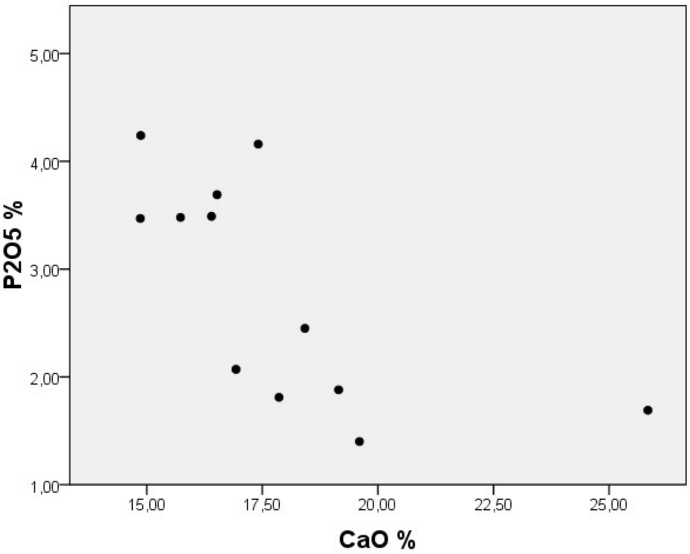

Figure 127. Scatter diagram showing strong negative correlation between % of P2O5 and CaO.

This negative correlation is puzzling because in most studies high levels of Ca and P are recorded together (Middleton et al. 2005), while in this case when P increases Ca decreases and vice versa. If we attempt to attribute the anthropogenic enrichment of elements to specific residue components identified in the sediments through micromorphology, we can relate Ca to ash and calcareous sediment input, P to the various components of organic origin, and Si to the phytolith material, thus, the pattern corresponds to ash and sediment related elements increasing when organic/plant related elements decrease and vice versa. To explain this, taphonomic factors should be taken into consideration because, unlike most multi-element studies, here the samples originate from mixed and redeposited material, and therefore they do not bear a clear geochemical signature corresponding to a specific activity context. Indeed, in Type B units there seems to be more plant material likely to have partly decayed in situ, while in Type A units, the more mixed ashy groundmass is likely to originate from a number of different contexts and contains less organic material which perhaps had partly decayed elsewhere. The fluctuation of elemental concentrations, however, does not completely correspond to unit types (Figure 128). Moreover, given that some Type B units are not included in this analysis, as they were not recognized macroscopically during sub-sampling, it is essential that more samples are analyzed before any conclusions are drawn on whether or not geochemistry here is mainly affected by taphonomy.

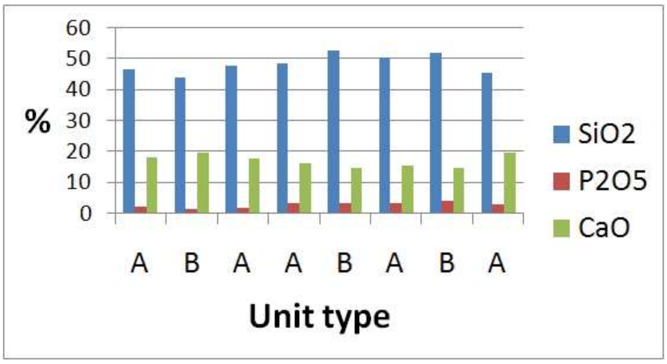

Figure 128. Concentrations % of CaO, P2O5, and SiO2 according to unit type.

Summary and future directions

Micromorphological analysis of a midden sequence from Late Neolithic levels at TP Area indicates continuous use of space in an open area, comprising mainly disposal of mixed and diverse material resulting in accretion of sediments, sometimes with discernible surfaces and more frequently thoroughly reworked due to disturbances like redeposition and possibly surface trampling. The geochemistry of these sediments does not reveal any clear associations with specific activities, as any particular signatures are masked by mixing and relocation, but it does appear to be sensitive to taphonomical differences.

Some issues remain unclear, however, and demand further investigation. To fully understand formation processes one needs to consider the time factor. Besides dating which would be extremely useful in defining rates of deposition, identification of seasonal cycles is another aspect related to the question of time. Phytolith analysis could be applied in that direction, as the phytolith types of flowering plant parts are seasonally specific (Rosen 2005: 207) and their quantification could show patterns of seasonal variation. Also, XRF analysis of additional samples from the sequence should be able to clarify the relationship between taphonomy and geochemistry.

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Modelling Chronology - Alex Bayliss (English Heritage) & Shahina Farid (Çatalhöyük Research Project)

Due to an administrative error the section on scientific dating was omitted from the 2009 Annual Report. We therefore outline here progress on the dating programme during 2009 and 2010.

At the start of 2009, on the basis of %N values on whole bone, we estimated that 134 of the 207 bone samples exported in 2008 (63%) would probably be sufficiently well-preserved for successful radiocarbon dating. Preservation is better lower down in the mound and significantly worse (with less than 20% of samples probably datable) in the deposits closer to the surface. In May 2009, 43 samples of articulated or articulating bone were submitted for dating to the Oxford Radiocarbon Accelerator Unit in order to provide a skeleton chronology for the upper part of the South Area.


Figure 129. Lisa Yeomans drilling an animal bone sample from the South Area

Meanwhile work continued apace on assessing the stratigraphic sequences and identifying units for faunal scanning in the TP and South Areas. By the end of May Alex & Shahina had completed this task for the South Area, and in June Alex went to Gdansk to complete a similar task on the finalised TP matrix with Arek Marciniak & Marek Barański. On site more than 450 units were scanned for faunal articulations by Lisa Yeomans and Marta Bartkowiak (ably assisted by Agata Czeszewska and Patrycja Filipowicz).

At the end of the 2009 excavation season Alex went to site to take samples, not only from those articulations identified from previous seasons of excavation but also from units excavated in 2009 (Figure 129). This strategy aims to minimise the stratigraphic gap between