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TOPSOIL FORMATION PROCESSES AS INDICATED FROM GEOARCHAEOLOGICAL INVESTIGATIONS AT TEL ʻETON, ISRAEL, AND ITS ENVIRONMENT

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ABSTRACT

The first encounter between archaeologists and the sites or areas of their study is the topsoil. Still, very little attention is paid to the processes that create the matrix of the topsoil and the archaeological assemblage contained within it, and hence to what data can be obtained from it. This paper, which is part of a larger study on the formation of the archaeological record at Tel ʻEton, aims to reconstruct the way the topsoil was formed. For this purpose, we studied not only the mound's topsoil and archaeological layers below it, but also the site's environment, in terms of texture (sedimentation/decantation method), color (Munsell charts), phosphate concentration (Olsen method) and vegetation (aboveground plant biomass). Results showed differentiation between the sampling groups and geographical settings in all the measured parameters – in both values and variance.

The data imply that the mound's topsoil was created by an upward movement of materials and their homogenization in the topsoil. Our results strongly suggest that these processes are likely to be more frequent on mounds, compared to their uninhabited environment. Beyond new insights on the processes of archaeological soil formation, this study has implications for both chemical and archaeological phenomena, such as the presence of artifacts on the surface, the color of archaeological soils, the widespread use of archaeological sites for agriculture (from antiquity to the 20th century), and the provenance of mud-brick material.

KEYWORDS: Site Formation Processes, Archaeological Record, Matrix Composition; Anthropogenic soil, Topsoil, Environment, faunalturbation, Plant-Soil Feedback.

1. INTRODUCTION

Archaeological mounds (tells) are formed as a result of long-term processes, mainly these involving human activities such as construction, destruction and even routine daily life. During construction phases, various materials are brought to the mound and are used for the construction of structures. These structures subsequently collapse and deteriorate, either rapidly during destruction, or slowly during their usage or following abandonment (Davidson, 1973; Rosen, 1986: chap. 2; Gifford et al., 1989). Those materials, along with others that arrive at the mound, either through human activities (e.g., pottery and other artifacts; Butzer, 1982; Rosen, 1986: chap. 2; Schiffer, 1987) or through natural processes (e.g., dust accumulation; Dan et al., 1972; Yaalon and Ganor, 1973; Yaalon, 1997; Crouvi 2017; Itkin et al., 2018), eventually form the groundmass of the tell. However, despite the growing scholarly attention to the archaeological soils and sediments (e.g., Davidson, 1973; Butzer, 1982; Rosen, 1986; Holliday, 2004; Goldberg and Macphail, 2006; Davidson et al., 2010; Walkington, 2010; Aleksandrovskii et al., 2015; Sedov et al., 2017; Itkin et al., 2018; Luria et al., 2020), the source and actual composition of the topsoil are not clearly understood. It is not clear, for example, (i) why the soils of mounds are distinguished from that of the surrounding areas, as many field archaeologists know first-hand, (ii) how the assemblage of surface artifacts is formed, and (iii) what are the processes through which artifacts from strata that are buried deep below the current surface of archaeological sites end up on the surface. Since there is apparently a clear relation between the topsoil and the archaeological remains, a better understanding of the formation of the topsoil – which is where archaeologists first engage any study area – is therefore important for both excavations and surveys (in this paper the term ‘topsoil’ is regarded as the approximately upper 10 to 40 cm of the soil).

The present paper, which is part of a larger study of the formation of the archaeological record at Tel ‘Eton, aims to analyze the current matrix of the mound's archaeological layers and topsoil, and to reconstruct the way the latter was formed. For this purpose, we studied not only the mound's topsoil, but also the archaeological layers below it and the surrounding environment. We believe that the analyses and discussion below will help to understand how soils and artifacts move, both vertically and horizontally, and how the topsoil of archaeological mounds receives its current, ‘mixed’ form. This has important implications, well-beyond understanding formation processes. It enables a new assessment of the finds unearthed in the topsoil, and subsequently also the reliability of surveys; it provides initial tools for identifying periods of abandonment in earlier layers; it opens a window for understanding the relations between the matrix of the mound and its surroundings, explaining why material was taken from the mound to the fields around it, further complicating the distribution of artifacts, and even for understanding the location from which material for mud-bricks was procured.

1.1. *Tel ‘Eton: Geographical and Archaeological Background*

Tel ‘Eton (heretofore "the site" or "the mound") is a large mound (ca. 6.6 ha), located in the southeastern Shephelah (Judean lowland), Israel, about 11 km southeast of Tel Lachish (Fig. 1). The bedrock is Maresha formation from the Middle Eocene, which is mostly composed of carbonate rocks (mainly chalk and calcrete, locally known as ‘nari’; Hirsch 1983; Sneh and Avni, 2008; Itkin et al., 2012).

The soils around Tel 'Eton are mostly Anthropic Calcic Haploxerepts (Inceptisols Order) and Chromic Calcixererts (Vertisols Order), while the soil of the mound itself had been defined to be Archaeological Calcareous Anthraltic Xerorthents. Desert loess is a major constituent of the Luvisols (Alfisols) and Vertisols, which are located mainly in the valleys and truncated hill tops (Itkin et al., 2018). The area climate is at the borderline between the Arid and the Mediterranean, with mean annual precipitation of ~350 mm/year (according to Israel Meteorological Service data, 2020; Sapir, 2016). The climatic conditions, despite some fluctuations, did not change drastically during the last 4000 yrs. (Bar-Matthews et al., 1998; Issar, 1998; Bar-Matthews and Ayalon, 2004).

The vegetation comprises mainly of dwarf shrubs and herbaceous annuals. Trees or shrubs, outside cultivated plots, are relatively rare and mostly grow in crevices of large rock outcrops or in relatively humid places such as shallow caves (see also Sapir et al., 2019).

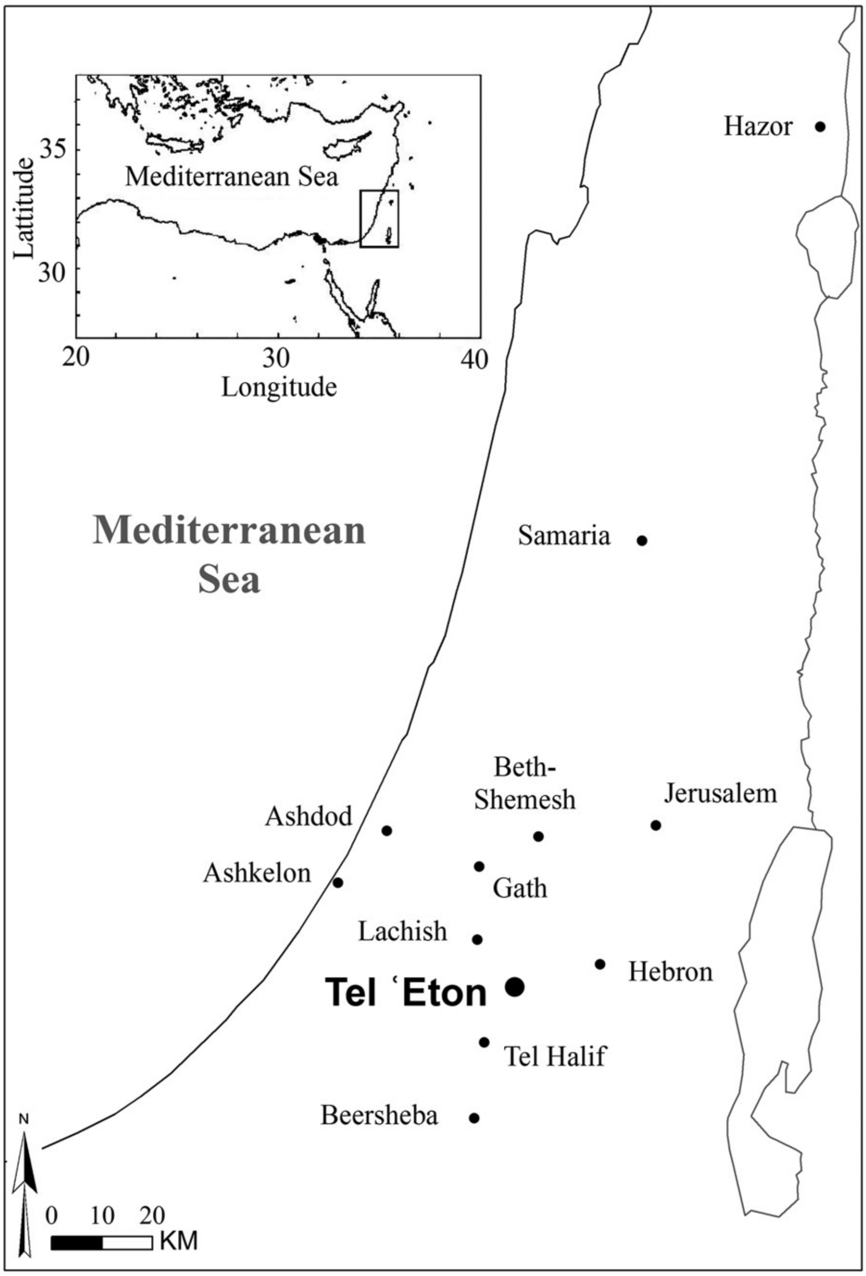

Figure 1. Location map for Tel ‘Eton with some important Iron Age sites. Inset shows regional map.

The site was first excavated in salvage excavations in 1976 by the Tel Lachish expedition (Ayalon, 1985; Zimhoni, 1985), and was surveyed as part of the Shephelah regional survey (Dagan, 2006; 2014). The site has been extensively surveyed and excavated by an expedition from Bar-Ilan University since 2006 (Faust, 2009; 2011; 2014; 2016; Faust and Katz, 2015; Faust et al., 2017). So far, six excavation areas were opened, and the earliest remains that were uncovered are dated to the Early Bronze Age (fourth millennium B.C.E.). This was followed by a gap in occupation during the Intermediate Bronze Age, and perhaps also during the Middle Bronze Age (a few sherds were found in the survey, but no remains were unearthed in the excavations so far). Settlement resumed in the Late Bronze Age (second half of the second millennium B.C.E.), and evidence for occupation down the slopes was found, indicating that the settlement was significantly large during this period. Unlike many other settlements in the Shephelah region, Tel ‘Eton continued to be settled during the Iron Age I (late second millennium B.C.E.) but became smaller in size. Settlement expanded during the Iron Age IIA and continued to flourish until it was destroyed in late eighth century B.C.E. (Iron Age IIB), probably during one of the Assyrian campaigns. Due to the extensiveness of the destruction, and the proximity of the remains to the topsoil, this is the best-known period in the history of Tel ʻEton and many of the archaeological layers that will be discussed hereinafter originate from this phase. The mound was then deserted for about 350 years, until a fortified structure and a village-like settlement were erected in the fourth century B.C.E. (Faust et al., 2015; Faust, 2018). After its abandonment in the fourth-third centuries B.C.E., the site was never resettled. However, it was cultivated during its era of abandonment, as agricultural terraces were constructed on it, probably during the Byzantine period (Faust, 2011; Faust and Katz, 2012; 2015).

2. METHODS AND RESULTS

A note on terminology: The terms soil and sediments are used differently by diverse scholars and in various disciplines. Itkin et al. (2018) made a strong case for the use of the term soil for the material in archaeological mounds (cf. Goldberg and Macphail, 2006), but we do not wish to go into the terminological debate. In this article we will use the term soil to name the matrix of the mound and its surrounding hills and sediment to describe the matrix of the wadi.

We should note that neither the alluvial/colluvial sediments nor the current topsoil of the surrounding slopes are necessarily contemporaneous with any specific archaeological layer. However, the climatic conditions, despite some fluctuations, did not change drastically during the last 4000 years (Bar-Matthews et al., 1998; Issar, 1998; Bar-Matthews and Ayalon, 2004). Moreover, the dust accumulation, which is a major component in the soils of the surrounding hills, began much earlier than any local pedogenesis (Yaalon, 1997; Crouvi et al., 2017). We suggest, therefore, that the soils and sediments do represent those from the historic periods. The study used both relatively stable soil properties (soil texture and color) and relatively dynamic parameters (available phosphate concentration and vegetation biomass).

The texture of the soils and sediments of Tel 'Eton and its environment was examined extensively, in order to identify processes affecting topsoil formation. This was followed by an examination of additional characteristics, including color, phosphates, and biomass. Below (cl. 2.1-2.2) we will separately present the methods and results of each analysis, and afterwards (cl. 3) discuss together the implications of all the discrete types of analysis for the understanding of the formation of the topsoil at Tel ʻEton. We found this unconventional structure to be more reasonable for the purposes of this paper and for making our point.

2.1. *The Texture of Sediments and Soils on the Mound and Its Environment*

Granulometry measures the size distribution in a collection of soil grains and characterizes soil texture quantitatively.

2.1.1. Sampling Design and Method

Our main aim was to study the matrix and the topsoil of the mound in order to understand the way they were formed. In addition, we wanted to put them in context by comparing them to those of the soil from the hills in the surroundings of the mound (plateaus, slopes and valleys facing the site). Since the common assumption is that mud-brick material, taken from alluvium of nearby stream channels, comprises (through deterioration) a significant percentage of the mound's matrix (e.g., Davidson, 1973; Goldberg, 1979; Rosen, 1986; Emery, 2011; Homsher, 2012: 368), we also sampled the sediments in the section of the nearby wadi, Nahal Adoraim (brook of Adoraim).

Twenty-four topsoil samples (0-5 cm depth, 20 x 20 cm in area) were taken during May 2012 from the mound and its surroundings (annotated by prefix TEFL in Fig. 2). The locations from which the samples were taken, were selected to represent the mound's topsoil as well as the adjacent environment (including plateaus, valleys and slopes facing the mound). During July 2014, we collected six additional samples from two locations in the nearby wadi. In each location, samples were taken from the top, the middle, and the bottom of the wadi sections (annotated by prefix WS in Fig. 2; both sections are about 1.3-1.5 m depth). Out of the total 30 samples collected, we selected 16 representative samples for the time-consuming texture analysis: five from the mound's topsoil, five from the topsoil of the surrounding hills, and six from the wadi (see soil texture samples in Fig. 2). The rest of the samples were used for other analyses (see below).

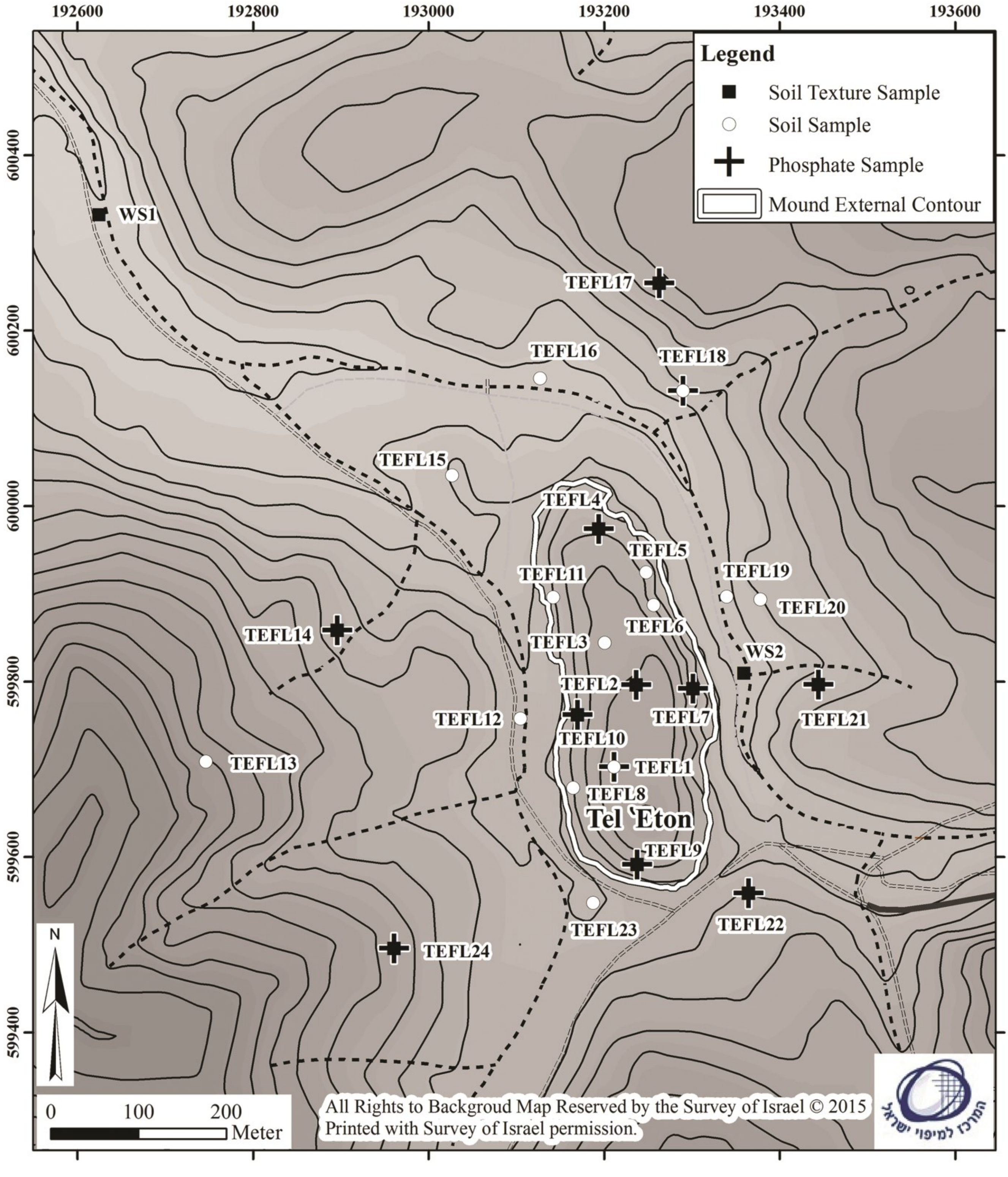

Figure 2. Sampling points on the tell and its environment (courtesy of the Tel 'Eton Archaeological Expedition). Soil Texture Sample (black squares): loci where granulometry was performed; Soil Sample (light-grey circles): color determination only (all the samples were analyzed for their color); Phosphate Sample (cross): loci where phosphate analysis was performed. Mound External Contour is the line of the city wall (partially estimated). For biomass samples see Fig. 9. All rights to the background map reserved by the Survey of Israel © 2015. Printed with the Survey of Israel permission.

In order to study the deeper matrix of the mound, additional samples were taken from the archaeological layers in the eastern balk section of Square N23 in Area A. This section cuts through the courtyard of an Iron Age building (Building 101) that was destroyed in the late eighth century B.C.E. (see Faust et al., 2017; Faust and Katz 2017). It includes the topsoil and 1.5 m accumulation of debris and rubble from a number of levels down to the floor of the building and was excavated as Locus L1307 (Figs. 3, 4). The layers in the balk were determined by archaeological and morphological features, stoniness (according to Museum of London Archaeology Service, 1994: Fig. 11), roots (percentage and width), color (descriptive at this stage), and compaction of the matrix (Table 1). We defined five grades of compaction: Hard (breakable only with sharp pick blow); Stiff (cannot be molded with fingers); Firm (molded only by strong finger pressure); Soft (easily molded with fingers); and Friable (crumbles in fingers). Thirty-four samples were taken in July 2012 from the 15 different layers that were identified in the balk, of which 20 were analyzed for their texture, at least one sample from each defined layer (with the exception of layer 10 which was too thin to be sampled properly). The other samples were used for color determination only (see below). Two of the samples from L1307 seemed to be mud installations according to their reddish color, the lack of stone inclusions in their bulk and their proximity to the floor. Three additional samples were taken from mud-bricks that could be identified in the section: two from the rubble and one from wall F1041.

Table 1. Description of the layers in balk section L1307. Colors notions are descriptive. Compaction grades: 1= Hard (breakable only with sharp pick blow); 2= Stiff (cannot be moulded with fingers); 3= Firm (moulded only by strong finger pressure); 4= Soft (easily moulded with fingers); 5= Friable (crumbles in fingers).

Layer	Color description	Compaction	Stoniness	Plant roots	Notes
1	Brown-grey	4	0-1%	<2 mm	Topsoil, includes krotovina
2	Brown	3	0%	None	Mud-feature
3	White/Brown	3-4	70%	Very few	Chopped chalk/Nari with brown sediment
4	Grey-brown	5	35%	Very few	Few mud-brick fragments
5	Reddish-white	5	40%	Few, <1 mm	Few mud-brick fragments
6	Grey	4	40%	Few, < 1mm	
7	Dark grey	3-5	2-20%	Tiny	Large mud-brick fragments, small cavities
8	Dark brown/ yellow/black	4	0%	None	Mud-feature/floor
9	Light grey	3-5	50-70%	Tiny	Lots of large sherds (~10 cm), small mud-brick fragments
10	Dark brown/black	5	5%	Tiny	
11	Light red	5	10%	<1 mm	Large stones, sherds & mud-brick fragments
12	Grey-pink	5	25%	None	Large sherds (~10 cm)
13	Light grey	5	15%	None	Small sherds and mud-brick fragments
14	Dark grey	4	25%	None	Few small mud-brick fragments
15	White/brown	3-4	70%	None	Crushed chalk/Nari with sediment

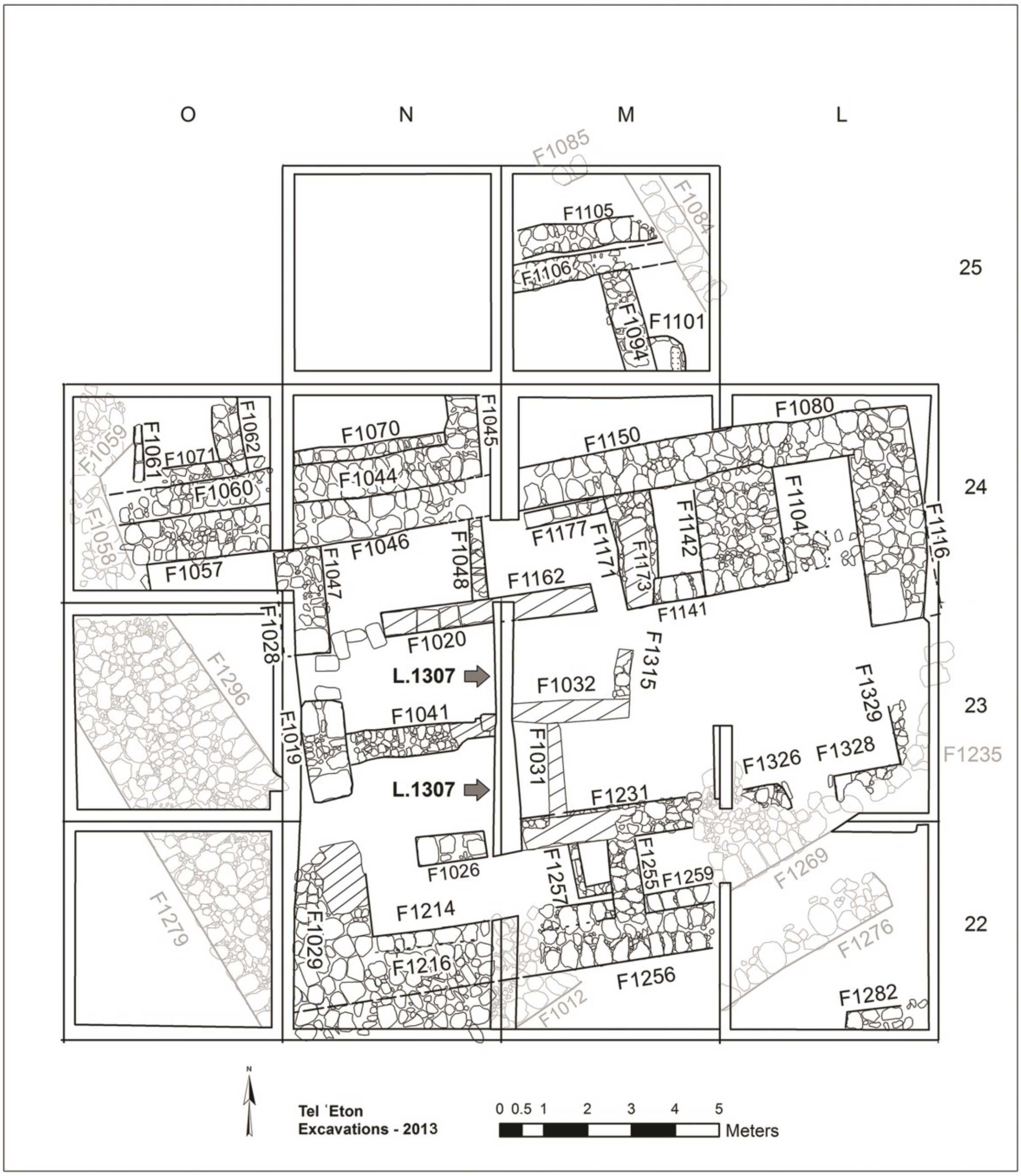

Figure 3. Plan of area A at Tel ʻEton, showing the walls of Building 101 and L1307 balk (between squares M23-N23). The yet un-removed walls of the Persian/Hellenistic fortified structure above the building are drawn in grey. Note that the plan is from 2013, when L1307 was sampled (courtesy of the Tel ʻEton Archaeological Expedition).

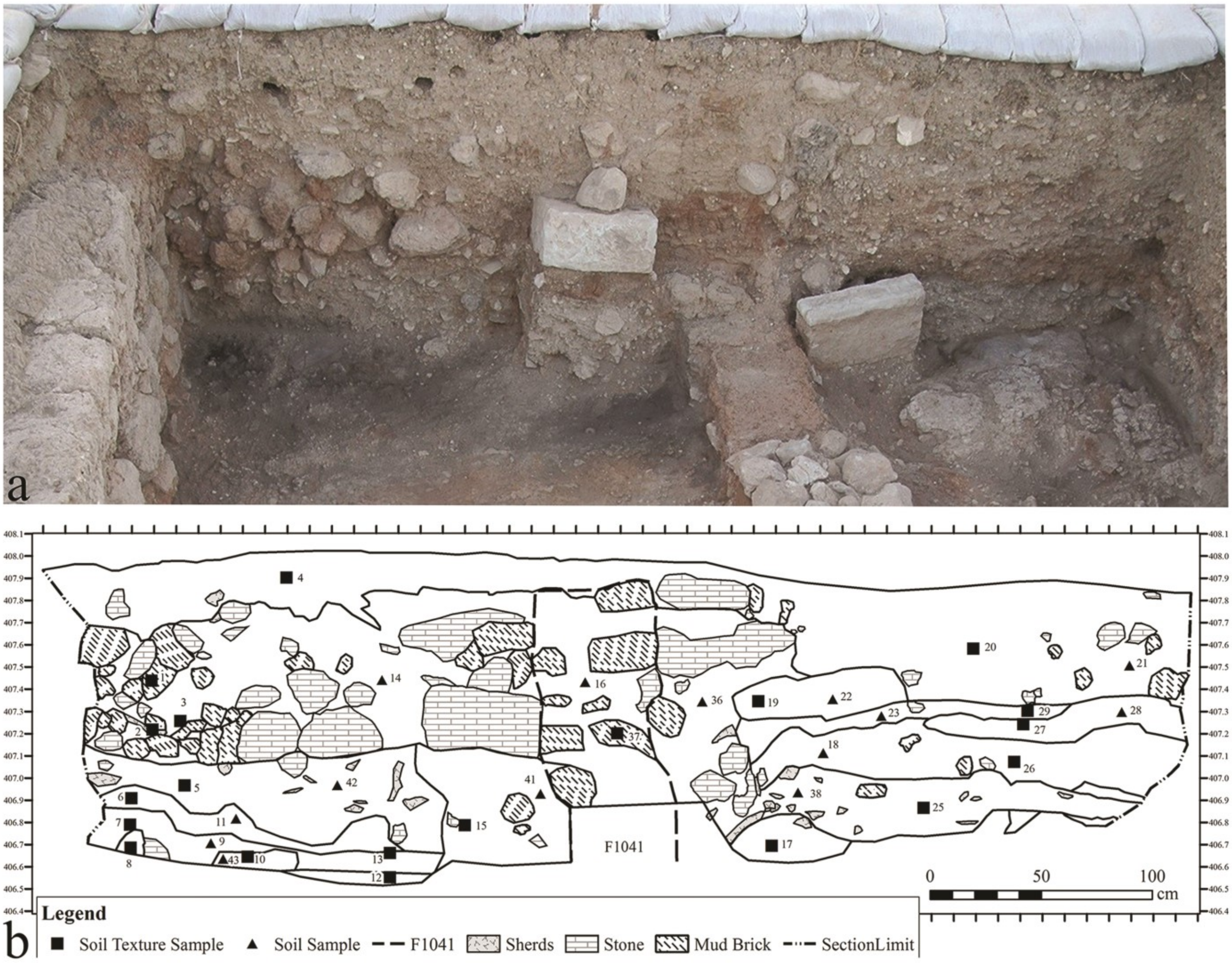

Figure 4. Photograph (a) and drawing (b) of Locus L1307 (square N23 eastern balk, looking east), and the samples taken from it (courtesy of the Tel 'Eton Archaeological Expedition). Soil Texture Sample (black squares): loci where granulometry was performed; Soil Sample (black triangles): color determination only (all the samples were analysed for their color). Note wall F1041 in the centre of balk (dashed line around sample 16). Photograph taken in 2007.

Out of a total of 64 samples collected in this study, 36 were taken for texture analysis, representing the topsoil of the mound and its surrounding plateaus, slopes and valleys, as well as the wadi sections and the archaeological section at the top of the mound (L1307).

All the samples were air-dried and sifted through 2 mm mesh (after minimal grinding). Organic matter was removed manually, using forceps. Soil texture was determined by the sedimentation/decantation method (Wright, 1939; Baver, 1956: 59), which is a well-established method in geology and pedology.[1] From each sample, sub-sample of 5-6 g of the sieved material was randomly taken and dispersed with 0.5% Na2CO3 solution. This solution was used because the soils in the study's region are calcareous, and we wanted to analyze the entire composition; thus, we did not dissolve the carbonates before the analysis. The soil fractions were than separated by multi-decantation using a 0.05% Na2CO3 solution into three grain size fractions: clay (<2 μm), silt (2-50 μm) and sand (50-2000 μm).

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[1] There are other methods which are commonly used (e.g., pipette method and hydrometer method), which are much faster than the decantation method. However, the advantage of the latter is its accuracy, since it directly measures the various fractions. For a detailed and systematic study that compares these three methods see Tennessee Valley Authority, Corps of Engineer, Department of Agriculture, Geological Survey, Bureau of Reclamation, Indian Service, and Iowa Institute of Hydraulic Research, 1941; Note the conclusions in p. 130 and table 4).

2.1.2. Soil Texture Results

The texture (Tables 2, 3, Figs. 5, 6) of the samples from the mound's topsoil was similar among samples, with a range of 20.9-26.7% for the clay, 49.2-54.9% for the silt and 20.1-29.0% for the sand. The soil of the surrounding hills (plateaus, slopes and valleys) differs from that of the mound’s topsoil and presents more heterogeneous texture. The range of the surrounding topsoil is 30.0-48.9% for the clay, 40.8-49.7% for the silt and 10.3-20.3% for the sand. The samples from the wadi sections have a wide range which forms a separate group with 19.7-34.7% clay, 24.5-40.2% silt and 26.1-47.3% sand. These results indicate that the surrounding’s topsoil and the wadi sediments are well differentiated from each other and from the mound’s topsoil. They also differ from the archaeological layers of balk L1307 that show the widest range of texture (Table 2). Strangely enough, despite the wide range of the latter, the samples do not fall within the mounds' topsoil range, except for sample 4 (B11094) that was taken from the balk's topsoil (Fig. 6). Thus, based on soil characteristics, the archaeological layers compose a distinct group. Moreover, the average of this group[2] (19.9% clay, 51.6% silt and 28.4% sand; Fig. 5) is not significantly different from the mound’s topsoil (Table 2).

Table 2. Soil and sediments average texture (±Standard error) on the mound, on its surrounding, in the wadi (Nahal Adorayim) section and in excavation balk section L1307. For each fraction (clay/silt/sand), groups with the same letter are not significantly different (GLM with ArcSin transformation; Contrast analysis: P>0.05). The MWD (Mean weight grain size diameter) is the sum of the fractions multiplied by the average diameter of each fraction (±Standard deviation). The COV (Coefficient of variation) is the ratio between the Standard deviation of the MWD and its average. The statistical analysis was executed by R software. While it is clear that the various layers have different proportions of grain size fractions and thus their averaging is not acceptable mathematically, the sample size is large enough to make it representative statistically.

	%Clay	%Silt	%Sand	MWD	COV
L1307	19.9±2.30^{a}	51.6±2.11^{a}	28.4±4.47^{a,b}	305±158.6	52.0
Mound	22.7±1.04^{a}	51.5±1.11^{a}	25.8±2.24^{a,b}	279±37.2	13.4
Surrounding	39.1±3.16^{b}	45.5±1.73^{b}	15.4±2.24^{a}	171±37.1	21.8
Wadi	27.3±2.06^{c}	33.3±2.67^{c}	39.4±2.45^{b}	413±88.8	21.5

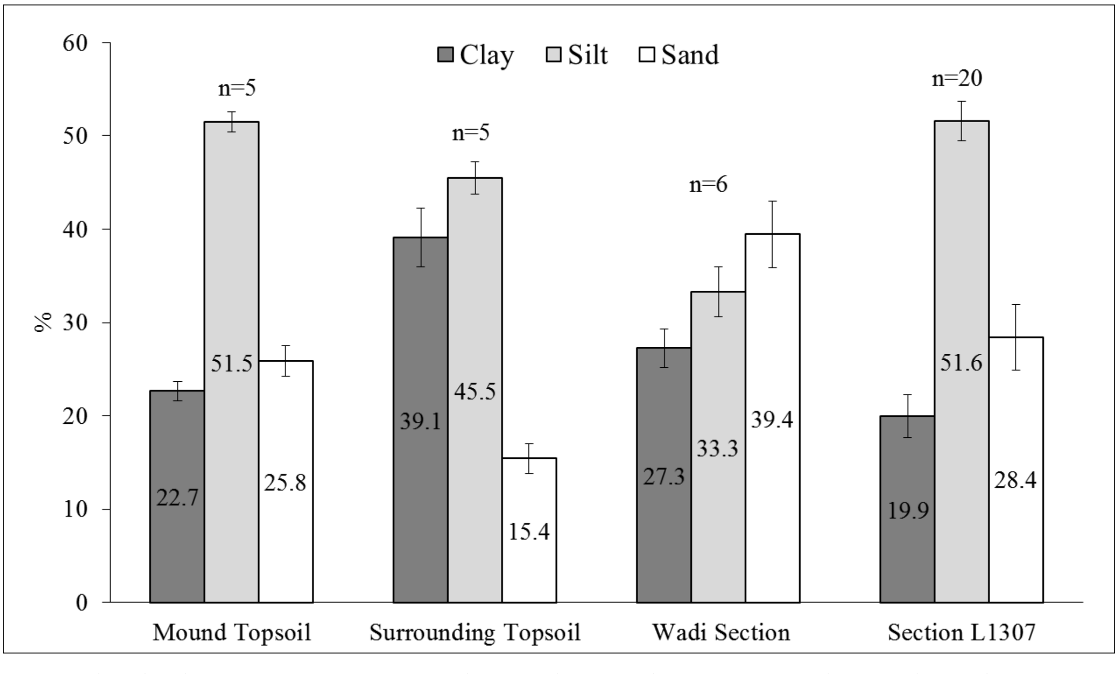

Figure 5. Soil and sediments texture average values on the mound, on its surrounding, in the wadi section (Nahal Adorayim) and in balk section L1307 (courtesy of the Tel ‘Eton Archaeological Expedition). Error bars represent ±1 standard error of each fraction. Note the similarity between the average of the mound’s topsoil and L1307, and the difference between these groups to the groups of the surrounding topsoil and the wadi. Also note the small error range of the mound’s topsoil compared to the other groups.

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[2] While it is clear that the various archaeological layers vary greatly in volume and therefore such averaging is not acceptable mathematically, the sample size is large enough to make it statistically representative for the archaeological layers of the mound and hence making this average meaningful.

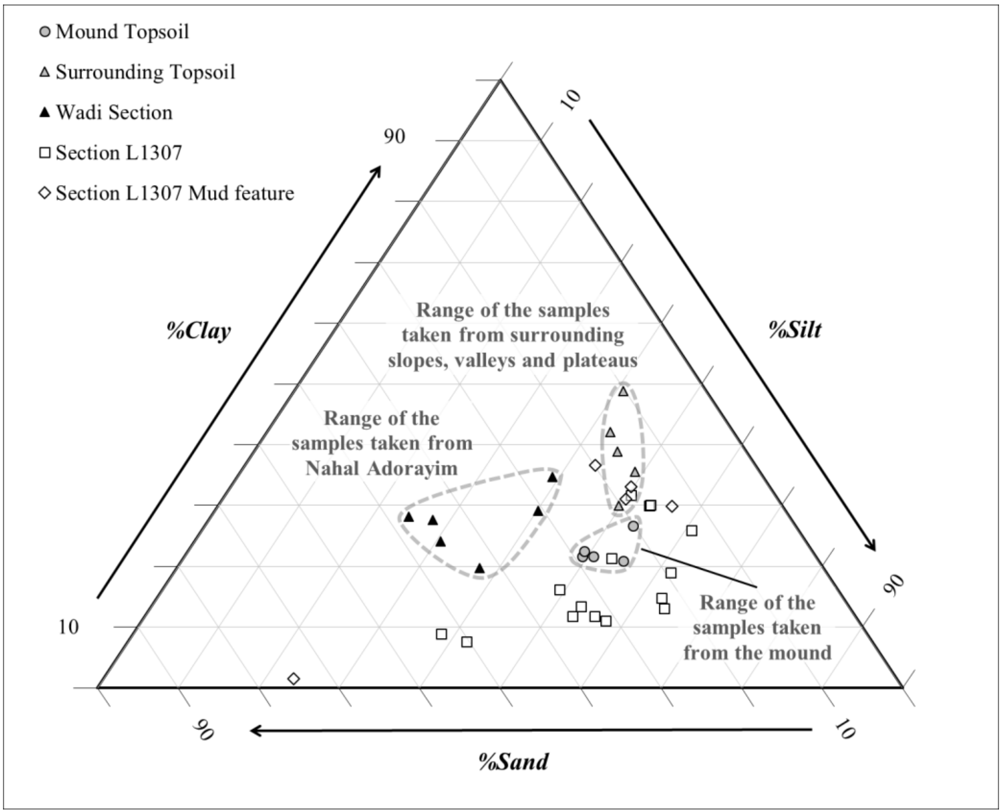

Figure 6. Soil texture triangle diagram for the samples collected on the mound and its environment (courtesy of the Tel 'Eton Archaeological Expedition). Note that there is no overlap between the mound's topsoil and the other groups, except the sample from the topsoil of section L1307 (4/B11094). Also note that all the mud-bricks/mud-installations from L1307 are with relatively high clay fractions except one sample (1/B11091) that came from fired mud-brick ex situ (rubble). Plotting was done using Graham and Midgley (2000) software.

Interestingly, none of the results of the mud features (bricks or installations) identified within section L1307 is similar to the results of the sediments that were analyzed from the wadi. Four out of five of these mud features were very close to the surrounding's topsoil texture (Fig. 6). The outlier sample [1 (B11091)] is a mud-brick from the rubble, of which the texture is very sandy. This specific brick was exposed to fire (FTIR analysis, following the procedure of Berna et al., 2007), and hence may have undergone change in the texture of its sediments (Ulery and Graham, 1993; Ketterings and Bigham, 2000; Terefe et al., 2008), in contrast to the other bricks or installations that were analyzed. The unfired mud features, at least, are therefore more likely to be sourced from the surrounding hills (plateaus, hills and valleys), rather than the wadi (See also Sapir et al., 2018).

2.2. *Differences between the Mound and Its Environment: Color, Phosphate Content and Vegetation Biomass*

Following the results that clearly differentiated the mound and its environment (both the surrounding hills and the wadi) in texture, we further explored whether other parameters would show such a distinction between the various settings.

2.2.1. Color determination method

The color of sediments may be affected by various parameters, such as organic matter, carbonate content, mineralogy and transformation of the solid matrix (Ulery and Graham, 1993; Pomies et al., 1998; Ketterings and Bigham, 2000; Sánchez-Marañón et al., 2004; Itkin et al., 2018). For example, the Hue[3] of sediments becomes redder following heating to high temperatures, while organic matter darkens it. All the 64 samples detailed above were examined for color determination. Color was determined for the dried fine earth (i.e., the sieved material) using standard

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[3] The color notations in Munsell system is composed of Hue (color, such as red or yellow), Value (lightness/darkness), and Chroma (saturation/brilliance).

Munsell color charts. In order to minimize subjectivity (Bratitsi et al., 2019), all color determinations were done by a single person and at the same light conditions.

2.2.2. Color results

The results show clear distinction between the various settings (Table 3; Fig. 7). The topsoil samples of the mound includes a single Hue of 10YR, high Value and low Chroma (i.e., overall tendency to light grey). The topsoil samples of the surrounding hills have also a single Hue of 10YR, but wider range in the other parameters. In the wadi sections, there is also redder Hue of 7.5YR (beside the 10YR), which does not appear in the surrounding topsoil samples, and the colors have Value and Chroma ranges which are distinct from the mound's topsoil. As in the texture, the mound's topsoil was found to be homogenous, while the surrounding hills and the wadi had wider ranges. The mound's archaeological layers, which were determined by their color (among other properties), exhibited the greatest internal variance, as they had the widest ranges of Value and Chroma including a unique redder Hue (5YR) found in a few of them. Overall, it seems that each feature or layer in this group is highly distinguishable by its signature of physical characteristics.

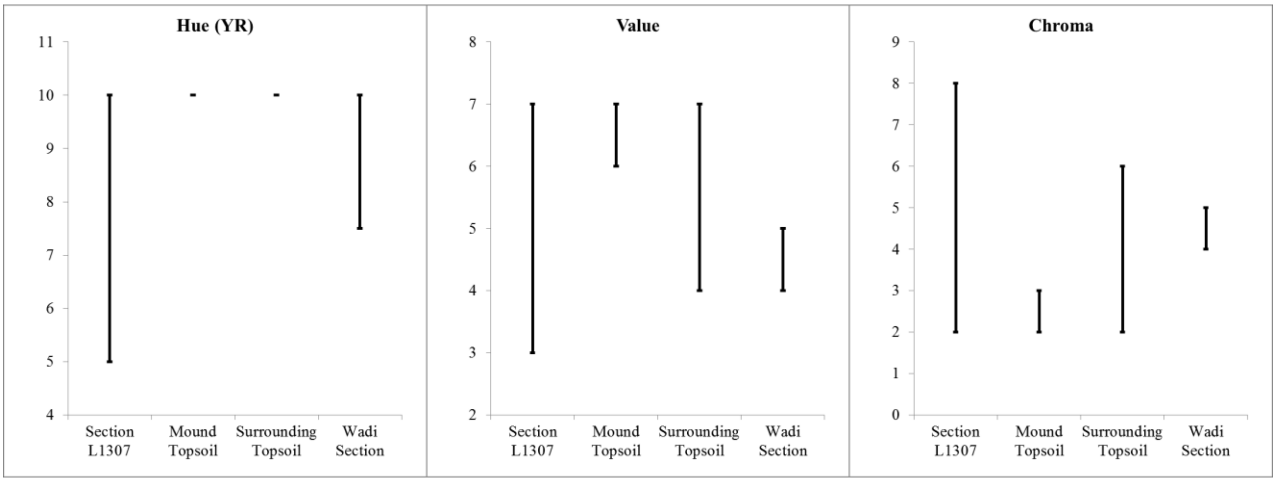

Figure 7. Color ranges of the samples from the topsoil of the mound, from the topsoil of its surrounding, from the wadi sections, and from excavation balk section L1307 (courtesy of the Tel 'Eton Archaeological Expedition). Colors are represented by Munsell system parameters. Note that the range of the samples from the surrounding is larger than that of the mound's topsoil, and includes higher Chroma and lower Value.

2.2.3. Phosphate Concentration Analysis method

Phosphorus (P) is an important nutritional component of plants, which can persist in soil for long periods as a phosphate, and was established as an indicator of human activity in the past (Holliday and Gartner, 2007, and many references therein). The available P (mostly organic or soluble pool of P available for plants in the soil) may be used as an indicator of human activity in relatively dry environments (Holliday and Gartner, 2007: 313). We used "Olsen method" (Olsen and Dean, 1965: chap. 73-4.4) to analyze P in six samples from the mound and six from its surrounding hills (Fig. 2). The wadi and the archaeological layers were not analyzed for P content.

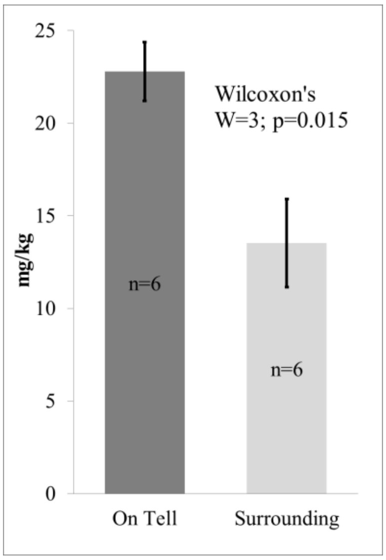

Figure 8. Phosphate analysis results. Error bars represent ±1 standard error (courtesy of the Tel 'Eton Archaeological Expedition). Note that the phosphate concentrations on the tell are significantly higher than the surrounding and that the tell is more homogeneous.

2.2.4. Phosphate Concentration Analysis results

Results show that while both the mound and its environment have relatively high P available (cf. Hagin and Katz, 1985), the mound has significantly higher phosphate concentration than its surrounding hills (means ± standard errors of 22.8±1.58 mg/kg and 13.5±2.39 mg/kg, respectively; Wilcoxon's W=3; p=0.015; Table 3; Fig. 8). Notably, as in the analyses above, the mound's topsoil is quite homogenous compared to the topsoil of its surrounding.

Table 3. Analytical results of all soil and sediment samples. All the analyses were conducted on air-dried fine earth (2 mm sieved). Color was determined by Munsell charts, and where the exact Chroma could not be determined (in samples TEFL12, 16) the average was taken. Texture fractions were separated by the sedimentation method to clay (<2 μm), silt (2-50 μm) and sand (50-2000 μm). Phosphate concentrations were analyzed using "Olsen method". For samples provenance see Figs. 2, 4.

Sample	Provenance	Color	Clay/Silt/Sand (%)	Phosphates (mg/kg)
1 (B11091)	L1307, mud-brick in rubble	7.5YR6/6	1.5/23.6/74.9	-
2 (B11092)	L1307, mud-brick in rubble	5YR5/8	31.1/50.1/18.8	-
3 (B11093)	L1307, Layer 11	7.5YR6/3	13.4/53.3/33.3	-
4 (B11094)	L1307, Layer 1	10YR5/4	21.3/53.2/25.5	-
5 (B11095)	L1307, Layer 12	7.5YR6/3	11.8/55.8/32.4	-
6 (B11096)	L1307, Layer 13	10YR5/4	11.1/57.6/31.3	-
7 (B11097)	L1307, Layer 14	10YR5/3	14.8/62.6/22.5	-
8 (B11098)	L1307, mud-feature, Layer 8	10YR3/4	29.9/56.4/13.7	-
9 (B11099)	L1307, Layer 14	10YR3/4	-	-
10 (B11100)	L1307, mud- feature, Layer 2	7.5YR5/4	33.1/49.7/17.2	-
11 (B11101)	L1307, Layer 13	10YR6/2	-	-
12 (B11102)	L1307, Layer 15	7.5YR7/3	30.0/53.5/16.5	-
13 (B11103)	L1307, Layer 14	7.5YR5/3	26.0/60.8/13.3	-
14 (B11104)	L1307, Layer 11	7.5YR6/4	-	-
15 (B11105)	L1307, Layer 3	10YR6/3	13.0/63.9/23.1	-
16 (B11106)	L1307, within F1041	10YR6/4	-	-
17 (B11107)	L1307, Layer 8	7.5YR5/3	18.9/61.7/19.3	-
18 (B11108)	L1307, Layer 7	7.5YR6/4	-	-
19 (B11109)	L1307, Layer 4	7.5YR6/3	31.7/50.4/17.9	-
20 (B11110)	L1307, Layer 1	7.5YR6/3	16.2/49.3/34.5	-
21 (B11111)	L1307, Layer 1	7.5YR6/3	-	-
22 (B11112)	L1307, Layer 4	7.5YR6/3	-	-
23 (B11113)	L1307, Layer 5	7.5YR6/3	-	-
25 (B11114)	L1307, Layer 9	7.5YR7/2	7.6/42.0/50.4	-
26 (B11115)	L1307, Layer 7	7.5YR5/4	30.1/53.6/16.3	-
27 (B11116)	L1307, Layer 6	7.5YR6/3	11.8/53.1/35.1	-
28 (B11117)	L1307, Layer 6	7.5YR7/2	-	-
29 (B11118)	L1307, Layer 5	7.5YR7/3	8.9/38.2/52.9	-
36 (B11126)	L1307, Layer 11	7.5YR6/3	-	-
37 (B11127)	L1307, mud-brick in F1041	10YR4/6	36.6/43.5/19.8	-
38 (B11128)	L1307, Layer 9	10YR6/3	-	-
41 (B11129)	L1307, Layer 3	7.5YR7/3	-	-
42 (B11130)	L1307, Layer 12	10YR6/3	-	-
43 (B11131)	L1307, mud-feature, Layer 2	7.5YR6/6	-	-
TEFL1	On Tell, head	10YR6/2	-	24.6
TEFL2	On Tell, head	10YR6/2	21.6/49.4/29.0	16.9
TEFL3	On Tell, head	10YR6/2	-	-

Sample	Provenance	Color	Clay/Silt/Sand (%)	Phosphates (mg/kg)
TEFL4	On Tell, N slope	10YR6/2	20.9/54.9/24.2	26.8
TEFL5	On Tell, E slope	10YR7/2	-	-
TEFL6	On Tell, E slope	10YR6/2	-	-
TEFL7	On Tell, E slope	10YR6/2	22.5/49.2/28.3	20.1
TEFL8	On Tell, W slope	10YR6/2	-	-
TEFL9	On Tell, S slope	10YR6/2	21.6/50.8/27.6	26.4
TEFL10	On Tell, W slope	10YR6/2	26.7/53.2/20.1	21.9
TEFL11	On Tell, W slope	10YR6/3	-	-
TEFL12	Surrounding, valley	10YR6/3.5	-	-
TEFL13	Surrounding, slope	10YR4/4	-	-
TEFL14	Surrounding, valley	10YR6/3	35.5/49.0/15.5	21.0
TEFL15	Surrounding, plateau	10YR7/2	-	-
TEFL16	Surrounding, valley	10YR7/2.5	-	-
TEFL17	Surrounding, plateau	10YR4/6	38.9/45.1/16.0	10.5
TEFL18	Surrounding, slope	10YR7/3	-	14.4
TEFL19	Surrounding, slope	10YR5/4	-	-
TEFL20	Surrounding, plateau	10YR5/4	-	-
TEFL21	Surrounding, plateau	10YR4/4	48.9/40.8/10.3	9.2
TEFL22	Surrounding, slope	10YR6/2	30.0/49.7/20.3	19.6
TEFL23	Surrounding, valley	10YR5/4	-	-
TEFL24	Surrounding, slope	10YR5/4	42.1/42.6/15.2	6.5
WS1.1	Wadi section, topsoil	10YR4/4	19.7/37.5/42.7	-
WS1.6	Wadi section, middle	10YR4/5	29.2/40.2/30.7	-
WS1.9	Wadi section, bottom	10YR4/4	34.7/39.1/26.1	-
WS2.1	Wadi section, topsoil	10YR5/4	24.1/30.6/45.3	-
WS2.6	Wadi section, middle	7.5YR5/4	27.6/27.8/44.6	-
WS2.10	Wadi section, bottom	7.5YR4/4	28.2/24.5/47.3	-

2.2.5. Plant Biomass method

Above ground biomass of plants can represent the intensity of vegetative growth and soil productivity, which is influenced mainly by the nutrients and the water content (e.g., García et al., 1993; Tzialla et al., 2006), putatively affected by P content and soil texture. Because these factors only partially determine aboveground biomass, we decided to measure vegetation characteristics as a separate (and more straightforward) indicator of soil traits. We tested for differences in vegetation biomass between the mound and its surrounding (the sections in the wadi and the archaeological layers are irrelevant here). To sample the vegetation, we used a square wooden frame of 28 x 28 cm and sampled the inner 25 x 25 cm to eliminate edge effects. For each sample, we chose a random starting point in the center of each environment, and the frame was thrown in random directions to distances of a few meters (see Fig. 9 for sampling loci). Samples were taken at the peak of vegetation growth (mid-March) in 2013 (21 samples from the mound and 14 samples from its surrounding), and again in 2014 (7 samples from the mound and 7 samples from its surrounding in each sampling point, total aboveground plant biomass was collected, stored in a paper bag and brought to the laboratory. On the next day, samples were dried at 60° C for 72 h in an oven. Samples were weighted and biomass was estimated as the total dry weight of the plant material.

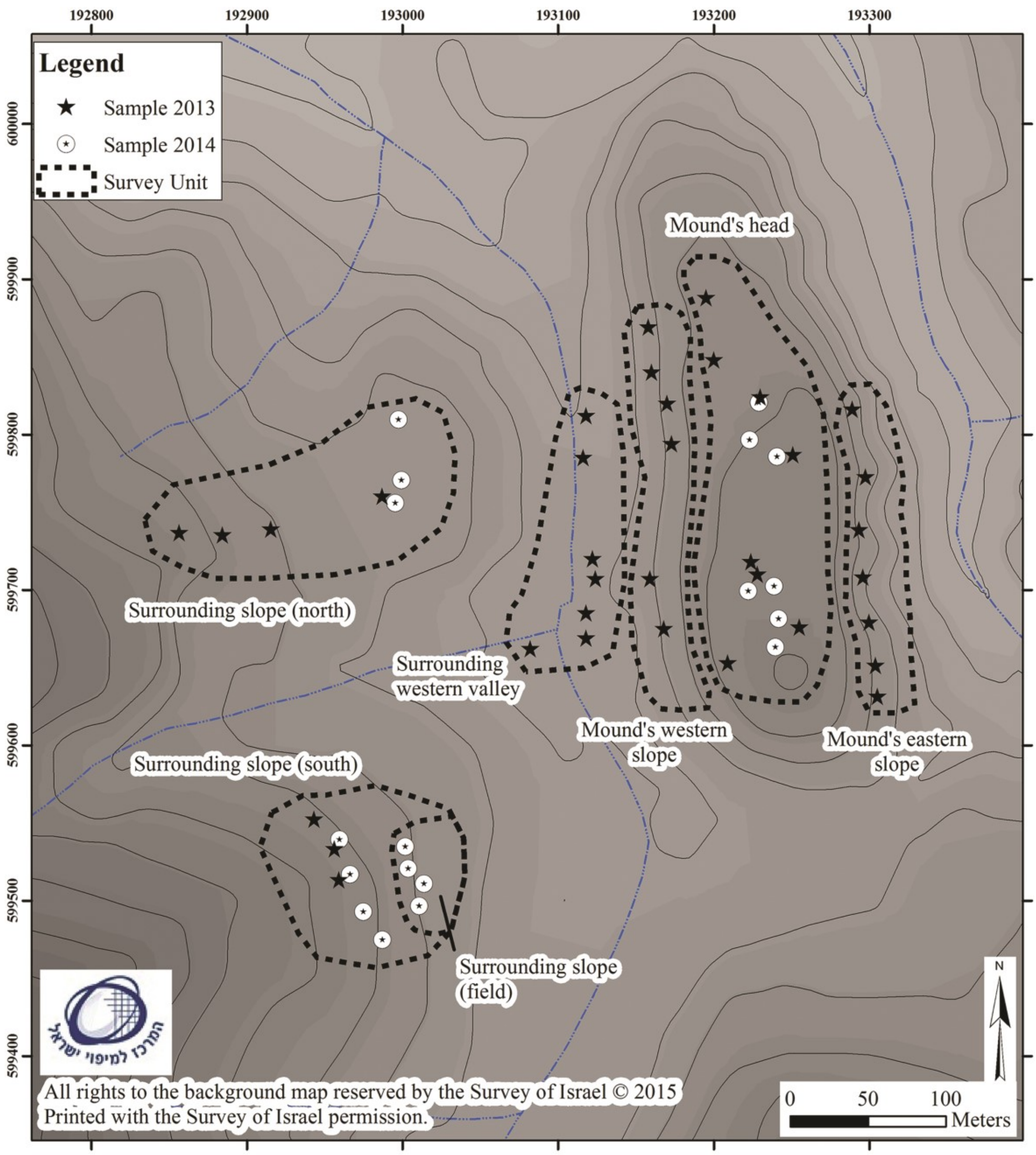

Figure 9. Sampling loci of biomass on the tell and its environment (courtesy of the Tel 'Eton Archaeological Expedition). Sampling was repeated in 2013 and 2014. All rights to the background map reserved by the Survey of Israel © 2015. Printed with the Survey of Israel permission.

2.2.6. Plant Biomass results

The results showed that in 2013 mean biomass per sample on the mound was higher in 6.7 g than the surrounding habitat (means ± standard errors of 28.1±2.51 g and 21.3±2.35 g respectively), but this difference was marginally significant (p=0.071; Fig. 10). In 2014, biomass on the mound was 9.9 g higher than the surrounding habitat (25.5±2.58 g and 15.6±2.44 g respectively), and this difference was significant (p=0.029).[4]

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[4] In this set we sampled also newly discovered settlement in the plain below the mound (Sapir and Faust, 2016), and in a nearby plot, located in the same plain in a similar topography that we considered to be non-settled. Interestingly, biomass in both was higher than on the mound (Sapir et al., 2019). Still, within these latter two plots, biomass on the settlement remains was higher than on the plot considered to be outside the settlement (in both cases the differences were not significant). This might suggest that while biomass on settlements is higher than on non-settled plots, topography plays a larger role than considered so far. This, however, is beyond the scope of the present discussion.

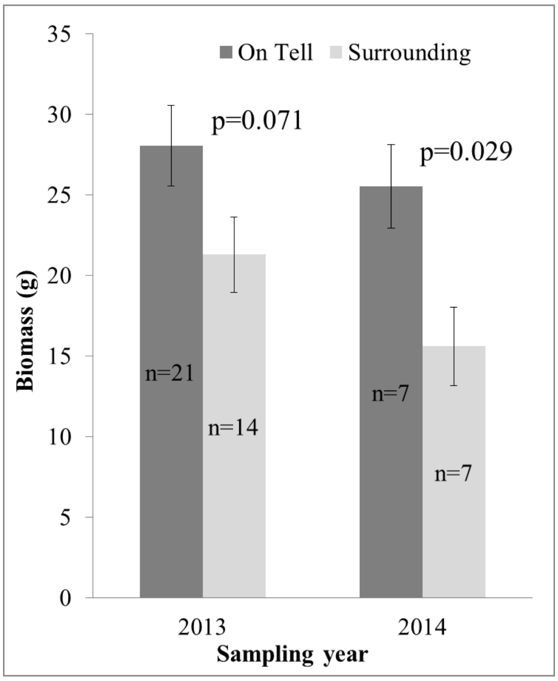

Figure 10. Above-ground biomass on the tell and on its surrounding hills. Error bars represent ±1 standard error (courtesy of the Tel 'Eton Archaeological Expedition).

3. DISCUSSION

We show here quantitatively that physical and biological characteristics of the topsoil can serve as excellent indicators for processes that form a mound and differentiate it from the surrounding environment.[5] Our results clearly show that the topsoil of the mound is distinguished from its surrounding hills (plateaus, slopes and valleys) in all the measured parameters (texture, color, phosphate concentrations and biomass). The topsoil is different not only in the mean values, but also in the variance, as the mound is relatively homogeneous in all parameters measured, compared with the surrounding environments. The wadi samples are distinguished in their texture and color from the other settings, including the archaeological mud features. The archaeological layers are highly heterogeneous and most of these layers are distinguished from the other groups in texture and color, but their average texture is very similar to that of the mound's topsoil.

In order to provide a possible explanation for these results, we should consider the soils in the hills surrounding Tel 'Eton, as they are better known due to past geological/pedological studies. These soils are composed of mainly weathered chalk on chalky bedrocks, and/or aeolian dust settling on Nari bedrocks (Dan et al., 1972). The dust contribution to the soil is most significant in the finer size particles – clay and fine silt (Dan et al., 1972; Yaalon and Ganor, 1973; Yaalon, 1997; Goldberg and Macphail, 2006: chap. 6; Singer, 2007: 120; Sandler, 2013). These materials (i.e. mainly weathered rocks and settled dust) accumulate in the fissures as soil pockets within the Nari outcrops or on the surrounding plateaus, and portions of them erode from the hill slopes to the valleys, where they accumulate and form deeper soils (Yaalon and Ganor, 1973; Dan, 1988; Yaalon, 1997; Singer, 2007: 120). The site's environment is typified by higher variety of surface cover (e.g. chalk or nari outcrops, vegetation coverage) and topographical settings in comparison to the mound (field observations, Sapir et al., 2019). This variety induces differences in leaching, erosion and sedimentation processes (Holliday, 2004; Schaetzl and Anderson, 2005) and in soil properties in general (Sarah and Zonana, 2015), resulting in a heterogeneous group.

The matrix of the mound itself was less studied in the past. A common assumption regarding the composition of the matrix of ancient mounds in the Near East is that its major fraction comes from decayed mud-bricks and mortar, and the rest from other sources such as decayed plaster, ash, aeolian dust and rubble (Davidson, 1973; Butzer, 1982: 77-79; Rosen, 1986: 10-13; Goldberg and Macphail, 2006: 226-227; Friesem et al., 2011). The raw material used for mud-bricks in the Eastern Mediterranean basin (and specifically in Israel) was usually silty and clayey sediments from the vicinity of the site (Rosen, 1986: chap. 5; Gifford et al., 1989; Kemp, 2000: 80-82; Goldberg and Macphail, 2006: chaps. 11, 13; Nodarou et al., 2008; Itkin et al., 2018). In many cases it is assumed that this raw material was taken from nearby stream channels (e.g., Davidson, 1973; Emery, 2011; Goldberg, 1979; Rosen, 1986; Homsher, 2012: 368). Should this assumption be correct, given that it is unlikely that significant amounts of mud or other durable construction materials were brought from far distances to Tel 'Eton, we could expect that the main source of the mound matrix came from its immediate surroundings. This, however, suggests that the mound's topsoil should be quite similar to either the surrounding hills or the wadi (or in-between). Nonetheless, our results show that the mound's topsoil is distinct from these two groups in texture and colors and apparently also distinct in phosphate concentrations and biomass (the latter two characteristics were studied only in the topsoil of the surrounding hills). In another study at Tel 'Eton, Itkin et al. (2018) showed that the soils of tells

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[5] Interestingly, a study (Sedov et al., 2017) conducted in another region showed that the original soil, buried below mounds, greatly differ from the mounds layers.

are ʻgeneticallyʼ related to those developed in the surrounding. However, they found that the soils outside the mound had stronger structure and occasionally darker colors, and the particle size distribution of the reference profile outside the mound is finer than the mound's soil. While we agree that the soil of the mound is sourced from the adjacent surroundings, we showed stronger differences between the settings, perhaps because we took more samples from various environmental settings.

In order to understand the differences between the soils of the various settings, we studied the texture of the archaeological layers. Balk section L1307 revealed layers that seemed to be distinct from each other in various parameters (Fig. 4), such as compaction, stoniness, color (Table 1) and texture (Fig. 6). These layers seem to be relatively untouched and preserved, with very few visual signs of bioturbation activity (very thin roots, tiny insects' holes, and one krotovina, i.e. re-filled mole-rat tunnel). As already noted, the samples from L1307 vary greatly in texture and color (Table 3; Figs. 5, 6, 7), and are heterogeneous compared to the other groups. Overall, each layer presents a unique "signature".

The great variability of the archaeological layers seems to result from different activities that created them. Each layer seems to represent the "signature" of a specific human activity, feature, or source of filling material (e.g., degraded construction materials, fired sediments, ash, charcoal, quarrying waste). As long as those are found in context, and not mixed, each has its own unique signature, which dictates high variability.

As noted, although there is hardly any overlap between the archaeological remains (L1307) and the mound's topsoil in terms of texture, we found that the average of all the (greatly varied) archaeological samples is very similar to the relatively invariable group of the site's topsoil (Fig. 5; Table 2), suggesting that the latter was created by the "mixture" of the former. This is strengthened by the fact that the uppermost sample taken from L1307 – from what was defined as its topsoil – is the only sample from this section that actually matches the mound's topsoil results, i.e., within the latter's range.

Another indication for the mixture of the archaeological layers comes from the restoration of the vessels that were unearthed in Building 101. Since every sherd of the restored vessels, including body sherds, was registered, the restoration of the vessels enables us to understand the "composition" of each vessel and where the various sherds came from. The reconstruction of the excavation baskets' heights shows that some of the restored vessels include sherds from a wide range of elevations – from the floor of the building up to the topsoil – difference of about 1.5 m. Such a pattern implies that despite the apparent distinction of the archaeological layers, there was some mixture of sediments and artifacts (cf. Villa, 1982).

It seems, therefore, that despite the apparent (visible and analytical) distinction between the archaeological layers and features, these were gradually disintegrated, and portions of them moved upwards to the topsoil (see also Aleksandrovskii et al., 2015). Simultaneously, the material which arrived at the topsoil, goes through lateral processes that bring to the uniformity of the mound's topsoil by homogenization. Therefore, we hypothesize that the mound topsoil is the end result of the disintegration, vertical movement, and homogenization of the archaeological layers. Hereinafter we would like to discuss the processes of each of these movements. We must stress that the following discussion is mostly theoretical, but we think that it provides a reasonable explanation to the results and to the formation of the topsoil of the mound.

3.1. Vertical Mobility Processes

Pedoturbation (soil mixing) and vertical movement of archaeological sediments and artifacts may come from various processes, both (1) cultural and (2) natural.

(1) Anthroturbation: Human activities such as foundation trenching, levelling before re-construction, and moving sediments for terracing, create an upward movement of sediments and small artifacts (Kirkby and Kirkby, 1976). At Tel ʻEton there are evidence for agricultural terracing, probably during the Byzantine period (Faust, 2011; Faust and Katz, 2012; 2015). The construction of a terrace requires some form of digging, piling and moving of earth and stone deposits (e.g. Gibson, 2015). Some of these artifacts and soil might stay on the surface and get assimilated in the topsoil (e.g., by bioturbation or heaving), or transported to other locations above the surface (e.g., by moving material during terrace construction).

(2) Natural pedoturbation may result from several agents, such as plants, tree growth, shrink-swell of clays, freeze-thaw of the soil, and animal activity (Wood and Johnson, 1978; Isard and Schaetzl, 1995). However, since field observations imply that no freeze-thaw cycles occur in the region, no trees grow on the mound, and no shrink-swell was found on it (the two latter agents do appear in the surrounding, where they seem to be less influential compared to the faunalturbation), the main natural agent that effects the mound is faunalturbation by rodents.

Burrowing rodents, such as the blind mole-rat (Spalax ehrenbergi; Nevo, 1961; Heth, 1989; Zuri and Terkel, 1996) cause an upward displacement of the matrix with small artifacts when they burrow their tunnels, but later they cause downward displacement that decay and fill the channels. These vertical movements of soil result in a mixture of the materials between the lower layers and the topsoil (Wood and Johnson, 1978; Hole, 1981; Bruder, 1982; Gifford et al., 1989; Bocek, 1992; Więckowski, Cohen et al., 2013). Specifically, at Tel 'Eton, mole-rat activity is extensive, and we found high concentrations of artifacts, originating from buried strata, in the molehills that were piled on the surface. The intensive activity of the burrowing mammals, which brings sediments and artifacts to the surface, clearly indicates that the contribution of the faunalturbation to the topsoil is significant (Sapir and Faust, 2016).

While the volume of sediments that move downwards is expected to be like the volume that moved upwards, mixture in the lower layers seems to be much limited. The main disturbances that mix the layers are of higher intensity in the upper 40-50 cm in our case, and are reduced in deeper layers (hence, in cases where the layers were not quickly and deeply buried by other deposits, we may find the mixing of some layers – which is in practice an ancient topsoil – in sections of archaeological sites). Our explanation for this difference is that while the material that moves downwards (as a consequence of the faunalturbation) remains isolated in krotovina (and therefore sometimes remains hidden from the eyes of the excavators, who may interpret the layers as intact), the materials that arrive at the topsoil goes through processes, to be discussed presently, which make the topsoil layer homogeneous.

3.2. *Homogenization*

The topsoil homogenization is affected by various natural processes such as faunalturbation, much of which involves mixing and moving materials within the topsoil layer (Wood and Johnson, 1978; Heth, 1989; Bocek, 1992), and from human activities such as ploughing (Taylor, 2000; Navazo and Díez, 2008). Notably, in the specific area of the archaeological section L1307, it is not likely that ploughing was significant since there are thick stone walls that were preserved to the level of the modern surface. However, on the site level and especially in the site's terraces, ploughing was probably a significant agent (Faust and Katz, 2012; see also Davidson et al., 2010), even if less intensive than in the surrounding (Sapir and Faust, 2016: 63; more below).

3.3. *Causes for Intensified Activity on the Mound*

As noted, the causes for both the vertical mobility of artifacts and sediments and the horizontal mixing in the topsoil can be divided into cultural and natural agents. Both types of agents appear to be influenced by the fact that the mound is different from its environment in several factors.

The first is the phosphate content, which (in accordance with previous studies) proved to be higher on the mound in comparison to the surrounding hills (Fig. 8). Higher phosphate content donates to the attractiveness of the mound for both humans and animals during abandonment, since it increases soil fertility, with resulting higher plant biomass, as indeed was found here (Fig. 10). Higher soil fertility, in turn, leads to higher intensity of faunalturbation (e.g., Bubel, 2002: chap. 6). The relatively high phosphate content in the mound's sediments means that the mound is attractive to agriculture, which further increases the mixing of the uppermost layer. While a previous study concluded that the surroundings of the mound went through more intensive tillage (Sapir and Faust, 2016: 63), this is true only for the upper part of the mound, and it is likely that the tillage was carried out in a different manner, such as shallow tillage practices for cereals. It should be noted that the terraces on the mound, not only reduce the erosion of sediments, but also increase the water infiltration (Arnáez et al., 2015; Gibson, 2015) and hydraulic redistribution – the process of passive water movement from relatively moist to drier regions of soil using plant roots as a conduit (Xu and Bland, 1993) – and therefore apparently increase the soil moisture. This, in turn, would increase the faunalturbation and the biomass on the mound. The soil fertility also suggests that soils might have been taken as a fertilizer (e.g., Wilkinson, 1982; 1988; Given, 2004; Holland, 2006: 6, 12; specifically for Tel 'Eton see Dagan, 2014: 91), thus increasing the pedoturbation.

The second factor is the presence of bones in the archaeological layers within the mound. Some rodents tend to gnaw bones (e.g. Nowak and Paradiso, 1983: 798; Horwitz et al., 2012; Więckowski et al., 2013), and thus prefer the mound on its surroundings. We are not familiar, however, with such a behavior in mole-rats (Eviatar Nevo, personal communication), which are probably the most significant agent of faunalturbation (Sapir and Faust, 2016), but porcupines, which are also active in the site, do gnaw bones.

The third factor includes some characteristics of the topsoil of the mound, such as the coarser texture (Figs. 5, 6). While this could have been in part a result of frequent heating of sediments on the mound (for the effect of firing on texture see Ulery and Graham, 1993; Ketterings and Bigham, 2000; Terefe et al., 2008), what is important for our purposes is that coarser texture is more auspicious to burrowing mammals (Bubel, 2002: chap. 6) and might result in longer and deeper burrowing patterns (Heth, 1989). Indeed, the molehills on the mound are apparently more voluminous than in the uninhabited surrounding (Sapir and

Faust, 2016: 65). Moreover, it seems that the matrix in archaeological sites are less densely packed than those of their environment, and this makes the mound easier for burrowing and therefore attractive, at least for some rodents (Horwitz et al., 2012; Więckowski et al., 2013; Itkin et al., 2018 also state that the surrounding soils have stronger structure).

4. SUMMARY AND CONCLUSION

An examination of the topsoil of the mound and its environment (both hills and wadi sediments) showed systematic differences in the texture, color, phosphate concentrations and plant biomass. It also showed that the topsoil of the mound was much more homogenous than that of its environment (both the surrounding hills and the wadi section). When we examined some of the archaeological layers which comprise the mound itself, those created a fourth, heterogeneous group, which was different from both the topsoil of the mound and of its environment. In this article we propose explanations to both the unique qualities of the different groups and their relations to each other, in order to understand the way the topsoil of the mound was formed.

The environment shows some diversity due to various local factors and processes that influence the micro- or meso-environment (e.g., ratio between bedrock outcrops and soil, relief, surface cover, leaching, erosion and sedimentation). Consequently, the environment is composed of various sub-units (namely the hills – including valleys – and the wadi) which differ from one another. In order to understand the processes that were dominant on the mound and created its unique qualities and its homogeneity, we examined the composition of the archaeological layers, taken from an artificial section (Balk L1307). As noted, these layers formed a heterogeneous group, with a different signature in each layer (in texture, colors, and other parameters), resulting from the human activities that created them. Surprisingly perhaps, all these layers, including the mudbricks, differed in texture from the wadi sediments (from where it is commonly assumed the mud-bricks material was taken). Moreover, none of the section's samples was included in the range of the mound topsoil (beside the topsoil of the section itself), but their average is very similar to the mound's topsoil. These results imply that the topsoil of the mound was created by an upward movement of degraded materials from below and their homogenization in the topsoil.

We hypothesize that various agents, natural and cultural alike, are responsible for the vertical movement of the degraded material from the archaeological layers, and its mixing in the topsoil, leading to the homogeneity of the latter. Since the mound is richer in phosphates than the environment (as a result of past human activity), it is also more fertile (as can be seen by the higher biomass on the mound) and is therefore attractive for both animals and humans activities. Consequently, some of the cultural and natural processes are likely to be more intensive on the mound (perhaps except for deep tillage), and hence the intensity of homogenization processes there should be higher compared to the environment.

While the material that is buried in the archaeological layers below the topsoil is much less prone to homogenization processes, and the back-filled material remains relatively without further movement, the above processes have a tremendous effect on the integrity of the archaeological remains in the topsoil, and are responsible for its homogeneity.

4.1. Further Archaeological Implications

These insights have implications for additional fundamental archaeological questions, and below we would like to (briefly) mention the following issues:

One important implication is the possibility to identify periods of abandonment of a site within its layers of deposition. A layer with a relatively homogeneous composition of sediments, which is similar to the average of the composition in the strata below it, may reflect lengthy abandonment (cf. Aleksandrovskii et al., 2015; Sedov et al., 2017).

The evidence for upward movement of the sediments from the archaeological layers to the topsoil allows us to partially explain the presence of artifacts originating from very deep layers in assemblages collected on the surface. These artifacts might arrive to the surface from depths of up to ca. 1.5 m (in our case study) by the burrowing activity of mammals such as mole-rats and porcupines, or by human activities such as pit burrowing and foundation trenching. This phenomenon is used in surveys for understanding buried deposits and may be even better used by enhanced understanding of the processes that create the movement (e.g., Dunnell and Simek, 1995; Sapir and Faust, 2016).

Additionally, many scholars noticed that the color of archaeological sites differ from their environment (James, 1999; Banning, 2002: 42; Holliday, 2004: 314-24; Lucke et al., 2005; Goldberg and Macphail, 2006; Walkington, 2010: 127; Green and Moore, 2010: 67; Menze and Ur, 2012). The uniformity of the results on the topsoil of the mound implies that we may expect to find grey colors (high Value, low Chroma and narrow range) on other mounds in the region. The reasons for that requires further study, but we may currently suggest that it might result from the relatively young age of the sediments (compared to the surrounding soils), and from the degradation of construction materials (e.g., chalk and plaster) and organic materials (such as bones and ash), which are subsequently homogenized at the topsoil. Lately, Itkin et al. (2018) reached similar conclusions by micromorphology methods of a few mounds in the region, including Tel 'Eton.

Our results also explain the widespread use of abandoned archaeological sites for agricultural activities such as terrace construction and ploughing. The higher phosphate content and biomass on the mound, compared to the surrounding area, makes the mound suitable for these purposes (perhaps with preference for crops that require shallow tillage practices, such as cereals, where stonewalls arrive at the surface), and it is therefore likely that such activities will be more intensive on it. Subsequently, the sediments of deserted mounds can also be used as a fertilizer for the fields in the mound's vicinity.

The study has also implications regarding the assumed provenance of the material used to create the mudbricks. Our results imply that the source material of the mudbricks is not the alluvial/fluvial sediments, as is commonly hypothesized. Rather, it was probably procured from the hills around the site. This strengthen the results of a previous study (Sapir et al., 2018), which showed that the carbonate content of most of the mud-bricks and the texture of all the unburnt ones are similar to those of the hills (and not to those of the wadi). Additional study, however, is required both to locate the exact provenance and to test it in other sites.

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