

Elateia 1 in northeastern Thessaly 8000 years ago: relative and absolute chronology of a flat extended settlement

Agathe Reingruber¹, Giorgos Toufexis², and Yannis Maniatis³

¹ Institute of Prehistoric Archaeology, Freie Universität Berlin, D
agathe.reingruber@fu-berlin.de

² Ephorate of Antiquities of Larissa, Diachronic Museum of Larissa, GR; geotoufexis@yahoo.gr

³ Laboratory of Archaeometry, Institute of Nanoscience and Nanotechnology, National Centre of Scientific Research "Demokritos", GR; y.maniatis@inn.demokritos.gr

ABSTRACT – *Intensive and systematic surveys in the area south of Mount Olympus and west of Mount Ossa revealed not only tell settlements, but also several flat sites from different prehistoric periods. For one of the settlements, namely Elateia 1, a detailed relative chronological assessment was made with the help of statistical evaluations of pottery assemblages. In addition, short-lived bone samples confirmed and more precisely defined the exact chronological position of this 10-hectare site within the Middle Neolithic period. The present study underlines the importance of statistical evaluations of complete pottery assemblages, even those obtained through survey investigations, and their significance for a better understanding of chronological, chorological and post-depositional processes.*

KEY WORDS – *Thessaly; flat sites; Early Neolithic; Middle Neolithic; absolute and relative chronology; pottery analysis*

Elateia 1 v severovzhodni Tesaliji pred 8000 leti: relativna in absolutna kronologija plane razširjene naselbine

IZVLEČEK – *Intenzivni in sistematični terenski pregledi na območju južno od gore Olimp in zahodno od gore Ossa so odkrili ne le naselbine tipa tell, ampak tudi številna plana najdišča iz različnih prazgodovinskih obdobj. S pomočjo statističnega vrednotenja zbirov lončenine smo za eno izmed teh najdišč, tj. Elateio 1, izdelali natančno oceno relativne kronologije. Najdišče, ki je veliko 10 hektarjev, smo tako lahko s pomočjo kratkoživih vzorcev kosti potrdili in bolj podrobno opredelili natančno kronološko pozicijo v obdobju srednjega neolitika. S pričujočo študijo poudarjamo pomen statističnega vrednotenja celotnih lončeninskih zbirov, tudi tistih, ki so bili pridobljeni s površinskimi preiskavami, in njihov pomen pri razumevanju kronoloških, horoloških in podepozicijskih procesov.*

KLJUČNE BESEDE – *Tesalija; plana najdišča; zgodnji neolitik; srednji neolitik; absolutna in relativna kronologija; analiza lončenine*

Introduction

Thessaly in central Greece is internationally renowned for the many multi-layered settlement mounds or *magoules* located not only in the vast plain, but also in hilly areas. A chain of mountains comprising the Lower Mt. Olympus in the north, followed by Mt. Ossa, Mavrovouni, and ending with Mt. Pilion and

its adjacent hilltops in the south, separates the Thessalian Plain from the Aegean Sea. Especially the western flanks of this chain of mountains provided basic resources, such as flowing bodies of water, some of them feeding lakes, or different kinds of precious rocks like marble, gabbro and serpentinite.

As such, they offered prehistoric peoples perfect living conditions with abundant water resources, fertile alluvial fans and soils, and direct access to raw materials.

One hundred and twenty years ago the famous sites of Sesklo and Dimini in the south-eastern part of Thessaly were extensively excavated, and 60 years ago two sites in the northeastern reaches, Nessonis I and Gediki (Fig. 1), were investigated with small trenches. Today, 60 years later, in an ongoing German-Greek cooperation project under the auspices of the Ephorate of Antiquities in Larissa and supported by the German Research Foundation, special attention has turned towards systematic and intensive surveys and non-invasive investigation methods. During this research we discovered several flat sites that had escaped attention in previous times.

Flat sites are much more difficult to locate, due to their comparatively thin cultural layer subjected to erosion or, in contrast, due to their coverage with thick alluvial deposits. They are extremely endangered, especially since today's agricultural machin-

ery with rotating deep ploughs not only destroys clods of earth, but also (pre)historic finds and artefacts. The few flat sites known so far were either discovered during extensive surveys or rescue excavations, or brought to the attention of the Ephorate by local people (Gallis 1992; Toufexis 2017: 28–30, 345–350; Anetakis et al. 2020). This was the case at Elateia 1 in the area called 'Bigmeni Petra' (Μπηγμένη Πέτρα) because of a 2.26m long 'standing stone' erected at the highest point of the site.

The Basin of Elateia

In the spring of 2017, we started systematic research in the north-easternmost area of Thessaly, south of Mt. Olympus and west of Mt. Ossa (Fig. 1). There, over time, two basins had formed, those of Sykourio and Elateia. The southerly Basin of Sykourio had already been investigated in the late 1950s to early 1960s by Dimitrios Theocharis (1962). He was able to identify several sites, all of which he classified as *magoules*. Six of them were presumably related to a lake, the 'Bara Toibasi', today desiccated (Reingruber et al. 2021). A seventh site was identified later in the very south of the Sykourio Basin (Gallis 1992). In the very north, near the opening leading to the Basin of Elateia, a *magoula* was founded upon a natural hill during the Neolithic period, which was inhabited mainly in the Bronze Age: Bounarbasi (Kilian 1976).

Less attention was given to the Basin of Elateia, north of Bounarbasi. It is crossed by the River Pinios in the north, whose course defines the northern limit of the investigated area. From the confluence of the Kalamitsa and Pinios rivers in the north down to the modern village of Kypselochori the distance is c. 9km. In east-west direction, from modern Elateia to Makrychori, the distance is only 4.8km. On both of its lateral sides the Basin of Elateia is bordered by either a steep mountain or by a chain of hills: Mt. Ossa in the east se-

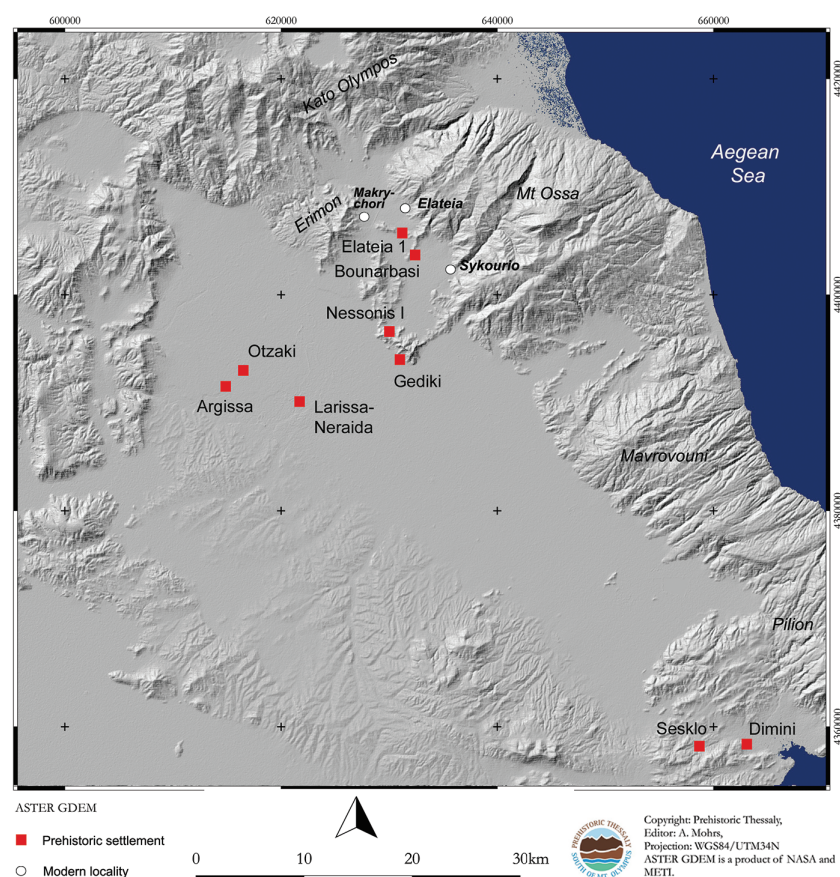


Fig. 1. Eastern Thessaly with the basins of Sykourio and Elateia and some of the Neolithic sites mentioned in the text.

parates it from the Aegean Sea, and the Erimon and the Drachmani (Patoma) hills separate the basin from the Thessalian Plain. From the latter, only a few and short rivulets empty into the River Kalamitsa, which enters the basin through an opening from the south. This river collects the water from both sides of the basin and finally flows into the Pinios – or rather, formerly flowed into it, as the Kalamitsa has dried up, just like its tributaries from the hills.

Until 2017 only the western part of the Basin of Elateia had been investigated through rescue excavations carried out by Giorgos Toufexis at the foot of the *magoula* Makrychori 1. This site is known for its ditch system, the oldest of which is dated back to the transition Early Neolithic (EN) to Middle Neolithic (MN) (Toufexis 2017:167–172; Reingruber et al. 2017).

Transects of our systematic survey were laid out both east and west of the Kalamitsa River, but especially in its eastern part we encountered several flat sites from different periods, the largest among them being Elateia 1 ('Bigmeni Petra').

Location of the flat site Elateia 1

The flat settlement south-west of the modern village of Elateia lies on the Late Pleistocene–Early Holocene alluvial fan west of Mt. Ossa. The western confinement of the site is determined by a natural scarp up to 12m in height (between 63 and 75 masl). It was formed by the alluvial fan ending there, cut by the waters of the Kalamitsa River, which has migrated up to 300m farther west over the millennia (Fig. 2). Another natural boundary is given in the north by the course of the Tsantarli streamlet ('rema') that has also dried up in modern days. To the south, the settlement area was probably bounded by a standing body of water, but this needs to be clarified through targeted drillings. To the east, a field path separates this spur in a N-S direction from the rest of the terrain, which rises continuously to the flanks of Mt. Ossa. The settlement area thus delimited is considerable: 400x260m (about 10 hectares).

The rather small fields in this settlement area not only belong to different field owners, but are also cultivated in very different ways: three areas have been lying fallow for years, so that a dense weed growth prevents a systematic inspection (Fig. 2). Generally, our return twice a year was worthwhile, as very good field inspection was achieved in two different campaigns per year, one in early spring and

the other in later autumn. Thus, of the 10 hectares 81% has been investigated, the coverage of the site being as complete and the finds collected as representative as possible.

With the exception of the relatively empty areas in the northeast, the rectangular walking units ('fields') were comparable in size (approx. 900m², depending on the topography of the site). These units were surveyed at a regular and constant pace, and the mass finds (sherds, daub and at first sight unidentifiable objects) were collected with their respective field numbers in separate bags. All decorated sherds, like the small finds, were measured three-dimensionally with help of GPS-devices and bagged separately. However, since sometimes decorations could only be recognized after washing, some such sherds were not measured with GPS, but they do contain the information about the field in which they were collected.

The pottery from Elateia 1

The complete inventory and its distribution in the area of the flat site

From 72 field units (designated with the letter F and a three-digit number, e.g., F023), 11 489 sherds were collected, of which only a very small proportion (1.3%) had to be sorted out because they belonged to younger periods. Thus, the total sum of 11 337 prehistoric sherds (182.73kg) was available for processing. The area remains – with the exception of modern agricultural use – only slightly over-impacted, and therefore the settlement of Elateia 1 ('Bigmeni Petra') can be considered one of the best preserved flat settlements of the early MN period. The state of preservation of some of the sherds is very good, considering that they are surface material. However, 3741 sherds, one-third of the total, are heavily worn, as if rolled by water. These sherds appeared in certain areas, so that we were also able to draw conclusions about post-depositional processes from the time after the settlement was abandoned.

The 11 337 Neolithic sherds were not scattered evenly over the area. At least four clearly recognizable focal points could be identified according to both number and weight (Fig. 3): one is in the north-western area with fields F049/F051, another in the central-western area with fields F201 and F203, while the most numerous sherds were found in the southern areas (F148–F149 and F143–F145). A concentration of domestic activity in these areas is con-

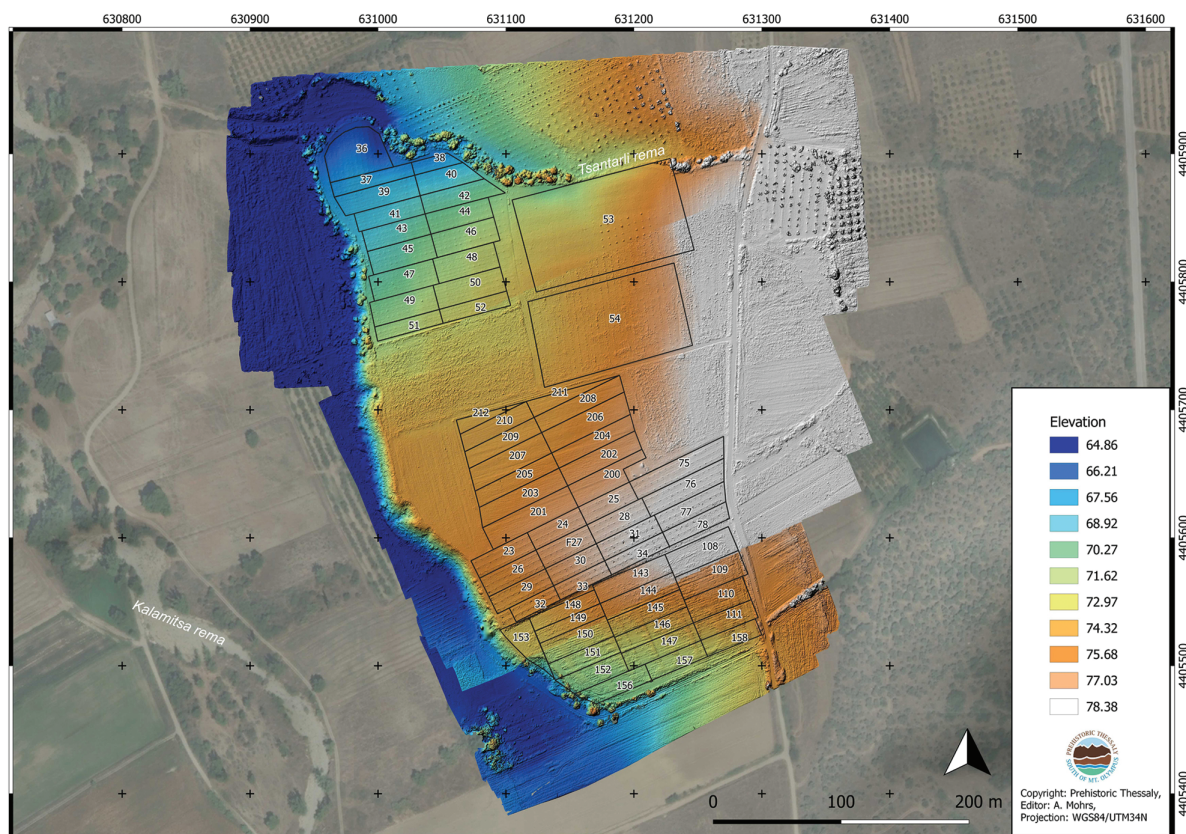


Fig. 2. A high resolution Digital Elevation Model (DEM) of the flat extended site of Elateia 1 with intensively surveyed field units (DEM by Vaggelis Kremastas).

firmed by the decorated sherds found there, probably not in a random scattering. Not only according to their number, but also when calculated in percentage-per-total, the previously established focal points can be validated and others proposed: the highest percentage of decorated sherds appeared in the almond grove, in F033 and F031 (Fig. 4). However, due to poorer visibility, fewer sherds (and finds in general) have been collected here.

Both in number and decoration only a few sherds were recorded in the northeastern part, in F053–F054, although the visibility there was excellent. We assume that this area was not part of the domestic space and as such was not used for dwellings. Instead, in this open area gardening or animal keeping may have been carried out (this is in line with the occurrence of other finds categories, e.g., stone tools).

The individual field units form the basis for the evaluation of all find categories. Due to the aforementioned differences in the distribution and frequency of finds, it seemed appropriate to group neighbouring fields with similar characteristics into areas. Thus, in the course of the evaluation of the finds

eight areas were defined starting from the north-west (area NW) and ending in the southeast (area SE). For the ceramic analysis, this meant that the comparison of features was based on the number of sherds-per-area, each of which accounted for 100% within its area. This puts the unevenly high numbers of finds from, for example, the SW area with 2994 sherds and the NW area with 679 sherds into perspective. Only the area NE with a sparse 77 sherds falls through this grid. Thus a uniform and consistent type of presentation is maintained.

Pottery categories

The total of 11 337 sherds could be assigned to seven pottery categories, which were determined on the basis of aesthetic (colour) and technological criteria, such as clay composition, temper, application of a slip and surface treatment (Fig. 5). Two categories are relevant only when discussing secondary changes: 81 sherds burnt in conflagrations, and 3741 sherds were heavily worn and rolled. These 3822 sherds (33%) were withdrawn from evaluation, as the surfaces were too greatly altered and thus no unambiguous assignment to a specific category was possible. Without them, 7515 sherds remain for examination (Fig. 6), which do not occur uniformly

in all areas. The reasons for these differences will play a determining role in the future analysis.

The seven ceramic categories represented are all monochrome. Monochrome surfaces occur in all phases and subphases of the Neolithic and Chalcolithic, and therefore this term cannot be used in a chronological sense. The term 'monochrome' is used here not in opposition to painted styles, but in opposition to bichrome burnt pottery styles. To the latter would belong the black-topped pottery of the EN II and of the LN I with different colours on the inner and outer surfaces (grey/black and light brown, respectively), additionally with a black rim, and no such sherds occurred in Elateia 1. Another bichrome burnt category refers to reddish oxidized surfaces contrasting with black reduced ones – mostly the interior is black and the exterior red, or, more rarely, the other way around. Such sherds are

represented in Elateia 1 with one piece each and are statistically irrelevant, as is the black polished type with only two specimens. These four sherds were added to the category closest to them. With these few exceptions, vessels were fired in an oxidizing atmosphere resulting in reddish/brownish surfaces both in- and outside.

Well over one-third of the sherds (43%) have red surfaces with or without coating. Brown surfaces, mostly light-brown, slightly less often dark-brown and only very rarely grey-brown, make up 21%. Very light surfaces were achieved by the application of a slip (1%) or were made of a very light clay: kaolin. This category is represented by only 69 pieces in Elateia 1, and thus is far less numerous (0.6%), just as it is generally rare, yet at the same time widespread during the EN/MN in Thessaly.

It is quite a coincidence that the three main categories 'red burnt', 'red slip' and 'light-brown burnt' appear with the same number of decorated pieces (133–135 sherds – cf. Tab. 1). In relation to the number of decorated sherds with intact surfaces (540 sherds), they account for 75% of the total, and can thus be regarded as standards for the application of a decoration. Within the respective category, however, only 5–6% of the red and dark-brown, but about 11% of the light-brown and grey-brown vessels were decorated. Even more popular as decorative backgrounds were the light-coloured coatings: more than one-half of all sherds of this type, almost 55%, were decorated, mostly painted (60 out of 69). The very light, kaolin-like surfaces are also relatively frequently decorated, at about 7%.

However, when looking at the frequencies of decorations on intact surfaces (7515 sherds), the proportions are different: the three main types are represented with almost 2% each,

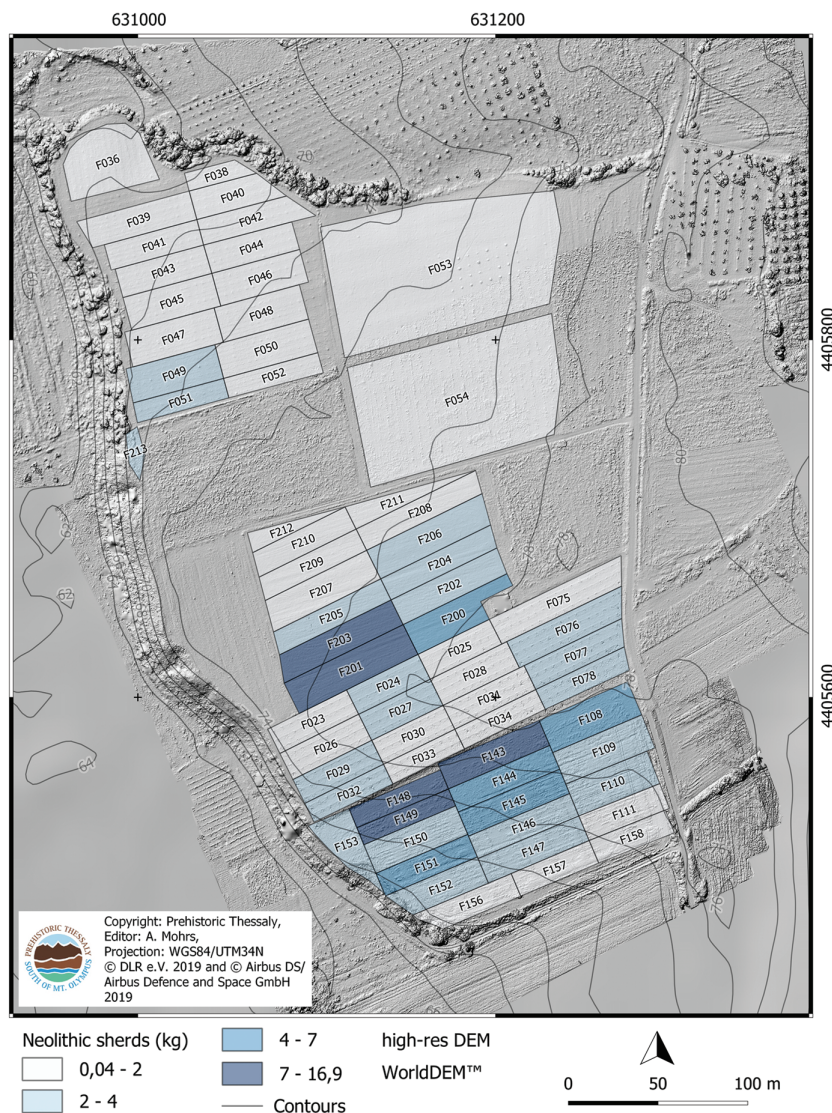


Fig. 3. Elateia 1, field units and frequency of Neolithic pottery (in kg).

whereas the decorations on a light coating represented just under 1%. They are thus much rarer and not evenly distributed throughout the settlement (see below). The darkish surfaces are also rather rarely decorated, with well under 1%, mostly with impreso. A special position can be attributed to the kaolin type: such vessels may have been considered particularly aesthetic on the basis of their appearance alone (similar to black-topped in EN II). Nevertheless, five out of 69 sherds were provided with impreso and plastic decoration, but at less than 0.1% of the total they must be regarded as exceptions.

Looking at the categories by area, some aspects stand out: most rolled/worn sherds occurred in the area NE, but they are also common in the areas CNE and CNW. In a representation without the rolled/worn sherds (Fig. 6), it can be seen that in these two areas red and light slipped sherds are also fewer, as the

coatings may have also been worn off. In the areas with little rolled/worn material, the coatings are also more frequent, especially in CSW. In the two southernmost areas, the percentages of the single categories are very similar: the ratio of red fired to red coated is relatively balanced, but in the case of the browns the light surfaces predominate. In the NW and CSW areas, however, the dark-brown surfaces are much more frequent. In the NW area, the kaolin-like variety is absent and the light coatings are rarer. In all areas, the grey-browns are constantly represented with about 1% of the total, while the light-browns tend to be more frequent in the south rather than in the north of the settlement.

Whether these quite significant differences might be of chorological and thus relative-chronological importance remains to be discussed based on the evaluation of further factors, such as shapes and orna-

mentations. For the moment we can summarize that the SW and SE areas show very great similarities, which also exist with CSE area. The two areas CNW and CNE also show very similar combinations. With minor differences (absence of kaolin in NW), the NW and CSW areas are also comparable.

Vessel shapes

Since in a surface survey many different kinds of shapes from all possible prehistoric and historical periods can appear, a recording system was designed that could deal with this. In a first step the diagnostic rims were sorted according to the angle of inclination of the vessel wall (Tab. 2): closed with less than 90° (T10–T17) or open with more than 90° (T20–T26). In the case of bases three main types were distinguished: those with a ring (T41), simple flat bases (T42), and inward raised bases (T44 and T43). Special shapes were given the code T50 (e.g., sieves), and jointed features (lugs, handles) were given

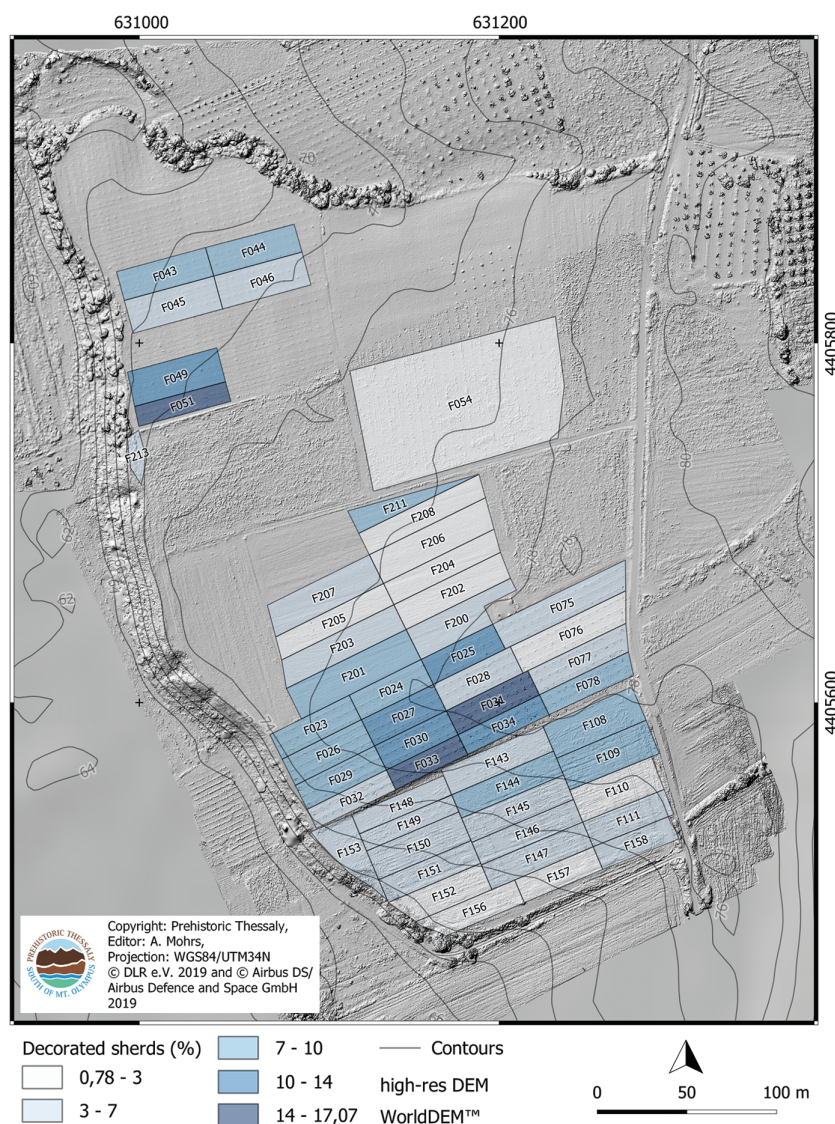


Fig. 4. Elateia 1, field units and frequency of decorated sherds (in %).

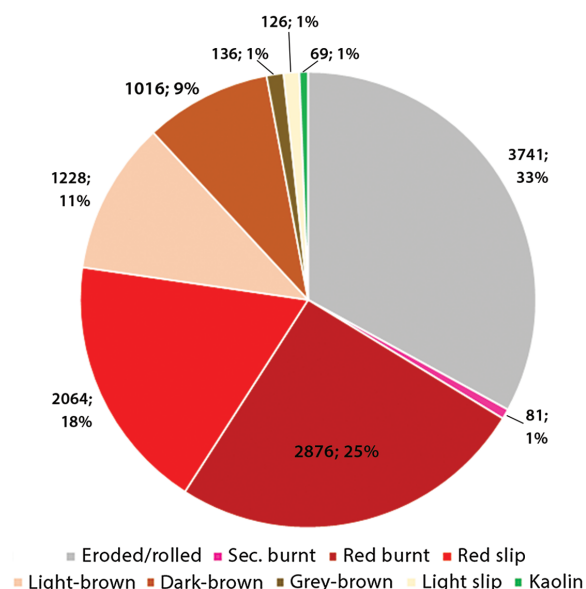


Fig. 5. Nine pottery categories as determined at the flat site Elateia 1.

the codes T60–T65. As many of the rims ended in different kinds of lips, and also bases displayed different traits in detail, these were distinguished by an additional code from a to z. With this combination of numeric and alphabetic codes all 3140 diagnostic sherds were systematically classified.

From a relative-chronological perspective, some types are ubiquitous, while others are chronologically sensitive. Shapes running throughout from the EN to the MN are well-known in the inventories published from sites in the Thessalian plain (e.g., Argissa and Oztaki: Reingruber 2008; Milošević-v. Zumbusch J. 1971). To these belong simple convex shapes with rounded (T11a) or beaded lips (T11b) and with a simple ring base (T41a) – they were present in Elateia 1 in all eight areas. Conversely, others, e.g., collared necks of closed pots (T16) or hole-mouthed jars (T17), are not as frequent. However, it is not the individual vessel type that is of particular significance here, but rather the combination of types. In order to understand which types are or are not relevant, it was first necessary to carefully process the entire inventory (as will be described in more detail in the final publication). Their various possible combinations result in a ‘set of dishes’ that can differ in composition from area to area (see below).

Decorative styles and ceramic categories

A total of 635 decorated sherds from Elateia 1 represent 5.6% of the full inventory (when excluding the rolled/worn sherds the number is even higher, at 7.18%). Five main decoration styles have been

distinguished: two in combination with negative decoration (impresso and incision), two in combination with colour application (painted and scraped) and one as positive decoration (plastic decoration). Within each decorative style slight variations can be identified, depending on what kind of implements were used to apply the negative decoration, or which colours were used on what kinds of slips.

There is a very clear preference for the impresso decoration in 442 examples (Fig. 7), followed by painting (91 examples with red and only four with white paint). Scraped decoration is comparatively rare, with 30 examples, and of an early style: sometimes the distinction between painted and scraped is not clear-cut. Incised decoration, with 10 examples, was seldom used and cannot be considered as representative. Plastic decorative elements were applied more often (43), but some of them may have been functional (15). On only a few pieces are these styles combined, resulting in the ‘fusion style’ of impresso and painted decoration.

Impresso decoration, *i.e.* the intervention with an instrument or even just the thumbnail on the still moist surface of a vessel, clearly predominates. Contrary to what is usually proposed (Milošević-v. Zumbusch J. 1971), impresso is not confined to the final

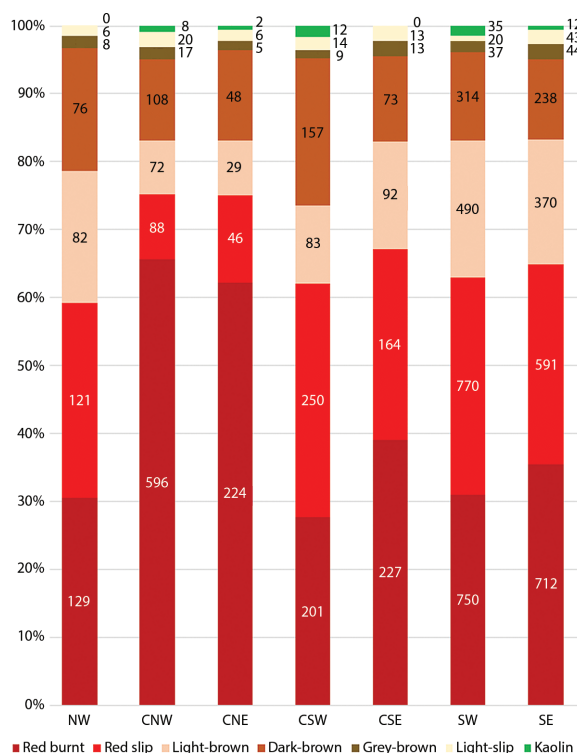


Fig. 6. Elateia 1, seven pottery categories (excluding the two secondary altered ones) in seven areas (excluding area NE).

stage of the EN, but occurs throughout the MN in different variations (Mottier 1981, *Typentafel D.25–46*). Either the pricked impressions were executed with a tool (more seldom, with the fingernail), and are in these cases rather randomly displayed over the whole surface (Fig. 8.7–8). Or the pointed impressions were made with the help of a comb: This kind of decoration was initially referred to by Milošević-v. Zumbusch as ‘Cardium decoration’, since it was thought to have been executed with a cockle shell (*Cardium edule*). In Elateia 1 a comb-like instrument was used in 138 cases, and it can have up to nine teeth. The arrangement of the ornaments is linear, and the overwhelming majority are displayed horizontally on the vessel, often in parallel rows (Fig. 8.1–2,13).

In Elateia 1 the varied methods of applying the impresso style (either with an implement, fingernail or comb) are abundant in number and rich in different arrangements, indeed unmatched at any other site so far. Impresso occurs on all categories of surfaces without exception, and can be regarded as ‘standard’. However, the red surfaces, with or without coating, were preferred. According to the instrument used, up to five different kinds could be identified, which will be analysed in more detail in the final publication.

Within the other decorations, a preference for certain styles for certain categories is more discernible, since red-on-buff painting was primarily executed on light-brown slip (57 examples) and only 24 times on plain surfaces, but never on grey-brown and kaolin surfaces. Ornaments are usually arranged linearly (13 parallel stripes, eight unidentifiable), running horizontally or diagonally over the vessel surface. Usually, the shapes are of the closed type (13 out of 20).

Well-known from the MN is the red-on-white painting, while less so the white-on-red painting: in Elateia 1 the former outnumbers the latter by 67 to four. In addition to linear patterns, single or repetitive (e.g., chevrons), more complex patterns occur, e.g., rhomboid (Fig. 8.3) and slightly curved lines, creating entirely new overall motifs, e.g., the flame pattern (eight times). The vast majority of these ves-

Category	no. of sherds	% from 7515	no. of dec. sherds	% dec. from 540	% dec. per category	% dec. from 7515
Red burnt	2876	38.3%	134	24.9%	4.7	1.78%
Red slip	2064	27.5%	135	25.0%	6.5	1.80%
Light-brown	1228	16.3%	133	24.5%	10.7	1.77%
Dark-brown	1016	13.5%	49	9.1%	4.8	0.64%
Grey-brown	136	1.8%	15	2.8%	11.0	0.20%
Light slip	126	1.7%	69	12.9%	54.8	0.92%
Kaolin(type)	69	0.9%	5	0.9%	7.2	0.07%
Total intact	7515	100%	540	100%	100%	7.18%
Rolled/worn	3822		95			
Total	11337		635			5.60%

Tab. 1. Frequencies of decorated fragments per category and in the total material.

sels were also painted on the inside (28 times, e.g., Fig. 8.3–6), or they at least had a coating (20 times), or the inner surface was burnished. The preserved rims and bases show that in particular the bowl of type T22d+T42a was painted (six examples).

White colour was already used as a coating in the EN II: in Argissa it was initially used to cover thick-walled vessels (Reingruber 2008.169, 214). Throughout Thessaly it was comparatively rarely applied for painted designs prior to the LN I. In the early MN the parallel white and thin lines were usually applied diagonally, probably on the shoulders of closed vessels (Fig. 8.11), similar to the necked jars from the ‘pottery workshop’, building with rooms 11–12, in Sesklo (Theocharis 1973.Fig. 5, 183–184, 281, Pl. II.13, 16). In Elateia 1 the white-on-red is restricted to the central-western and southern areas. This also applies to the T16 vessel shape (see above), so that there would be a good spatial correlation between shape and decoration.

Scraped decoration is present on all unslipped categories, because the colour is basically the streaky scraped-out light or red coating. In a few cases, in which no polish had been applied after scraping, a distinction between linear painted and scraped ware is sometimes difficult to make. In most of the cases (30) the effect of blurred and even serrated boundaries between paint and background are obvious, as if polished over (Vitelli 1984). Both combinations occur: either darker brown and red surfaces are provided with light (scraped) coatings (light-on-dark: 13 times) or, the other way around, light-brown surfaces with darker scraped coatings (dark-on-light: 17 times). In Otzaki, both styles occur on the same vessel, which is why Mottier suspected that they were the result of irregular firing processes and not of intentional colour contrasts. While in the lower levels of that site the patterns are still very straight,

in the upper ones they are often blurred (*Mottier 1981.33, Typentafel F*).

With this decorative technique, thin lines, much less complex geometric ornaments, cannot be created, and at most chevrons might result (two cases). Shapes with scraped decoration are thin-walled and show sharp breaks (seven out of 10). If rims and bases are preserved, they belong to open shapes, occasionally to closed ones, both with flat bottoms (Fig. 8.9–10,16). Strap handles (T65b) were also scraped.

Plastic decoration is one of the oldest ornaments in Thessaly (e.g., *Reingruber 2008.Taf. 1.14*). Here a distinction must be made between individually applied decorative pellets, knobs or thin strips (43) and pierced lugs (15). The former were found mainly on body-sherds (39) and only four in connection with a rim (never with a base) that belonged to an open shape (T21, T22). The chevron pattern, as known in the painting, was rendered two times with applied plastic strips (Fig. 8.15).

Since lugs are quite varied in design, they might not have been solely functional in nature (to hold a rope for hanging up the vessel), but possibly also of aesthetic value. Lugs can be elongated or round, sometimes angular in cross-section, and even tunnel-

Shape (description)	Shape (types)		Shape (description)	Shape (type)
Simple bowls, closed	T11–T12	vs.	simple bowls, open	T21–T23
Structured dishes, closed	T14–T15	vs.	structured dishes, open	T24–T25
Jars (with neck)	T13, T16	vs.	hole-mouth jar	T17
Simple base with ring	T41	vs.	simple flat base	T42
Inward curved base with ring	T44	vs.	curved without ring	T43
Pierced lugs	T62–T63	vs.	handles	T64–T65

Tab. 2. Closed (T11–T17) and open (T21–T25) shapes of vessels, bases (T41–T44) and attached elements (T62–T65) as determined for the site Elateia 1.

like. One such piece is known from the EN (Nessos I, *Theocharis 1962.Pl. VIII.3*), and was vertically applied to the pot. In Elateia 1 lugs were never found in connection with a rim or base. Judging by the inner surfaces, they were attached to both open and closed vessels, probably in the central zone of the vessel.

Incisions made with pointed implements have been common since at least the MN, yet they are always small in number. The few specimens from Elateia 1 belong mostly to the light-brown category. Usually this type of decoration occurs in conjunction with impressions, framing them. Exclusively incised lines as an independent type of decoration appear only on 10 sherds.

Combinations of shapes and ornaments

For this preliminary analysis only a few but representative shapes were selected that were either common already in the EN (T11b and T21b, e.g., *Reingruber 2008.521, Fig. 6.1–6.4; Milošević-v. Zumbusch 1971.Taf. 1–14*), or they appeared during the MN (T16, T22d, T65b: *Mottier 1981.Typentafel E–F*). In addition, the newly described base (T44a) was evaluated. In Figure 9 one such combination of shapes is exemplified for each area: The simple convex bowl with beaded rim (T11b) occurs in all areas, but in different frequencies, mostly in NW and CSW areas. The simple open dish with beaded rim (T21b) also occurs throughout the site, but more often in the central four areas. The chronologically sensitive base T44 occurs more often in the three western areas and only rarely in the two southern ones. The opposite is true for the simple open, slightly concave dish with thinning rim (T22d) and strap handle (T65b), which is frequent in the south and east. Colored jars were widely used in SW and CNE.

In two areas (NW and CSW) only four of the shapes discussed above appear, while all six are present in the southern areas, and five shapes in two areas

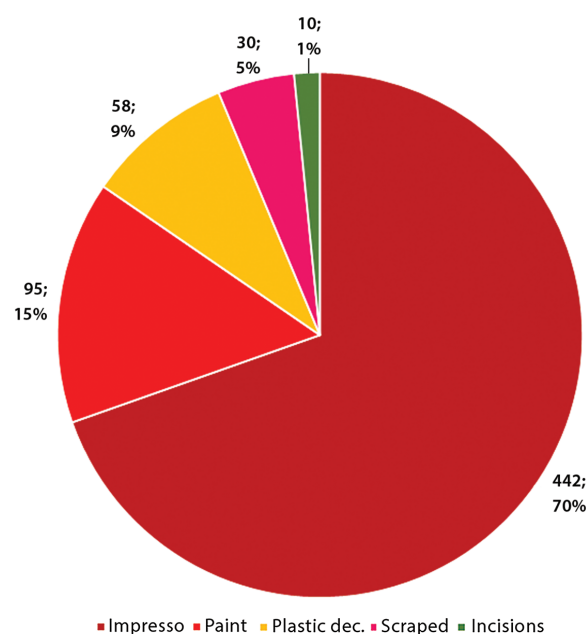


Fig. 7. Elateia 1, all five decorative styles (n=635 sherds).

(the area NE is not of statistical relevance). It remains to be evaluated with other statistical methods whether this distribution is of chronological relevance and/or of functional significance. Namely, within a settlement area of 10 hectares it is quite possible that not all areas were used with the same intensity and also not for similar activities. In this evaluation, we suggest that in addition to functional significance, temporal importance may also be relevant.

As pointed out above, some vessel types were decorated more often than others and with specific techniques and patterns. The analysis is based on 121 both decorated and diagnostic vessel fragments.

With one white painted exception, the closed shapes are always ornamented with impresso and scraped decoration (Fig. 8.16). However, while impresso appears on traditional convex shapes with ring bases (T11, T12 and T41), the scraped decoration is asso-

ciated with vessels with carinated walls, concave rims and flat bases. Often the walls of these vessels are very thin and may have a strap handle: such shapes are of a new appearance in the MN.

Impresso and scraped decoration, however, also occur on open shapes. As with the closed vessels, they are represented on mutually exclusive shapes: Impresso is again applied to open bowls well known since the EN II, and only rarely does impresso occur in association with the open concave shapes. It is never present on pointed rims (those are mainly painted or scraped) – a very clear dichotomy.

Chronologically sensitive are the bases T43 (15 examples) and T44 (31 examples). T43 is a flat base, reinforced on the inside by an additional layer of clay (Fig. 8.8). The base T44 has some similarities with the ring base T41 (Fig. 8.14), yet together with the body of the vessel it forms a slightly concave shape (Fig. 8.2). Single such pieces have been described already in Otzaki as

base shape II.4. There they occur in the late EN (*Milojčić-v. Zumbusch 1971.53, Taf. 15.24–25, Taf. XXV.12*) and early MN (*Mottier 1981. Typentafel D.4–22*). In Elateia 1 they are usually decorated with impresso, be it with a comb-like instrument or a pointed stick, yet never with fingernails nor with a broad instrument. These two shapes seem to have been especially designed for impresso pottery. As they are very well burnished inside, they could have originally belonged to open shapes in combination with the straight or slightly concave rims T21/T22 (Fig. 8), or, alternatively, with a slightly closed variant thereof (T11/T12).

Similar pairs of bases and rims can be found within the painted and scraped shapes, too: Here, the flat base T42 can be best combined with the open, slightly concave, pointed rim T22d (Fig. 8.3–6). The majority of the flat

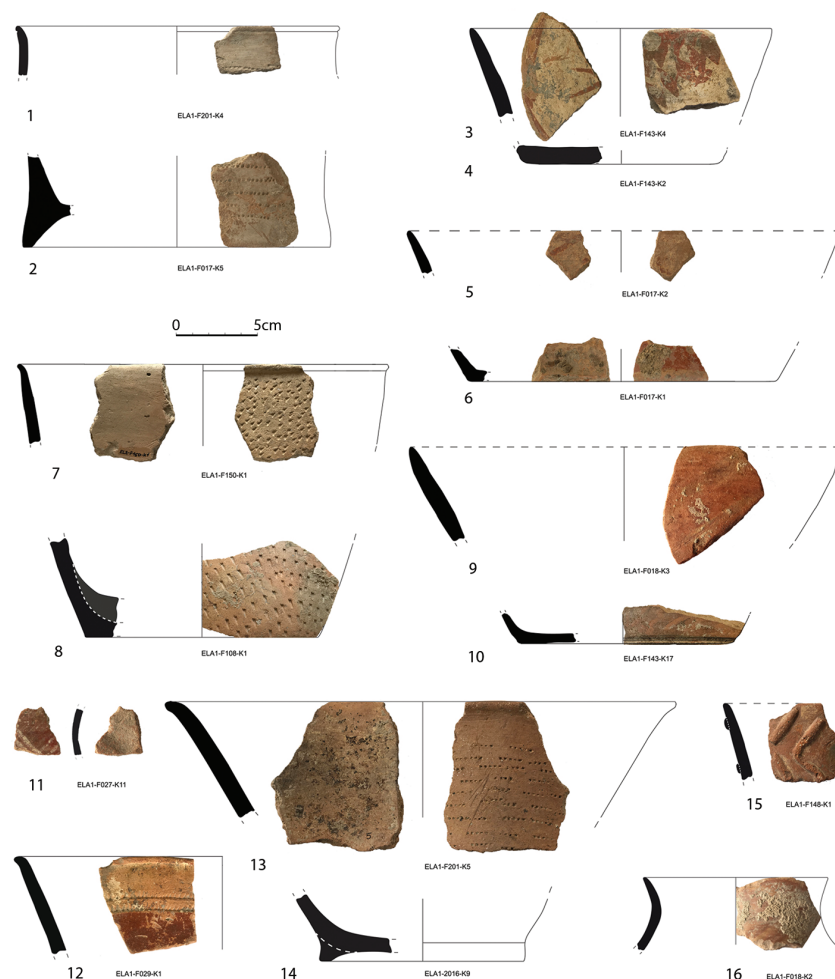


Fig. 8. Elateia 1, Reconstructed pottery shapes and decorative styles (drawings by Ellen Kühnelt; digitizing by Aggeliki Chalkia; photos by Frank Lünsmann, Agathe Reingruber).

bases with decoration are red painted (14) or scraped (3); in nine examples the paint also survived on the inside, proving that they belonged to open shapes.

The combination of wares, categories, shapes and decorative styles reveals which vessels (as end products) belonged to the 'standard repertoire' (Tab. 3), whereby combinations and exceptions are possible. In all styles, the patterns are of a simple linear nature, usually in the horizontal direction. Repetitions of lines and geometric elements can result in complex patterns. However, wavy patterns, circles or spirals are not present in the Elateia 1 repertoire. It can be assumed that most of the vessels were made, fired, used and also disposed of on site.

An interesting finding from this evaluation is that certain decorations were applied to certain shapes

(Tab. 3), meaning that from the outset shape and style were planned together by probably the same person, the potter as a specialist (Vitelli 1995). The thus emerging standard vessels with impressed decoration are: (1) the closed or open convex or straight-walled bowl with a ring base (e.g., Fig. 8.13–14); (2) the open bowl with a low or high arched base (T43/T44) together with a straight or slightly concave rim and usually decorated with comb-impressions (Fig. 8.1–2).

Vessels with red painting are mostly open, with a flat base, occasionally with a high ring base. The carinated or concave thin walls with a flat base and strap handle have scraped decoration, although this kind of decoration occurs with single specimens on different kinds of shapes. Plastic decorations and incisions are mostly related to open convex bowls.

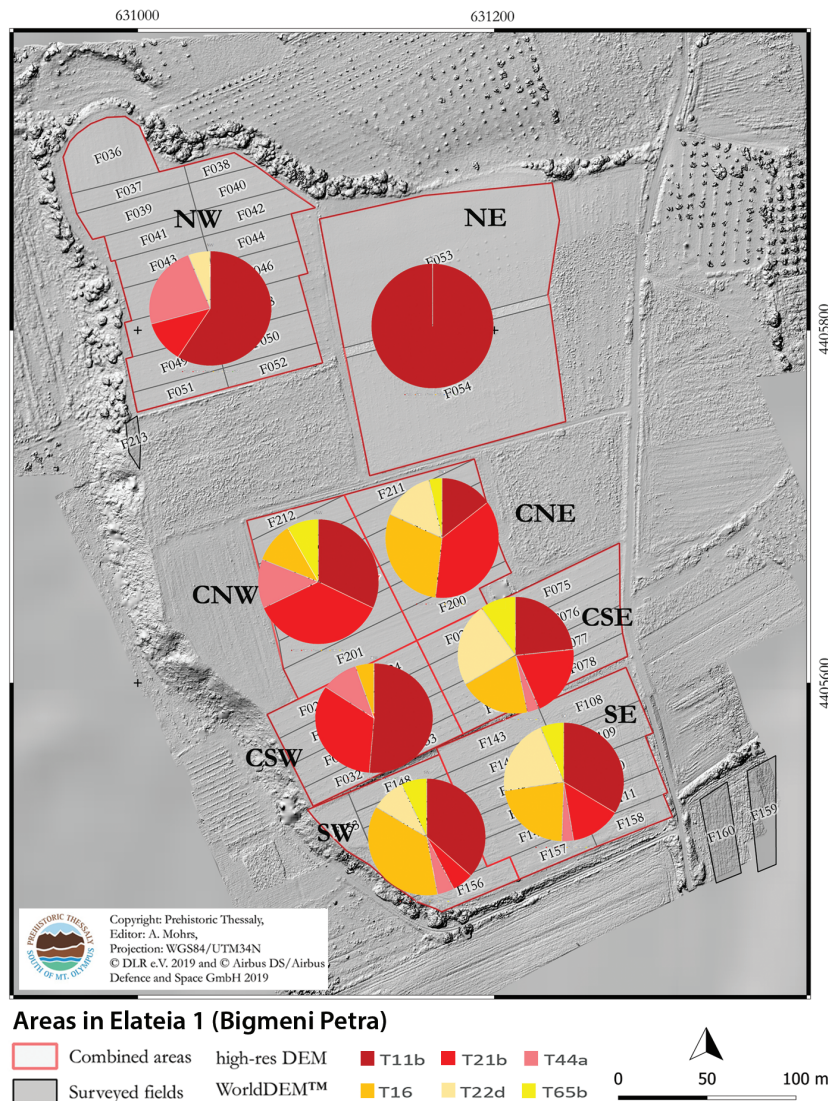


Fig. 9. Elateia 1, areas and frequencies of certain pottery shapes (% per area).

Both by the nature of the decoration and by the shapes, impressed and scraped pottery can be considered as two mutually exclusive categories: in Elateia 1 there are no carinated, impresso-decorated sherds, just as there is no scraped pottery on traditional ring bases. These two styles are never combined as they belong to the respective ends (extremes) of the spectrum, the one (impresso) having elements from the older end, the other (scraped) containing novel elements and thus belonging to the younger end. This result is of great importance for the relative chronology of the site.

All the more remarkable are the overlaps in styles, such as the overlap between impresso and painted (so-called 'fusion style', Fig. 8.12). In Elateia 1 these were an exception, with only two sherds of this kind, whereas in the later MN they became dominant. This could be an indication that the occupation in Elateia 1 ended early in the MN.

Relative chronological appraisal

In this first examination of the data recorded during our fieldwork some preliminary insights shall be proposed, which will be discussed in more detail in the final publication. As illustrated in Figures 6, 8 and 9, we were able to distinguish specific characteristics for each area, which relate to categories, temper, shapes and ornamentations. These particularities were not evenly distributed throughout the site, but instead showed distinct combinations of specific traits.

In the NW and CSW areas, the combinations of categories are similar, with the dark-brown surfaces being more frequent. The SW and SE areas show very strong affinities, which also exist with the CSE area, where the light-brown surfaces tend to be more common. The two areas CNW and CNE also show very similar combinations of pottery categories.

Figure 9 shows that the traditional shapes occur mainly in the western areas (T11b especially in NW and CSW), whereas the new shapes appear in the southern and eastern ones. Further, T44 was spread in the western part of the site. This chronologically sensitive shape appears in all areas and indicates that the site must have been founded at the transition EN/MN, since such bases never occur in the earlier EN and they were not found in the later MN, at least not in a stratigraphical context.

Regarding the decorative styles, all five of them are plotted here without going into further detail (Fig. 10). Even on such a general analytical level it is possible to show that impresso, plastic decoration and

red painted ornaments were found in all seven areas (there is only one sherd with plastic application in the NE, and this area is not further taken into account). If we look more closely at the distribution of the styles, we notice that in the NW, CNW and CSE impressed decoration clearly predominates. Few painted sherds were found in the NW, and no scraped sherds occurred there. Therefore, only four of the five styles are present in this area. The situation is similar in the CSW, although incised ornaments were not found there.

Like no other category, the scraped ware can be spatially very well delimited, since it occurs mainly in the SE, but also in the CNE, CNW and SW, and only sporadically in the CSW and CSE. Together with the painted sherds, they convey a very consistent pattern: the areas CNW, CNE, SW and SE are those in which the two styles commonly occur. Since it is known from archaeological literature that scraped pottery is a more recent feature of the MN and impresso an older one (*Mottier 1981*), signs of a horizontal shift in the settlement pattern can be traced therein.

Despite (or perhaps even because of) the few incised sherds, the division between the areas presents a clear picture: while in the two areas NW and CSW incised lines appear as boundary lines for impressed patterns, independent incised decoration is more likely to be found in the other areas (CNW, CSE, SW and SE).

Judging by both the distribution of shapes and of ornaments some conspicuous similarities can be pointed out regarding the individual areas.

Category	Decoration	Rim (type)	Rim (description)	Base (type)	Base (description)	Lug/ handle
Red burnt, red slip, light-brown	impresso (all styles)	T11–12b/c T21b/c	closed, convex open, convex	T41a/e	low ring	–
Light-brown, red burnt, red slip	impresso (comb, instr.)	T22a/e	open, concave	T44	raised base with ring	–
Light slip	painting (red)	T22d, T23d, T30d	open, concave; thin-walled	T41c, T42a	high ring, flat base	strap handle
Red slip	painting (white)	body-sherds only	closed	–	–	–
Light-brown, red burnt	scraped	T21–T24, T31/32y, T34	open (all types) thin-walled, carinated	T42a, T42b	flat base, reinforced	strap handle
Red slip, light-brown	plastic decor. (knobs)	T21b/c/d	open, convex	–	–	–
Red slip, red burnt	plastic decor. (lugs)	body-sherds only	–	–	–	pierced lug
Light-brown	incision	T21b	open, convex	–	–	–

Tab. 3. Elateia 1, predominant combinations of category, decorative style, and vessel type.

● Especially in the NW and CSW, similar combinations of categories, shapes and ornaments are present. In these areas only four of the six examined shapes and only four of the five decorative styles occurred. As was argued above, simple convex shapes and the impresso decoration both belong to the older features of pottery production.

● A completely different picture emerges in the southern part, where in the SW and SE (partly also in CSE) a much broader spectrum of both shapes and ornamentation can be seen. In particular, the shapes typical for MN (concave rims and collar vessels) occur there. They fit very well with the observed characteristics in terms of painted and scraped decorations.

● The CNW and CNE areas also show a certain degree of comparability, mainly on behalf of categories and shapes.

The earliest pottery features appeared in Elateia 1 within two foci in the western part of the site, and it is proposed that the original settlement was founded around (at least) two households in this area. New dwellings were built later on in the southern areas, and the NW area was probably abandoned as a living space but may have been further used for other purposes. The area CNW certainly was still in use, as new styles (scraped ware) appeared there too.

Apart from a chronological interpretation we should keep in mind also the potentially different kinds of uses of the areas. As will be shown in the final publication, based on the geophysical investigations and the evaluation of small finds from this site, next to the dwelling areas, other parts of the site were used for the transformation of resources, e.g., grains were milled, pots were burnt, animals were

slaughtered and processed: this was the case mainly in the areas CNW and CNE. Therefore, the fact that in these areas open bowls or collared jars were found may have to do with specific tasks carried out here.

Water must have been a major reason for the choice of this advantageous location by the first generation of settlers, and water may have been the reason why the last generation abandoned this site. Climate curves show that the absolute maximum of a warm and humid climate was reached around 5800 cal BC, a peak that was never equalled again in the entire Holocene of the last 11 600 years. Flooding and the swelling of small rivers into dangerous flows may have been a problem. If so, we can assume that the Tsantarli must have affected the settlement, and indeed there are two indications of

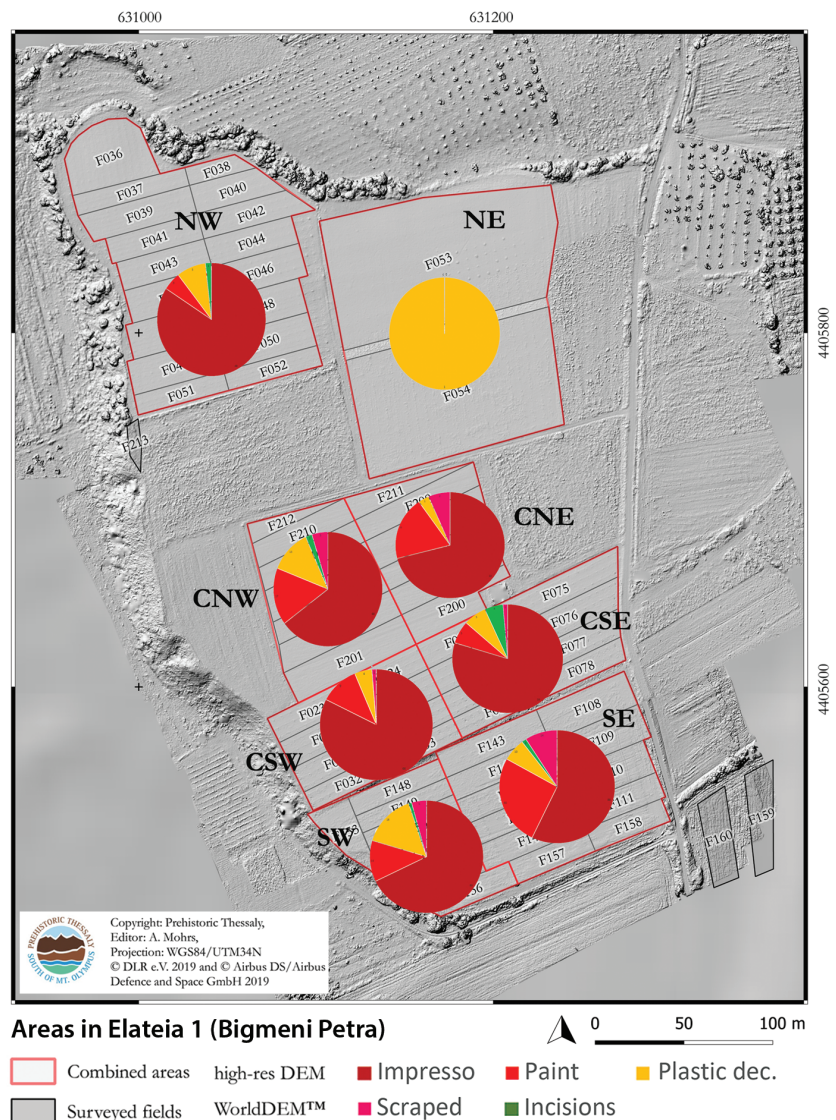


Fig. 10. Elateia 1, areas and frequencies of all five decorative styles (% per area).

this. As can be seen in the DEM (Fig. 2), there are two large gullies in the central part of the western escarpment, created by the drainage of excess water¹. During our pottery processing, we observed heavily eroded and even water-rolled sherds between contour lines 76 and 74, in the areas NE and CNW (Fig. 11). It is therefore possible that water entered the settlement from the NE and crossed the site towards the SW, where it formed the gullies. The fact that a lot of water collected in this area is also indicated by the animal bones, because it is precisely the bones from there that did not contain collagen, because it may have been washed out by the water.

Absolute chronology

Evaluation of the results obtained from short-lived animal bones

During our surface surveys we were able to collect 117 animal bones, teeth and shells. Of these 39 animal bones were selected for radiocarbon analysis. Priority was given to sheep-goat and cattle, whereas pig was omitted. First, a collagen test was undertaken in the Laboratory of Archaeometry, NCSR 'Demokritos' in Athens. This involved treating tiny fragments of bone with a mild acid (HCl, 0.6N) at 7°C for several days and monitoring the dilution of the inorganic part and the possible production of collagen. The degree of preservation was rather poor, so most of them failed to produce any collagen at all: either they dissolved completely or they left a dark sediment.

The 12 most promising samples with some quantities of collagen, although of lesser quality, were sent to the 'Klaus Tschira' AMS laboratory of the Curt-Engelhorn-Centre Archaeometry gGmbH in Mannheim. Unfortunately, several of them did not produce manageable quantities of collagen and were not further processed, yet six bones were found with sufficient datable matter. The collagen extracted was purified by ultrafiltration (fraction >30kD) and freeze-dried. It was then combusted to CO₂ in an Elemental Analyzer (EA) and the CO₂ was converted catalytically to graphite on iron foils.

Table 4 shows the results of the six samples that were finally measured with the collagen yield, the C/N ratio and the percent of carbon combusted. Of these, three contained less than 1% collagen, the li-

mit most of the laboratories accept for dating. These dates were run in 2018, before the laboratory in Mannheim lowered the limit to 0.6% collagen (report by Dr. Susanne Lindauer, May 6, 2020). However, the C/N ratio of these collagen samples with values between 2.9 and 3.3 indicates uncontaminated collagen and is regarded as highly reliable for dating and isotope analysis by most researchers (Brock et al. 2012.Fig. 4; Sealy et al. 2014). Therefore, we do not exclude these dates from the general assessment of the site, but refrain from placing too much emphasis on them because of the doubts raised by the low collagen yield: While one of the dates is consistent with the results from the samples with higher collagen yield, two gave very high or very low results compared to the others (Fig. 12). These two dates could still be valuable, as they may suggest human activity at the site not represented in the pottery record: MAMS-37738 at 6400–6260 cal BC (at 1 sigma interval) is of EN times and MAMS-37740 of late MN (5670–5620), but no archaeological materials from the surface of Elateia 1 can be related to either of these periods. Pottery styles of the EN (black-topped, early painted pottery) are absent and so are the late MN-styles (e.g., grey-on-grey). It is not impossible that the site was repeatedly visited during these times, but we cannot confirm this adequately yet. Pending the results from other bone samples we consider these two dates for the moment as outliers. Moreover, from the same field units (F148 and F149) results were obtained that comply with the relative chronological appraisal.

Only three of the eight areas supplied bones that were adequate for dating, and these are the areas with the lowest proportions of water-rolled sherds and presumably least affected by intruding waters. The only date from area NW is – together with a date from area SW – the oldest. From the latter area a second date (exclusive of the two discussed above) is somewhat younger and identical in result to the single date from area SE.

The three consistent dates cover a maximum period of 200 years: between 6000 and 5800 cal BC. When judging by the medians of the three reliable dates in Fig. 12, calibrated with the latest version of the program OxCal v4.4.4, rounded to the nearest decade², this period can be limited to only 110 years between 5980 and 5870 cal BC (this calculation benefits enormously from the precise dates with small

1 We would like to thank the geologist Sotiris Valkaniotis for drawing our attention towards these features.

2 Last updated: 1/3/2021, © Christopher Bronk Ramsey 2021; atmospheric data from Reimer et al. (2020).

standard deviations of only $c. \pm 30$ BP, but is somewhat impaired by the wiggle in this part of the curve). According to our previous evaluations of the Aegean data sets (Maniatis 2014; Reingruber et al. 2017), this period marks the beginning of the Middle Neolithic (MN I) in Thessaly. This result fits perfectly with that of the pottery analysis.

Pottery analysis points to a horizontal shift inside the settlement area: the oldest pottery styles appear in areas NW and CSW, the youngest in SW and SE. Although the absolute dates are too few to be statistically analysed in a model, they seem to support this view; at least they do not contradict the suggested horizontal shift. In view of their origin as surface material this result is all the more significant and encouraging. Based on the results we can even conclude that the site was inhabited only during

four to five generations (calculating with 25 years per generation in time).

Failed samples and post-depositional processes

Dating surface materials is admittedly not without risk. The fact that no later archaeological material than that from the MN was found on the surface of Elateia 1, as well as the good conditions of some of the animal bones, encouraged us to use them for dating purposes. To our surprise and relief, all results fall within the same time-range. This fact once more supports our appraisal of the relative chronology of the site and that indeed no younger activities took place on this spot. We were further rewarded by the fact that even bones that did not contain any collagen are not useless, since they also carry information: their specific position may not be a matter

of coincidence, but determined by post-depositional processes. If no collagen-matter is preserved, this may be an indication that it had been washed out when standing over longer periods of time in water. As such, it must be pointed out that from 12 samples collected from five fields in the northern areas NW and CNW (F046, F049, F051, F201, and F213), only a single bone contained enough collagen for dating (F213-B1) – a ratio of 1:12. On the other hand, the bones from the southern part of the site, south of the almond grove, gave almost three times as good results: five out of 24 samples contained datable collagen (ratio of nearly 1:5). The fields from which they derive in areas SW and SE (F145, F148, and F149) are among the higher parts of the settlement, which were presumably safe from intruding waters.

We conclude therefore that water did indeed pose a problem at the end of the site's occupation and for several generations thereafter since the dwellers never returned. Mo-

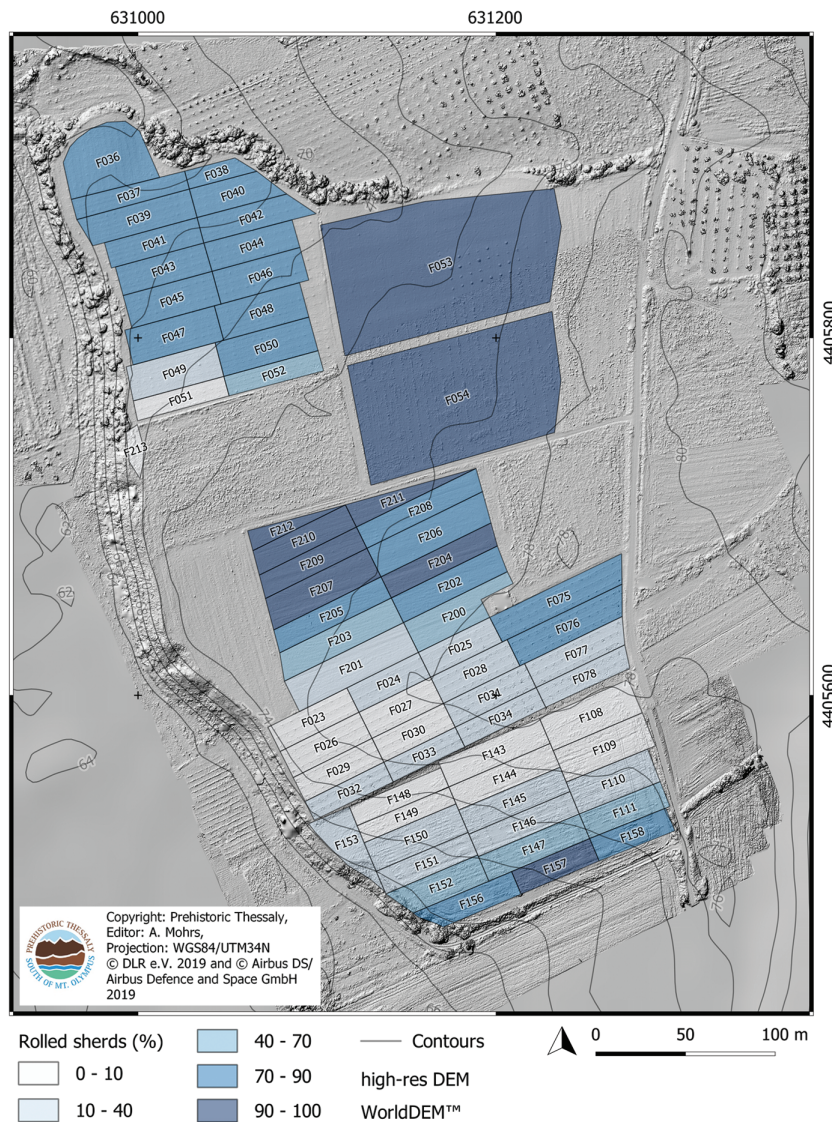


Fig. 11. Elateia 1, field units and frequency of worn sherds with surfaces as if rolled by water (in %).

MAMS	DEM	BP	+/-	d13c	calBC 1σ	%C	C/N	% Collagen	Context	Area	Material
MAMS-37738	DEM-3269	7464	26	-19.6	6400–6250	21.2	3.2	0.6	F148-B1	SW	cattle
MAMS-37739	DEM-3270	7098	26	-21.4	6020–5920	27.8	3.2	1.7	F148-B2	SW	n.d.
MAMS-45204	DEM-3403	7044	33	-13.9	5990–5890	32.9	3.3	6.1	F213-B1	NW	n.d.
MAMS-37741	DEM-3272	6995	25	-20.6	5970–5840	28.8	2.9	1.3	F149-B5	SW	large mammal
MAMS-37737	DEM-3268	6989	25	-18.3	5970–5830	19.3	3.2	0.5	F145-B3	SE	cattle?
MAMS-37740	DEM-3271	6732	26	-20.5	5670–5620	19.7	3.3	0.5	F149-B4	SW	sheep/goat

Tab. 4. ¹⁴C dates from Elateia 1 with samples containing insufficient collagen marked in red.

reover, subsequent dense vegetation cover may have been a reason why the area was not inhabited again thereafter.

Conclusions

A process that started in the previous generations of archaeologists and is still a challenge for our generation (and will certainly continue into the next) is the integration of results obtained by relative chronological appraisal into the system of a revised absolute chronology. One such example where this task is still ongoing is the re-interpretation of finds previously considered to be of late EN date, where the EN was expected to have lasted until 5800 cal BC. With the firmly established ¹⁴C chronology the time between 6000 and 5800 cal BC is demonstrably of early MN. Indeed, pottery categories from the EN were still in use in the MN, especially the red monochrome pottery (with or without a slip) and red painted surfaces, although new shapes were added to the repertoire. Therefore, on the basis of monochrome pottery alone a reliable relative-chronological dating cannot be obtained, and this fact is very important to acknowledge in connection with older

appraisals dating back to the 20th century and the first years thereafter.

Transitions between phases are never clear-cut: this is a simple but sometimes forgotten truth. With only a few exceptions, older styles continue into the new phase (established by archaeologists). For example, red coating and red paint on a (predominantly) light-brown clay surface had been in use in Thessaly since the EN II (c. 6300 cal BC). All such examples from Elateia 1 preserved on diagnostic sherds can be dated to the Middle Neolithic. Even though the materials were collected from the surface, they still belong to a settlement that was inhabited for few generations only and that had not been damaged by subsequent occupation events.

Based on the evaluation of the pottery and together with the results from radiocarbon analysis, we are now able to determine more precisely which pottery categories and styles were in use coevally: the different categories correlate with certain decorative styles applied to them. One such ‘standard’ is clay with quartz temper, usually well smoothed and burnished, often coated with a red slip after impressed

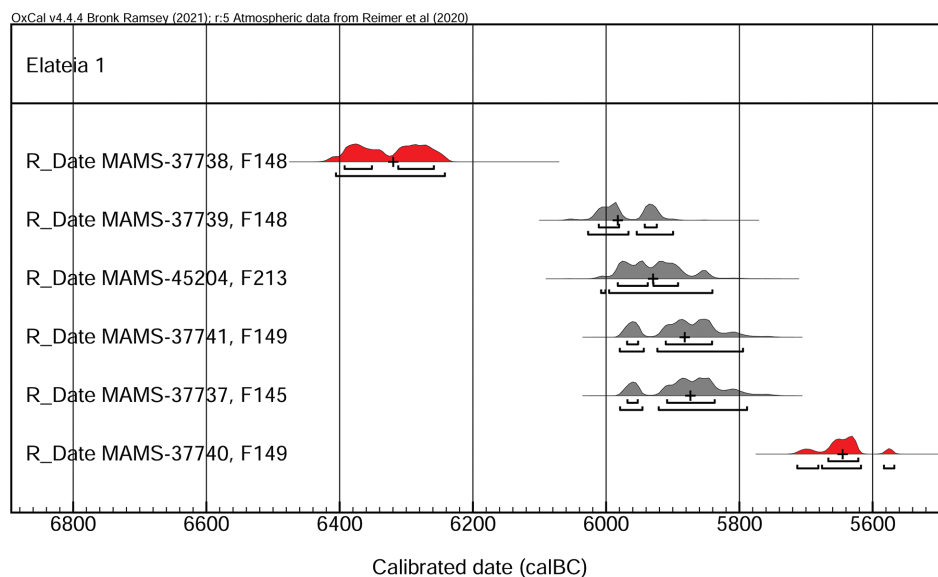


Fig. 12. Calibrated ¹⁴C dates from Elateia 1 with two potential outliers marked in red.

decorations were applied to the still elastic surface. A second, but much rarer 'standard' is lime-tempered clay, usually with a burnished or polished surface. Yet to such vessels a light slip and red colour were added, or the slip was first added and then scraped away. If the painted or scraped lines were burnished over before the firing took place in an oxidizing atmosphere, they obtained a blurred appearance.

We were thus able to identify certain style combinations that can be anchored relative-chronologically with the help of published inventories from excavated sites: we could show that no materials predating 6100 cal BC and none postdating 5600 cal BC were found in Elateia 1. Additionally, the narrowing down of the sites' occupation within a maximum of 200 and a minimum of 110 years with the help of radiocarbon dates can serve to even better grasp the more or less coeval pottery styles: for this reason, the combination of styles as established at this site is all the more significant.

The impressed ornaments belong to the oldest documented decoration in Elateia 1. This style therefore cannot be confined to a specific phase of the EN (the so-called Pre-Sesklo of the EN III): it continues with new shapes and styles into the later MN. Indeed, the overwhelming amount of such products belong to the MN I and not to the EN III. Therefore, in the future more thought should also be given to such sherds when discussing their chronological position.

Two very different techniques in applying decoration on pottery – to penetrate the clay on the one hand and to add paint to it on the other – were practiced coevally during the EN and early MN, first without being combined. This finding could indicate that the vessels were not produced at the level of individual households, but by specialized potters. Eventually, impressions were accompanied by red stripes, and only later a 'fusion style' was created

with red-on-white paint added to impressed surfaces. In Elateia 1 only one such sherd was found, but in Otzaki this kind of decoration prevailed during the later MN (*Mottier 1981.Typentafel D*). The case is similar with the scraped surfaces that came in use in Elateia 1 at a later stage during the site's occupation.

For Elateia 1 a precise stratigraphical context is not given, as all the sherds collected were from the surface. In the case of the survey material we expected some displacements due to cultivation and other human interventions or due to geomorphological transformations. But to our surprise, neither was the material randomly scattered nor was there a noteworthy mixing or blending that would have blurred the picture, and only the eroded sherds may have been carried over short distances by water. This made it possible to distinguish, on the one hand, focal points of activity and, on the other hand, different combinations of categories, wares, shapes and styles in certain areas. We therefore encourage accurate three-dimensional measurements of finds during systematic surveys, as their informative value should not be underestimated. At the flat site of Elateia 1, they led to the creation of a model that shows not only when, but also how the site was used 8000 years ago. This model is complemented by non-invasive geophysical surveys (forthcoming) and needs to be validated by excavations in the future.

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References

- Anetakis M. 2020. Synoikia Neraida, Odos Ikarias 80 (oikopedo Papageorgiou). *Archaeologiko Deltio* 69. *Chronika B* 2014: 1434–1436.
- Brock F., Wood R., Higham T. F. G., Ditchfield P., Bayliss A., and Bronk Ramsey C. 2012. Reliability of Nitrogen Content (%N) and Carbon: Nitrogen Atomic Ratios (C:N) as Indicators of Collagen Preservation Suitable for Radiocarbon Dating. *Radiocarbon* 54(3–4): 879–886. <https://doi.org/10.1017/S0033822200047524>
- Gallis K. 1992. *Atlas Proistorikon Oikismon tis Anatolikis Thessalikis Padiadas*. Etaireia Istorikon Erevnon Thessalias. Larissa.

- Kilian K. 1976. Der Siedlungshügel Bunar Baschi bei Sikourion. In V. Miložić, A. von den Driesch, K. Enderle, J. Miložić-von Zumbusch, and K. Kilian (eds.), *Die deutschen Ausgrabungen auf Magulen um Larisa in Thessalien 1966: Agia Sofia-Magula, Karagyös-Magula, Bunar Baschi*. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes 15. Verlag Habelt. Bonn: 65–71.
- Maniatis Y. 2014. Radiocarbon dating of the major cultural changes in prehistoric Macedonia: Recent developments. In E. Stefani, N. Merousis, and A. Dimoula (eds.), *A Century of Research in Prehistoric Macedonia 1912–2012*. International Conference Proceedings. Archaeological Museum of Thessaloniki. Thessaloniki: 205–222.
- Miložić-v. Zumbusch J. 1971. *Die deutschen Ausgrabungen auf der Otzaki-Magula in Thessalien I. Das frühe Neolithikum*. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes 10. Verlag Habelt. Bonn.
- Mottier Y. 1981. *Die deutschen Ausgrabungen auf der Otzaki-Magula in Thessalien: Das mittlere Neolithikum*. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes 22. Verlag Habelt. Bonn.
- Reimer P., Austin W., Bard E., + 38 co-authors, and Talamo S. 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon* 62(4): 725–757. <https://doi.org/10.1017/RDC.2020.41>
- Reingruber A. 2008. *Die Argissa Magula: Das frühe und das beginnende mittlere Neolithikum im Lichte transägäischer Beziehungen*. Die deutschen Ausgrabungen auf der Argissa Magula II. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes 35. Verlag Habelt. Bonn.
- Reingruber A., Toufexis G., Kyparissi-Apostolika N., Anetakis M., Maniatis Y. and Facorellis, Y. 2017. Neolithic Thessaly: Radiocarbon dated periods and phases. *Documenta Praehistorica* 44: 34–53. <https://doi.org/10.4312/dp.44.3>
- Reingruber A., Toufexis G., Valkaniotis S., and Manakos A. 2021. The Basins of Sykourio and Elateia in Northeastern Thessaly: an attempt at reconstructing the (pre)historic landscape. *Proceedings of 6th Scientific Conference on Archaeological Works in Thessaly and Central Greece (AETHSE)*. University of Thessaly and Ministry of Culture. Volos.
- Sealy J., Johnson M., Richards M., and Nehlich O. 2014, Comparison of two methods of extracting bone collagen for stable carbon and nitrogen isotope analysis: comparing whole bone demineralization with gelatinization and ultrafiltration. *Journal of Archaeological Science* 47: 64–69. <https://doi.org/10.1016/j.jas.2014.04.011>
- Theocharis D. R. 1962. Apo ti neolithiki Thessalia. *Thessalika D*: 63–83.
1973. *Neolithic Greece*. National Bank of Greece Athens.
- Toufexis G. 2017. *Oikistiki drastiriotita kai organosi tou horou stous oikismous tis Neoteris Neolithikis sti Thessalia: Paradeigmata apo tous oikismous ston Profiti Ilia Mandras, Makrychori, Galene and Rachmani*. Unpublished PhD thesis. University of Thessaly. Volos. <http://hdl.handle.net/10442/hedi/41426>
- Vitelli K. D. 1984. Greek Pottery by Experiment. In P. M. Rice (ed.), *Pots and Potters. Current Approaches in Ceramic Archaeology*. Institute of Archaeology. University of California. Los Angeles: 111–131.
1995. Pots, potters and the shaping of the Greek Neolithic. In W. K. Barnett, J. W. Hoopes (eds.), *The Emergence of Pottery: technology and innovation in ancient societies*. Smithsonian Institution Press. Washington: 55–64.