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TOWARDS A REGIONAL HISTORY

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Cover: The Early Hellenistic fortress Agios Donatos of Zervochori seen from the south. Photo: Esko Tikkala.

Layout: Vesa Vahtikari

Contents

Geo-archaeological Investigations at Mavromandilia of Prodromi

Mika Lavento and Maria Lahtinen

Since the early 1990s, geo-archaeological investigations have been adopted as a basic part of archaeological projects carried out in the Mediterranean. Geo-archaeological or other kinds of natural scientific methods have for instance been used when searching for new sites in surveys. Such methods can be applied for modelling the environment of the past, to tell why sites of a certain period are situated where they are, and to date sites and even individual finds.[1]

Only very few sites are normally completely excavated. Still, archaeologists want to know how large sites are, what kind of find concentrations they include, or to get a better understanding of the different phases of sedimentation that have taken place after the sites were deserted. It is important to know if all activity at the site is synchronous, or if there exist individual phases of settlement which have nothing to do with each other, as well as what kinds of cultural layers remain unexcavated and thus are available for research in the future.[2]

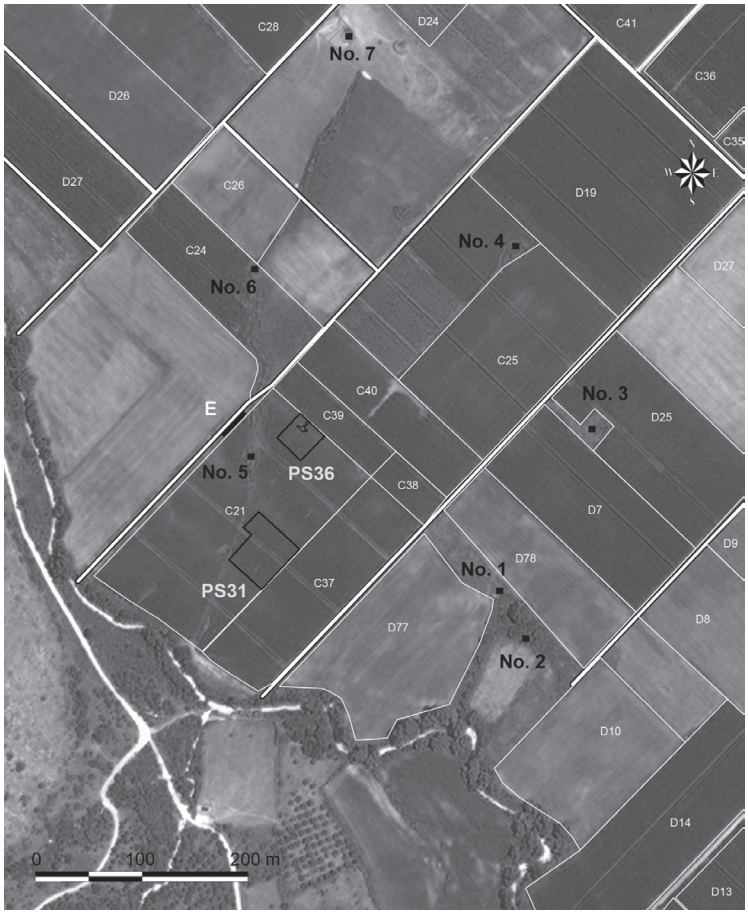

Fig. 1. Satellite photo of Mavromandilia, showing the location of PS 36 in relation to PS 31 and the spot excavated by the Greek Archaeological Service (E). Marked are also the fields walked as tracts by the Thesprotia Expedition as well as the location of springs (nos. 1-7).

The objective of this chapter is to give a description of the geo-archaeological setting of the mainly Early Iron Age site, or sites, located at Mavromandilia of Prodromi, ca. 250 m east of the Kokytos river (Figs. 1-2 and 4). This location was the object of a rescue excavation conducted

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[1] See e.g. Bintliff 1977, 1992; Cherry *et al.* 1991; Alcock *et al.* 1994.

[2] See e.g. Wiseman and Zachos 2003; Jansen *et al.* 2005; Rapp and Hill 1998; Bescoby 2007.

Fig. 2. Photo of Mavromandilia from the west side of the Kokytos river. The arrows show the approximative locations of the spot excavated by the Greek Archaeological Service, PS 36 and PS 31 (from left to right).

by the Greek Archaeological Service in 2005,[3] followed by intensive surface survey and trial excavation conducted by the Thesprotia Expedition in 2006, focusing on two new find concentrations, PS 31 and PS 36.[4] Parallel with the trial excavation of PS 36 geo-archaeological research was carried out in the area in 2006 and 2007 by taking soil samples for analysis with a hand auger (Fig. 3).[5]

This chapter aims at answering the following questions:

1. Are we dealing with one large site or several smaller sites? How large an area is covered by the site(s)? Can the geo-archaeological investigation add any new information concerning the function of the site(s)?

2. What is possible to say about the stratigraphy of the site(s)? Are there several different cultural layers belonging to different phases?

3. What sedimentation conditions prevailed at the site(s) before it was used and after it was abandoned? Why is the cultural layer in some places relatively thick?

4. What is the relationship of the site(s) to the Kokytos river? Has the river bed stayed relatively stable throughout the past, or should we assume that it was situated somewhere else during the period of use of the site(s)?

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[3] See Tzortzatou and Fatsiou, this volume.

[4] See J. Forsén, this volume.

[5] We would like to thank all team members who took part in the drilling work as well as B. Forsén, J. Forsén and J. van Leuven for constructive criticism and help while writing this chapter. All illustrations are made by E.Tikkala, Fig. 4 on the basis of a general map drawn by J. Okkonen and T. Okkonen and Figs. 7-8 on the basis of drawings made by us.

General geological setting and hydrological conditions

Fig. 3. The geo-archaeological team drilling with the hand auger at Mavromandilia.

The find concentrations PS 31 and PS 36 as well as the spot excavated by the Greek Archaeological Service are all located in two fields sloping gently towards the west and the Kokytos river (Figs. 1-2 and 4). A series of hills rise steeply on the opposite side of the river, giving space for only some single fields between the meandering river and the hills. Probably the river bed at some point, several thousands of years ago, was located further to the east, towards the middle of the valley, and then later moved to its present place. The reason for this movement is unclear and can only be elucidated through more detailed geological information and geophysical observations of the sedimentation conditions in the area. At any rate the location of the Early Iron Age site(s) at Mavromandilia indicates that the Kokytos river at least for the last 3,000 years has stayed more or less at its present place.

The meandering of the Kokytos river is an essential question to ponder. The satellite photograph from 2005 reveals close to Mavromandilia at least part of an earlier river bed, which today is blocked (Fig. 1). It is probable that changes in the meandering of the river took place also during the Early Iron Age, although the effect of such changes on the site(s) is unclear. Since the Second World War, active cultivation and effective utilisation of water resources have drastically changed the water conditions of the area. Draining of the fields and overuse of water have caused several seasonal lakes in the region to disappear. Thus, today also the Kokytos river nearly dries out in the summers although this clearly was not the case in the past.

Another hydrologically interesting feature of the Mavromandilia area is the group of small springs that exist in its neighbourhood. At two of them (Fig. 1, nos. 4 and 7), located to the northeast of PS 36, the water rises up through the surface, developing small

seasonal ponds in the spring, from where the water runs towards the southwest and the Kokytos river. These springs produce a trickle of water also today during dry summers. The water from spring no. 4 is today led towards the Kokytos river in a ditch ca. 50 m to the south of PS 36, the location of the old water course being unclear (Fig. 4).

Most water has apparently run from the northernmost spring, from where at some stage it has formed a small stream leading to the Kokytos river (Fig. 4). This stream passes between PS 36 and the place excavated by the Greek Archaeological Service. The stream has recently been covered by soil in order to create new and larger fields, but on

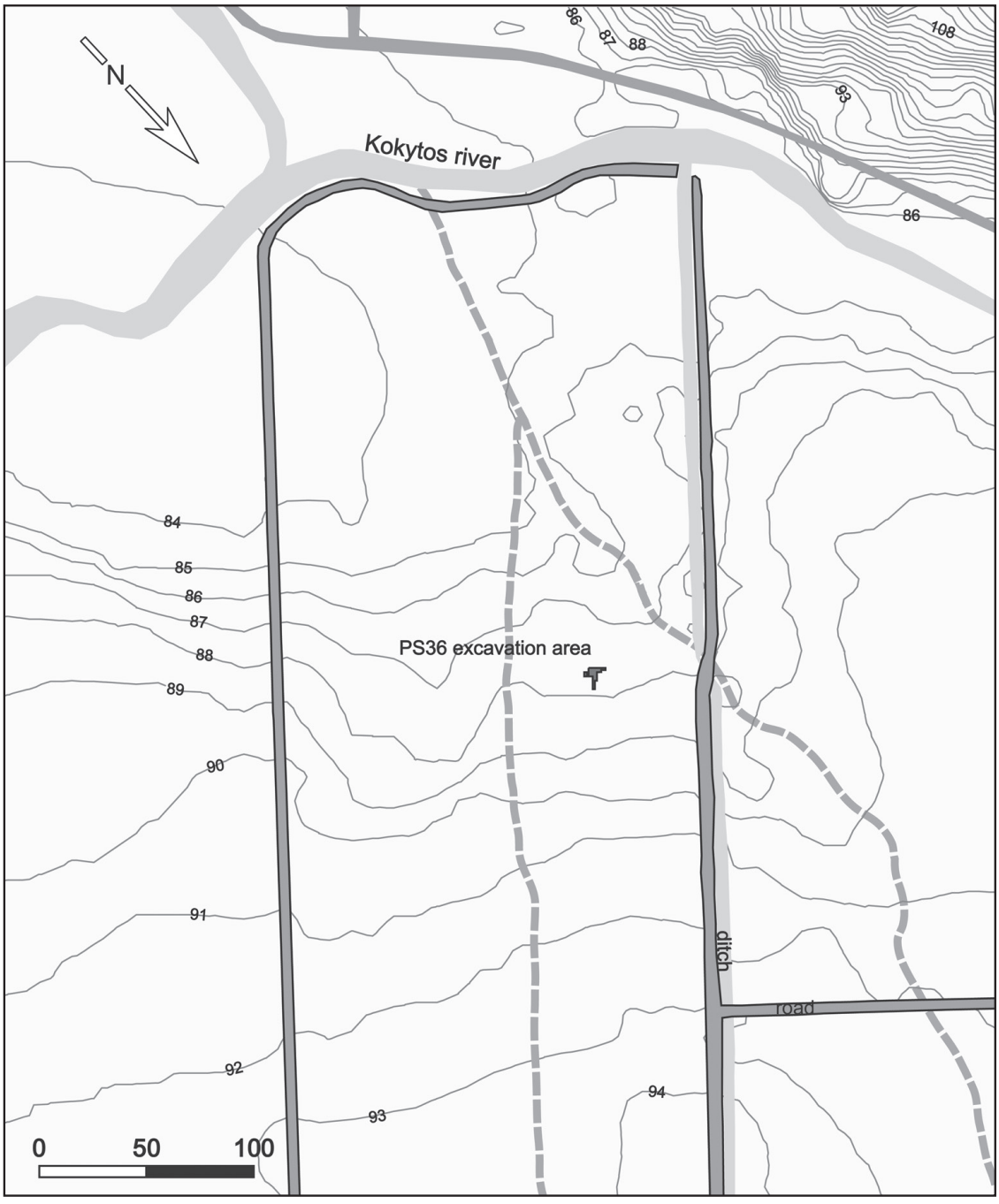

Fig. 4. Topographical map of Mavromandilia showing the PS 36 excavation area in relation to the two assumed water streams leading to the Kokytos river.

the basis of our drillings it may at one stage have been up to 2-3 m deep. Water still runs below the topsoil along the previous stream channel, e.g. emerging from the northern side of the deep ditch that some years ago was dug along the new dirt road running from the northeast to the southwest, thereby cutting through the old stream. The subsurface water channel was also visible in augering hole no. 13, where running water was found at a depth of ca. 3.2 m below the contemporary topsoil.

Springs, such as nos. 4 and 7 in Fig. 1, may through time be covered by natural sedimentation or human activities and can also find new outlets. Thus the farmers have covered another similar natural spring in the neighbourhood (no. 3) and channelled the water onwards to two new artificial springs (nos. 1 and 2). A close study of the satellite photograph from 2005 reveals two further possible springs (nos. 5 and 6) visible as shallow depressions. They are located along the small stream running from the spring no. 7 to the Kokytos river, thus indicating that the stream may have received water at several places along its course. One of these possible dried-out springs (no. 5) is located between PS 36 and the spot excavated by the Greek Archaeological Service.

The soil at Mavromandilia consists mostly of loam and silty clay favourable for cultivation. The plough zone reaches a depth of 35-40 cm. It is easy to penetrate with the auger whereas the sediment below it sometimes includes gravel and stones. It is conspicuous that these deeper sediment layers are coarser, including limestone particles and gravel, as well as cultural layers which at least partly are in their original position. The genesis of these layers is probably connected with conditions where running water has brought and accumulated coarse particles together with thinner layers of finer soil.

The depth of the fine topsoil varies considerably at Mavromandilia. The cultural layers revealed in the excavation of PS 36 and at PS 31 were located just below the plough zone, whereas the layers excavated by the Greek Archaeological Service were recovered as deep as 1.5 m below surface. This post-Iron Age sedimentation is partly due to natural causes with the small stream bringing fine-grained soil downhill, but partly also caused by the farmers filling in the stream in order to create larger fields better suiting modern cultivation. Mavromandilia is thus a perfect location for a settlement, with access to plenty of water in the springs and the Kokytos river as well as to soils favourable for cultivation.

Nature and size of the settlement

In order to clarify the size of the site(s) at Mavromandilia as well as the thickness of the cultural layers, a total of 89 augering holes were made with a hand-driven auger with a cone of 5 cm in diameter, in addition to a section (no. 61) that was cleaned in the ditch (Figs. 5a-b). Most of the augering holes were made in an area of 30 x 30 m, next to the excavation trench of PS 36, where the distance between the holes was only 5 m. Soil samples were taken at different depths in the holes in order to analyse, among other things, the phosphorus content. Anomalous phosphorus content in the soil indicates human occupation and thus is one parameter for defining what is a dwelling site or a cultural layer.[6]

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[6] For the methodology see e.g. Lavento 2003; Lavento *et al.* 2008.

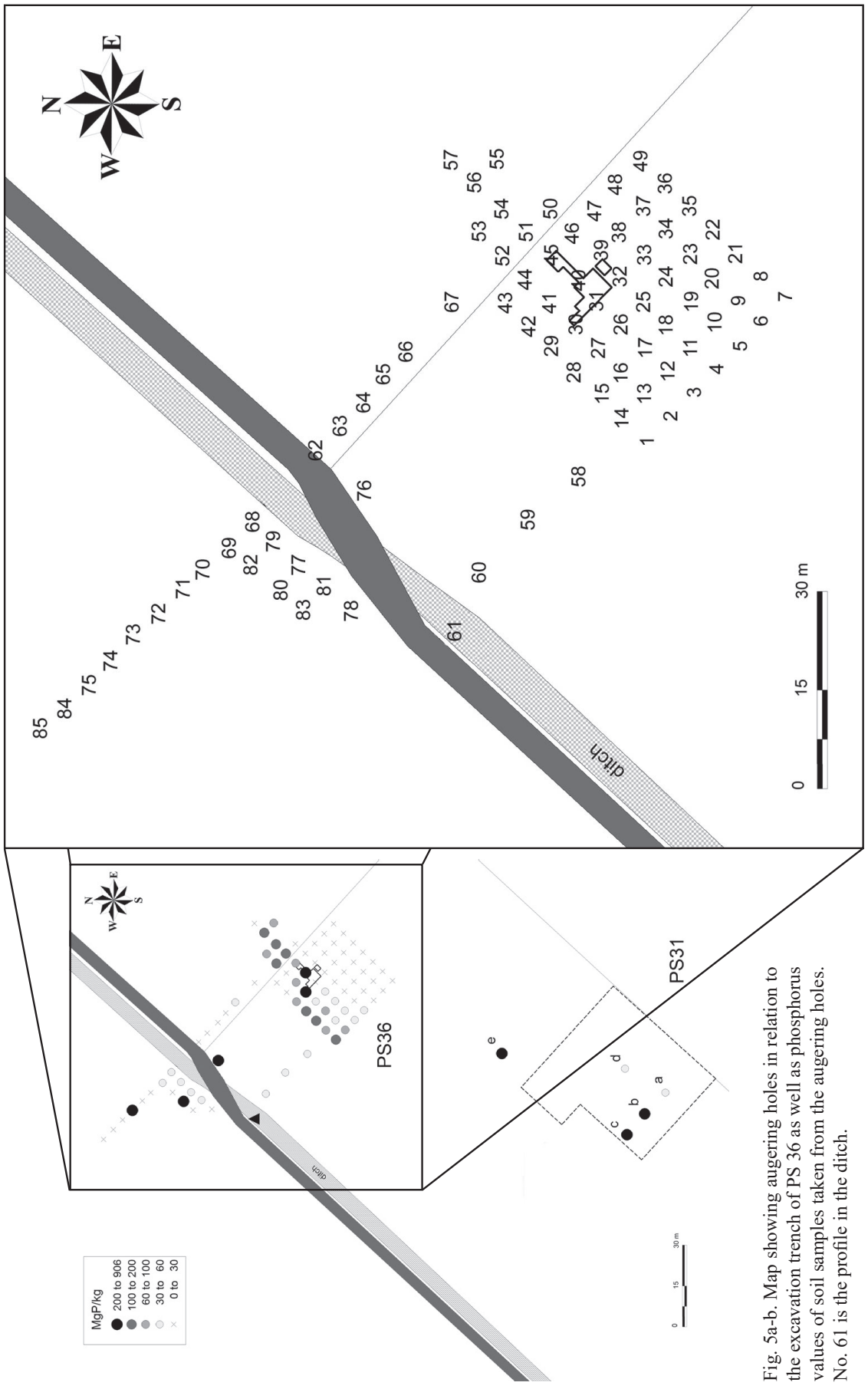

Fig. 5a-b. Map showing augering holes in relation to the excavation trench of PS 36 as well as phosphorus values of soil samples taken from the augering holes. No. 61 is the profile in the ditch.

In many cases, already the topsoil included remains of tiles, ceramics and sometimes even bones. Still, the cultural layer which was untouched by contemporary cultivation was normally situated at a depth of ca. 25-110 cm below surface, and in some cases even deeper. In most of the augering holes around the excavation trench of PS 36 the cultural layer was located at a depth of 40-60 cm below surface, whereas on the northwest side of the ditch it was located deeper, in most cases around 90-130 cm below the surface (Fig. 6). In general the cultural remains occur in a layer mixed with coarse sand or gravel. This is hardly surprising as the coarse, mixed gravel and sand constitutes a more solid ground for any buildings than loam without gravel. Soil mixed with coarse sand or gravel also absorbs rainwater better than clay and loam and thus dries up faster.

In the augering holes located to the south and southeast of the excavation trench of PS 36 the cultural layer is less clear or disappears altogether. The same holds for the two augering holes furthest towards the northwest (nos. 84-85). Traces of cultural layers, even though less clear ones, were on the other hand noted in all augering holes located between PS 36 and the ditch. The thickest cultural layers, at the same time richest in artefacts, were located to the southwest and northeast of the excavation trench in PS 36 as well as in the holes cored to the northwest of the ditch (Fig. 6).

The phosphorus content of the soil was analysed at the depth of the cultural layer and, in cases where no clear cultural layer was visible, usually at a depth of 40-60 cm below the surface. The phosphorus values are in general relatively low, the mean value of the samples being 73 mgP/kg if the samples from PS 31 are not taken into account. Altogether the differences between the values are considerable, the lowest value being 0 mgP/kg and the highest 906 mgP/kg (Fig. 6). Furthermore, the anomalous values seem to correlate with the existence of a clear cultural layer in the augering holes, thus strengthening the picture of three concentrations of activity: one around the excavation trench of PS 36, another at PS 31, and a third next to the spot excavated by the Greek Archaeological Service (Figs. 5a-b).

Although the augering holes normally did not reach deeper than 60 cm, some of the holes were drilled as deep as possible in order to enable us to reconstruct the sedimentation history of the site(s) and to test whether several habitation phases existed or not. Geo-archaeological work conducted at other sites has proved that several phases of resettlement may occur, i.e., local processes of sedimentation have at different stages buried earlier settlement phases, thus creating superimposed cultural layers separated from each other by sterile layers.[7]

In the great majority of augering holes, only one single cultural layer was observed. However, hole no. 13 reached a depth of 3.2 m below surface (Fig. 7). Remains of a cultural layer were visible already immediately below the topsoil. After a sterile dark soil layer at ca. 60-100 cm depth followed what looked like two further cultural layers at a depth of 100-170 and 220-250 cm below the surface, separated from each other by sterile layers of clay and gravel. These two deeper cultural layers contained charcoal and fragments of tiles or ceramics. The phosphorus contents of soil samples taken at a depth of 43-48 cm (57 mgP/kg) and 235-240 cm (47 mgP/kg) below the surface are also slightly anomalous and most likely caused by anthropogenic activity. On the other hand, the soil sample taken at a depth of 110-115 cm below the surface has a low phosphorus content.

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[7] See e.g. Forsén and Forsén 2003; Zangger 1993; van Andel and Zangger 1990.

No.	Cultural layer noticed at the following depth(s)	Depth at which soil sample was taken	Phosphorous value (mgP/kg)
1	20-45	40-48	138
2	30-45	40-47	73
3	20-47	42-47	39
4	35-50	42-47	47
5	30-45	42-47	23
6	no c.l.	42-47	20
7	no c.l.	42-47	20
8	no c.l.	43-48	25
9	25-50	43-48	22
10	15-40	40-46	26
11	35-50	43-48	20
12	20-58	42-47	38
13	100-170	43-48	57
	220-250	100-115	16
		200-205	20
		235-240	47
		305-310	27
14	35-60	45-50	84
15	40-65	43-48	169
16	25-35	44-49	94
17	25-45	46-48	47
18	40-50	43-47	15
19	no c.l.	55-60	25
20	no c.l.	53-58	21
21	no c.l.	53-58	19
22	no c.l.	55-60	16
23	no c.l.	53-58	20
24	25-47	55-60	15
25	33-50	55-60	23
26	27-47	43-47	58
27	35-45	43-47	52
28	40-110	54-59	114
29	40-70	55-60	67
30	30-60	43-48	354
31	35-60	55-60	21
32	10-55	55-60	23
33	no c.l.	53-58	1
34	35-40	55-60	2
35	no c.l.	53-60	2
36	no c.l.	53-58	2
37	no c.l.	54-59	12
38	30-38	56-60	17
39	25-50	55-60	19
40	40-77	45-55	449
41	20-70	43-48	85
42	no c.l.	53-60	23
43	-	no sample	0
44	30-75	41-47	16
45	67-97	82-87	72
46	30-100	55-60	10
47	20-35	55-60	12
48	no c.l.	55-60	9
49	no c.l.	50-55	7
50	no c.l.	55-60	1
51	28-77	55-60	158
52	38-70	53-60	101
53	36-99	54-58	91
54	no c.l.	53-58	117
55	52-82	54-60	70
56	30-72	54-58	170
57	30-56	52-56	8
58	35-125	60-65	33
59	15-101	60-64	55
60	55-71	61-71	34
62	35-45	60-67	16
63	25-35	45-50	20
64	35-40	35-40	24
65	30-45	50-55	29
66	20-55	44-48	41
67	25-55	50-55	5
68	50-70	73-79	51
69	50-80	50-55	33
		195-200	10
70	25-180	52-57	10
71	120-140	50-55	10
		127-130	14
72	78-94	78-83	233
73	45-80	65-70	11
	130-170	155-160	10
74	40-150	84-90	20
75	65-95	64-70	0
76	10-70	48-59	298
77	45-110	55-60	57
	115-195	105-110	34
78	90-120	105-110	18
79	30-150	105-110	59
80	90-120	100-105	217
81	100-129	120-124	54
82	10-20	95-100	0
83	50-130	88-93	2
84	no c.l.	40-46	0
85	55-65	64-67	2
a	no c.l.	54-64	51
b	1-50	50-60	906
c	1-50	48-56	870
d	42-80	60-65	31
e	no c.l.	50-60	480

Fig. 6. Depth of cultural layers and phosphorus values observed in the augering holes.

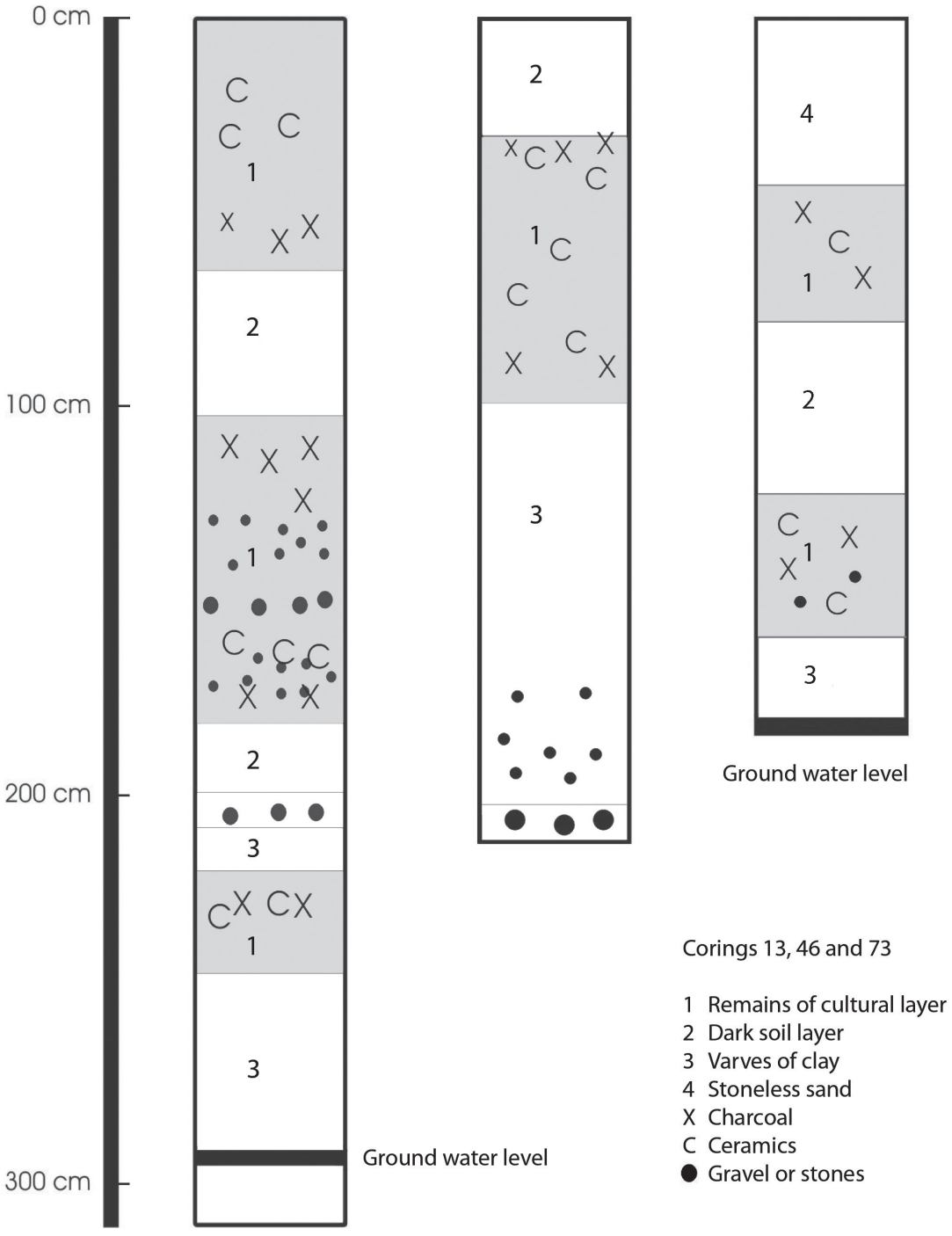

Fig. 7. Drawing of the profiles in augering holes no. 13, 46 and 73.

This may be due to the fact that it was taken in the uppermost part of the second cultural layer (100-170 cm below surface). At any rate, more drillings would have been needed in order to confirm with certainty the existence and horizontal spread of the deeper cultural layers in augering hole no. 13.

Another deep augering hole was no. 46 which was drilled to a depth of 211 cm below the surface (Fig. 7). Here only one possible cultural layer was noted, between 30 and 100 cm below the surface. Coarser sand layers were reached at the depth of ca.

180 cm. The drilling stopped at the depth of 211 cm because of a large stone. The phosphorus value taken at a depth of 55-60 cm below the surface was very low, perhaps indicating that this augering hole was located outside the main area of anthropogenic activity.

Particularly interesting information was received from a scarp which was cleaned in the ditch along the dirt road next to the spot excavated by the Greek Archaeological Service. The profile in the scarp is 120 cm wide and reaches a depth of 180 cm (Fig. 8). Four clearly different soil layers were observed in the profile. The uppermost layer (1) represents the sterile sand which has partly been formed during the building of the road. Below it followed a nearly sterile silt layer mixed with gravel (2). Very few finds were noted in these two uppermost layers.

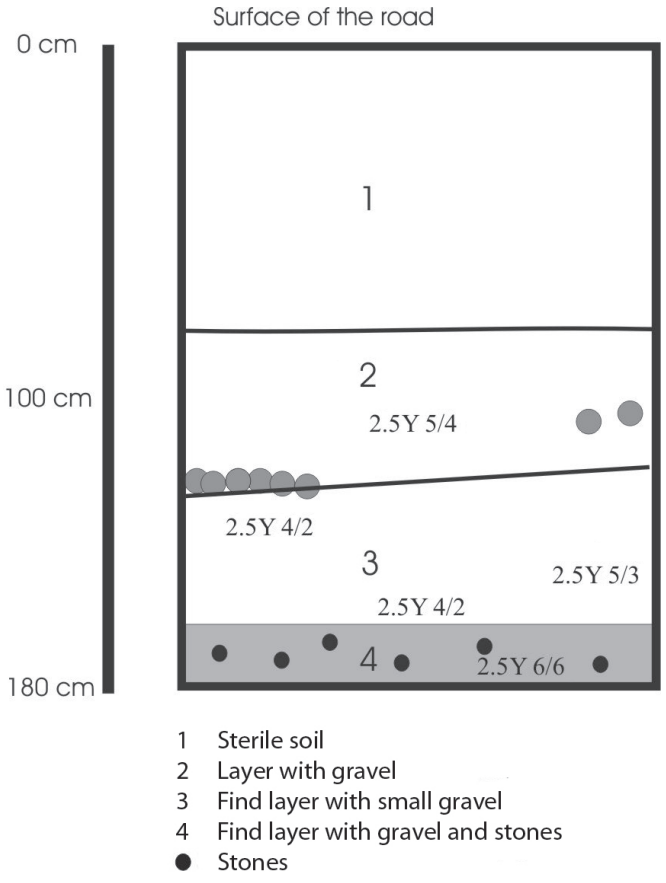

Fig. 8. Drawing of the profile in the ditch.

In the cleaned profile, the cultural layer was not reached until a depth of 120-125 cm and continued at least until a depth of 180 cm below the surface, where the groundwater level was reached. It can be subdivided into two separate layers (3 and 4) differing from each other in colour, layer 3 being darker than layer 4. Both layers were very rich in finds, mainly pottery, but also contained large amounts of tile fragments as well as large particles of charcoal. The phosphorus content of the soil in both layers is clearly anomalous (180 mgP/kg in layer 3 and 112 mgP/kg in layer 4). Although the range of dates obtained by C-14 samples is rather wide, the samples still indicate that layer 4 (Hela-1242: 2495±40 BP or cal. 790 (0.913) 500 BC) most likely is older than layer 3 (Hela-1241: 2465±40 BP or cal. 675 (0.698) 410 BC). Layers 3 and 4 also included relatively fine gravel and round stones, which refer to running water. The development of these layers may thus partly be related to the small stream which leads to the Kokytos river and which passes between this spot and the excavation area of PS 36. The existence of the stream must have exposed the cultural layers to frequent sheetwash and re-deposition, and may have depleted the phosphorus content.

Among the drillings made on the northwest side of the ditch, the augering hole no. 73 finally also contained two separate and distinct cultural layers, both containing charcoal particles and pottery (Fig. 7). The upper one was found at a depth of 45-80 cm below the surface. The lower and perhaps more interesting cultural layer was located at a depth of 130-170 cm below the surface. It was almost as rich in finds as layers 3 and 4 in the ditch profile. Another common feature was that the groundwater level was reached

at a depth of 180 cm. Shortly after this, the drilling was stopped by a hard layer of gravel. Although especially the lower cultural layer in hole no. 73 was rich in finds, none of the soil samples taken from this hole showed any phosphorus anomaly, thus exemplifying the occasional inaccuracy of the method.

On the basis of the geo-archaeological work we get a better idea of the size of the three find concentrations at Mavromandilia. The first one, located roughly where the excavation trenches of PS 36 were opened, is at most ca. 40 x 20 m in size. The size of the second concentration at PS 31 is more difficult to estimate, but it seems to be at least ca. 30 x 30 m, and possibly as large as 40 x 60 m. The third concentration is located at the spot where the Greek Archaeological Service excavated, continuing on both sides of the ditch, especially towards the northwest. The size of it is probably not larger than 40 x 40 m.

The find concentrations at PS 36[8] and in the Greek excavations of the ditch[9] most likely represent different parts of a synchronously settled site. Thus, the pottery found in these concentrations is roughly contemporaneous in date. The people at this site probably lived on both sides of the small stream and above the small possible spring located at the bottom of the stream (Fig. 1, no. 5). However, we cannot altogether exclude the possibility that also PS 36 and the find concentration next to the ditch represent separate dwelling sites that – despite the similar-looking finds – were settled at different stages, perhaps by different groups of people or different generations.

The relationship between the find concentration(s) at PS 36 and the ditch on the one hand, and at PS 31 on the other hand, is more problematic and can only be clarified through more drillings in the area between PS 31 and PS 36 or through excavations at PS 31. However, something that speaks for PS 31 being a separate site is the fact that the few badly preserved surface finds from PS 31 seem to be Archaic to Classical in date,[10] thus in general slightly later than the main horizon of activity at PS 36 and in the Greek excavations of the ditch. Secondly, no phosphorus anomaly was located in the south to southeast parts of the surroundings of PS 36 (augering holes nos. 5-10, 19-24, see Figs. 5a-b and 6), which face towards PS 31.

Sedimentation history

The excavation and coring results have attested that the richest remains of the cultural layer at Mavromandilia are covered by silt or in some cases even by layers of gravel. In many cases, the thickest find concentrations were located between 50 and 100 cm below surface and below it, in some cases even at a depth of ca. 150 cm. The reason for this lies in the local sedimentation history, which has been influenced by both natural and human processes.

What were the processes causing the sedimentation of the thick topsoil? The origin of the accumulated material is to be found on the eroding mountain slopes. The sun, rain and wind make the rock weather into smaller particles, which form alluvial fans at the

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[8] See J. Forsén in this volume.
[9] See Tzortzatou and Fatsiou in this volume.
[10] See J. Forsén in this volume.

foot of the mountain slopes. Strong winds may have moved soil, thus layering it all over the valley through time. On the other hand, ravines and smaller streams have also played a role in the erosion and re-deposition of the material from the alluvial fans. Such a process requires the influence of running water, and therefore does not take place simultaneously everywhere in the valley, but rather concentrates on particular areas along the water courses. In a long time perspective, alluvial sedimentation may spread over large areas, because river beds continuously meander and change their actual courses. However, in a shorter historical perspective of only some thousands of years, the river beds have probably stayed relatively stable, only changing their places in restricted areas.[11]

In the case of Mavromandilia it seems that the small stream located between the spot excavated by the Greek Archaeological Service and PS 36 existed already in the Early Iron Age, and that the existence of running water made the place attractive for human occupation. The deposition of sterile soil on top of the settlement remains has thus taken place during a time period of some 2,500-3,000 years. The sedimentation may have been caused by the stream while it meandered and changed course through time. Another factor influencing the sedimentation is the fact that the neighbourhood of Mavromandilia in general slopes down towards the Kokytos river, making finer particles move in that direction over time.

Since the desertion of the place, the channel of running water has slowly been covered by alluvial sedimentation. However, one should not forget the influence of human processes. Thus part of the especially thick sterile layers covering the cultural layers along the ditch probably was created by farmers when they created larger fields suitable for modern machines in the 1990s. Thereby ditches, ravines and small cavities were filled with soil in order to smooth out the surface of the new large fields.[12]

Human sedimentation processes did, of course, also take place at an earlier stage in history. Thus, the thick and rich cultural layers in the ditch could theoretically be explained as some kind of dump created by the original settlers. However, it seems more likely that the layers have been re-deposited here and bound together by running water. Although the layers during this process may have become mixed with each other, the C-14 dates taken from the profile in the ditch still indicate some kind of stratigraphy with younger material deposited above older layers. This fact, combined with the rich amount of finds, clearly indicates that the site has been intensively settled for a long time, producing consecutive accumulation layers on top of each other.

The geo-archaeological work occasionally indicated the existence of two different superimposed cultural layers, separated from each other by layers of sterile silt or gravel with a thickness of 15 to 85 cm. This indicates the possible existence of an even more complicated stratigraphy and sedimentation history with several (at least two) different phases of settlement, in between which the site would not have been occupied. Unfortunately the deeper cultural layers could not be dated, and thus we lack information about how much older they are than the main occupational horizon at the site. Only further drilling or extended excavations may shed light on these possible early sedimentation phases.

The sedimentation history at Mavromandilia can thus be described as a combination of the natural effects of running water and soil moving down-slope towards the Kokytos

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[11] Niemi 1990; James *et al.* 1994.
[12] See Zangger *et al.* 1997.

river on the one hand, and human effects on the other hand, such as the existing settlement causing the accumulation of archaeological material and recent farmers bulldozing the fields. The differing combination of these effects has, in some parts of the site, resulted in finds of different date getting mixed, whereas in other places it has resulted in accumulated layers of material.[13]

Conclusions

Through the geo-archaeological work we now have a somewhat better picture of the character and size of the interesting, mainly Early Iron Age settlement cluster at Mavromandilia, as well as of the local sedimentation processes. Although the questions posed at the beginning of the chapter have partly been answered, many questions connected with the location and its natural surroundings still remain open and can only be clarified through further geo-archaeological work not only at Mavromandilia, but also elsewhere in the Kokytos valley. There is a clear need for more research on the connection between archaeological sites and their environment in northwestern Greece. We hope that this chapter has shed some light on the possibilities entailed in this kind of research.

It should be added that an important aspect of the connection in question is not geo-archaeological but economic and social, since the relation of these sites to the local rivers has implications for how the early inhabitants exploited, and were influenced by, the environment. In this case the nearby river may have played any of several roles: a food source, a communication medium, a defensive barrier, even a cause of problems such as flooding and disease. These should be kept in mind during further excavation for relevant finds, which is obviously assisted by the investigation of factors like sedimentation. One must therefore not overlook the potential opportunity presented here of reconstructing an ancient riparian culture in an inland area where it might be unexpected.

[13] See Bintliff and Snodgrass 1988.

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