11. Synthesis: Anthropogenic practices in water level fluctuations

11.1. The lake before the settlement

The environmental and anthropogenic processes (chapter 7) described in the vertical and lateral distribution of the facies (chapter 8) and microfacies (chapter 9), together with the radiocarbon results (chapter 10), are here combined in order to reconstruct the configuration of the mound, as a result of anthropogenic activities within naturally induced alterations. Before the advent of anthropogenic presence at the mound of Dispilio, the lake underwent a series of regression-transgression events, which are visible at the lake cross section (fig. 8.2). These episodes, which cannot be securely dated, are tentatively related to the sequence of fluctuations recorded by Kouli (2002).

More specifically, the deepest part of the cross section (fig. 8.2) constitutes a low energy depositional environment with reduced clastic inflow and little overturn influx. During this time, there may have been only short periodic regressions, as inferred from the very fine and diffuse mottling (see 7.1.1.1 section). The abrupt storm event that follows (B1) washes pebbles and fine to coarse sands in the lake. A stream seems to be located at DMG11, constituting the main source of clastic input at that time. The mound-shaped distribution of the deposits is suggestive of the formation of a sand bar at the mouth of DMG11; the coarse sediments at Giole (DMG09) designate that the stream constituted at the time a source of clastic material and not yet an outlet of the lake to Aliakmon River (Pavlopoulos pers. communication).

This period of increased clastic input has been interrupted by a stage of lake regression with redox alterations, calcareous concretions and a Mn-layer (B1), all indicative of low water levels (Granina et al., 2002), which occasionally result in the exposure of sediments (fig. 8.2). At Giole stream the accumulation of decayed organic material points to a short-term marsh formation, protected and favored by the development of the sand bar (B2). This stage of low water level is cautiously related to the lake regression placed by Kouli (2002) to ca 9000 BC, an episode, which has been already recorded in the Balkan region (Bottema, 1974) and the central Mediterranean (Peyron et al., 2011), as a short period of drought and subsequent erosion.

After this regression, a stage of slight rising of the water levels takes over, which is very gradual and heterogeneous along the lakeshore, characterized by successive events of
gentle transgressions, interrupted by longer periods of regressions and subsequent exposure of sediments (fig. 8.2).

Particularly, at the easternmost part of the lakeshore (C3), over the marshy sediments, fluctuations of water levels are attested by reduced organic matter content, alternating with occasional subaerial exposure, seen as rusty mottling and fine laminations of organic material; these are intercalating with sandy laminations. Fine layers of congeria shells identified at the upper part of the sequence are generally interpreted as relicts of short storm events (Collinson et al., 2006). The presence of charcoal at this level can be tentatively related to a first evidence of anthropogenic presence; due to its scarcity, however, it cannot be securely attributed to anthropogenic activity. At the western part of the lake (C1), the water level is very shallow. The proximity and sedimentological resemblance of the western part of the lake (particularly DMG06) (fig. 7.3) to the eastern part of the archaeological mound, (DMG14) (fig. 8.4), cautiously associates C1 (fig. 8.2), to facies S1, implying a period of relative low water levels with slight fluctuations and short subaerial exposures. The exposed east part of the site representing the littoral zone, is in this case extending to DMG11 (fig 4.1), where the proximity to a perennial stream feeds the lake with clastic material, shaping the lakeshore and creating an undulating shoreline. Here the sediments appear less oxidized (C2), demonstrating deeper water levels, though at a later stage a tendency of shallowing is observed, with fine sands and oxidized roots. As noticed in fig. 4.1, the morphology of the modern lakeshore is not uniform, creating bays and exposures, which are reflected in the sedimentological record.
as reduced and oxidized sediments. The stream flowing to the west of Dispilio, probably creates similar lakeshore morphology.

More specifically, while the eastern part of the mound is characterised by shallow waters and periodically exposed sediments (green formation in fig. 11.1), deep water levels are designated for the western part (blue formation), where bluish fine muds are recorded, representing the off-shore part of the lake S1a (fig. 11.1). At the same time, a low ridge of oxidized sediments runs across the site in a E-W axis; at the south of the site and sporadically dispersed, a thick layer of fine to coarse poorly sorted sands, is identified (S1c). These sediments signal the presence of small sand ridges, which are covered by lake plants (Karkanas et al., 2011) and are occasionally exposed, as shown by the alternation of reduced to oxidized sediments.

The low energy lacustrine setting described above is subject to an abrupt flooding event, which transports well sorted rounded sands across the site, due to an intensive storm (Reineck and Singh, 1980: 395, 421) (S2a) (fig. 11.2). The sands cover homogeneously the underlying deposits, in both areas of shallow and deep water levels. At the biggest part of the site the sands are covered by shallow waters and are only periodically and locally exposed; partially the mound mainly the north-eastern part is still found under deep waterlogged conditions. The southeastern part, on the other hand, is only slightly covered by sandy deposits (microfacies SM2); the oxidized sediments, which are still recorded (S2b) are characteristic of low lake water levels, indicating that the storm sediments only marginally reached this part. Following the sequence of the lake
stratigraphy (fig 8.2), this stage can be associated with a late stage of C3 (fig. 8.2), where the relicts of a storm event are preserved as microlayers of congeria shells recorded in the lake sequence (fig.7.3).

What follows is the formation of a sand bar, as a result of the successive storms described above, at the north of the site (fig. 11.3) in a west-east axis (S3b). As mentioned already (chapter 7), the formation of sand bars is generally originating from the swirling turbulence of waves during storms, breaking off at the shore and excavating a trough in the sandy bottom. Some of this sand is carried forward onto the beach and the rest is deposited on the offshore flank of the trough. Sand suspended in the backwash adds to the bar, as does some sand moving shoreward from deeper water. This sand bar buries anthropogenic features, i.e. charcoal and vertical wooden posts, which are however considered intrusions from subsequent habitation episodes, with piles being driven into the underlying sediments. Widespread accumulations of organic-rich sediments with decayed plant remains to the south of the bar indicate the subsequent gradual formation of an extensive marsh, with intercalating layers of congeria shells, relicts of the corresponding flooding events (S3a); the sand bar served as a protection from subsequent strong wave action, by trapping backwash deposits.

These stratigraphic markers are tentatively related to both the sand ridge of D1 and the congeria shell microlayers (at the lower part of D1) (fig.8.2). Here, big pieces of charcoal are found dispersed at the upper part of the facies (DMG27 and DMG26), giving a range of chronology results (5335+/-145BC (Ua-43102), cal 2215 +/-85BC (Ua-43103).
These have most likely drifted in the sands during the storm. The sand ridge is periodically exposed, as shown by the presence of oxidized roots and sediments. Furthermore, the coarse-grained deposits at the Giole stream support the hypothesis that the stream was still feeding the lake with clastic material. This event has apparently increased the water inflow of the lake, which led to the deepening of the lake level at the western part of the section (D2), as the reduced sediments designate, with indications of periodical exposure. This rise of the lake water levels is cautiously correlated to the transgression recorded by Kouli (2002) before 8000BP, and is in close agreement with the transgression described by Peyron et al. (2011) for central Mediterranean, due to the precipitation increase documented in eastern Mediterranean before 7700 BP (Wright, 1993).

An evidence of conflagration expressed by a charred laminated material with sand intercalations is embedded over the sand ridge (E4, facies L5.4, microfacies LM10) (fig.7.3 and fig.8.2). This material is interbedded within a standing water environment with organic rich sediments indicative of a marsh formation. The remnants of this fire event have been deposited in waterlogged anoxic conditions and have been subsequently levelled by the low energy water action, preserving in this way their laminated structure. The overlying anthropogenic construction materials, which have formed a homogeneous, plastic mass have been further dissolved and covered by a charred layer. The whole alternating sequence of charred material and clays constitute parts of anthropogenic structures including wooden parts, branches and grasses, as well as muds for building materials. At the banks of Giole stream a couple of intact wooden posts have been found (Sofronidou pers. communication), indicating the presence of a post-dwelling settlement. The gradual marsh formation, coincided with a phase of lake regression, as this is demonstrated by the strongly oxidized sediments (E2) and the abundance of calcareous concretions at the corresponding sediments to the west. In this sense, D1 and facies S3a found at an approximate elevation of 625.5m and comprise a clear substrate influence for the formation of the landscape, where the first settlers have built their site. This landscape is a marsh formation contemporaneously formed as E and facies S3a at minimum elevation of 627.2m (fig.11.4).

The chronology results of facies E indicate a later anthropogenic activity (760-890 AD). Nonetheless, the chronologies of the upper part of microfacies LM4.1, indicate the initial use of this area at ca 5400BC, tentatively contemporary to the mound of Dispilio.
Figure 11.4. Correlation of cross section B of the site with the cross section of the lake, where the approximate elevation of the first anthropogenic presence is indicated with an arrow.
and associated to the presence of extended marshy deposits. The settlement has been subject to at least one destruction episodes, after which the anthropogenic deposits have fallen in the low energy waters, being reworked and forming homogeneous massive distinct layers. The formation of this marshy regime (E4) resulting from the precedent storm event (D1), was contemporaneous to a lowering of the water level (E2). An analogous phase of lake regression is recorded by Kouli (2002) and Peyron et al. 2011 after 6000BC; at lake Maliq the first evidence of peat accumulation is documented after 6000BC (Fouache et al., 2010).

Equally, in the site, the widespread accumulations of organic-rich sediments suggestive of a marsh formation (S3a) are thinning out at the north and east edges, with the thickest deposition being found at the centre of the site, right behind the sand bar at a north-south axis (fig. 11.3). At this marsh setting the first anthropogenic presence is identified, described as a 5cm layer with scattered charcoal fragments and fine burnt bones, located sporadically at the central and southern part of the site (DMG45 and DMG21). No radiocarbon data are corresponding to this phase, however the early radiocarbon results \{(Ua-43105 (cal. 5520+/−50 BC) and Ua-43106 (cal. 5500+/−75 BC))\} found at the northern part of the site (DMG39) within the subsequent facies S4 and S5 could be cautiously related to an early and sporadic stage of habitation. In this case, the remnants of this facies would be found as relicts in a subsequent stratigraphic context, as natural and anthropogenic processes distorted the original stratigraphic sequence.

11.2. The selection strategy
As suggested above, the accumulation of marsh deposits at Dispilio corresponds to the formation of the marsh at Giole stream, following an analogous chronostratigraphic sequence. Concerning the anthropogenic presence, the pile dwelling settlements of Giole and Dispilio, even if not contemporaneous, they nonetheless decipher a habitation selection strategy associated with the preference for specific environmental regimes, including lacustrine and marshy wetlands, and perennial streams. Why would this type of setting, which is considered inhospitable nowadays, attract the Neolithic dwellers? Who would prefer to pad over the damp grass or through reeds (Hatzitoulousis 2006:151), under the regular flooding risk? There is a variety of materials available to those who choose to live in the damp. These settings unequivocally offer a wide range of resources, among which fishing on the platforms, as described by Herodotus for the dwellers of lake Doirani (referred to as lake Prasias), is a significant attraction; agricultural potential must have also played an important role, as discussed by Sherratt (1980), demonstrating
the preference for interfluvial soils by the early cultivators, being very fertile when drained (Brown, 1997). Moreover, marshes are thought to provide excellent grazing, even in times of flooding.

More importantly however, the vulnerability of a place is related not only to its physical, but also its social perspective. There must have existed a sustainable balance between humans and the natural world, altered over time and varying with opportunities and circumstances. The choice of wetland environments, as offering abundance and variety, was therefore logical and unsurprising. It is furthermore suggested that the attractions of lake margins apparently outweigh the perceived risk (Brown, 1997: 297). There are several means, by which the nuisance of flooding and the damages can be minimized and it is now accepted that catastrophic flooding has not been the cause of abandonment of wetland settlements. Even in historical periods the abandonments of sites due to flooding are very rare. The relationship between environmental factors and cultural choices, therefore and the reason why a site is where it is, often remains far from resolved in most cases. There is however an unavoidable conflict of negative and positive aspects of wetland habitation. In 1931, an alluvial site in the marshlands of Tigris and Euphrates, in southern Iraq was flooded (Thesiger, 2007), but despite the damage to the site the local inhabitants, cheerfully set about rebuilding it, in the knowledge that the rain assured a particularly abundant harvest.

11.3. The main occupational period: the lacustrine phase
At a later stage and within the marshy wetland, an extensive settlement was built (fig.11.5). This event is chronologically placed within the MN, after 5500 BC, when the first habitation is recorded as described above, and before cal. 5365-5367 BC (mean age), when a destruction episode is inferred. The presence of wooden piles found in the
sandbar at the north of the mound indicates the construction of raised dwellings next to the shore. The dwellings may extend further offshore into the modern lake, as the distribution of piles of unknown age implies. The presence of exposed and raised pile dwellings is verified by the vertical distribution of lacustrine molluscs on wooden piles (Veropoulidou, 2009).

The dense charcoal concentration and the enrichment of the sediments with anthropogenic materials are interpreted as remnants of a destruction event due to conflagration (fig. 11.6). It is not clear if this episode affected uniformly the settlement. At the moment, however, the evidence from the excavated east sector and the cores along the site do not yield any differentiation in regard to the conflagration impact. The absence of char-rich material at the west and east edges, nonetheless, suggests the concentration of the destruction at the centre of the mound.

Concerning the occurrence of fires in swamps, it has been claimed (Ismail-Meyer et al., 2013) that, fire can be a major hazard, as it can burn almost indefinitely. Fire events in wetlands occur frequently, with the major sources of combustion being human activities and lightning. Furthermore, at the surface of marshes, swamps and bogs, vegetation rots and gradually forms a crust that prevents oxygen from reaching the organic material trapped below. This is the condition that allows fermentation of any plant or animal material, which produces methane. In some cases, there is sufficient heat, fuel and oxygen to allow spontaneous combustion and underground fires to smolder for some considerable time. Marshes in general have a modal fire-free interval on the order of 30 to 100 years, with a minimum fire-free interval.
of approximately 5 years (Fischer et al., 1996). Evidence from the marsh villages in Iraq point out that the fires could be very disastrous, burning more than 10 houses in a few hours and potentially occurring in different parts of the marshes in a monthly interval (Thesiger, 2007: 177-178). Moreover, micromorphological analyses of building structures in all lakeside settlements in Swiss lakes have shown traces of fire, confirming that fire management was problematic (Ismail-Meyer et al., 2013). In Dispilio the preservation of charred plant material is a sign that the temperature of the fire would not have exceeded 450°C and that the burning effect would not have lasted very long, possibly a few hours; otherwise, no plant remains would have been recovered (Margaritis, 2011).

As an aftermath, the burnt structures fell into an anaerobic waterlogged low energy setting, as designated by the laminated structure of the sediments and inclusions. At the same time, locally, at different parts of the mound, or even overlying microfacies SM4a (KS7e, KS7f) the sediments include laminae of coarser elasic groundmass (microfacies SM4b) indicating more dynamic conditions capable of moving coarse sands, whose microstructure indicates the existence of oscillatory waves.

This low energy lacustrine environment, where gentle waves create troughs and ridges of fine and coarse sediments, must have had a certain effect on the collapse of construction material, acting as a sediment trap for finer charred deposits and for some unburnt seeds preserved in the waterlogged conditions (Karkanas et al., 2011, Margaritis, 2011). The rapid burial of the materials, nonetheless together with the evident absence of exposure had no post-depositional effect, preserving the microstructures of sediments and articulations of materials. Reduced post-depositional movement is verified by several
articulated bones (Phoca-Cosmetatou, 2008); weathering due to exposure of bones is very limited.

Construction materials are identified as layers of dissolved brownish red and greenish compacted muds forming a homogeneous mass of plastic deposits (see 7.1.1.1), often being the only evidence of wall construction of raised houses, which have collapsed on the wet sediments after the destruction, forming a sharp boundary and deforming the underlying sediments (fig. 11.7). The muds were mainly used for daub, hearth, and floor construction. The brownish muds often include phytoliths and plant impressions suggesting that plants have been used as temper, most likely for the construction of mud bricks. Experimental observations have in fact shown that during conflagration only part of the loam walls were burnt, the rest consisted of unburnt daub (Goldberg and Macphail, 2006). The excavation of Dispilio has revealed abundant aggregates of unburnt daub and floor remains. The green fine-grained muds, comprising compact, homogeneous layers with sharp upper boundaries can be interpreted as parts of the constructed floors (fig.11.9 and 7.22).

Locally at the NW part of the excavated sector (KS17d and KS17e) (fig. 8.3), the muds are covered with charred materials and charcoal, as well as fine pottery fragments in successive layers, pointing to re-plastering (fig.7.22). Fine char-rich layers including burnt phytoliths and big pieces of charcoal are locally found, associated with constructions. The organic remains accumulated on
floors may be interpreted as daily waste from food processing and cooking (seeds, bones, charcoals), fuel (wood, bark, and twigs), and insulation (twigs, mosses, and bark residues) against humidity (Ismail-Meyer et al., 2013). At this same area, a significant number of *pithoi* was found, unique in the site in terms of number and technology (Facorellis et al., 2014). More information on the use of space has been extracted from the archaeobotanical and archaeozoological records. Thousands of waterlogged blackberry seeds and hazelnut were recovered from this section, indicating storage areas; large amounts of unburnt and macroscopically burnt mammal and fish bones (Stathopoulou et al., 2013), have been yielded.

To conclude, all the sedimentological and micromorphological evidence designate that the settlement has been built in a marshy regime, where low water level conditions predominate and no signs of exposure are noticeable in the sediments or the materials (facies S4). Periodical stages of subaerial exposure cannot be entirely excluded; they must have been too brief though to leave any signal on the sedimentological and archaeological record. In this case, the construction of rough provisional structures on the ground is suggested; the prevailing humid conditions and the potential for periodical floods would not permit the investment of time, efforts and materials for constructing permanent ground structures as houses.

More dynamic depositional conditions prevail subsequently at the site, including successive flooding episodes, which would inundate homogeneously the site. These floods, being the result of intensive storms, transport sandy deposits and shells along the site, partially eroding and drifting the anthropogenic material across the mound (S5). The chaotic microstructure of the sediments designates the presence of turbulent waves, with continuous influx (Reineck and Singh, 1980: 249) in the shallow littoral area. The wave action must have influenced the sorting of the materials, as it is evident at fig. 7.19, where finer material is sorted from the collapsed structure, leaving large stones and construction materials as lag. There is not enough proof though of severe erosion of the underlying material, as the articulation and the crudely laminated structure of the materials indicate.

This is probably due to the fact that severe storms are associated with rapid burial without drifting of the underlying burials. There are cases, however, where the transgressions and accretions of waves rework the newly deposited material and destroy
any lenticular and wavy bedding that may have existed, leaving behind reworked sands and shells in the form of stacked lag deposits.

Under these conditions of successive inundations, the settlement was extensively rebuilt as the distribution of anthropogenic material indicates (microfacies SM5). The char-rich material and the presence of construction and anthropogenic deposits at the upper part of the facies suggests that this habitation phase ended shortly after its construction at the end of MN period (mean age 5307-5274 BC), due to a destruction event. The radiocarbon data from the two destruction events (facies S4 and S5) are marginally overlapping (see chapter 10), however the stratigraphic observations reveal the existence of two separate episodes, excluding the hypothesis that facies S5 is an aftermath of facies S4, in which case the underlying material would be drifted during the subsequent floods. More specifically, the upper part of facies 5 (S5b) includes big pottery sherds, more noticeable at the southeast part of the east sector (fig.11.7). These artefacts due to their size and weight could not have been drifted by wave action and are therefore thought to have collapsed in the coarse material at this location during the destruction event. On the other hand, the accumulation of anthropogenic material at the upper part of the facies, overlying an almost depleted of anthropogenic materials layer, reinforces the theory that SM4 and SM5 represent two habitation stages.

The depositional conditions during this facies are still waterlogged, with no signals of exposure. Layers of dissolved construction materials are visible at the northwest and south profile of the east sector. The occurrence of provisional ground structures in brief periods of drought is again here not excluded. A presumable ground construction is seen in the south profile of the eastern sector (fig. 8.3), where abundant subangular stones and aggregates of clay loams are found, together with big sherds, bones and tools; the reddish hues of the clays are interpreted as subjected to heat (fig. 7.19). The presence of this structure, however, does not necessarily prove the prevalence of dry conditions, as the construction of raised stone platforms could be used, as insulation from the wet soils. In any case, stones are found abundantly in the site and they may have been occasionally used as part of the “home furnishing” of a raised house. This structure is based on an intercalating layer of fine muds and sands, belonging to microfacies SM4b (KS10, Appendix 2), and therefore it is more likely that it has collapsed during the previous destruction event.
The SW part of the excavated sector is still depleted of construction materials indicating the existence of an outer space; the abundance of coarse pottery sherds at the SE, not found at the underlying layers is suggestive of a change in the use of space, albeit more archaeological evidence from the excavation results is needed to prove this hypothesis.

The frequent inundations, to which the site has been subject, do not seem to pose severe restrictions to the rebuilding and expansion of the site. As already discussed the floods did not always signify a problem for the inhabitants of wetlands and moreover the post dwellings would constitute a significant component to cope against the rising of the water level. Thesiger (2007: 121) vividly describes how the marsh Arabs, confronted occasional inundations:

Houses are built on artificial islands created by enclosing a stretch of marsh with a fence of reeds. From the distance the houses seem like floating on the water. Then reeds and rushes are packed inside the fence becoming the foundation of the house. This process is completed during the dry seasons or where the water is shallow. If the floor sinks or the water level rises, more reeds are added to the floor to bring it back up above water level. A more permanent type of house is produced when mud from the floor is used to cover the foundation. “Floods were an intimate part of everyday life even in the schoolroom. When the
marshes were flooded, we put reeds and plants in the classrooms and at the desks on it. The water entered the classrooms, the birds entered the classrooms, there were fish with us sometimes”.

Artificial dams and bank reinforcements were also implemented to prevent the marshes from flooding, surprisingly made of disproportionately paltry materials (reeds, muds and branches) to cope with the extensive inundations of the rivers.

Dispilio, after the destruction, seems to return to more gentle environmental conditions (microfacies SM6), identified by the presence of very fine sediments found locally, mainly at the south and the west profiles of the east sector. This facies can be interpreted as an aftermath of the collapse of anthropogenic material creating waddles, wherein fine sediments are trapped and fine charcoal floats into suspension (fig. 11.9). The massive, however microstructure of the facies and the absence of laminations and bedding signify a rapid depositional process (Reineck, and Singh, 1980: 135)—rather than suspension—probably attributed to a mudflat, formed due to an inundation. Microfacies SM6 could be the result of a gentle episode of inundation, washing in muds in the site; the sporadic distribution of the deposits could be explained by the heterogeneous relief, artificially created by the collapse of anthropogenic material, forming troughs and ridges. In this case, the low energy mudflat would only be deposited in the depressions, not affecting the elevated destruction loci comprised of anthropogenic material (fig. 11.9).

The site is subsequently re-inhabited, as is designated by the rich in anthropogenic materials overlying deposits. The thick layer of charred plant remains, which overlies

Figure 11.10. 3D reconstruction of the site demonstrating the third conflagration event (facies S7)
microfacies SM6 and SM5 (SM7a), includes phytoliths and charcoal, which can be micromorphologically identified as wood, grass or reed remains (probably straw) (Karkanas et al., 2011) (fig.11.10). These fine laminations of clearly separated alternations between phytoliths and fragments of carbonized plant material, with parallel orientation, high degree of articulation and lack of sedimentary matrix designate in situ decay of the material. The low percentage of clastic material–apart from the scattered sand grains–indicates that it is deposited in a very low energy, most likely standing regime.

The deposits are extending at the southeast and north part of the east sector, as well as to the centre of the mound in an east-west axis (fig. 11.10). At the rest of the site the sediments include charred remains and anthropogenic materials in a crudely laminated microstructure (SM7b). The settlement was at that time more extended (compared to microfacies SM4 and SM5). For the first time at this depth, there are few signs of periodical exposure, as is evidenced by the sparse oxidation staining, the calcitic nodules and the local bioturbation, though the molluscs of the site are still exclusively lacustrine (Veropoulidou, 2009). The periodical exposure of sediments, nonetheless, is not necessarily associated with the prevalence of low lake water levels, but can be a result of the taphonomy of the preceding destruction events, accumulating anthropogenic
materials and forming elevated and periodically exposed mounds of collapsed and reworked anthropogenic deposits (Karkanas et al., 2011). These factors explain the different microstructures in the successive sedimentological facies, even in cases where similar environmental conditions predominate under analogous water levels. The coarse matrix of the deposits though, together with the crude laminations and chaotic structure, reinforces the hypothesis that the mound is still affected by at least periodical wave action.

Karkanas et al., (2011) have posed the question whether this facies (S7) constitutes a distinct destruction event, or if it is an aftermath of the previous destruction episode (facies S5), whose material is floating over the collapsed structures, being levelled by wave action. The radiocarbon data from the facies place this episode to the beginning of LNI (mean age 5241 - 5202 BC), (see chapter 10). The fact that this microfacies constitutes a separate event is further reinforced by micromorphological results, which exhibit a distinction between the collapsed material of microfacies SM5 (KS5 Appendix 2) and the crudely laminated deposits of microfacies SM7, as an intervening layer depleted of anthropogenic material.

As a conclusion, it can be therefore suggested that the second destruction of the settlement at the end of the MN (microfacies SM5), was followed by an extensive rebuilding and a subsequent conflagration, chronologically placed to the beginning of the LNI (microfacies SM7). During this time, the occurrence of ground structures is more plausible even if not evident, though the presence of pile dwellings must be still prevalent.

In relation to the nature and interpretation of the laminated charred organic material (S7a), several implications have been made. Huisman et al. (2009) point out that a series of human activities may produce such accumulations, such as the cutting down and burning of dead vegetation to clear the site, layering the site with bundled vegetation to keep dry feet and later burning them, or burning straw left over from harvesting and food processing. Any of these activities must take place in certain intervals and this cyclicity of activities is demonstrated in the interlaminations of charcoal and phytoliths deposition visible in the micromorphological samples (Appendix 2: KS1, KS2, KS3, KS7, KS9, KS10). Each cycle would have consisted of a phase of burning plant material (resulting in a layer of carbonized material) and a phase of decay of a layer of reeds, grass or straw (resulting in the end in a layer of phytoliths).
In the case of Dispilio, another possible interpretation is that these deposits constitute a remnant of a collapsed structure (Karkanas et al., 2011). A compact burnt raised wooden platform with grass and reeds used as coating, when collapsing on wet sediment can preserve the articulation of the organic materials and cause the deformation of the underlying sediments, as it is visible in the profiles of the excavated trench (fig. 7.20). Moreover, the existence of other types of structures, as the artificial islands of the marsh Arabs mentioned above, could leave similar traces on the sedimentological record. In any case, the presence of this extended structure of any type at this phase of habitation signifies a differentiation in the use of space compared to the previous phases, probably related to the replacement of individual raised dwellings with an extended wooden platform, which would support several isolated houses. Moreover, the fact that this facies is mainly concentrated in east sector and only sporadically found in the cores surrounding it, further supports this hypothesis.

A distinct feature of the stratigraphy is a multiple layered mound identified at the west profile of the east sector. This feature includes abundant anthropogenic material with interlaminations of fine charred organic matter (microfacies SM7b). The complex mixture of the accumulations can be interpreted as a result of different human (and animal) activities, for example food preparation in, around, and beneath the houses. Mud lenses, which occur as small features (fig. 7.18) are due to natural weathering of daub elements during the lifespan of a house. The chaotic structure of the sediments with crude laminations indicates areas that underwent a further reworking. This area therefore could serve as a dumping location, where material from all the above activities is deposited and then reworked and levelled by the wave action. Charcoal would float on the surface creating distinct boundaries between the cycles of deposition. This interpretation has been supported, by fish bone analysis, pointing out that this area has been probably used for processing/preparing fish for storage (Stathopoulou et al., 2013). The co-existence of emmer, einkorn grains and lentils has been further interpreted as cooking refuse (Margaritis, 2011).

Another process, which can leave mound-like features on the stratigraphy, is the construction of the wooden posts of the raised dwellings themselves (Gosden and Webb, 1994). Post dwellings built in shallow water can readily cause sand to build up underneath them. The house piles have a baffling effect by reducing the strength of the waves and tidal currents underneath the houses and sand, which would otherwise have
been continuously transported through the area, is instead trapped to form sand banks. Any artifact material or refuse, that is dropped or thrown from the houses, adds to the sediment accumulating beneath them.

Following this, a sandy inundation partially covers the remnants of the conflagration/destruction (microfacies SM8) (fig. 11.12), not reaching the western part of the mound. The thickness of the deposits is remarkable at the northwest part of the site (DMG 17), (fig.8.4) exactly at the location when the sand bar of microfacies SM3 was formed, implying that the lakeshore was found in a similar position under analogous lake water conditions. The groundmass locally contains aggregates of massive green muds occasionally preserving an outer rim, which have been related to weathered construction materials (KS20b) (S8b) (fig.11.13). Excavators describe postholes and floors placed on this substratum, implying that the sandy layer has been used as a foundation, on which the rebuilding of the settlement has been based, probably this time with sporadic constructions on the ground. It has been further suggested (excavation diaries) that the sand has been purposefully transported and used as an insulation from wet soils, as it has been the case in other lake settlements (Brochier, 1983). However, the extent of the facies does not justify any origin of the deposits other than natural. On the other hand, the mud aggregates embedded in the sandy matrix (microfacies SM8b), can be associated with the previous phase of habitation, being part of the wooden and reed constructions described above (microfacies SM7a), and being
drifted and dissolved by the subsequent wave action (fig. 7.20).

11.4. Towards terrestrialization
In a later stage the settlement is found under transitional and gradually terrestrial conditions, with distinct evidence of bioturbation and exposure (calcitic hypocoatings and nodules) of sediments (SM9b) (fig. 11.14). However, the influence of the lake is still apparent in the crude layered appearance of the sediments (SM9a). The predominance of fungal remains over algae is also indicative of a drying up of the depositional environment (Karkanas et al., 2011); the molluscs of this facies are characteristic of shallower and more eutrophic waters, depleted of oxygen (Veropoulos, 2009).

Furthermore, the taphonomy of animal bones exhibit lack of articulation and movement of material in the lake after the deposition (Phoca-Cosmetatou, 2008). Dispersed microenvironments of exposed sediments, alternating with more humid deposits, are probably a result of the heterogeneous relief formed by the taphonomy of the collapsed material described above, among which wetter deposits are accumulated. Locally, these depressions (DMG16) (fig. 7.12), are filled with very fine massive sediment depleted of any anthropogenic material and contain only very fine muds with scattered oxidation dendritic nodules. They could represent a drying-out phase of a water puddle, revealing at the same time the abandonment of certain parts of the settlement (Karkanas et al., 2011).

These massive sediments and the general absence of coarse groundmass, imply the presence of a mudflat, a product of an abrupt inundation, in which case the coarse material would be deposited at the periphery of the mound not reaching the elevated

![Figure 11.13. Micromorphology sample KS20 in dry, impregnated and thin section format. A mud aggregate preserving an outer rim is illustrated (S8b) (arrows) within a sandy matrix (arrow). The collapse of this material has deformed the underlying facies S7a (circle).]
central part, where the finer sediments are deposited. This hypothesis is supported by the existence of a layer of low-angle cross-bedded coarse sands interpreted as a beach bar (Karkanas et al., 2011) at the southeastern sector of the site and a thin layer rich in ostracods found in cores DSG2, DMG40 and DMG41 related to this event. This sand bar is tentatively dated to the middle late LNI (5000–4800 B.C.). Alternatively, the mudflat could be interpreted as a post storm, fair weather effect reflecting the final fall out of storm-derived sediments. In this case, it must be an aftermath of microfacies SM8a.

At this amphibian regime, a mixture of construction techniques must have coexisted, with ground structures alternating to pile dwellings, where the sediments were still wet (fig. 11.14). Evidence of ground constructions at the stratigraphy are visible mainly on the west profile of the east sector, where relicts of construction materials and a complete collapsed structure have been identified in the profiles (fig. 8.3, fig. 7.20) creating a low mound. Zooarchaeological analysis (Phoca-Cosmetatou, 2011) has yielded abundant animal bones indicative of an intensive use of the settlement.

As a conclusion, after the last destruction event (facies S7), the settlement underwent a period, when transitional microenvironments were formed and the selection strategies of the dwellers were adapted to these reciprocating depositional conditions. Thereafter, the site displays a complex pattern of formation, as this is indicated by the arbitrary radiocarbon dates, particularly for microfacies SM10. The thickness of the deposits suggests rapid rates of sedimentation towards terrestrial conditions. This formation is
thought to be a result of human activity rather than of natural processes, as there is not environmental evidence of excessive drought or lake regression during this period (Kouli, 2002). Therefore, this artificial increase of the sedimentation rate would differ in the different parts of the site. The description that follows is based on the availability of the radiocarbon data, following the discussion of Karkanas et al. (2011) and is in a large extent based on the extrapolation of the results.

Abundant anthropogenic in situ ground features are seen on the excavated profiles (accumulations of ash layers) (fig. 8.3). The complete absence of aquatic elements is demonstrating the complete drying up of the ground (Karkanas et al., 2011). As already mentioned, the deposition of this microfacies does not follow a homogeneous pattern, creating depressions at the northwest and southern parts of the settlement. It is not clear, however, if this pattern is a result of the terrestrialization rates of these areas in an early stage related to a more rapid accumulation of anthropogenic materials (fig. 11.14), or if it is attributed to a later disturbance from subsequent anthropogenic activities, which have eroded the underlying sediments (microfacies SM9) (fig. 8.4), (as it is attested by the construction of pits in the subsequent facies S11, disturbing S10 (fig. 8.3)). There is a clear, however, elevation difference (of more than 50 cm) of microfacies SM10, in an NW-NE axis (fig. 11.14). This observation is probably related to a more intensive use of these areas, as is undoubtedly attested by the abundance of construction debris in DMG16. The accumulation of these materials would create exposed mounds, when more humid conditions would prevail at the rest of the mound (microfacies SM9).

Nonetheless, the later radiocarbon dates at the south part of the mound (DMG1) ca 2200 BC, indicate that at least at this location the sediments were disturbed by subsequent human activity. Gradually though and at an unknown stage, the whole site has turned to drier conditions.

Soon after this transition, the central part of the site (east, west sectors) becomes entirely terrestrialized (microfacies SM10, fig. 11.15). A terrestrial regime with evidence of construction of houses directly on the ground is identified (fig. 8.3) and the anthropogenic input in the sediments increases. The most rapid sedimentation is concentrated in the eastern and western sectors of the mound. Moreover, anthropogenic material from the cores is found around the west sector (DMG15, DMG16, and DMG40) and more sparsely at DMG43 (fig. 4.2); the rest of the cores exhibit little anthropogenic input or are depleted of archaeological material.
At the same time, the western part of the west sector exhibits slightly earlier dates than the eastern part and the east sector, indicating different formation processes within short distances, verified by the very abundant structures of the west sector and the intensive use of the habitational space. More specifically, a destruction layer has been recorded during the excavation of the west sector (Facorellis et al., 2014), which includes all specific spatial organization structures of a “household” (ovens, cases, low benches). Pottery sherds date the event at the LNI. At the east sector the use of space is less dense. An in situ collapsed structure is identified at the north profile, with layers of construction materials and charcoal (KS9); successive pits, rich in archaeological material and charcoal are visible at the south profiles, all dated to ca 5000BC (fig.8.3).

Under these dry conditions the sediments, rich in calcium carbonate concretions, have undergone soil formation processes, which led to gradual cementation. Seasonal floods during this time must have been still present as indicated by the persistence of organic mottles and the low-angled layer of subrounded to rounded coarse sands at the north of the east sector (fig.8.3). Successive pits, occasionally excavated into the underlying microfacies SM10 are visible at the south profile (fig. 8.2). At a later stage a massive indurated layer was created, including disturbed anthropogenic material (Karkanas et al., 2011) and a calcretic hardpan has been formed within the calcretic soil (microfacies SM12). As described in chapter 7, the formation of a hardpan can be related to a post depositional natural process. Therefore, the hardpan at Dispilio could appear any time during the late habitation or after the abandonment of the site.
It is challenging to describe the depositional conditions at the surroundings of the mound during this period: the radiocarbon results indicate that the anthropogenic sediments and the use of habitation space are very diverse. It seems however that, houses were built on semi-dry and dry soils, forming an island, surrounded by humid soils (fig. 11.15). This hypothesis is supported by the radiocarbon results from the south and north parts of the site, where dry soils must have formed at a later stage (Chalcolithic and EBA) (fig. 10.5). The chronological differences though, together with the arrhythmic terrestrialization at different parts of the mound (particularly the rapid terrestrialization in the east sector, where S10 and S11 are both dated to ca 5000BC), cannot exclude the occurrence of an artificially elevated structure, with earth derived from other parts of the settlement. This type of technique has been attested in one of the lake dwelling sites excavated in the Amyndaio basin (Chrysostomou pers. communication), probably being used as a dam.

The excavators of Dispilio suggest, as described above, that the settlement underwent a destruction phase at the end of the LNI and thereafter the signal of habitation has been very scarce. For this period onwards, this project did not reveal any new data. According to Karkanas et al., (2011) and regarding the occupation pattern from 4800 to 4300 B.C. (LNII, and early part of the Chalcolithic), there is evidence of human activity only at the transitional land of the southeastern part, and probably at the north, adjacent to the lakeshore; nonetheless the intensity of occupation of the site at this stage is unknown (fig. 11.16).

Around 4000BC habitation is apparent on the dry land of the south part of the mound (fig. 11.17). After that, there is a hiatus of habitation until EBA, when a sparse evidence
of human activity is recorded at the south of the mound in a transitional amphibian regime (fig. 11.18). During the EBA, a ring wall, which surrounds the site, is tentatively dated at the same period; a hypothesis attested by several finds, mostly EBA and late Mycenaean pottery sherds found adjacent to the wall. Therefore, this last anthropogenic activity at the mound could be related to the building of this structure (Facorellis et al., 2014).

During the abandonment of the site, agriculture and grazing are steady, but not intense; the vegetation and the landscape return to the conditions similar to those prior to the habitation of the site (Kouli, 2002). The continuous presence of man -though not so intensive-is still evident, suggesting that human activity is hitherto more terrestrial and not so closely associated with the lacustrine regime.

Kouli (2002) records a lake transgression at the time of the site abandonment; the low angled sand layer at the north of the east sector (fig.8.3) verifies this hypothesis. This event is furthermore associated with an increase in fluvial sedimentation between 4000BC and 3600BC in the eastern Mediterranean Sea (Bar- Matthews and Ayalon, 2011) related to an increase in precipitation.

In a recent research in Angitis valley (Region of Central Macedonia) (Lespez et al, 2016), the environmental data show significant changes in the deposits from 4400 to 3800 BC, with the marshy environments being replaced by fluvio-lacustrine conditions followed by successive dry episodes starting from 3.800-3700BC. During the turn from marshy to
During the abandonment of the sites though, as in Dispilio, there is strong persistence of agropastoral activities. It is supported therefore that the populations moved to cope with environmental change, but although they moved away from areas most affected by the rising water table, they probably settled in the foothills.

It is evident therefore that the abrupt succession of environmental alterations could have affected the populations of the broader region, but it is unlikely that the wet and dry conditions of the short-time climatic events would have led to the abandonment of settlements located around the large wetlands in the lowlands of the region. The lack of archaeological sites dated to this intermediate period and the weakness of archaeological evidence of such continuity, raise the question of changes in settlement patterns. It is possible that subsistence change supported the development of mobile groups practicing pastoral activities.