

RADIOCARBON DATING OF THE NEOLITHIC LAKESIDE SETTLEMENT OF DISPILIO, KASTORIA, NORTHERN GREECE

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ABSTRACT. Dispilio is the only excavated Neolithic lakeside settlement in Greece. Archaeological research provided evidence that the site was continuously used from the Early Neolithic (~6000 BC) to the Late Chalcolithic period (~1200 BC, Mycenaean period). During several archaeological campaigns, a portion of the settlement has been excavated that enabled a sufficient understanding of the architectural layout of homes, the building materials, and the organization of space, while the finds (fragments of pottery, stone and bone tools, anthropomorphic and zoomorphic clay figurines, miniature representations of objects also on clay, animal and fish bones, charred cereal grains, and other fruits) provided information on the everyday lives of the Neolithic inhabitants. A series of charcoal and wood samples, originating mostly from the Middle and Late Neolithic layers of the site, were radiocarbon dated and their dates range from ~5470 to 4850 BC. The most unexpected of the finds, a wooden tablet from the lake bearing engraved symbols, was ¹⁴C dated to 5260 ± 40 BC. In addition, clay tablets and pottery vessels engraved with similar symbols were also unearthed from layers dated to the same period. If this proves to be a primary source of written communication, the history of writing should be reconsidered and Neolithic societies should not be considered “societies without writing.”

INTRODUCTION

Dispilio is a prehistoric lake settlement located 7 km south of Kastoria, northern Greece (40°29'7"N, 21°17'22"E), on the southern shore of the Orestias Lake at the site called Nissi (“island”), where a small church of the Ascension has been built. In 1932, traces of this settlement were first located by Professor A Keramopoulos of the Aristotle University of Thessaloniki (Keramopoulos 1932). The first information about the existence and excavation of the site comes from a report in the local newspaper *Kastoria* on 28 August 1938. The news coverage refers to the excavation, also listing the telegram of A Keramopoulos to the Hellenic Ministry of Education and the Archaeological Society at Athens. The details of this first survey, which lasted a few days, are published in the Proceedings of the Archaeological Society at Athens (Kavvadias 1900; Keramopoulos 1938).

Keramopoulos returned in 1940 and carried out excavations at two different sites, already known in the literature not for its prehistoric finds, but for its surrounding wall. This wall was first recorded during the Balkan Wars by N G Papadakis (1913). As noted by Keramopoulos, various technical works that were held in the area since 1935, including the construction of the road that connects Dispilio with Kastoria, resulted in the Orestias lake water level to fall and leading to the discovery of a significant number of piles (Figure 1) that were the motive of the investigation (Keramopoulos 1940). Thirty years later, Professor N Moutsopoulos (1974, 1997–1998) conducted surface investigations and confirmed the existence of the settlement.

MODERN EXCAVATION RESEARCH

More than 50 yr passed since the first excavations of 1940 until the beginning of the modern systematic excavations, which are still in progress by the Aristotelian University of Thessaloniki under the direction of Professor G Hourmouziadis (1996, 2000a,b, 2002, 2008; Chourmouziadis and Sofronidou 2007). The modern investigations started in 1992 with four trial trenches excavated in the eastern region of the site Nissi and continues from 1993 until today as a systematic excavation with

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Figure 1 Mid-1930s photograph of the southern shore of Orestias Lake showing a significant number of piles belonging to the prehistoric lakeside settlement Dispilio after the fall of the lake's water level, which was due to construction work in the area since 1935 (Moutsopoulos 1972).

horizontal expansion. The fluctuation of the level of the aquifer horizon is the most determining factor for the stratigraphic data identification and the horizontal investigation for the oldest inhabitation phases, because this is often the cause that overthrows the excavation schedules.

To date, a total of 5250 m² have been excavated in an area of ~17,000 m² (Figure 2). Figure 3 presents an updated excavation grid of the Dispilio site showing the excavated trenches and squares. Each excavation square is 10 × 10 m, divided into four subsquares 5 × 5 m named a, b, c, and d. The deposits of the three trenches (Western, Eastern and Southern) located at the center and the eastern part of the site covering an area of 2000 m² are safely dated to the prehistoric period. According to the stratigraphic data (Figure 4) and in association with the fixed and movable finds, three cultural phases were distinguished (characterized as “lakeshore,” “shore marsh,” and “dry land” environments), which include individual inhabitation episodes (Hourmouziadis 2008; Karkanias et al. 2010). Thus, gradually, a mound was formed and further shaped by subsequent lake-level fluctuations. One of the lake-level rises is tentatively related to the abandonment of the mound in the Chalcolithic and the development of a hardpan on its surface (Karkanias et al. 2010). A few archaeological remains, mostly collected on the surface, provide evidence for later occupation during the Bronze Age.

The purpose of the Dispilio excavation is to study the time of the settlement as reflected in the elements related to its spatial organization; in other words, to study the beginning of its existence, its lifespan, and its extinction, abandonment, or destruction. Finally, this study aimed to gather and study all finds that provide information about the settlement, divided into three groups defined by economy, technology, and ideology. It would not be arbitrary to distinguish Dispilio finds into four main categories: time, space, economy, and ideology finds (Hourmouziadis 2008).

The finds of the archaeological excavations have a special significance. Not so much because Dispilio is the only excavated, Neolithic lakeside settlement in Greece, but because the systematic

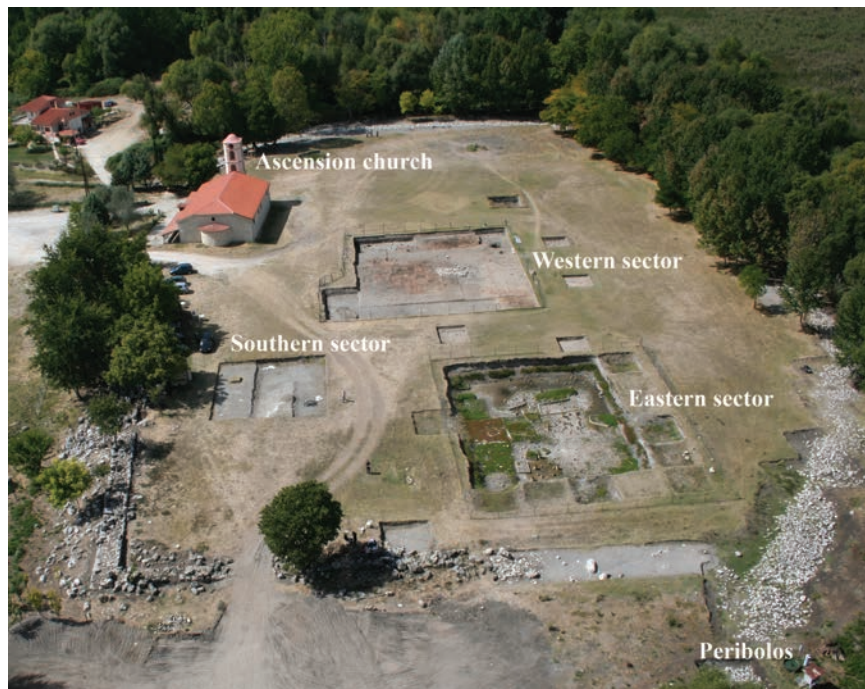


Figure 2 Panoramic view of the Aristotelian University of Thessaloniki modern excavations at the site Nissi (modified from Sofronidou 2009).

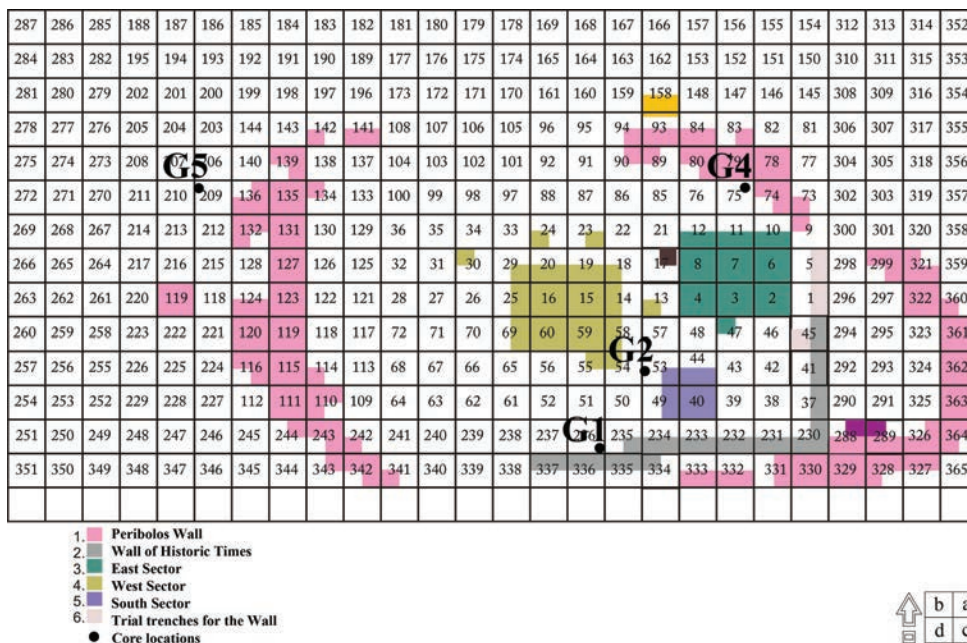


Figure 3 The excavation grid of Dispilio site showing the excavated trenches and core locations (G1=DSG1, G2=DSG2, G4=GSG4, and G5=GSG5). The peripheral shaded squares mark the edge of the mound and generally follow the peribolos wall. Each excavation square is 5 × 5 m.

investigation showed that we are not dealing with a static society of primitive people, but with a dynamic one. At the same time, the wooden piles that were found still stuck to the bottom of the lake provide insight into the domestic architecture (Chourmouziadi 2002).

This article presents two subgroups consisting of unique archaeological finds belonging to the ideology category, presented here for the first time, and dated by association with the results of already published radiocarbon-dated samples (Facorellis and Maniatis 2002; Karkanis et al. 2010). The data here are reinterpreted together with new unpublished information. The final goal would be the absolute dating of the strata where these artifacts were found in comparison with the chronological framework of the site established by the available relative (archaeological) and absolute (^{14}C) dating.

ARCHAEOLOGICAL EVIDENCE

Based on the relative chronology, it was found that the Dispilio settlement dates to the end of the Middle and Late Neolithic period. The corresponding archaeological deposits range from 0.40 cm and in some cases reach 2.15 m in depth (Eastern trench). This is the horizon of the lake's natural deposits, which has been possible to trace after running the drainage system that was completed in the eastern trench in 2009. However, during the excavation campaigns of 1997, 2001, and 2002, the drought at the time gave the opportunity to explore deeper deposits of the settlement. Thus, in some areas constructions and pottery fragments dated to the final phases of the Middle Neolithic or early phases of the Early Neolithic period were revealed, as evidenced by the relevant literature (Wace and Thompson 1912; Theocharis 1973; Perlès 2001; Anthony and Chi 2009; Papadimitriou and Tsirtsoni 2010). Therefore, the settlement probably developed during nearly the entire Neolithic period, as the excavation research has not yet identified an abandonment phase (Hourmouziadis 1996, 2002; Chourmouziadis and Sofronidou 2007; Sofronidou 2000, 2008).

Among the fauna (Stratouli 2002) and flora (Mangafa 2002; Ntinou 2010) remains, as well as the mobile excavation finds (e.g. pottery, tools), the whole range of economic activities of the prehistoric inhabitants of Dispilio (Touloumis 2002; Phoca-Cosmetatou 2008) has been represented: farming (Margaritis 2011); animal husbandry, hunting, and fishing (Almatzi 2002; Theodoropoulou 2008). Numerous bone hooks (Stratouli 2008) and traces of a boat (Marangou 2001), identical to those used to this day by the fishermen of Kastoria, provide clear evidence that fishing was practiced. Finds, such as leaf-shaped and triangular arrowheads of obsidian from Melos (Tsagouli 2002), pottery similar to that of the neighboring Balkan areas (Sofronidou 2000, 2002; Voulgari 2002), and a stone ring idol pendant, place the settlement of Dispilio within the exchange networks developed in Greece during the Late Neolithic period.

The number of pottery vessels found in Dispilio record the morphological, stylistic, and technological choices of the people who lived there and tried to serve their needs during each prehistoric period. These changes are often obvious and distinct but sometimes indiscernible or nonexistent through time. The same decoration techniques continue to exist (painted, incised, grooved, channeled, pointillé, barbotine, and applied wares), but what changes is their combinations or abundance, while in some cases some decoration techniques are improved, e.g. the blacktopped wares. The raw materials used for the pottery production exhibit individual differences, but their basic structure remains the same and comes from the surrounding area of the village. There is a change in preference observed from the early to the later phases of the site occupation or use (end of Early Neolithic or beginning of Middle Neolithic to the Early Bronze Age) from the fine black burnished surfaces to the red or red-brown medium burnished ones and back again to the dark burnished ones towards the Late Neolithic and the Bronze Age. There is a predomination of the spherical or hemispherical shapes during the early phases of the settlement, which are gradually replaced by the biconical ones, while

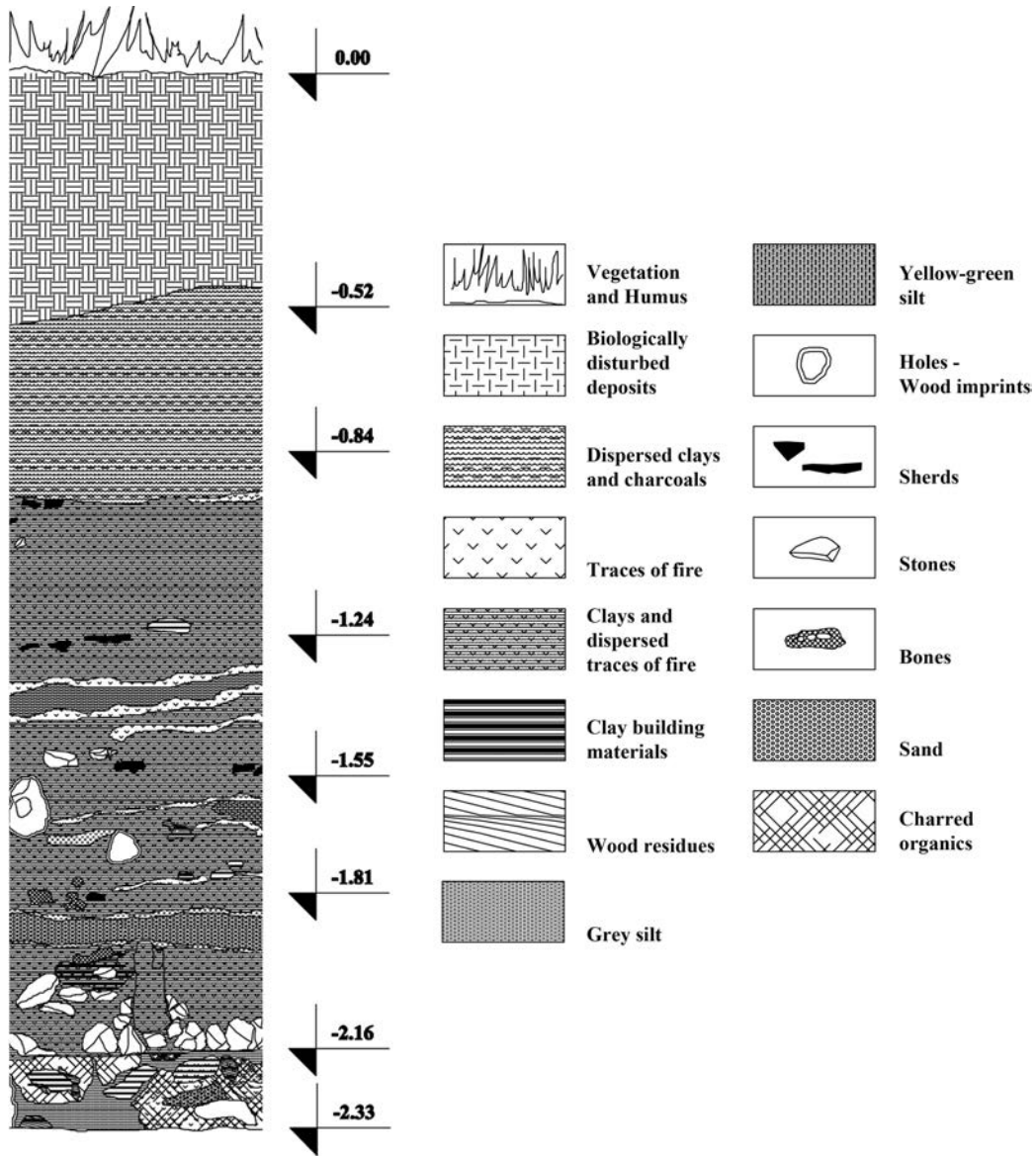


Figure 4 General plan of the stratigraphy of the excavated trenches

a significant increase of the carinated ones is observed in the Late Neolithic. At the same time, their individual morphological elements (rims, bases, or handles) are differentiated, presenting in the Late Neolithic and Bronze Age significant deviations from known shapes of previous periods. The repertoire of shapes includes open vessels of various types and sizes, which predominate, while the closed ones used for transport or storage of liquids or solids exist in smaller numbers. For example, a significant number of *pithoi* have been restored originating from specific archaeological layers of the excavated area (Eastern trench, squares D8a, D8b, D8c, and D8d) corresponding to the residential horizon of the end of the Middle Neolithic period. So far, a similar group of pottery of this type, as far number and capacities are concerned, has not been found in any other occupation phases of the settlement, which makes us speculate that either this was a space for collective actions, or it rep-

resents a storage “choice” that is closely connected to the spatial organization commitments of the settlement caused by the proximity to the lake. Three more types of pottery belonging to the same phase characterize the pottery production of Dispilio. These are boat shaped, tetrapods, and fruit stand vessels related to cooking and consumption of food, which gradually, and according to the aforementioned order, cease to appear in the Late Neolithic. Pottery fragments found *in situ* dated to the Late Neolithic I (Western trench) originating from a destruction layer where all specific spatial organization structures of a “household” have been preserved (ovens, cases, low benches, where in many cases pottery sherds were used as construction material) give us enough information about the various activities of the people and their daily habits (Sofronidou 2000, 2002, 2008; Voulgari 2002; Chourmouziadis and Sofronidou 2007).

Finally, regarding the dating of the settlement deposits as a whole, it should be noted that archaeological layers dated to the Bronze Age were also identified. Several finds from this period, mostly pottery fragments, were found in the upper deposits of the site. Moreover, significant quantities of pottery fragments dated to the same period and the late Mycenaean phases were found in excavated trenches, which are in progress in order to reveal the *peribolos* (Stavridopoulos and Sianos 2009) that defines the site (Figure 2).

Two subgroups of “ideology” finds are presented here, which are both unique and important due to their strong relation to areas of social significance:

- i) The first subgroup consists of a piece of wet cedar wood (*Cedrus* sp.) with an almost quadrilateral shape measuring $23 \times 19.2 \times 2$ cm that bears traces of fire. The tablet was found during the July 1993 excavation campaign in a trial trench into the water very near the lakeshore. There are archaeological finds and traces of anthropogenic activity into the water in the entire area (Sofronidou 2009). This trench was performed some meters away from the northwestern side of the Eastern trench (Figure 2). An excavation square (D158dc, Figure 3) was framed using wooden boards and the water was continuously pumped away. When the mud was gradually removed, the wooden tablet appeared floating on the water surface that was still entering inside the framed area, passing through and over the wooden boards due to the waters rippling. On the surface of the artifact, which is characterized as the front one, up to 10 rows of linear vertical and horizontal carved “signs” can be distinguished (Figure 5). Similar carved signs can also be seen on the upper thin side of the tablet. The signs were preserved due to the anaerobic conditions of the tablet’s taphonomic environment. However, during the drying process most of their engraving depth has been lost.
- ii) The second subgroup consists of a small number of clay finds bearing signs that cannot be considered as decorative. Therefore, they cannot be dated according to their typology and most probably belong to the same category of “message-conveying” finds.
 - ii.a. Clay gray-brownish cup with a ringed base. On its external surface, this cup bears two circumferential rows of engraved signs. The lower one near the base is defined with an engraved up and down limit. The upper row is free and established by the circular development of the engraved signs (Figure 7a). It was found in a layer together with pottery typologically dated to the end of the Middle Neolithic period.
 - ii.b. Pottery sherd bearing engraved Λ -shaped signs and horizontal lines (Figure 7b). It is also dated to the end of the Middle Neolithic period.
 - ii.c. Fragment of a polished clay object with peripheral incisions, possibly a clay tablet. On the one side it bears engraved Λ -shaped signs and horizontal lines. The other side, which is



Figure 5 Cedar tablet carved with 10 rows of linear (vertical and horizontal) signs, some of them resembling the letters Δ, E, or Λ. Dated to 5202 ± 123 BC (5324–5079 BC) within 2σ (DEM-321).

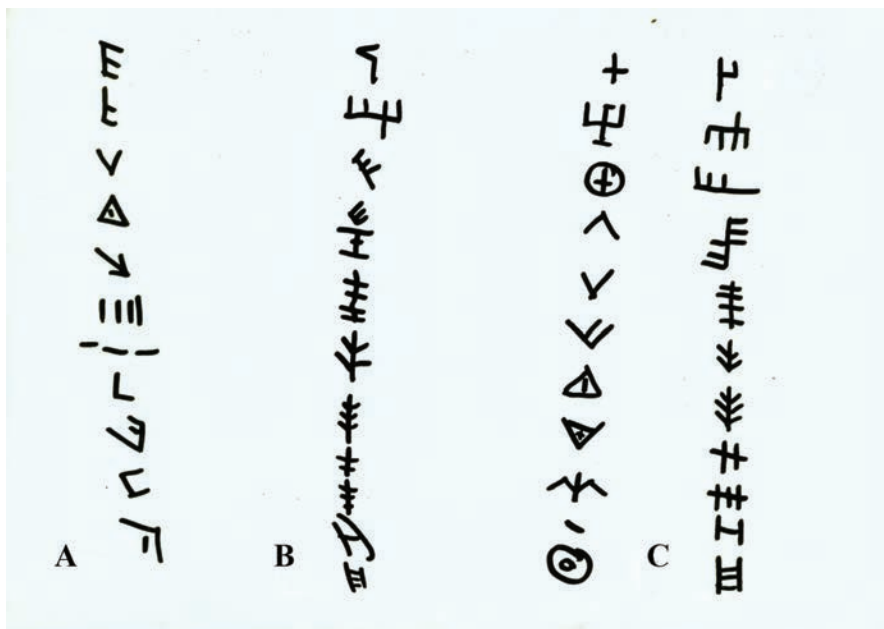


Figure 6 (A): Samples of carved “signs” on the wooden tablet and other clay finds from Dispilio; (B) samples of Linear A signs; (C) samples of signs on Paleoeuropean clay tablets (modified from Hourmouziadis 1996).

characterized as the rear one, is flat with traces of abrasion (Figure 7c). It was found in a layer together with pottery typologically dated to the Late Neolithic I period.

- ii. Clay brown bowl with visible traces suggesting that it had been handcrafted. The outer surface bears a large number of engraved signs mainly distributed on three parallel circumferential lines (Figure 7d). It is dated to the Late Neolithic I period.



Figure 7 (a) Cup. End of Middle Neolithic. (b) Sherd. End of Middle Neolithic. (c) Clay tablet with peripheral incisions. Late Neolithic I. (d) Carved bowl. Late Neolithic I.

- ii. Handmade clay brown miniature vase with relatively sharp engravings, which is not very elaborately manufactured (its surfaces are quite rough). It bears incisions around the rim and the outer surface. Even at its base, numerous linear spots organized in small groups are engraved. A crooked line can be observed on the inner surface, which is mainly located under the rim, bearing extra incisions on three parallel circumferential lines, as well as in other spots (Figures 8a1, a2). It is dated to the Late Neolithic I period.
 - ii. Pithos sherd engraved with W (Figure 8b). It is dated to the Late Neolithic I period.
 - ii. Circular clay object, possibly a clay tablet. It consists of five fragmented pieces. In the upper part, it bears two mounting holes spaced 3.6 cm apart. One surface, which is characterized as the rear one, is flat with traces of abrasion. The front one has a number of engravings between the two holes, e.g. a horizontal Λ . In the middle of the engraved lines, it is possible to distinguish a limitedly defined shape of an animal composed by them (Figure 8c). It is dated to the Late Neolithic I period.

Table 2 summarizes all the available archaeological data concerning these clay finds. They have all been found in neighboring squares (D2d, D3c, D4a, D4b, D6d, and D7d) of the Eastern trench

in depths ranging from 1.20–1.95 m. They could not be directly and accurately enough absolute dated using the luminescence method (TL or OSL) because they were buried for millennia in a water-soaked soil due to close proximity to the lake.

The “signs,” which were engraved on these two subgroups of ideology finds, resemble a large number of Neolithic clay finds discovered particularly at settlements in the southern Balkans, called the Vinca culture (Winn 1981), the Tartaria tablets (Lazarovici and Merlini 2005), as well as the well-known Linear A script (La Marle 1997–1999, 2006). Figure 6 shows samples of the carved signs on the Dispilio wooden tablet (A) in comparison with samples of Linear A signs (B) and samples of signs (Vincan symbols) on Paleoeuropean clay tablets (C) (Hourmouziadis 1996; Owens 2009). Their study is still in progress, which must now take into account the fact that the cultural aspect of prehistory is not documented only by the sherds of pottery (Sofronidou 2000, 2002, 2008) and tools (Adamidou 2008; Ninou 2008; Ifantidis 2008; Chatzitoulousis 2008; Doulkeridou 2009), bones (Stratouli 2008; Petroutsa 2009), or carbonated grains (Mangafa 2002; Kouli 2008; Ntinou 2010; Tsartsidou 2010) that were unearthed; it can also be found in objects possibly manifesting a system of written communication. So, these two groups of socially significant finds consist of various Neolithic “messages” that we will never be able to decipher, despite the scattered unscientific and rather naive efforts made until now towards this direction (Hourmouziadis 2008).



Figure 8 (a1, a2) Miniature vase, Late Neolithic; (b) Pithos sherd engraved with W, Late Neolithic I; (c) Clay tablet with mounting holes, Late Neolithic I.

THE RADIOCARBON DATING EVIDENCE

During the more than 21 yr of recent excavation campaigns, a large number of vertical hydrated wooden structural elements (piles) and some horizontal ones were revealed. They were preserved

in good condition due to the nature of their taphonomic environment, which is characterized by anaerobic conditions (Pournou 2010). In addition, deposits rich in charred wood were also found in various destruction layers (Ntinou 2010). These hydrated and charred woods are mostly related to the houses of the Neolithic inhabitants (Chourmouziadi 2002).

A series of 24 samples (21 charcoal and 3 wood) were selected among hundreds of organic samples collected during various excavation campaigns and from four drilling cores (DSG1, DSG2, DSG4, and DSG5) extracted with a portable drilling rig, originating mostly from the Middle and the Late Neolithic layers of the site. They were all ^{14}C dated for previous studies (Facorellis and Maniatis 2002; Karkanis et al. 2010) and in this paper they are reanalyzed and used in association with the finds bearing engraved “signs,” together with new information that follows, which is not found in the literature. Seven of the samples were dated at the Centre for Isotope Research of the University of Groningen and another three at the ^{14}C unit of the Laboratory of Archaeometry, NCSR Demokritos, Athens, Greece, using the conventional gas proportional counting technique. Additionally, five samples were dated at the CEDAD (Center for Dating and Diagnostics of the Department of Engineering for Innovation) at the University of Lecce, Italy, and nine more at the Radiocarbon Dating and Cosmogenic Isotopes Laboratory of the Weizmann Institute of Science in Rehovot, Israel, by accelerator mass spectrometry (AMS). The sample descriptions follow:

Samples DEM-656 and DEM-657 originate from the external tree rings of two vertical wooden piles found at layer 9 of square D8a and the layer 14 of the square D2a, respectively.

Sample DEM-321 originates from the trial square D158dc. It consists of a piece of wood that was cut from the aforementioned wooden tablet.

Sample GrN-30956 originates from layer 2 of square D59b. It consists of pieces of charred wood tangential to the SW of the base of a pottery vase (A3) that has been removed. The specific vase was built on the site and dates to the Late Neolithic period. In the same area, two small vases, sherds belonging to another big vase and other sherds, small burnt stones, and hard clayey soil have been found.

Sample GrN-30963 originates from layer 3 of square D25a. It consists of pieces of charred wood collected at the northern region of the square. This area was rich in building elements: pockets; building materials fragments bearing impressions of woods and branches, some of them vitrified; loom weights; grinding stones; sherds; and lekani sherds. In the whole region, there were intense traces of fire on top of a thin and hard clay layer, possibly a floor.

Sample GrN-30961 originates from layer 2 of square D139c. It consists of pieces of charred wood collected at the lateral test square.

Sample GrN-30958 originates from layer 6 of square D8d. It consists of pieces of charred wood from the eastern baulk of layer 6. They originate from a layer with charred woods 3–6 cm thick, which covered the northern part of the baulk. Below that followed a layer with sand, charred woods, an accumulation of fragmented building materials, sherds, stones, clay, etc.

Sample GrN-30960 originates from layer 9 of square D4a. It consists of pieces of charred wood collected in a region among wooden piles containing sherds, fragments of the nail impressions decorated vase, wet woods, and wood chops. The vase dates to the Middle Neolithic period.

Sample GrN-31012 and GrN-30959 originate from layer 9 of square D8d. They consist of pieces of charred wood found at the SW region of the square, essentially outside the SE limit of an accumulation of fragmented building materials. They were collected in an area with pieces of charred woods and small white burnt stones. Below the charred woods there was a layer with sand.

The samples RTT-5031 and LTL-1084A originate both from the same depth of the eastern region of square 55a. They consist of pieces of charred wood.

The samples from the four drilling cores (Core DSG1: RTT-5035, LTL-1085A, LTL-1519A, RTT-5037, RTT-5036; Core DSG2: RTT-5032, RTT-5033, LTL-1520A; Core DSG4: RTT-5034, RTT-5038, Core DSG5: LTL-1086A, RTT-5039) have no association at all with phases, as the origin of organic material within the cores cannot be assigned with certainty (e.g. whether it originates from a hearth, a destruction layer, or it consists of dispersed charred wood pieces due to the lake water action in the past, etc.).

Table 1 presents the dating results of the Dispilio samples sorted by age. The conventional ¹⁴C ages of the samples are calibrated with the IntCal13 calibration curve (Reimer et al. 2013) using the OxCal v 4.2 software (Bronk Ramsey 2009). When the conventional ¹⁴C age inaccuracy of a sample is ≥ 50 yr, the corresponding calibrated dates are rounded to the closest decade. The calibrated dates range within 2σ from 5470–1980 BC, or a period ranging from the end of the Middle Neolithic until the Middle Bronze Age (RTT-5035, LTL-1085A, and LTL -1519A). Figure 9 shows the probability distribution, within 1 (1σ) and 2 (2σ) standard deviations of the calibrated dates of the samples. All calibrated dates in the text are given within 2σ (probability 95.4%).

The ¹⁴C data show that the occupation begun during the end of the Middle Neolithic period 5355 ± 125 BC (RTT-5039) and it was inhabited continuously until 3644 ± 118 BC (RTT-5031). It appears then that the excavated site was abandoned between 3530–2460 BC as there is a gap in the ¹⁴C dates within this time interval (Figure 9 and Table 1). This abandonment is tentatively related to one of the lake-level rises in the Chalcolithic (Karkanias et al. 2010). There is also evidence of later occupation during the Bronze Age from 2300 ± 160 BC (LTL-1519A) until 2129 ± 152 BC (RTT-5035).

The dates of two samples, DEM-656 (5263 ± 51 BC) and DEM-657 (5299 ± 76 BC), which originate from the external tree rings of two vertical wooden piles, certainly do not give the date of the corresponding layers (Table 1), but instead, they date the construction phases of the associated houses. The majority of the vertical wooden piles used in the construction of the settlement's houses are made of *Juniperus* sp., while other conifers, such as *Pinus*, type *Pinus nigra* and *Conifera*, have also been used to a lesser extent (Ntinou 2010). It is worth noting that the majority of the wooden piles have just a few tree rings (less than 20–30), so dendrochronology cannot be applied.

As one can see in Table 1, the dates of the samples in all drilling cores (1, 2, 4, and 5) and within the same drilling core are consistent with depth within 2σ . In the case of Dispilio, which initially was a mound leveled by natural and anthropogenic activity in the millennia that followed, it is not sound to compare dates between different cores drilled several meters away from each other. For instance, the samples GrN-30961 (5145 ± 195 BC) and GrN-30956 (4930 ± 86 BC) originate almost from the same depth, but the first one was collected at the periphery near the *peribolos* and the second one from about the center of the site. Their age difference is due to the fact that the anthropogenic deposits have had a different accumulation rate in the center of the mound than in its periphery. Therefore, the dates of the samples from layers in the periphery should not correspond to those in the center of the mound for the same depth. This is not always the case with samples collected during the excavation as, i.e. the dates of the samples RTT-5031 and LTL-1084A, although they originate from the same square and depth, do not overlap within 2σ (3644 ± 118 and 4100 ± 130 BC, respectively). Although the date of the core sample RTT-5032 (3915 ± 125 BC), which originates from almost the same depth as the two latter samples, overlaps within 2σ with the date of sample LTL-1084A.

Table 1 Dating results of the Dispilio samples.

Lab nr	Location	Sample type	Depth (cm)	Age (yr BP)	Calibrated age (yr BC)
RTT-5035	Core DSG1, Square D236c	Charcoal	140–170	3720 ± 45	2198–2036 (68.3%) 2281–1977 (95.4%)
LTL-1085A	Core DSG1, Square D236c	Charcoal	140–170	3773 ± 55	2290–2060 (68.3%) 2450–2030 (95.4%)
LTL-1519A	Core DSG1, Square D236c	<i>Quercus</i> type deciduous Charcoal	140–170	3828 ± 55	2430–2150 (68.3%) 2460–2140 (95.4%)
RTT-5031	Square D55a east	Moloidae Charcoal	45	4860 ± 45	3699–3544 (68.3%) 3761–3526 (95.4%)
RTT-5032	Core DSG2, Square D53d	<i>Fraxinus</i> sp. Charcoal	45–66	5125 ± 50	3980–3810 (68.3%) 4040–3790 (95.4%)
RTT-5034	Core DSG4, Square D75a	Charcoal	175	5180 ± 60	4050–3820 (68.3%) 4230–3800 (95.4%)
LTL-1084A	Square D55a east	<i>Quercus</i> type deciduous Charcoal	45	5253 ± 55	4230–3980 (68.3%) 4230–3970 (95.4%)
RTT-5033	Core DSG2, Square D53d	<i>Fraxinus</i> sp. Charcoal	82–105	5395 ± 45	4331–4183 (68.3%) 4343–4067 (95.4%)
LTL-1086A	Core DSG5, Square D209b	<i>Quercus</i> type deciduous Charcoal	205	5774 ± 60	4690–4550 (68.3%) 4780–4490 (95.4%)
GrN-30956	Square D59b, Layer 2, S: 4.12 m x W: 0.95 m	<i>Pinus</i> type nigra Charcoal	80	6040 ± 30	4991–4858 (68.3%) 5016–4844 (95.4%)
LTL-1520A	Core DSG2, Square D53d	Charcoal	145–161	6133 ± 65	5210–5000 (68.3%) 5290–4850 (95.4%)
GrN-30963	Square D25a, Layer 3	<i>Quercus</i> type deciduous Charcoal	55–60	6200 ± 50	5220–5060 (68.3%) 5300–5030 (95.4%)
GrN-30961	Square D139c, Layer 2, Lateral Test Square	Charcoal	76	6210 ± 80	5290–5060 (68.3%) 5340–4950 (95.4%)
RTT-5037	Core DSG1, Square D236c	Charcoal	221	6220 ± 60	5290–5070 (68.3%) 5320–5020 (95.4%)
RTT-5038	Core DSG4, Square D75a	<i>Quercus</i> type deciduous Charcoal	224	6220 ± 50	5290–5070 (68.3%) 5310–5050 (95.4%)

(continued)

Table 1 (Continued).

Lab nr	Location	Sample type	Depth (cm)	Age (yr BP)	Calibrated age (yr BC)
DEM-656	Square D8a, Layer 9, N: 2,42 m × E: 0,20 m	External tree rings from a vertical wooden pile	167	6269 ± 29	5298–5224 (68.3%) 5314–5212 (95.4%)
DEM-321	Square D158dc, Wooden tablet collected during excavation near the lake shore	Wood <i>Cedrus</i> sp.		6270 ± 38	5299–5224 (68.3%) 5324–5079 (95.4%)
RTT-5036	Core DSG1, Square D236c	Charcoal	201–204	6270 ± 50	5310–5210 (68.3%) 5360–5070 (95.4%)
GrN-30958	Square D8d, Layer 6, Eastern region, S: 3,14 m × W: 4,72 m	<i>Quercus</i> type deciduous Charcoal	182	6300 ± 25	5313–5230 (68.3%) 5320–5220 (95.4%)
DEM-657	Square D2a, Layer 14, S: 1,70 m × W: 0,00 m	External tree rings from a vertical wooden pile	174–191	6338 ± 29	5361–5301 (68.3%) 5375–5223 (95.4%)
GrN-30960	Square D4a, Layer 9, Southwestern region, S: 0,75 m × W: 1,15 m	Charcoal	217	6360 ± 50	5460–5300 (68.3%) 5470–5230 (95.4%)
RTT-5039	Core DSG5, Square D209b	Charcoal	275	6380 ± 50	5470–5310 (68.3%) 5480–5230 (95.4%)
GrN-31012	Square D8d, Layer 9, Western region, S: 1,15 m × W: 1,78 m	<i>Quercus</i> type deciduous Charcoal	210	6385 ± 15	5371–5325 (68.3%) 5465–5317 (95.4%)
GrN-30959	Square D8d, Layer 9, Western region, S: 1,15 m × W: 1,78 m	Charcoal	210	6400 ± 15	5464–5331 (68.3%) 5467–5324 (95.4%)

Table 2 List of clay objects from Dispilio carved with signs.

Collection date	Square	Layer	Nr	Coordinates (m)			Depth (m)	Location	Description	Dimensions	Figure nr
				E.	W.	N.					
14/8/1993	Trial trench near the lake shore, D158dc							Wooden tablet	Length 23 cm Width 19.2 cm Thickness 2 cm	5	
27/7/2001	D4a	9	4	1.60	4.44	1.95	S. flank	Cup. End of MN	Height 5.95 cm Rim diameter 5.7 cm Base diameter 4.9 cm (slightly elliptical) Wall thickness 1 cm Weight 161.5 g	7a	
29/7/1994	D4a	7	37	2.60	2.40	1.76	Center of the square	Sherd. End of MN		7b	
16/8/1994	D4b	6	29			1.20–1.22	Southern half of the trench	Clay tablet with peripheral incisions. LNI	Length 5.5 cm Width 4 cm Thickness 1 cm Weight 24.7 g	7c	
21/7/1995	D6d	5	A1	2.40	0.50	1.66	N. baulk of earth between the squares of the grid	Carved bowl. LNI	Height 4.3 cm Rim diameter 8.7 cm Base diameter 5.8 cm Wall thickness 0.9–1.4 cm Weight 266.5 g	7d	
26/9/1997	D7d	8	A2	3.90	0.02	1.58	NW region	Miniature vase. LNI	Height 3 cm Rim diameter 3.75 × 3.55 cm	8a1, 8a2	
9/8/1994	D2d	11				1.62–1.78	SE region	Pithos sherd engraved with W. LNI	Base diameter 2.4 cm Wall thickness 0.5 cm Weight 25.2 g	8b	
28/8/1997	D3c	11	236			1.75	NE quadrant (from the debris)	Clay tablet with mounting holes. LNI	Length 7.5 cm Width 7.5 cm Thickness 1 cm Weight 91.8 g Hole diameter 0.3 cm	8c	

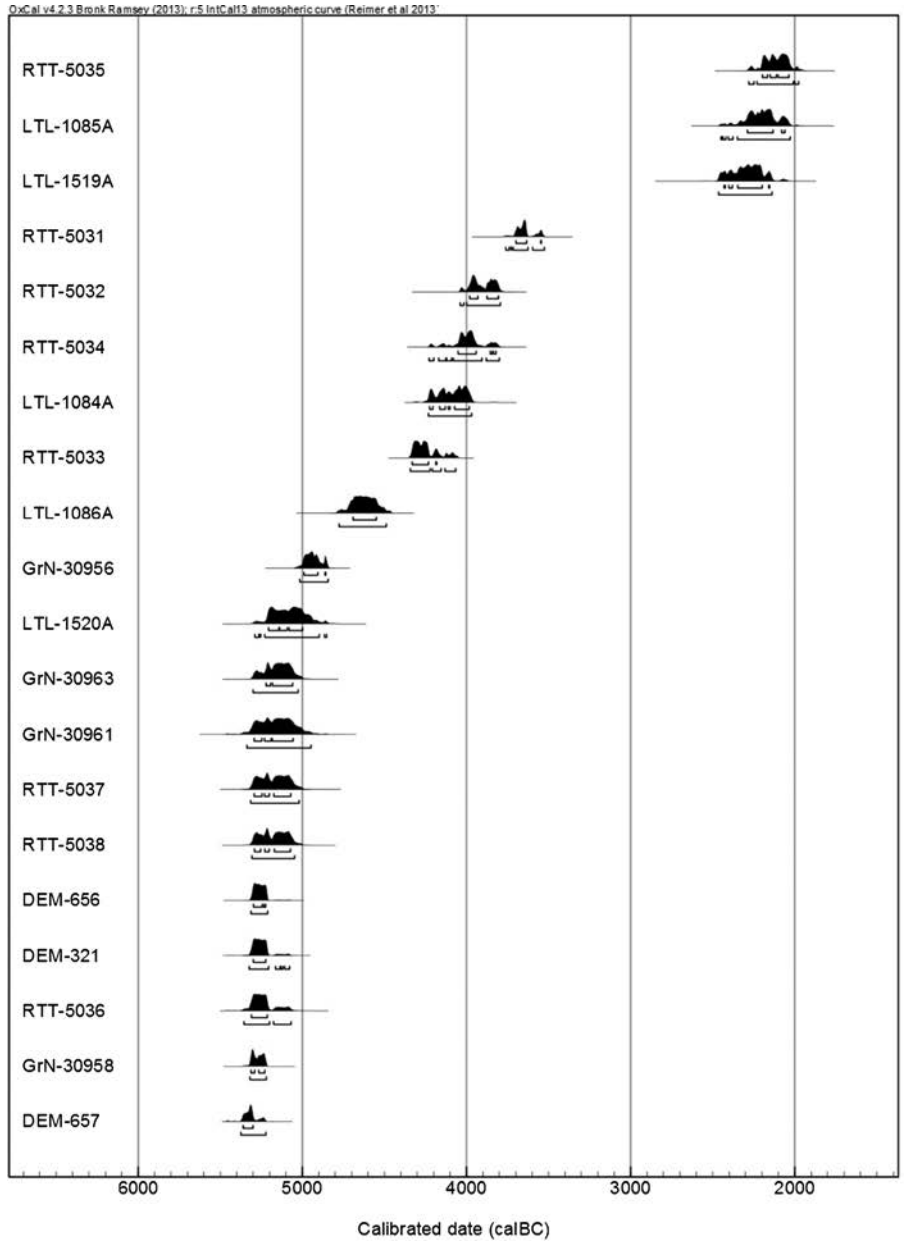


Figure 9 The probability distribution, within 1σ and 2σ, of the calibrated dates of the samples from Dispilio sorted by age.

The piece of wood sampled from the wooden tablet gave an age of 5202 ± 123 BC (5324–5079 BC) within 2σ (DEM-321) (Facorellis and Maniatis 2002). The cup (Figure 7a) and the sherd (Figure 7b) were found in Middle Neolithic layers associated with the sample GrN-30958 (5270 ± 51 BC). All the other clay finds bearing engraved signs (Figures 7c,d and 8a1, 8a2, b, c) were found in Late Neolithic I layers remotely associated with sample RTT-5034 (4015 ± 215 BC).

CONCLUSIONS

Prehistoric Dispilio was a typical lakeside settlement, the first of its kind ever excavated in Greece. During several archaeological campaigns, a portion of the settlement was excavated that enabled a sufficient understanding of the architectural layout of homes, the building materials, and the organization of space, while the finds (pottery, stone and bone tools, anthropomorphic and zoomorphic clay figurines, miniature representations of objects also on clay, animal and fish bones, charred cereal grains, and other fruits) provided information regarding the everyday lives of the Neolithic inhabitants of Dispilio.

The ^{14}C data show that the occupation began at the end of the Middle Neolithic period (5355 ± 125 BC) and was inhabited continuously until 3644 ± 118 BC. It appears that the excavated site was eventually abandoned between 3530–2460 BC. This abandonment is tentatively related to one of the lake-level rises in the Chalcolithic (Karkanis et al. 2010). There is also evidence of later occupation during the Bronze Age from 2300 ± 160 until 2129 ± 152 BC.

The most unexpected of the finds, a cedar tablet the lake carved with 10 rows of “signs” was ^{14}C dated to 5202 ± 123 BC, and is the oldest known engraved wooden tablet. In addition, clay tablets and other clay finds engraved with similar signs were also unearthed from layers dated either to the end of the Middle Neolithic or to the Late Neolithic I period. The dating of the Dispilio engraved finds is similar to those that appeared in southeastern Europe around 5300 BC, some 2000 yr earlier than any other known writing. These signs and inscriptions are considered by some scholars a specific script of literacy (Winn 1981; Merlini 2005; Lazarovici and Merlini 2005; Owens 2009). If this proves to be a primary source of written communication, the history of writing should be reconsidered and Neolithic societies can no longer be considered “societies without writing.”

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