Reference: Sarris, A., Kalayci, T., Simon, F-X., Donati, J., Garcia, C.C., Manataki, M., Cantoro, G., Moffat, I., Kalogiropoulou, E., Karampatsou, G., Armstrong, K., Argyriou, N., Dederix, S., Manzetti, C., Nikas, N., Vouzaxakis, K., Rondiri, V., Arachoviti, P., Almatzi, K., Efstathiou, D., and Stamelou, E., 2017, *Opening a New Frontier in the Study of Neolithic Settlement Patterns of Eastern Thessaly, Greece*, in Sarris, A., Kalogiropoulou, E., Kalayci, T., Karimali, L., (Eds.) Communities, Landscapes, and Interaction in Neolithic Greece, Proceedings of the International Conference, Rethymno 29-30 May, 2015, 13: 4-16.

Title: Opening a New Frontier in the Study of Neolithic Settlement Patterns of Eastern Thessaly, Greece

Authors: Apostolos Sarris, Tuna Kalayci, François-Xavier Simon, Jamieson Donati, Carmen Cuenca-García, Meropi Manataki, Gianluca Cantoro, Ian Moffat, Evita Kalogiropoulou, Georgia Karampatsou, Kayt Armstrong, Nassos Argyriou, Sylviane Dederix, Cristina Manzetti, Nikos Nikas, Konstantinos Vouzaxakis, Vasso Rondiri, Polyxeni Arachoviti, Kalliopi Almatzi, Despina Efstathiou, Evangelia Stamelou

The Innovative Geophysical Approaches for the Study of Early Agricultural Villages of Neolithic Thessaly (ARISTEIA-IGEAN) Project made an extensive use of geospatial technologies in the study of the natural environment and social dynamics of Neolithic settlements within the coastal region of eastern Thessaly, Greece. The goal of the project was to offer a broad and non-destructive remote sensing coverage of a number of Neolithic settlements to study habitation practices that were developed in various ecological niches and to document site-specific cultural and environmental characteristics. The methods and techniques used in the IGEAN project included satellite remote sensing, Remotely Piloted Aircraft Systems (RPAS), ground-based geophysical surveys exploring new generation prospection instrumentation, and soil analyses. The manifold research agenda proved to be effective for the detailed mapping of soils in which archaeological residues of past occupation reside. The full open-access geospatial data is served online at <http://igean.ims.forth.gr/>.

The IGEAN project exposed a large degree of variation in the occupation of the landscape and the usage of space in both small and large settlements. The study was able to capture an integrated image of the habitation settings and highlight the large degree of divergence in the intra-site settlement patterns of these agrarian societies. The synthesis of the results opens up further research questions regarding early agricultural villages of Neolithic Thessaly.

Introduction

The southern Balkan Peninsula, and especially the area of Greece, was of critical importance in serving as the gateway to the Neolithization of Europe from the Near East (Perlès 2001). Early farming communities first appeared on an extensive scale in Thessaly (central Greece) and provided the seeds for a new European cultural landscape. The early chronology and high density of Neolithic sites in Thessaly makes the region a key area for understanding the pathways in which the Neolithic emerged and pushed northwards into the continent.

The ARISTEIA-IGEAN (Innovative Geophysical Approaches for the Study of Early Agricultural Villages of Neolithic Thessaly) Project, which has been running for the past three years, has undertaken a systematic and extensive geophysical exploration of the Neolithic landscapes of Thessaly. The research project focuses on the study of the natural environment and the social dynamics of Neolithic settlements within the coastal regions of eastern Thessaly, Greece (Figure 1). The goal was to offer a broad non-destructive remote sensing coverage of a number of Neolithic settlements in order to study habitation practices that developed in various ecological niches and to document their cultural and environmental characteristics.

The geospatial technologies employed satellite remote sensing, aerial reconnaissance through the use of Remotely Piloted Aircraft Systems (RPAS), ground-based geophysical surveys using new generation prospection instrumentation, and soil analyses. The manifold research agenda, which was developed specifically to approach the particular archaeological questions, proved effective for the detailed mapping of soils in which archaeological residues of past occupation are situated. The engagement of the specific methods made it possible to capture both the horizontal and vertical extent of the cultural layers, offering a more holistic image of the plan of the settlements.

The results of the methodology applied proved to be revealing in terms of the internal spatial organization of tell sites (known locally as *magoules*) and the usage of space in their vicinity, outlining at the same time details of the environmental settings of Neolithic settlements. The intra-site distribution and clustering of built environments, their structural differences (daub or stone-built structures of variable sizes), the existence of ditches and enclosures demarcating the limits of the sites, the differentiation between habitation quarters and open spaces within the settlements, and the existence of corridors and entrances within the enclosures are some of the key discoveries of the survey campaign.

Figure 1. Locations of Neolithic sites mentioned in the text.

Thessaly constitutes one of the main regions of Mainland Greece where first farming groups migrating from Anatolia settled. Permanent habitation was adapted to the specific geomorphological conditions of the area, which consists of extensive alluvial and Fluvial plains with direct access to the Aegean Sea. Two major plain basins, the southwestern Karditsa-Trikala Plain and the northeastern plain of Larissa-Velestino, were important regions for Neolithic occupation. The analysis of the distribution of pottery and lithics suggests that there

was frequent communication between the two plains and the coast (Karimali 1994; Pentedeka 2008; Rondiri 2009; Vouzaxakis 2008).

The identification of several Neolithic *magoules* in Thessaly goes back to the beginning of the twentieth century. With the work of Tsountas (1908), Wace and Thompson (1912), Theocharis (1958), and French (1972), the discovery of new sites became an intriguing topic of investigation, partly due to the outstanding, nearly monumental size of most of the sites and to other features (e.g. height, visibility, duration). From the works of Halstead (1984), and more recently Gallis (1992), van Andel and Runnels (1995), and Perlès (1999), the focus of attention turned to the location of new sites and the identification of the distribution patterns of Neolithic settlements within different environments of Thessaly.

The issue of the connection of sites with their environment was only pursued by Halstead (1984), van Andel and Runnels (1995), and Perlès (1999, 2001), who were interested in the distribution of sites in their wider environmental/geological matrix, based on the macroscopic inspection of the topography and geology through fieldwork investigations. A more synthetic and multi-parametric regional research was carried out by the GeoSat ReSeArch Lab of IMS-FORTH. Through an extensive GPS survey, it was possible to create an updated corpus of sites (ca. 340) to reconstruct the geomorphological settings of Thessaly in various phases of the Neolithic period, to use satellite remote sensing for the detection of new *magoula* sites, and to study the dynamics of the regional Neolithic habitation patterns through the use of multi-criteria spatial processes in a Geographic Information Systems (GIS) environment (neolithichessaly.ims.forth.gr) (Alexakis et al. 2008, 2009, 2010, 2011). A similar project in western Thessaly that is currently running makes use of coring and spatial analyses (Orengo and Krahtopoulou 2014).

Despite the above studies that focus on the regional tendencies of Neolithic habitation patterns, the internal spatial organization of the settlements remains poorly defined. Most of the information derives from the early excavations at Sesklo and Dimini, as well as the most recent work at Palioskala, suggesting different templates of settlement organization (Halstead 1992; Toufexis 2006; Tsountas 1908). Both Sesklo and Dimini are located close to river channels, but only Dimini exhibits evidence of six enclosures encircling the settlement (Chourmouziadis 1979). In contrast, Sesklo deviates from the “usual” template of a *magoula*. Still, the core habitation zone of the settlement consists of highly clustered one- or two-room stone-built structures (Kotsakis 1994). Similar clustering and a series of concentric stone-built enclosures are exhibited at the Final Neolithic (FN) *magoula* of Palioskala, located on the banks of Lake Karla (Toufexis 2006). The few remaining sites that have been partially excavated provide ample evidence of some of the internal characteristics of the settlements. However, the limited size of the excavations provided little information regarding the extent of the settlements, their internal organization, the sprawling of habitation outside the limits of the *magoules*, and the existence of enclosures. Previous geophysical survey has been carried out at Zerelia (Papadopoulos et al. 2011), Sesklo Pyrgou (Sarris 2003), Dimini (Sarris et al. 2001, 2002), and Koutroulou (Kyparissi-Apostolika and Hamilakis 2012; Tsokas et al. 2009), but it was not on a sufficient scale to map patterns and extents of occupation.

In order to address the above questions related to the organization of settlements and the context of their dynamic local landscapes, the ARISTEIA-IGEAN project followed a multicomponent and systematic remote sensing campaign targeting a series of Neolithic settlements in the coastal hinterlands of eastern Thessaly. Single- and multi-sensor geophysical instrumentation, coupled with other geospatial technologies, targeted 21 Neolithic settlements of various periods

(Table 1) to identify both common and divergent spatial elements in light of their environmental setting (see igean.ims.forth.gr).

Table 1. List of Sites Surveyed during the ARISTEIA-IGEAN Project.

Site ^a	Period ^b	Coverage (ha) ^c			
		Magnetics	EM	GPR	RPAS
Agios Dimitrios	EN, MN	.39	.75	.08	5.19
Agios Nikolaos	LN	-	-	.09	-
Almyriotiki	EN-LBA	8.38	4.03	1.30	20.70
Almyros 2	EN-MN	6.63	2.35	.37	7.33
Bakalis	FN-beyond	.46	.38	.29	8.84
Belitsi	EN, MN	3.02	1.83	.20	11.74
Dexameni	N, EBA	.07	.28	.07	3.20
Eleuterochori	undefined	-	.17	.22	-
Kamara	MN	1.55	1.05	.10	-
Karatsantagliou	LN	2.94	1.19	.22	12.17
Karatsantagli	EN	2.65	.56	.18	12.38
Kastro Kokkinas	LN, FN, and historical	1.01	.82	.06	7.02
Velesino 2 (Nikonanou)	MN-EBA and Byzantine	2.95	2.05	-	4.10
Perdika 1 (Daoutza)	EN, MN, MBA	5.27	2.17	.44	3.12
Perdika 2	MN	3.83	1.95	.32	13.41
Perivlepto (Kastraki 2)	EN, MN	5.09	1.78	.64	20.46
Rizomilos 2	N, EBA	10.52	3.22	.33	6.81
Vaitsi Mylos	EN-MBA	3.16	2.68	.88	10.37
Velesino 3 (Mati)	EN-MN, EBA, and historical	3.19	1.78	.45	2.50
Velesino 4 (Visviki)	MN-LBA	5.36	-	.17	2.56
Zerelia	EN-LBA and historical	4.82	1.85	.29	30.16
Total		71.29	30.89	6.7	182.06

^a See Figure 1 for site locations.

^b Period of habitation is based on diagnostic material from each site: Early Neolithic (EN), Middle Neolithic (MN), Late Neolithic (LN), Early Bronze Age (EBA), Middle Bronze Age (MBA), and Late Bronze Age (LBA).

^c Coverage represents the total area surveyed by each major prospection technique (soil resistance and magnetic susceptibility are not included in this table). In total, the geophysical coverage is the largest ever covered in a single project within the Eastern Mediterranean.

Methodological Tools

In order to achieve an extensive and detailed coverage of Neolithic settlements and explore their organization and built environments, a manifold remote-sensing protocol was designed (Sarris 2013). The environmental settings of the sites and their geo- Morphological attributes were first studied through satellite and aerial reconnaissance. Broad scanning of the *magoules* and their surrounding environs was achieved with the use of magnetic and electromagnetic techniques. Ground-penetrating radar (GPR) and soil resistance techniques were also employed, coupled with the collection of soil samples for further analysis of their chemical and magnetic properties.

From a top-to-bottom approach, satellite remote sensing and RPAS aerial images were obtained and processed in a specific pipeline to accentuate archaeological features. Satellite images taken from high-resolution multispectral sensors (WorldView-2, Quickbird, GeoEye-1) were processed and a number of feature enhancement indices (PCA, Tasseled Cap, IR/R, Decorrelation Stretch, and RGB to IHS) were applied together with the calculation of various vegetation indices (ARVI, EVI, MSAVI, MSR, NDVI, WdVI, TSAVI, and SAVI) (Sarris et al. 2013). Additionally, low-altitude aerial photography using RPAS was mainly engaged to

detect any shallow architectural features that may exist in the vicinity of the *magoules* through conventional and infrared cameras.

The magnetic surveys employed a SENSYS GmbH MX Compact system, consisting of a cart carrying eight fluxgate gradiometer sensors, spaced 25–50 cm apart and connected to a DGPS navigation system. Measurements were taken every 1–10 cm along each transect, depending on the survey speed. Data were processed based on despiking, sensor-offset removal, and FFT deconvolution. Electromagnetic induction instruments were used to measure the magnetic susceptibility and soil conductivity of the soils at various depths (Tabbagh 1986). These surveys employed a Geophex GEM-2, GF Instrument CMD Explorer, and a Geonics EM-31, coupled with a DGPS navigation system, to measure the soil properties at five different frequencies (coil spacing of 1.66 m) with the GEM-2, three different depths (coil spacing of .32 m, .71 m, and 1.18 m) with the CMD, and a coil spacing of 3.66 m for the EM-31. Vertical Electrical Soundings (VES) were performed to normalize the soil conductivity measurements, and at the same time a calibration protocol was applied in a systematic way, providing comparable results between the EM magnetic susceptibility and geomagnetic datasets and between resistivity and EM electrical conductivity datasets. Both techniques were applied to provide a high-resolution map of the architectural features existing in the upper strata of the sites. Single- (Sensors & Software Noggin Plus GPR system with 250 MHz antenna) and multi-antenna (MALÅ MIRA GPR with 400 MHz antennas) GPRs were employed for the acquisition of stratigraphic data at various sections of the site with a sampling interval of about 2.5 cm along the parallel traverses 50 cm apart. GPR was particularly useful in revealing the depth of subsurface architectural features.

In total, all of the remote sensing, geophysical, and geochemical data were integrated into a GIS platform for better comparison of the measurements and interpretation of the various features. It should be stressed that the use of such a wide array of methods, in a systematic approach, is unique among archaeological research in Greece. The following section highlights eight representative case studies that produced some significant results in regards to the organization of space.

The Neolithic Built Environment ***Almyros 2***

The Early Neolithic (EN) to Middle Neolithic (MN) *magoula* of Almyros 2 is located 2 km south of the village of Almyros (Vouzaxakis 2008). The landscape around Almyros 2 is diverse and characterized by flat agricultural floodplains, large riverbeds, and streambeds that produce deep gorges, and mountains on the southern periphery. The site rises above the plain by 5–7 m.

Magnetic data indicate that the extent of the Settlement was not confined within the limits of the *magoula*, which has an oval shape 54 x 48 m in dimensions. Instead, the settlement spreads out toward the south, outside the core habitation zone (possibly as a consequence of the population growth) (Figure 2). The inner oval enclosure (A10) is related to an enclosure wall about 1.5 m in width. The outer enclosures are much wider but appear to be fragmented. From magnetic and EM magnetic susceptibility measurements, the outer enclosures (A1, A2, A3, A5), with variable width (wider at the east and south, spanning 7–14 m), were most probably built to mitigate flooding events. There are signs of an intermediate ditch (A4, A6, and A7) of smaller width, especially to the east and north.

Along the perimeter of the outside ditches there are definite signs of side exits or entrances (C1, C2, C3, C4, and C5) for pathways that radiate out from the settlement. Exits C2 and C3 to the east are much wider than the others, with a width of 3.5–6.5 m. Radially outwards and narrower are the entrances C1 and C5 to the south and east. Entrance C1 is of particular interest, as there are indications of a passage (possibly a type of bridge) over the outer ditch. At least 12 rectilinear structures (B1–B12) are outlined within the limits of the inner enclosure, most of which are oriented in the north-south direction. Two of the largest structures (B4 and B7 with approximate dimensions of 7 x 9 m) are located at the southeast and southwest sides of the settlement, while the smallest structures (B5, B8, and B11) have dimensions of 5 x 3 m. Structures B10 and B12 were verified through soil resistance measurements and produced high resistance anomalies. Geophysical data suggest that the structures are made of daub and are burnt (either intentionally or unintentionally). About half of the area that is confined within the enclosures (ca 1000 m²) consists of an unfilled space with no evidence of any constructions. This area is clearly distinguishable from the built environment to the south. The magnetic data indicate a wide exit toward the south, and more structural remains (B13–B24) sprawl toward the south and east between the enclosure walls and the surrounding ditches. A simplified flooding simulation indicated that the first water frontier could be expected to arrive toward ditch A8 to the north. On the whole, Almyros 2 indicates an aggregated settlement that seems to have expanded outside the core of the habitation zone to the south with an obvious susceptibility to flooding episodes.

Figure 2. Results of the survey of Almyros 2: (a) results of the vertical magnetic gradient survey; (b) diagrammatic interpretation and annotation of the geophysical features.

Rizomilos 2

The Neolithic–Early Bronze Age (EBA) settlement of Rizomilos 2 extends over an extensive hill in the middle of a floodplain in close proximity to lake Karla (Vouzaxakis 2008). The circular shape of the *magoula* is evident from the topographic map, reaching a relative altitude of about 8 m with respect to the surrounding flat areas. At the top of the *magoula* an illegal farmstead has been installed. The magnetic survey covered a very large area (10.5 ha) of the settlement and around it (Figure 3). According to the vertical electric soundings, the cultural layers (resistivity of 25 ohm) are buried at a depth of .6–2.2 m. The main locus of the *magoula* spreads over an almost circular area with a diameter of 210–250 m. The main *magoula* of Rizomilos 2 is confined by a series of 2-3 concentric ditches (A1, A2, and A3) with widths of 3–5 m. These features were confirmed by the GEM-2 magnetic susceptibility measurements with a depth from 0 to 1.7 m.

Within these larger external ditches, another series of features (B1, B2, B3, and B4) appears, having much smaller widths (less than 2 m) and a more intensive magnetic signature, perhaps suggesting the existence of enclosures. Four main gates to the settlement appear by the openings to both the ditches and the enclosure walls: G1 and G4 are located at opposite sides along east-west directions, while G2 and G3 have northwest-southeast orientations. Geophysics identified only two rectangular structures (C3 and C4) in the core habitation zone of the *magoula*; however, one should note that a large region of the top of the hill could not be surveyed because of the farmstead. The rest of the structures seem to be located farther from the center, with C1, C10, and C14 and the cluster of C7, C8, and C9 located close to the gates of the *magoula*. Almost all of them are rectangular and a few (C4, C6, C7, and C8) seem to consist of two rooms. The structural anomalies seem to be positioned with respect to the wider enclosures at the exterior, rather than with the thinner enclosures of the interior. Moving toward the east, the magnetic measurements indicate another probable series of enclosures (B5, B6) that look like fortification walls encircling a small area of the main *magoula*. The concentric pattern of these rings suggests another smaller settlement, which may predate the main *magoula*.

Karatsantagliou

The LN settlement of Karatsantagliou was established near a seasonal stream that passes along the northern side of the *magoula*, forming a deep ravine, while a smaller stream flows to the south (Vouzaxakis 2008). The modern coastline is just over 5 km from the prehistoric settlement to the east.

A contiguous curvilinear magnetic anomaly (A1) separates the natural and cultural deposits, the latter showing higher heterogeneity and higher vertical magnetic gradient values (Figure 4). The magnetic signature of A1, which has a maximum width of about 3.8 m and is probably correlated to a ditch, decreases toward the east. The GEM-2 readings of the soil conductivity indicate higher values of conductivity at the eastern section of the site as well. A flooding simulation based on a recent digital terrain model (DTM) also supports the above assumption, since the virtual 1–2 m flooding front from the southern meander seems to match with the eastern and southeastern outline of A1. The core of the *magoula* is confined within the almost circular anomaly A3, which has a diameter of 41–47 m. The low amplitude reflections from the GPR indicate that the particular feature represents a 1-m wide enclosure wall. A number of magnetic features are evident within the core of the *magoula* (A17, A18, A19, and A20), measuring 1,520 m². All of these features indicate extreme values of the vertical magnetic

gradient, which may suggest residues of burning. In contrast, at the position of A17 and A18 strong reflection signals from the GRP outline linear segments of structural remains that mostly consist of stone. GPR slices and VES measurements indicate that architectural features are located within a depth of .6–1.3 m.

Toward the east and west, magnetic anomalies A7 and A17 indicate entrances to the inner enclosure of the *magoula*. To the west of A7, an almost linear anomaly (A14) extends for more than 72 m until reaching A13. Another entrance is suggested by A6, which runs perpendicular to A1 and is oriented in the same direction as A17. Magnetically similar to A3 is A2, which may represent another enclosure wall. In contrast, A1 is much wider and more homogeneous in terms of its magnetic signature, which is more suggestive of an outer ditch. Most probably, A1, A2, and A3 constitute three concentric enclosures of the *magoula*, with the outer one (A1) used as a defensive construction against periodic flooding from the nearby streams and especially from the one that runs to the south of the *magoula*, since the elevation difference is less than 2 m. The truncation of these features to the north by the stream suggests that it may have moved to this location by channel avulsion from the north since the Neolithic. Outside of the outer enclosure (A1), a few anomalies appear. The one at A4 may represent the natural levee bank of the adjacent stream meander. Anomaly A9 to the southwest has large dimensions (ca. 15 x 9 m), with an extension toward the east for another ca. 10 m.

Figure 4. Results of the survey of Karatsantagliou: (a) results of the vertical magnetic gradient survey together with the results of the flooding simulation based on the DTM; (b) diagrammatic interpretation and annotation of the geophysical features.

Velestino 2 (Nikonanou)

The MN–EBA settlement of Nikonanou (Vouzaxakis 2008) is located just 800 m northwest of Velestino 4 (Visviki) and 1 km northeast of Velestino 3 (Mati). A Byzantine church was built on top of the *magoula*, severely disturbing the cultural layers of the settlement—which was also destroyed later. The environment around Nikonanou is leveled agricultural land that rises gradually toward the west. The eastern topography rises more sharply toward the foothills of Mount Pelion.

As a consequence of the heavy plowing and excavation damage to the site, the geophysical measurements and especially the magnetic data suffered from high noise levels. Despite these challenges, a number of fragmented enclosures can be detected around the *magoula*. They are not very wide (less than 3 m) and may define at least two enclosures of oval shape (Figure 5). Features A1, A2, A3, and A7 suggest the outer enclosure, and features A6, A8, A12, and A13 the inner enclosure, while A4 and A5 may designate an intermediate enclosure to the south of the *magoula*. The outer enclosure defines the boundary between the high- and low-conductivity zones (A10), which are suggested from the EM (GEM-2 and EM-31) conductivity measurements. The enclosures appear to have entrances to the northwest and southeast. It is hard to interpret the built area within the *magoula*, but features B2, B3, B4, and B8 are the most obvious candidates for structural remains. The most intense magnetic anomaly is exhibited at the location of B4 (5.5 x 6.5 m) toward the south-central region of the *magoula*. B1, B2, B5, B6, and B7 are also identified moderately magnetic, suggesting that all the B anomalies are the result of burning.

Karatsantagli (Karatsandagli)

The Neolithic settlement of Karatsantagli is located about 1,100 m south of *Magoula Zerelia* and was inhabited since the EN period (Vouzaxakis 2008). The landscape around Karatsantagli is diverse and characterized by semi-hilly terrain within agricultural floodplains. The topography rises gradually from south to north. Karatsantagli is positioned on top of a natural hill that overlooks the surrounding plain. Large riverbeds and streambeds produce deep gorges in areas, and there are mountains on the southern periphery. In particular, two streams run to the east and west of the settlement, which expands through an elevated zone (on a natural hill) between them.

A significant contrast in electrical conductivity values, obtained using GEM-2-HCP eastern side of the settlement. On the other hand, the measurements of the magnetic susceptibility for 0–1.7 m depth are very high and show a close correlation to the magnetic results (Figure 6). The magnetic data define a series of linear anomalies interpreted as terrace walls (C1–C9) that seem to surround the western side of the site, and a number of isolated, rectangular structures, the combination of which appears to define the limits of the settlement's built area (Figure 7). A possible western entrance between features C1 and C2, C5 and C6, and C8 and C9 leads to the site. Further to the north, more terrace walls appear (C10–C15) that run along the elevation contours of the natural ridge of the hill. An amorphous terrace wall (C16) toward the south delineates the southeastern edges of the habitation zone. Outside, the magnetic values become distinctly lower and more homogeneous compared to those inside the settlement. Another intense terrace-like anomaly (C17), much wider than the other anomalies mentioned above, appears farther to the south at a distance of about 50 m from the southeastern edge of the settlement.

In general, the structural remains appear to extend above the higher elevations of the mound. Thirty-seven structures (A1-A37) have been identified through the magnetic survey, ten of which (A3, A4, A6, A9, A11, A13, A16, A19, A21, A27) are registered in the EM magnetic susceptibility measurements. The core of the settlement is in the northern section, defined by the highest density of dwellings. A sparse cluster of buildings, probably a neighborhood, appears in the southern section of the site, suggesting an expansion of the settlement toward this direction. Most structures are aligned in a north-south direction, although the structures to the northwest have a circular arrangement. The structures are rectangular, and some (e.g. A21, A25, A26, A27, A33, A37) show evidence of internal divisions. Most of the features encountered especially within the nucleus of the *magoula* to the northwest are interpreted as burnt daub structures on the basis of their elevated magnetic and magnetic susceptibility values. Similarly elevated magnetic values also appear in other sections of the site, especially to the south, despite these features being clearly rectilinear and having larger dimensions than those in the core habitation zone of the *magoula*. One possibility is that structures like A19, A21, A31, A32, and A33 may have been constructed in both stone and daub, which then was burnt, in contrast to structures like A24 and A25 that seem to have been constructed exclusively of stone. If the above assumption is validated by directed investigation, then it may suggest three different phases of occupation, indicating a transition of building techniques from daub to stone based structures.

Figure 5. Results of the survey of Velestino 2 (Nikonanou): (a) results of the vertical magnetic gradient and the GEM-2 conductivity survey; (b) diagrammatic interpretation and annotation of the geophysical features.

Figure 6. Results of the survey of Karatsantagli: (a) results of the vertical magnetic gradient survey; (b) results of the EM (GEM-2) magnetic susceptibility survey, which covered the center of the settlement and verified the magnetic targets

Perdika 1 (Daoutza)

Perdika 1 or Daoutza is a low *magoula* located in the western part of the Almyros Plain, occupied during the EN–MN periods, but also in the Middle Bronze Age (MBA) (Vouzaxakis 2008). Habitation expands over an area of about 230 x 140 m and consists of a densely organized settlement that developed mainly to the south, west, and northwest of the core *magoula* (Figures 8 and 9). The broader landscape around the prehistoric site is diverse. It is characterized by flat agricultural floodplains, large riverbeds and stream-beds producing deep gorges, and mountains on the western and northern peripheries.

Magnetic and electromagnetic induction data demonstrate that the settlement is encircled by at least one or two enclosures. Enclosures are particularly evident to the north-northeast (A1), northwest (A2, A3), and south (A4, A5)—while fragmentary and less magnetically intense, but still present. At least two entrances are visible at A8 and A9 to the west, and one more (A7) to the east.

The core habitation zone on the *magoula*'s summit seems to be confined by another smaller enclosure inside which there are at least 13 structures (together annotated as C52) that indicate residues of burning. This almost circular enclosure (anomaly A6 with a diameter of about 31–34m) is clearly differentiated from a relatively empty area at A11 to the east. The low values of the vertical magnetic gradient in region A11 match with the very low apparent magnetic

susceptibility contrast that is exhibited from the same area through the measurements of the EM GEM-2. The clustering of the dwellings within the core habitation zone is clearly defined. The manifestation of the structural remains as thermal targets (designated by C numbers) suggests burnt clay and mudbrick. About 52 similar (burnt daub) structures, well defined by magnetometry and magnetic susceptibility have been found dispersed all over the remainder of the settlement, most of which are within the enclosures. Four such structures (C50, C51) also seem to be located close to the stream to the southeast. It is worth noting that the structures on the plateau and within the enclosures are clustered within specific regions, having an alignment toward the north (ca. 2.2° west of true north). In general, the size of the structures spreading outside the nucleus of the *magoula* is larger than those within the core, spanning from about 8–64 m² with an average size of 31 m² (taking into account 46 structures).

Figure 7. Diagrammatic representation and coding of the geophysical anomalies at Karatsantagli.

Figure 8. Results of the vertical magnetic gradient survey at Perdika 1 (Daoutza).

Figure 9. Diagrammatic representation and coding of the geophysical anomalies of Perdika 1 (Daoutza).

A different type of rectangular buildings (designated by B numbers), identified by low magnetic values, suggests another occupation phase with different construction methods. This particular type of architecture is spatially blended with the rest of the high-magnetic daub structures. As is suggested from the resistivity values (for structures B1, B3, B4, B5, B6, B7, B8, B9, B10 and B11), the specific buildings are interpreted as being stone-built and consisting of two rooms. The fact that there is a lack of overlap between the two different types of architecture suggests that they were either constructed in between the empty space of the previous occupation phase or else there was deliberate clearance and removal of the residues of the older structural remains. It is also important to note that this phase of construction avoided completely settling within the core habitation zone of the *magoula*. About 25 such stone based structures were identified, having northern orientations and sizes ranging from 14–80 m².

Perdika 1 appears to consist of a *magoula* and a flat settlement with at least two (and probably three) phases of occupation. Based on geophysical data, it is possible that the original habitation of the core habitation zone of the *magoula* expanded outside the limits and then a second phase of occupation followed.

Perdika 2

Perdika 2 is located on a steep hill about 800 m northwest of Perdika 1. Perdika 2 stands on a natural hill that towers over the surrounding landscape. The western side of the settlement has a precipitous ravine, while the eastern and southern sides have steep slopes. The position of the site up on a steep hill and not directly in the plains below may indicate different modes of human activity. Surface material indicates that the site was active during the MN period (Vouzaxakis 2008). Geophysical survey revealed a complex system of enclosures (ca. 2 m wide), interpreted as having been constructed in a very different way from the rest of the Neolithic sites that were surveyed as part of this project (Figure 10). The internal one, A3, seems to define the core of the settlement (63 x 55 m). An internal wall (A13) divides the core of the settlement into two sections. Adjacent to the southern part, there is a series of 4 to 5 continuous structures (A22) with dimensions of about 4.5 x 3.5 m. The structures were revealed clearly from the GPR measurements as strong reflectors located at medium depth (ca. .7-.8m below the surface). Similar stone-built structures (A21) were identified at the center of the settlement. Both magnetic and apparent magnetic susceptibility measurements indicate the particular features as thermal (magnetic) targets, suggesting intense burning. Two gates, about 6 m wide, appear opposite each other along the northwest and southeast sections of the enclosure. Another gate of similar dimensions appears at the exterior enclosure (defined by A1, A4, A5, and A9). This outer enclosure seems to encircle the settlement in a kind of an elliptical shape (ca. 150 x 100 m), without following the elevation lines to the east. Between the northern (A6) and inner enclosures (A3), more enclosures appear on the plateau of the hill. A12 divides the northern section into two sectors with an opening toward the eastern side. With the exception of the isolated features A18, A19, and A20, which are also associated with burning activities, the rest of the region is magnetically subdued. Some dispersed strong magnetic values appeared at A23, and some extreme values were detected at A17. Despite the diffuse nature of the anomalies, the site indicates a concentration of large structures within a region of about 30 x 40 m. The same region exhibits high values of apparent electrical conductivity (GEM- 2). Finally, two more enclosures are suggested from the magnetic data to the south (A15) and east (A10) of the surveyed area.

Given the location and the plan of the site with multiple enclosures and a limited number of structural remains, it can be suggested tentatively that the site was used mainly for animal husbandry and/ or agricultural activities. Acting as a kind of large farmstead or pastoral farming complex, the internal divisions of the settlement may have been used to confine the animals when they were released on the open landscape for grazing. A similar kind of facility, but of a much smaller scale, has been excavated at the EN–MN site of Kanalia 2 (Adrimi-Sismani 2013). Perdika 2 is of much larger dimensions and consists of a multi-complex system of curving enclosures that may have been constructed for the confinement of stock or/and for diverting ground water coming from rain.

Figure 10. Results of the survey of Perdika 2: (a) results of the vertical magnetic gradient survey; (b) results of the EM GEM-2 magnetic susceptibility survey; (c) results of the EM GEM-2 soil conductivity survey; (d) diagrammatic representation and coding of the geophysical anomalies.

Almyriotiki

Almyriotiki is located within a fertile plain 1 km east of the modern town of Almyros and about 4 km from the present coastline. The settlement sits within a diverse landscape characterized by flat agricultural floodplains, large rivers, and mountains on the western periphery. A few farm installations and rural housing complexes pocket the terrain around Almyriotiki. Elevations around the target site range from 25 to 30 masl. The persistence of habitation in the area of Almyriotiki (EN-LBA) (Vouzaxakis 2008) must be taken into account, as the prehistoric coastline was much closer at that period, consisting also of swamps and marshlands.

The geomagnetic survey indicates a wealth of architecture that covers not only the top of the *magoula* but also farther away over a total area of about 300 x 200 m (Figure 11). VES and GPR data indicate that cultural layers exist around 1 m below the current surface of the soil. The basic elements of the habitation zone consist of a densely occupied nucleus at the top, a more extended organized settlement at the lower outskirts, and a series of ditches enclosing the settlement. The core contains at least 37 burnt daub rectangular (25–60 m²) structures. Most of these are located at the edges of a circular ring about 100 m in diameter, leaving an open space at the center. There is no distinct sign of an enclosure wall here, but the outer walls of the adjacent buildings may have been used as such. A few more structures with similar magnetic signatures are found to the south. Beyond the summit of the *magoula*, an organized settlement with fewer magnetic structures, interpreted as having been constructed of stone, extends all around the central nucleus except to the north. About 60 buildings were identified by magnetic, EM, and GPR surveys, most of which have similar or larger dimensions than those of the core zone. Many have more than one room. A large rectangular (10 x 25 m) structure toward the south was shown in the GPR measurements to be three separate buildings built very close to one another. Farther to the west, the density of dwellings seems to gradually decrease.

A series of longitudinal anomalies encircle the built-up area and seem to belong to ditches. Evidence for the existence of a second concentric parallel ditch comes from the east and south-central region of the settlement. In contrast to the other Neolithic settlements covered in the survey, the ditches at Almyriotiki do not have a circular morphology around the *magoula*, but instead divert abruptly where required to encircle most of the extended settlement. The double-ditch system seems to diverge in the southeast, where one segment turns at an angle of 90° toward the west, while the other continues to the south to become a double system again to the southwest. The ditches appear to project toward the north around the western part of the nucleated settlement, but their signatures quickly become indistinct. In contrast, two or even three ditches are present farther to the west, encircling even the sparsely occupied part of the settlement. Further to the north, both magnetic and EM measurements suggest that the ditches were severely damaged due to flooding episodes. At least four entrances were also noticed through the interrupting trajectory of the ditches. These are especially evident toward the northeastern, southern, and western sections of the enclosures.

Final Remarks

This article summarizes some of the results of the ARISTEIA-IGEAN project that brought to light an extensive amount of new data regarding the spatial organization of Neolithic settlements in eastern Thessaly. The results of remote sensing and geophysical fieldwork offer unique insights for 21 sites, revealing the spatial patterning of settlements on a scale never

examined in the archaeology of Neolithic Greece. Only the results of a few representative *magoules* are presented in this article.

The geophysical results presented in this paper reveal a number of important new insights for the Neolithic life in Thessaly. First, the project demonstrates the important contribution of a manifold geophysical approach in revealing the details of the organization and use of space of prehistoric settlements and their relation to the landscape. Second, the results of the geophysical survey contribute to the broader conceptualization of Neolithic landscapes, and it becomes evident that scholars are dealing with a landscape of variation where settlements were adapted to both specific and localized factors. Similar and divergent characteristics can be seen in the planning of the Neolithic villages and structural materials. In most cases, the early daub-built structures were burnt down (intentionally or unintentionally). In almost all cases, the basic nucleus of habitation was encircled by an enclosure wall. This habitation core was often respected in later occupational phases of the settlements. It is perhaps an indication of intentional settlement planning, even in cases where habitation persisted through time. The sprawling communities at Perdika 1 and Almyriotiki indicate a persistence of habitation and a transition from a small, nucleated settlement to a much larger village type of settlement. In these large villages, the dwellings were clustered in small diagrammatic representation and coding of the geophysical anomalies. neighborhoods. Open/unbuilt spaces were also left in between the structures. In other cases, such as at Rizomilos 2, there is evidence of a spatial movement of the settlement to an area adjacent to its original location.

Figure 11. Results of the survey of Almyriotiki: (a) results of the vertical magnetic gradient survey; (b)

Moving to the periphery, geophysics has identified a large number of enclosures with various entrances at many of the sites. The exact function and meaning of these enclosures remains unresolved, and various theories have been suggested, including the demarcation of space, defensive purposes, or socio-political obstructions (Andreou et al. 1996; Runnels et al. 2009). Additionally, some enclosures may have been used for animal husbandry or for the storage of water (Pappa and Besios 1999). The results of the IGEAN project support the observation of Toufexis (2006) that wall or ditch enclosures were common elements of Neolithic settlements, although the number and widths of ditches varied markedly between sites. Their trajectories sometimes followed the topography of the *magoules*, but at other times the ditches enclosed an extension of the built area, even if some structures are also observed at the edges of the ditches and even in the area between them.

Most of the settlements that contain ditches were found to be either in the middle of the plain and/or in very close proximity to paleo- or extant channels. A simplified flooding simulation model suggests that ditches may have been used to minimize the impact of repeated flooding episodes (Sarris et al. 2015). This is supported by the subdued magnetic response of the ditch system at Almyros 2 and Almyriotiki, as well as the possible relocation of the settlements at Rizomilos 2 and Visviki (Alram-Stern et al., this volume). The argument becomes even more persuasive if one takes into account the multiple flooding episodes of the Pineios River and Lake Karla, the historical record of severe (sometimes catastrophic) flooding events in Thessaly that appear with cycle periods of 25–50 years (Migiros et al. 2011:218), and the rapid creation of accommodation space due to a tectonic subsidence rate of 1.5 m per 1,000 years (Demitrack 1986). The persistence of habitation in some of these regions suggests the utilization of regional hydrology for extensive farming, supporting the suggestion of van Andel and Runnels (1995) and Vouzaxakis (2008) against the small intensive gardening cultivation proposed by Bogaard (2004). Taken as a whole, the results of the IGEAN project provide a fresh new perspective of Neolithic settlement organization in ways that transcend traditional methods of archaeological exploration. Despite the implications of the project regarding sustainable populations, the spatial context and organization at intra-site, local, and regional levels, the chronological continuation of habitation, the persistency in occupation, and land use practices, it is obvious that we have just scratched the surface of Neolithic landscapes in Thessaly.

Acknowledgements

This work was performed in the framework of the IGEAN (“Innovative Geophysical Approaches for the Study of Early Agricultural Villages of Neolithic Thessaly”) project, which is implemented under the “ARISTEIA” Action of the “Operational Programme Education and Lifelong Learning” and is co-funded by the European Social Fund and National Resources.

References Cited

Adrimi-Sismani, Vasiliki

2013 Αγρότες και Ψαράδες: ‘Παρά Καλλίναον
Βοιβίαν Λίμναν.’ *Anaskamma* 6:49–62.

Alexakis, Dimitrios, Apostolos Sarris, Theodoros Astaras, and Konstantinos Albanakis 2009 Detection of Neolithic Settlements in Thessaly (Greece) through Multispectral and Hyperspectral Satellite Imagery. *Sensors* 9:1167–1187.

Alexakis, Dimitrios, Apostolos Sarris, Theodoros Astaras, and Konstantinos Albanakis 2010 Application of GIS, Remote Sensing, and Geomorphology to the Reconstruction of Habitation in Neolithic Thessaly, Greece. *SAS Bulletin* 33(3):2–4.

Alexakis, Dimitrios, Apostolos Sarris, Theodoros Astaras, and Konstantinos Albanakis 2011 Integrated GIS, Remote Sensing and Geomorphologic Approaches for the Reconstruction of the Landscape Habitation of Thessaly during the Neolithic Period. *Journal of Archaeological Science* 38:89–100.

Alexakis, Dimitris, Apostolos Sarris, Theodoros Astaras, Konstantinos Albanakis, and Dimitris Oikonomidis 2008 Contribution of Satellite Imagery and DEMs to the Detection of Neolithic Settlements in Thessaly, Greece. In *Proceedings of the 1st International EARSeL Workshop on Advances on Remote Sensing for Archaeology and Cultural Heritage Management, CNR, Rome, September 30–October 4, 2008*, edited by Rosa Lasaponara and Nicola Masini, pp. 325–328. Aracne, Rome.

Andreou, Stelios, Michalis Fotiadis, and Kostas Kotsakis 1996 Review of Aegean Prehistory V: The Neolithic and Bronze Age of Northern Greece. *American Journal of Archaeology* 100:537–597.

Bogaard, Amy 2004 *Neolithic Farming in Central Europe: An Archaeobotanical Study of Crop Husbandry Practices*. Routledge, New York.

Demitrack, Anne 1986 The Late Quaternary Geologic History of the Larissa Plain Thessaly, Greece: Tectonic, Climatic, and Human Impact on the Landscape. Unpublished Ph.D. dissertation, Stanford University.

French, David 1972 Notes on the Prehistoric Pottery Groups from Central Greece. Manuscript on file, British School at Athens, Athens.

Gallis, Kostas

1992 *Ατλας Προϊστορικών Οικισμών της Ανατολικής Θεσσαλικής Πεδιάδας*. Society of Historical Research of Thessaly, Larisa.

Halstead, Paul 1984 Strategies for Survival: An Ecological Approach to Social and Economic Change in the Early Farming Communities of Thessaly, N. Greece. Unpublished Ph.D. dissertation, University of Cambridge.

Halstead, Paul 1992 Dimini and the ‘DMP’: Faunal Remains and Animal Exploitation in Late Neolithic Thessaly. *The Annual of the British School at Athens* 87:29–59.

Chourmouziadis, Giorgos

1979 *Το Νεολιθικό Διμήνι*. Society for Thessalian Research, Volos.

Karimali, Evagelia 1994 The Neolithic Mode of Production and Exchange Reconsidered: Lithic Production and Exchange Patterns in Thessaly, Greece, During the Transitional Late Neolithic–Bronze Age Period. Ph.D. dissertation, Department of Anthropology, Boston University. University Microfilms, Ann Arbor.

Kotsakis, Kostas 1994 The Use of Habitational Space in Neolithic Sesklo. In *La Thessalie. Quinze Années de Recherches Archéologiques, 1975–1990: Bilans et Perspectives. Actes du Colloque International, Lyon, 17–22 Avril 1990*, Vol. A, edited by Jean-Claude Decourt, Bruno Helly, and Kostas Gallis, pp. 125–130. Kapon Editions, Athens.

Kyparissi-Apostolika, Nina, and Yannis Hamilakis 2012 Archaeological and Ethnographic Research at the Site of Koutroulou Magoula in Phthiotis, 2009–2011. Paper presented at the 4th scientific meeting AETHSE 4, 15–18 March, Volos, Greece.

Migiros, Giorgos, Giorgos Bathrellos, Harikleia Skilodimou, and Theodoros Karamousalis 2011 Pinios (Peneus) River (Central Greece): Hydrological–Geomorphological Elements and Changes during the Quaternary. *Central European Journal of Geosciences* 3(2):215–228.

Orengo, Hector, and Athanasia Krahtopoulou 2014 Land Reclamation and the Archaeological Record of Central-Western Plain of Thessaly, Central Greece. Paper Presented at the 3rd Landscape Archaeology Conference, 17–20 September, Rome, Italy.

Pappa, Maria, and Manthos Besios 1999 The Neolithic Settlement at Makriyalos, Northern Greece: Preliminary Report on the 1993–1995 Excavations. *Journal of Field Archaeology* 26:177–195. Papadopoulos, Nikos, Apostolos Sarris, and Maria

Cristina Salvi 2011 Reconstruction of the Archaeo-Landscape around the Area of the Magoula “Zerelia” in Almyros (Volos, NE Greece). Paper presented at the 9th International Conference of Archaeological Prospection, 19–24 September, Izmir, Turkey.

Pentedeka, Areti

2008 *Δίκτυα Ανταλλαγής της Κεραμικής κατά τη Μέση και Νεότερη Νεολιθική στη Θεσσαλία*. Ph.D. dissertation, Aristotle University of Thessaloniki. Available online, <http://invenio.lib.auth.gr/record/110203?ln=en>, accessed October 11, 2015.

Perlès, Catherine 1999 The Distribution of Magoules in Eastern Thessaly. In *Neolithic Society in Greece*, Edited by Paul Halstead, pp. 42-56. Sheffield Studies in Aegean Archaeology 2. Sheffield University Press, Cambridge

Perlès, Catherine 2001 *The Early Neolithic in Greece: The First Farming Communities in Europe*. Cambridge University Press, Cambridge.

Rondiri, Vasso

2009 Θεσσαλική Νεολιθική Κεραμική: Τεχνολογία και Κατανομή στο Χώρο. Ph.D. dissertation, Aristotle University of Thessaloniki. Available online, <http://invenio.lib.auth.gr/record/114741/?ln=el>, accessed October 11, 2015.

Runnels, Curtis, Cantel White, Claire Payne, Nicolas Wolff, Noam Rifkind, and Steven LeBlanc 2009 Warfare in Neolithic Thessaly: A Case Study. *Hesperia* 78(2):165–194.

Sarris, Apostolos

2003 Τεχνική Έκθεση του Έργου των Γεωφυσικών Ερευνών στην Περιοχή του Πύργου, Σέσκλου, 2002. Manuscript on file, Geosat Research Lab, Institute for Mediterranean Studies, FORTH, Rethymno.

2013 Multi+ or Manifold Geophysical Prospection? In *Archaeology in the Digital Era: Papers from the 40th Annual Conference of Computer Applications and Quantitative Methods in Archaeology (CAA), Southampton, 26–29 March 2012*, edited by Graeme Earl, Tim Sly, Angeliki Chrysanthi, Patricia Murrieta-Flores, Constantinos Papadopoulos, Iza Romanowska, and David Wheatley, *Southampton, 26-30 March 2012*, Amsterdam University Press, Amsterdam.

Sarris, Apostolos, Vaso Adrimi-Sismani, Sofia Topouzi, Steven Soetens, Fotis Triantafyllidis, Vaggelis Kevgas, Charalampos Karathanasis, Anthi Giourou, Katerina Tzaneteas, Thodoros Mavroudis, Kostas Karimalis, Evagelia Karimali, Athina Papadaki, and Giorgos Kritikakis 2001, Geophysical Prospection in Mycenaean Dimini, Magnesia (Greece). Paper presented at the 4th International Conference on Archaeological Prospection, 19–23 September, Austrian Academy of Sciences, Vienna, Austria.

Sarris, Apostolos, Nasos Argyriou, Tuna Kalayci, François-Xavier Simon, Jamieson Donati, Carmen Cuenca Garcia, Gianluca Cantoro, and Meropi Manataki 2015 Neolithic Ditches in

Thessaly. Paper presented at the Third International Conference on Remote Sensing and Geoinformation (RSCyp2015), 16–19 March, Paphos, Cyprus.

Sarris, Apostolos, Nikos Papadopoulos, Athos Agapiou, Maria Cristina Salvi, Diofantos Hadjimitsis, William Parkinson, Richard Yerkes, Attila Gyucha, and Paul Duffy 2013 Integration of Geophysical Surveys, Ground Hyperspectral Measurements, Aerial and Satellite Imagery for Archaeological Prospection of Prehistoric Sites: the Case Study of Veszto-Magor Tell, Hungary. *Journal of Archaeological Sciences* 40(3):1454– 1470.

Sarris, A., Topouzi, S., and Adrimi-Sismani, V., 2002, Mycenaean Dimini: Integration of Geophysical Surveying and GIS. Paper presented at the International Conference of the Computer Applications and Quantitative Methods in Archaeology (CAA2002), “The Digital Heritage of Archaeology,” 2–6 April, Heraklion, Crete, Greece.

Tabbagh, Alain 1986 Applications and Advantages of the Slingram Electromagnetic Method for Archaeological Prospecting. *Geophysics* 51:576–584.

Theocharis, Dimitrios R.

1958 Εκ της Προκεραμικής Θεσσαλίας. *Thessalika* 1:70–86.

1967 *Η Αυγή της Θεσσαλικής Προϊστορίας: Αρχή και Πρώιμη Εξέλιξη της Νεολιθικής*. Filarkhaios Society of Volos, Volos.

Toufexis, George

2006 Η Λίμνη Κάρλα (Βοίβης) και η Ανασκαφή στον Προϊστορικό Οικισμό στη Θέση Παλιόσκαλα. Πρώτα Συμπεράσματα και Προοπτικές. In *Πρακτικά Επιστημονικής Συνάντησης, Βόλος 27.2–2.3.2003*, edited by Alexandros Mazarakis Ainian, pp. 55–64. Archaeological Meeting of Thessaly and Central Greece 1. Ministry of Culture and the University of Thessaly, Volos.

Tsokas, Grigoris N., Georgios Vargemezis,
Alexandros Stampolidis, and Nina Kyparissi-
Apostolika

2009 Γεωφυσική Διασκόπηση στη Θέση Κου-
τρουλού Μαγούλα Πλησίον του Νέου
Μοναστηρίου (Ν. Φθιώτιδας). In *Πρακτικά
Επιστημονικής Συνάντησης, Βόλος 16.3–
19.3.2006: II. Στερεά Ελλάδα*, edited by
Alexandros Mazarakis Ainian, pp. 829–837.
Archaeological Meeting of Thessaly and
Central Greece 2. Ministry of Culture and
the University of Thessaly, Volos.

Tsountas, Chistos

2000 [1908] *Αι Προϊστορικά Ακροπόλεις Διμην-
ίου και Σέσκλου*. The Archaeological Society
at Athens, Athens.

van Andel, Tjeerd H., and Curtis N. Runnels 1995 The Earliest Farmers in Europe. *Antiquity* 69(264):481–500.

Vouzaxakis, Kostas 2008 Geographical Patterns and Theories of the Intercommunal Space in the Neolithic Thessaly. Unpublished Ph.D. dissertation, School of History and Archaeology, Aristotle University of Thessaloniki.

Wace, Alan John Bayard, and Maurice Scott Thompson 1912 *Prehistoric Thessaly*. Cambridge University Press, Cambridge.____