NIKONANOU

Archaeological Background

The archaeological site Velestino 2, also named as Magoula Nikonanou, is a Middle Neolithic Period to Early Bronze Age site in Greece. The site is located 800 m northwest of the Magoula Visviki (Velestino 4) and 1000 m northeast of Magoula Mati (Velestino 3). Nikonanou is situated on a low hill and once contained a byzantine church on the top of magoula. It is believed that the construction of the church destroyed most of the prehistoric layers. Today there is nothing there than cultivated fields. The site was known to be archaeologically significant place from the beginning of the 20th century as it was listed among the few Neolithic sites mentioned by Tsountas. Most of the chronological details about the site result from the surface survey made by Gallis at the late 1980s.

Satellite Remote Sensing and Historical Aerial Photography Survey

A GeoEye-1 image from 4 May 2010 was used for satellite remote sensing at Magoula Nikonanou (Figure 1). The satellite image has an off-nadir angle of 9.9°, a ground sampling distance (GSD) of 0.50 m (panchromatic) and a 1.81 m (multispectral). In addition to the satellite imagery, an aerial photograph from 26 August 1960 was used with a scale of 1:15,000 (Figure 2).

The landscape around Magoula Nikonanou, like the nearby prehistoric tell of Visviki (Velestino 4), is a level agricultural land that rises gradually toward the west 400 m beyond the National Road and 2.3 km from the town of Velestino. The eastern topography rises more sharply toward the foothills of Mt. Pelion where there is a large quarry about 1.7 km away and a military base about 1.5 km. Various streams, irrigation channels and roads leading to Volos are present within the area. There are some modern constructions, including large industrial installations south of the site. Several other prehistoric settlements are also located nearby. As stated, these include Magoula Visviki (Velestino 4) 800 m to the southeast, Magoula Mati (Velestino 3) 1.4 km to the southwest, and Magoula Bakalis about 2.8 km to the southwest. Cultivation in the region is predominantly wheat and corn. Elevations around Magoula Nikonanou range from 60–70 mean average sea level (masl).

The local environment and land use around Magoula Nikonanou has changed significantly during the second half of the 20th century following intensive farming activities and industrialization. Field boundaries and field orientations are different in the 23 August 1960 aerial photograph than they appear in the 4 May 2010 GeoEye-1. During the 50 year interval, the landscape has been heavily altered to include industrial facilities, a military base and the National Road. This activity has clearly affected the local environment around Magoula Nikonanou. Moreover, the 23 August 1960 aerial photograph documents streams and river beds that are no longer present in the landscape (see Figure 2). In 1960, a river passed 400 m south of the prehistoric magoula. This river is now filled and covered over with vegetation as the land has been converted for agricultural purposes. The dirt road 50 m north of Magoula Nikonanou has an undulating course that appears to be adopted from the path of a (former) stream. If so, then the site would have been positioned between two water sources in the past.

Satellite remote sensing within a 1 km radius around Magoula Nikonanou produced minimal results (Figures 3-4). The majority of features correspond to a palaeochannels (designated in blue) associated with the rivers and streams that were once present on the landscape. Other anomalies relate to agricultural activity (brown), such as former field divisions and plough lines. A third category of anomalies is unclassified (yellow). The double line of linear anomalies that run in an east-west direction south and southeast of Magoula Nikonanou are from underground pipes. Their presence was confirmed with geophysical prospection at Velestino 4 (Visviki) and local correspondence. No surface anomalies in the satellite imagery could be associated with the prehistoric settlement. The poor preservation of the site is probably one reason for this. Agricultural activity has disturbed much of the settlement mound, unlike nearby Velestino 4 (Visviki). The geophysical results (see below) also suggest that the below surface remains are largely destroyed.

Figure 1. Magoula Nikonanou from a 4 May 2010 GeoEye-1 image.

Figure 2. Magoula Nikonanou from an aerial photograph taken 26 August 1960.

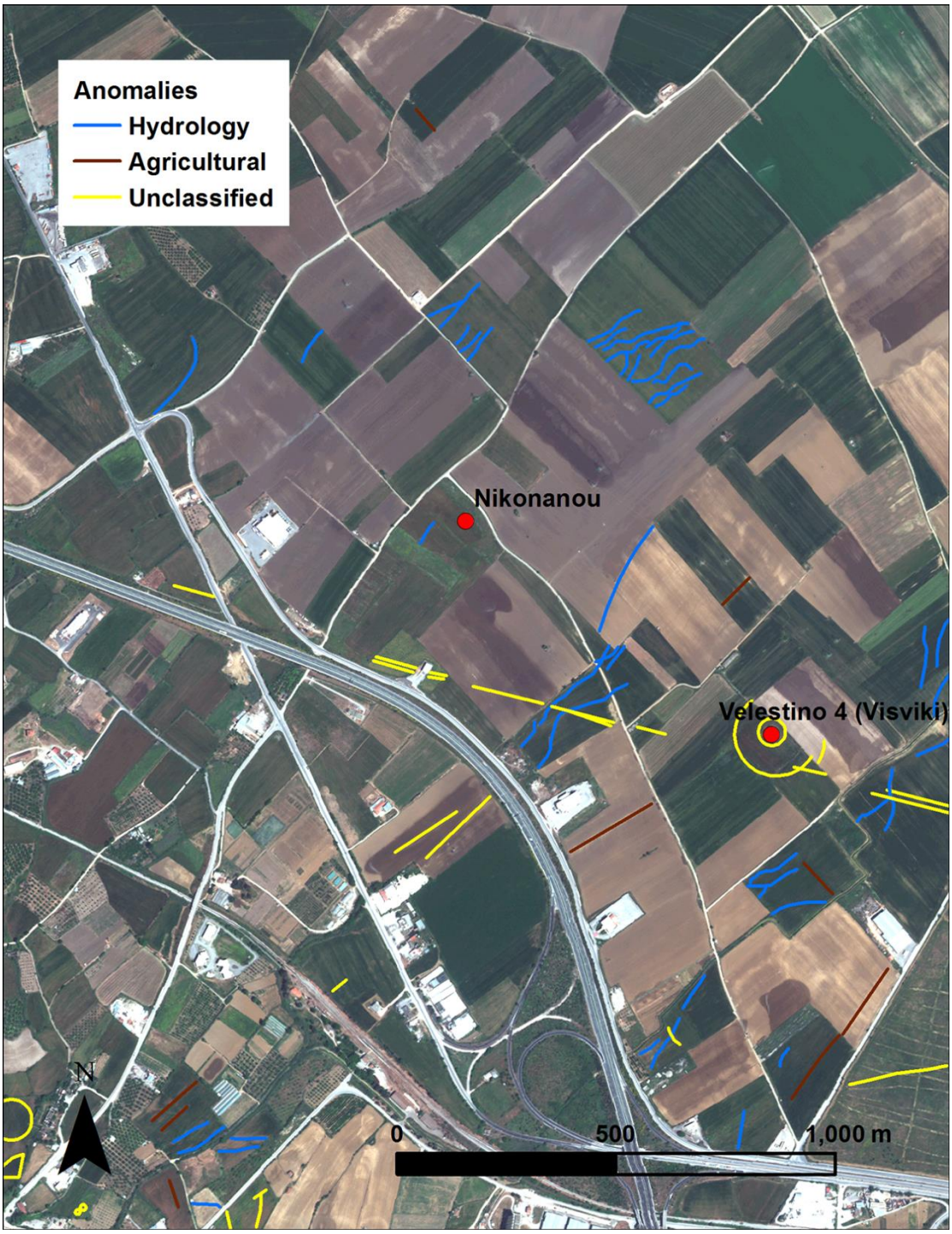

Figure 3. Surface anomalies from the 4 May 2010 GeoEye-1 image within a 1 km radius around Magoula Nikonanou.

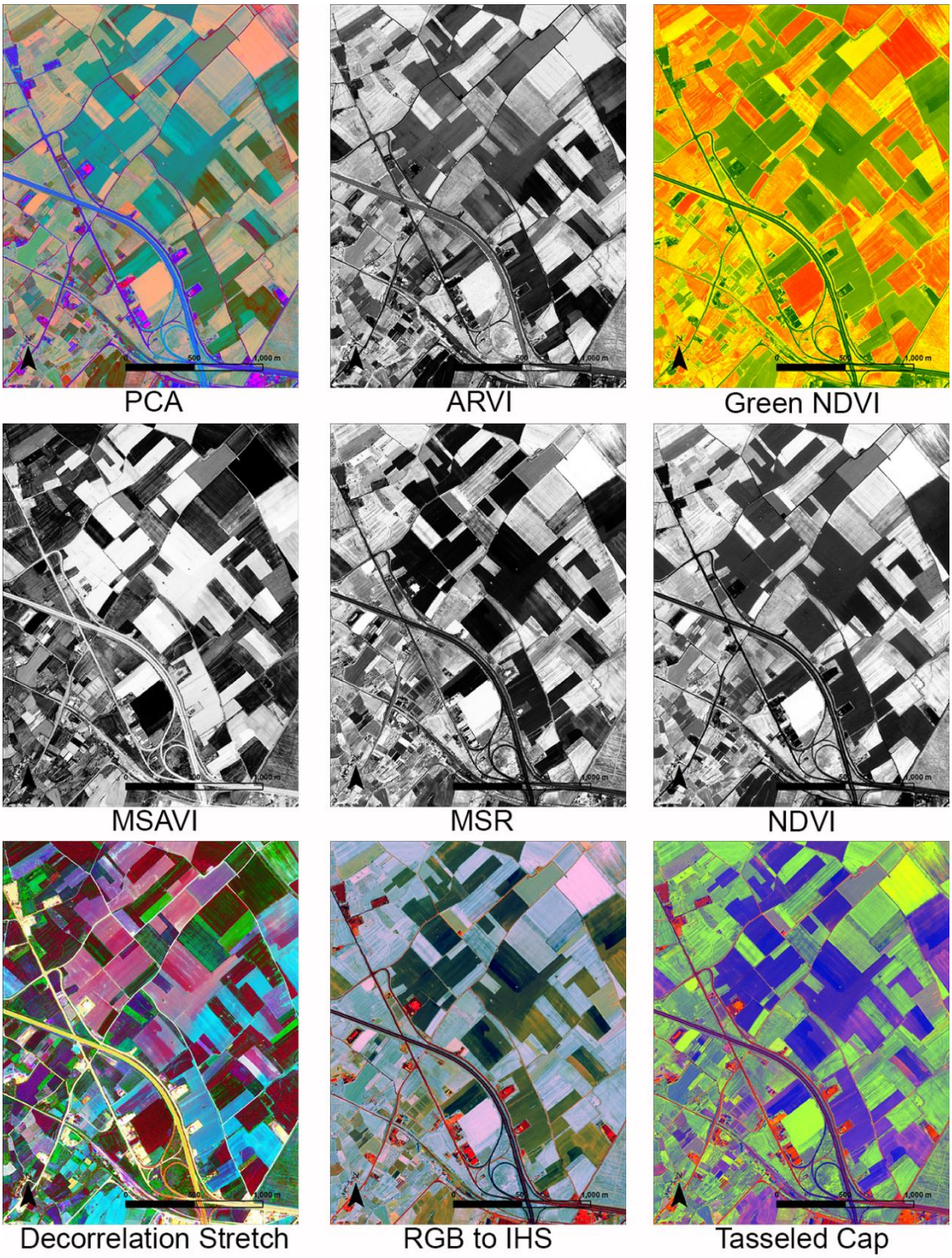

Figure 4. Spectral filters and vegetation indices applied to the 4 May 2010 GeoEye-1 image around Magoula Nikonanou.

Remotely Piloted Aircraft Systems (RPAS) Survey

Despite the good quality of final orthophotos and digital elevation models (DEM) available for red-green-blue (RGB), near infrared (NIR) and GoPro, no traces with archaeological significance were identifiable in the area around Magoula Nikonanou (Figures 5 and 6). Many structural stones have been documented in the center of the magoula and some of these are likely still in place. Other stones may be present but could be covered with vegetation from the field during cultivation activities. Additionally, historical Google and Bing imagery were also examined along with the Web Map Service (WMS) of national orthophoto archives. All images did not reveal any traces of archaeological interest.

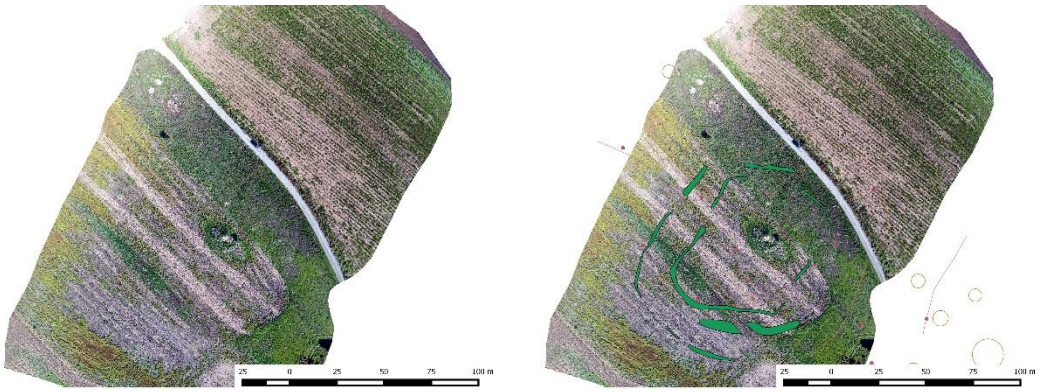

Figure 5. High-resolution orthophoto from the GoPro camera (on left). The same view overlaid with the geophysical interpretations (on right).

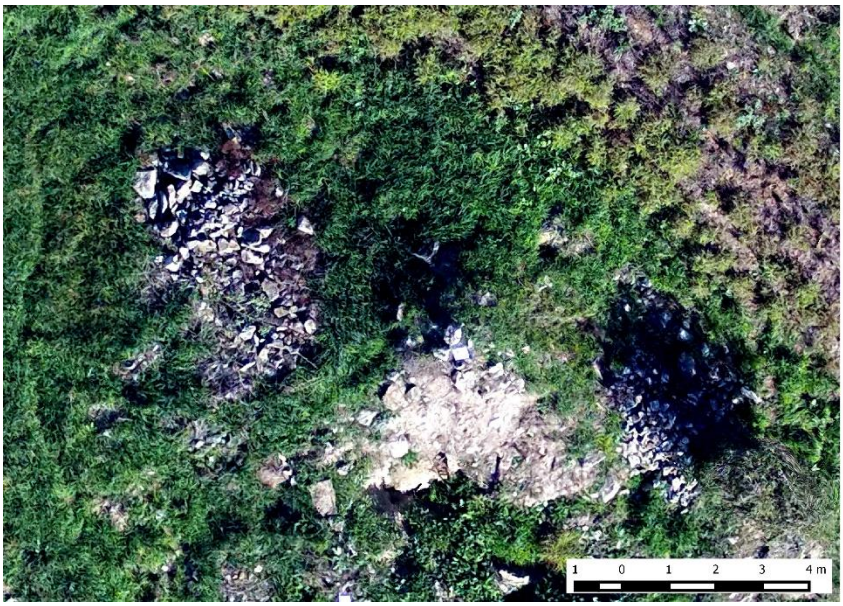

Figure 6. Details of the structural stones at the center of the magoula.

Geophysical Prospection

Geomagnetic Survey

The geomagnetic data from Nikonanou is noisy, meaning that iron-rich material was present in the area, possibly related to modern surface metal (Figure 7). Despite this, the settlement can be detected based on the distribution of geophysical anomalies. Although there are sections of missing data due to inaccessibility of the instrument during the survey, the shape of the anomalies (circularity) defined suggests that they are anthropogenic (Anomalies A1, A2, A3, A4, A5, A6, A12, and A13). Furthermore, if these anomalies represent some sort of an enclosure, we may suggest there are at least two are present, forming a complex boundary system around the site. Considering the relatively small size of the settlement, this configuration might have been an expensive effort for the inhabitants of the site.

There are no immediate intra-site settlement patterns visible in the data —other than a handful of potential structures located at the center (Anomalies B2, B3, B4, and B8). Anomaly B1 is located in between two potential enclosures. The size and shape of this anomaly is relatively large in comparison to the space between the enclosures so its nature is questionable as to whether it is anthropogenic or natural.

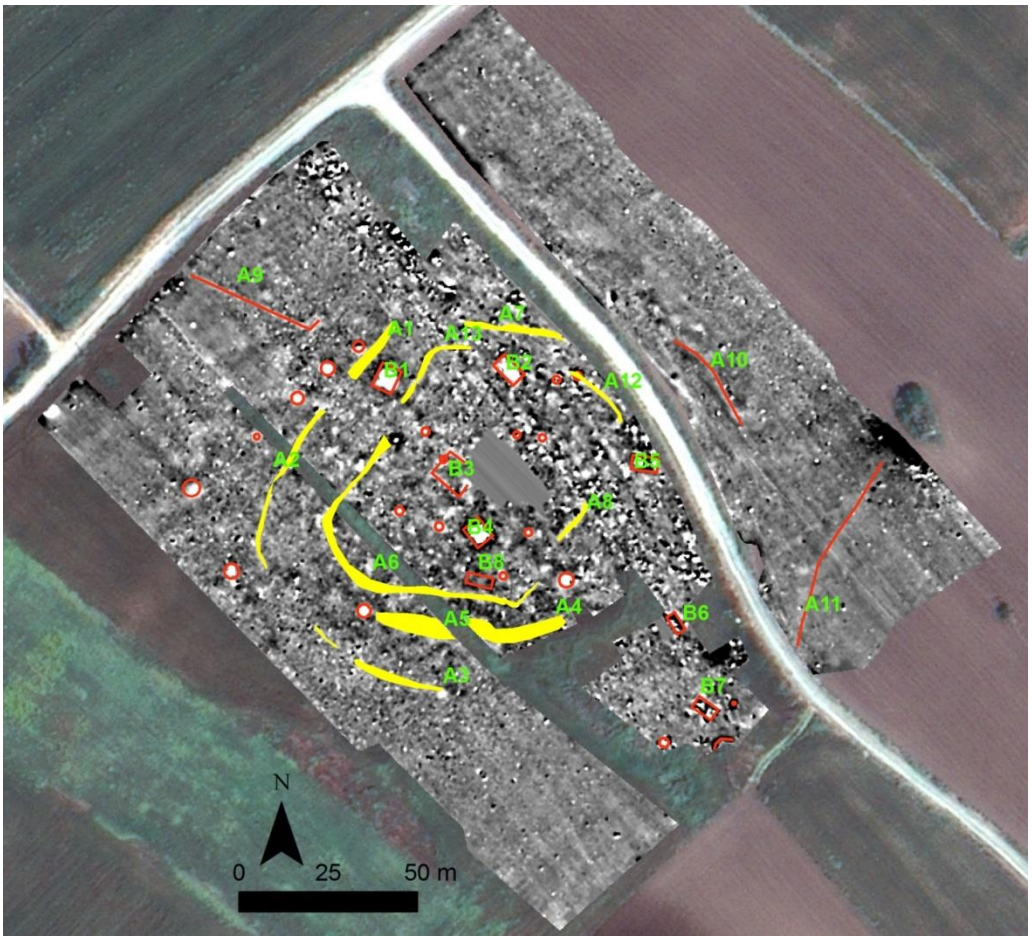

Figure 7. Geomagnetic results from Nikonanou; white: positive magnetic values, black: negative magnetic values.

Electromagnetic Induction Survey

The electromagnetic Induction (EMI) survey was done on the site of Nikonanou with the Geoplex GEM-2. It was used with a global position system (GPS) unit, acquiring simultaneously the location of the point and the value of the electromagnetic field for five different frequencies (from 5 kHz up to 90 kHz). A vertical electrical sounding was conducted prior to survey, but this was affected by a close electrical transformer. The sounding was not enough accurate to expect a processing step transforming the ppm of the EMI measurement in physical properties. As the coil spacing is 1.6 m, we have a 2.5 m depth of investigation for the quadrature out-of-phase and 1.6 m for the in-phase measurement. The total area covered for the EMI survey was 1.38 ha with 1 m spacing between each profile, done in one day by one surveyor.

The site was also surveyed with the Geonics EM31. This instrument allows the measurement of electrical conductivity up to 6 m depth. It works with a frequency of 9.8 kHz and with a coil spacing of 3.6 m. It was used in an horizontal-coplanar (HCP) mode. The acquisition was done with a GPS with a metric accuracy. Both GPS and instrumental data were merged through Dat31W software. The total area covered with the EM31 was approximately 1.3 ha using 1 m spacing between each profile.

Both the electrical conductivity from the EM31 and the quadrature part of the signal of the GEM-2 show the same variability of electrical conductivity despite big differences of depth investigation (Figures 8-9). This similarity could come from a near-surface variability of the electrical conductivity affecting mostly the response of the EM31 and a more homogeneous deeper soil. Both are showing conductive anomalies in the middle of the field possibly coming from the extension of the magoula in this direction.

Only the GEM-2 was completed on the top of the magoula. This survey shows a lower conductivity anomaly on the top of the magoula that may represent the only potential archaeological feature visible on this site using this methodology. The magnetic susceptibility proved unsuccessful and revealed poor results. Any difference visible could be a result from the magoula and the surrounding soil. This technics was not appropriate for this particular site which has been significantly affected by a deep ploughing.

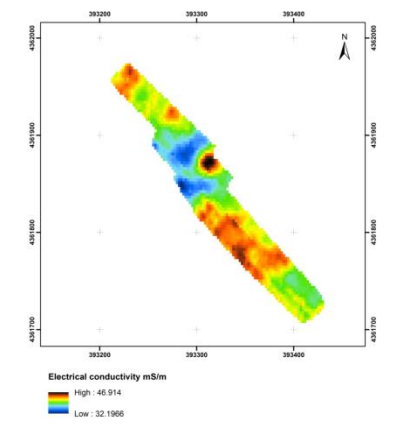

Figure 8: Apparent electrical conductivity (EM31- HCP)

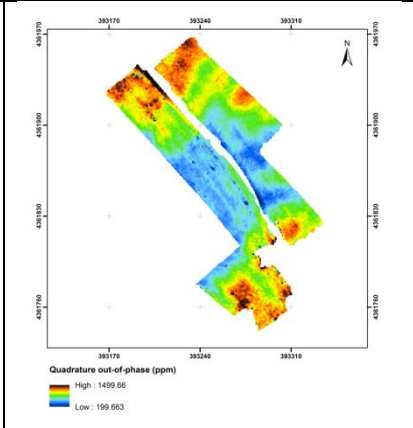

Figure 9: Quadrature out-of-phase (GEM 2-HCP)

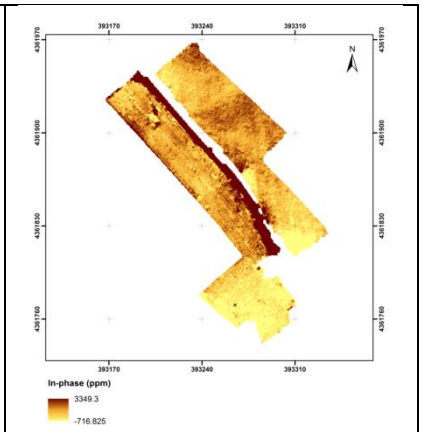

Figure 10: In phase (GEM 2-HCP)

Integration of Geophysical Results

The geophysical survey at Magoula Nikonanou included the use of magnetic (SENSYS) and soil conductivity/magnetic susceptibility (GEM2 and EM31). The data have been superimposed to show their relationship in regards to potential subsurface archaeological features (Figure 11). In the center of the site, a large excavation trench was observed as well as a number of architectural remains, which have been exposed in parts of the trench. Around the trench there were large piles of stones that have been collected as a result of the land clearing for agricultural ploughing.

As a consequence of the heavy ploughing and surface scraps of the site, the geophysical measurements, particularly the magnetic data suffered from high noise levels. The location of the magoula seems to be the most severely affected by past ploughing activities, as the adjacent field to the right of the road and the area to the south of the magoula exhibit much lower noise levels. Even if they are vaguely manifested, a number of fragmented circular features can be detected around the magoula. These features are not very wide (<3m) and may define at least two oval shape enclosures (Figure 12). Anomalies A1, A2, A3 and A7 define the outer enclosure and anomalies A6, A8, A12 and A13 define the inner enclosure. Anomalies A4 and A5 may designate an intermediate enclosure to the south of the magoula. The outer enclosure can be further completed from the boundary between the high and low conductivity zones (A10) which are suggested from the conductivity measurements. The inner and outer enclosures appear to have entrances to the northwest and southeast directions.

It is hard to identify the built area within the magoula, but magnetic features B2, B3, B4 and B8 are the most obvious anomalies for buried structural remains. The most intense magnetic anomaly is exhibited at the location of B4 (5.5 x 6.5 m) towards the central south region of the magoula. Anomalies B1, B2, B5, B6 and B7 are also potential targets for archaeological material and are probably related to residues of burning. In contrast, anomaly B3 has a very weak signal. Of the above mentioned targets, B1 is located between the two enclosures and close to the entrance of the magoula to the northwest. This is similar to B5, which is located in the opposite direction to the east, with respect to B1. Despite the noisy image, this allows us to question whether B5 is another entrance in this particular location.

Despite the excellent correlation between the measurements produced by the two EMI instruments used in the site, both of which pinpointed some isolated high conductivity anomalies, it was not possible to verify the existence of the suggested structures (at least in the area covered by both EMI and magnetic techniques).

Figure 11. Comparison of magnetic and electromagnetic results.

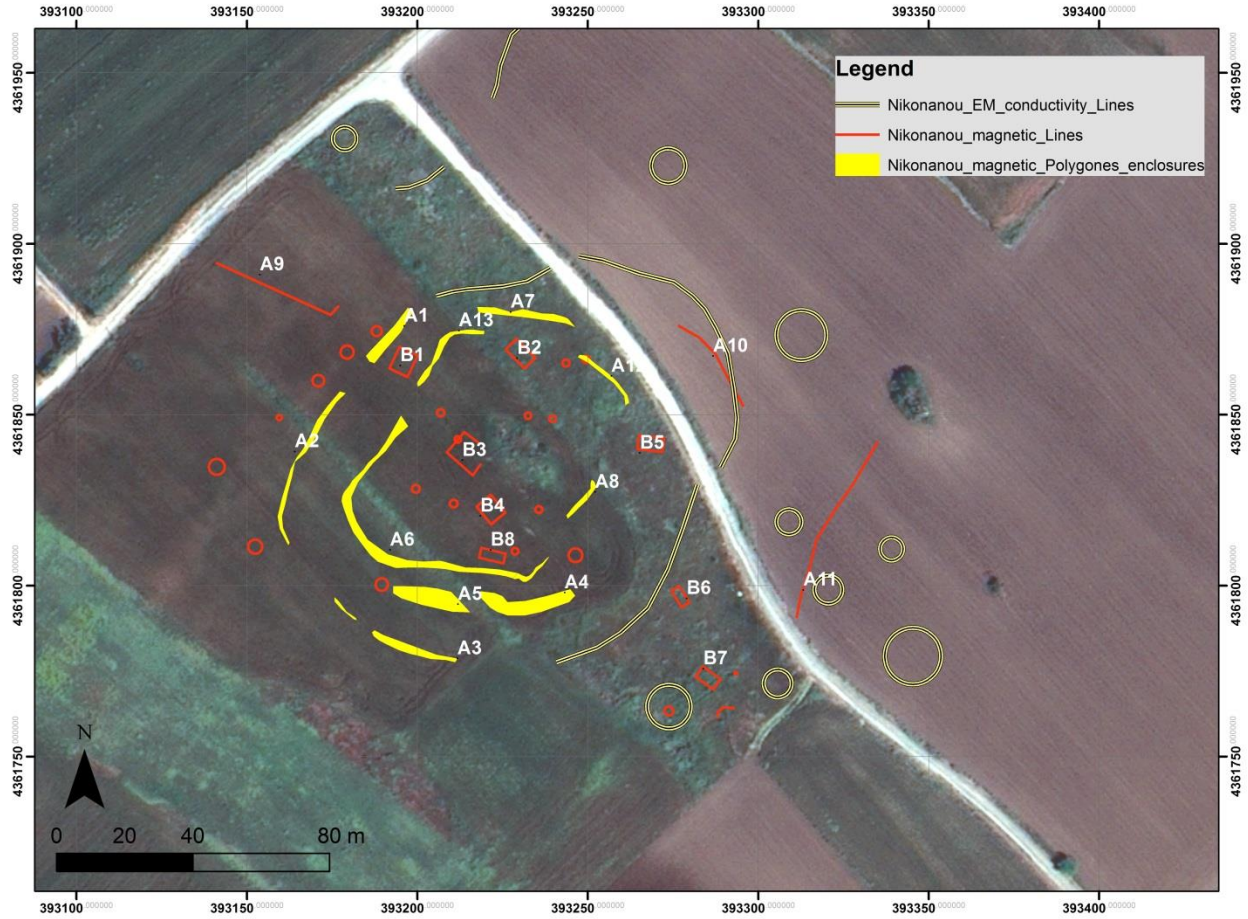

Figure 12. The distribution of anomalies based on the results from magnetic and electromagnetic prospection.

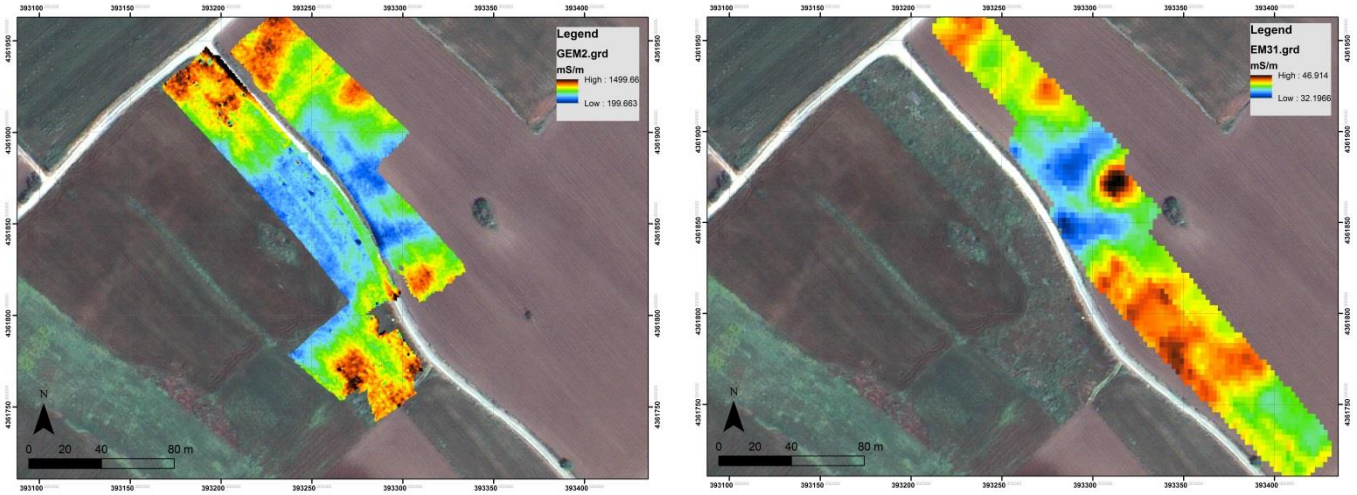

Figure 13. Details of the electromagnetic prospection: GEM2 (left), EM-31(right).

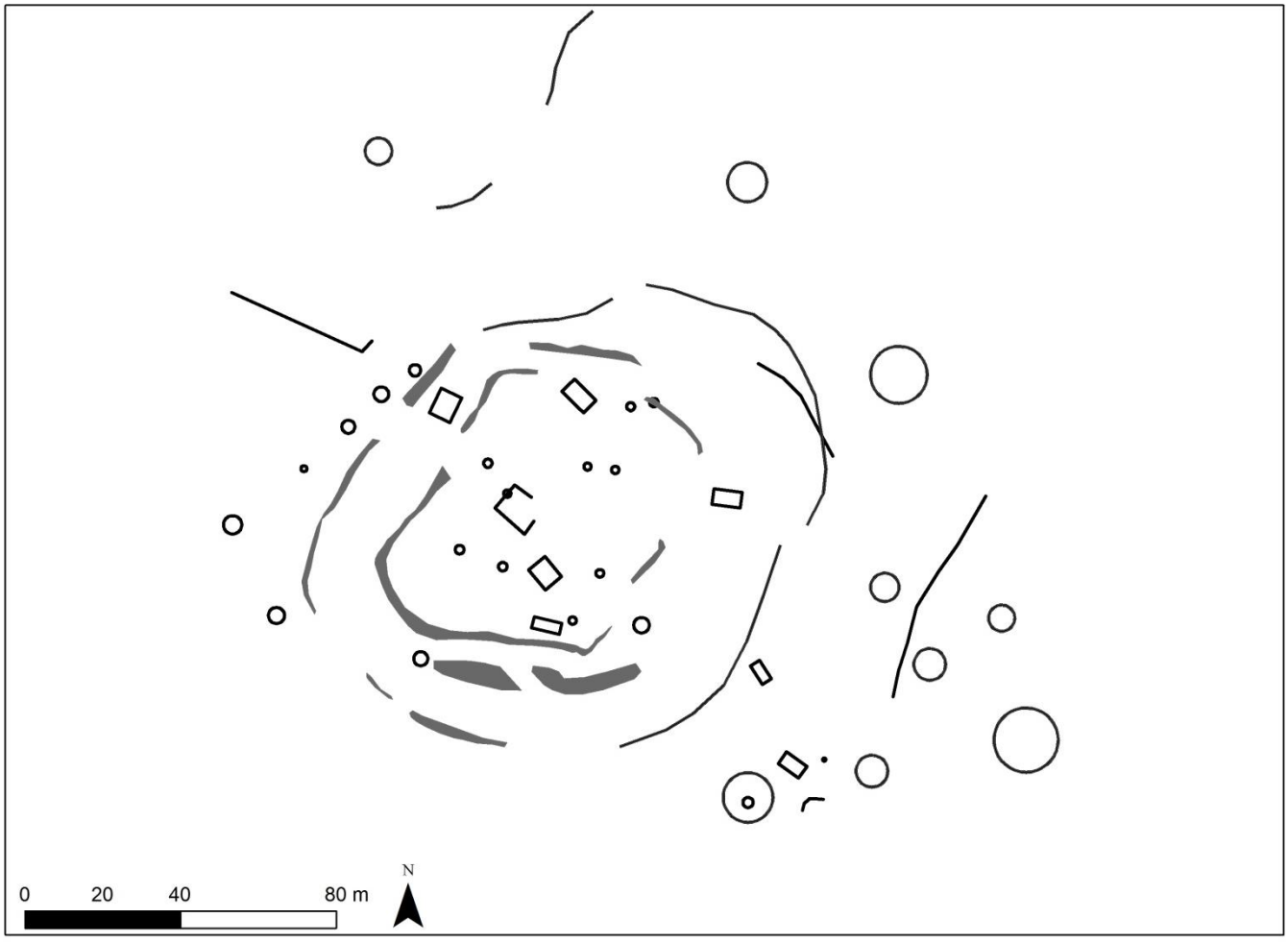

Figure 14. Simplified plan of the suggested geophysical features of magoula Nikonanou.

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