

## Perivlepto Kastraki2

### Archaeological Background

Kastraki 2 settlement, near the village of Perivlepto, is a low magoula which was inhabited mainly in the Middle Neolithic Period with some evidence for occupation during Early Neolithic period as well. It is located just beside another large magoula (Kastraki 1) where the remains of a Bronze Age settlement and possible a town (maybe fortified) of the historical period exist. It is important to note that the location of the site just at the middle of a passage leading from the east coast Thessalian (Volos – Almyros) plain to the west Thessalian plain (Karditsa plain).

### Remotely Piloted Aircraft Systems (RPAS) Survey

Two drone flights at the site of Kastraki2 produced approximately 320 photographs, covering a total area of approximately 20 hectares. One orthophoto and one digital model were created for the site (Figure 1). The only field that provided some visual feedback of potential archaeological buried features is the plowed stripe at the South of the area surveyed with RPAS (Figure 2). In this field-plot, one evident soil-mark is identifiable and it appears to have a circular elongated shape. Different concentric rings (perhaps two or three) also seem to be isolated but recent plowing activity has disturbed the traces, causing them to overlap each other.

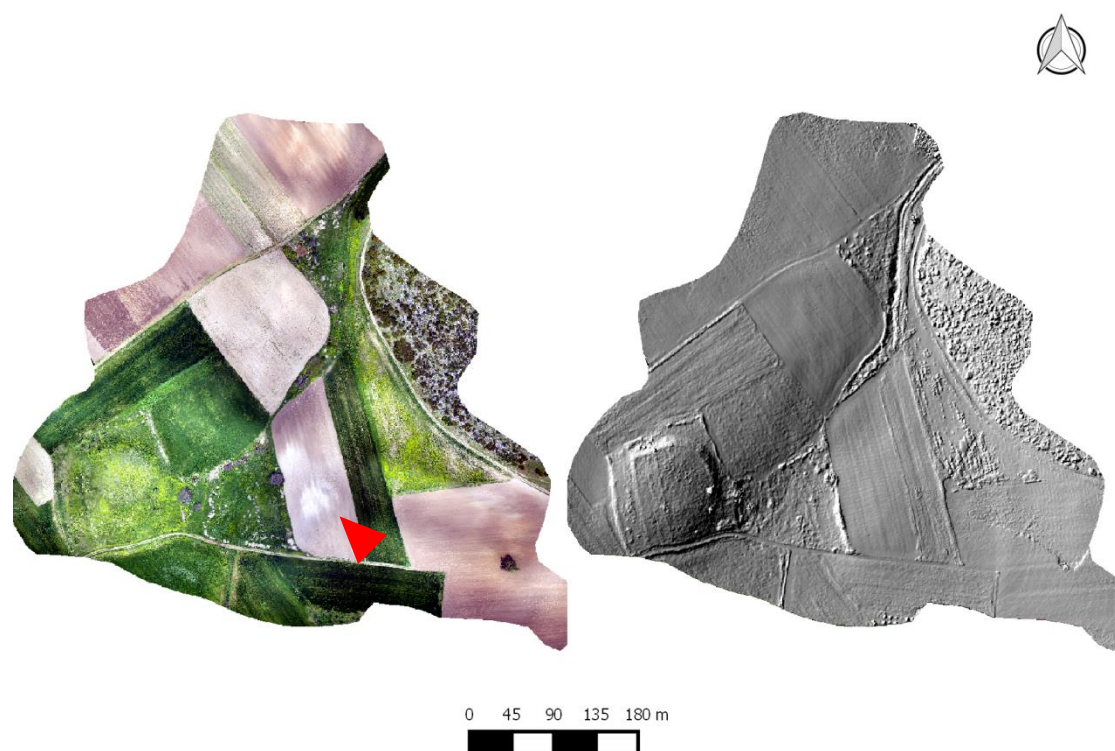


Figure 1: KASTRAKI: Orthophoto (left) and hill-shade view of the DEM of the site. The arrow is pointing at the field-plot with soil mark.



Figure 2: KASTRAKI: Detail of the orthophoto where soil-marks are visible.

## Geophysical Prospection

### *Geomagnetic Survey*

Geomagnetic survey in Kastraki was conducted in three different sectors and provides substantial evidence in regards to the settlement organization. The results show extent of the settlement and indicate the location of another possible small settlement to the north of the site (Figure 3).

Two enclosures are visible at the north end of the settlement core. High magnetism and their irregular shape suggest these enclosures were ditches surrounding the settlement. Both enclosures have magnetically homogenous areas immediately to their south. It is not clear if these areas were intentionally kept free of the magnetic materials (i.e. reduced anthropogenic activities) or if later taphonomic processes resulted in this pattern.

Two more enclosures are visible to the south of the survey area. These enclosures do not match in their spanning angles and thus probably have different dates of origin. . Furthermore, at least one of the enclosures in the south does not match with the enclosures in the north in terms of its angle and layout. Therefore, one can suggest that three enclosures ran around the settlement (Figure 4).

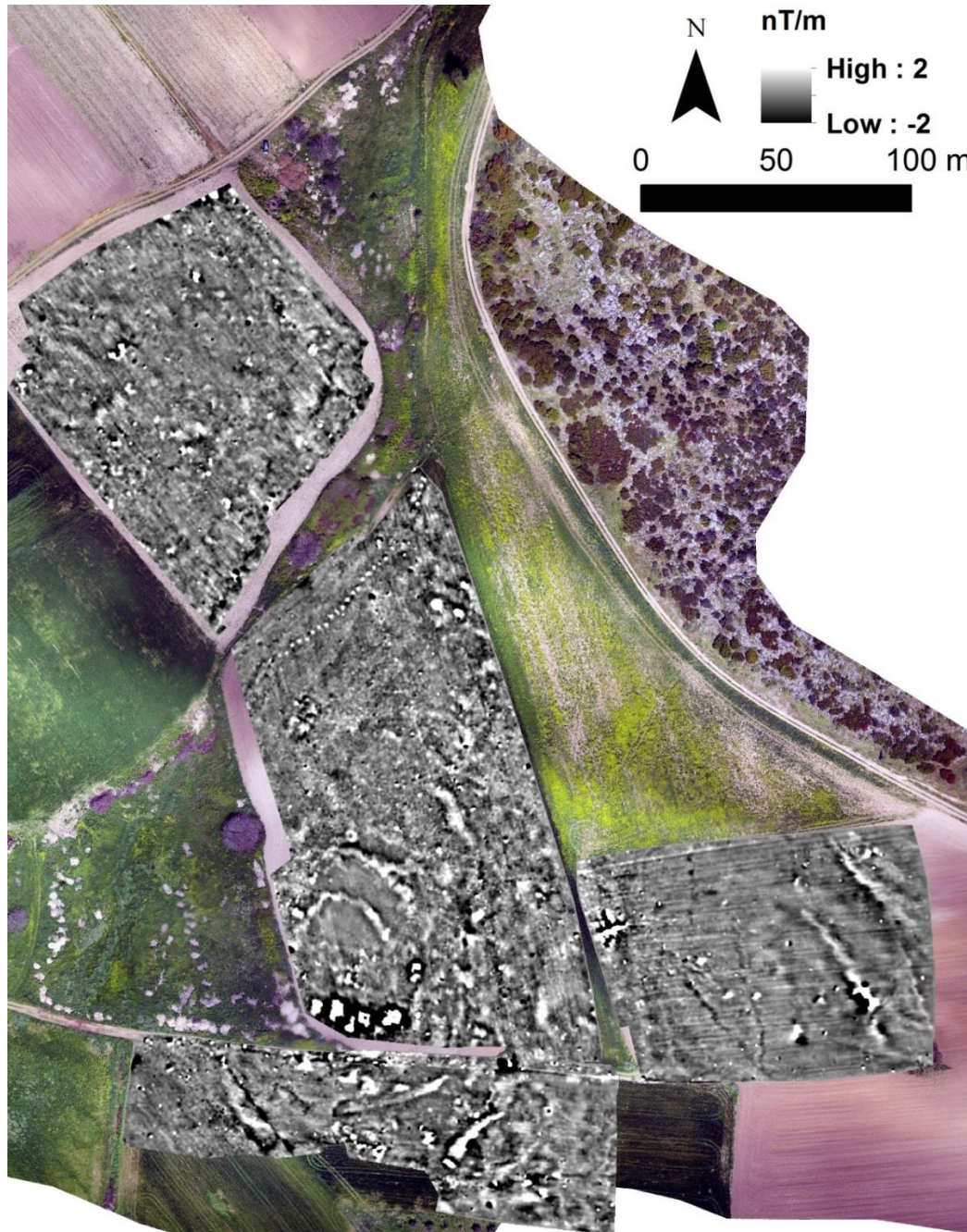


Figure 3: Geomagnetic prospection results at Kastraki 2

To south of the settlement core, at least six magnetic anomalies are detected. Five of these anomalies are aligned in east-west direction and one remains in isolation to the north. Their shapes are rectangular and these results are confirmed in the GPR data. (Figure 4).

A series of high anomalies are aligned in northeast-southwest direction (Figure 5) just north of the settlement core. These highly magnetic dots are most likely anomalies from some installation that was meant to define field boundaries, but they are also aligned along the course of an active river. Their monopole signature suggests the anomalies are not due to ferromagnetic material, ruling out the possibility of metallic fencing or postings.

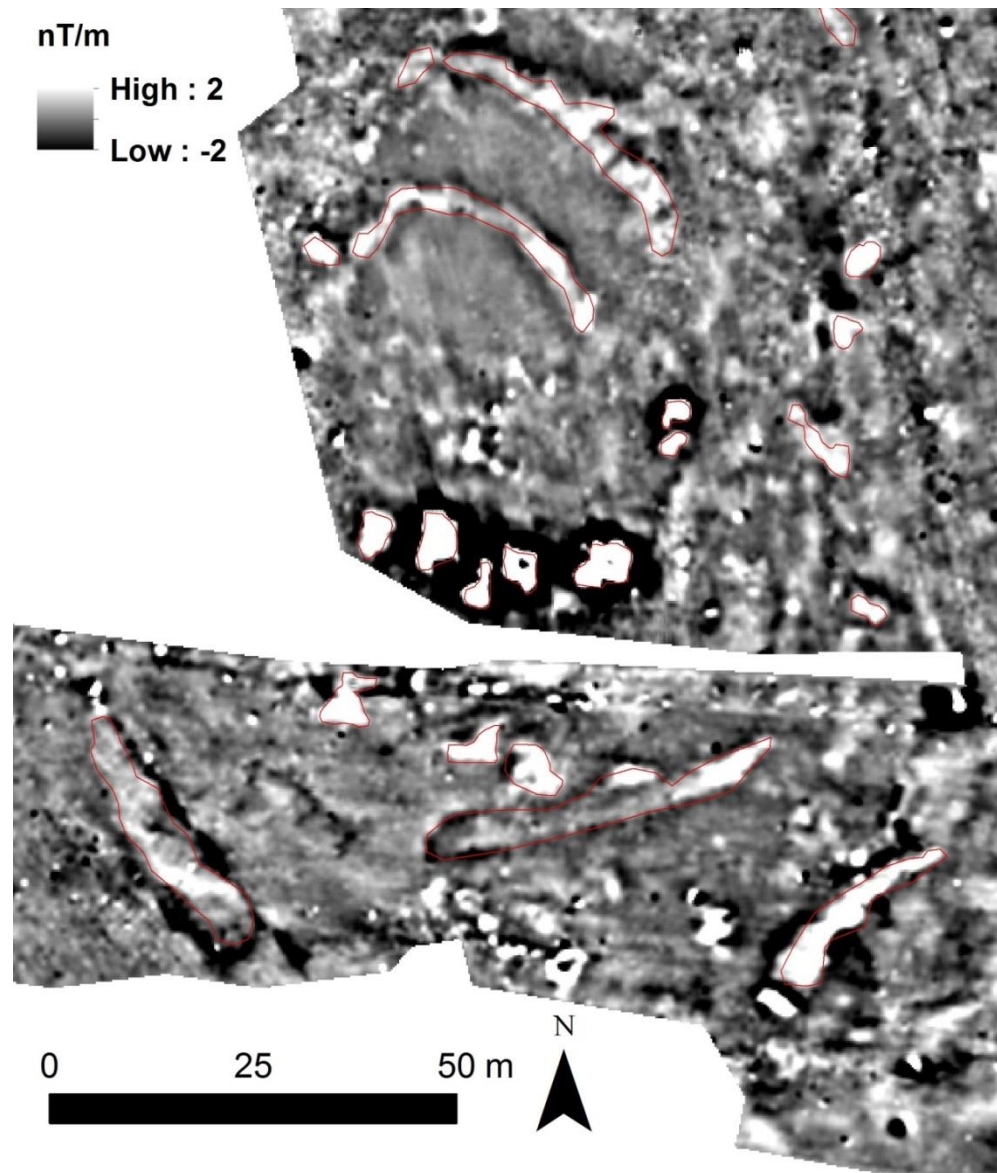


Figure 4: Geomagnetic results at the settlement core

A circular closed space is also detected at the northwest corner of the northern survey sector (Figure 5). There are no visible architectural anomalies within the bounds of the enclosure. Its size, however, fits well with the main core of Kastraki 2 settlement so that it may be argued that this was the initial settlement and inhabitants later moved to the south to establish a more substantial main settlement.

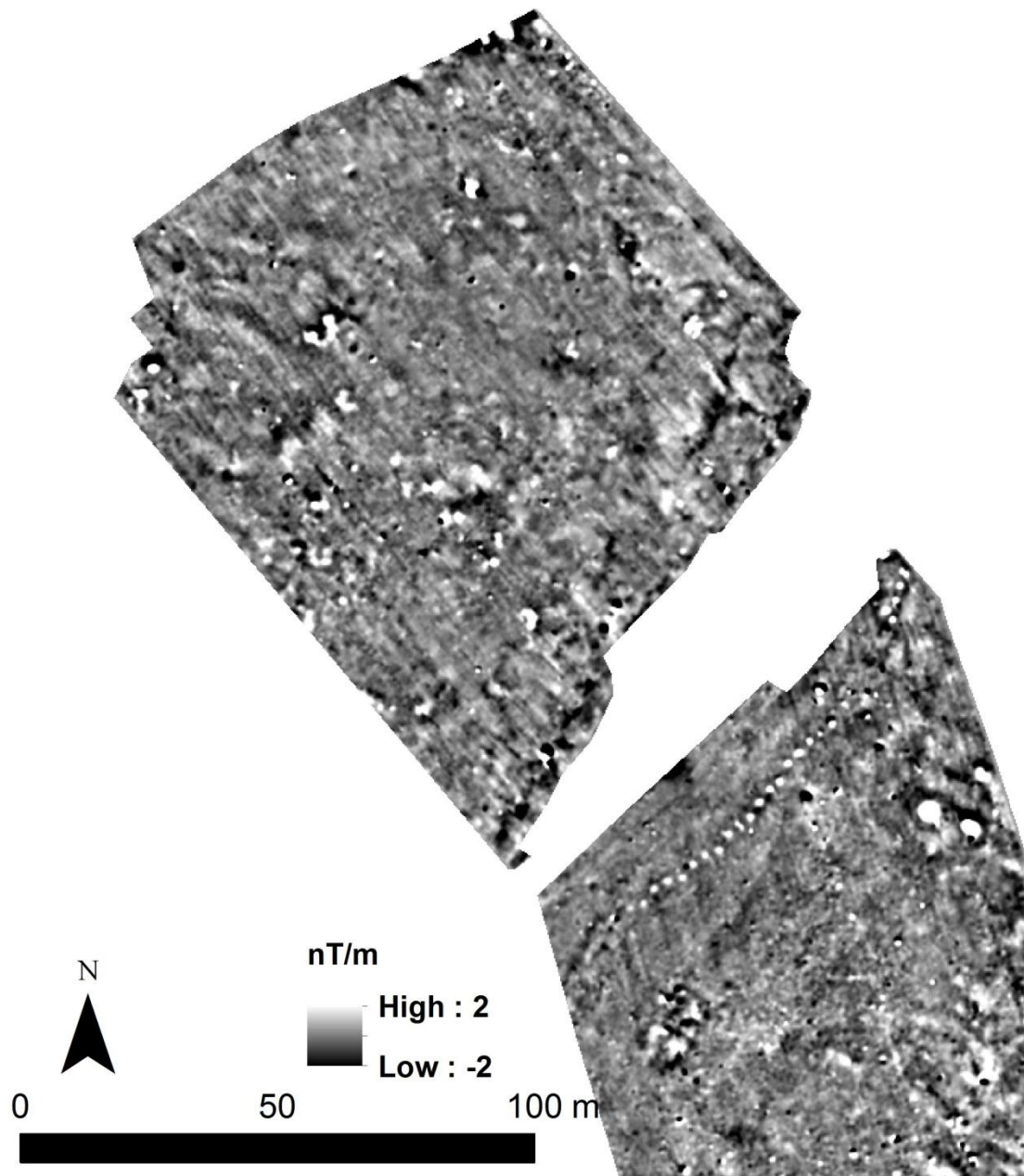


Figure 5: Geomagnetic results from the northern section of the settlement

#### *Electromagnetic Induction Survey*

The electromagnetic induction survey at Perivlepto Kastraki 2 was undertaken using a Geophex GEM-2 instrument collecting in-phase and quadrature data. The GEM-2 uses five frequencies of 4950, 10230, 21030, 43350 and 89430 Hz. Data were collected on approximately 1 m spaced lines at a rate of 2 samples per second for both instruments, with positions collected using a differential GPS.

The electromagnetic induction data reveal two areas of elevated values compared to the background readings in the conductivity, magnetic susceptibility, and magnetic viscosity datasets (Figure 10 and 11). These are shown as linear anomalies in the conductivity and magnetic viscosity datasets, and as a large amorphous shape in the magnetic susceptibility image. All significant anomalies are found in the northern portion of the survey area and could represent archaeological material. The magnetic

susceptibility data also reveals a semi-circular anomaly of elevated susceptibility in the southwest part of the grid. This anomaly is particularly interesting due to its shape and because it does not appear in the conductivity nor the magnetic viscosity datasets.

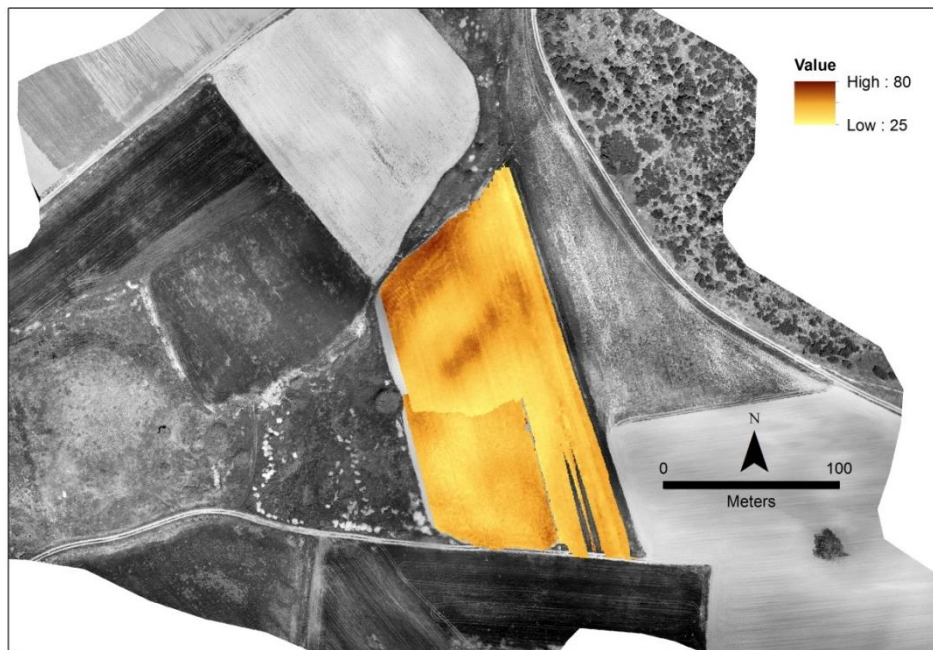


Figure 6: EMI map showing conductivity at Kastraki 2.

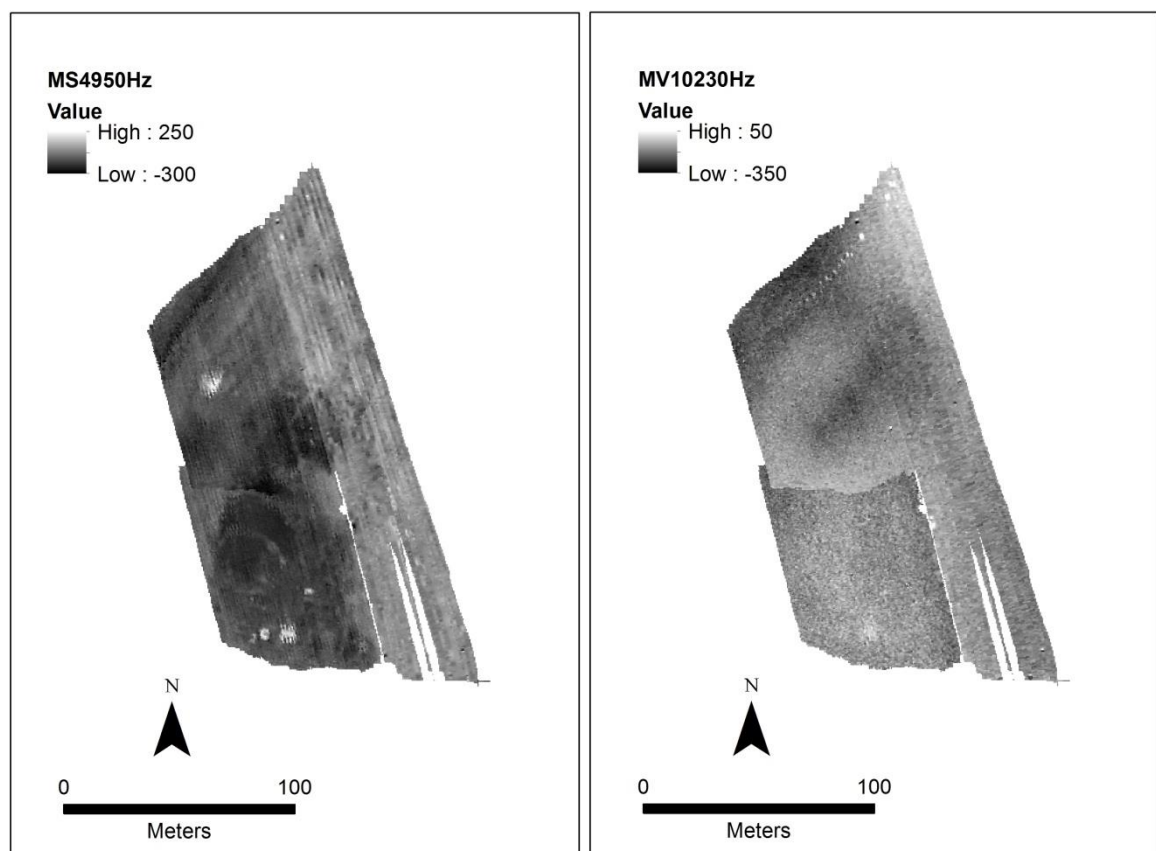
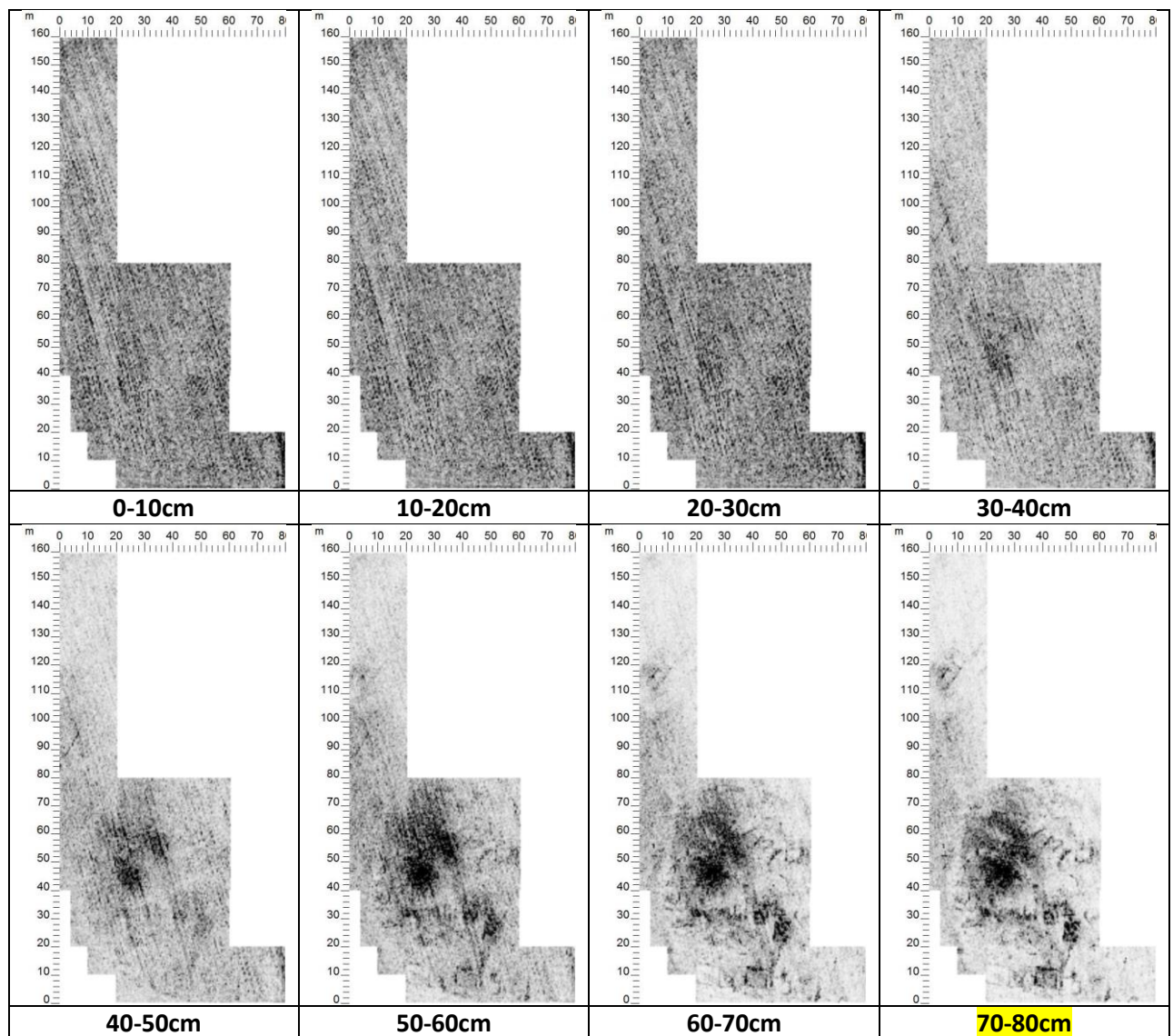


Figure 7: EMI maps showing magnetic susceptibility (4950 Hz) (left) and magnetic viscosity (10230 Hz) (right) from the GEM-2 instrument.

### Ground Penetrating Radar Survey

The resulting slices of the survey that conducted at Magoula Kastraki 2 with Noggin Plus smart cart are presented in Table 1. The area covered is 6400m<sup>2</sup> and consists of 8 grids. The grids were set at the top of the Neolithic settlement. The processing that was applied at the collected GPR scans are: Trace reposition, Repick first break (10%), Dewow, SEC2 (Atn=10db/m, StrtG=4, MaxG=500), Background average subtraction, Lowpass filter (f=50% Nyquist) and Highpass filter (30% Nyquist).

Within the range 0-50cm depth the results are noisy due to the rough surface and do not present any apparent reflections that can be interpreted as Neolithic features. From 50 to 200cm below the surface, several anomalies appear that can be identified as the well-preserved remains of houses, probably related to the Neolithic settlement. The differences and the similarities in the orientation, reflectivity, and the depth of these anomalies suggest at least two structural phases. Figure 6 presents a 3D model of the subsurface for this location, where the strongest amplitudes are shown. The results are further analyzed in the following passage.



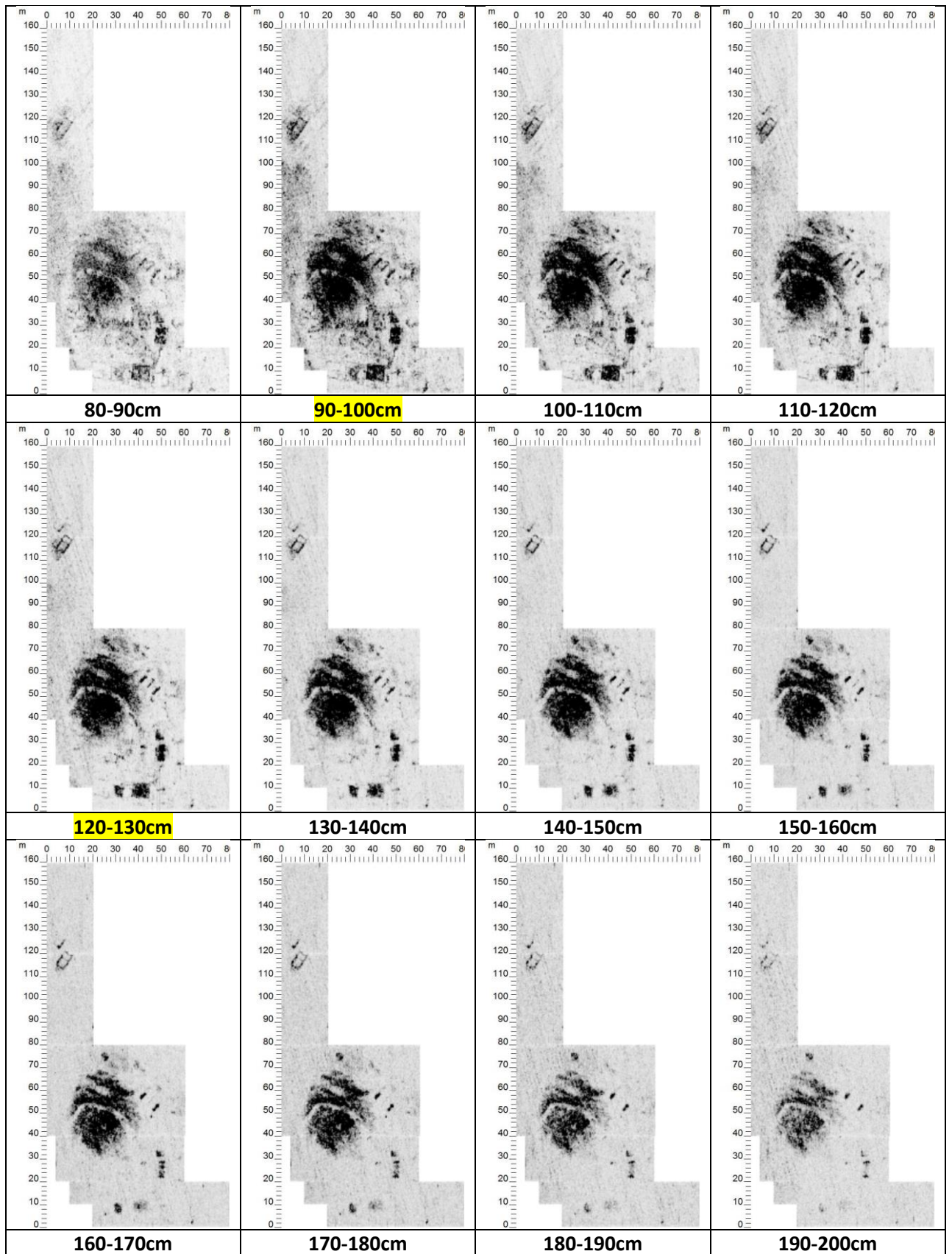


Table 1: GPR depth slices for the grids with code names K1 to K17 at Magoula Kastraki 2-Perivlepto with 10cm thickness.

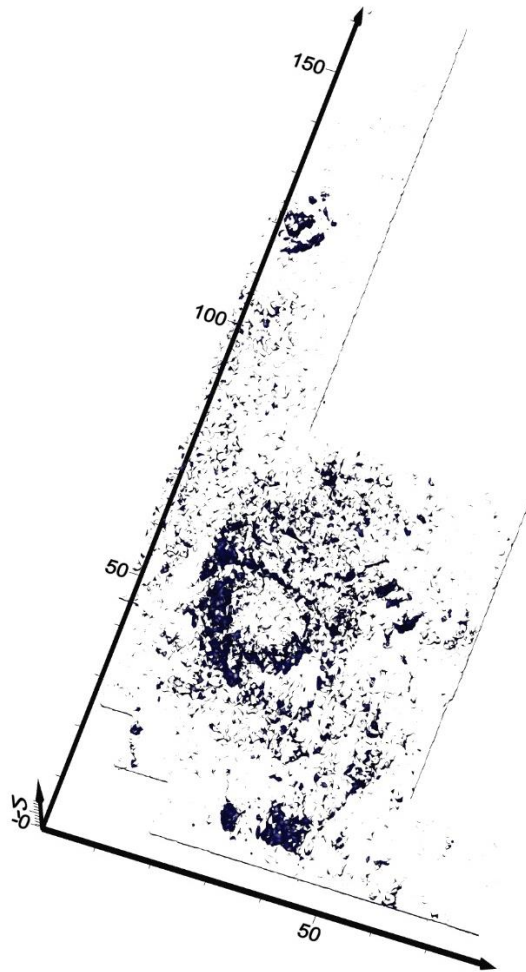


Figure 8: 2D view of the GPR 3D model of the subsurface for Kastraki 2 – Perivlepto.

The georeferenced slices at 90-100cm and 120-130cm are presented along with their corresponding interpretation in Figures 7 and 8 respectively. Some of the strongest reflections are anomalies A1 and A2 (Figures 4b and 5b) that show up at 50cm and extend up to 200cm below the surface. They combine to form one feature, with a 32.0m diameter along the N-S direction and 26.0m along the W-E direction and demonstrate a layer of high contrast in electrical properties from the surrounding matrix. This feature indicates an area that matches the circular elongated crop-mark.

A3 and A4 (Figure 7b) are linear anomalies that extend within the range 60-100cm below the surface. Their shape suggests walls where in the case of A3 are the two opposite fragments of a structure with approximate dimensions of 2.0 by 3.0m. Similar areas of strong reflectivity are denoted as linear anomalies A21, A22, A23 and A24 (Figures 4 and 5), which extend from 60 to 150cm below the surface. Their similarities in orientation, reflectivity, and depth indicate either wall fragments of an elongated structure including three rooms (12.0 x 3.0m) or opposite walls of houses built very close to each other. The anomalies A18 (Figure 7) and A20 (Figures 7 and 8) also present a linear orientation indicating the remnants of structures. The fact that

A20 becomes clearer at deeper level could be interpreted as a semi-demolished wall fragment.

The next group of anomalies is also linear and form corners, therefore they are identified as fragments of demolished houses. The anomalies A8 and A19 (Figure 7b) exhibit higher amplitudes within the range 60-100cm depth, while the anomaly A10 presents very high reflectivity from 60 to 150cm below the surface. A5 (Figure 7) and A6 (Figure) are most likely to be fragments of a single demolished structure with A5 as part of the lower left corner and A6 the upper left that appears at deeper levels. A14 (Figure 7) and A15 (Figure 8) are most likely to be structural remains from different building phases. A14 has weaker amplitudes and is placed close to the surface while A15 appears deeper and exhibits very high reflectivity.

The reflectors A7, A13 and A17 (Figure 7) are identified as houses, present weaker amplitudes and extend from 50-110cm depth. The anomalies A12 and A16 (Figures 7 and 8) are also identified as houses and exhibit strong reflectivity. A12 describes either a single structure divided by two rooms (4.0 x 3.0m) or two individual houses. The fact that this feature appears as a single, solid anomaly indicates a collapse roof or walls that fill the interior with structural material. A16 presents a similar signature to A12, defining an almost square structure that is 6.0 x 6.0m. North from the center of the settlement we see anomalies A25 and A26 (Figures 7 and 8), part of a structure with at least two rooms. However is not clear if they are part of a larger structural complex or remains from different phases.

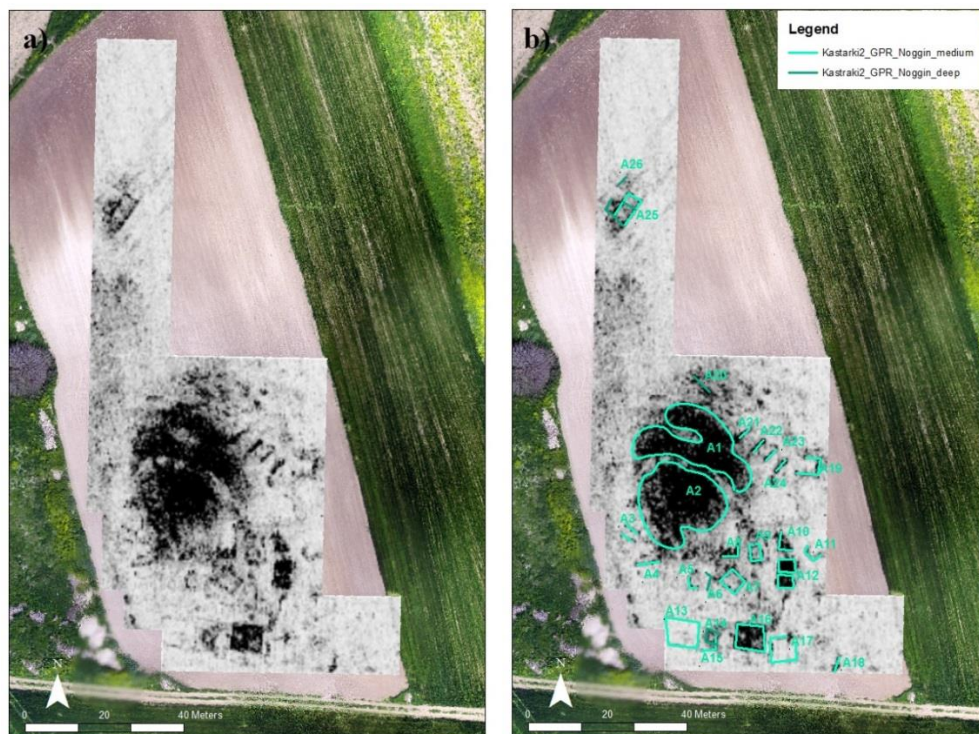


Figure 9: GPR results interpretation where (a) is the georeferenced slice at 90-100cm superimposed on the UAV image, while in (b) the outlines of the identified anomalies.



Figure 10: GPR results interpretation where (a) is the georeferenced slice at 120-130cm superimposed on the UAV image, while in (b) the outlines of the identified anomalies.

### *Resistance Survey*

Resistance survey at Kastarak 2 shows the settlement core with high resistance values and surrounding enclosures with relatively low resistance characteristics. In consideration of the results of the geomagnetic survey we can confirm that these enclosures are indeed ditches; later filled with highly magnetic topsoil, but also low in resistance due to probably higher moisture content. Not all, but some of the aligned structures to the south of the settlement are also show up in the resistance survey results, suggesting differential preservation conditions and/or building characteristics.

The northern extension of the survey contains a high resistance area. This amorphous anomaly is more clearly defined in the geomagnetic data, but the real evidence comes from the GPR survey in which a building is clearly visible at this location.

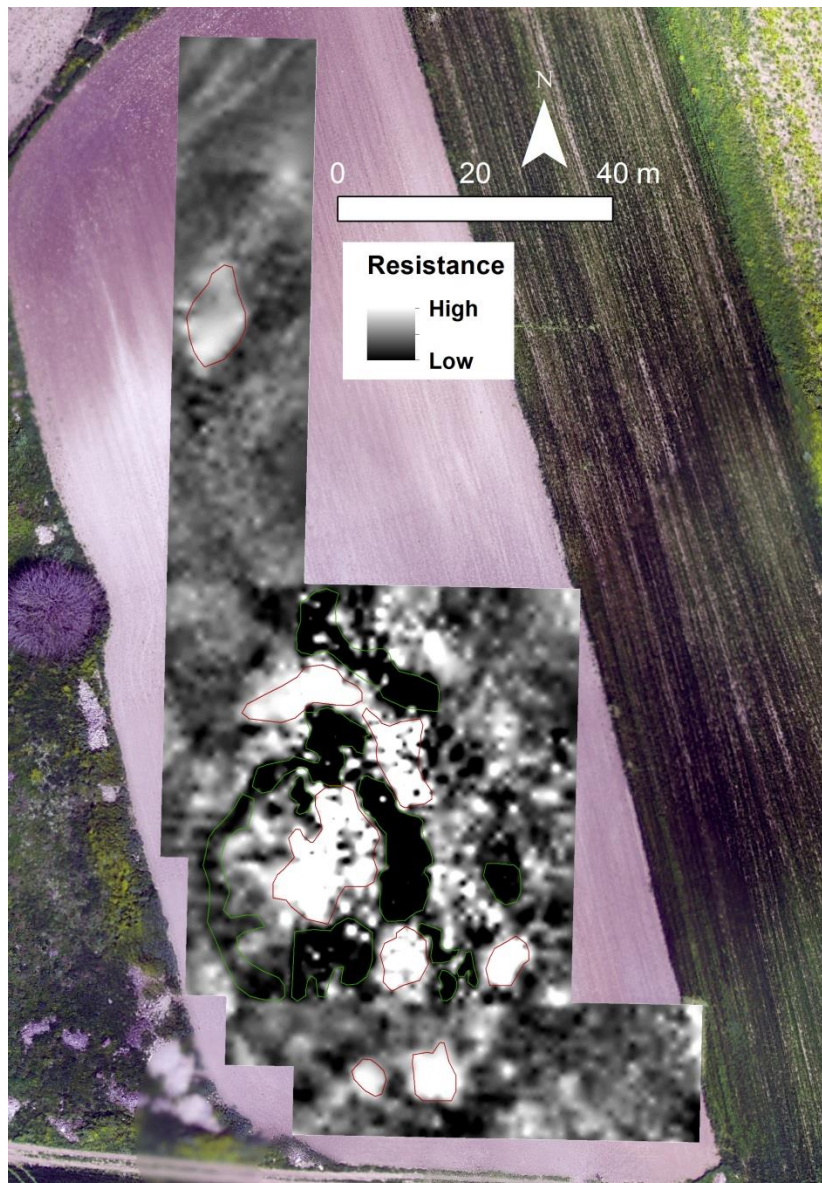


Figure 11: Resistance survey results from Kastraki 2

### Site Bibliography

Βουζαζάκης Κ., 2009. *Νεολιθικές θέσεις στη Μαγνησία. Ανασκόπηση – Ανασύνθεση δεδομένων*, στο Αρχαιολογικό Έργο Θεσσαλίας και Στερεάς Ελλάδας 2 (2006), τ. Ι, σελ. 61-74.

Ιντζεσίλογλου Α., 1995. *Επιφανειακές έρευνες, Νομός Μαγνησίας*, ΑΔ 44 (1989), Χρονικά, 228-229