Dexameni

Archaeological Background

The Neolithic settlement of Dexameni was first discovered a few years ago during the construction of a modern concrete water tank, in a hill cut which exposed stratigraphically cultural layers. The Dexameni site is situated on the low hills between the Almyros Plain and the plain of Velestino. Although there is some surface evidence indicating that the settlement dates to the Bronze Age, there is also evidence of an earlier occupation, particularly in the last phases of the Neolithic period.

Remotely Piloted Aircraft Systems (RPAS) Survey

The site of Dexameni has been covered with three flights using a remote piloted aircraft systems (RPAS) survey. A total of around 260 photographs for an area of about 3 hectares were covered. One orthophoto and one digital elevation model (DEM) have been created for the site (Figure 1).

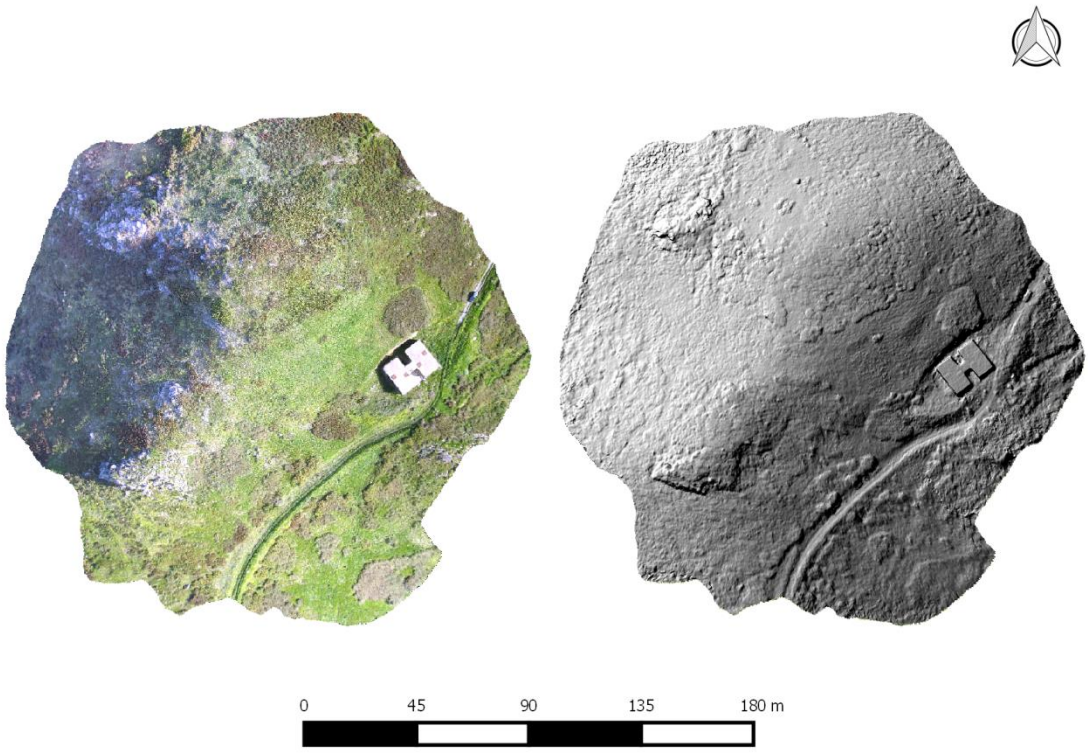


Figure 1. Dexameni: Orthophoto (left) and hillshade view of the DEM of the site.

The site was quite complex to survey with both RPAS and geophysical applications. In particular, the topography (steep slopes and hills) made it exceptionally difficult for data collection (Figure 2). The site was also exposed to large wind gusts from all directions, which made it difficult and somewhat unstable to fly the device. Despite this, the resulted output as ortho-photo and digital elevation model is quite accurate and of good quality.

Figure 2. Perspective view southwest of the site with contour-lines at 2 m intervals.

The site contains very low, natural vegetation due to the shallow soils found above and between the rocks outcrops. The local geological bedrock tends to also form a long linear axis across the site, producing some alignment that could be misinterpreted as archaeological structures if not analyzed with high resolution images.

Geophysical Prospection

Geomagnetic Survey

The geomagnetic survey was performed using a Bartington Instruments Grad601-2 gradiometer in two survey grid areas (Figure 3). Despite the limited spatial coverage, no architectural features were visible, yet some patterning still exists suggestive of archaeological significance. At the western half of the study area, negative response magnetic anomalies are slightly aligned in an east-west direction, bounding a relatively positive magnetic response. In the eastern half, low magnetic anomalies make an angular turn and roughly aligned in northeast-southwest direction while still bounding the high magnetic response. The morphology of the study area does not explain such spatial configuration and thus the distribution of anomalies suggestive of anthropogenic activities in the area should be viewed with caution.

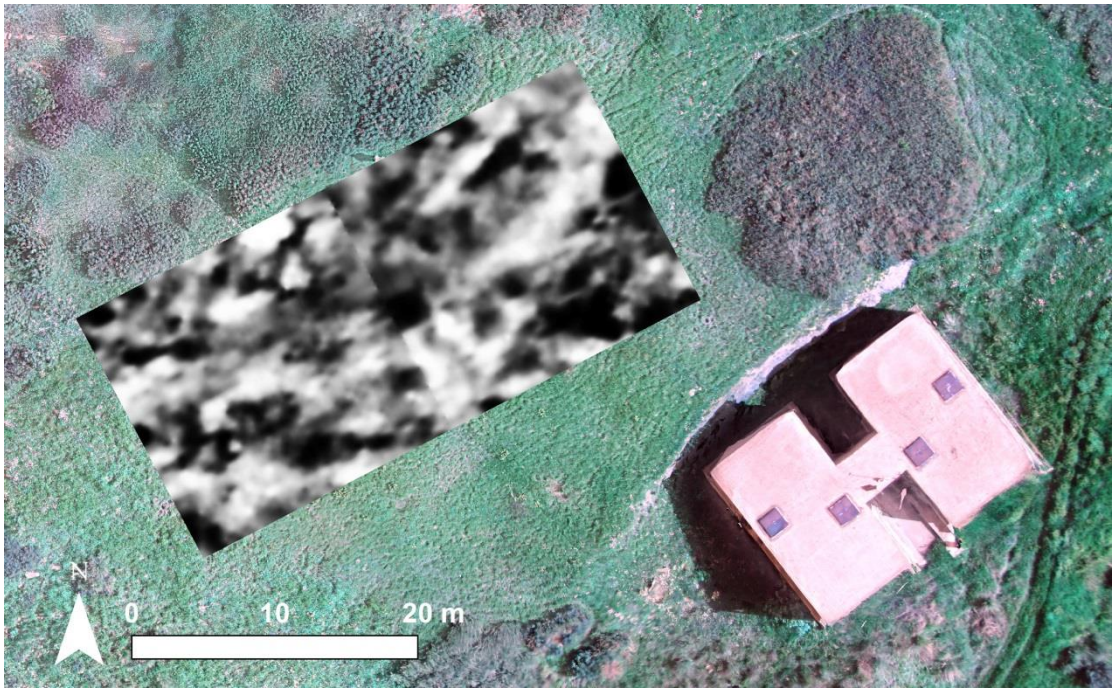


Figure 3. Vertical gradient measurements at Dexameni; white color indicates high magnetism and black color depicts low magnetism.

Electromagnetic Induction Survey

The electromagnetic induction (EMI) survey at Dexameni was performed using a Geophex GEM-2 and a GF Instruments CMD-Mini Explorer instruments collecting in-phase and quadrature data. The GEM-2 used five frequencies of 4950, 10230, 21030, 43350 and 89430Hz while the CMD utilized three effective depth ranges from shallow to deep (0.5 m, 1.0 m and 1.8 m). Data was 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 from the GEM-2 at Dexameni show a cluster of low magnetic susceptibility and magnetic viscosity anomalies in the central-west portion of the survey area that may represent archaeological material (Figure 4). A curved, linear low magnetic susceptibility and magnetic viscosity anomaly is visible directly north of these. Another small clustering of low magnetic susceptibility and magnetic viscosity anomalies are visible in the northeast section of the grid. These anomalies appear to be more linear and could be associated with archaeological material. Higher valued linear anomalies are also found adjacent to these ones. As shown in the CMD data in Figure 5, a large concentration of elevated conductivity compared to the background readings is visible in the lower part of the survey area. In the northern part of the survey area, in an area that contains moderately low conductivity values in general, a number of linear low conductivities anomalies are apparent and could be associated with archaeological material. The curved, linear anomaly is the same one visible in the GEM-2.

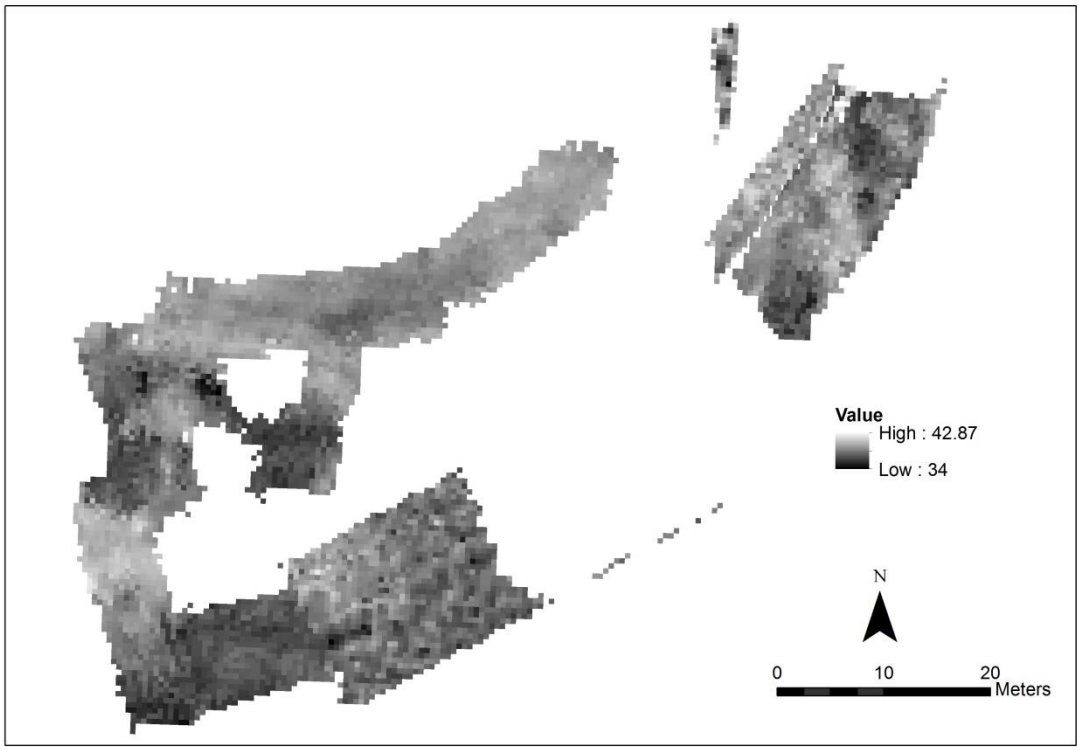


Figure 4. EMI map showing magnetic viscosity (4950 Hz) at Dexameni from the GEM-2.

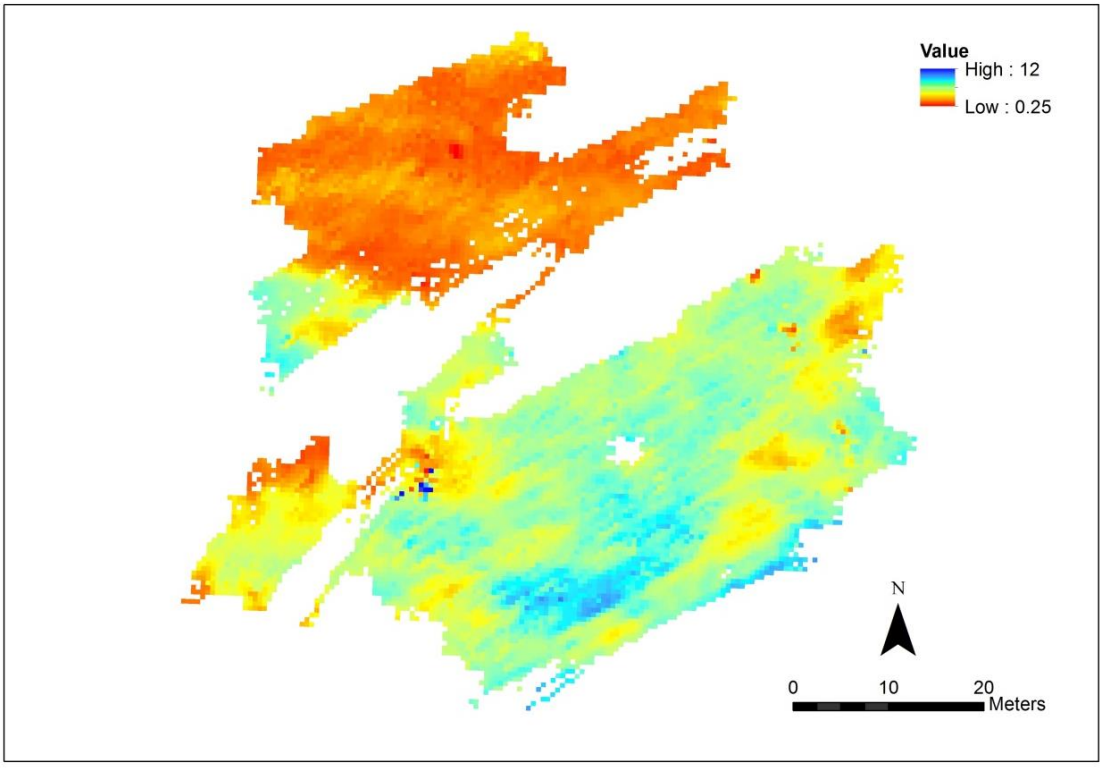
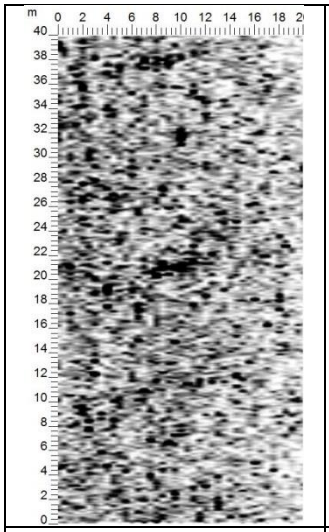
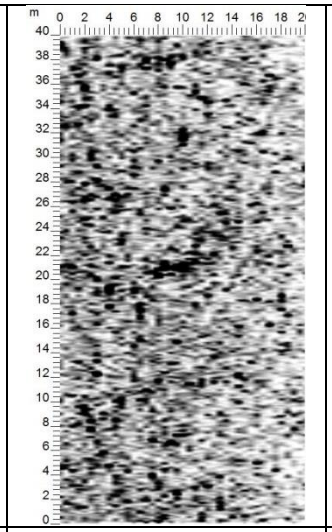
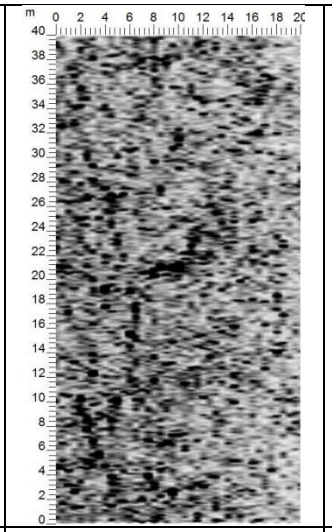
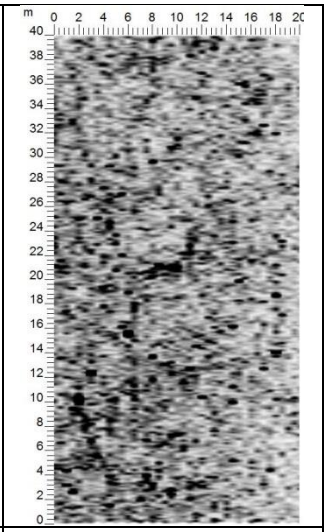
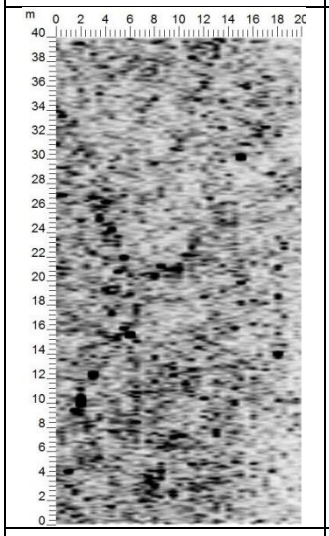
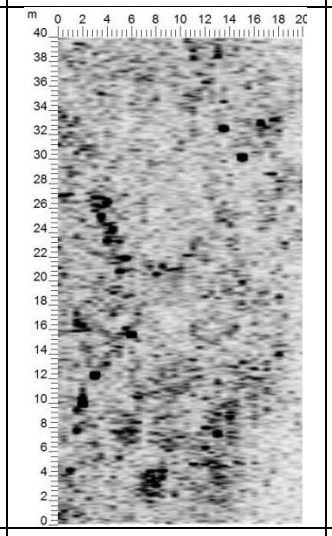
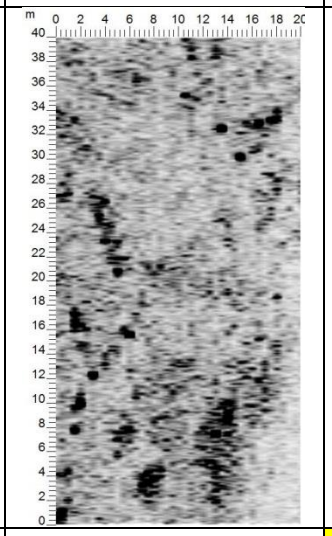
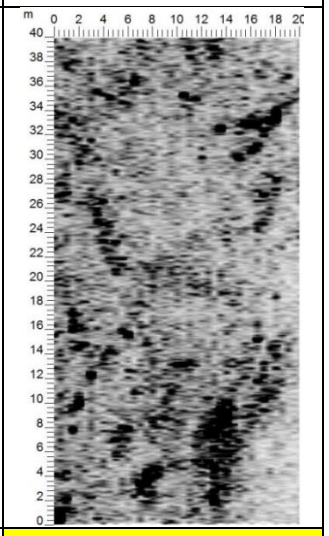


Figure 5. EMI map showing conductivity (deep) at Dexameni from the CMD-Mini Explorer

Ground-Penetrating Radar Survey

The total area covered with ground-penetrating radar (GPR) on Dexameni is 800 m^2. This survey was challenging due to the slope of the natural hill and the rough surface of the site. The resulting amplitude slice-maps are presented on Table 1. Processing of the GPR data include: Trace Reposition, Repick first break (10%), Dewow, Sec2 (Atn=25dB, StrtG=3, MaxG=600), Background Average Subtraction, Low-pass filter (f=50% Nyquist), and High-pass filter (f=30% Nyquist). The results reveal some areas with high amplitudes or reflections (darker colors), especially from 60 cm below the surface down to 200 m. These areas are shown better on the 3D model of the subsurface in Figure 6. The shape of these anomalies indicate that were likely caused by geological features.

			
0-10cm	**10-20cm**	**20-30cm**	**30-40cm**
			
40-50cm	**50-60cm**	**60-70cm**	**70-80cm**

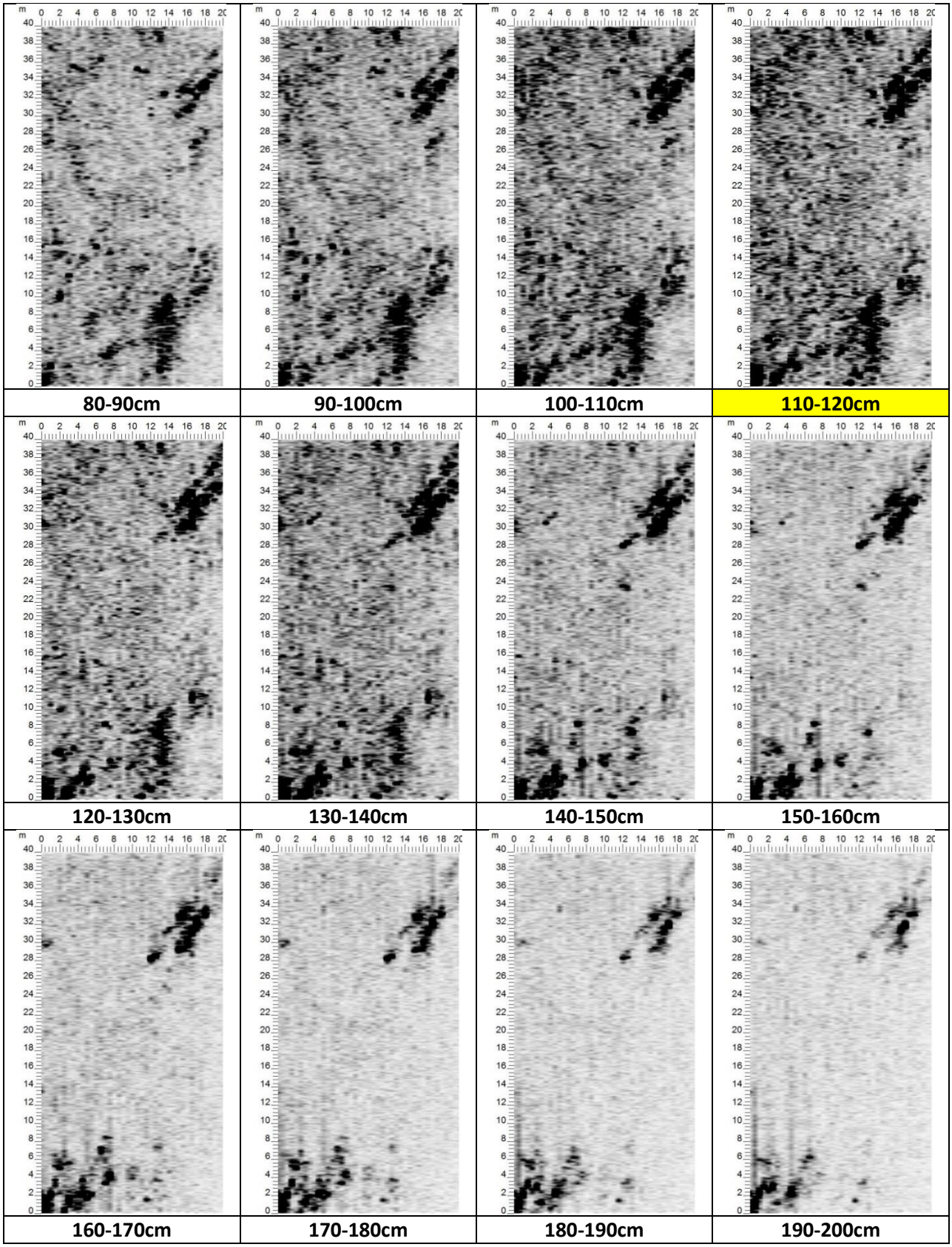


Table 1. GPR amplitude slice-maps for the grid at Dexameni showing 10 cm depth thickness.

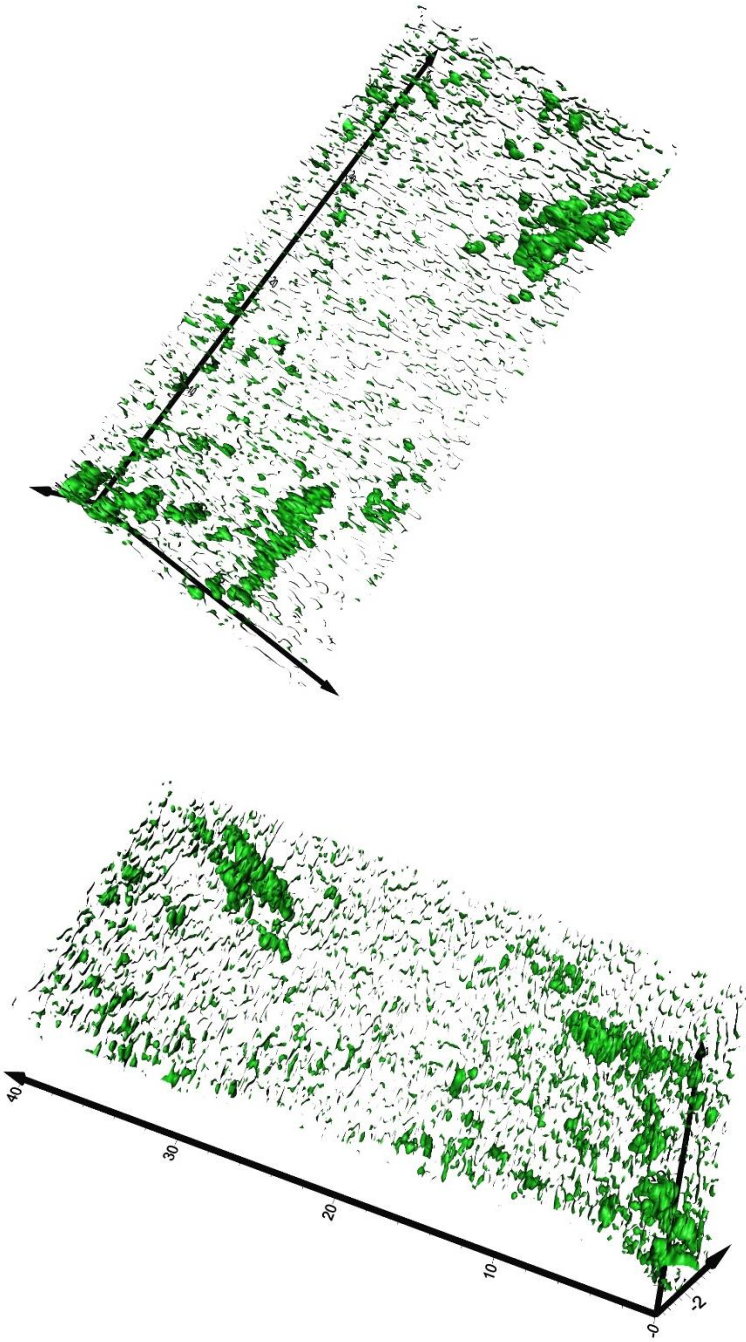


Figure 6. A 3D model created from the GPR slices showing high reflections.

Figure 7a reveals GPR slices where the most obvious anomalies from 50–100 cm appear. The anomalies designated A1 and A2 exhibit very high amplitudes values indicating reflections with higher contrasts in electrical properties. Considering their irregular shape and their extension in depth, especially A2 that reaches 200 cm, it is possible these could be related to bedrock. These anomalies are also visible in the resistivity results. Anomalies A3 and A4 are part of a group of scattered high amplitudes that show some linearity in space in addition to a similar orientation. Other linear anomalies are the ones defined as A5. These are also visible in the resistivity results, and as A8. The anomaly A6 has weaker amplitudes but also presents linearity

in space. Anomaly A6 also appears in the resistivity results, which this as high resistance values. Additionally, the anomalies A4, A5 and A6 appear to join, defining a possible geological boundary that could be linked with the anomaly A2. The anomaly A7 is also linear, with very strong amplitudes. Based on its size, shape and length, it could be associated with an architectural feature, such as a wall.

At deeper depths, the anomaly A9 is detected and appears to be associated with anomalies A1 and A2 (Figure 8). Anomaly A10 is also visible as a high amplitude in the shape of a 'Y' within the depth range of 60–90 cm. However from 100 cm down to 200 cm from the surface, it is shown as two parallel linear anomalies with very high amplitudes that have the same orientation as the anomaly A4.

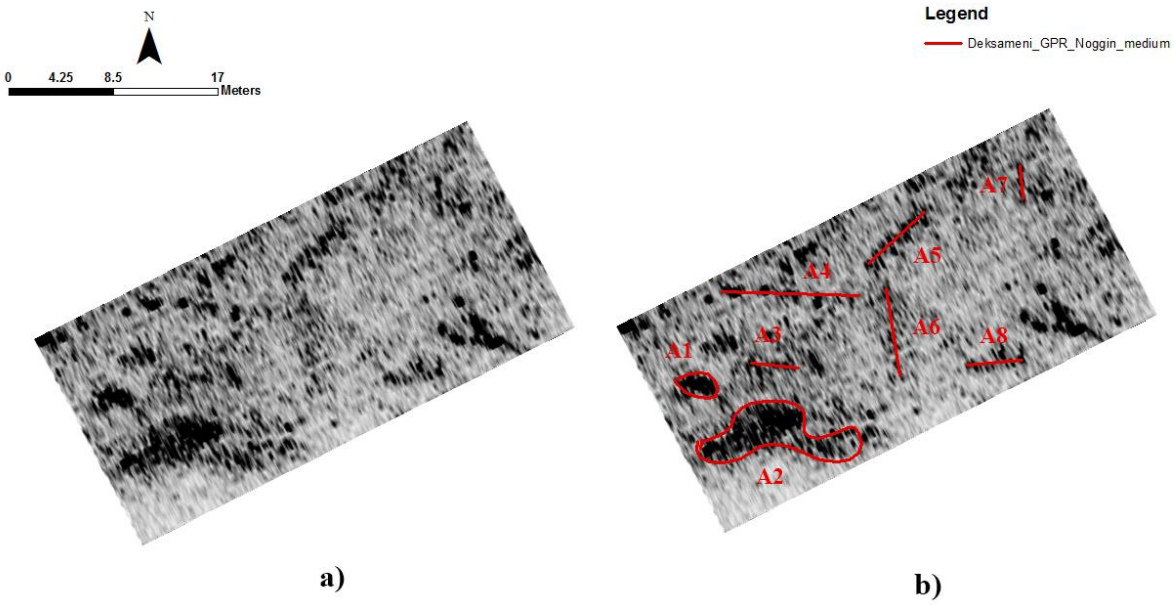


Figure 7. GPR results from Dexameni where a) is the georeferenced GPR slice from 70–80 cm, and b) the high amplitude anomalies outlined in red.

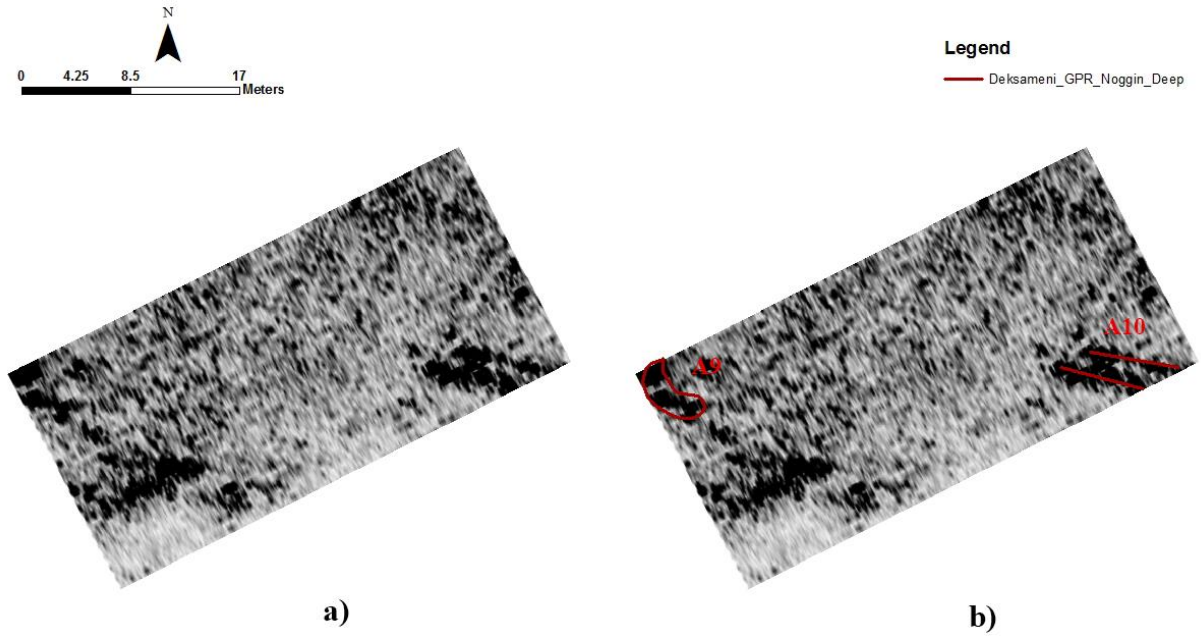


Figure 8. GPR results showing a) the georeferenced GPR slice from 110–120cm, and b) the high amplitude anomalies outlined in red.

Resistance Survey

The resistance survey from Dexameni does not provide clear evidence for the distribution of underground archaeological features. Low and high resistance readings were present in the survey areas and formed sizable anomalies of interest (Figure 9). However, their boundaries and shape do not suggest that these could have interpreted as architectural features. Their orientation; however, is complimentary to that observed in the magnetic anomalies, especially in the western half were they are aligned in an east-west direction and in the eastern half were they are aligned in a northeast-southwest direction.

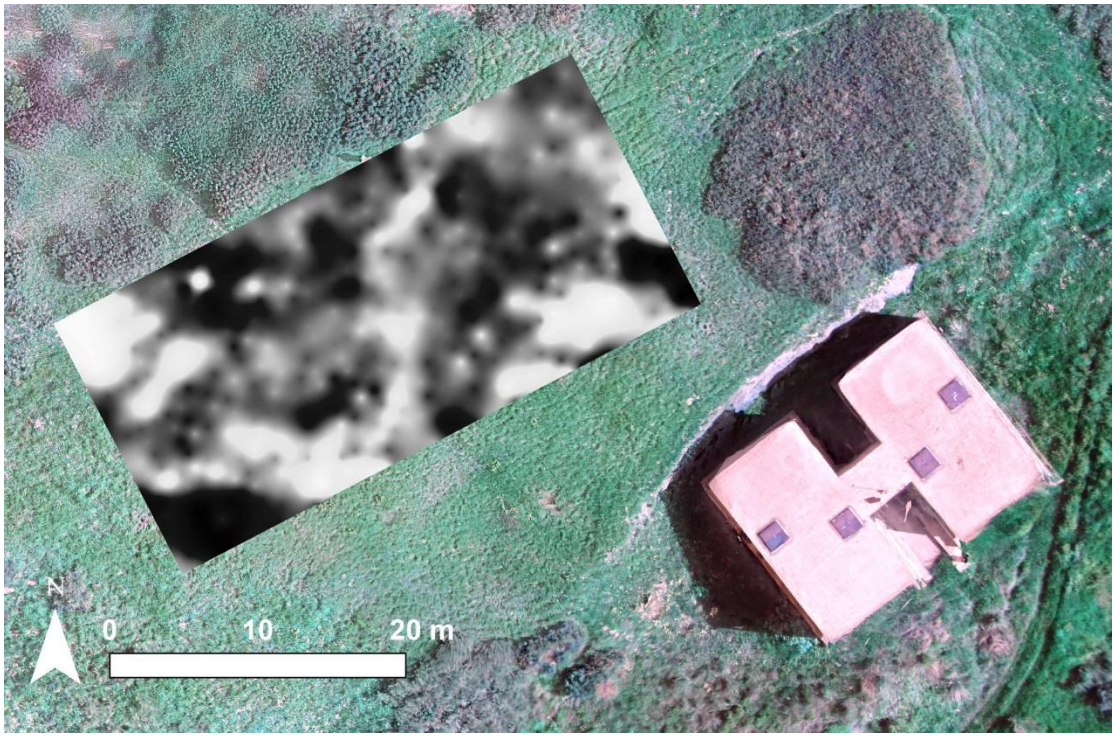


Figure 9. Resistance results from Dexameni showing high (white) and low (black) resistance values.

Integration of Geophysical Results

The Neolithic settlement of Dexameni deviates from the rest of Neolithic magoulas and expands at the top of a natural hill (between the Almyros Plain and the plain of Velestino) covered by thick vegetation and rock outcrops. The site was first discovered during the construction of a modern concrete water tank, where stratigraphically cultural layers dated during the last phases of the Neolithic period and the beginning of the Bronze Age period were revealed.

The RPAS survey indicated a few curvilinear topographic features that are related to natural terraces, which were most probably used for the establishment of habitation quarters (figure 10). Despite the rough terrain, various geophysical methods were applied, producing however very poor results. Still, from the small sections of the site that have been surveyed and the information that we have from the construction of the modern tank, it becomes obvious that towards the SE the settlement expanded from the top of the hill (high elevations) to the iso-elevation line defined by the modern road. The situation may be similar to the East but it will definitely deviate towards the rest directions due to the abrupt slopes.

A relative good correlation has been between the high magnetic values, the low conductivity measurements obtained via the CMD mini-explorer and the high resistance values measured through the twin probe array, but most of the detected anomalies are related to the terracing (natural or anthropogenic) of the hill. Very limited evidence of architectural residues has been suggested by the GPR and the magnetic survey data indicating the relative crude degree of preservation of them (Figure 10).

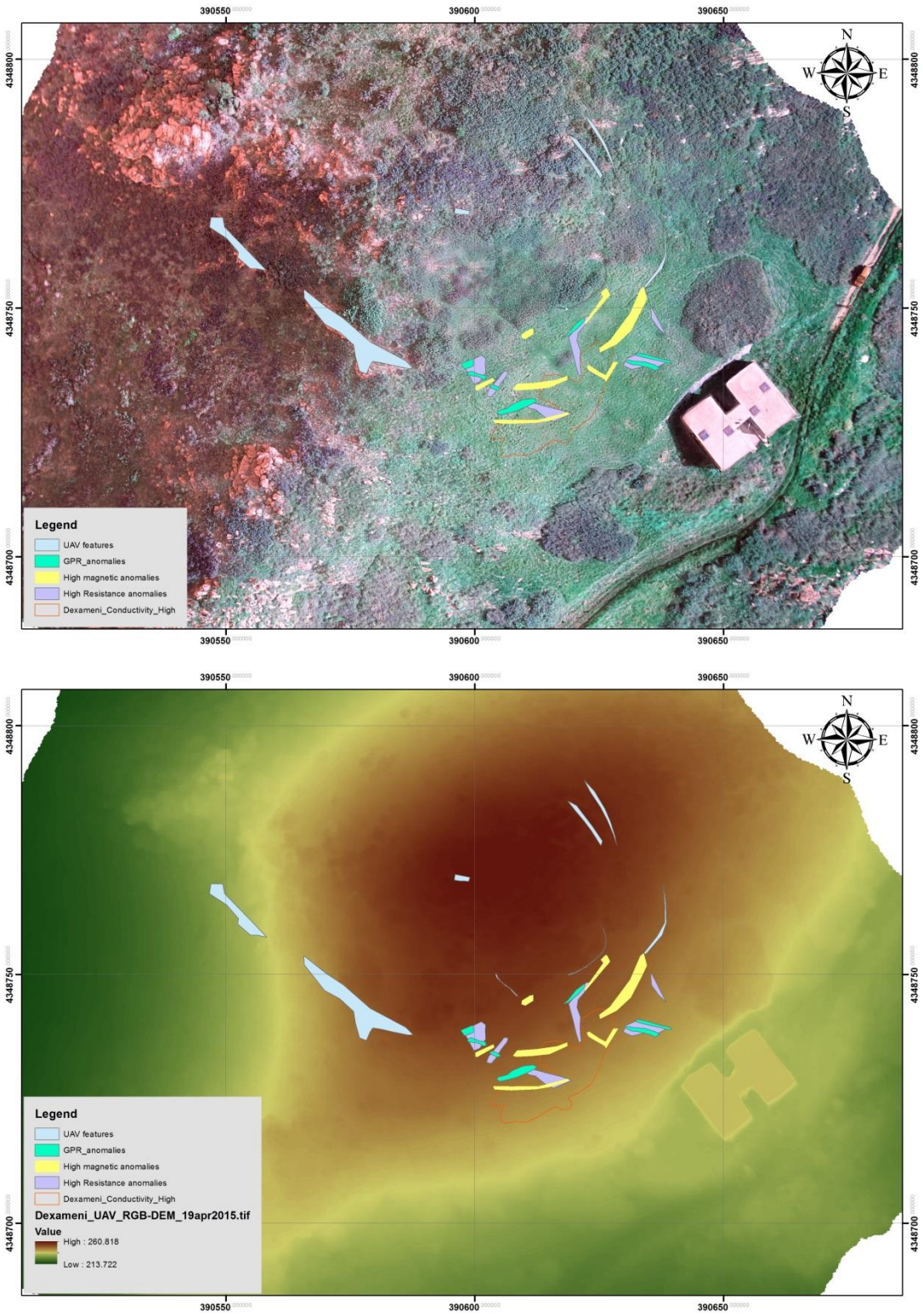


Figure 10. Overlay of all the major geophysical anomalies on the orthophoto of the site (above) and on the DEM produced by the RPAS flight (below).

Site Bibliography

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