MAGOULA VELESTINO4 – VISVIKI

Archaeological Background

Magoula Velestino 4 - Visviki is located on a flood plain at the foot of Mount Chalkodonion and to the south of Lake Karla, which during the Neolithic period used to be shallow resulting in various flooding episodes during the Neolithic period and also in later periods. The magoula extends over an area of about 200 x 200 m and is today used for cereal and corn cultivation. The site lies to the west of the National Road that connects Volos with Larissa. At the top of the magoula, where most of the concentration of sherds is noticed, there is also a geodetic base of the Geographical Service of the Army. There are not any obvious architectural remains on the surface of the magoula. When surveyed for the first time in 1941, magoula Velestino4 – Visviki was reported to be about 7 m in height and 200 m in diameter (Alarm-Stern, 2014a), similar to what we notice even today. According to Johnson and Perles (2004) it is one of the smallest magoules of Thessaly; however, the results from the IGEAN Project place its size within a middle category of the existing magoules in eastern Thessaly.

The archaeozoological and archaeobotanical record specifies the existence of domestic ruminants, cattle and pig, constituting the main subsistence of the Neolithic population, surviving in a landscape cultivated with einkorn and emmer (Galik, et at. 2014). These results came from the study of the excavation material that came out during the excavations of 1941 by a German campaign during the Second World War. In 1942, Benecke (1942) published the results of the excavations carried out on the magoula, including the ground plan of a long house which was identified as the oldest megaron type building found in Greece, similar to the type of structures that were excavated by Tsountas at Sesklo and Dimini (Tsountas 1908:49-59, 88-98). Within the rooms of the long house, a hearth, a mudbrick oven and postholes were revealed from the excavations. Reinerth also reported the excavation of two trenches (A [6.61 m deep] and B [3.12 m deep]) at a distance of about 15 m and 27 m correspondingly towards the northwest from the highest point of the magoula, in order to study the stratigraphy of the cultural layers. Pottery that was revealed from the excavations dated to the Early to Middle Neolithic, Dimini period and Tsangli-Larisa and Arapi period. The Late Neolithic pottery resulted mainly from the highest altitude of the magoula and also from trenches A and B (Dürauer 2014).

Alram-Stern (2014b) mentions that the reassessment of the plans based on the archives of the National Museum of Athens and the Pfahlbaumuseum Unteruhldingen indicated various differences with the original simplified plan of the structure. The most important observation was that of using different construction techniques for the various parts of the walls and the rooms, indicating a diachronic usage of the building with various types of interventions in it during the various phases of the Neolithic period. The western compartments seem to consist of stone walls, whereas the eastern compartment is indicated to be constructed of mud bricks. It seems that the particular building was used in various (at least two) occupation phases. Alram-Stern argues that the multiple room complex excavated at magoula Velestino 4 - Visviki is similar to the long house construction found “in the Chalcolithic layers at the Pefkakia Magoula and at Late Neolithic Dikili Tash” (Koukouli-Chrysanthaki 1993:68–75, Weisshaar 1989:9–12; Andreou et. al. 1996:546).

Satellite Remote Sensing and Historical Aerial Photography Survey

A GeoEye-1 image from 4 May 2010 was used for satellite remote sensing at Velestino 4 - Visviki (Figure 1). The satellite image has an off-nadir angle of 9.9° and a ground sampling distance (GSD) of 0.50 m (panchromatic) and 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 environment around Velestino 4 - Visviki is level agricultural land that rises gradually toward the west beyond the National Road (500 m away) and the town of Velestino (2.5 km away). The eastern topography rises more sharply towards the foothills of Mt. Pelion where there are a large quarry (1.2 km away) and military base (800 m away). Various streams, irrigation channels, and roads leading to Volos pocket the terrain. There are some modern constructions, including large industrial installations especially towards the south. Several other prehistoric settlements are located in the same area. These include Nikonanou (800 m to the northwest), Velestino 3 (Mati) (1.8 km to the west), and Magoula Bakalis (3.1 km to the southwest). Cultivation in the region is predominantly wheat and corn. There are also some olive and citrus orchards. Elevations around Velestino 4 - Visviki range from 60 to 70 masl.

The local environment and land use around Velestino 4 - Visviki have changed 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 Velestino 4 - Visviki. Moreover, the 23 August 1960 aerial photograph documents streams and river beds that are no longer a part of the landscape (Figure 3). In 1960, two rivers passed 200-300 m from the prehistoric tell at the north and south. Now these rivers are covered over and the land has been converted for agricultural purposes. A smaller branch of the northern river appears to pass by the prehistoric tell at a distance of only 50 m.

Satellite remote sensing within a 1 km radius around Velestino 4 - Visviki produced some interesting results (Figures 4-5). The majority of features correspond to palaeochannels (blue) associated with the rivers and streams that once pocketed the terrain. Palaeochannels that appear as soil and crop marks to the immediate north and south of the site were still streams in the 23 August 1960 aerial photograph. Most of these are now agricultural fields with little evidence of past hydrological activity. Other anomalies relate to agricultural activity (brown), such as former field divisions and plow lines. A third category of anomalies is unclassified (yellow). The double line of linear anomalies that run in an east-west direction south of Velestino 4 - Visviki are from underground pipes. Their presence was confirmed with geophysical prospection (see below) and local correspondence. Surface anomalies in the satellite imagery and in various combinations of spectral filters indicate the outlines of the circular shape of the prehistoric tell (Figure 6). The evidence suggests that the mound is nearly 200 m in diameter. Vegetation stress and soil marks appear in true color (RGB) images, and define, in particular, what would appear to be a smaller circular feature around 60 m in diameter at the top part of the settlement.

Figure 1. Velestino 4 - Visviki from a 4 May 2010 GeoEye-1 image

Figure 2. Velestino 4 - Visviki from an aerial photograph taken 26 August 1960

Figure 3. Comparison of the 26 August 1960 aerial photograph (top), and 4 May 2010 GeoEye-1 (bottom) around Velestino 4 - Visviki . The aerial photograph identifies several rivers and streams (red arrows) that are no longer a part of the local topography by 2010

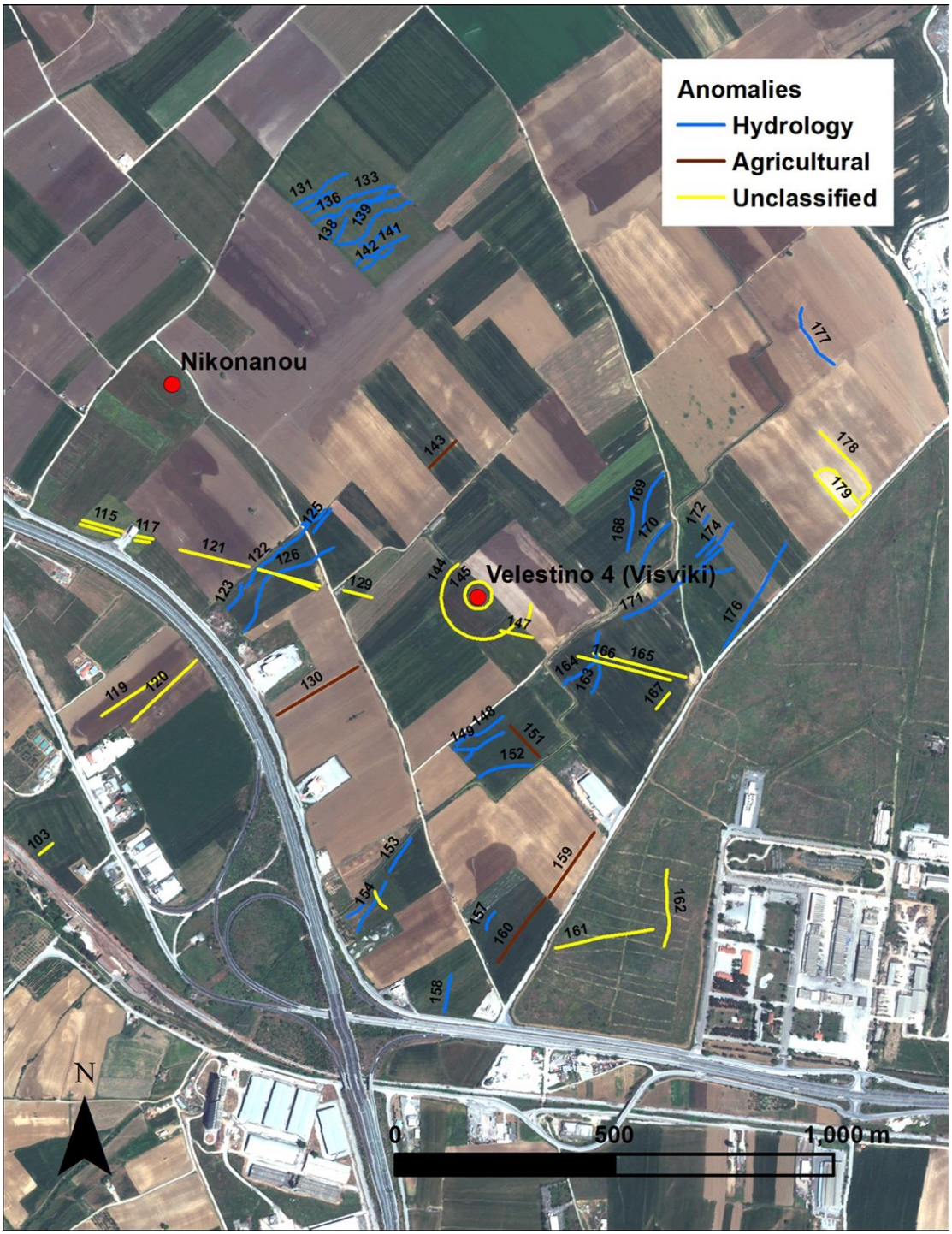


Figure 4. Surface anomalies from the 4 May 2010 GeoEye-1 image within a 1 km radius around Velestino 4 - Visviki

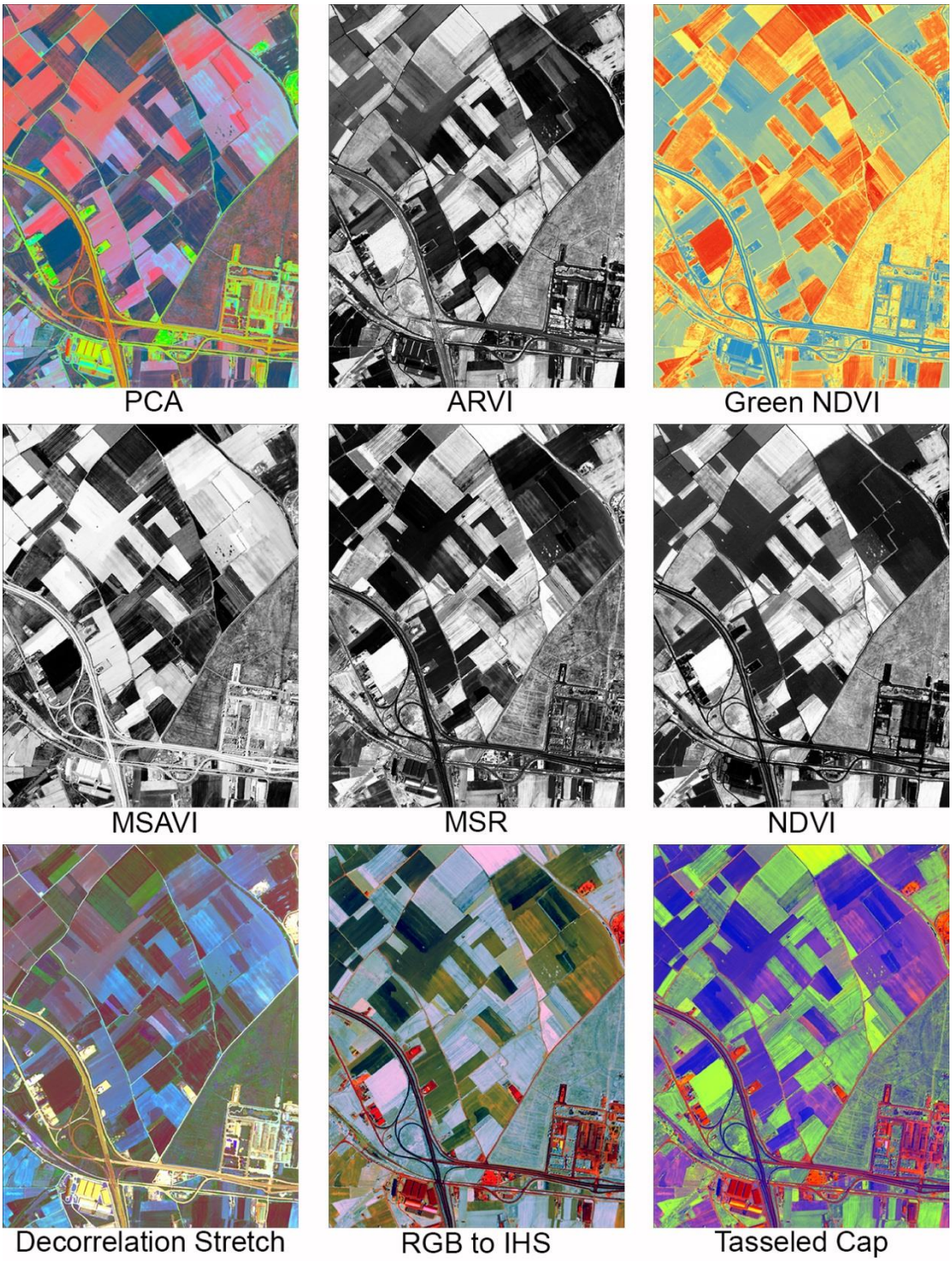


Figure 5. Spectral filters and vegetation indices applied to the 4 May 2010 GeoEye-1 image around Velestino 4 - Visviki

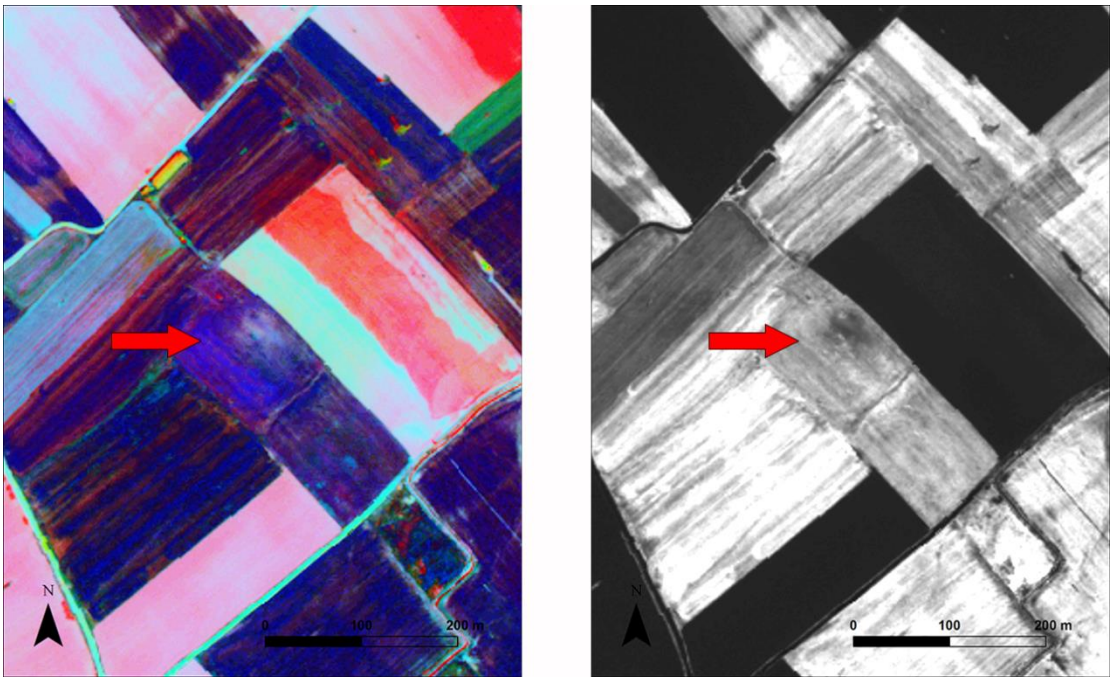


Figure 6. PCA (left) and IR/R (right) of the 4 May 2010 GeoEye-1 image around Velestino 4 - Visviki showing circular anomalies that mark the location of the prehistoric tell

The overall quality of orthophotos produced with photogrammetry does not seem to be particularly good, mainly because of some spots of blurriness due to wind gusts during fieldwork. No significant traces could be identified, not even the modern underground pipeline detected with satellite remote sensing and geophysics. Nevertheless, it is quite interesting the perfect matching (especially in the northern part) between the presumed structures from geophysics and the isolines extrapolated from the DTM (Figure 7). Interesting results have been identified on the national orthophoto (ktimatologio) (Figure 8). Here some circular linear features, shown as vegetation stress in germinating crops, perfectly match, and in some places complete, the structures spotted with geophysics (Figure 9).

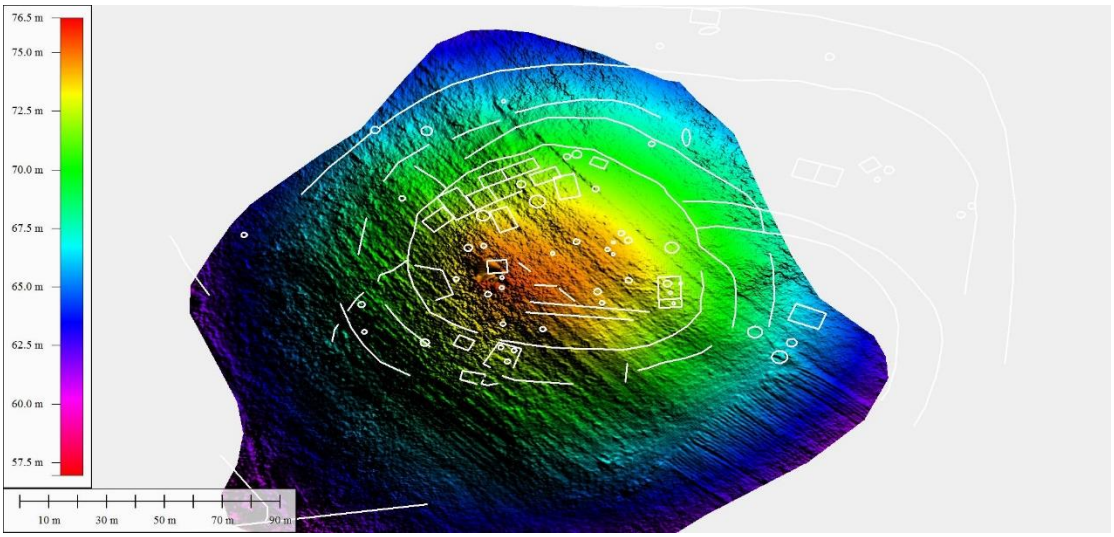


Figure 7: Photogrammetric DTM overlaid with geophysics (white lines).

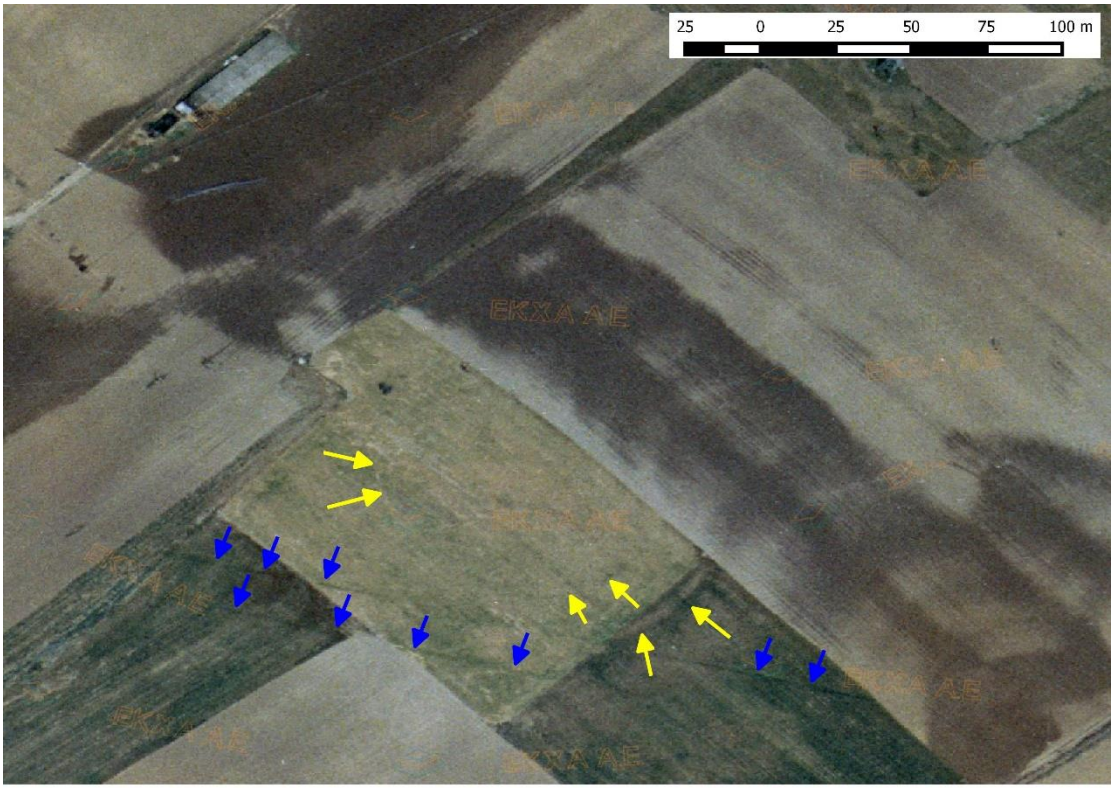


Figure 8: Anomalies located on the Ktimatologio orthophoto. Blue arrows locate the modern pipes and yellow arrows possibly indicate the position of buried archaeological features.

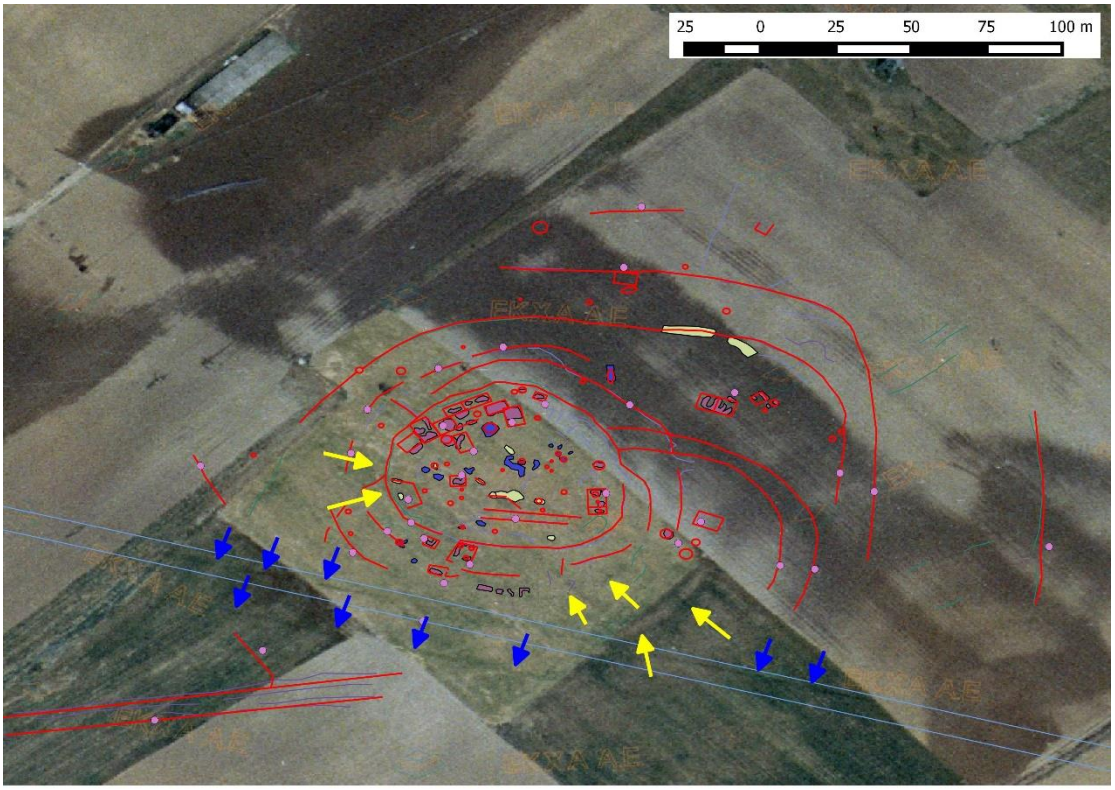


Figure 9: Comparison of the Ktimatologio orthophoto and geophysical anomalies

Geophysical Prospection

Geomagnetic Survey

Geomagnetic data clearly indicates that the prehistoric site was surrounded by enclosures (Figures 10-11). The core of the habitation is encircled by A5. Following the same spatial pattern of A5, a series of anomalies (e.g. A32, A20-23, and A3) circumscribe the settlement at various concentric intervals. A14 and A15 are additional circular extensions, bounding the settlement to the east. It is possible that A6 is connected to A15. However, considering the angle of A6 with respect to the core of the settlement, such association would drastically increase the size of the habitation zone. Another set of circular enclosures are east of the settlement (A12 and A13). Considering the spatial configuration of these anomalies - cutting other enclosures (A31 and A32) and sharply diving into the core of the settlement - A12 or A13 likely represent an earlier architectural phase of the settlement or alternatively the inhabitants intentionally created a more complex layout of enclosures of which similar examples have been attested elsewhere.

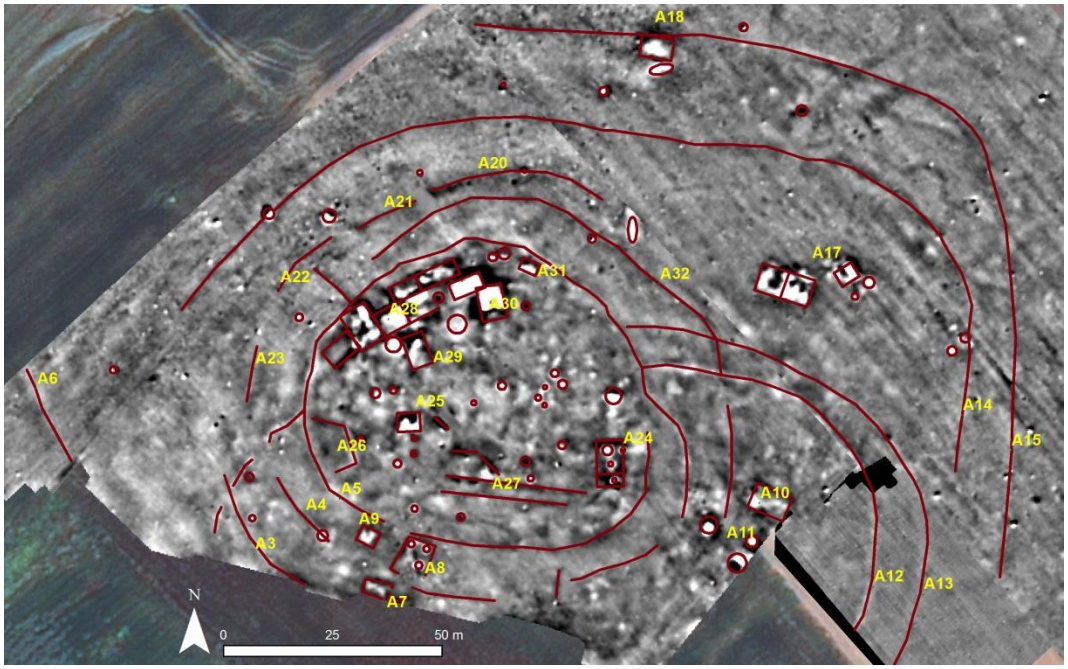
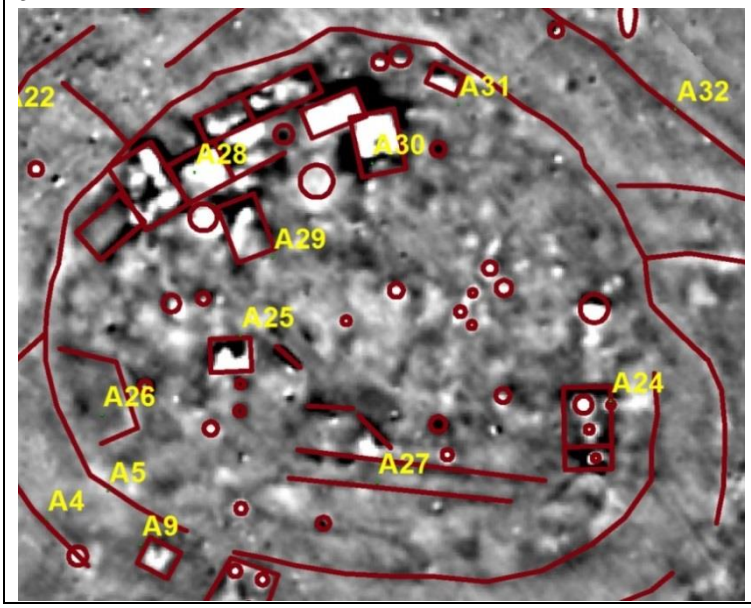


Figure 10: Anomalies detected on geomagnetic results

a



b

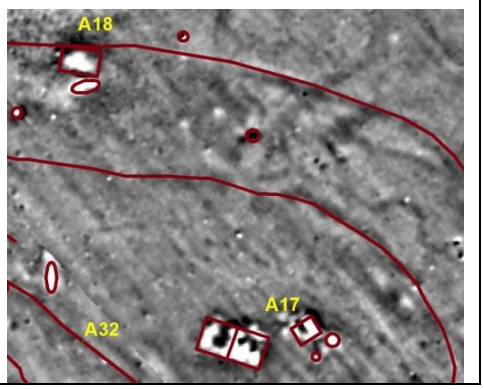


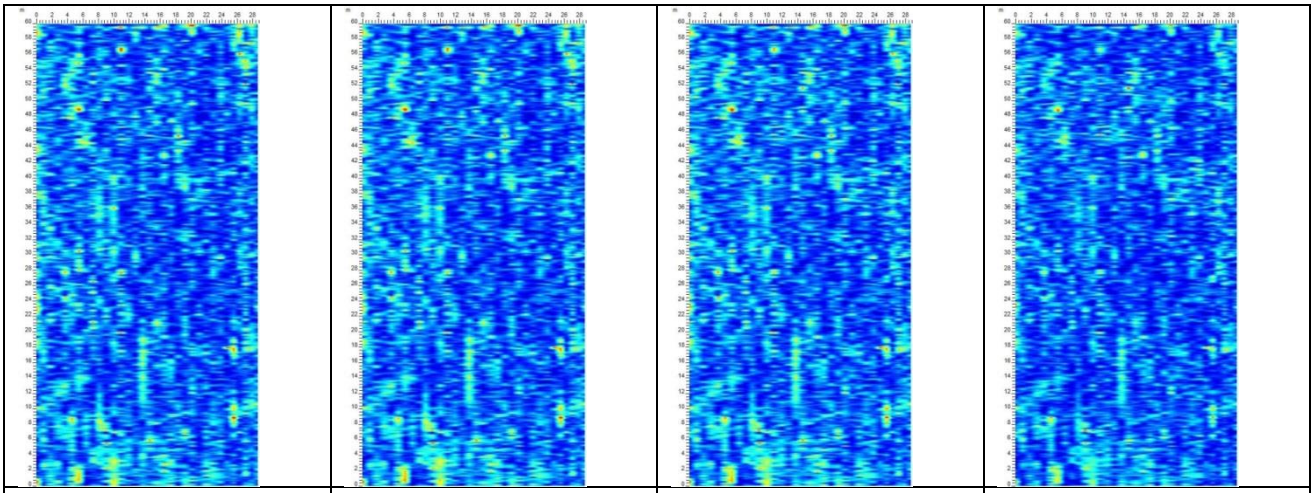
Figure 11: The core of the settlement (a) with the details of a secondary settlement (b)

The core of the settlement also exhibits interesting features. The main interest lies in the series of rectangular anomalies (A28) located to the north of the core. It is possible that this anomaly represents the large structure reported in the 1941 German excavations (see discussion below). There is also evidence for localized burning, an indication of anthropogenic activities. This localized evidence along with the high magnetic readings is scarce inside the enclosures, suggesting differential use of space in the settlement. Another anomaly of interest is A27; two parallel lines running in an east-west direction. The size and shape of these features suggest that they were a retaining structure rather than an architectural feature.

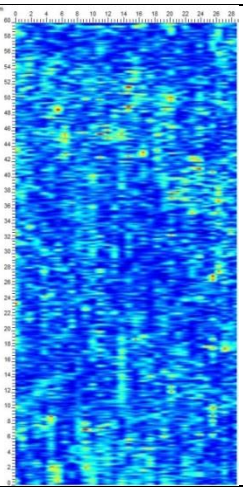
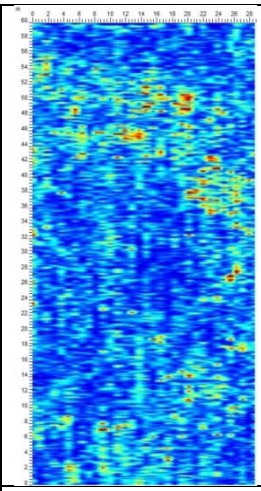
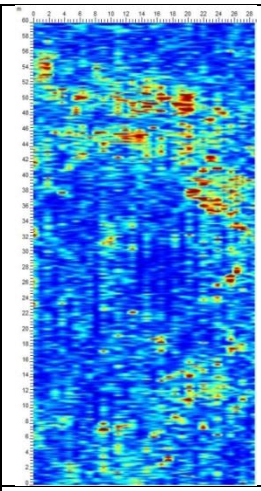
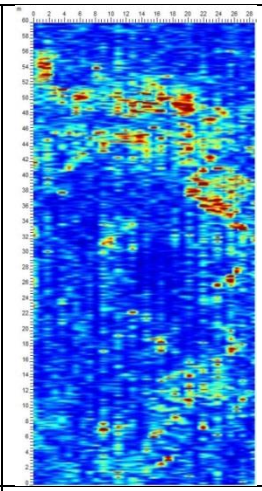
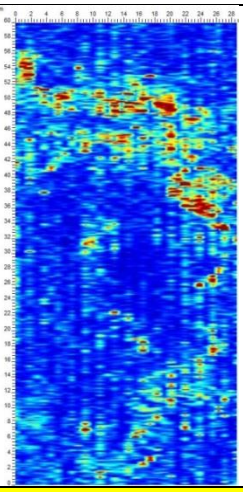
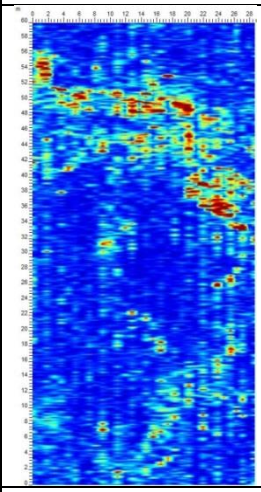
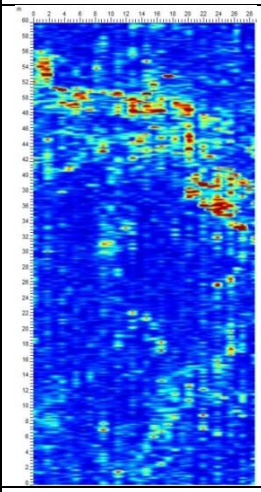
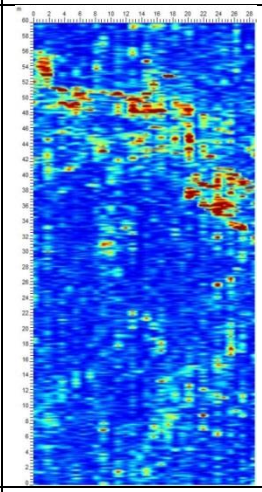
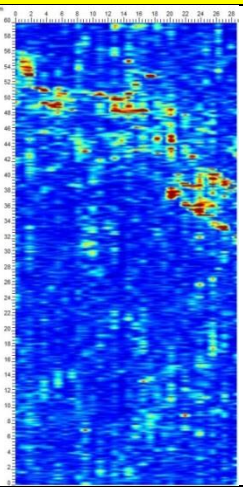
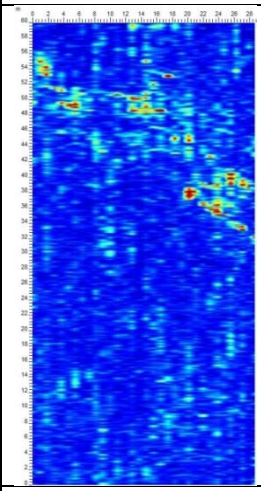
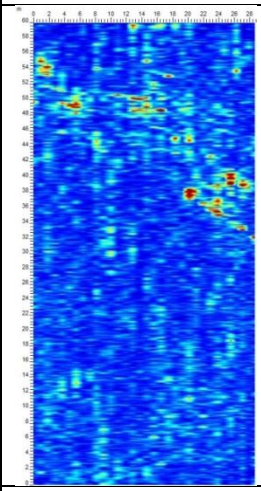
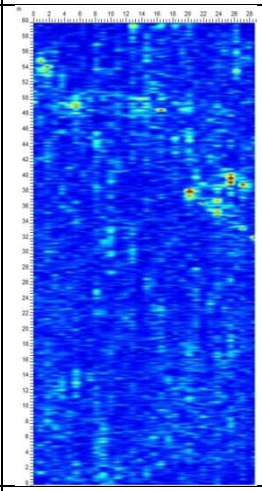
Two distinct anomalies (A17 and A18) are located to the northeast of the settlement. Despite the fact that they are bounded by the enclosure A15 there are no other visible anomaly around them, suggesting a later phase of occupation or specialized use of space within the series of enclosures.

Ground Penetrating Radar Survey

The total area covered with Noggin GPR Smart Cart Plus at Velestino Visviki is 960 m^2. The survey grid was set on the top of the magoula according to pottery distribution. The scans collected were processed as: Trace reposition, Repick first break (15%), Dewow, SEC2(Atn=22.14 dB_m,StrtG=4.42,MaxG=423), Background average subtraction, Bandpass filter (Fc1=160 % Freq,Fp1=180 % Freq,Fp2=200 % Freq,Fc2=220 % Freq). The resulting slices are summarized in Table 1. The depth of interest in this case is from 50 cm and up to 150 cm where an area of very strong anomalies appears. Those anomalies are also presented in the 3D GPR cube of Figure 12.



0-10cm	10-20cm	20-30cm	30-40cm

			
40cm-50cm	50cm-60cm	60cm-70cm	70cm-80cm
			
80cm-90cm	90cm-100cm	100cm-110cm	110cm-120cm
			
120cm-130cm	130cm-140cm	140cm-150cm	150cm-160cm

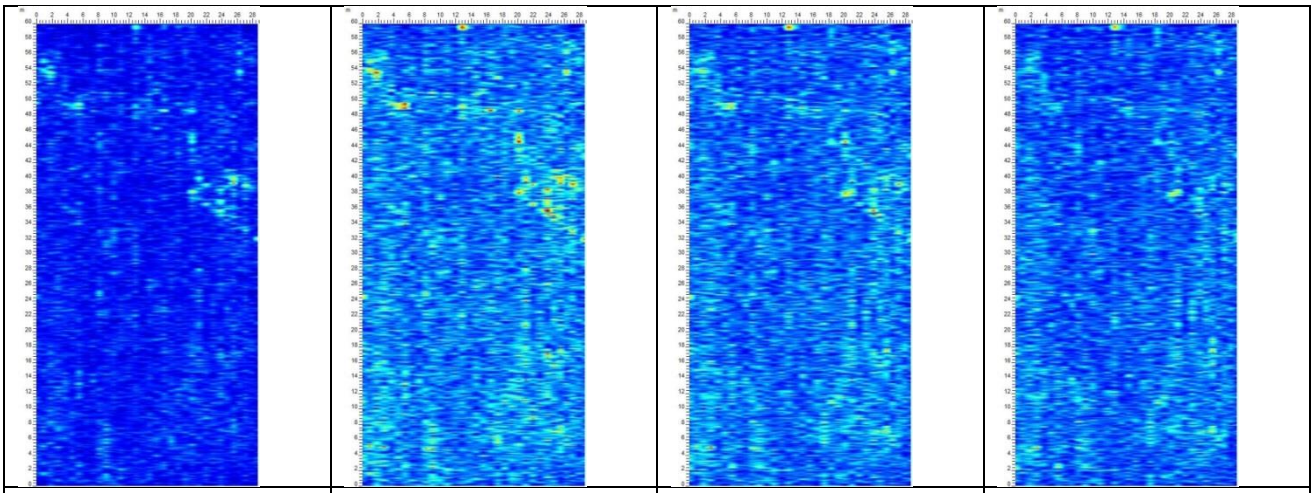


Table 1: GPR depth slices for the grid with code name VISVIKI_1, at Magoula Visviki with 10 cm thickness

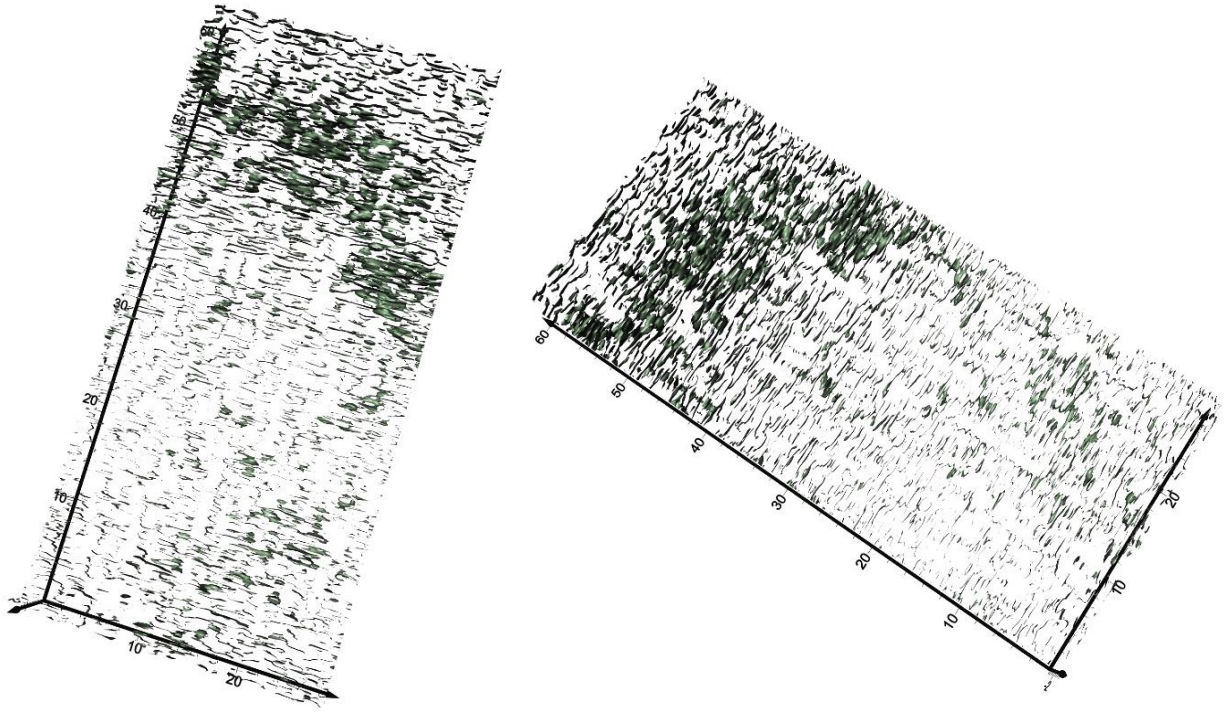


Figure 12: Different perspectives of the GPR 3D model at the area of Magoula Visviki

Figure 13 combines the GPR and magnetic results for better comparison. The large reflector A28 also visible in the magnetic results indicates an area of demolished structures which created strong anomalies of irregular shape that follow a linear trend. The anomaly A34 does not appear as clear in the magnetic results and it is oriented the same as A28. Therefore, it could be related with structural remains that are not well-preserved. The reflection A20 has a different orientation

than A28 and A34, and from the magnetic results it is identified as a house. In the GPR data it appears more scattered, an indication that the interior walls of the structure have collapsed. Finally, a cluster of anomalies is also identified (A35). They exhibit medium intensity amplitudes and seem to presents linearity along a north-south orientation. These reflections were not detected with the magnetic method and could be related with structural remains as well.

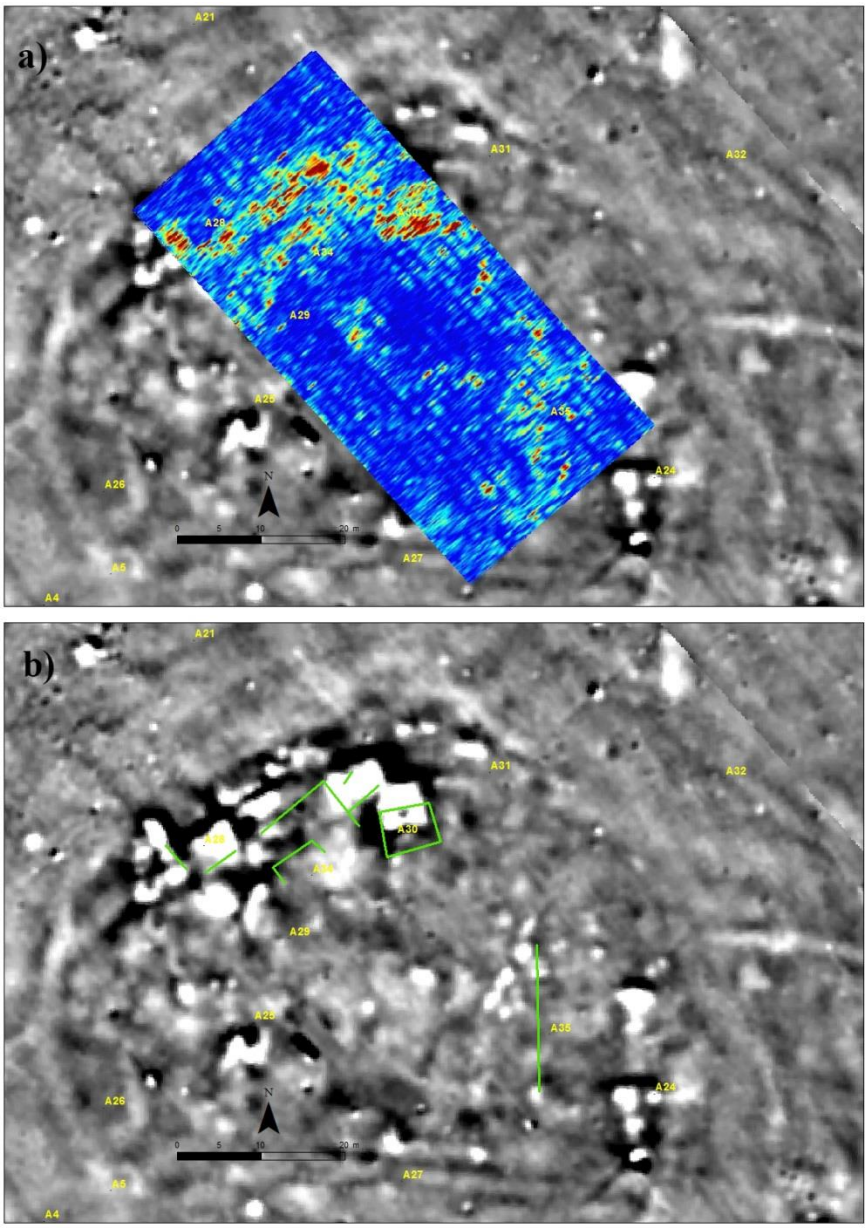


Figure 13: GPR results at Magoula Visviki superimposed on the magnetic results where a) is the georeferenced slice at 80-90 cm depth while b) is the outlines of the identified anomalies regarding the magnetic results

Integration of Results

Despite the lack of detailed information and ground control points, the simplified plan of the long house, which was the only one depicted in the excavations together with the iso-elevation lines, was rectified based on the interpretation of the results of the magnetic (SENSYS multisensor configuration) and GPR surveys, though the matching of the orientation of the complex and taking into account its dimensions. The RMS error of the rectification was kept lower than 4 m. It has to be mentioned that extended magnetic anomalies do not exist at the highest elevation point, and that if the results of the geophysical survey are compatible with the plan of the excavated long building, the trenches should not exist at the pre-mentioned distance from the highest elevation of the mount. Instead they should be located at a distance of about 20 m and 46 m correspondingly for trenches A and B from the longhouse (or 57m and 82m correspondingly from the highest elevation of the magoula).

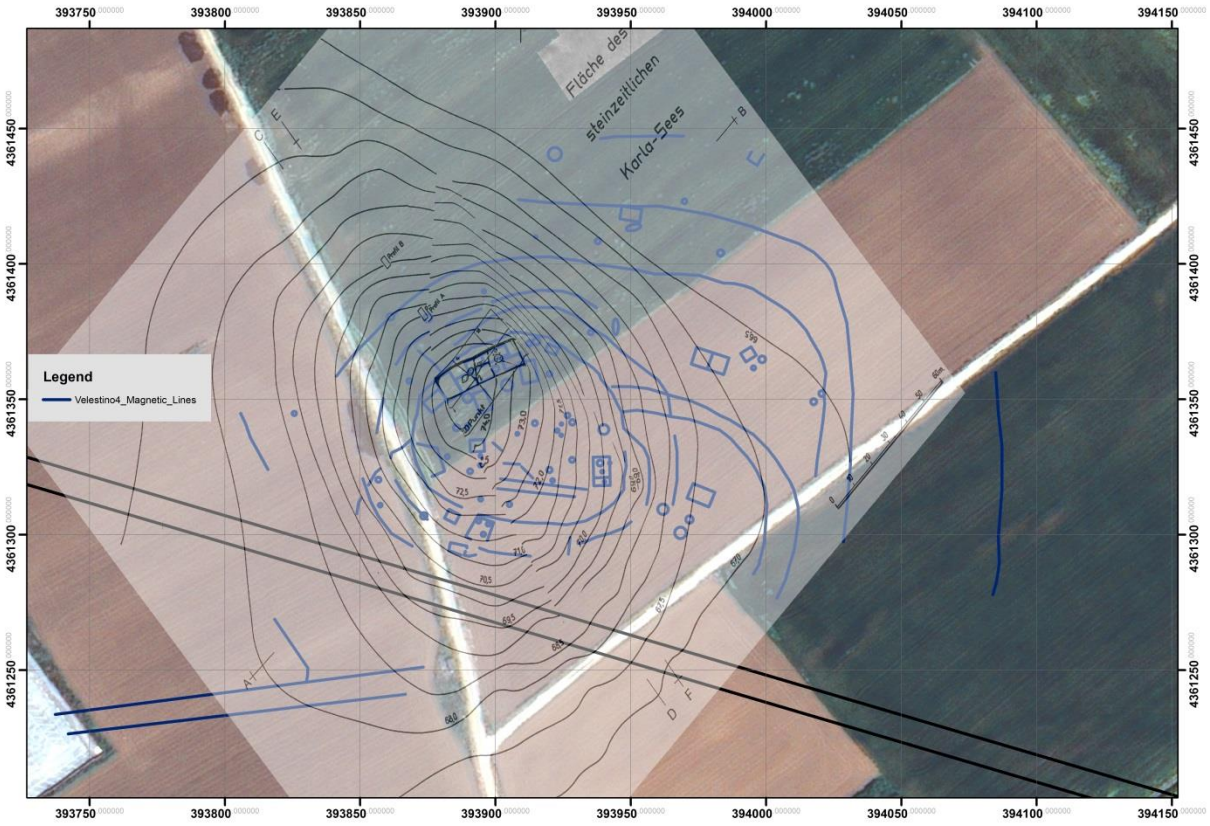


Figure 14: Magnetic anomalies with respect to the topography of the settlement

The geophysical survey at magoula Velestino 4 - Visviki was carried out using the SENSYS configuration for the measurement of the vertical magnetic gradient and two GPR systems, the Noggin Plus with a 250MHZ antenna and the MALA with a 400MHz antenna. The later one produced very noisy signals and it did not offer any useful information. In contrast, the Noggin Plus GPR verified the results of the magnetic survey that produced a detailed image of the plan of the magoula. More specifically, the core habitation zone seems to be confined by an enclosure (A5) of oval shape having a diameter ranging from 70-80m. Within this area of about 4,500

square meters a few architectural remains are shown. The most extended one is a long compound (A28) consisting of various compartments at the NW side of the core habitation zone and very close to the inner enclosure. The dimensions of the compound are about 38 m x 9 m and it is the particular feature that has been identified with the megaron type building resulting from the German excavations of 1942. The intense magnetic signature of the outline of the compound suggests residues of burn mud brick and also hot targets within the rooms. In a close distance from the long house, two more architectural features (A29 and A30) are indicated, having a similar magnetic signature with the longhouse. With the exception of a small feature (A25), the center of the core habitation zone has been left empty reminding the central country yard in Dimini. This was also confirmed by the signals of the GPR survey which registered intense reflections from the area of the large compound at A28 mainly from a depth of about 90-100cm below the surface and no reflections at all from the central area of the magoula. A strong magnetic feature (A24) representing a smaller longhouse of dimensions 10.6mx6m is also evident to the opposite side within the enclosure. Two more vague anomalies are included within the inner enclosure: A26 and A27, the first being most probably associated to a structure and the second possibly representing residues of modern activities.

More enclosures are also noticed as we move outwards from the inner core of the magoula. There are at least two enclosures around the magoula and sections of them can be seen clearly at the magnetic traces A3, A4, A20, A21, A22, A23 and A32. A few more extended enclosures (A14 and A15) expand further to the north and NE, where the terrain is flatter with respect to the south. A two room (12.5mx6.5m) and a single room (3.5mx4.5m) structures (A17) are located between the probable ditches A14 and A32 towards the NE, and another candidate structure (A18) can be found inside ditch A15. At least three more structures (A7, A8 and A9) are located towards the SW, between the inner enclosure and the second enclosure in an area that may constitutes one of the gates of the settlement. To the east, a rectangular structure (A10) of dimensions 9mx6m, together with some large dipole anomalies (probable pits, A11), seems to constitute another smaller habitation core, as there are signs of two almost concentric enclosures (5-12m apart) that run around the particular features to the north and east directions. The traces of these enclosures are lost as they project towards the center of the magoula, suggesting they probably belong to an earlier habitation phase than the one of the magoula itself.

Both clusters at A17 and at A10/A11 are located at the lower elevations of the terrain and it is possible that the accompanied enclosures of them (A14/A15 and A12/A13 respectively) acted as defensive constructions against flooding, as the simulation models have proven that the northern and western sides of the magoula are more susceptible to flooding. If we take into account that the habitation at these lower elevations at A10/A11 and A17, and even at A18, predates the occupation phase of the magoula, as it is suggested from the magnetic survey, it is logical to suggest that we notice a dispersed settlement in the earlier phase of occupation and a tendency of aggregation within the magoula in the later phases.

Finally, the large linear anomalies (A1, A2 and A33) which are located to the southern region of the magoula, are caused by recent human interventions. A33 is the most recent one and it is caused by the ditch that has been constructed for the water pipe network that leads towards the city of Volos.

In general, it is most probable that we are dealing with two phases of habitation, namely an original dispersed settlement that was followed by a more dense occupation shifted to the west.

This observation is supported by both the geophysical results (indicating enclosures east of the later enclosures which are overlaid by later settlement layers) and from past excavation trenches (trench A) that shows a 2.8m thickness of habitation from the EN to MN period.

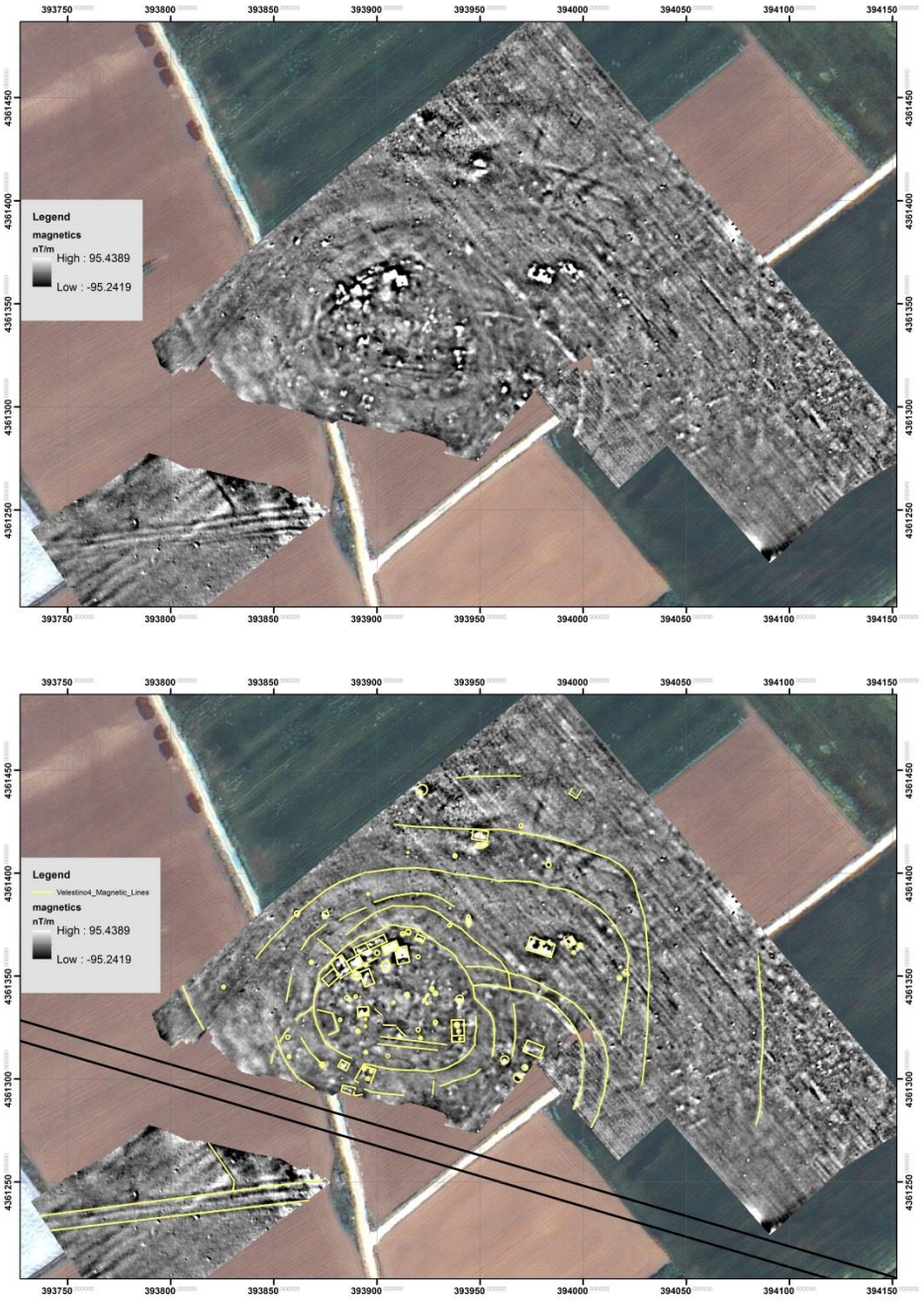


Figure 15: Distribution of magnetic anomalies

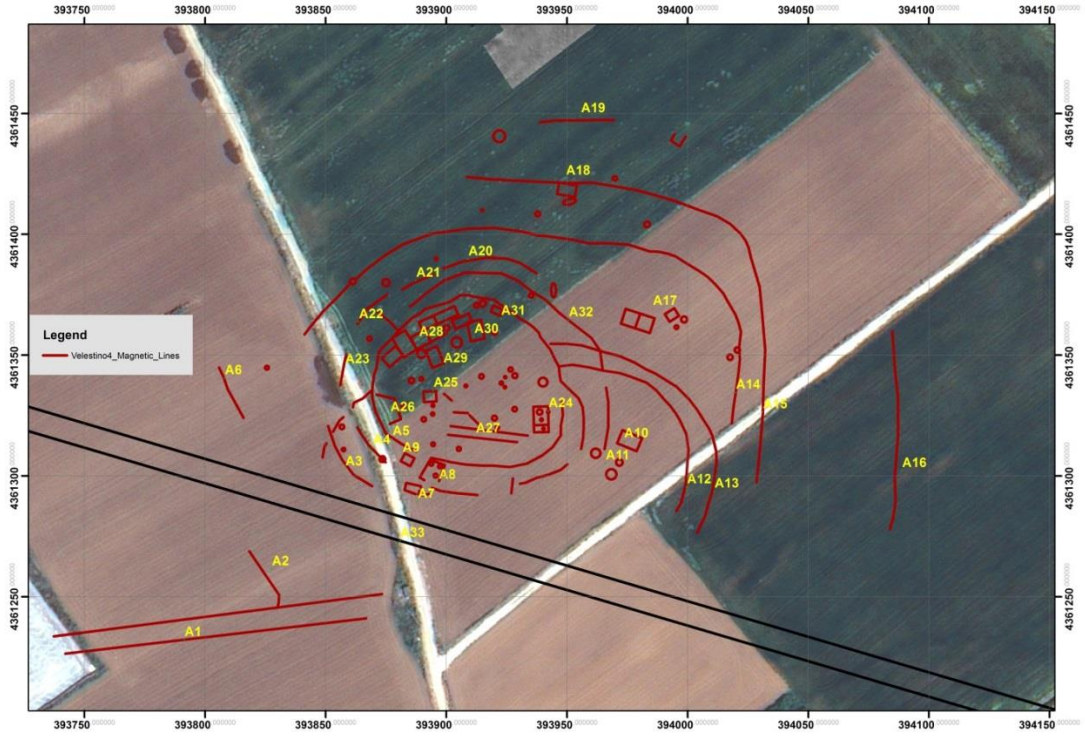


Figure 16: Annotations for anomalies

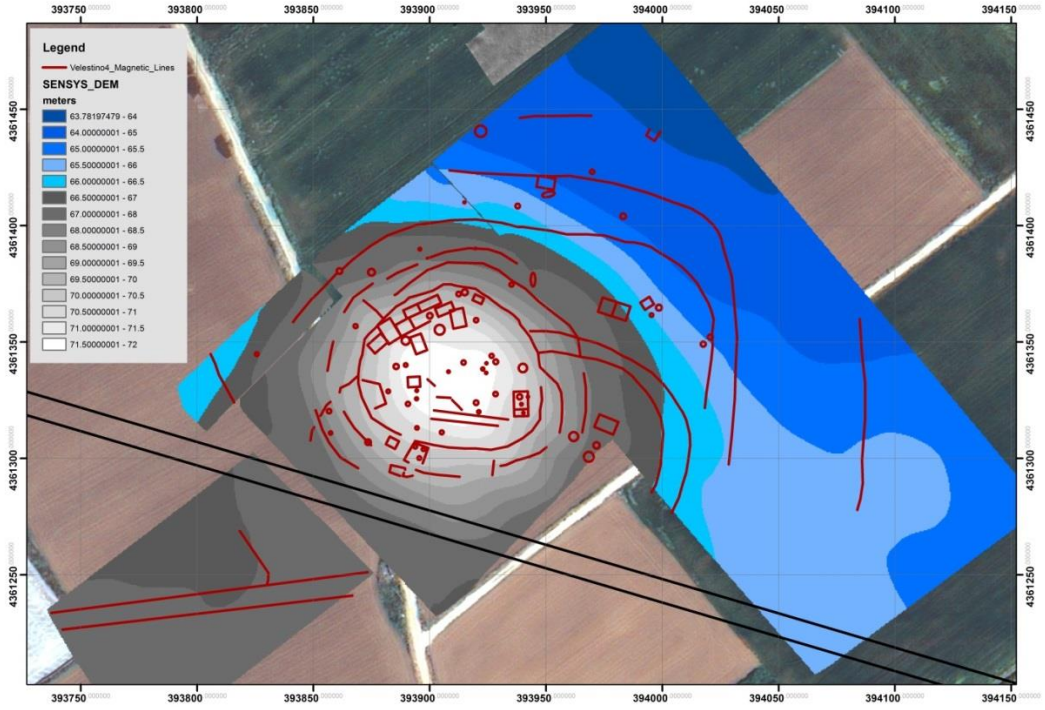


Figure 17: Flooding simulation based on the DEM

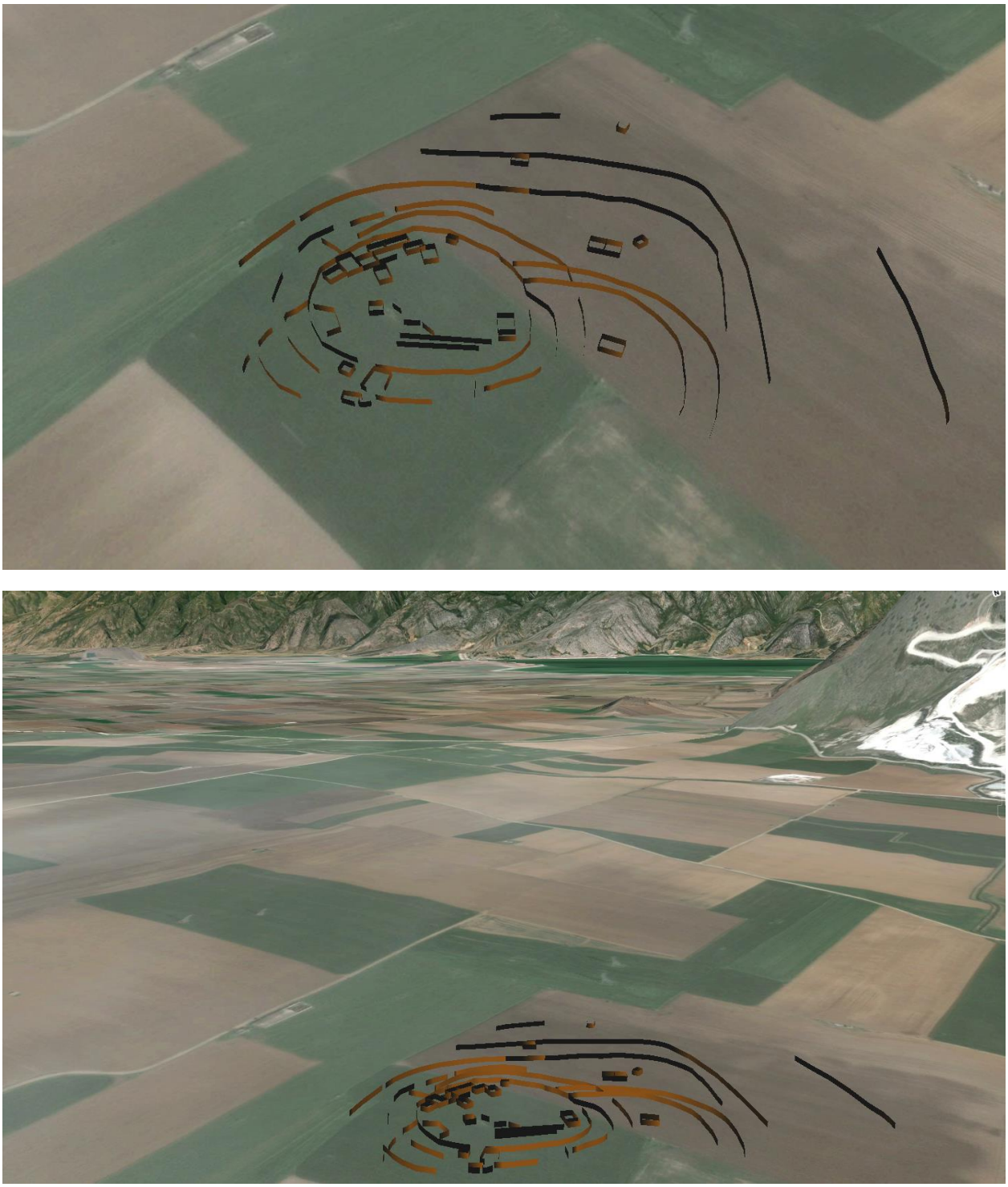


Figure 18: A tentative reconstruction of anomalies from the site

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