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Geophysical investigation on the presumed Appian way

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***Abstract* – The Appian Way - Rome's gateway to the East - was Europe's first highway and the wonder of its day. Built in 312 BC, it connected Rome with Capua (near Naples), running in a straight line for much of the way. Eventually, it stretched 644 km to Brindisi, from where Roman ships sailed to Greece and Egypt. With the aim of highlighting its route, geophysical surveys were carried out in some areas of southern Puglia. This paper deals with the results of an archaeogeophysical approach based on the comparative use of gradiometric and Ground Penetrating Radar (GPR) measurements. The results of one investigated area are presented.**

I. INTRODUCTION

The Appian Way (Latin and Italian: Via Appia) is one of the earliest and strategically most important Roman roads of the of the Republic age. It connected Rome to Brindisi, in southeast Italy. Its importance is indicated by its common name, recorded by Statius, of *Appia longarum regina viarum* (“the Appian Way, the queen of the long roads”).

Research was undertaken to study the path of the Appian way that crosses some areas of southern Puglia. For this purpose, a geophysical measurements campaign was performed.

The aim of geophysical prospections is based on the use of different geophysical techniques able to detect contrasts of physical properties of the subsoil associated with archaeological buried structures.

This paper deals with the results of a geophysical approach based on the comparative use of magnetometric in gradiometric configuration and Ground Penetrating Radar (GPR) measurements. Among the various geophysical techniques, the most interesting and effective are the magnetic and electromagnetic techniques which are able to locate and identify archaeological structures at different scales and depths with good resolution in different scenarios [1, 2, 3].

These methods were used in a suburban area situated in Grottaglie a city near Taranto (Fig. 1).

II. GEOPHYSICAL DATA ACQUISITION AND PROCESSING

The magnetic measurements were taken using the bartington grad 601 magnetometer in gradiometric configuration, with four magnetic probes set in a vertical direction at a mutual distance of about 1 m (Fig. 2).

Such a configuration allowed the automatic removal of the diurnal variations of the natural magnetic field. Before defining the acquisition modalities, it was necessary to set up the proper orientation of the two magnetic sensors. Such an orientation depends on the survey direction and site location in the world.

All the magnetic acquired data were processed using the TerraSurveyor 64 software (DW Consulting) that provides a wide range of processes, allowing the data to be manipulated to produce the best magnetic anomalies distribution.

The GPR surveys were performed with a RIS MF Hi-Mod GPR System of IDS equipped with an array of two multi-frequency antennas using simultaneously 200 and 600 MHz antennas mounted on a survey cart equipped with an incremental encoder. The 200 MHz and 600 MHz data were acquired in continuous and reflection mode with a time window of 160 ns and 80 ns, respectively, samples per scan set at 512 with a resolution of 16 bits and a transmit rate of 100 kHz (Fig. 3).

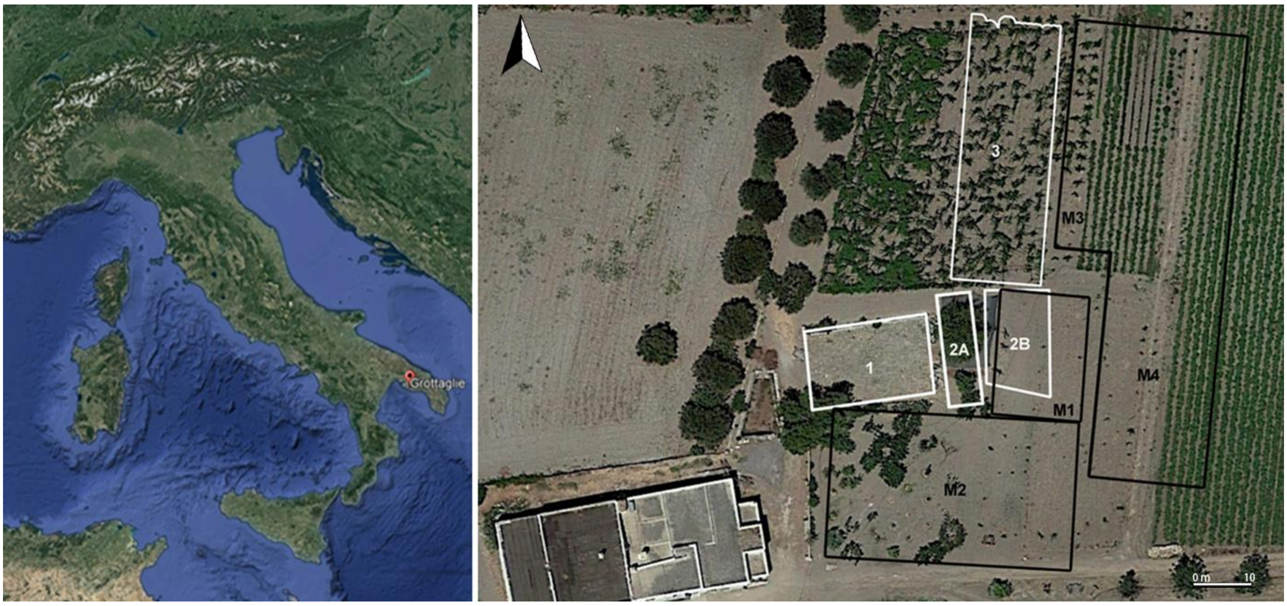

Fig. 1. Grottaglie (TA). localization of the areas investigated using GPR instrumentation (Areas 1, 2A, 2B, 3) and using magnetometric instrumentation (M1, M2, M3 and M4).

Fig. 2. Photo relating to the measurement phases with a magnetometer.

Fig. 3. Photo relating to the measurement phases with a GPR.

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The GPR acquisition was supported by a topographic survey that gave the possibility to georeference the obtained data that were managed with a QGis software.

GPR raw data have required some processing operations addressed to reduce the noise of the measurements and attenuation phenomena. A Gpr-slices software was used (GPR-SLICE Software; gpr-survey.com). The results of magnetic processed data are show in Fig. 4.

Magnetic results provided an identification of several magnetic anomalies related to the presence of a significant buried archaeological structures (Fig. 4). In detail, the geomagnetic map shows several iso-oriented anomalies potentially related to the presence of buried structures: they probably prove the presence of relevant buildings (M) and roads (A). In the same area investigated with GPR the acquired data identified very interesting reflections within the depth ranging between 0.50 and 1.20 m as the radargram of figure 5 shows. Since the buried archaeological structures appeared so shallow, in accordance with the information of archaeologists, only the data obtained at the greater frequency characterized by a better resolution are considered.

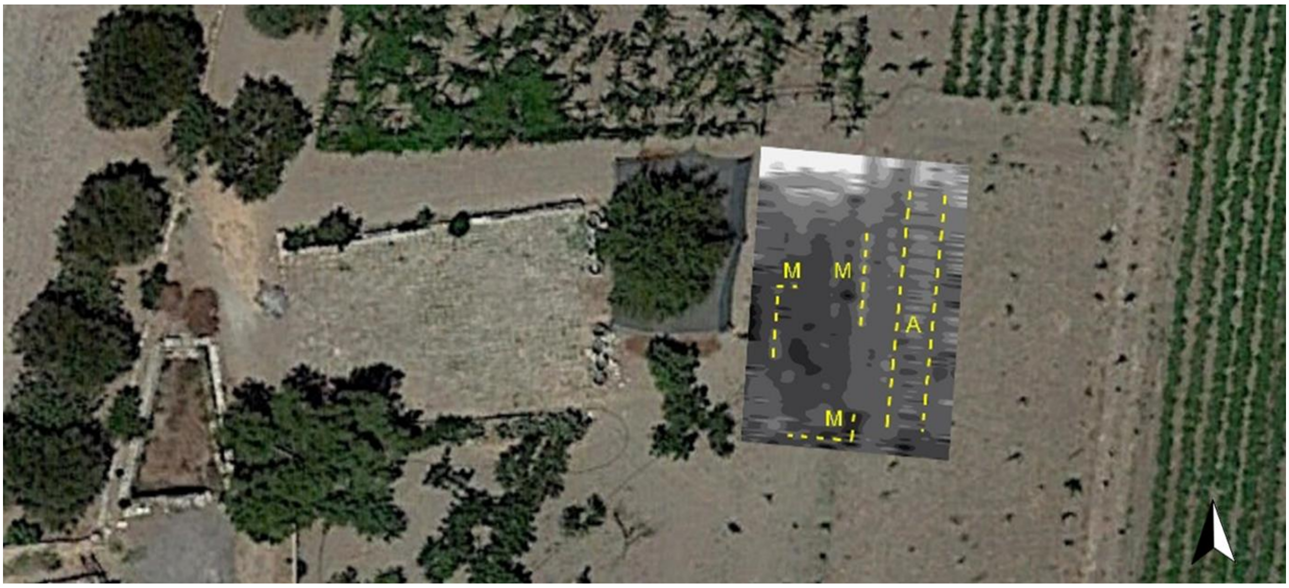

Fig. 4. Area M1: georeferenced gradiometric data.

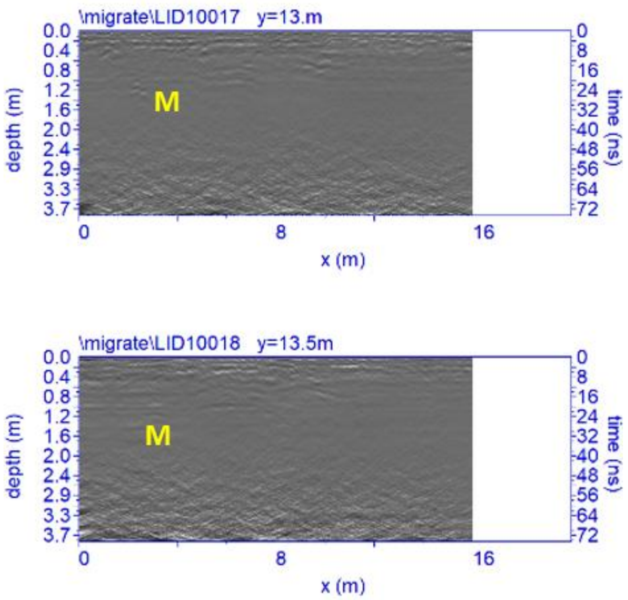

Fig. 5. Area 2B. Radar sections processed relating to profiles 17 and 18.

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As plotted the time slices GPR images in figure 6, despite a inhomogeneous distribution of reflections, it was possible to define some area more reflective associable to the presence of walls and structures with orientation in good agreement with the magnetic map.

The time slicer GPR image highlights several reflections aligned to some walls yet excavated at the east of the investigated area and the results suggest a prosecution of the main structure characterized by quadrangular rooms of limited size as highlighted (black dashed lines in figure 6).

Figure 7 illustrates another way to visualize the GPR data. It is the isosurface representation [1]. It is possible to see better the anomalies related to walls and road.

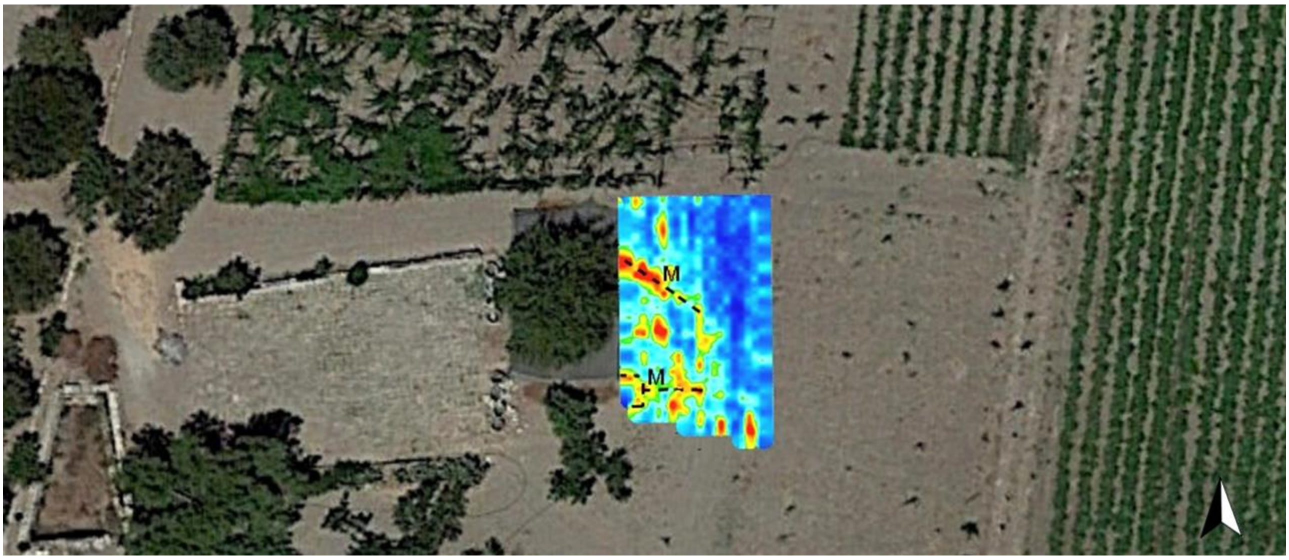

Fig. 6. Area 2B: georeferencing of the depth slice relative to the depth of 0.5-0.7 m (600 MHz antenna) with indication of the probable buried masonry structures (M).

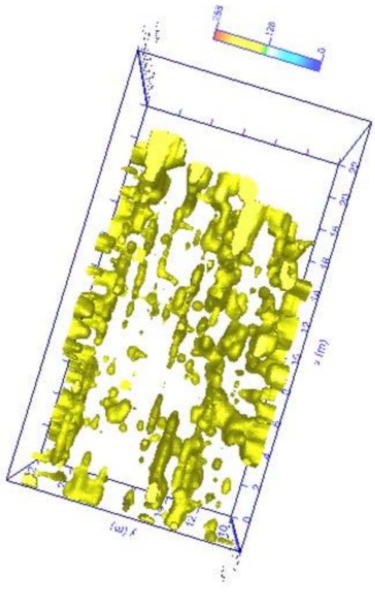

Fig. 7. Area 2B: 3D visualization of amplitude isosurfaces.

III. CONCLUSIONS

The described research has shown an important integration of different approaches relates to geophysical survey. The geophysical information has allowed the archaeologists to individuate the excavation zones. In fact, the excavation (Fig. 8) has confirmed the geophysical results.

The presented approach, based on the use of different geophysical methods of investigation, highlights how it is a good starting point for planning excavation activities saving time and money.

Moreover, the integration of different techniques can effectively support the detection of a potential archaeological site from one side, while from the other one can give the possibility to reconstruct the ancient urban and rural planning without expensive excavations or strongly reducing them.

Fig. 8. The results of the excavation in the investigated area with geophysics.

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