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GEOPHYSICAL SURVEYS TO INVESTIGATE THE SANTA FILITICA ARCHAEOLOGICAL COMPLEX (NORTHERN SARDINIA)

V. Testone [1*], V. Longo [1], P. Mameli [1]

[1] Dipartimento di Scienze della Natura e del Territorio, Università degli Studi di Sassari,
[*]vtestone@uniss.it

Introduction

The archaeological prospection of a site is a slow and costly operation. When the site is located close to coast, the effects of the sea and of the wind, and the submersion and burial of the structures, represent the most serious problems in terms of the site's conservation.
In similar situation, non invasive geophysical methods are widely used to prospect for and characterize the remains of buried archaeological structures [1] [2] [3] [4].
In this work Electrical Resistivity Tomography (ERT) and Ground Penetrating Radar (GPR) surveys were conducted in the monumental complex of Santa Filitica, a coastal archaeological site located in northern Sardinia (Italy) (Figure 1).
The purpose of the investigation was to identify the location, depth, orientation, and thickness of buried walls by integrating information from the GPR and ERT models.

Archaeological features

Santa Filitica is a multilayered archaeological complex, consisting of the remains of an imperial Roman villa, a settlement to V-VI century and a village of Byzantine period, reflecting a long continuity of use of the site since at least III to the IX century [5].

Figure 1: Aerial photo of the Santa Filitica archaeological site.

The archaeological campaigns have identified 14 different rooms of the Roman villa, including a thermal area where block- and mortar-bearing walls and mosaic floors occur.
The latest excavations have ascertained that in the early sixth century, and perhaps already at the end of the fifth century, the building spaces were reoccupied by a new community, the original plan was modified and existing spaces were assigned new functions.

Between the sixth and seventh centuries, the whole complex of the villa was abandoned and almost completely submerged by alluvial deposits. They have raised the ground surface more than one meter and a half in the area close to the sea. On this new surface an inhabited of Byzantine period has been constructed with quadrangular rooms and with reusing blocks of the Roman villa.

Geophysical investigations

The GPR surveys were conducted in reflection mode using a monostatic GPR IDS model "RIS_MF_HiMod Duo", consisting of a control unit (DAD control unit, fast wave) working simultaneously with two transmitters (Tx) operating at frequencies of 200 and 600 MHz, and two receivers (Rx). A hitherto unexplored area of approximately 900 m^2 adjacent to the excavations was investigated by four irregular grids (Figure 2A); data were acquired every 50 cm.

Figure 2 - A) Map of the excavation with GPR surveys location. B) Map of the excavation including electrical resistivity surveys position.

The ERT survey was performed by using an Abem Terrameter SAS 1000 device (ABEM Instruments - Sweden), combined with an ES 10-64 electrode selector [6].

For each 2D electrical line, 64 metal electrodes were deployed in a straight line with a constant spacing of 50 cm and a unit length of 31.5 m (Figure 2B). Resistivity measurements were acquired using the dipole-dipole array, sensitive to horizontal changes in resistivity and thus suitable for detecting vertical structures like walls and cavities.

The 2D cross sections of both methods were interpolated to produce 3D ERT and 3D GPR models.

Results and Conclusions

The geophysical surveys, performed in the Santa Filitica archaeological complex, revealed anomalous patterns related to buried man-made structures throughout investigated area.

The layer containing the archaeological targets has a maximum thickness of 3 meters.

The Roman structures, later reworked in the Byzantine period, resulted in a thickening of buried structures in some areas of the site, causing a low electromagnetic contrast between targets and host alluvial sediments, thus producing a weak and confused signals in the GPR horizontal depth slices.

Moreover, seawater intrusion into the deeper level has given rise to high moisture levels, resulting in strong attenuation of the radar waves.

Even if both methodologies can be considered suitable to detect buried archaeological remains, the electrical resistivity tomographies gives more detail on the size and depth of some targets, such as walls and vertical structures (Figure 3).

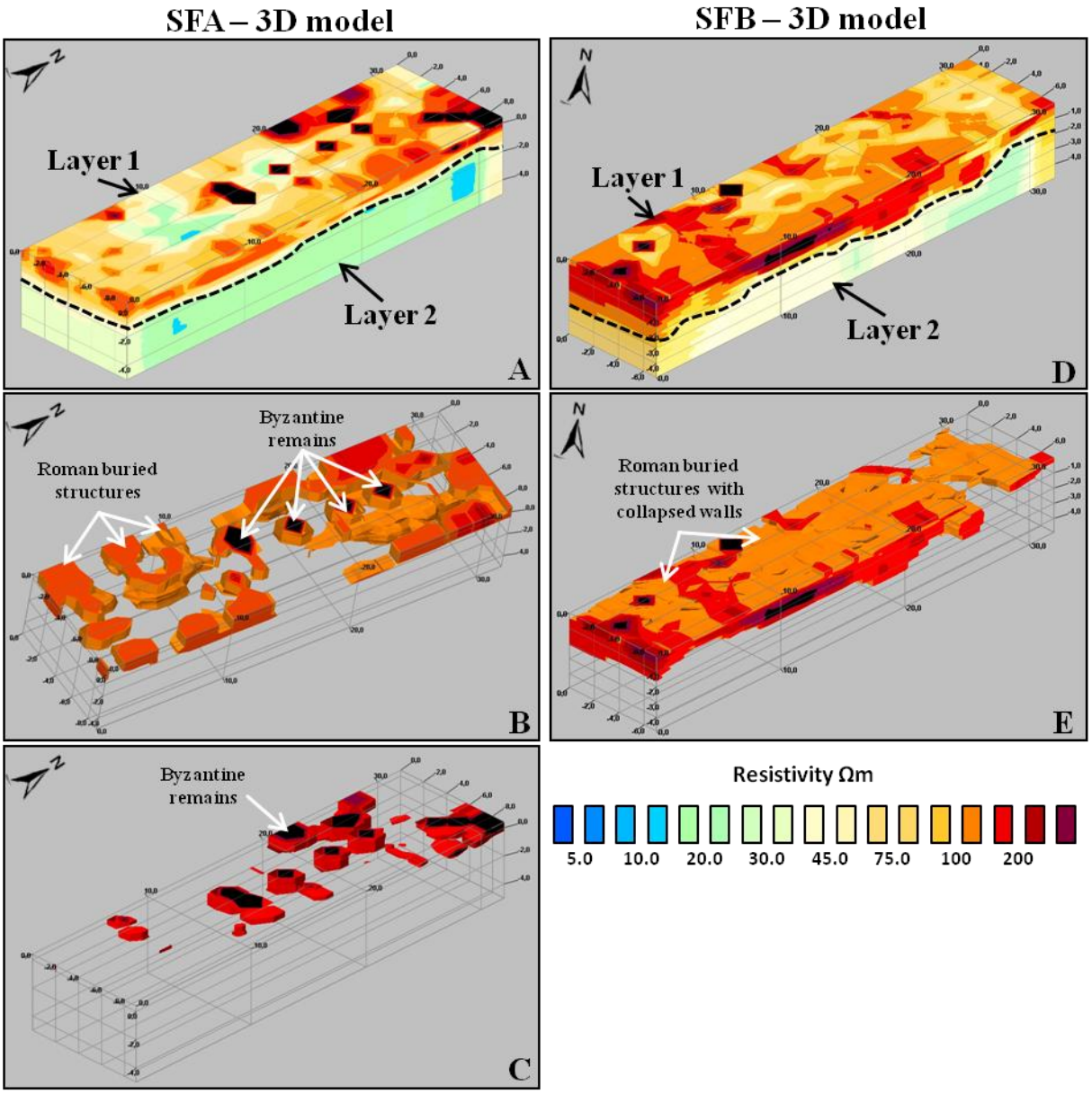

Figure 3 - 3D resistivity models displayed in a 3D virtual space.

In synthesis, the combination of information, obtained from the different methods, has proved an useful tool to design future archaeological excavations, otherwise not achievable with a single methodology.

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