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Integrated archaeological and geophysical surveys for the knowledge of the Medieval cave village of Casalrotto (Mottola, Apulia)

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***Abstract* – This study concerns the main results of the research activity aimed at a new integrated knowledge of Casalrotto, a Medieval cave village (12th-13th century) near Mottola (TA). The research was based on archaeological and geophysical surveys performed in 2015 by researchers of the Laboratory of Geophysics applied to the Archaeological and Monumental Heritage and the Laboratory of Ancient Topography, Archaeology and Remote Sensing of CNR-IBAM in Lecce. In particular, archaeological investigations have allowed the upgrading the existing plan of the village through DGPS topographical surveys, while geophysical measurements, using ground-penetrating radar (GPR) have allowed a better delimitation of the necropolis and the detection of buried structures, both in masonry and carved in the bedrock.**

I. INTRODUCTION

Research activities described in this paper carried out in 2015 within IT@CA project (PON01 00625 "Ricerca e Competitività" 2007-2013), whose main goal was the study and experimentation of innovative technologies and methodologies to apply in the knowledge and management of cultural heritage.

In particular, this study regarded the Medieval site of Casalrotto, within the western territory of Taranto and partially excavated between the late 1970s and early 1980s by the Institute of Medieval and Modern History of the University of Lecce in collaboration with the Superintendence for Archaeological and Monumental Heritage of Apulia Region, under the direction of C.D. Fonseca [1]. The staff of the Laboratory of Ancient Topography, Archaeology and Remote Sensing, and the Laboratory Geophysics applied to the Archaeological and Monumental Heritage of CNR-IBAM in Lecce have carried out archaeological and geophysical surveys aimed at the systematic documentation and study of the Medieval cave village.

New investigations have been carried out in order to clarify some aspects of the ancient topography of Casalrotto: i) the extension of the inhabited area, characterized by caves spaces, many of which overgrown, or in bad state of conservation, or reused; ii) the extension of the necropolis, only partially excavated in 1979-1982, especially along the south and south-west sides; iii) the general organization of the settlement, especially the relationship between inhabited area, necropolis, religious buildings, access roads.

II. STUDY AREA

The studied area is located within the "Parco Naturale Regionale Terra delle Gravine", characterized by wide dry karst valleys (called "*gravine*", or "*lame*" or "*valloni*" in the local language) carving the calcareous terraces of Murge platform.

The site of Casalrotto («*Casal Ruptum*» in the Medieval sources) is just nestled in one of this valleys (Fig. 1), exactly close to the homonymous eighteenth-century farmhouse, about 2 km south-west of the modern town of Mottola (Taranto). On the base of archaeological excavations and documentary sources, the lifetime of the village is dated to the period between the 11th and the 14th century, although a gradual decay is already attested since the 13th century.

The settlement is characterized by about hundred "terraces" cave houses and spaces with other uses, carved along both the rocky slopes of the NE-SW karst valley (Fig. 1, A). These caves are the result of the enlargement and adaptation of natural cavities dug out by water. Moreover, many of these caves overlook small vegetable gardens bordered by stone drywall. A sector of this settlement was excavated (Fig. 1, D). The investigations highlighted the entrances of two semi-underground spaces, the widest of which has an original residential use because of the presence of holes for wooden partitions and niches carved in the interior; subsequently this space is partially collapsed and was re-used as reservoir between the sixteenth and seventeenth centuries.

To the north-west of this complex there is the necropolis of the village (Fig. 1, C), partially brought to light in 1979 and 1982. It is north-east of the modern farmhouse, on the plateau between the southern edge of the karst valley and the old road connecting Mottola and

Palagiano, whose carriages grooves are still visible on the limestone bedrock.

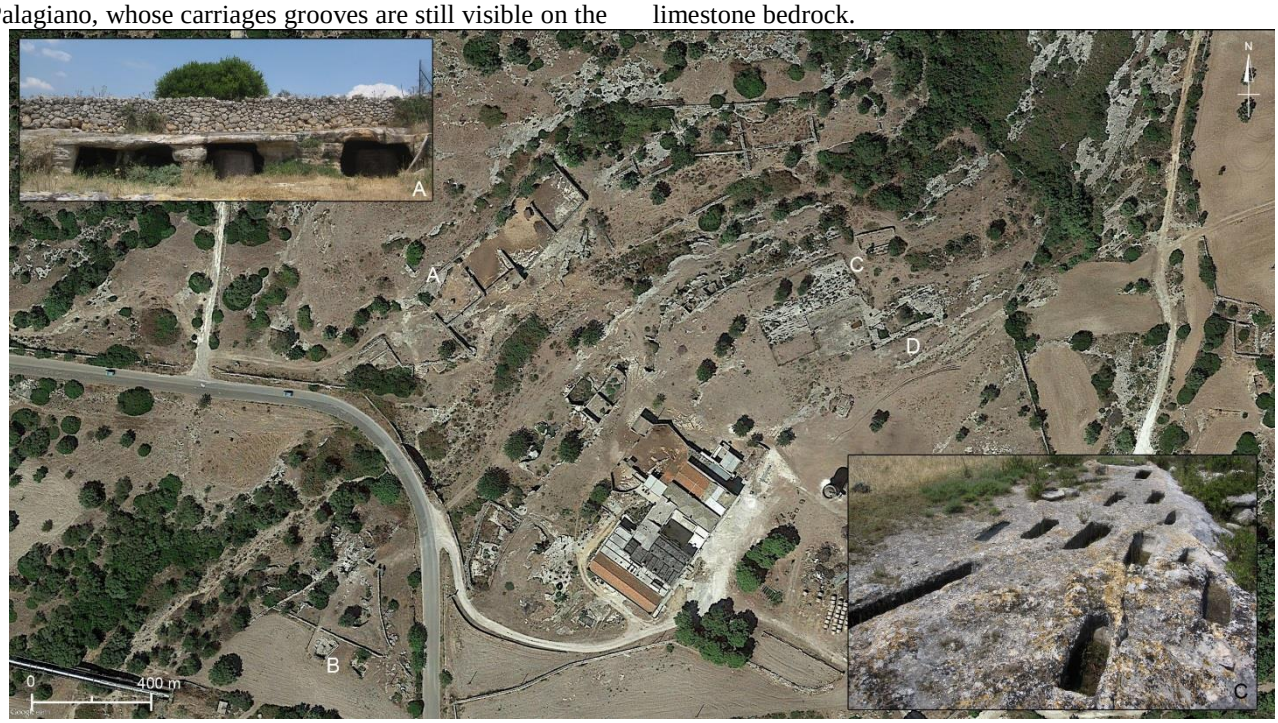

Fig. 1. The site of Casalrotto in a Google Earth image (2016): A. cave houses reused as stables and barns; B. Church of Sant'Angelo; C. Necropolis; D. hypogeal houses.

The excavated sector covers an area of 40 x 15 m. It consists of simple rectangular grave tombs with trapezoidal section (108 in all with single, double or multiple depositions) carved into the bedrock, according to a system widespread since the Middle Ages, although a precise chronological definition is difficult because of the absence of grave goods and personal items. The southern sector of the necropolis is partially destroyed to arrange a modern farmyard, obtained by lowering the original bedrock by 50 cm. On this floor, the archaeological evidences such as tombs, cisterns and wells have been subsequently fill up by stones to get a uniform level. The archaeological excavation did not clarify the extension of the necropolis along the southern and south-western sides.

At the south-western end of the village, where the karst valley sags and opens to wide areas of cultivable field, in the southern side of the valley there is the Church of Sant'Angelo (Fig. 1, B), consisting of two large hypogeal rooms on two floors including fresco paintings executed between 12th and 14th century [2]. Another possible religious cave could be at the north-eastern end of the village, where the large cave "cripta no. 4" preserves painting traces. Its identification with the Church of Santa Maria built between 1155-1165, as mentioned by Medieval sources, could be possible.

It was assumed that the original nucleus of the village of Casalrotto was the Church of Sant'Angelo, but around this cave are only a few remains of houses. After the settlement gradually moved to the large complex of caves placed north-east of the eighteenth-century farmhouse. The church annexed to farmhouse is of the same period and its

type is common to the conventual churches; therefore, the hypothesis that the present farmhouse includes an ancient convent and the annexed church is built over a more ancient ecclesiastical edifice is possible.

III. ARCHAEOLOGICAL AND TOPOGRAPHICAL SURVEYS

In order to produce a more detailed definition of the ancient organization of the Casalrotto village, archaeological and topographical surveys were carried out in integration with geophysical prospecting.

First of all, the raster documentation produced in 1979-1982, such as the general plan of the site at a scale of 1:200, the detailed plans of the caves and the excavated sectors, have been acquired, digitized and georeferenced on a large-scale topographical map. So, new topographical surveys have been performed using a high-precision GPS system with dual differential antenna, in RTK mode (Fig. 2). They were carried out both to check the old plans and in the areas around the settlement in order to identify its extension and the access roads. Moreover, an archaeological examination of the caves, in order to define their original use and chronology, was performed with the aim of evaluating previous hypothesis about the gradually displacement of village core around the Church of Sant'Angelo to the area of caves located north-east the eighteenth-century farmhouse. At this

regard, it is important to highlight that the research was in many cases very difficult, because the interior of the hypogeal caves was in poor state of conservation and often invaded by vegetation or reused as stables and barns.

Fig. 2. Topographical surveys performed using a high-precision GPS system with dual differential antenna, in RTK mode.

Fig. 3. Some hypogeal caves documented at the north-west end of the settlement by topographical survey in 2015.

Evidence not documented in the previous studies has been detected: in particular, some hypogeal caves at the north-western end of the settlement (Fig. 3), near carriages grooves of an ancient road. In addition, the discovery of a scattering area of tiles and pottery fragments, as well as numerous stone fragments, detected in the flat and rocky area overlooking from the north the karst valley, could suggest the presence of further masonries and structures connected to the settlement.

Lastly, topographical surveys have also provided the positioning the areas investigated by geophysical prospecting, useful for georeferencing the profiles and time slices on the cartography.

IV. GEOPHYSICAL SURVEY

Geophysical survey was performed in five areas using Ground-penetrating Radar (GPR) technique. A Ris Hi mod georadar system with a dual band 600MHz-200MHz antennae was used. The chosen areas are located immediately south and south-west of the excavated sector of the necropolis.

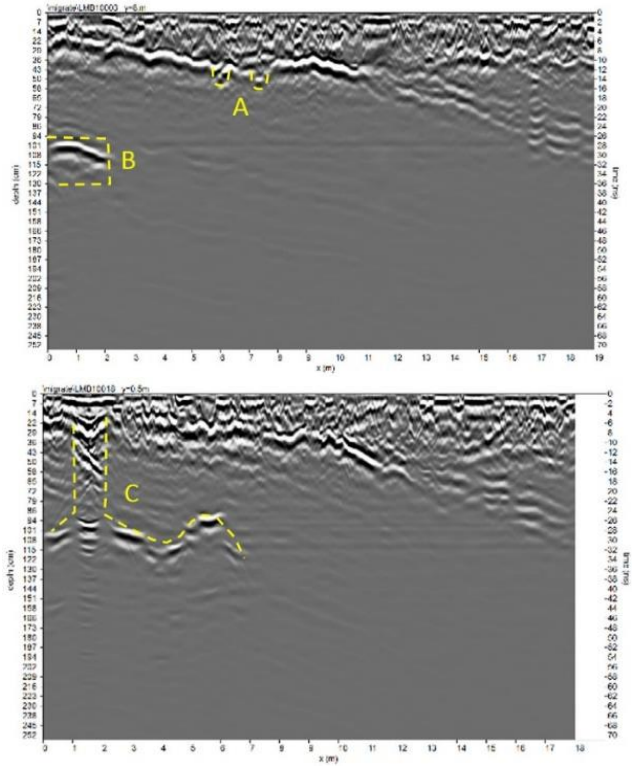

Fig. 4. Processed radar sections related to two acquired profiles. "A" indicates a pit grave; "B" indicate a hypogeum; "C" indicate a silos or cistern.

The GPR data have been gathered with a transect of 0.5 m between any two adjacent measurement line, and the data have been processed by making use of the GPRSLICE code [3]. Particularly, the processing has consisted in zero timing, background removal, gain variable vs. the depth and Kirchhoff migration [4]. The dielectric constant has been retrieved from the diffraction hyperbolas [4].

In particular, here we focus on the results obtained with the antenna at 600 MHz.

The analysis of the GPR data pointed out (Fig. 4): (i) the presence of an interface, denominated "base rock", located between 0.3 m and 0.8 m in depth; (ii) the presence of numerous anomalies ("A") that represent a cut in the bed rock. These anomalies are due to the probable presence of grave tombs. Other reflection events labelled "B" and "C" respectively; such anomaly could be related to the probable presence of an hypogeum ("B") and a man-made (silos or cistern) structure ("C").

In Figure 6 and 7, the horizontal slices at the respective estimated depths of 0.15 m (Fig. 6) and 0.65-0.70 m (Fig. 7) are represented. They show the most interesting results among those gathered in the investigated areas. In particularly, in Figure 6 is evident the distribution of the anomalies "A", "B" and "C". Moreover, other very interesting anomalies are labelled "A" in Figure 7 and they may be related to buried structures (see below *Discussion*).

Fig. 5. GPR surveys at the south and southern boundaries of the necropolis.

V. DISCUSSION

Data collected by archaeological, topographical and geophysical survey has allowed to upgrade, as far as possible, the level of knowledge of the Medieval site of Casalrotto despite the bad conservation status and the partial modern reuse of the caves related to the farmhouse activities.

To manage different types of data, such as DGPS measurements, vector cartography and raster maps, a dedicated GIS platform was developed for the research project. It was based on the open source Quantum GIS software and it was characterized by various layers that include, in addition to the archaeological entities, web map service of the Apulia Region (such as the cartography with a scale of 1:5,000 and ortho-images of 2006 and 2010), previous plans that have been vectorized and georeferenced, and the time slices processed from of the geophysical measurements; such slices, available as raster information, have been upload in depth order, to clarify the sequential reading of the subsoil marks that reveal the presence of buried structures. Through the correct georeferencing of the slices by DGPS positioning of the vertices of the investigated areas, it has been possible to contextualize the results of the geophysical prospecting in the new archaeological map of Casalrotto.

Regarding GPR prospecting useful to identify the south and south-western limits of the necropolis, these measurements have highlighted the presence of a few and very low depth anomalies, under a thin layer of topsoil. These anomalies could be referred to grave tombs located immediately to the south and south-west of the boundaries of the excavated necropolis area (Fig. 6, A). Other anomalies visible more south-west (Fig. 6, B-C) could be referred to silos and hypogea carved into the bedrock. Moreover, in the area immediately to the south-

west of the necropolis, about 25 meters to the north-east of the farmhouse, other anomalies related to buried structures (Fig. 7, A) have been identified, whose nature and typology can only be clarified by stratigraphic excavations; it could be interpreted as structures related to the nearby farmhouse, or older structures. It would be very impressive to identify these anomalies as the remains of a church near whose the necropolis was located. It could be identified as the *sub divo* Church of Sant'Angelo mentioned in a document of 1618, which generally is considered as included in the nearby eighteenth-century church annexed to the farmhouse.

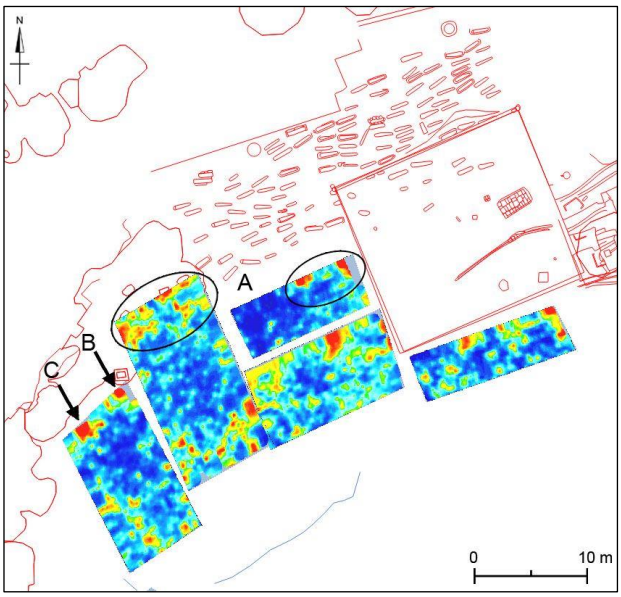

Fig. 6. Casalrotto: GPR time slices (about 15 cm depth) with anomalies linked to buried grave tombs (A), silos and hypogea (B-C).

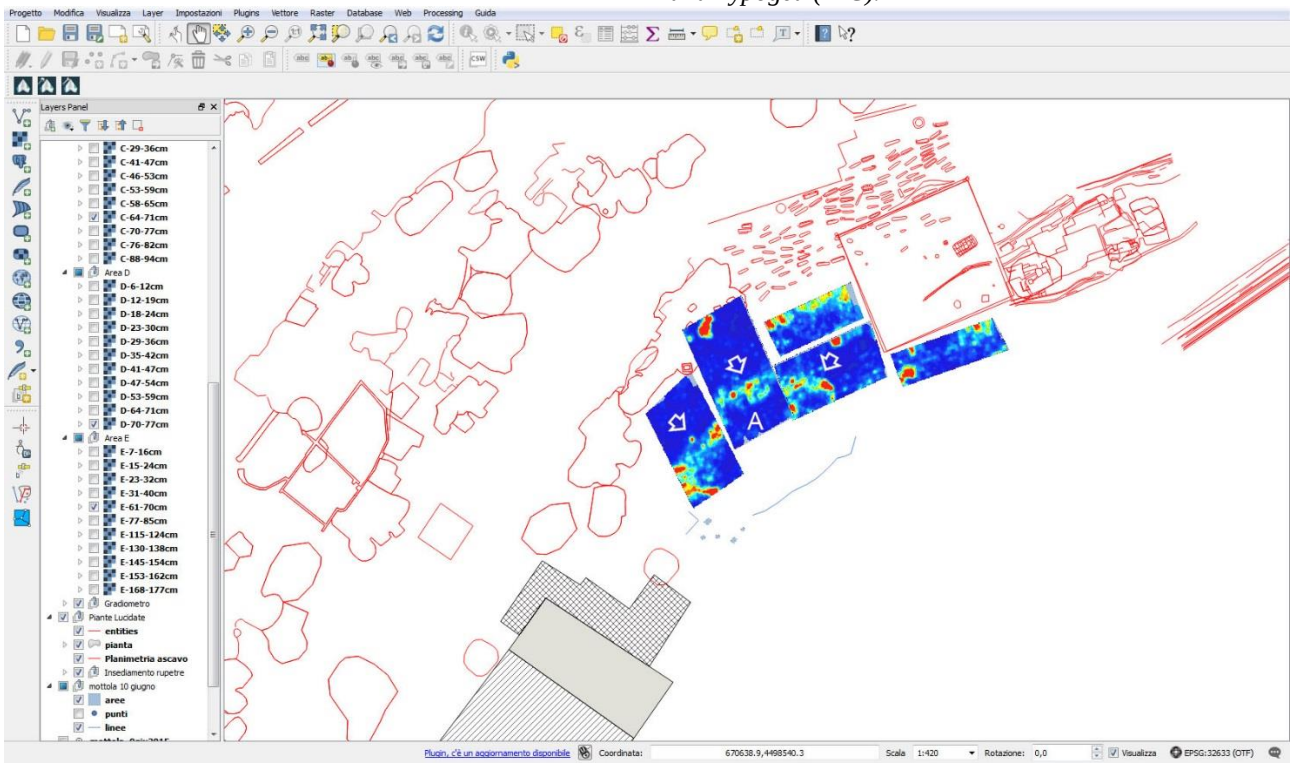

Fig. 7. Casalrotto GIS platform: GPR time slices (depth of 65-70 cm) georeferenced on the archaeological map.

VI. CONCLUSIONS

The research approach described and explained in this paper demonstrate how traditional archaeological studies can be enhanced through the application of multidisciplinary investigations. In fact, an upgrading and increment of the knowledge of the Medieval village of Casalrotto has been obtained by the acquisition of new archaeological, topographical and geophysical data, which have been integrated in a dedicated GIS platform and in a new digital archaeological map. The georeferencing of these processed data has allowed a contextual overview of the dynamics of the site organization and evolution. The research has documented the extension of the inhabited area, the routes of the main

roads, the location of the holy centres, and the extension of the necropolis. About the last matter, very important has been the contribution of geophysical data, which showed the possible presence of grave tombs to the south and south-west of the excavated sector of the necropolis, allowing a better definition of its

boundaries, while the detection of possible nearby silos and hypogea a has supported the understanding of the use of this area. Moreover, very interesting is the possible presence of a buried building in the area between the farmhouse and the necropolis. The hypothesis that it could be an ancient church may be valued by future excavations.

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