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Unveiling the Hidden Past: exploring the historical evolution of Borbona (Rieti, Italy) through archaeological surveys and geophysical prospections

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***Abstract* – The research project aims to uncover the unknown territory and trace its origins. It's conducted by the ISPC CNR to study the historical and archaeological context of Borbona (Rieti, Italy) with the collaboration of the Department of Agricultural Environmental and Food Sciences (University of Molise) for the geophysical prospections. Despite the limited historical and archaeological studies on Borbona, unexpected discoveries emerged during the research. Through various activities, including surveys and analysis of findings, the project has identified ancient habitation areas and significant Roman architectural fragments. The research seeks to transmit the history and culture of Borbona to future generations, fostering a sense of belonging. Protecting historical heritage and areas at archaeological risk, enhancing and promoting existing cultural assets, represent fundamental actions to increase the country's attractiveness in the present and preserve its identity in the future.**

Keywords – Borbona, Rieti, ancient artefact, wall structures, villa rustica, archeological survey, geophysical prospections.

I. INTRODUCTION

The study of the historical and archaeological context of the Municipality of Borbona has been entrusted to the Institute for Heritage Science (ISPC) of the National Research Council (CNR) in order to promote and enhance a territory that is undoubtedly generally understudied but especially unknown from an archaeological perspective. Thanks to the contribution of the "Regione Lazio" and the "Fondazione Varrone Cassa di Risparmio di Rieti", it was possible to initiate the research project "Camminando nella storia" to trace the origins of Borbona and reconstruct the historical evolution of the territory, verifying the real consistency of the archaeological traces. This project arises from the need to know and deepen the territory of Borbona with the aim of transmitting to young people and future generations the history, traditions, and culture of the places, creating a sense of belonging and sharing of their own territory.

The ISPC, in particular, has carried out a series of activities such as the historical study of the territory and the collection of local news and sources, the cataloguing and analysis of archaeological findings, reconnaissance activities in the municipal and neighbouring areas, archaeological surveys using GPS and with the aerial photogrammetric surveys with Remotely Piloted Aircraft System (SAPR). Furthermore, cartographic positioning, and the creation of a GIS system in which all the collected data have been included and analysed.

The ISPC has also coordinated research activities involving researchers from the Department of Agricultural, Environmental and Food Sciences (University of Molise) for geophysical investigations, as well as experts in Roman and medieval numismatics and ancient road networks.

Borbona is located in a region particularly neglected from the point of view of historical and archaeological studies, partly due to its geographical position, always surrounded by mountain ranges, and partly because it seems to lack relevant archaeological evidence, most likely because of the high seismicity that characterizes the entire area. Borbona is indeed located in the internal Sabina, in a valley surrounded by the great chains of Terminillo, Laga, and Gran Sasso. It has always been a border territory: inserted in the *Regio V Picenum* in the Augustan age but adjacent to *Regio IV Samnium*, incorporated into the Ducato of Spoleto in the late antique period and under the dominion of the Regno di Sicilia and later the Regno delle Due Sicilie, in a border area with the Papal States. Also from the 17th century, it was one of the border areas of the Regno di Napoli in the region of Abruzzo Ultra. Its position as a "frontier" has determined both a cultural richness, a mixture of cultures and peoples, but also a certain poverty in historical documentation and

cartographic production. For all these reasons, and many others, there is a certain lack in the studies concerning Borbona; there are only a few sporadic contributions published in regional volumes that present generic information about the localities of the province of Rieti [1], or included in local magazines but limited to specific themes [2]. However, despite the somewhat discouraging promises, some rather surprising unexpected discoveries emerged during the research.

From the analysis of the archaeological artefacts delivered to the Municipality as part of the project, areas of greater concentration have been identified, on which surveys and geophysical investigations have focused. Some remains of masonry structures have been examined and interpreted within a historical and territorial context. Significant architectural fragments from the Roman period have been rediscovered.

The study of all this data has allowed for the hypothesis of ancient habitation areas and potential settlements.

C.G.

II. AREAS OF CONCENTRATION OF ARCHAEOLOGICAL FINDS

One of the initial activities of the project involved the collection, cataloguing, and analysis of archaeological finds accidentally discovered in the study area. Thanks to this project and the subsequent renewed interest in more precise and systematic historical research, these finds were primarily handed over by Augusto Brugnoli to the municipal headquarters, where they are now kept. Some of them were found during archaeological surveys.

The large quantity of collected objects, 354, spanning a wide chronological range, provides relevant information about the continuous habitation of the area, documenting the transition from the archaic era to the modern age. By entering the discovery location, along with all the other information obtained from cataloguing, into the GIS project, two main areas with concentrated findings emerged: La Terra, the historic centre of the town, situated on an elevated position, and Piano di Santa Croce, a plain used for agriculture and pastoral purposes, expanding at the southern end of the modern settlement (Fig. 1).

In the area of La Terra, 152 archaeological object were found, many of them at the NE extremity of the hill and along the southern slope. Notable discoveries on the hill include three Roman coins, one from the Late Antique period, and eleven from the Early Middle Ages. Along the slope, artefacts from the Early Middle Ages were predominantly collected, including five coins and a variety of metal objects associated with personal use, such as various types of fasteners, applications, and personal adornments, as well as tools for craft and domestic use. Among these, it is worth highlighting the presence of eight small objects that were likely used as decorative eyelets or to reinforce existing holes in garments for the attachment of hooks or clasps. These copper lamina specimens, which have only recently been studied and catalogued in archaeological literature, can be placed alongside other metallic artefacts dating from the 14th to the 15th century due to their discovery within Early Medieval burials in Italian territory [3].

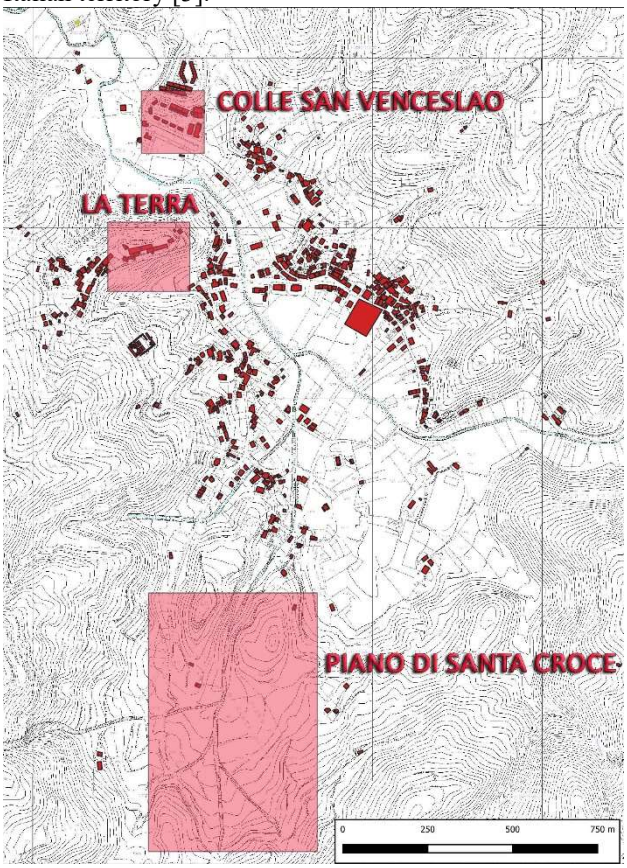

Fig. 1. Borbona, areas of concentration of archeological finds.

These objects, ranging in size from 1-1.5 cm, were engraved with a larger circular hole for the attachment of hooks, and featured a series of small perforations allowing the passage of thread to fasten them to garments (Fig. 2).

Fig. 2. Borbona, La Terra: decorative eyelets dating from the 14th to the 15th century.

Together with other artefacts from the same period, these findings demonstrate the fortification of the Borbona hill at least since the Early Middle Ages, as described by Sebastiano Marchesi in his 1593 document. The document was created for the Duke of Parma, Ranuccio I, grandson of Margherita of Austria, with the aim of describing the estate and income of the Farnese family. It contains historical information about 16 locations, including

Borbona, which is said to have been established around 1292, two years after the destruction of Macchielone Castle. Each location is accompanied by perspective views drawn by the same author. Borbona is depicted as surrounded by walls and equipped with a fortress (both built, according to Marchesi, following a fire in 1326), along with a series of small villages situated along the valley and adjacent hills.

The Piano di Santa Croce, which extends to the southern end of the settlement and is also devoid of modern buildings, has yielded a greater quantity of ancient artefacts, allowing for further activities and investigations such as the photointerpretation of historical images, photogrammetric surveys, and geophysical surveys. The place name seems to preserve the memory of the *Ecclesia S. Crucis in Burbone extra* which, according to the 18th-century episcopal records, was supposed to have been destroyed but with recognizable traces on a small hill towards S. Maria del Monte [4]. The mentioned hill could be the elevation north of the Piano di Santa Croce known as the "Colle della Cappella" (Chapel Hill). Its summit is surrounded by poorly preserved wall structures.

In ancient times, the hilltop may have served as a vantage point for controlling the valley it overlooks. Its orographic formation, with the summit facing south towards the valley, would make it an ideal location for such a function. Furthermore, it is the only elevated point from which the valley to the south and the plains to the east and west can be observed. From the observation of the exposed rocks on the hill, it can be noted that they make the walls of the southern and western slopes particularly vertical, with a total elevation difference of about 30 meters (Fig. 4).

Discoveries have so far only been found along the slopes, not at the summit of the hill. However, the area is now heavily damaged by human intervention and daily grazing by animals. The masonry technique used in the more intact structures at the summit, although only a few courses remain, resembles the polygonal work of the early style found in fortified centers from the archaic period. One of these sites was discovered in 2011 on Monte Frontino in the nearby Cicolano, where the Equi established an oppidum with polygonal walls and terraces [5]. It bears many similarities to the structures identified on the hill of Borbona and their function of controlling the plain and ancient routes. In fact, in Borbona, an ancient communication road must have run along the western side of the hill, as evidenced by the presence of two parallel walls running in the NE-SW direction converging towards the hill itself.

The two structures are about 2 meters apart, made of stone blocks, more or less regularly laid, with a maximum preserved height of about 1.2 meters but largely collapsed. It is worth noting that these walls follow a path shown on the 1955 IGM (Italian Military Geographic Institute) map.

Many archaeological finds have come from the entire Piano di Santa Croce and the mentioned hill slopes, discovered during field plowing and small earth movements for the installation of lighting services. totally 169 artefacts have been recovered: 37 ceramic fragments, 8 bricks of *opus spicatum*, 78 numismatic finds, and 46 various metallic artefacts. The Roman period and the medieval era are notably attested, with particular mention of 17 coins dating between the Republican and late Imperial periods, and 29 Provinsian denarii from the Roman Senate (11th-13th centuries), all found in a single area, along with a series of garment accessories (Fig.3).

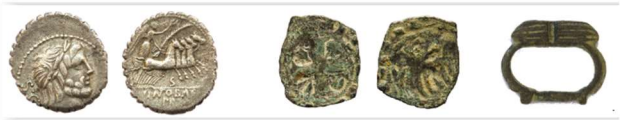

Fig. 3. Borbona, Piano di Santa Croce: archeological finds, from left to right a silver coin from the Republican era, a Provisian denario, a medieval buckle.

In addition to these discoveries, some architectural fragments from the Roman era, possibly belonging to a typical rustic villa of the Apennine area [6] and beyond, have been recovered. These are mainly found from the late Republic to the early Imperial period and are currently preserved in municipal offices and private residences.

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III. PHOTOGRAMMETRIC SURVEYS AND PHOTOINTERPRETATION

The CNR continued its investigations by conducting additional photogrammetric surveys using a Remotely Piloted Aircraft System in the area of Piano di Santa Croce, which was identified as having a higher concentration of archaeological finds and wall structures. Approximately 80 aerial photographs were captured and processed using specific software that utilizes the *Structure from Motion* technique. This process generated a photorealistic 3D model by creating a high-definition texture. The generation of the 3D model allowed for the creation of a *Digital Elevation Model* (DEM) of the surveyed area, which highlighted the slopes of the agricultural fields, as well as the distribution of hills and ditches.

The orthophoto was geolocated in the WGS 84 system within the GIS project. The chosen georeferencing technique was to utilize the integrated GPS data in the RPAS, flown at an altitude of approximately 60 meters above ground. The accuracy of the geomatic surveys, calculated by assessing the alignment error of the photographs primarily derived from GPS data, is approximately 70 cm. The *Ground Sampling Distance* calculated is about 3 cm.

The orthofoto provided a detailed examination of the entire area from an aerial perspective. Photointerpretation of this product led to hypotheses about the presence of ancient structures beneath the current ground surface, considering the presence of identifiable marks or traces in the

othophoto. These traces were then compared with additional historical satellite images or those available on online resources, datable from the 1950s to the more modern ones from 2006 and 2008. Although these images were less detailed, they still confirmed the presence of the same traces over time. Subsequently, geophysical surveys were conducted in the same areas to verify the presence of underlying structures (Fig. 4).

Modern cartography, such as the 1950s IGM maps, and historical and recent aerial photographs, are the only sources of detailed documentation for the area. In fact, Borbona does not have a historical, geometric, and cadastral registry, as, for example, the 19th-century Gregorian Cadastre of the Papal State, since it belonged to the Kingdom of Naples and later the Kingdom of the Two Sicilies. Furthermore, it represents a small centre for which the Kingdom did not produce dedicated cartography but was instead included in general maps describing border areas.

The research conducted at the National Aerophotographic Archive of ICCD has also yielded results, as aerial images taken for the Base Flight in 1954 and photos from 1944 acquired by the Royal Air Force of the United Kingdom have been recovered. The examined frames, particularly those from the Base Flight, reveal some traces in zone "A" of Fig. 5.

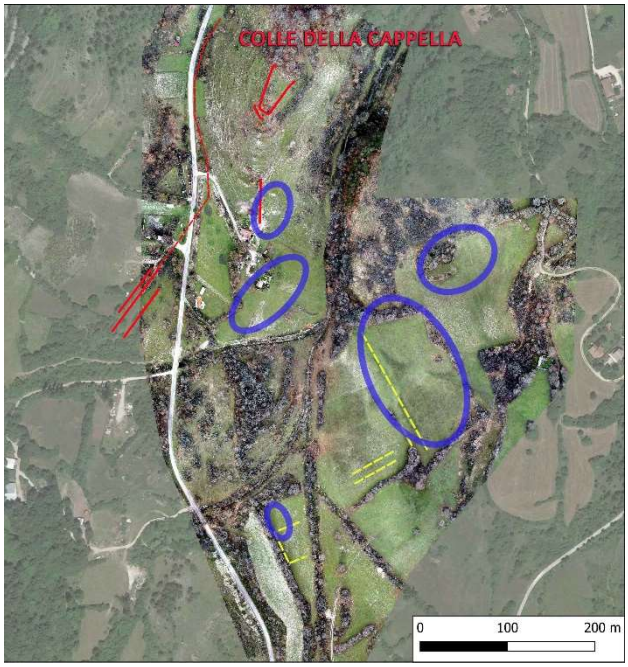

Fig. 4. Borbona, Piano di Santa Croce: orthofoto with wall structures (red), traces on the ground identified during the photointerpretation (yellow), areas of archaeological finds (blue circles).

Furthermore, the photogrammetric survey has also effectively captured the structures surrounding the top of the so-called "Colle della Cappella" (Chapel Hill), which were so poorly preserved that in many areas it was difficult to reconnect and identify them. From above, it is apparent that there must have been a continuous structure following the morphology of the summit to the south, east, and west. These combined methods, including photogrammetric surveys, photointerpretation, and geophysical surveys, allowed for a comprehensive analysis of the archaeological site. By integrating aerial imagery, historical photographs, and geophysical data, researchers gained valuable insights into the presence of ancient structures and their relationship to the current landscape.

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IV. GEOPHYSICAL PROSPECTIONS

In order to verify the presence of buried structures, a geophysical search was planned in the areas where traces on the ground had been identified through proximal remote sensing and archeological surveys.

A system based on the measurement of the electromagnetic fields associated with alternating currents induced in the subsoil was used during data acquisition implementing the GSSI Profiler EMP-400 [7]. Measurements were collected in continuous mode using frequencies in the range 2–15 kHz with vertically oriented dipoles. The investigation area was covered by profiles spaced 1 m inserted in a regular grid.

During data processing, the measured conductivity values were transformed in resistivity values and visualized in 2D maps through a contouring software. In order to accommodate the wide resistivity range detected inside the data set and to better show order of magnitude changes frequently appeared, a common logarithmic scale was used for visualization of resistivity maps.

The procedure of geophysical analysis is based on the concept of “anomaly”. The measurement of the electromagnetic field generates always the same value in a homogeneous and isotropic soil. On the contrary, in proximity of a buried body with different physical features respect to the surrounding material, the measured value tends to differ from the unperturbed value: the observed physical field indicates an anomaly that is a variation respect to the reference value relative to the homogeneous condition. Therefore, considering these variations, it is possible to hypothesize the nature and the geometry of the hidden bodies. In archaeological prospecting, the presence of a high resistivity anomaly is usually an indicator of some resistive structure, such as the presence of accumulated tiles, a stone wall, building foundation or a cavity respect to the less resistive hosting soil. Instead, the presence of a moist ditch filling in a resistive rock background is characterized by a low conductive anomaly. In this work, the geometries of the geophysical anomalies, with particular reference to the high-resistivity cores, were visually analyzed.With respect to the average values

measured in the survey areas, several regular pattern of resistivity highs were identified (A-F in Fig. 5) whose spatial arrangement is particularly interesting and is worthy of further studies. Among the others, the area indicated with A is remarkable as it highlights high resistivity values drawing well-defined contours.
It suggests the presence of some alignments defining probable internal divisions associated with walls, room limits, even if defined in a fragmented way. Since geophysical diagnostics is an indirect methodology, aimed at the spatial definition of the anomalies in the subsoil, direct verification with archaeological excavations is suggested for the complete study of the sites giving certainty of the nature, age and archaeological value of the anomalies found.

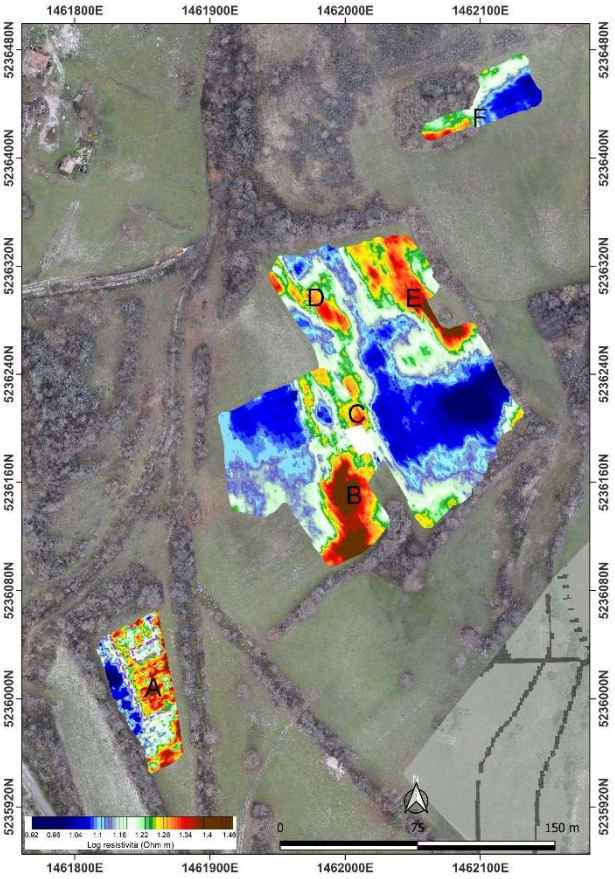

Fig. 5. Borbona, Piano di Santa Croce: resistivity map relative to the frequency of 11 kHz.

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V. CONCLUSIONS

The ancient history of Borbona was completely unknown to most until now. Its toponym appears for the first time in written sources in 1018 on the Farfa maps, which mention some landed properties located in 'Borbone' [8]. Its ancient origins could be inferred from accounts of past archaeological discoveries, now destroyed, and its strategic position. Indeed, it is centrally located in relation to the northernmost centres of Romanized Sabina, such as *Nursia* to the north, *Reate* to the southwest, and *Amiternum* to the southeast, in an area between the ancient Via Salaria to the west, Via *Caecilia* to the south, and the *Falacrinae-Amiternum* route along the Apennine ridges. Research is underway on ancient roads and transhumance, which demonstrate direct connections along the Apennine ridges to major centres near Borbona. Furthermore, thanks to the discovery of significant Roman-era artefacts, the conducted investigations and the geophysical prospection, it is possible to hypothesize the existence of at least two inhabited areas: the San Venceslao hill and the Piano di Santa Croce, likely characterized by the phenomenon of Romanization through dispersed settlements with typical villas of this period, especially in central Italy.

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