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Integrated geophysical methods to investigate the archaeological structures in the ancient town of Norba (Norma, Italy)

Salvatore Piro (1), Enrico Papale (1), Daniela Zamuner (1), Emanuela Nepi (1), and Stefania Quilici Gigli (2)

(1) CNR - ITABC, Cultural Heritage Department, Monterotondo Scalo, Italy (salvatore.piro@itabc.cnr.it), (2) Università della Campania, Luigi Vanvitelli, Caserta, Italy

The site of Norba is located in the Latium Region, about 90 Km south of Rome, in Italy. The city represents one of the best example of urban town planning, with a regular layout dating back to an ancient age. Over the years, many studies and archaeological excavations have brought to light important remains of several buildings which are still very well preserved.
In the last two years, geophysical surveys have been planned and conducted to investigate unexcavated portions of the archaeological site to enhance the urbanism plane of the ancient town. Ground Penetrating Radar and the Magnetometric Method have been used to investigate the site. In particular, GPR system SIR 3000 (GSSI), equipped with a 400 MHz antenna with constant offset was employed to survey 18 different areas close to some of the unearthed structures. Furthermore, differential magnetic surveys were carried out using the Geoscan FM256 in two areas, overlapping the GPR areas.
All the GPR profiles were processed with GPR-SLICE v7.0 Ground Penetrating Radar Imaging Software (Goodman 2017). The basic radargram signal processing steps included: post processing pulse regaining; DC drift removal; data resampling; band pass filtering; background filter and migration. With the aim of obtaining a planimetric vision of all possible anomalous bodies, the time-slice representation technique was applied using all processed profiles showing anomalous sources up to a depth of about 2.5 m.
The magnetic data was instead processed employing GEOPLOT 3.0 software (GEOSCAN research). After de-spiking, filtering and rearranging, the data was processed using 2D cross-correlation technique to enhance the signal to noise ratio and to better define the spatial location and geometry of possible targets.
With the aim to have a better understanding of the subsurface, a qualitative and quantitative integration of the results, have been employed. For the integration process the following techniques: maps overlays and RGB colour composites (graphical integration), binary data analysis and cluster analysis (discrete data integration) and data sum, data product and principal component analysis (continuous data integration) have been used.
The results obtained from the geophysical surveys were interpreted together with the archaeologists to define the meaning of the individuated structures and to enhance the knowledge of the ancient town's layout and mapping.

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