

# GPR survey at the historical centre of Nardò (Lecce, Italy)

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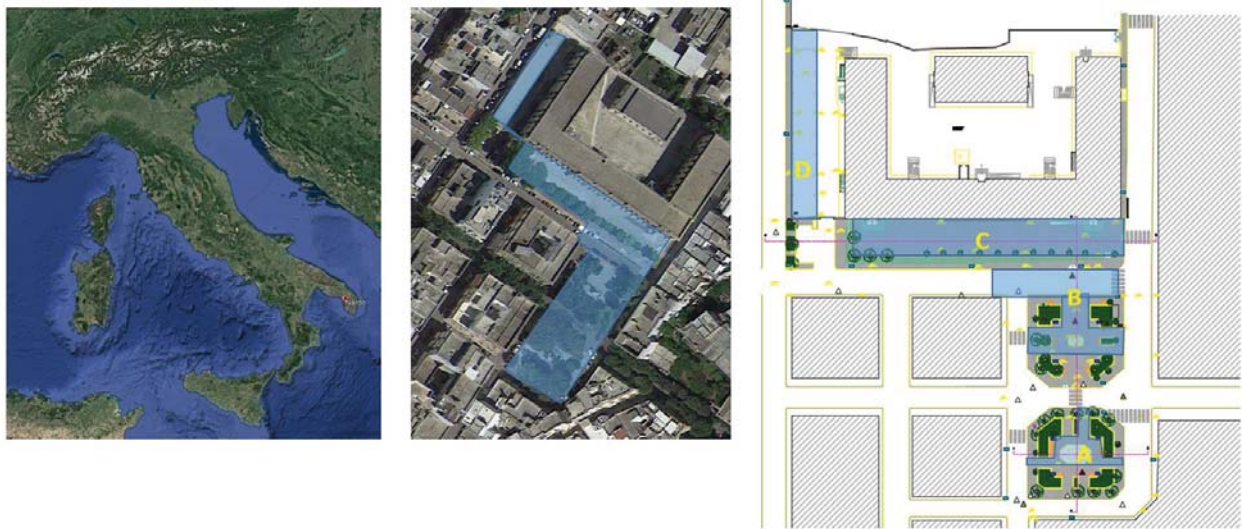
**Abstract** – The city of Nardò has Messapian origins (second half of the 8th - 3rd cent. BC) and subsequently became the important Roman centre of Neretum. The the continuity of life up to the present day through the Byzantine, Angevin and Aragonese dominations conditions and limits the knowledge of the most ancient phases of occupation. Indeed, the archaeological evidence of the Messapian and Roman period is very limited. To investigate about the presence of buried archaeological remains some geophysical surveys were undertaken at the historical centre of Nardò. Particularly some areas in Umberto I square were considered. Ground penetrating radar method was used. Results revealed anomalies that could be related to archaeological structures.

## I. INTRODUCTION

The birth of Nardò (Fig. 1) as an inhabited centre dates back to the second half of the 8th cent. BC with the presence of a Messapian village. The settlement grew during the Archaic and Classical age, and in the 4th cent. BC it was defended by a city wall built with large parallelepiped blocks of limestone; on the basis of the scarce remains preserved and the analysis of the historical air-photos, a circuit almost 4 km long was reconstructed, which enclosed an area of over 100 hectares [1]. In 269 BC, together with its port of Emporium Nauna (the current Santa Maria al Bagno), it was conquered by the Romans

and became a municipium (named Neretum) after the social war [2]. In the 6th cent. AD it was absorbed by the Byzantine Empire (552-554) and, for a short period (662-690), was annexed to the Lombard Kingdom. During the five hundred years of Byzantine rule the presence of Basilian monks increased, whose influence determined the spread of the oriental rite and cult. Between 901 and 924 Nardò was attacked and sacked by the Saracens from Sicily. In 1055 the Normans conquered the city and the Benedictine monks were allowed to settle in the place of the Basilian monks in the Abbey of Santa Maria di Nerito. In the second half of the 13th cent., the Angevin domination followed and it determined the birth and spread of feudalism. It was a fief of the Del Balzo family and in the 15th cent. Nardò was involved in the struggles between the Aragonese, Venetians and Turks. In 1413 the antipope John XXIII elevated the Neretine abbey to an episcopal seat. From 1497 until 1806, as a duchy, it was a fief of the Acquaviva. In that period it became an important cultural centre and it was called the Nuoua Atene litterarum.

Since the historical centre is rich in buried structures of archaeological interest, the municipality of Nardò has undertaken a restoration project in Umberto I square and for this reason, it was necessary to undertake geophysical investigations to verify the presence or absence of buried archaeological structures. Ground-penetrating radar (GPR) measurements were thus undertaken (Fig. 1) in Umberto I square, at the north-western end of the historical centre.



*Fig. 1. The surveyed areas at the north-western end of the historical centre of Nardò.*

## II. GPR MEASUREMENTS AND RESULTS

The measurements have been performed with an IDS Ris Hi-mode system equipped with the dual band antenna at a nominal central frequency of 200-600 MHz. A grid of 0.25 m spaced profiles was performed in four areas. Each B-scan has a time window of 80 ns (600 MHz antenna) and 120 ns (200 MHz antenna), discretized using 512 samples. When moving the antenna on the surface, extreme care was taken to pull the antenna at a constant velocity. The choice of these GPR antenna frequencies is closely related to the purpose of the investigation, which is based on the identification of elements related to structures of archaeological interest, such as tombs and/or building structures and roads, indicated as mid-size anomalies (0.5-2.0 m), located at depths that can range from a few tens of centimetres to a few meters.

The processing of the GPR data was linear [3], as customary in GPR prospecting, to avoid troublesomely computational problems and deceiving local minima of the cost object functional [3]. The processing consisted of zero

timing, background removal [3], declipping, Kirchoff migration [1] and bandpass filter [3]. This processing was implemented by means of the GPRslice code [4]. An average electromagnetic (EM)-wave velocity equal to 0.085 m/ns has been evaluated from the shape of the diffraction hyperbolas [3]. Considering the radar sections collected with the antenna at 600 MHz in the area A it was possible to put in evidence (Fig. 2):

- 1) a significant signal penetration until 40 ns (which, considering a propagation velocity of the electromagnetic waves in the ground of the order

of 0.085 m/ns, corresponds to a depth of about 1.7m);

- 2) the presence of different hyperbolic reflections which could be referred to some filling materials;
- 3) the presence of some weak reflections of the signals (A) which are probably due to some archaeological structures buried at a depth of 0.9 -1.3 m from the ground level. In this case, the weak signals could be ascribable to the presence of partially or half-empty areas.

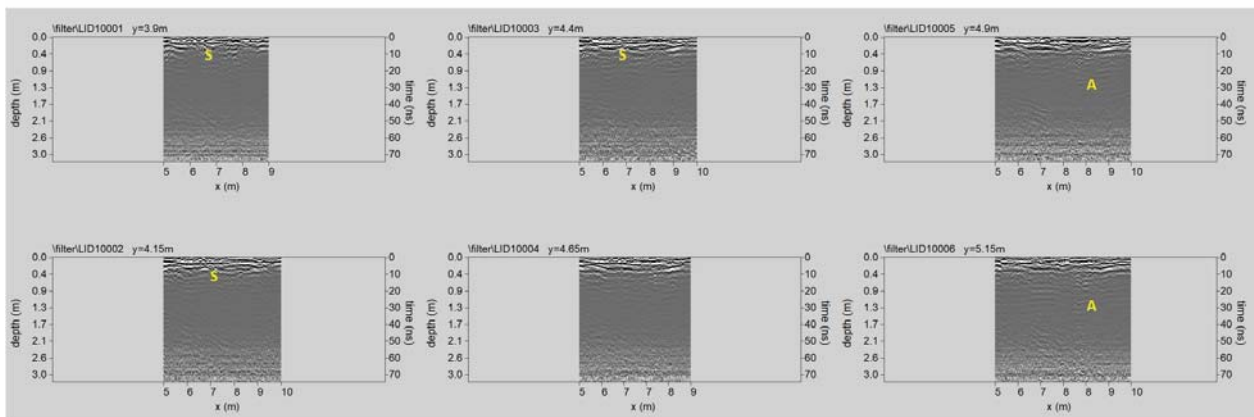


Fig. 2. Some GPR processed radar sections acquired in the area A: S = pipe; A = wall.

Afterward, horizontal depth-time slices were obtained using the processed data. Slices from 0 to 1.4m were achieved and each slice was retrieved by averaging data within a time window  $\Delta t = 3.5$  ns, which corresponds to a soil thickness of about 15 cm. In each depth time slices reported in the Figure 3 we have indicated the main

electromagnetic anomalies A. As it can be seen, several isolated anomalies are visible, part of which (A) likely to be ascribable to structures of archaeological interest. Due to the size of the anomalies, a possible interpretative hypothesis is that there are walls. Figure 4 shows a better visualization of the anomaly A.

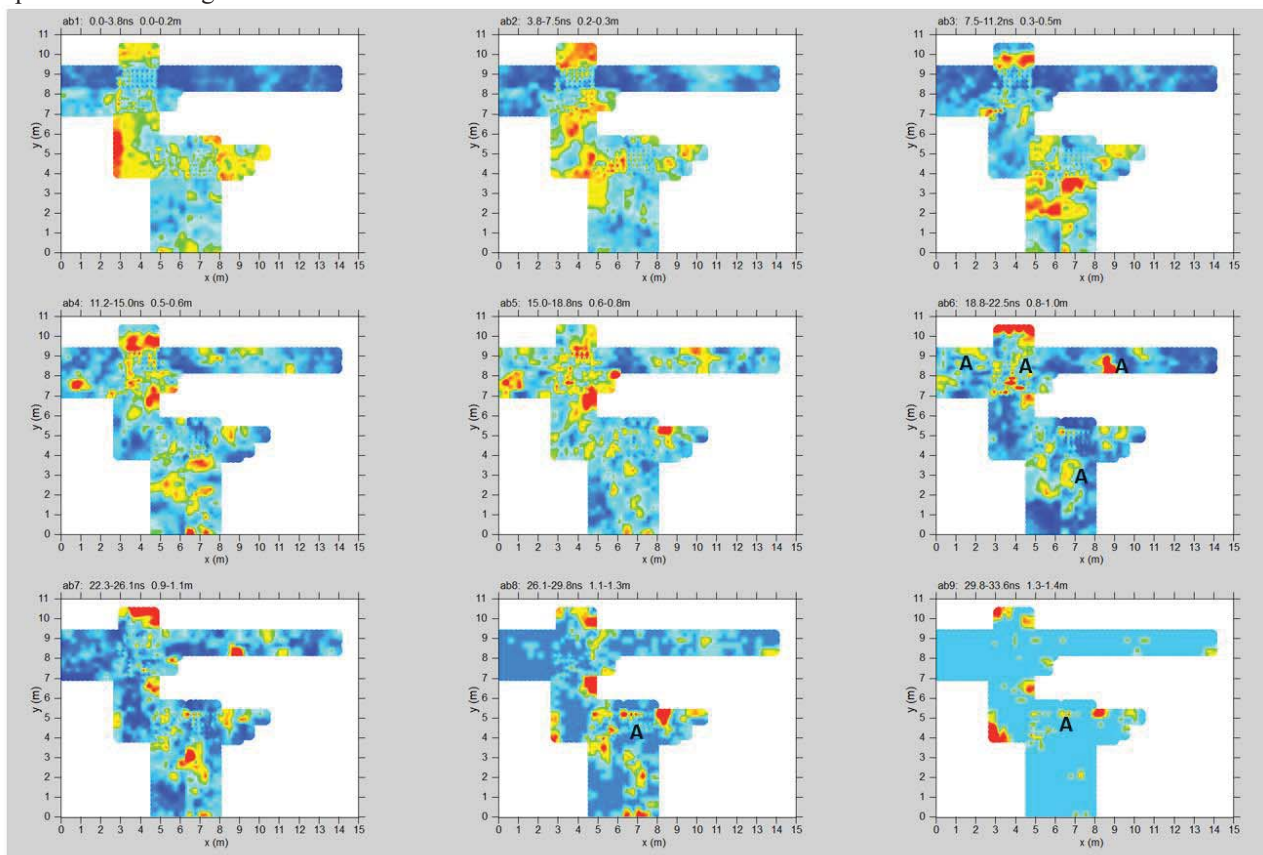


Fig. 3. 600MHz antenna depth slices.

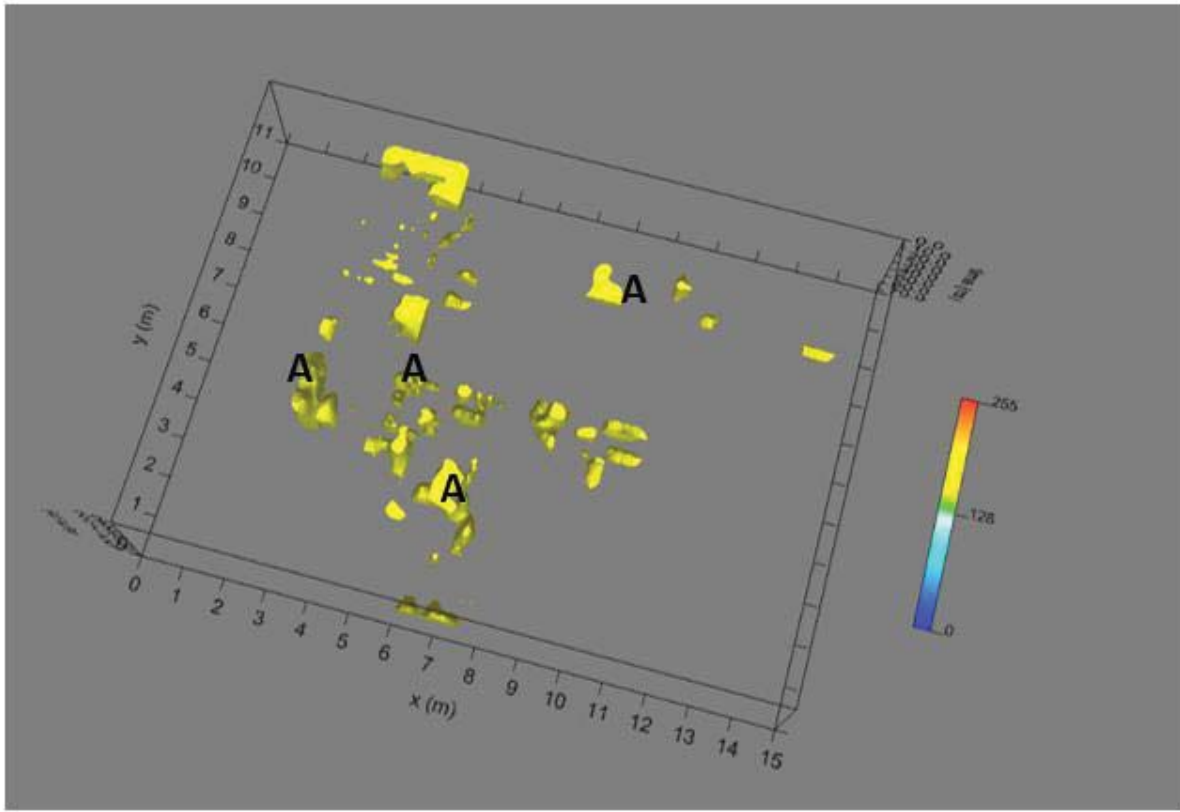


Fig. 4. The 3D isosurface amplitude visualization.

### III. CONCLUSIONS

In this paper, a GPR within the urban tissue of Nardò has been presented. The investigated areas, let us remind, is quite larger than that shown here, and further results will be shown at the conference.

This approach revealed the effectiveness of the integrated methods to identify a series of anomalies that could be ascribed to anthropogenic features. Indeed, it is definitely probable that at least part of the anomalies are ascribable to remains of archaeological interest, and in particular, it is possible that some of them are ascribable to walls, because their apparent shape and size are comparable with other ancient walls, excavated and frequently discovered in the area of Nardò in the past.

At the conference, further results will be shown too; in particular, results also regarding the other three investigated areas will be presented.

### REFERENCES

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