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Geophysical investigation at the Roman Amphitheatre (Lecce, Italy)

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***Abstract* –Lecce's historical character is expressed by its historical centre, rich in cultural and architectural marvels of the past. However, the symbol of Lecce's ancient origins is the Roman amphitheatre in St. Oronzo square, the core of the city. The amphitheatre was discovered during the construction of the building of the Bank of Italy by some workers in the early '900. In order to have pieces of information related to the structure of the amphitheatre, geophysical surveys were undertaken inside and outside it. In this paper, some of the interesting results obtained will be presented.**

I. INTRODUCTION

The Roman amphitheatre of Lecce (Figure 1) is completely covered under the city, even now it is not 100% visible, but only partially. The side that is still covered features some historic buildings, including the Church of Santa Maria delle Grazie, which could obviously not be demolished. The amphitheatre is the most important testimony of *Lupiae*, the ancient name of Lecce, during the Roman era. It is thought to be dated between the I and the II century AD, between the age of Augustus and the Trajan-Hadrian one. The external volume of the amphitheatre was 102 x 83 meters, with an arena of 53 x 34 meters, accommodating about 25,000 spectators.

To investigate the ancient buried structure present in the subsoil of the amphitheatre, geophysical investigations were undertaken.

A ground penetrating radar (GPR) method was chosen. The GPR surveys were carried out in several areas inside and outside the amphitheatre (Figure 2). GPR surveys were carried out according to a 0.25m pitch grid with 512 samples/track; the other acquisition parameters were optimized on site and kept constant for all the acquired profiles.

A georadar Ris Hi Mod equipped with a dual band antenna 200-600 MHz was used. The results related to the GPR data acquired with the 600 MHz antenna in the area F will be shows here.

Fig. 1. The Roman amphitheatre of Lecce

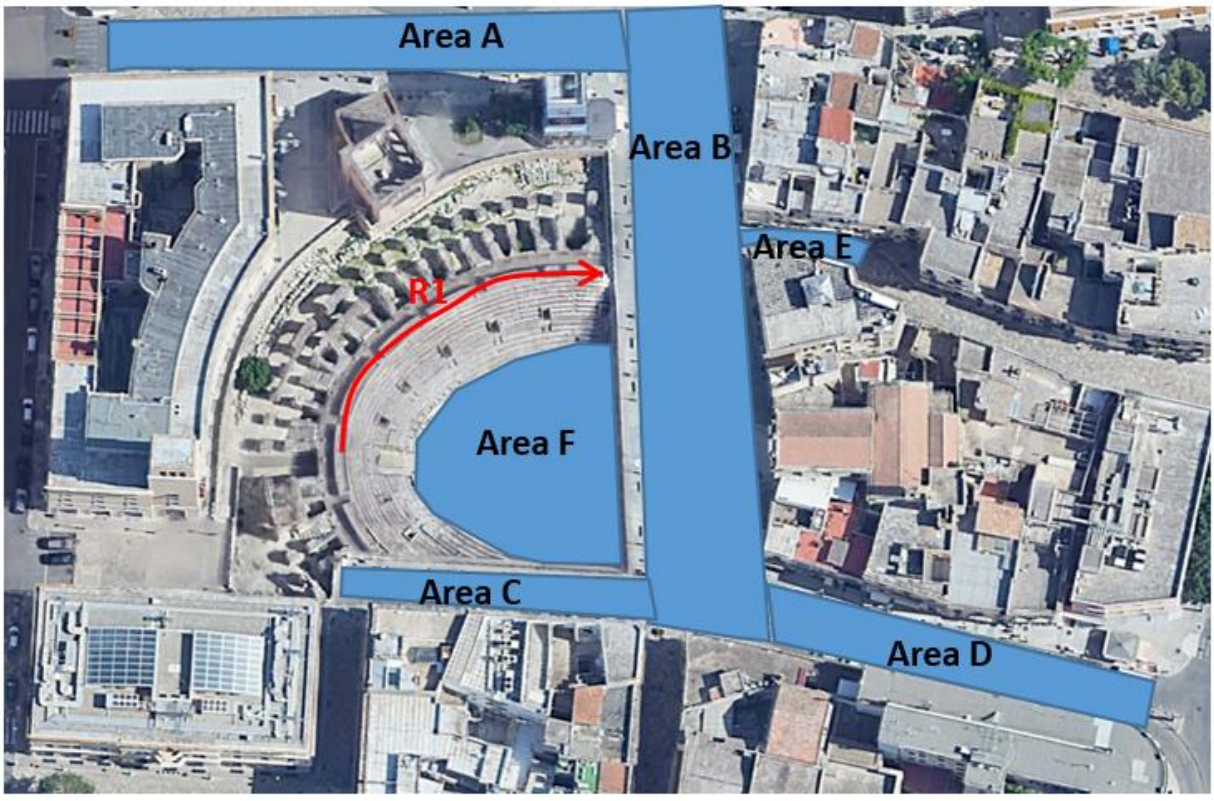

Fig. 2. Investigated areas with geophysics

II. GEOPHYSICAL DATA PROCESSING AND INTERPRETATION

For the GPR the quality of the raw data was good thanks to a series of expedients adopted in the acquisition phase. However, in order to try to eliminate a noise component, present in the data, and to allow simple interpretation of the data themselves, a processing was carried out [1].

The data analysis highlighted a good penetration of the electromagnetic signal which allowed to investigate up to a depth (for the 600MHz antenna) of about 2.4 considering an average velocity of propagation of electromagnetic waves in the subsoil equal to about 0.075m/ns.

The analysis of the data acquired in the ambulacrum with the 600MHz antenna has highlighted (Figure 3):

• some hyperbolic reflections of the electromagnetic signal linked to the probable presence of a void space (indicated with V). They are at about 0.6m in depth;

• some weak reflections (indicated with the letter W) related to the presence of structures of archaeological interest (walls) placed at a depth of about 1.2 m;

• the reflection event labelled M is related to a manhole visible on the surface.

The analysis of the data acquired in the area F with the 600MHz antenna has highlighted (Figure 4):

• some hyperbolic reflections of the electromagnetic signal linked to the probable presence of a void space (indicated with V). They are at about 0.8m in depth;

• some reflections (indicated with the letter W) related to the presence of structures of archaeological interest (walls) placed at a depth ranging from 1.8 m to 2.1 m.

The planimetry of the profiles, acquired in a grid with a step of 0.25m, made it possible to spatially correlate, in a 3D way, the anomalies present on each section using the analysis of the amplitude of the events reflected within assigned time intervals (time slices) [2, 3].

Figure 5 shows the most significant slices superimposed on the plan of the amphitheatre. The blue colour indicates a weak amplitude of the reflected signal (substantially homogeneous material); the colours from light blue to more intense red indicate variations in the amplitude of the reflected signal and therefore the presence of significant electromagnetic discontinuities. The variations in amplitude (therefore in colour) in the same slice indicate horizontal variations in the electromagnetic characteristics of the medium being investigated. In them, it is possible to identify alignments indicated with P (pipe), W (walls) and V (void spaces).

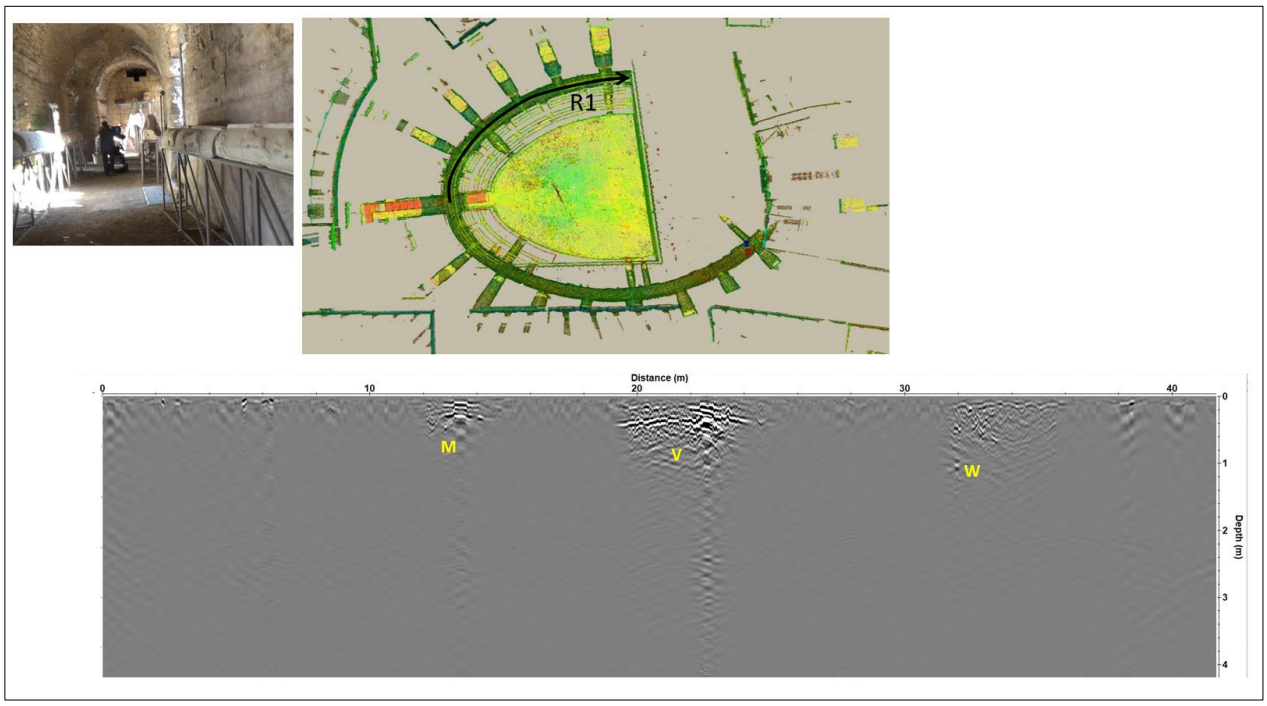

Fig. 3. Processed radar section R1 acquired with 600MHz

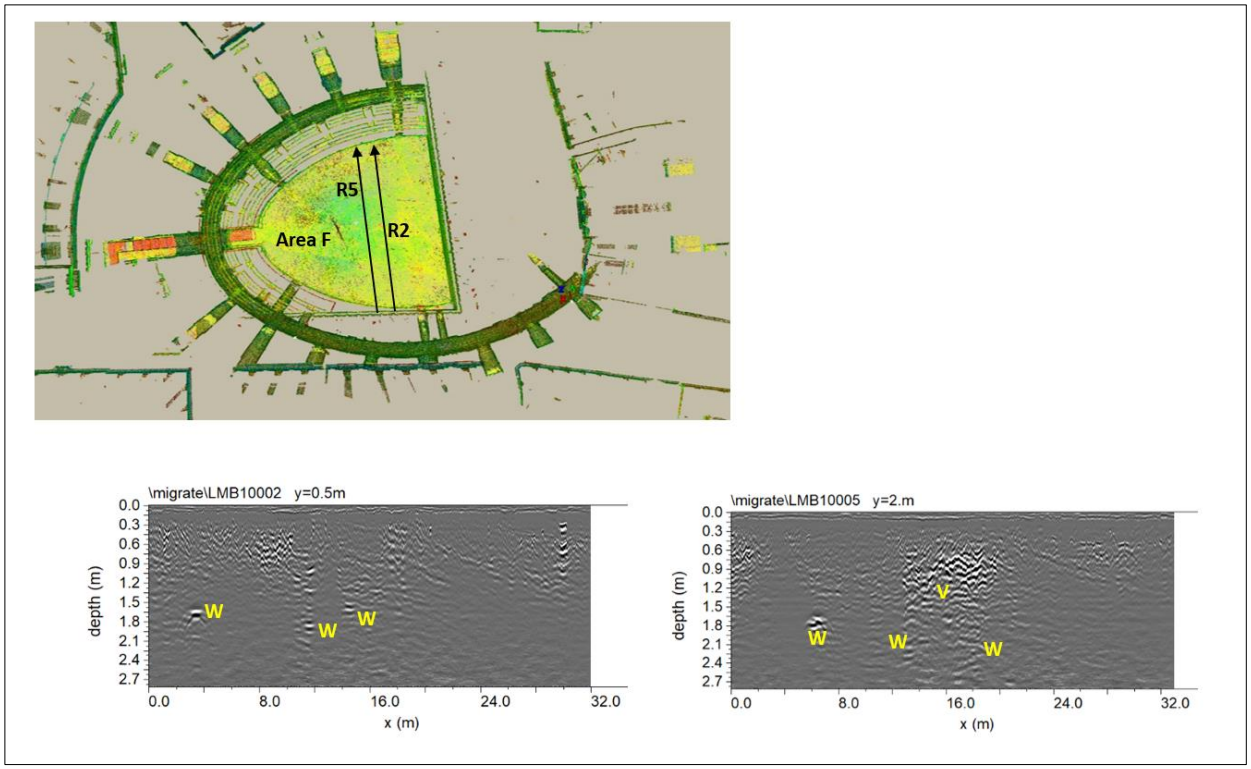

Fig. 4. Processed radar section R2 and R5 acquired with 600MHz

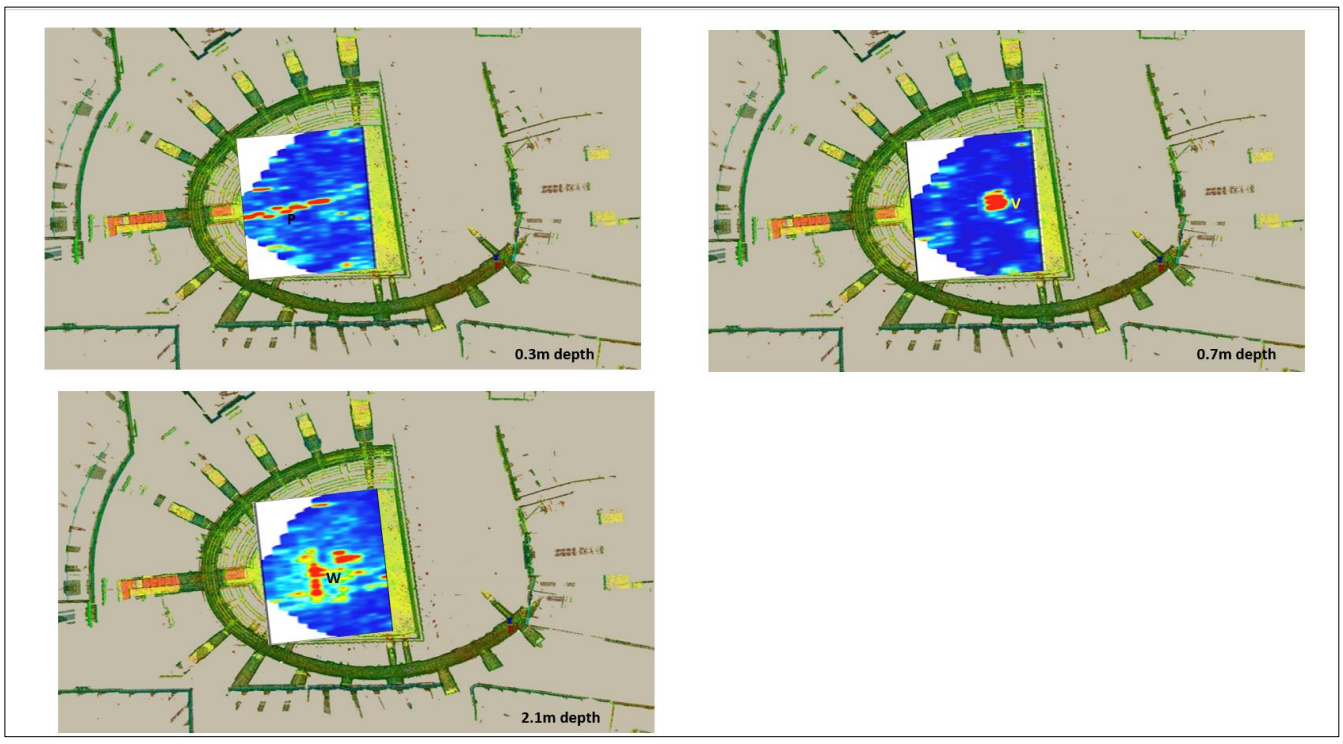

Fig. 5. Area F: depth slices superimposed on the plan of the amphitheatre (600MHz antenna) the dashed black lines indicate structures of probable archaeological interest

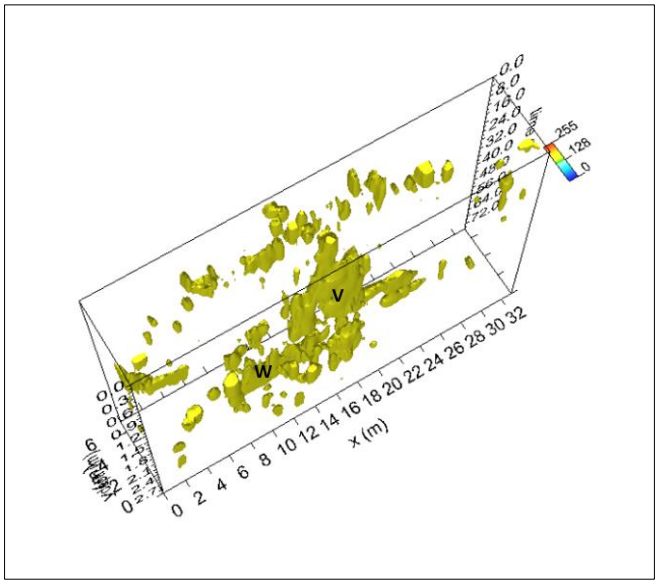

Fig. 6. Area F: 3D visualization with the iso-surcace amplitude

In the area F the 3D visualization [1] using the iso-surfaces of the electromagnetic amplitude (Figure 6) shows the 3D distribution of the anomalies (W and V).

III. CONCLUSIONS

The geophysical investigations have provided good results regarding the identification of structures present in the subsoil of the Roman amphitheatre. The GPR method made it possible to extend the investigation to a depth of approximately 2.4 m, highlighting anomalies probably attributable to the unknown structures related to the amphitheatre.

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