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Geophysical investigation at the Cathedral of Nardò (Lecce, Italy)

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***Abstract* – The Basilica of Maria Santissima Assunta is the Cathedral of Nardò, in the province of Lecce. Located in the historical center, it has been a national monument since 1879, and in 1980, during the episcopate of Antonio Rosario Mennonna, it was elevated to a minor Basilica. In order to have pieces of information related to the ancient structure of the Cathedral, geophysical surveys were undertaken inside it. In this paper, the interesting results will be presented.**

I. INTRODUCTION

The Cathedral of Maria Santissima Assunta is located in the historical center of Nardò (Fig. 1).

The Cathedral probably stands on the site where the ancient church of Sancta Maria de Nerito was once founded by some Oriental monks who escaped iconoclastic persecution in the 7th century. The cenoby, dedicated to Our Lady of the Assumption, has been present since 1088. The body of the building was modified over the centuries, starting from 1354 when the abbot Azzolino De Nestore rebuilt the façade, which had collapsed following an earthquake, and lengthened the nave with two chapels on each side, thus creating the two aisles. Other consolidations were carried out in the first half of the fifteenth century, probably after the earthquake of 1456, until the reconstruction of the facade in 1725, under the episcopate of Antonio Sanfelice, by the architect Ferdinando Sanfelice, brother of the bishop, to whom we also owe many interior reconstructions works in the style of the time (baptistery 1728). Finally, the current appearance of the factory is due to the restoration and restoration work carried out between 1892 and 1899, bringing the church back to its more classic appearance.

The church, with a basilica layout, is divided into three naves, with two orders of round and pointed arches, supported by rectangular pillars surrounded by semi-columns: the columns and walls are frescoed with thirteenth, fourteenth and fifteenth century works, including the icons of San Nicola (early 14th century), Sant'Agostino (late 14th century), Christ Pantocrator (late 12th century), Madonna and Child (attributable to the Angevin period, early 14th century) and the triptych of San Nicola, Madonna with Child and Mary Magdalene (c. 1390), the Madonna della Sanità (1234, author Bajlardo).
At the end of the central nave is the high altar with the choir stalls in walnut, inlaid in 1590 by Monsignor Fabio Fornari. Of notable importance is the 12th century wooden Crucifix, known as the Black Christ due to the particular dark color of the cedar wood. The other walls of the nave and the ribs of the vault on the altar were frescoed between 1896 and 1899 by Cesare Maccari and in the same period the high altar was rebuilt on the model of the Romanesque ciboria. The altar of the Souls in Purgatory (Placido Buffelli di Alessano, 1688), the altar of San Michele Arcangelo (1647, with altarpiece attributed to Francesco Solimena) and the Cappellone di San Gregorio Armeno (Buffelli, altar dated 1680) date back to the Baroque period, San Gregorio altarpiece by Pietro Locatelli, end of the 17th century).

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

A ground penetrating radar (GPR) method was chosen. The GPR surveys were carried out in two areas inside the cathedral (Fig. 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 600 MHz results will be shows here.

Fig. 1. The Cathedral of Nardò, province of Lecce, Italy.

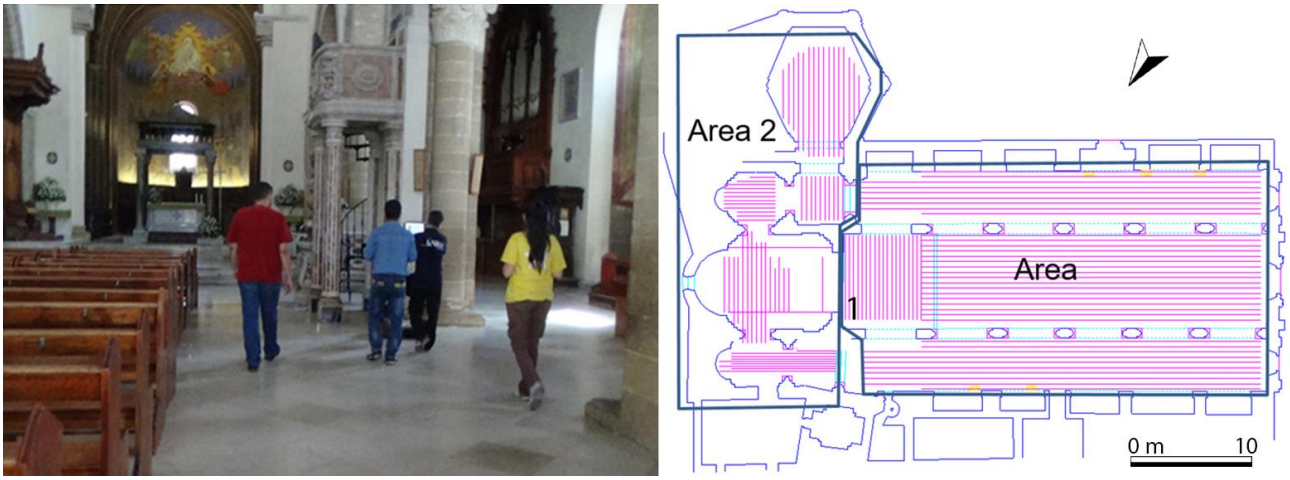

Fig. 2. The areas investigated with geophysics.

II. GEOPHYSICAL DATA PROCESSING AND INTERPRETATION

For the GPR the quality of the raw data was moderate 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 in times equal to 70 ns (for the 600MHz antenna) which correspond to a depth of about 2.4 considering an average speed of propagation of electromagnetic waves in the subsoil equal to about 0.07m/ns.

The analysis of the data acquired in the area 1with the 600MHz antenna has highlighted (Fig. 3):

• a good penetration of the signal which reaches up to

about 70ns (corresponding to about 2.5m of depth considering an average speed of propagation of the electromagnetic waves equal to about 0.07m/ns);

• some hyperbolic reflections of the electromagnetic signal linked to the probable presence of a reworked layer (indicated with R inside the dashed yellow box) inside which there is a metal grid. This layer has a thickness of about 0.5 m;

• some weak reflections (indicated with the letter "T") related to the presence of structures of archaeological interest (tombs) placed at a depth of about 0.7m;

• some weak reflections (indicated with the letter "A") related to the presence of structures of archaeological interest placed at a depth of about 0.7m.

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].

The type of analysis applied to the study area gave satisfactory results. Amplitude slices were constructed at about 0.17m intervals. The blue color indicates a weak amplitude of the reflected signal (substantially homogeneous material); the colors 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. Figure 4 shows the amplitude slices relating to the 600MHz antenna. In them, it is possible to identify alignments indicated with "A" and "T" relating to probable archaeological structures.

In the area 2 the depth slices (Figure 5) show other interesting structures (a and T) that could be related to archaeological features.

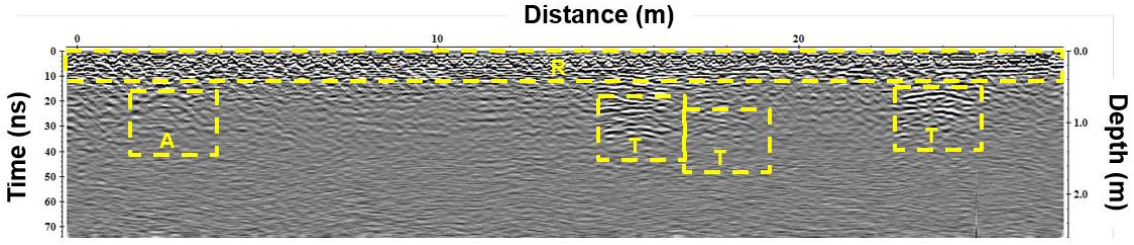

Fig. 3. processed radar section acquired with 600MHz.

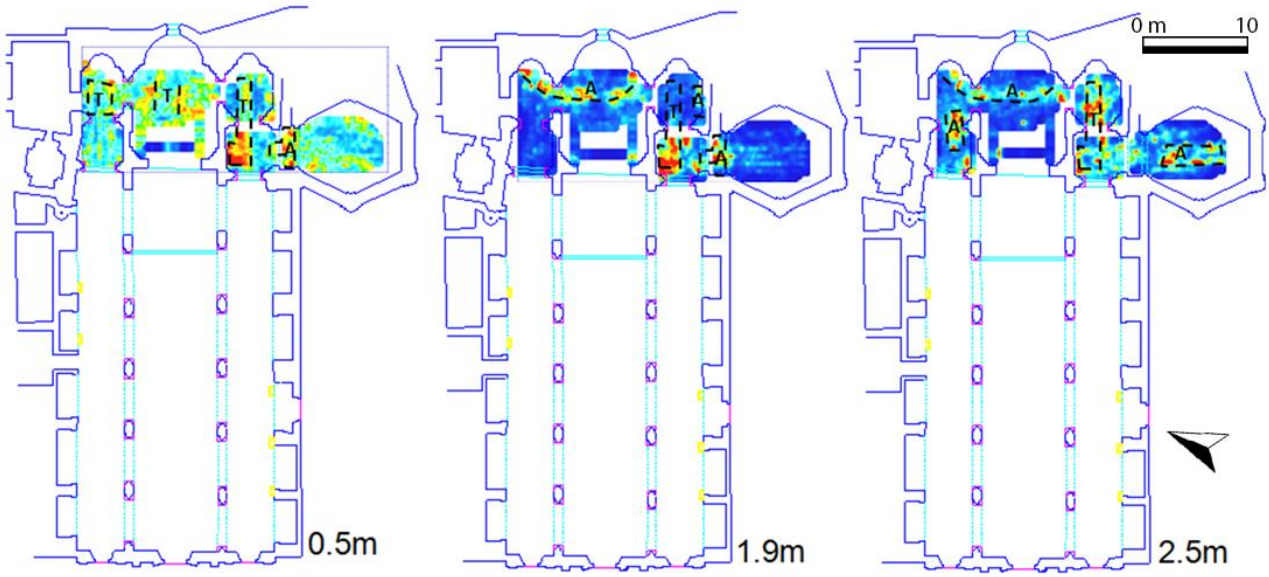

Fig. 5. Area 2: depth slices superimposed on the drone photo (600MHz antenna) the dashed black lines indicate structures of probable archaeological interest.

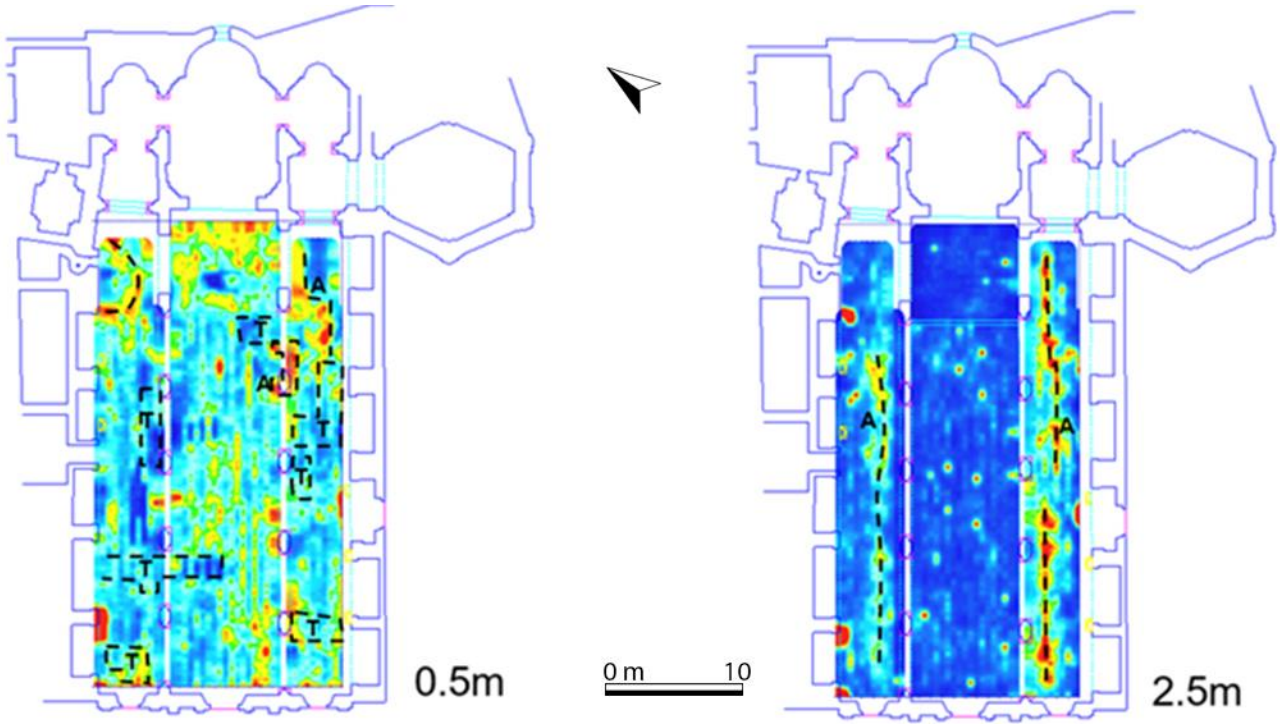

Fig.4. Area 1: depth slices superimposed on the drone photo (600MHz antenna) the dashed black lines indicate structures of probable archaeological interest.

III. CONCLUSIONS

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

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