

# Geophysical investigations on hypogeic monuments. The case study of the Crypt of St. Sebastian in Sternatia (Lecce – Southern Italy).

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In this paper, GPR data gathered by the non-destructive investigation campaign, performed by means of geophysical surveys carried out on the vault and the inner pillar of the Crypt of San Sebastiano are shown. The study is part of a wide preliminary diagnostic campaign aimed at the restoration of the monument, which included a thermographic relief on the painted walls and on the vault, a monitoring of climatic parameters such as temperature and relative humidity of the air and of the wall surfaces. In addition, in order to identify the materials constituting the wall paintings and their alteration products, a complex microdestructive diagnostic plane were also performed on micro samples taken from . The gathered GPR data allowed us to identify the anomalies of the calcarenitic mass in order to highlight structural problems that could affect the stability of the monument. To this regard, a different behavior, in terms of homogeneity, alteration and microfracturing of rocky mass has been highlighted for the vault and the pillar of the crypt.

milestones: non destructive diagnostic for conservation and restoration, energetic efficiency and development of ICT tools for the fruition and enhancement of cultural heritage. In this paper, we report the data gathered by GPR investigation performed on the vault.

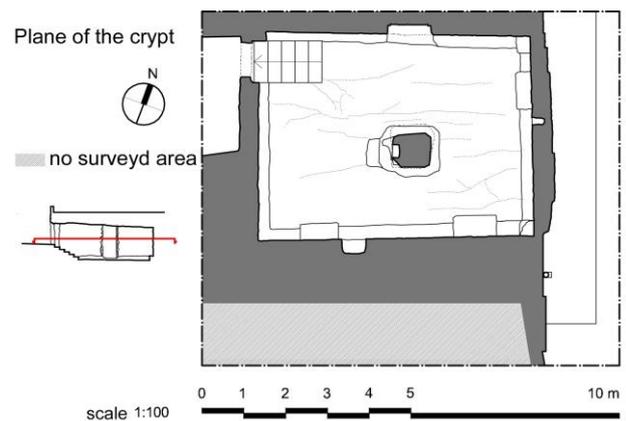


Fig. 1. Plane of the St. Sebastian Crypt

## I. INTRODUCTION

Before the restoration works of the wall paintings present within the Crypt of St. Sebastian (Sternatia, LE), a complex diagnostic study was carried out, with the aim to evaluate the environmental conditions (relative humidity and temperature of the air and of the painted surface) and the stability of structure.

These investigations, conducted in collaboration with Ibam-Cnr of Lecce and with the Non-Destructive Diagnostic Laboratory of the Politecnico di Torino, were carried out within the research project "IN-Cul.Tu.Re. Innovation in CULTure, TURism and Restoration ", funded by MIUR within the call "Smart Cities and Communities and Social Innovation "and carried out in the period 2012-2015. This project promoted a multidisciplinary research on the cultural heritage of Grecia Salentina (LE) based on three thematic



Fig. 2. The inner of the St. Sebastian Crypt

## II. GPR PROSPECTIONS

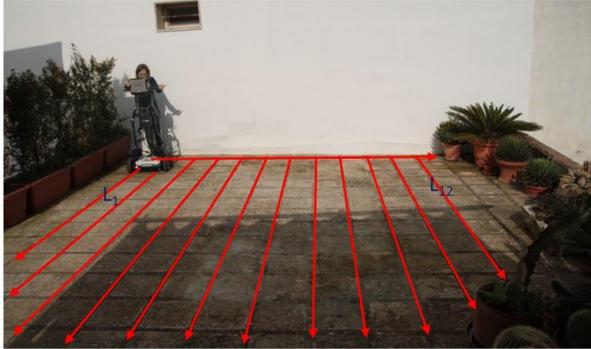


Fig 3a. First GPR prospection scheme on the vault



Fig. 3b. Second GPR prospection scheme on the vault

Geophysical survey was undertaken in five areas using Ground-penetrating Radar (GPR) technique. A Ris Hi mod georadar system with a dual band 600MHz-200MHz antennae was used. The GPR data have been gathered with a transect of 0.5m between any two adjacent measurement line, and the data have been processed by making use of the GPRSLICE code [1]. Particularly, the processing has consisted in zero timing, background removal, gain variable vs. the depth and Kirchhoff migration [2]. The dielectric constant has been retrieved from the diffraction hyperbolas [2]. In particular, here we focus on the results obtained with the antenna at 600 MHz.

## III. RESULTS AND DISCUSSION

Observing the slices, it is possible to highlight that at few centimeters from planking level, namely in the slice between 0.1 and 0.28 cm (Fig. 4), an anomaly curved shaped is present. It could be related to the higher part of the ceiling of the crypt showing an irregular and different thickness of the as shown in the photo of figure 5, shot from the garden of the house located above the crypt.

Moving in depth, the slices show the signals of rocky substrate of the crypt which increase up to the slice represented in Fig. 6. The strong signals recorded remark the interface of the ceiling of the vault that can be signed by the dashed red line (Fig. 6). In correspondence of the slice located to 0.84-1.02 m in depth, another regular and circular anomaly, marked by red circle, is present.

The B-scans of Fig. 8 and 9 show the rock mass constituting the vault of the crypt is sufficiently homogeneous that allow us to exclude anomalies related to micro fracturing or other instability phenomena. The thickness of the vault of the crypt is between about 0.75 and 1.0 m.

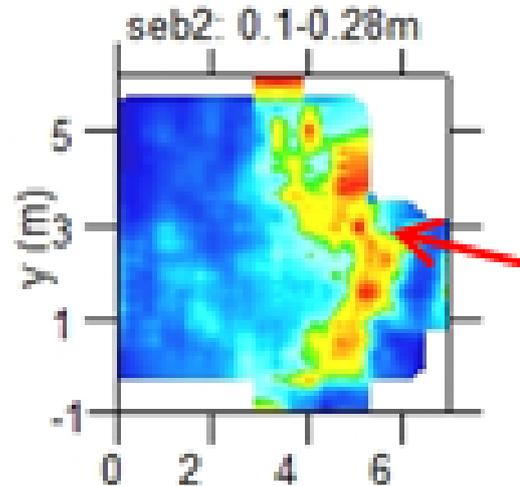


Fig. 4. - Time slice 0.1 – 28 m depth



Fig. 5. View of the irregular thickness of the vault of the crypt.

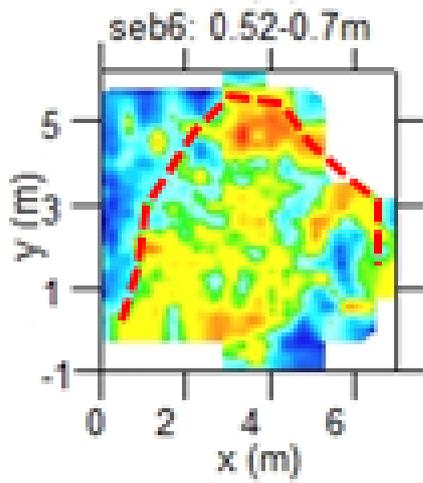


Fig. 6. Time slice 0.5 – 0.7 m depth

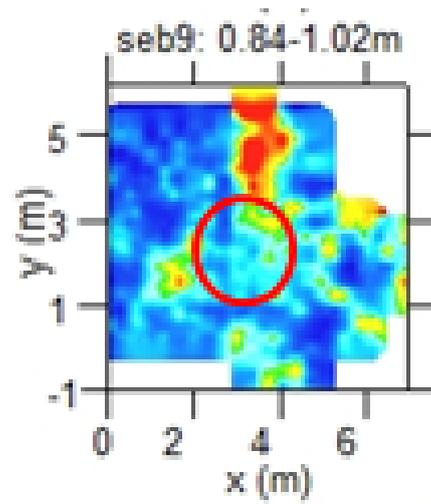


Fig. 7. – Time slice 0.8 – 1 m depth

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