Microclimatic and Ground-Penetrating Radar surveys in the Crypt of the Duomo of Lecce (Italy)

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Microclimatic and Ground-Penetrating Radar results

Comparing the microclimatic results with the amplitude spectrum analysis, done on the GPR signal, windowed around 1m depth, corresponding to the frequency 200MHz (Fig. 1 and Fig. 2), we observe that in areas with high volumetric water content (along the side aisles and the main nave) the EM energy attenuation is higher. This situation is almost similar to that observed for the spatial RH distribution (Fig. 1b).

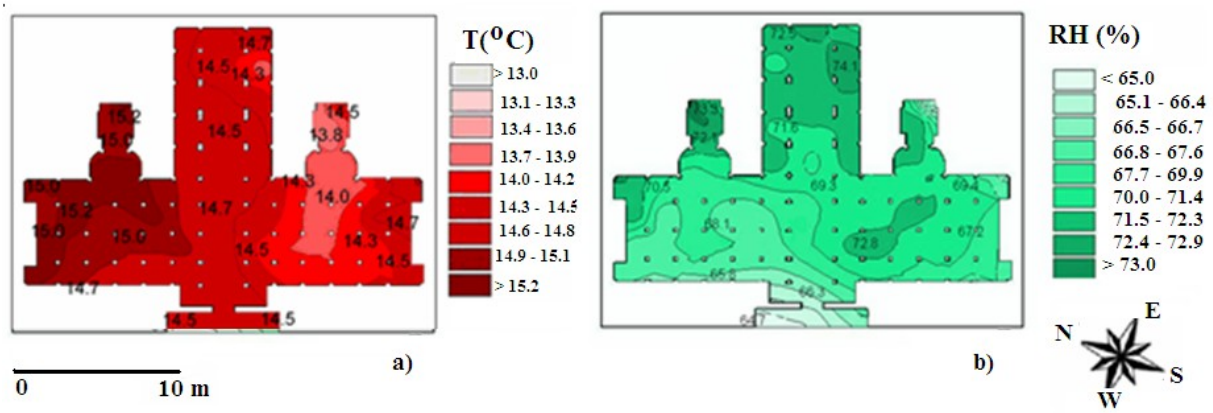

Figure 1. Typical spatial distribution of a) T and b) RH (06/11/2009).

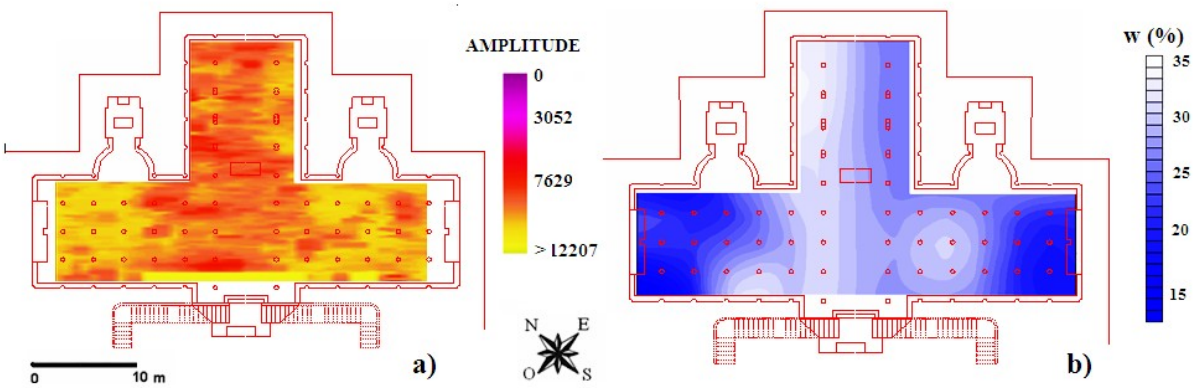

Figure 2. a) The slice corresponding to 200MHz, b) the map of the volumetric water content (w).

This scenario describes a situation in which salt efflorescences on the surfaces are due both to rain water absorbed on the walls, and from rising damp which is fed by the subsoil, especially on the columns [1].
The crypt masonry is built with a local soft bioclastic limestone ("pietra leccese") with high porosity, so when rain water is absorbed, it dissolves the $CaCO_3$ of the limestone and salts deposit on its surface over

time. During late spring, summer and autumn salt solution migrates within the pore system of the walls, but does not precipitate. The solution reaches saturation and begins to crystallize visibly when surface temperature is about 12 °C, or below. As water percolates through stones, it accumulates niter that originated from the subsoil, as assessed by chemical analysis. This origin could be attributed to organic matter on which the Crypt was built, in fact it was used as burial place over a long period [2], thus probably that farmland was not completely cleared prior to construction.

Reconstruction of the archaeological stratigraphy

The GPR images (Fig. 3) show the presence and distribution of features with shapes, sizes and burial depths that suggest they are of Roman and possibly earlier age. Most of them are interpreted as tombs. High to moderate-amplitude GPR anomalies were identified as tombs in the shallow subsurface (Fig. 3a), placed just under the floor of the Crypt, while in the deeper subsoil anomalies (Fig. 3c) of regular shape were found. These could be interpreted as other possible archaeological structures, probably from the Roman period, while the geometrical shape of a deeper and regular anomaly could be related to another older tomb.
These results show that the surveyed area was used as a burial location by people of different cultures who inhabited the town over a long period, at least since the second part of the fourth century BC, in the Messapic age, through the Roman age. Burials probably continued all the way into the twentieth century as shown by the known tombs present in the Crypt. Our findings confirm the same orientation of De Giorgi's findings [3], showing cultural continuity of the area as a sacred place over time.
Very intriguingly, we think is also important to consider that the structures revealed by GPR could belong to the Roman 'forum' area (not yet documented or located), in agreement with the hypothesis of many archaeologists who suggested it was probably situated in the area of the actual Duomo.

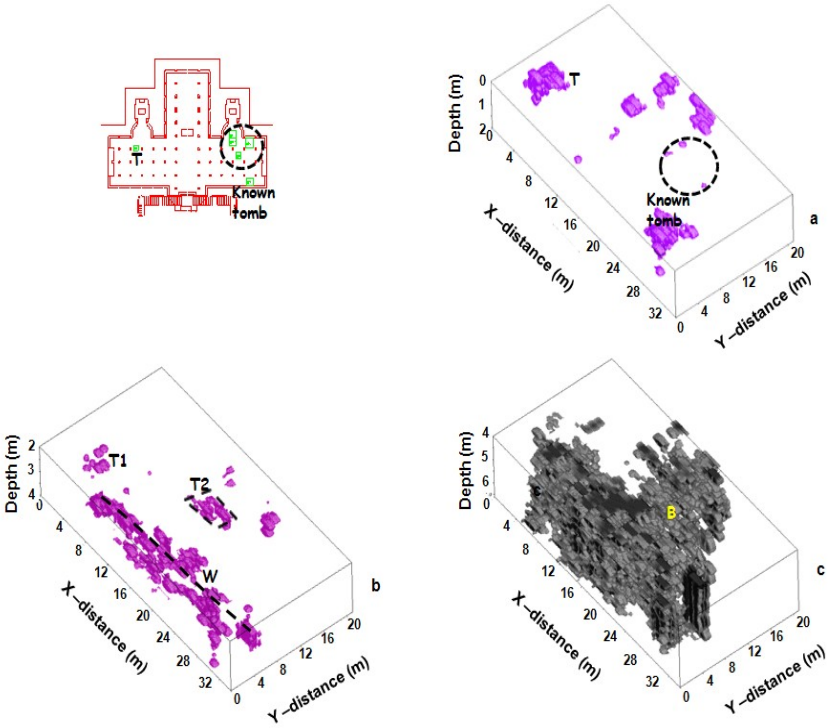

Figure 3. Iso-surface visualization of the envelope of the processed data, showing (a) shallow (b) medium, and (c) deep GPR anomalies related to the buried remains.

REFERENCES

1. Cataldo, R., Leucci, G., Siviero, S., Pagiotti, R., Angelini, P. 2009. Diagnostic of the conservation state in the crypt of the Abbey of Montecorona. Journal of Geophysics and Engineering 6: 205–220.
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3. De Giorgi, C., 1907. Lecce sotterranea. Relazione su gli scavi archeologici eseguiti in Lecce dal MCM al MCMVI.