GEORADAR AND ENDOSCOPIC INVESTIGATION INSIDE ZUCCARI PALACE - ROME (Italy)

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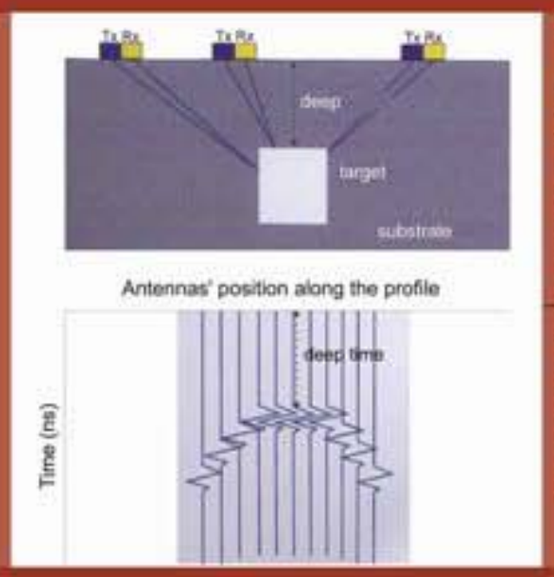


THE GPR METHOD

Ground-penetrating-radar information is acquired by collecting radar pulses reflected by subsurfaces features, in a way is similar to how a airborne radar detect an airplane The radar waves are emitted in distinct pulses from a surface antenna; reflected by buried objects, features or bedding contacts, and detected back by a receiving antenna.

As radar pulses are trasmitted through various layers on their way to the burried target feature, their velocity changes depending on the electrical and magnetic properties of the material through which ther are traveling. When the travel times of the energy pulses are measured and their velocity through the ground is know, distance (or depth in the ground) can be accurately measured. In the GPR method, radar antennas are moved along the ground and two-dimensional profiles of a large number of traces are created, producing a profile of subsurface stratigraphy and archaeological features along transects.

DATA ACQUISITION

The scope of the GPR survey was the investigation of the inner structure of the vaults in order to better understand the constructive techniques used. The data of two rooms, identified with the code R1 (room1) R2 (room2) have been acquired mostly with 900 MHz antennas, to obtain a good vertical resolution and, at the same time, a good signal penetration. Moreover, in each room, along the greater aces, data have been collected also with the 1200 MHz antenna. The measures have been executed placing the antennas Tx and Rx with prefixed distance (0,17 m), maintaining them perpendicular to the direction of the profile (Pr-bd, perpendicular broadside). The data have been acquired with a sampling step of 0.02 m (step mode) to avoid the spacial aliasing and, therefore, a false image of the not-horizontal reflectors and of the diffraction tails. The traces have been acquired with a stacking equal to 16 and the time window of 40 ns for the 900 MHz antennas and of 20 ns for 1200 MHz antenna. Videoendoscopic investigation have been also carried out in correspondence of 25 holes (with the maximum diameter of 2-3mm) in the vault and in the garret of R1 and R2 with two atmospheres, to define the structural and physical characteristics.

ROOM1

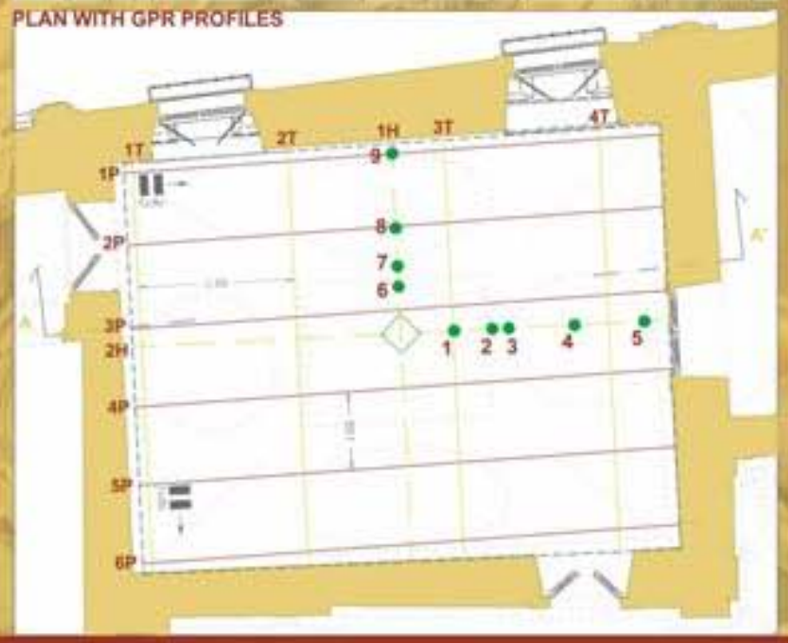
TABLE

Profiles	(MHz)	(mt)
1R9001P	900	6.54
1R9002P	900	6.5
1R9003P	900	6.54
1R9004P	900	6.54
1R9005P	900	6.54
1R9006P	900	6.54
1R9001T	900	4.92
1R9002T	900	4.94
1R9003T	900	5.55
1R9004T	900	5.24
1R9001H	900	2.44
1R9002H	900	3.08
1R12G1	1200	5.24
1R12G2H	1200	6.80

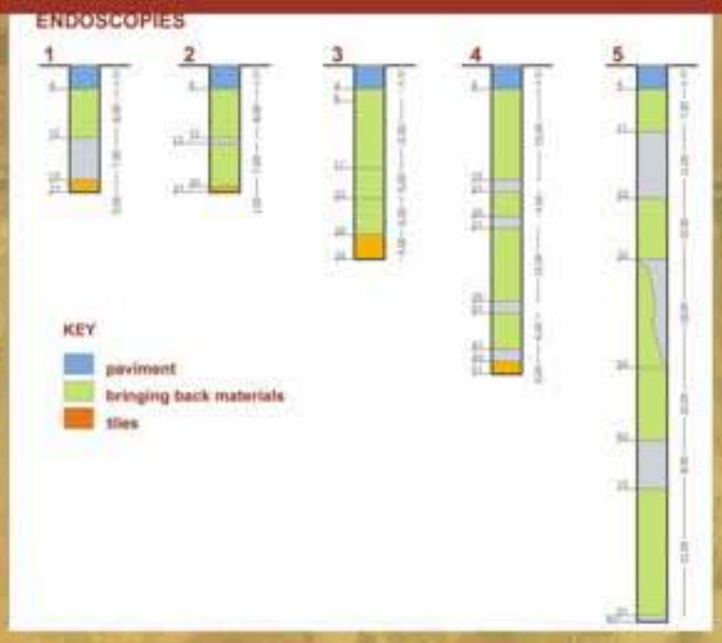
In these pictures are represented the section and the plan of room1 profiles GPR and the relative endoscopies, indicating the depth and the material of every layer that constitutes the structure of the vault, such layers are evidenced in section GPR 2D and the relative reconstruction 3D where the presence of corner reflectors is clear.

SECTION AA'

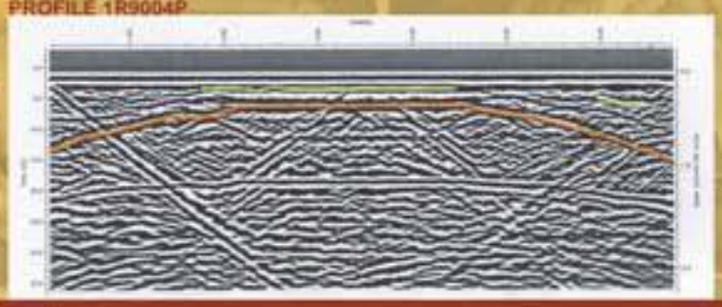
PLAN WITH GPR PROFILES

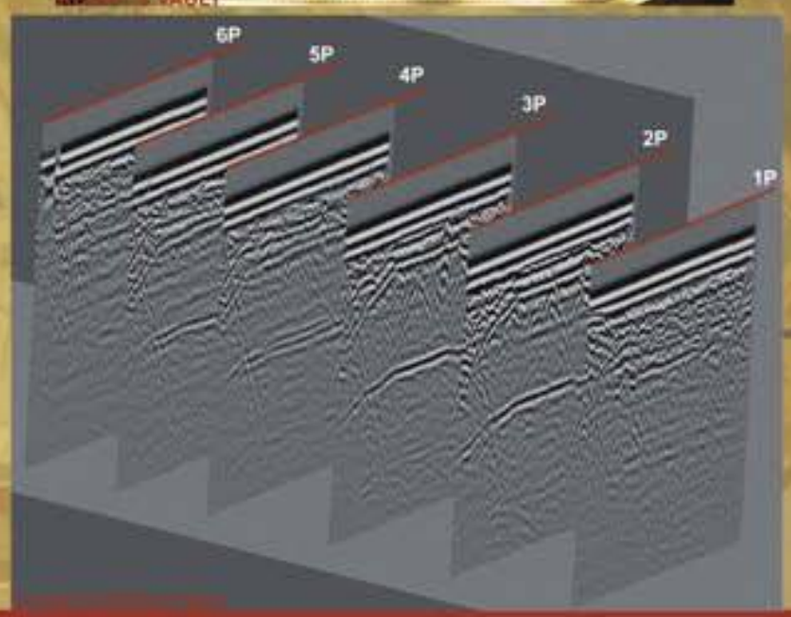


ENDOSCOPIES



PROFILE 1R9004P



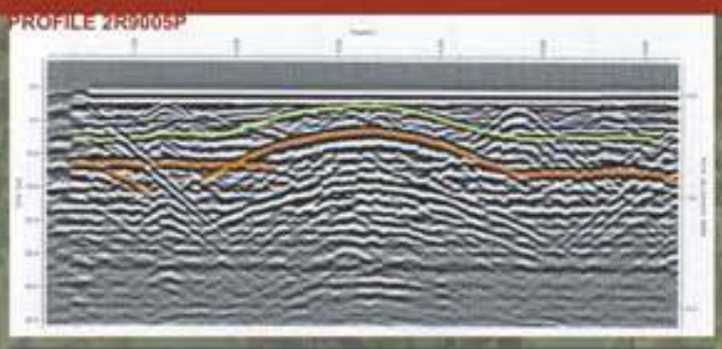


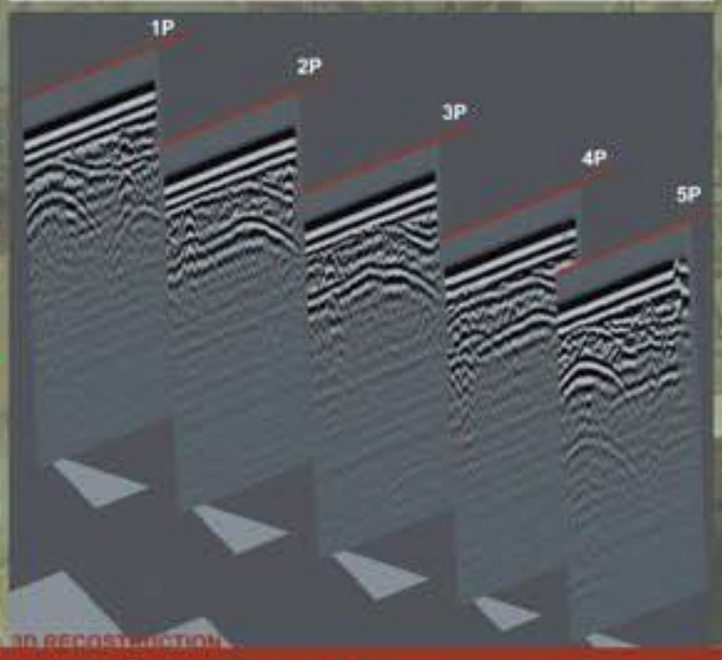
ROOM 2

TABLE

Profiles	(MHz)	(mt)
2R9001P	900	3.29
2R9002P	900	3.29
2R9003P	900	5.12
2R9004P	900	3.07
2R9005P	900	5.45
2R9001T	900	3.36
2R9002T	900	1.92
2R9003T	900	3.36
2R12G1H	1200	4.63
2R12G2H	1200	6.16

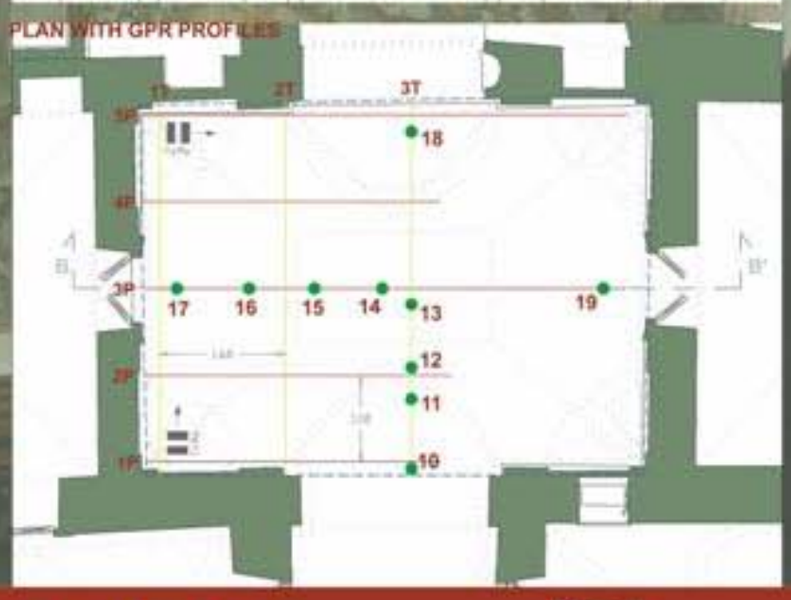
PROFILE 2R9005P





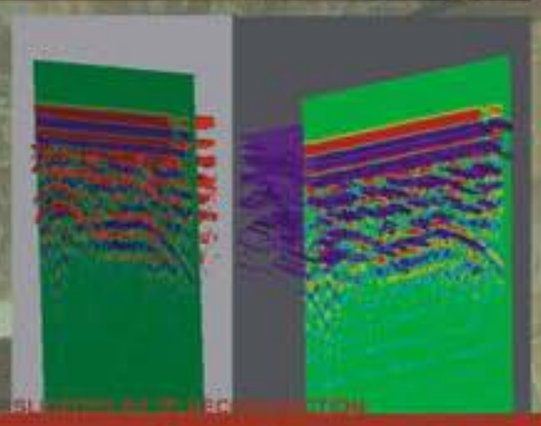
SECTION BB'

PLAN WITH GPR PROFILES



CONCLUSIONS

The single GPR sections, the endoscopies and the 3D reconstruction have allowed to visualize in continous way the contacts between the progressive filling and the bulkhead and between the bulkhead and the empty layer; it has been, therefore, possible to characterize the geometry of the vault. In this way, a very detailed information about the variation of the thicknesses of the single layers (already finds in buildings of the XVI th century) as a function of the position in the paving has been obtained. The present results demonstrate the potential of using nondestructive techniques like GPR to investigate the state of the structure of the vault on the precious frescoes work of Federico Zuccari at the end of 1500.



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