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PHOTOGRAPHING INTERNAL FRACTURES OF THE ARCHAEOLOGICAL STATUES WITH 3D VISUALIZATION OF GROUND PENETRATING RADAR DATA

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The aim of the study is to illustrate a new approach to image the discontinuities in the archaeological statues before restoration studies using ground penetrating radar (GPR) method. The method was successfully applied to detect and map the fractures and cavities of the two monument groups and lion statues in Mustafa Kemal ATATURK's tumb (ANITKABIR) in Ankara-Turkey. The tumb, which has been started to build in 1944 and completed in 1953, represents Turkish people and Ataturk, who is founder of the Republic of Turkey. Therefore this monument is very important for Turkish people. The monument groups and lion statues have been built from travertine rocks. These travertine have vesicular textures with the percent of 12. They have been mainly composed of calcite, aragonite with rare amount of plant relict and clay minerals. The concentrations of Fe, Mg, Cl and Mn may lead to verify their colours changing from white through pale green to beige. The atmospheric contamination of Ankara has been caused to cover some parts of the surface of these travertine with a thin film of Pb as blackish in colour. The micro fractures have been observed specially at the rim of the vesicular of the rocks by the polarizing microscope.

Parallel two dimensional (2D) GPR profile data with 10cm profile space were acquired by RAMAC CU II system with 1600 MHz shielded antenna on the monument groups (three women, three men and 24 lion statues) and then a three dimensional (3D) data volume were built using parallel 2D GPR data. Air-filled fractures and cavities in the travertine had maximum positive reflection coefficient. Therefore, after processing, a simplified amplitude-colour range was assigned for maximum positive and negative polarities and the rest. The colour limitation made small scale fractures visible on the radargrams. However, solid 3D block data with linear opacity could not image the fractures and cavities exactly. A new opacity function was constructed, which dominates maximum positive amplitudes and eliminates other irrelevant amplitudes. Therefore, transparent 3D image of the GPR data were obtained for the fractures. Interactive visualization of the fractures with their depth and direction was done by using sub-blocks of the transparent 3D volume. Vesicular textures within travertine were supported by the GPR results. Mapping fractures and cavities in the statues could indicate the stability case of them and showed the best way to minimize restore cost.