Ground-penetrating radar discovery at Petra, Jordan

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FIGURE 1. *GPR grids at the 'Lower Market' site, looking north.*

FIGURE 4. Trench 6 excavation showing Corner A of the northern structure (mapped in FIGURE 3). The function of the wall extension below the corner is not known.

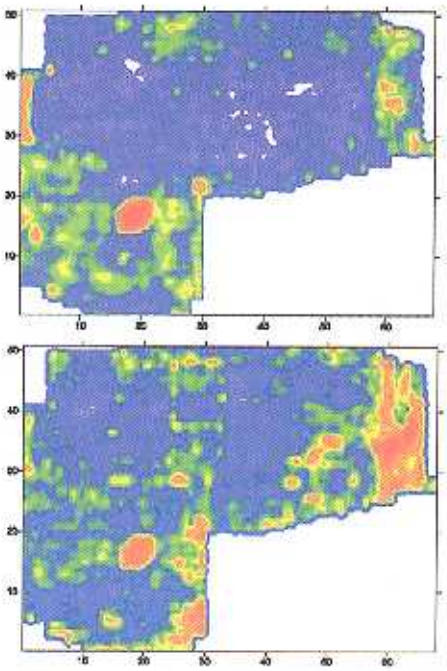

FIGURE 2. *GPR amplitude slices from 25–50 cm depth (upper map) and 50–75 cm (lower) in Grid 1. Blue colours are very low-amplitude reflections, indicating open areas. Red areas are high-amplitude reflections, indicating the presence of buried stone architecture. The northern structure, mapped more precisely in Grid 2, can be seen in the lower slice at the centre top of the map.*

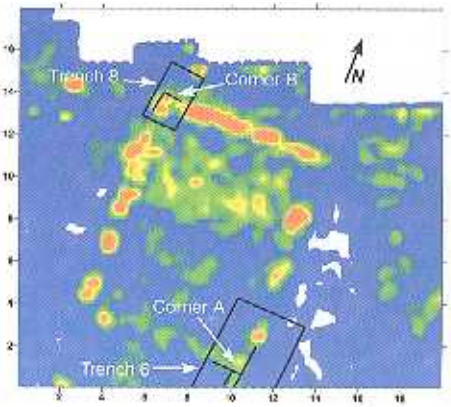

FIGURE 3. Amplitude slice map from 50–75 cm depth of the northern structure. Two corners were confirmed in test trenches.

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The archaeological site of Petra is noted for its impressive monumental architecture and rock-cut façades. An open portion of the site (termed the 'Lower Market'), located at the heart of Petra's city centre just east of the 'Great Temple', was tested with ground-penetrating radar (GPR). The purpose of this survey was to locate buried architecture as a guide for the placement of excavations.

Although there were few surface indications of buried architecture in this area, its central location suggested the area might be somehow related to the ceremonial, economic or political activities of the city. Previous excavations near by discovered an open-air pool with an island-pavilion at its centre (Bedal 2000). These findings indicated that the 'Lower Market' area was likely a formal garden.

In July 2001 GPR mapping of the northern portion of the Lower Market was begun, using a GSSI (Geophysical Survey Systems Inc.) SIR-2000 radar system. A 400-MHz dual antenna was used to collect GPR reflection data over two grids with a maximum extent of 68x51 m (FIGURE 1).

Ground-penetrating radar is a geophysical method that can map the spatial extent of buried objects and archaeological features in three dimensions. Radar waves are propagated in pulses from a surface antenna, reflected off buried objects, features, bedding contacts or soil units, and detected back at a surface receiving antenna (Conyers & Goodman 1997). Any contrast in buried materials will produce a reflected wave whose amplitude is a function of the difference in physical or chemical properties.

When the travel times of radar pulses are measured, and their velocity through the ground is known, depth in the ground can be accurately measured (Conyers & Lucius 1996). In the GPR method, radar antennae are moved along the ground in transects producing many two-dimensional profiles of subsurface stratigraphy and buried features. When the reflections are correlated and processed within a grid of data, an accurate three-dimensional picture of buried features and associated stratigraphy can be constructed. Horizontal slice-maps of the highest amplitude reflections produce images of buried architecture while areas of low amplitude denote little reflection and therefore open areas between buildings.

A number of buried structures were discovered in the 'Lower Market' using these methods, the most impressive being a 10x8-m rectangular structure in the northern portion of Grid 1 (FIGURE 2). This building was of interest because it appeared in the GPR maps as a rectangular stone outline with an open interior space (FIGURE 3), unlike the solid stone construction of nearby buildings. Also of interest were the regularly spaced gaps around three sides, which give the impression of colonnades, indicating a possible pavilion, or shrine. This type of architecture is anticipated in a formal garden setting where the visibility of surrounding gardens would be of primary importance. Its location, directly opposite the previously excavated island-pavilion overlooking the colonnaded street to the north, suggests an important focal point of the ancient garden.

The GPR maps were used as a guide for positioning test trenches to encounter the northwest and southeast corners of the structure. Both excavations found them in exactly the location mapped by GPR (FIGURE 4). Adjacent to the building's walls, two organic rich layers, also visible in GPR profiles, were found to have characteristics consistent with cultivated soils.

Future excavations will involve additional exposure to test each soil unit in the hope of determining their relationship to the architecture. Many additional architectural features found by GPR will also be tested, now that their exact locations are known.

References

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