# Ground-penetrating Radar Exploration and Mapping in the American Southwest

Lawrence B. Conyers, University of Denver

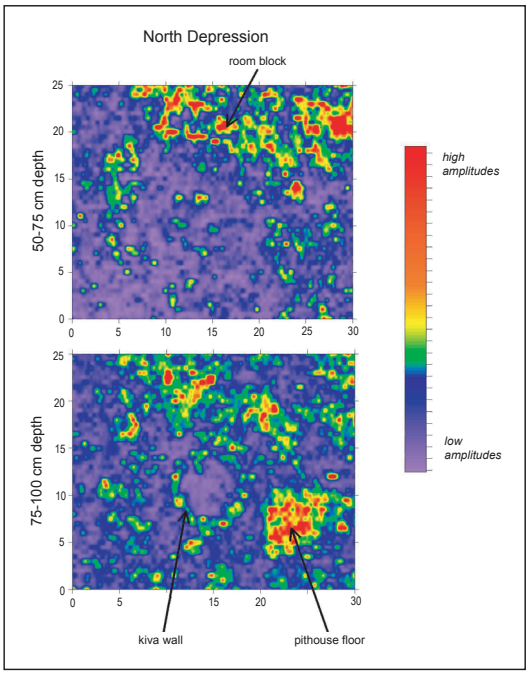
*Larry Conyers operating GPR equipment at a site in Ecuador.*

ARCHAEOLOGISTS WORKING in the American Southwest have long appreciated the potential of geophysics for locating, mapping, and understanding the buried cultural materials that historically have been found through surface surveys, random shovel tests, and backhoe trenching. A method called ground-penetrating radar (GPR) enables us to readily detect stone walls, stone or compacted earth foundations, and clay or compact earth floors. As such, GPR may transform the way sites are discovered, mapped, and interpreted.

GPR works by reflecting radar pulses off of buried materials and then placing them in three-dimensional space. Data are usually collected in parallel transects spaced 50 centimeters apart in grids of up to 100 by 100 meters. Reflections are processed into two-dimensional vertical profiles and plan-view maps, which produce images of the location and strength of the reflections.

Some buried features made of stone or compacted clay, such as those commonly found on the Colorado Plateau, are very reflective to radar waves. These produce high-amplitude reflections that are identifiable in two-dimensional GPR reflection profiles and in amplitude slice-maps, which are analogous to excavation levels. In the Hohokam area of southern Arizona, however, buried architecture is usually made of the same earth as its surrounding matrix, so it does not produce distinctive interfaces that can reflect radar waves. In these cases, buried architecture may be delineated as areas of no reflection or as regions where more highly reflective adobe melt layers are found adjacent to intact walls of more homogeneous adobe. Other archaeological features readily visible through GPR include baking ovens, storage cisterns, pit structures of various shapes and sizes, and irrigation canals filled with coarse sediment.

An example of GPR's interpretive power comes from my student Tiffany Osburn's study of Pueblo II (A.D. 900–1150) and Pueblo III (1150–1300) period sites at Comb Wash in southeastern Utah. Archaeologists had identified at least five circular surface depressions with associated pottery. Interpreted as great kivas, the depressions were seen as evidence of strong ties between this area and Chaco Canyon during the Pueblo II period. To test this hypothesis, we collected grids of closely spaced GPR profiles over each of the depressions, producing horizontal amplitude slice-maps. In three locations, Tiffany mapped small domestic kivas with associated room blocks and earlier pit structures. These remains are consistent with individual farming households, not great kivas. The other two depressions contained no buried architecture whatsoever, and are of unknown origin. GPR mapping not only produced images of buried architecture, but also provided a non-invasive means of testing ideas about human behavior and cultural connections.




*A horizontal amplitude slice-map from a large, circular depression at a site in Comb Wash, Utah. GPR detected the remains of a room block at 50-75 cm depth. Remains of an associated kiva and an earlier pit structure also became apparent at 75-100 cm depth.*

Examples of GPR mapping from southern Arizona sites support its utility and illustrate the limitations that certain geological conditions present. The walls of a Hohokam Classic period mound at University Indian Ruin in east Tucson were visible as areas of low amplitude reflections or no reflection. At this site, low amplitudes denoted walls that had no surface expression other than a low, broad rise. At the Rillito Fan site, on the east bank of Tucson's Santa Cruz River, GPR reflection profiles revealed distinctive canals from the Early Agricultural period. About 75 centimeters of overburden had to be removed prior to GPR collection in this area, however, because river sediment is electrically conductive, and tends to destroy radar energy with depth. Moreover, only those stretches of the buried canals containing sediment fill different from the surrounding matrix produced radar reflections.