INL/CON-05-00330
PREPRINT

Geophysical Investigations of Archaeological Resources in Southern Idaho

Great Rift Science Symposium

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October 2005

The INL is a
U.S. Department of Energy
National Laboratory
operated by
Battelle Energy Alliance

Idaho National Laboratory

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Archaeologists today are frequently turning to sophisticated tools, many from the field of geophysics, to use along with traditional shovels and trowels in the study of the past. Long a mainstay in the archaeology of Great Britain, Europe, and the Middle East, these techniques are now being deployed in an increasing number of archaeological settings in the U.S. largely because major advances in instrumentation have increased speed, sensitivity, and digital image processing to allow for rapid, effective identification of low-contrast features such as hearths, middens, and house floors, which characterize prehistoric archaeological sites in the U.S. (Mussett 2000).

Devices like ground penetrating radar and magnetometers are ideally suited to many archaeological research problems because they provide rapid three-dimensional images of sensitive deposits and do this in a nondestructive manner. One of the primary values of near-surface geophysical methods to the practice of archaeology lies in their cost-effectiveness. Mapping of the basic subsurface structure of a site and the layout of archaeological features within it can guide the placement of traditional excavations to areas of potentially greater interest, saving time and money in the process. Geophysical methods are also attractive because they are non-destructive and allow for the preservation of archaeological deposits for future generations. They permit non-invasive examination of culturally sensitive burial, sacred, or ceremonial sites, which can be essential in maintaining positive relationships among stakeholders and Native American Tribes.

In archaeological contexts, geophysical tools key on basic differences in moisture, compaction, and other physical characteristics of the soil that are associated with cultural features such as fire hearths, activity areas, and various cavity features like burials, caches, or earth ovens. In cave settings, it is also possible to see natural features like roof-fall and buried chambers that are of interest in planning archaeological excavations. So, while a concentration of obsidian debitage left next to a fireplace will not necessarily be visible, certain devices will highlight the burned soil within the fire pit. Differential compaction and moisture content within the hard-packed soils surrounding the fireplace will also map differently from areas that were used less intensively.

There are a number of tools available for use in archaeological applications. These tools are either active (create and direct their own primary fields of energy), or passive (measure existing fields such as the Earth's magnetic field). In our investigations in southern Idaho, we have achieved success with two active methods, Ground Penetrating Radar (GPR) and Electro-Magnetic Induction (EMI).

GPR is an active method where a transmitter and receiver are pulled along the surface of the ground. Electromagnetic waves are sent through the ground where they continue to travel until they meet an object, which reflects them. The waves bounce back to the surface and the time taken to travel the distance can be measured and imaged.

EMI is another active method where a handheld instrument that contains a transmitter on one end and a receiver at the other is carried across the site surface. Oscillating electromagnetic energy penetrates the ground and induces secondary electromagnetic fields in regions of elevated electrical conductivity. These differences in the electrical properties of soils beneath the instrument can be measured and imaged.

Geophysical studies have been sporadic in archaeological investigations in southern Idaho, largely as a result of the relatively ephemeral cultural features that characterize the prehistoric archaeology of the region. The Idaho National Laboratory (INL) in southeastern Idaho is a storehouse of valuable equipment and scientific expertise and INL scientists have begun to explore opportunities for collaborative research and fieldwork in this growing field. Both GPR and EMI have been employed successfully by the INL team to successfully map a 1,300 year-old hunting campsite located on INL lands (Pace et al. 2003, Pace 2004) and a lava tube cave known as Kelvin's Cave on Bureau of Land Management property near Twin Falls (Henrikson and Long N.D., Pace et al. 2004).

The INL in southeastern Idaho occupies 890 square miles at the base of the Big Lost, Lemhi, and Bitterroot Mountains. Craters of the Moon lies a short distance to the southwest. This landscape is characterized by rolling sagebrush plains punctuated by volcanic buttes and cut through by the Big Lost River. People have lived here for 12,000 years or more. Throughout most of this time, they hunted and gathered, taking advantage of a wide variety of resources like buffalo and other game, fish, edible and useful plants, and tool stone like obsidian. Evidence of their activities is preserved in thousands of archaeological sites within the protected boundaries of the INL (DOE-ID 2005) and on surrounding Bureau of Land Management (BLM) lands.

Contemporary tribal people view these earlier hunter-gatherers as esteemed ancestors and continue to value the resources that this cool desert offers.

Although much of the INL remains undisturbed, there are several main facility areas where development is ongoing. Archaeological compliance at the INL is largely focused on completion of surveys in advance of ground disturbing projects in these areas. One of the archaeological sites identified during these surveys, designated as 10-BT-810, is located in an area of preferred development at the Firing Range facility.

10-BT-810 is a small hunting campsite, probably 1500 – 3500 years old, as evidenced by the large corner-notched points found there over the years. In addition to point and tool fragments, the site assemblage also included debitage and indications of subsurface fire hearths. The information contained at this site is important for its potential to contribute to a greater understanding of prehistoric human use of the region, particularly in the form of datable subsurface cultural materials. As a result, the resource was originally evaluated as eligible for nomination to the National Register of Historic Places, pending confirmation of the significant subsurface cultural deposits.

With funding for homeland security at an all-time high, the Firing Range is currently one of the most active facilities on the INL. This small archaeological site, important as it is, was also quite simply in the way and protecting it had become increasingly difficult given its location in a zone preferred for new development. Since the site was important for the information it contained, under the INL Cultural Resource Management Plan (DOE-ID 2005) it was possible to design a small data recovery effort to preserve the important information before disturbance by new development. On the INL, work of this nature is also completed in consultation with the Shoshone-Bannock Tribes.

The standard INL approach to determine if there are important archaeological features at a site is to excavate a series of systematic 30 x 30 x 30 cm shovel probes and intuitively placed 1 x 1 meter test units across the area to sample the cultural deposits located beneath the ground. These methods were still employed at 10-BT-810 in 2003, but geophysical surveys were completed first.

Although target practice was suspended during the archaeological investigations, the surface of the ground within 10-BT-810 was littered with expended modern projectile points made of metal and plastic. After all, target practice had been ongoing for more than 50 years. Pedestrian surveys were initially completed at the site to remove as much of this debris as possible because of the impact it would have on the geophysical devices.

After initial cleanup of stray metal, the site area was surveyed with two geophysical instruments. One survey utilizing the GEM-2, an instrument that measures electromagnetic induction, proved unreliable at 10-BT-810 because the instrument was too susceptible to the effect of the metal remaining in and around the site area.

More interesting and reliable results at 10-BT-810 were obtained from a GPR unit using antennae of 250 and 500 MHz. The data are still affected by the metal so prevalent on this site however, some interesting patterns probably associated with prehistoric human use of the area were also apparent. Most notably, a linear feature running through the southern portion of the site area and a less definitive anomaly located along the edge of the linear feature were apparent in the GPR images. These anomalies showed up most clearly around 20 cm below surface, where most of the artifacts were also concentrated.

The linear feature is interpreted as a buried stream channel. Although it was not readily apparent on the current ground surface, it is now clear that this small archaeological site is associated with a now-abandoned side channel of the Big Lost River. We believe that the other anomaly located on the edge of the apparent channel is related to the ancient human activities represented at the site.

Several types of artifacts were recovered during the excavation including large corner-notched dart point fragments that are typically found in dated contexts of 1,500 – 3,500 years BP in this area and obsidian debitage, a common component of nearly all sites on the INL. Nearly 75% of the 30 x 30 x 30 cm shovel probes excavated within the boundaries of 10-BT-810 yielded 1 - 5 flakes of obsidian and the 1m x 1m x 30 cm test units yielded 50 – 80 flakes. In marked contrast, a 30 x 30 x 30 cm shovel probe excavated within the boundaries of the anomaly adjacent to the stream channel yielded more than 100 flakes, significantly more than any other excavation unit on the site. Although the excavations failed to reveal any stratigraphic evidence of a cultural feature, it is still likely that the anomaly is reflecting a small remnant of a surface created from human activity concentrated in this location, probably physically evidenced today by a very subtle differential in soil moisture content.

Once again, in "seeing" this concentration of artifacts, the radar unit wasn't actually seeing artifacts, it was showing that the portion of the site that contained these materials exhibits different soil characteristics, perhaps a higher organic content, or a compacted zone, which holds more moisture than the surrounding soils. By focusing our excavation efforts in this zone, we were able to maximize the amount of information collected.

Kelvin's Cave is a lava tube located on BLM land about 16 miles north of Twin Falls, Idaho. Excavations in the late 1980s revealed Pleistocene megafauna in possible association with debitage. Curiosity about this association and an increase in vandalism at this well-known site prompted BLM archaeologist, Lisa Cresswell, to work with Suzann Henrikson and the

University of Oregon Field School to conduct new excavations at the site in the summer of 2004 with the hope of confirming the Pleistocene association and establishing the scientific importance of the site. The goal of the INL geophysics team was to try to provide images of the targeted Cave deposits for possible use in directing the excavators to areas that would be most productive for their research questions.

Several types of data were collected:

- Ground Penetrating Radar data at 250 and 500 MHz within the west interior of the Cave
- Electromagnetic survey data (GEM-3 instrument capable of seeing near surface features in detail) within the same interior area.
- Electromagnetic survey data (GEM-2 instrument best suited to larger scale mapping) outside and over the Cave

The geophysical mapping area in the Cave interior was located in the western end of the Cave. Exterior geophysical mapping covered virtually the entire area on top of and around the edges of the open eastern and western entrances.

The shielded, directional, 500 mhz antenna provided the highest resolution of deposits inside the Cave. It is very responsive to shallow anomalies down to about 1.5 meters below surface. The radar data showed anomalies consistent with roof-fall in several spots. Excavation in Unit 9 confirmed the presence of roof fall at approximately 93 – 119 cm below surface.

An electromagnetic induction survey was also collected with the GEM-3 device in the interior of the Cave. Since the GEM-3 is unshielded, the instrument measured signal from all directions inside the basalt cave. As a result, the effective survey depth was limited by interference from the cave roof. The GEM-3 does clearly show shallower deposits to the west with deepening soils to the east. Excavation of Unit 7 in the western end of the Cave confirmed the presence of roof fall at 30-35 cm below surface in this area.

One electromagnetic induction device, the GEM-2, was used to survey outside the Cave, criss-crossing over the roof to image the open chambers beneath and investigate the surrounding area for possible buried chambers. The data collected during this survey show a possible buried chamber to the southeast of the existing open chamber. Deep deposits of soil extending to the south and into the buried chamber were confirmed by the University of Oregon's archaeological excavation of Unit 10.

We are encouraged by these initial attempts to incorporate geophysics into archaeological investigations in southeastern Idaho and continue to look for opportunities to practice these new techniques.

Our interests are varied but include:

- Identification of subtle archaeological features like fire hearths and activity areas common in archaeological sites throughout our region
- Non-intrusive mapping of sensitive sites like Caves and burials, where excavation may be problematic
- Mapping structural remains and features at recent historic archaeological sites
- Identification of old stage and wagon roads buried by aeolian sediments
- Planning excavations to direct limited resources to areas that will provide the most information

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