H5 Multi-Instrument Geophysical Surveys of Buried Human Remains in East Tennessee

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The goal of this presentation is to provide crime scene investigators and physical anthropologists with innovative and comprehensive information on the identification of clandestine graves and associated evidence using advanced and readily available geophysical instrumentation. This presentation provides a review of current collection strategies and data processing techniques to present flexible and standardized protocols for the identification of this type of geophysical anomaly under controlled environmental conditions. Attendees will be provided with information to determine the utility and applicability of particular geophysical techniques in clandestine grave searches.

This presentation will impact the forensic science community by showing how the search for human remains must incorporate appropriate and methodical approaches that aim to identify evidence while not adversely affecting a crime scene. The methods of archaeology can provide critical tools for the crime scene investigator, particularly those involving the search for buried human remains and associated evidence. This project examines the application of several geophysical instruments to the detection of buried human remains drawing upon a long history of successful use in archaeological fieldwork. A comparative assessment of the use of Ground Penetrating Radar (GPR) and soil resistivity will be presented to demonstrate the most appropriate instrument given important variables of burial depth, time interval, and especially environmental conditions.

Geophysical survey data were collected on burials examined in both forensic and archaeological settings throughout areas of Tennessee. Three historic (and active) cemeteries in varying soil types and surface conditions were surveyed with multiple geophysical techniques including GPR, soil resistivity, and geo-magnetic survey. In addition, data were collected on four burials, created in 2010 at the University of Tennessee Anthropological Research Facility (ARF), that were subsequently excavated in 2012. The archaeological and forensic burials represent varied soil types, differing interment periods, and diverse pit attributes, thereby providing a unique opportunity to examine and compare data collected with several geophysical survey instruments. The resulting data were correlated with available information on the burials and include excavation records, body condition (before and after), time since death, soil properties, pit morphology, and recent weather and soil conditions to demonstrate critical factors and the most appropriate methods to incorporate in geophysical surveys.

East Tennessee has a variety of soil series and soil types, but clayey and loamy soils dominate. These clay-rich soils pose their own set of obstacles and opportunities for the application of geophysical techniques to locate buried targets. Moisture and porosity in these soils have a significant effect on the type of signal return, and these effects that confound geophysical detection can be systematically accounted for only through controlled studies over time. Geophysical data were collected in soils of differing moisture contents with the experimental burials surveyed twice prior to excavation, once under wet and rainy conditions, and again in dryer conditions. While the more recent experimental burials are consistently detected, the range of contrast at the targets was greatly affected by moisture levels. Shallow human burials in the clay-rich soils at the ARF appear as low-resistance anomalies in moist to saturated soils, while the GPR signal return is attenuated or scattered by the wet, clayey soils. When the soils are *saturated*, the GPR depth of penetration is hindered substantially, and this is true for both the 400MHz and the 200MHz systems that the researchers had access to for this study. Clay particles in general, especially when wet, charge differentially and can cause GPR signal scatter and system noise such that the likelihood of detecting burials with GPR in saturated clay soils is reduced dramatically.

Burials both at the ARF and at historic cemeteries were surveyed using multiple instruments. The comparison of soil resistivity and GPR data in these soils provides further insight into the subsurface effect on radio-wave and electrical-resistance responses under similar conditions. The historic cemeteries provide a large sample of burial contexts spanning more than 200 years of use with varying depths, and accoutrements, and they provide a baseline of comparison for the experimental human burial contexts at the ARF.

In this research, factors of the environment that constrain when and how to use GPR and soil resistivity in a search for clandestine burials are identified. Fieldwork indicates that the incorporation of soil resistivity with the GPR return data (as a multiple-instrument survey) can dramatically increase the chances of characterizing a buried target.

Geophysics, Clandestine Graves, Buried Remains

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