H94 Human Grave Identification Using GPR and Its Implications for Recognizing Covert Burials of Greater Antiquity

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The goal of this presentation is to investigate the effectiveness of Ground Penetrating Radar (GPR) for identifying longer-term (e.g., cold case) covert human graves in diverse burial environments. By comparing GPR signals of known historic human graves across diverse burial environments and treatment, the effect of these variables on GPR signals can be visualized. This will lead to a clearer understanding of the effectiveness of identification of longer-term covert burials in a modern forensic context.

This presentation will impact the forensic science community by providing guidelines for the use and interpretation of GPR technology in detecting long-term human covert graves. Attendees will learn the significant impact that burial environment and time have on the GPR signal. The outcome of this presentation will be the description of GPR-produced grave images which distinguish more formal grave sites from those potentially produced to hide a criminal act. This presentation will also raise awareness of the utility of geophysical remote sensing in searching for covert burials of greater antiquity.

Ground-penetrating radar is arguably the best geophysical tool to use for covert burial searches in forensic contexts.[1] Several researchers have recently illustrated the potential for GPR to successfully identify covert graves over short to moderate periods of time. [2,3] These studies have utilized pigs as human models and have suggested that pig graves with additional burial treatment (e.g., wrappings, tarpaulin, rocks) showed clearer signals than those without.

This poster examines variation in ground-penetrating radar (GPR) images from human burial sites of greater antiquity and differing burial environment to test the following hypotheses: (a) GPR signals are capable of detecting covert graves of greater antiquity than those created for experimental study; and, (b) GPR signals are capable of identifying graves of individuals who have less "formal" burial preparation (a situation comparable to covert forensic burials) than those with more grave preparation.

The burial sites examined are two historic cemeteries on the R.J. Reynolds Homestead in Critz, Virginia. The Reynolds family cemetery contains 24 marked graves dating from 1849 to 2004, representing individuals from the wealthy and prominent Reynolds family (founders of the R.J. Reynolds Tobacco Company and Reynolds Metals [Aluminum]). Approximately 200 meters north of this cemetery in a wooded area is the second cemetery for slaves and (after 1865) former slaves who worked in tobacco production or as servants for the Reynolds family. At the slave cemetery are 54 probable graves (based on ground depressions and field stones); only four of these manifest marked "formal" stones. These two cemetery samples represent economically and ethnically distinct historic individuals who varied significantly in terms of their burial treatment and environment. While individuals from the Reynolds family cemetery were encased in burial vaults and underwent more formal burial treatment, those from the slave cemetery were in pits with wood coffins and shroud coverings (representing the "less formal" burial more typical of a modern covert grave).

GPR surveys of both cemeteries were conducted in July and November 2008, and for the slave cemetery again in May 2011. All surveys were conducted using a PulseEKKO GPR system, with a 500-MHz antenna being used for the July 2008 surveys and a 100-MHz antenna for the later surveys. The 500-MHz antenna produces better resolution of smaller subsurface targets but has a shallower penetration depth, especially in the clay soils of the survey area. The lower frequency 100-MHz antenna provides lower resolution but deeper penetration (more than two meters).

The 500-MHz scan of the Reynolds Family cemetery identified anomalies correlated with graves; however, some anomalies were inconsistent with the position of above-ground gravestones. The survey of the slave cemetery using this antenna was less productive, due to the damp, forested environment. The soil conditions resulted in expected signal loss, but the scan did identify anomalies correlated with a previous map of grave sites.

The November, 2008 scan of the Reynolds cemetery used the 100-MHz antenna along a 0.5 meter grid, with the instrument reading north-south transects along this grid. Scans produced much clearer images of graves in relation to their markers. Also, the grave of a four-day old child that was not seen in the 500-MHz scan was revealed.

The 2011 slave cemetery 100-MHz scan also produced clearer associations of GPR signals with mapped grave locations in many cases. However, the GPR signals for graves became much more subtle and in several cases disappeared at shallower depths (1.5 meters from the surface) as opposed to 2.0 meters for the signals for the Reynolds family. This suggests a shallower depth and less grave preparation for the slave burials - a scenario common to modern covert burials. This study indicates that GPR surveys for covert graves of considerable antiquity in similar moist, clay-rich soils can be productive if the appropriate antenna is used. However, the signals for such graves will be far more subtle and diffuse than those from a formal cemetery setting.

References:

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