An Assessment of Geophysical Methods for Locating Animal Mass Graves and Observations Pertinent to their Use in Locating Human Mass Graves

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This paper presents the findings obtained from a series of integrated geophysical surveys conducted on two known animal mass graves to assess the ability of the techniques to locate anomalies associated with the graves. It will focus on the results obtained from the surveys in terms of issues that may be relevant in the investigation of crime scenes involving the use of geophysical techniques to locate buried human remains. The integrated geophysical surveys, undertaken as part of an MSc in Forensic Archaeology, Crime Scene and International Investigations at Bournemouth University, succeeded in detecting anomalies associated with the known location of two graves: a 1967 foot and mouth grave in Shropshire and a lambing grave dating back to 2001 in Dorset. Ground penetrating radar (GPR), earth resistivity (ER), Slingram electromagnetic (EM) and magnetic gradiometry (MAG) were employed in the study.

Belhuish House, Dorset

A series of five surveys using the Geoscan RM-15 (twin-probe array) with probe separations ranging from 0.25m to 1.50m at Belhuish House, Dorset, produced a sequence of unambiguous results that clearly indicated anomalies associated with the grave. The EM3B vertical dipole quadrature also produced comparable results (Figure 1.). The results from the surveys using the Mala Ramac GPR at 250 MHz and 500 MHz antennas produced clear anomalies associated with the grave at Belhuish House with the 250MHZ giving the better response.

Pear Tree Farm, Shropshire

The GPR results at Pear Tree Farm were quite different from those from the previous site and potentially inconclusive on their own. Both 250 and 500MHz surveys failed to identify any anomalies at depth and only the 500MHz appeared to delineate the grave by a area of very shallow noise presumably caused by disruption of the topsoil subsoil interface (Figure 2). The EM38B in-phase response also delimited a similar area of lower susceptibility, again probably resulting from the dilution of magnetically enhanced topsoil caused by its disturbance and subsequent mixing with subsoil (Figure 3). Also note the strong high susceptibility anomaly to the south resulting from a target also detected on the magnetic surveys. The EM38B quadrature response clearly detected the site of the grave (not shown).

The Magnetometry surveys using the Scintrex Smartmag and a Bartington 601 Dual Fluxgate Gradiometer detected anomalies from ferrous features at both sites indicating disturbance and inclusion of cultural items that would not normally be found in the soil. The geophysical surveys conducted at Pear Tree Farm and Belhuish House succeeded in detecting anomalies associated with the Foot and Mouth animal mass graves that corresponded with the location of the depressions and vegetation changes at both sites.

Magnetometry (gradiometry)

Magnetic surveys were undertaken using the Scintrex Smartmag SM4G, a Bartington 601 Dual Fluxgate Gradiometer, and Geoscan Research FM36. At both sites the instruments detected

anomalies that would appear to be arising from the inclusion of ferrous materials/items into or associated with the grave fills, thus indirectly indicating disturbance and so the site of the grave.

Conclusions

In conclusion, the work on these sites suggests the EM38B conductivity and earth resistivity systems produced good and compatible results while GPR and MAG produced less consistent but still good results. The only instrument/technique that failed to produce good results the one site it was tried on was the EM31, however, this instrument may well have performed more successfully at the Belhuish House site had it been available for these surveys. Not surprisingly perhaps, these results support the widely held view that individual geophysical techniques do not provide conclusive results on their own, but that by using a combination of various techniques and configurations and comparing the results, the ability to detect and recognize anomalies associated with grave features increases considerably regardless of whether graves are 5 or 40 years old. However, this work does suggest that ER or EM (conductivity) should be there in the first choices of technique, with the ability to also provide magnetic susceptibility and metal detection data an additional advantage in employing EM instruments.

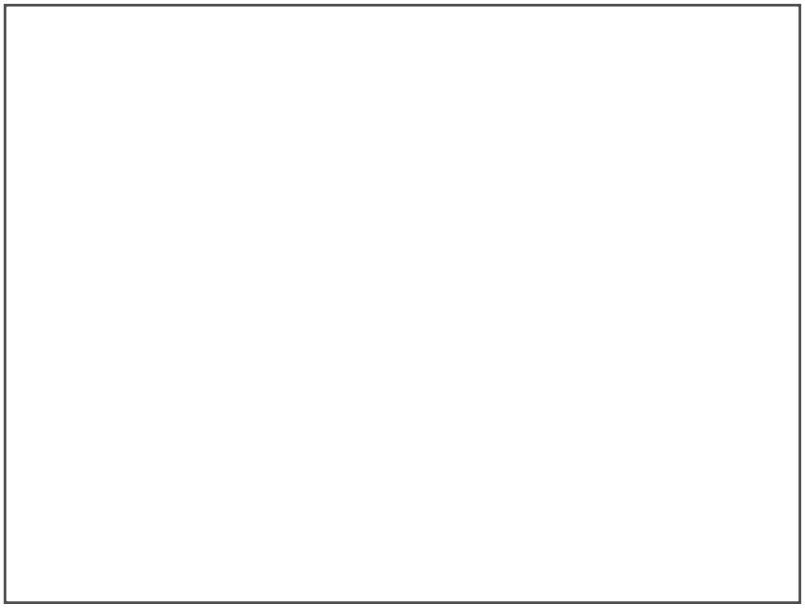

Figure 1: Belhuish House, Dorset. Comparison of RM-15 0.5m and 0.75m twin results with the EM38B quadrature phase results displayed as resistivity. Note the low resistance anomaly one third of the way along the top side of the survey area that corresponds to the position of the known animal grave from 2001.

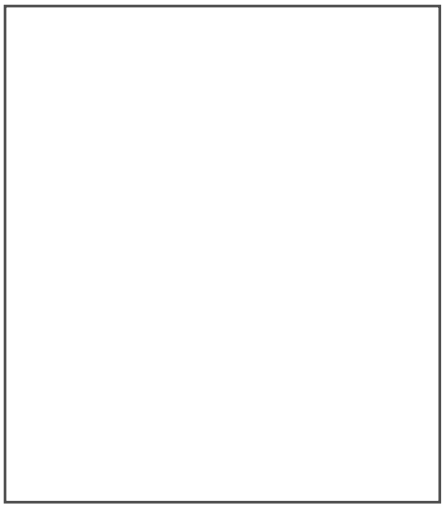

Figure 2: Pear Tree Farm, GPR @ 500MHz

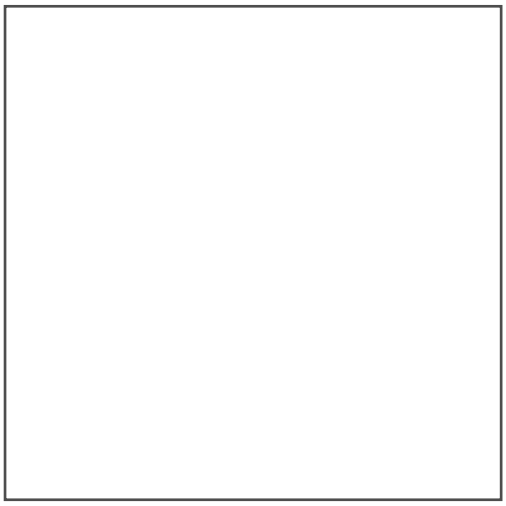

Figure 3: Pear Tree Farm, EM-38B In-phase