CASE STUDY

Magnetic Susceptibility Measurements in Forensics

Forensic search investigators commonly use a variety of techniques to detect buried material. Every forensic case is unique, having specified target(s) and search areas that vary widely in extent, soil composition, land use type, local climate, etc. Once a search area has been identified by investigators, a sequentially phased approach of forensic site investigations usually begins (see Harrison & Donnelly, 2009).

Early search phases often involve a rapid survey using equipment or specialists (including trained search dogs) to pinpoint suspected anomalous areas that require further investigation. Pinpointed anomalous areas are then investigated in detail. This commonly involves near-surface geophysical methods of which the foremost is Ground Penetrating Radar (GPR). However, there is increasing awareness that GPR may not be appropriate in all cases; in clay-rich soils, for example.

Other forensic search techniques are currently being trialled to quantify their usefulness and usability in forensic searches. One of these is magnetic susceptibility surveying. For example, research studies using magnetic susceptibility surveying over simulated clandestine graves of murder victims are finding promising results; a recent research study (by Pringle et al. 2012) that used a Bartington Instruments MS1 magnetic susceptibility system with a 30cm diameter probe observed good target detection rates over simulated graves buried in sand dunes in coastal environments (Figure 1). Magnetic susceptibility surveys also worked well in the foreshore sub-environment, in contrast to the GPR and resistivity surveys also trialled. (Using magnetic susceptibility to detect a simulated clandestine grave in an urban environment, where soil is typically disturbed for a multitude of reasons, proved less successful (see Pringle et al. 2008) and further research in this environment continues.)

Recent research studies have also used magnetic susceptibility surveys over a variety of buried forensic targets beneath a concrete patio, as this is a fairly common domestic property forensic scenario. The forensic targets were typical of those commonly searched for by search investigators, including munitions, a replica firearm, knives and non-forensic targets to act as control (see Figure 2). Targets were buried ~0.2 m below ground level in an urban environment before a concrete patio was overlaid. Magnetic susceptibility results

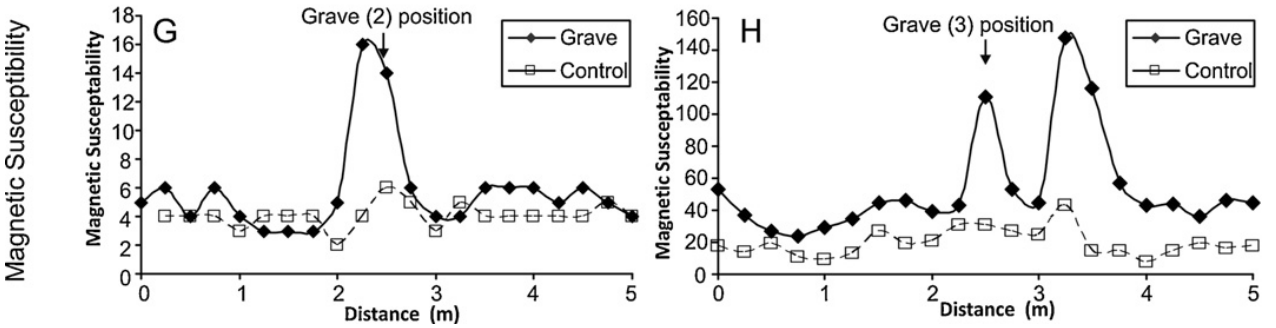

Figure 1. Magnetic susceptibility 2D profiles collected over simulated clandestine graves of murder victims in coastal environments in (G) sand dunes and (H) foreshore environments near Southport, UK. Simulated grave positions are marked. Modified from Pringle

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showed target detection rates (Figure 2) that were better than other electromagnetic survey types undertaken here, including the multi-frequency GPR surveys which detected a lot of non-forensic targets. Therefore, in typical urban environments with heterogeneous ground conditions and a variety of buried non-target objects possibly being present, magnetic susceptibility surveys could potentially provide an alternative and more cost-effective technique to other geophysical survey methods.

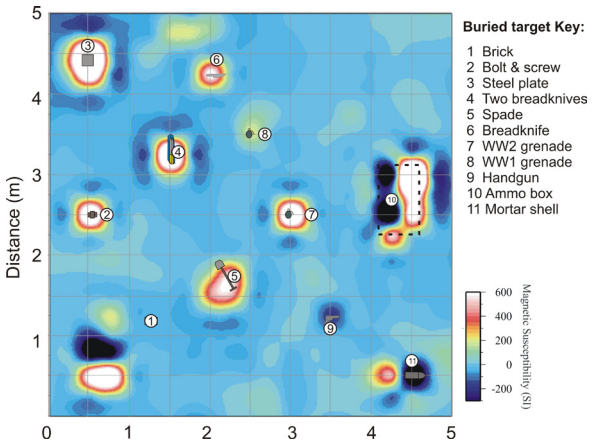

Figure 2. Magnetic susceptibility survey contoured results over a simulated forensic crime scene patio with buried forensic targets (see key: target images are added).

Clearly magnetic susceptibility surveying has great potential in forensic searches for buried targets. This remains an area with plenty of scope for further research and Bartington Instruments would be interested to hear from anyone working in this area.

References

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Pringle, J.K. Jervis, J. Cassella, J.P. Cassidy, N.J. 2008. Time-lapse geophysical investigations over a simulated urban clandestine grave. Journal of Forensic Sciences, 53, 1405-1417.