Using geophysics to locate shallow graves

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1. Introduction

Although more routinely used in engineering applications, the search for minerals in the ground and in locating buried archaeological ruins, geophysics has now been used in several murder investigations to locate shallow graves (e.g. Buck (2003) and Nobes (2000). However, results from several cases in which geophysics has been used have gone unpublished because of the legally sensitive nature such surveys. Because of this there is very little background literature available for consultation before performing this type of survey. Scientists in Keele University's Applied and Environmental Geophysics Group and Staffordshire University's Forensic Science department are using a simulated grave in a garden in Stoke to test several different methods to locate graves (some of which are as yet untested for this purpose).

2. Simulated murder investigation

In 2006, a simulated forensic investigation using geophysics was undertaken in the garden of Staffordshire University's Crime Scene House. A mock shallow grave was created by burying a clothed plastic skeleton, along with animal matter (heart, lungs and liver) and eight pints of physiological saline. The garden provides a challenging environment for geophysics: the presence of a large amount of building rubble beneath the ground will provide a high level of natural noise in the survey results and the large size of the garden (approximately 31m by 6m) will both contribute to significant difficulty in determining the grave location from the geophysical data.

Figure 1: Survey techniques employed in the mock forensic investigation: (a) Lateral Wenner array resistivity and (b) Self Potential (SP). The layout of the crime scene is well illustrated in (a).

3. Full garden search

A full garden resistivity survey was carried out at the crime scene in an attempt to identify the grave location. Because decaying organic matter produces a highly conductive fluids a low resistivity anomaly is expected at the burial location. A total of four such features were seen in the survey data (Fig. 2).

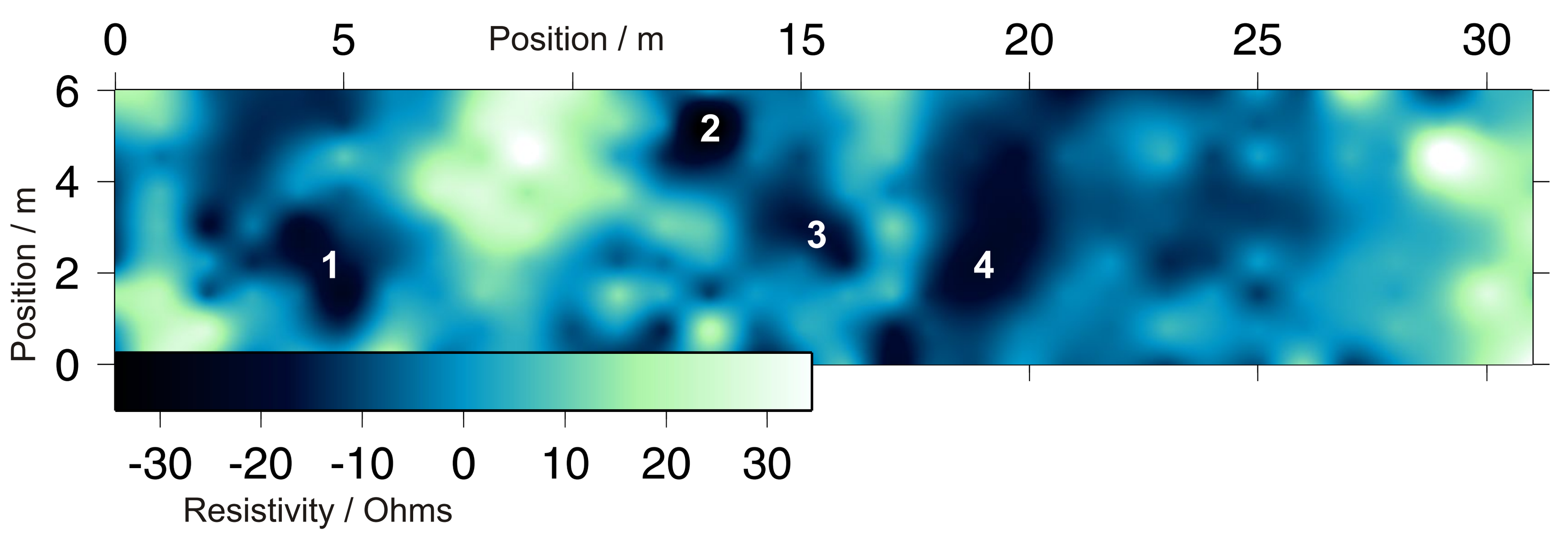

Figure 2: Map view of resistivity data obtained from the crime scene. Four low resistivity anomalies are identified (white numbers).

4. Follow up investigation

In order to determine which of the four features identified in the resistivity survey is most likely to be the grave an SP survey (Fig. 1b) was conducted over the areas of interest. An area of consistent highs or lows in an SP survey can be an indicator of the presence of electrically-charged fluids (and hence decaying organic matter) in the ground.

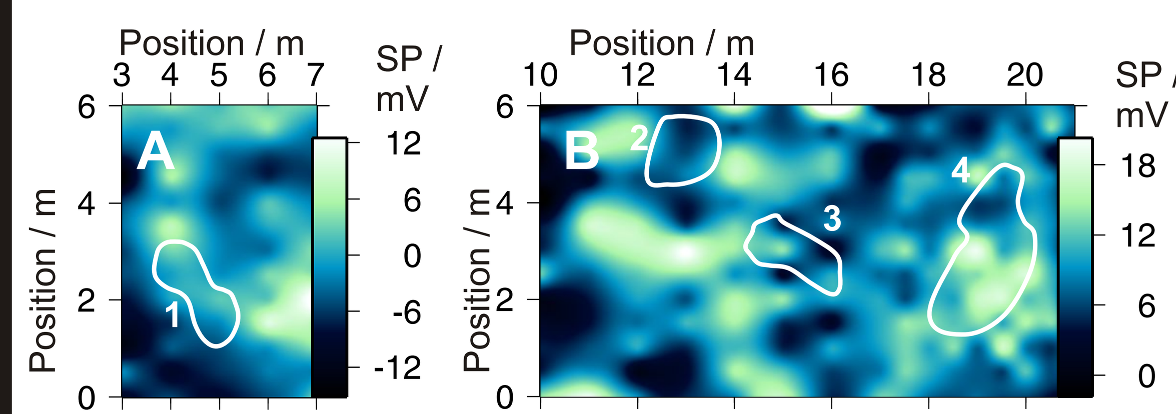

Figure 3: Map view of SP data obtained from the locations of (a) resistivity anomaly #1 and (b) resistivity anomalies #2 - 4

An area of high SP values (light blue) can be seen in the lower half of anomaly #4 whilst the other three features are comparable to background SP values (Fig. 3). Hence, from this investigation, it is recommended that excavation of the garden begins at anomaly #4, before moving on to features #1, #2 and #3 if nothing is found.

5. Investigating grave structure

Having identified anomaly #4 as the most likely location of the grave, an Electrical Resistivity Tomography (ERT) profile was performed over this feature. ERT operates in a similar fashion to the lateral resistivity survey shown in Fig. 2 but looks down in to the ground, allowing the vertical nature of the ground to be probed. The results (Fig. 4) suggest that the area of low resistivity in the soil is within the upper 0.5m of soil -consistent with the presence of a shallow grave at this location.

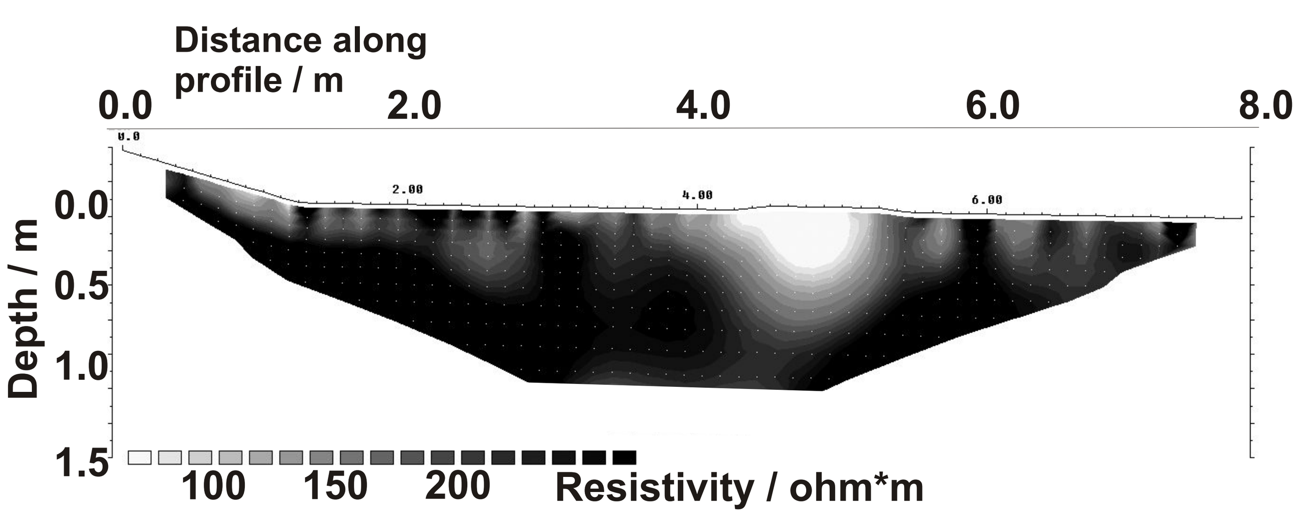

Figure 4: ERT data taken from the crime scene. The low resistivity feature (white) in this image is in the same position in the garden as anomaly #4 in Fig. 2.

Armed with the knowledge that anomaly #4 may be a shallow (~0.5m deep) grave, forensic science students from Staffordshire University began excavating at this location (Fig 5). The 'body' was indeed found at this precise position, vindicating the use of geophysics in this investigation.

Figure 5: Students from Staffs. Uni recover the body.

References: Buck, S. C, *Searching for graves using geophysical technology: field tests with ground penetrating radar, magnetometry and electrical resistivity*, J. Forensic Sci., V.48 pp.5-11, 2003

Nobes, D. C., *The search for 'Yvonne': a case example of the delineation of a grave using near-surface geophysical methods*, J. Forensic Sci., V.3 pp715-721, 2000.

A paper based on work presented here will shortly be submitted for publication- look out for: Pringle et al., (In prep.) *Time-lapse geophysical investigations over a simulated urban clandestine grave*, J. Forensic Sci.

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