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RINGLEMERE FARM, WOODNESBOROUGH, KENT. REPORT ON GEOPHYSICAL SURVEYS JANUARY 2002.

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Summary

Magnetometer and earth resistance surveys were conducted around the findspot of a rare Bronze Age gold cup in January 2002. Both surveys provided good correlation with aerial photographic evidence and the resistance survey further highlighted the presence of a possible barrow associated with the find. Despite subsequent excavation, other anomalies have remained enigmatic.

Keywords

Geophysical Survey

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RINGLEMERE FARM, Woodnesborough, Kent.

Report on geophysical survey, January 2002.

Introduction

Geophysical surveys of approximately 1.4 hectares were conducted over the findspot of a Bronze Age gold cup, similar to that found at Rillaton in Cornwall in the 19th century, at Ringlemere Farm, Woodnesborough, Kent. In November 2001 a metal detectorist, Cliff Bradshaw, discovered the gold cup whilst prospecting on what he perceived to be a slight but distinct mound in the field. The cup was sent to the British Museum for analysis and assessment whilst a programme of archaeological investigation, proposed by a Steering Group consisting of representatives of local and national archaeological organisations (Parfitt 2002, 5), was begun at the site.

The aim of this survey was to assess the geophysical response over the findspot to inform additional non-intrusive survey and targeted excavation to further investigate the context of the find. The other surveys, including field walking, systematic metal detecting and aerial photograph analysis demonstrated that burnt and worked flint was found in particular concentration around the findspot; few metal objects were present (perhaps due to previous unreported metal detector activity); the presence of several ring-ditches clustered near the findspot, but no apparent features in the direct vicinity of it (Parfitt 2002, 6-7).

Two periods of excavation were undertaken by Canterbury Archaeological Trust (CAT), the first funded by English Heritage (EH), in the spring of 2002, and the second in the autumn of 2002 funded by the British Museum (BM). The first trench encompassed the findspot and located part of the barrow mound and ditch. The second, an off-shoot to the east of the first revealed another section through the barrow in an attempt to further define the ditch and mound downslope from the findspot (B Corke *pers comm.*). The location of the trenches and two comparative sections taken from these are shown on Figure 2, overlying the OS map and a rectified aerial photograph (JAS 1990) in which parch marks near the findspot are visible. The two sections are presented in Figure 6, together with a traceplot of the corresponding line of geophysical data.

The site (TR 293 569) lies on fine silty soils of the Hamble 1 association (Soil Survey of England and Wales 1983) underlain by Thanet Beds and Upper Chalk sealed by Head Brickearth (British Geological Survey 1966) and patches of gravel (Parfitt 2002, 5). At the time of the survey the field had a young crop of wheat.

Method

Magnetometer survey

Magnetometer survey was conducted over all the shaded grid-squares (Figure 1) using the standard method outlined in note 2 of Annex 1. Plots of the data-set are presented as both an X-Y traceplot and a linear greyscale, at a scale of 1:1000 on Plan A. A plot is also superimposed over the OS base map (1:1500) on Figure 3.

Limited corrections have been made to the measured values displayed in the plots. Heading errors were removed from the data by subtracting a constant value from each line of data to zero the median and the detrimental effects produced by surface iron objects were reduced through the application of a 2m by 2m thresholding median filter (Scollar *et al* 1990; 492). Additionally two grid-squares were 'destaggered' to correct for the herring-bone effect that can be introduced into magnetometer data surveyed using the zigzag method where the instrument has been carried in an offset position, causing readings to be measured slightly before or after their correct positions along the traverse.

Earth resistance

An earth resistance survey was conducted over all the hatched grid-squares (Figure 1). Measurements were collected with a Geoscan RM15 resistance meter and PA1 mobile probe array in the Twin-Electrode configuration. Readings were collected using the standard method outlined in note 1 of Annex 1 at mobile probe spacings of 0.5m with a reading interval of 1m x 1m. Plots of the data-set are presented as both an X-Y traceplot and linear greyscales of the raw and high-pass filtered data in Plan B at a scale of 1:1000. A linear greyscale of high-pass filtered data has been superimposed over the base OS map in Figure 4 (1:1500).

Results

Magnetometer survey

A graphical summary of the significant anomalies discussed in the following text is provided on Figure 5a.

The general background response at this site was subdued (± 1nT), with little magnetic enhancement exhibited from archaeological features. As would be expected, ferrous disturbance accounts for the strongest readings, such as the magnetic noise at [1], suggestive of a former field boundary. The fragmented linear response [2] probably relates to the gas main known to cross the field.

The most notable of the archaeological responses is the positive magnetic response [3], a large ring ditch also visible on aerial photographs. Possible traces of other smaller ring ditches are at [4-6].

Near the find-spot, the arc of magnetic activity or noise at [7] is unexplained as it falls well within the line of an encircling ditch defined by the excavation. The latter ditch, appears to have been only partially detected, to the north-east, at [8]. Curiously, the remainder of the projected ditch circuit has not proved detectable despite its shallower depth of burial (see Figure 6). Near the centre of the barrow, a curvilinear positive magnetic anomaly [9] seems to be apparent but was not found during the excavation. Instead, the excavation revealed two intriguing L-shaped slots and a large ?central pit in this vicinity. The survey did, however, locate a significant pit [10] off-centre to the north-east, partially uncovered during the second episode of excavation.

The broad band of raised magnetic response [11] running north-south, perhaps a buried shallow channel or trackway, is also apparent in the resistance data and on aerial photographs (see below and Figure 2).

Earth resistance

A graphical summary of the significant anomalies discussed in the following text is provided on Figure 5b.

The earth resistance survey has produced a clear high resistance response [R1] to the mound feature. The latter was found to relate to a 'soft core of soil, clay and turf...enclosed by an outer envelope of re-deposited clay/brickearth' (Parfitt 2002, 10). The apparent low resistance response at [R2], surrounding the mound, most evident in the filtered data (see Plan B3), may be an artefact of the latter processing; however, it does serve to further distinguish the broader area of raised resistance [R3] that almost completely encircles [R1]. Initially it was thought that [R3] might be some form of remnant penannular bank around the central mound, but no definitive evidence for such a feature was found by excavation. Though [R3] roughly correlates with the position of the ditch found during excavations, it is doubtful that this feature is responsible for the raised resistance. Firstly, the anomaly is approximately twice the maximum width recorded for the ditch, and the excavation has shown that the ditch circuit is not interrupted at the gap suggested by the anomaly. Secondly, high resistance responses are unusual for ditch features. Such a response might occur if, for instance, the ditch was filled with coarse material; however, the lenses of gravel recorded in the fill (Figure 6) do not seem either to be of sufficient volume, nor of sufficient contrast with their surroundings, to account for the anomaly. The slight local increase in resistance over the upper lenses of gravel in the ditch fill (contexts 1047 and 1158 in sections 2 and 33 respectively) is not significant enough to account for the overall pattern of [R3]. In addition, the eastern part of the ditch circuit is buried beneath almost a metre of soil (Section 33), at a depth unlikely to result in the raised resistance values recorded.

During the second excavation, these higher levels of overburden on the eastern side of the barrow may be reflected in the broadening of the anomaly here, possibly suggesting that [R3] relates to a later flattening of the mound rather than activity contemporary with its construction. Alternatively, in-fill patterns of the ditch indicate the likely presence of a bank outside the ditch (Parfitt 2002, 10) and perhaps the resistance response relates to the spread of this material.

The area of low resistance [R4], coincident with the raised magnetic response [11], intersects regions of higher resistance [R5-7]. This patterning, discernible on aerial photographs, may be archaeological or perhaps geological in origin. The low resistance areas may also relate to the apparent 'gap' in [R3], somehow having more of an effect than the material creating the rest of that anomaly (P Linford *pers comm*).

Conclusion

The magnetometer survey has shown good correlation with aerial photographs of the site and has responded, albeit very slightly, to elements of the main barrow feature. Indeterminate magnetic activity is more apparent on the eastern side of the mound and includes at least one pit. The ditch circuit has only been partially and very weakly detected owing to poor magnetic contrasts and a variable depth of burial.

The earth resistance survey appears to have successfully defined elements not apparent on any aerial photograph as yet studied but the relationship of anomalies to known archaeological features is still very unclear. The find-spot of the cup lies on the periphery of a prominent circular area of high resistance seemingly corresponding with the central mound of the barrow. This central area is encircled by a halo of more subdued high resistance [R3] partially coincident with the ditch circuit. This anomaly is not easily explained by the presence of the narrower ditch feature, and may instead be linked with the former presence of a degraded bank, or some other aspect of the monument's evolution. On present evidence the patterns of earth resistance are difficult to explain and require further comparative analysis with the evidence from excavation.

Surveyed by: A Payne
L Martin

Date of survey: 14-17/01/2002

Reported by: L Martin

Date of report: 25/03/2002

Archaeometry Branch,
English Heritage,
Centre for Archaeology.

Acknowledgments

With thanks to the landowners, Messers Smith, for access to the site, Barry Corke and Keith Parfitt of CAT for their assistance and provision of excavation plans and sections, some of which are replicated here, and to Paul Linford for discussions on interpretation and rectification of the aerial photograph.

References

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JAS AIR 2490 12/7/90; Scale 1:10,000. Source Kent County Council.

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Soil Survey of England and Wales 1983 Soils of England and Wales, Sheet 6, South East England.

List of enclosed figures.

Annex 1: Notes on standard procedures

1) **Earth Resistance Survey:** Each 30 metre grid square is surveyed by making repeated parallel traverses across it, all aligned parallel to one pair of the grid square's edges, and each separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metres from the nearest parallel grid square edge. Readings are taken along each traverse at 1 metre intervals, the first and last readings being 0.5 metres from the nearest grid square edge.

Unless otherwise stated the measurements are made with a Geoscan RM15 earth resistance meter incorporating a built-in data logger, using the twin electrode configuration with a 0.5 metre mobile electrode separation. As it is usually only relative changes in resistivity that are of interest in archaeological prospecting, no attempt is made to correct these measurements for the geometry of the twin electrode array to produce an estimate of the true apparent resistivity. Thus, the readings presented in plots will be the actual values of earth resistance recorded by the meter, measured in Ohms (Ω). Where correction to apparent resistivity has been made, for comparison with other electrical prospecting techniques, the results are quoted in the units of apparent resistivity, Ohm-m (Ωm).

Measurements are recorded digitally by the RM15 meter and subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to the Centre for Archaeology using desktop workstations.

2) **Magnetometer Survey:** Each 30 metre grid square is surveyed by making repeated parallel traverses across it, all parallel to that pair of grid square edges most closely aligned with the direction of magnetic North. Each traverse is separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metre from the nearest parallel grid square edge. Readings are taken along each traverse at 0.25 metre intervals, the first and last readings being 0.125 metre from the nearest grid square edge.

These traverses are walked in so called 'zig-zag' fashion, in which the direction of travel alternates between adjacent traverses to maximise survey speed. However, the magnetometer is always kept facing in the same direction, regardless of the direction of travel, to minimise heading error.

Unless otherwise stated the measurements are made with a Geoscan FM36 fluxgate gradiometer which incorporates two vertically aligned fluxgates, one situated 0.5 metres above the other; the bottom fluxgate is carried at a height of approximately 0.2 metres above the ground surface. The FM36 incorporates a built-in data logger that records measurements digitally; these are subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to the Centre for Archaeology using desktop workstations.

It is the opinion of the manufacturer of the Geoscan instrument that two sensors placed 0.5 metres apart cannot produce a true estimate of vertical magnetic gradient unless the bottom sensor is far removed from the ground surface. Hence, when results are presented, the difference between the field intensity measured by the top and bottom sensors is quoted in units of nano-Tesla (nT) rather than in the units of magnetic gradient, nano-Tesla per metre (nT/m).

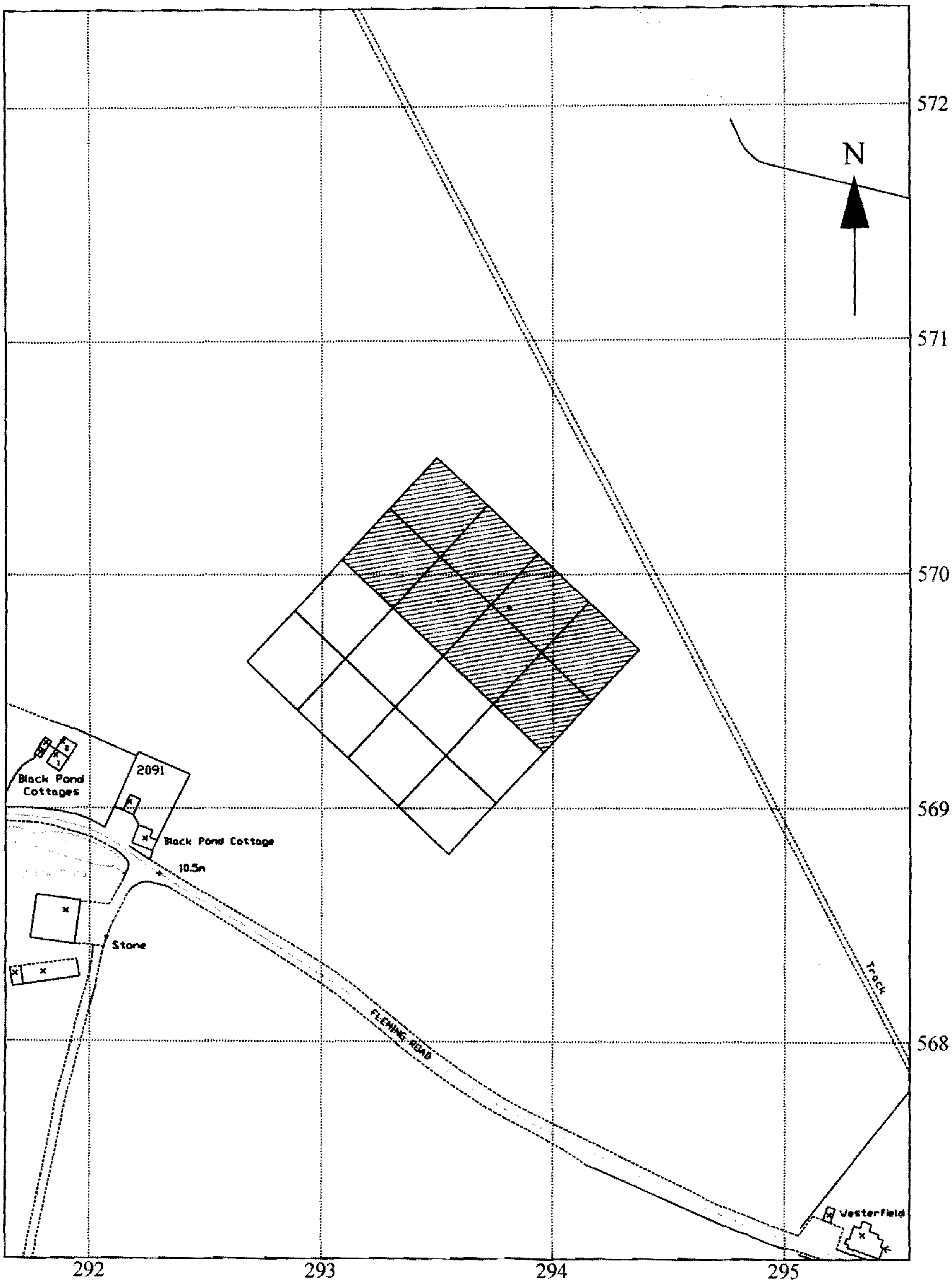
3) **Resistivity Profiling:** This technique measures the electrical resistivity of the subsurface in a similar manner to the standard resistivity mapping method outlined in note 1. However, instead of mapping changes in the near surface resistivity over an area, it produces a vertical section, illustrating how resistivity varies with increasing depth. This is possible because the resistivity meter becomes sensitive to more deeply buried anomalies as the separation between the measurement electrodes is increased. Hence, instead of using a single, fixed electrode separation as in resistivity mapping, readings are repeated over the same point with increasing separations to investigate the resistivity at greater depths. It should be noted that the relationship between electrode separation and depth sensitivity is complex so the vertical scale quoted for the section is only approximate. Furthermore, as depth of investigation increases the size of the smallest anomaly that can be resolved also increases.

Typically a line of 25 electrodes is laid out separated by 1 or 0.5 metre intervals. The resistivity of a vertical section is measured by selecting successive four electrode subsets at increasing separations and making a resistivity measurement with each. Several different schemes may be employed to determine which electrode subsets to use, of which the Wenner and Dipole-Dipole are typical examples. A Campus Geopulse earth resistance meter, with built in multiplexer, is used to make the measurements and the Campus Imager software is used to automate reading collection and construct a resistivity section from the results.

Figure 1

WOODNESBOROUGH, KENT.
Location of geophysical surveys, January 2002.

TR2956



Magnetometer survey

Findspot

Earth resistance survey

0 — 90m

1:2500

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Figure 2

WOODNESBOROUGH, KENT.
Location plan over aerial photograph.

TR2956

Findspot

Excavation trench (after CAT)

Conjectured line of ditch from excavation evidence

Survey grid

Section line

0 90m

1:2500

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Figure 3

WOODNESBOROUGH, KENT.
Magnetometer survey, January 2002.

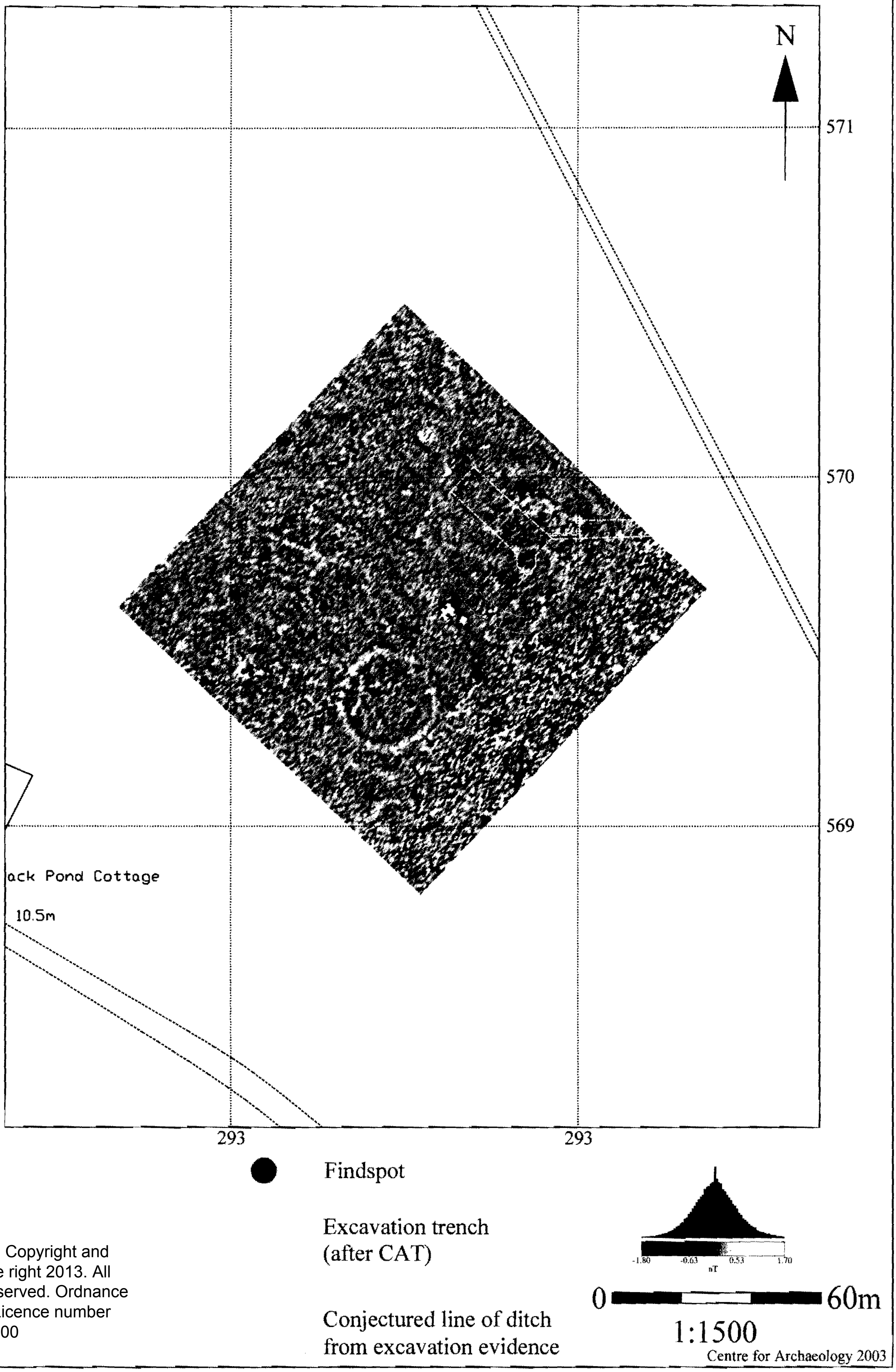

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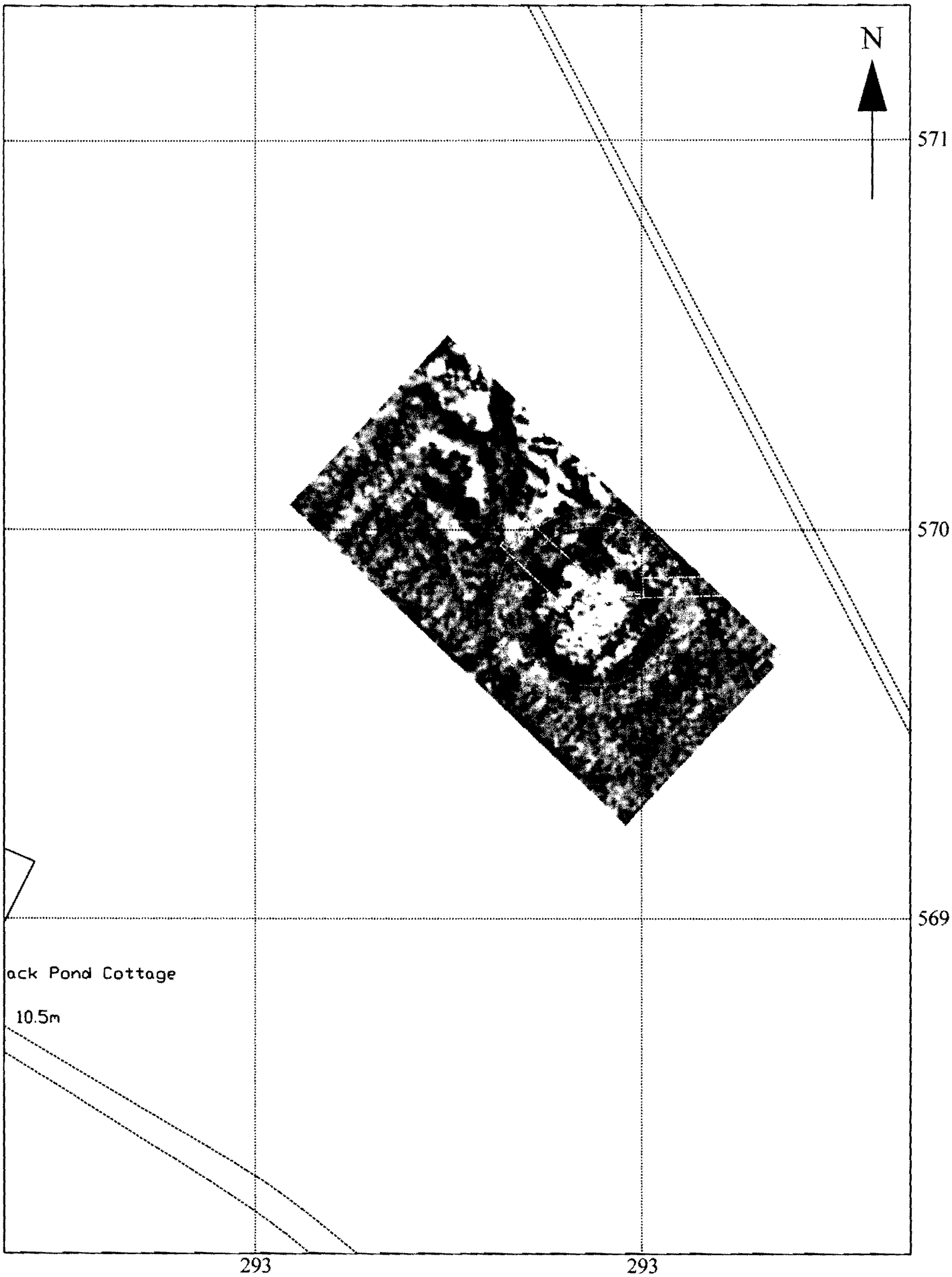
Figure 4

WOODNESBOROUGH, KENT.
Earth resistance survey, January 2002.

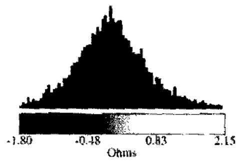
TR2956



Findspot

Excavation trench
(after CAT)

Conjectured line of ditch
from excavation evidence



0 60m

1:1500

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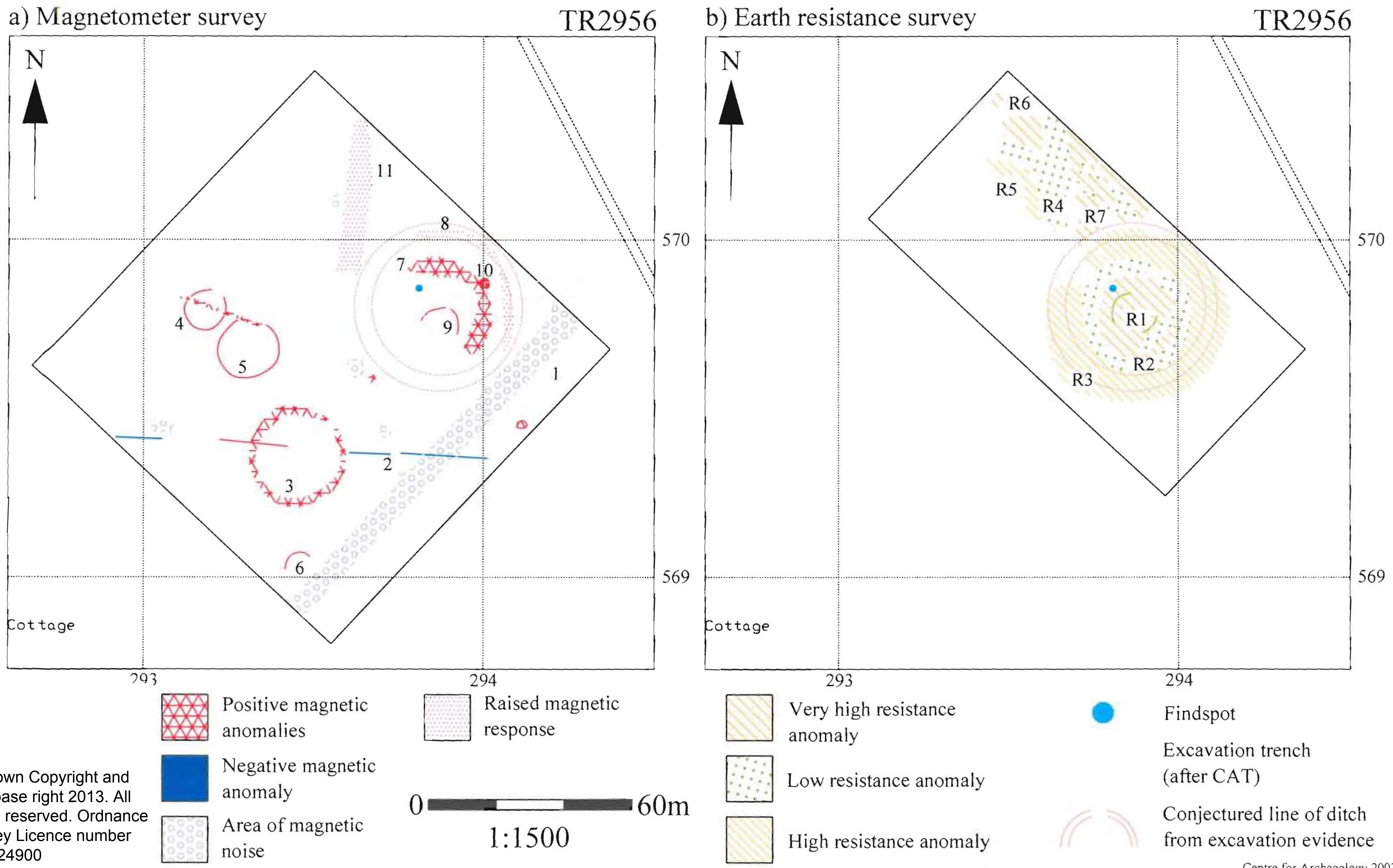
WOODNESBOROUGH, KENT. Figure 5

Graphical summary of significant geophysical anomalies.



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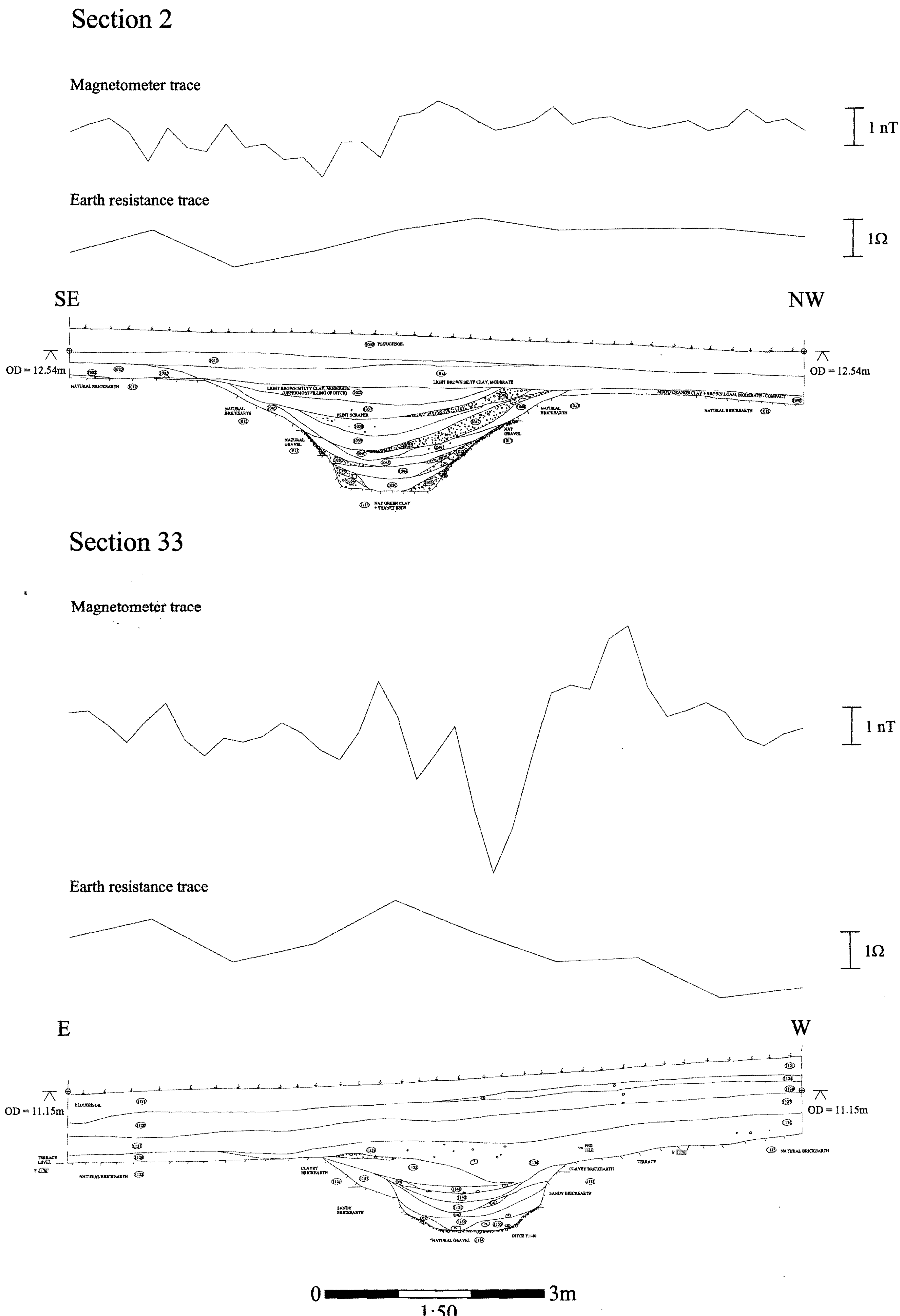
WOODNESBOROUGH, KENT.
Geophysical response over barrow ditch.

Figure 6



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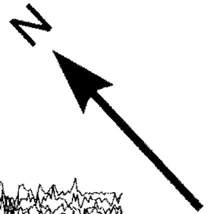
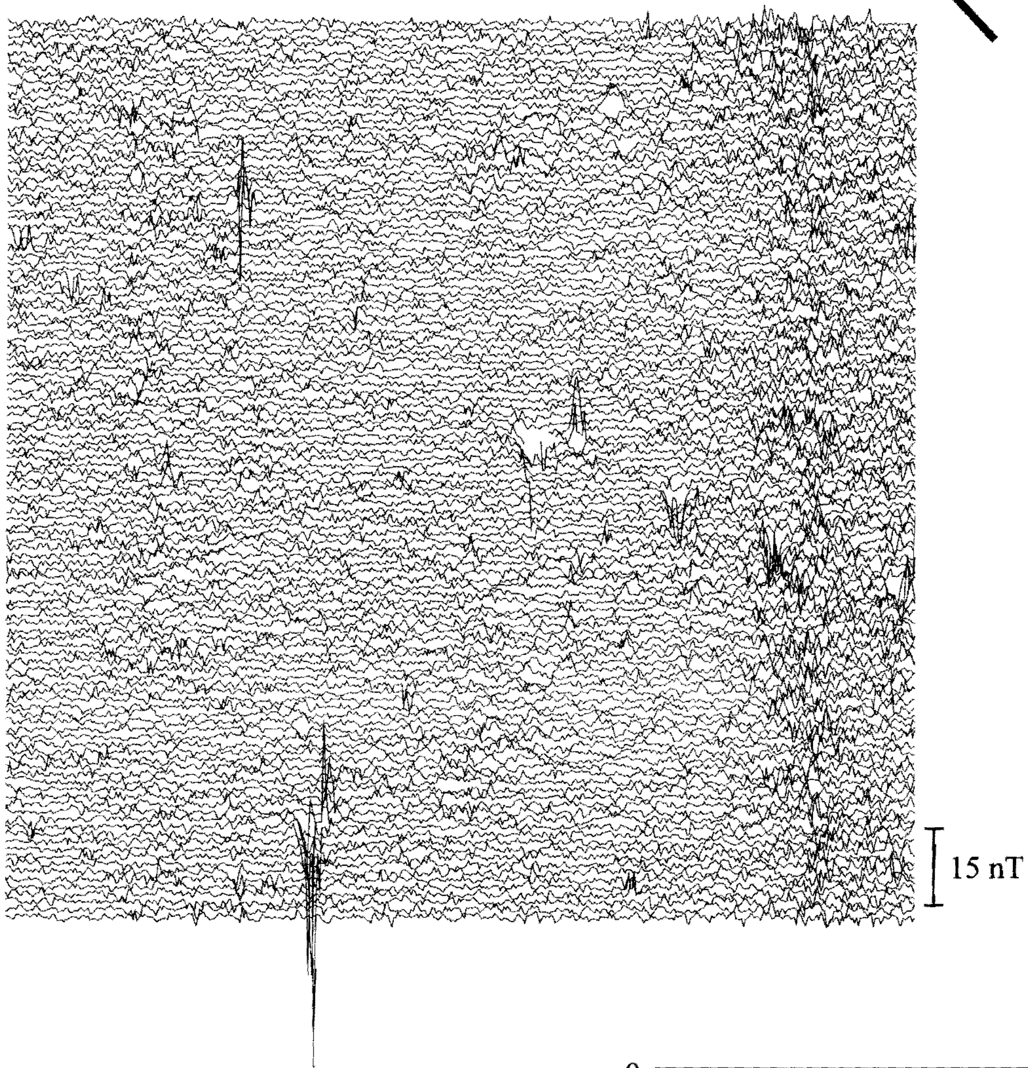
WOODNESBOROUGH, KENT.
Magnetometer survey, January 2001.

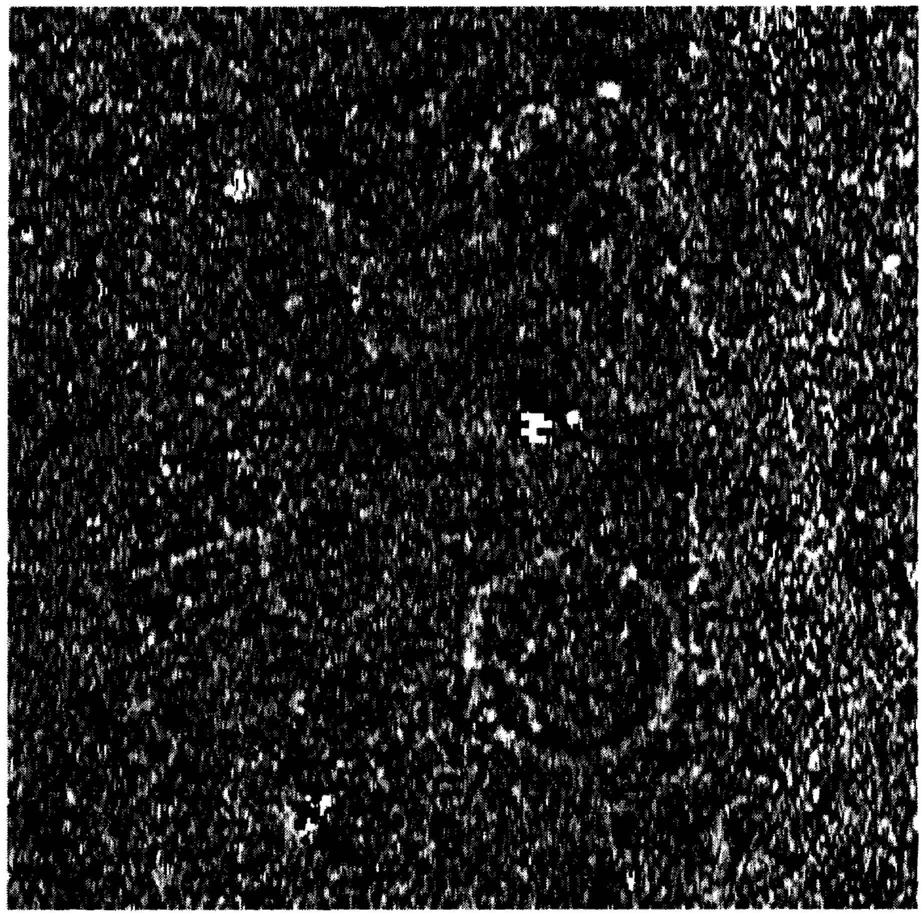
PLAN A

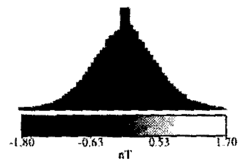


1) Traceplot of raw magnetometer data.



2) Linear greyscale of raw magnetometer data.





1:1000

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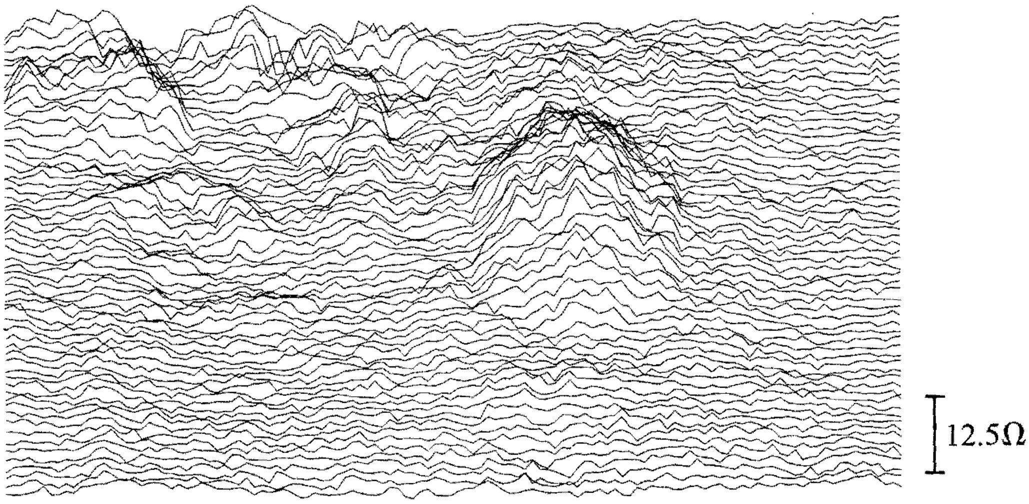
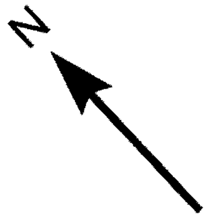
WOODNESBOROUGH, KENT.

Earth resistance survey, January 2001.

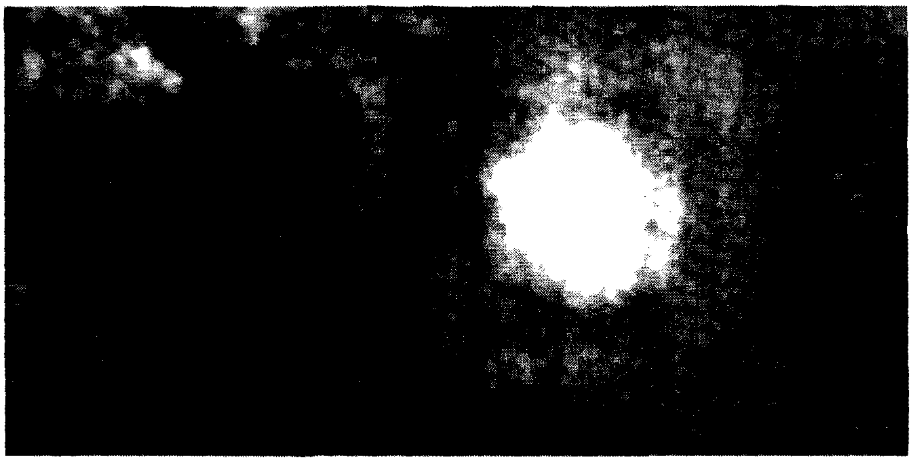
PLAN B

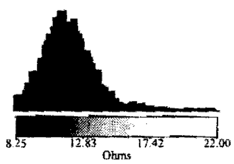
1) Traceplot of raw earth resistance data.



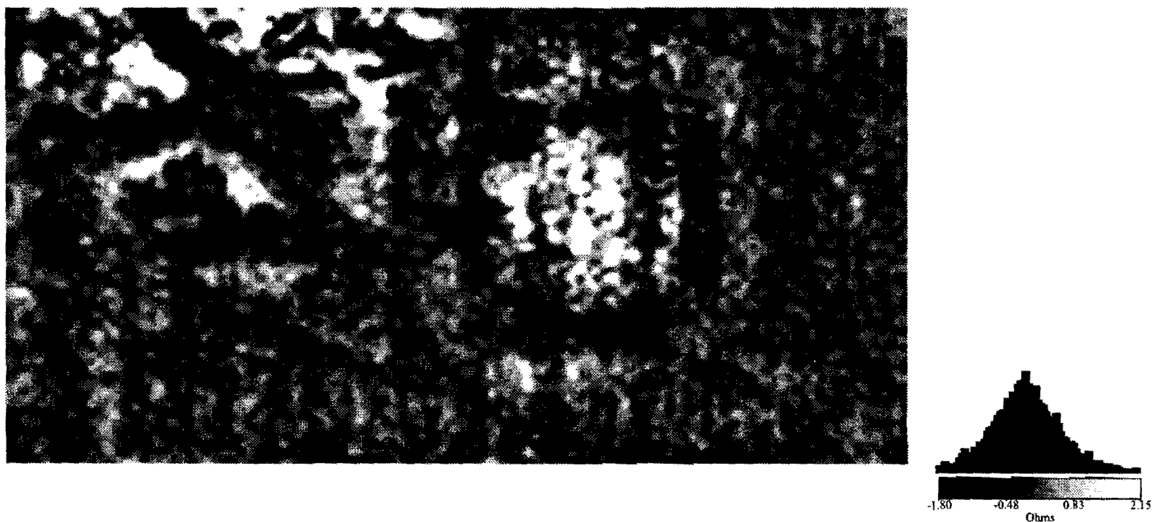


2) Linear greyscale of raw earth resistance data.





3) Linear greyscale of filtered earth resistance data.



0 90m

1:1000