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West Fiskerton, Witham Valley, Lincolnshire. Report on Geophysical Surveys, January 2003

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Summary

Magnetometer, magnetic susceptibility and earth resistance surveys were conducted over the site of two round barrows in part of a suspected round barrow cemetery to the west of Fiskerton, Lincolnshire. Results generally corroborated aerial photographic evidence although contributed to the uncertainty of the interpretation of one of the presumed barrows.

Keywords
Geophysical Survey

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WEST FISKERTON, Witham Valley, Lincolnshire.

Report on geophysical survey, January 2003.

Introduction

Geophysical surveys of approximately 1.6 hectares were conducted over the site of a possible barrow cemetery at Fiskerton, Witham Valley, Lincolnshire. A line of round barrows, believed to be situated on a sandy ridge amongst the peat and alluviated plain of the Witham, has been identified by the National Mapping Programme (NMP) (see Figure 1). Two of these barrows lie within the ~80 hectare project area of the English Heritage survey programme (Last 2002) which is centred on an Iron Age causeway approximately 1km to the east of this site. Subsequent analysis of all available aerial photographs (there are only a limited number, due to the restricted flying zone imposed around nearby RAF Waddington (Jones 2003, 5)), conducted as part of the EH survey, has cast doubt on the location of the western of these two features, whilst refining the plan of eastern one (*ibid*. Fig 3).

This survey was undertaken to further investigate and assess the geophysical response in the Witham Valley around Fiskerton, following the disappointing results of an earlier survey over the line of the causeway (Martin 2002). It was hoped a different target feature and the speculated higher, drier ground might be more conducive to standard survey.

The site (TF 040 716) lies on peaty soils of the Adventurers' 2 association, with complex soil patterns locally (Soil Survey of England and Wales 1983) developed over alluvial deposits underlain by Cornbrash (Institute of Geological Sciences 1973). At the time of the survey the field was in 'set-aside'.

Method

Magnetometer survey

Magnetometry was used to survey an area encompassing the two barrows to try to locate them and characterise their form. The survey was conducted over the shaded grid-squares (see 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 1:1250 on Plan A. A plot is also superimposed over the OS base map (1:2500) on Figure 2. Also included on this figure is the recent aerial photograph transcription (after Jones 2003).

Various corrections have been made to the measured values displayed in the plots. Heading errors were removed from the data by either subtracting a constant value from each line of data to zero the median, or by subtracting a quadratic polynomial of best fit from the data to additionally correct for a non-linear trend in the data caused

by the proximity of large ferrous objects to the end of the line. The data from all grids were 'despiked' through the application of a 2m by 2m thresholding median filter (Scollar *et al* 1990; 492) to reduce the detrimental effects produced by surface iron objects. A Butterworth filter in the frequency domain was applied to the data from six grid-squares to remove periodic artefacts caused by operator gait.

Magnetic Susceptibility

Topsoil volume magnetic susceptibility (MS) measurements were made *in situ* with a Bartington MS2 meter and field loop at 15m intervals across the grid (at the locations shown on Figure 1). In addition, one grid-square was surveyed at 5m intervals (not figured) in an attempt to refine an area of markedly high readings.

There was almost no surface vegetation across the site so optimum contact between field loop and topsoil was achieved. The results are presented as a greyscale plot superimposed on the base OS map and aerial photograph transcription on Figure 3 at a scale of 1:2500.

Earth resistance

An earth resistance survey was conducted over all the hatched grid-squares (see 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. Plots of the data-set are presented as an X-Y traceplot, linear greyscale of the raw data and a greyscale of high-pass filtered data in Plan B at a scale of 1:1250. A linear greyscale of high-pass filtered data has been superimposed over the base OS map and aerial photograph transcription (1:2500) on Figure 4.

Results

Magnetometer survey

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

The background response was uniform at ~ ±1.5nT. Ferrous disturbance has been recorded at [1], a pipe and at two adjacent discrete features [2]. The direction of modern ploughing can be seen over the whole survey area, but is illustrated at [3].

Several areas of strong magnetic readings have been recorded at [4-7]. These very localised responses, though strong (~16-46nT), are not all characteristic of ferrous material and may relate to burnt material of uncertain origin. The location of the largest of these [4], correlates with the position of the westerly barrow recorded on the NMP transcription (see Figure 1). However, the latter evidence for this was discounted during the recent AP study (Jones 2003, fig 3) and the disturbed nature of the geophysical response suggests a possible non-archaeological origin for [4]; and a similar interpretation might also be applied to the remaining alike anomalies.

By contrast, an area of intermittent raised but very weak magnetic readings (<3nT) partially surrounded by a sub-circular anomaly at [8] is likely to relate to a ploughed-out barrow mound and ditch; the response is similar to an example recently surveyed and excavated near Woodnesborough, Kent (Martin 2003). The location of this Fiskerton barrow correlates with one in the NMP transcription, and to one in the recent aerial survey (Jones 2003), known as Feature 8, although the shape in the magnetometer survey appears to differ to that in the latter study. The geophysical response indicates a slight elongation north to south, the AP transcription, east to west. The latter could be a phenomenon of ploughing, the orientation of which is approximately E-W (see [3]).

Other positive magnetic anomalies include two adjacent responses (4-8nT) at [9], which may be large pits, or perhaps even salterns; two areas of raised response at [10] and various small discrete anomalies across the data-set that could well be pits of archaeological origin. West of [10] a slight mottled appearance perceivable in the greyscale and increased noise at the corners of the western grid-squares nearest the drainage channel suggest that this latter feature may have once flowed further to the east and/or been subject to episodes of flooding. The stronger readings at [11], in the SW corner of the survey, may relate to more recent management of the ditch.

Magnetic Susceptibility

A clear hotspot in the MS data (262 ^{K} x 10^{-5} *cf.* an average of ~50 ^{K} x 10^{-5}), from both the 15m and 5m grid, correlates with the enigmatic magnetic anomaly [4], lending weight to the interpretation that burning has taken place here. The remaining data-set shows increases at [5], [6] and [11], but no significant correlation to any of the other anomalies such as [7] and [8], or with the general uniformity of the background response observed in the magnetometer survey.

Earth resistance

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

The earth resistance data-set is dominated by a broad band of high resistance [R1] running NW-SE. This does not correlate with any patterning in either of the magnetic surveys, but closely matches the edge of the natural feature 19 listed in the aerial survey gazetteer as an area of light coloured soil (Jones 2003, 12 and Fig 3). This is presumably a manifestation of underlying drift geology, the effect of which appears to have overridden any response to archaeological features, though the lack of any resistive anomaly at [4] may further signify the non-archaeological origin of this anomaly.

Conclusion

The background magnetic response is fairly uniform over most of the survey area and this has allowed the detection of faint contrasts of potential significance, as in the case of the likely barrow at [8]. However, other magnetic responses are stronger and less characteristic of those expected of burial mounds. In particular, the anomaly at [4] is of

uncertain derivation and the strength of the anomaly (and the results of MS survey) suggest that recent burning/disturbance may have taken place here. Alternatively such burning might be ancient but not related to burial activity (burnt mound?). Contrary to the NMP transcription, the recent analysis of aerial photographs does not place a feature at this location. The latter study suggests, alternatively, that a possible barrow is located at feature 9, some 58.6m to the south. However, no corresponding geophysical anomaly was recorded at this position.

The earth resistance survey has seemingly responded predominantly to natural features and no extra information has been gained that was not discernible from the aerial photograph study.

On the whole the results of the geophysical surveys successfully corroborate what has been interpreted from the air, both geologically and archaeologically. In addition several smaller, potentially archaeological features have been identified and more information has been gained about the eastern of the two barrows observed in the NMP exercise. The evidence for a barrow at [4] is equivocal however, as is the interpretation of some other strongly magnetic anomalies, which would benefit from a more intrusive investigation.

Surveyed by: P Cottrell
A Payne

Date of survey: 27-30/01/2003

Reported by: L Martin

Date of report: 14/05/2003

Archaeometry Branch,
English Heritage,
Centre for Archaeology.

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List of enclosed figures.

Figure 1 Location plan of survey grid squares over base OS map and NMP barrows (1:2500)

Figure 2 Linear greyscale of magnetometer data over base OS map and aerial survey transcription (1:2500).

Figure 3 Linear greyscale of magnetic susceptibility data over base OS map and aerial survey transcription (1:2500).

Figure 4 Linear greyscale of earth resistance data over base OS map and aerial survey transcription (1:2500).

Figure 5 Graphical summary of significant geophysical anomalies (1:2500).

Plan A Traceplot and linear greyscale of magnetometer data (1:1250).

Plan B Traceplot and linear greyscales of earth resistance data (1:1250).

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.

WEST FISKERTON, WITHAM VALLEY, LINCOLNSHIRE

Figure 1

Location of geophysical surveys, January 2003.

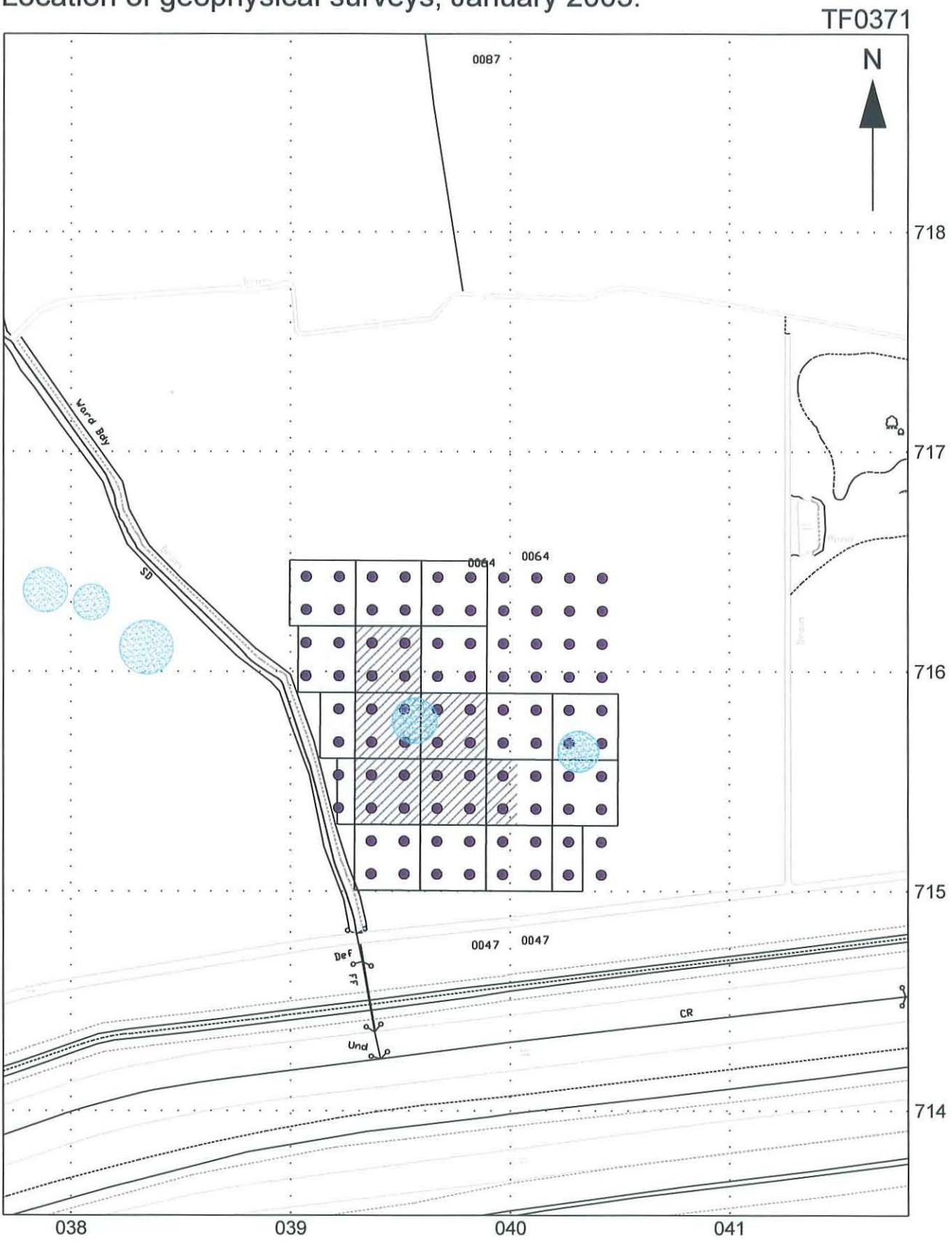

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Figure 2

Magnetometer survey, January 2003.

Natural features

Bank

Ditch

8 Feature number

(all after Jones 2003, fig 3)

-2.80 -1.08 0.63 2.35 nT

0 90m

1:2500

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Figure 3

Magnetic susceptibility survey, January 2003.

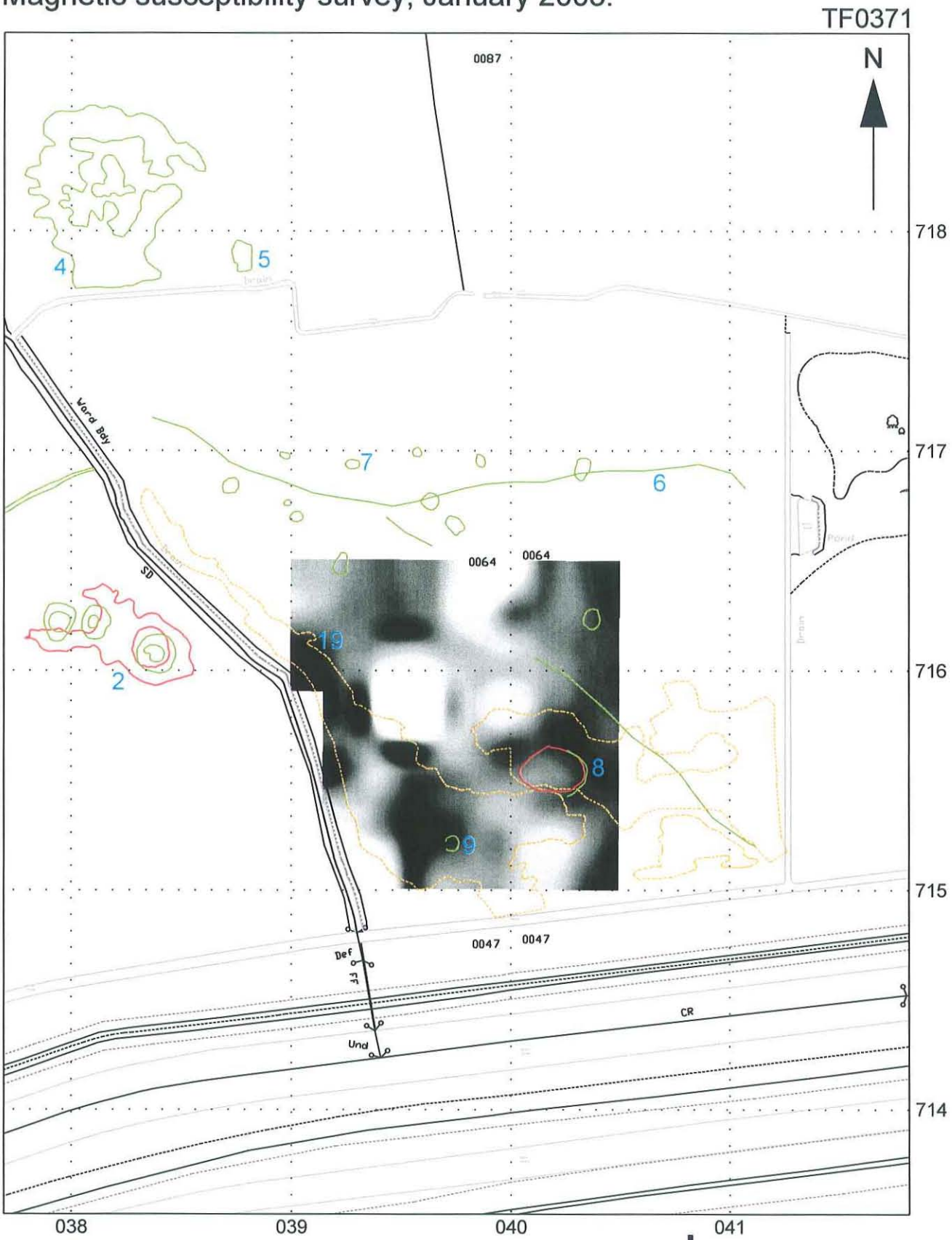

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Figure 4

Earth resistance survey, January 2003.

(all after Jones 2003, fig 3)

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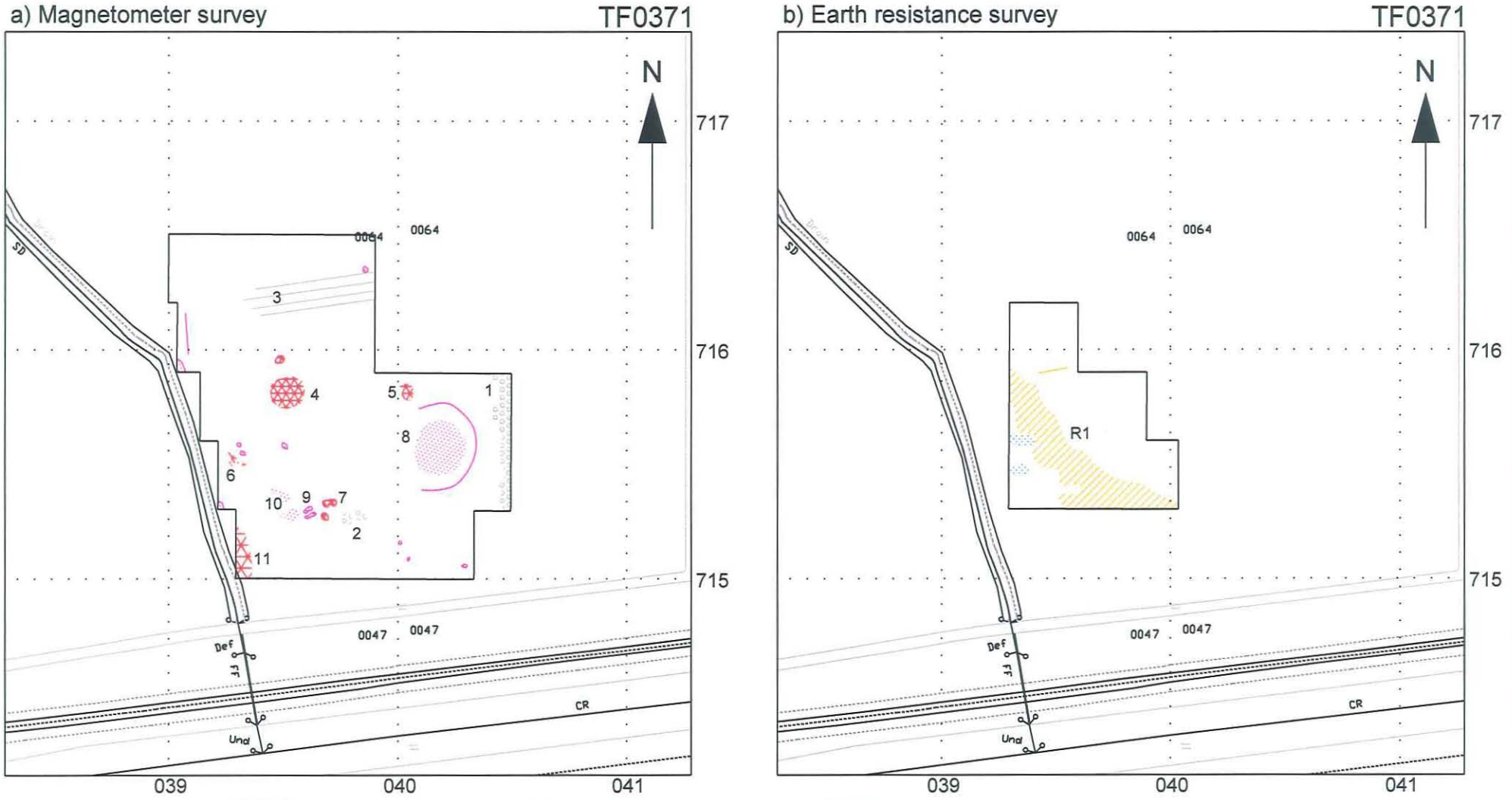
Figure 5

Graphical summary of significant geophysical results



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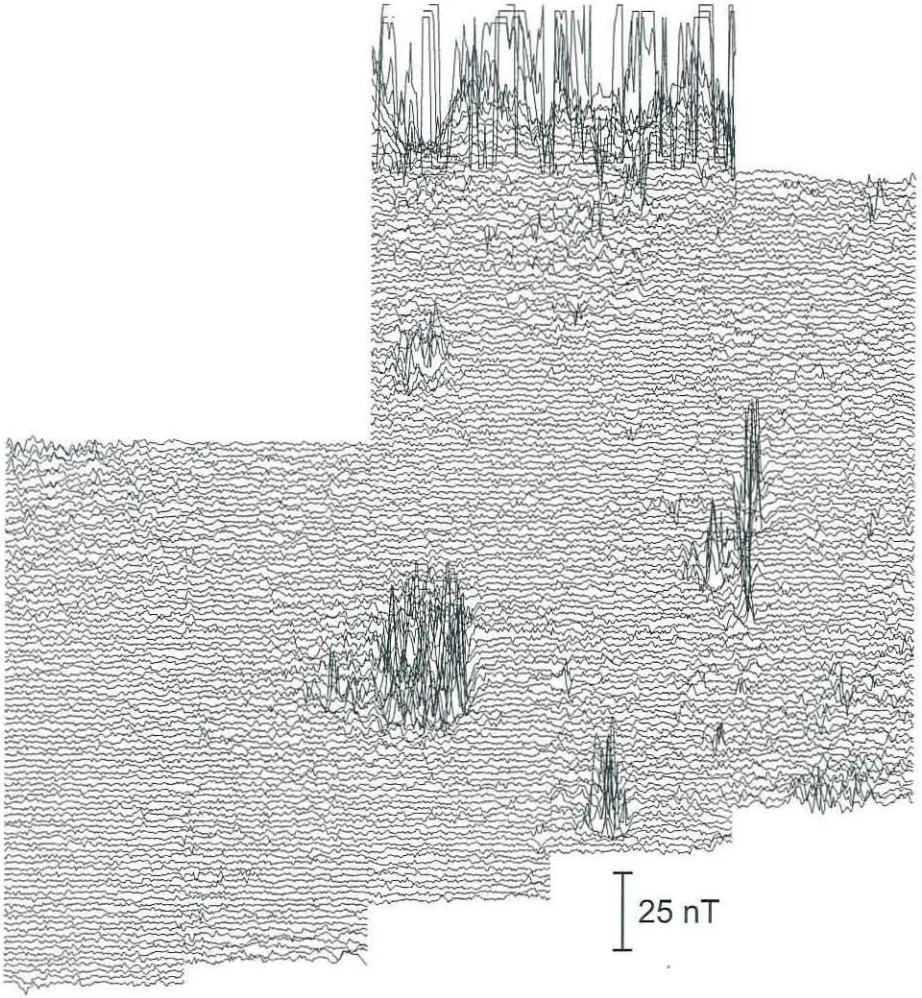
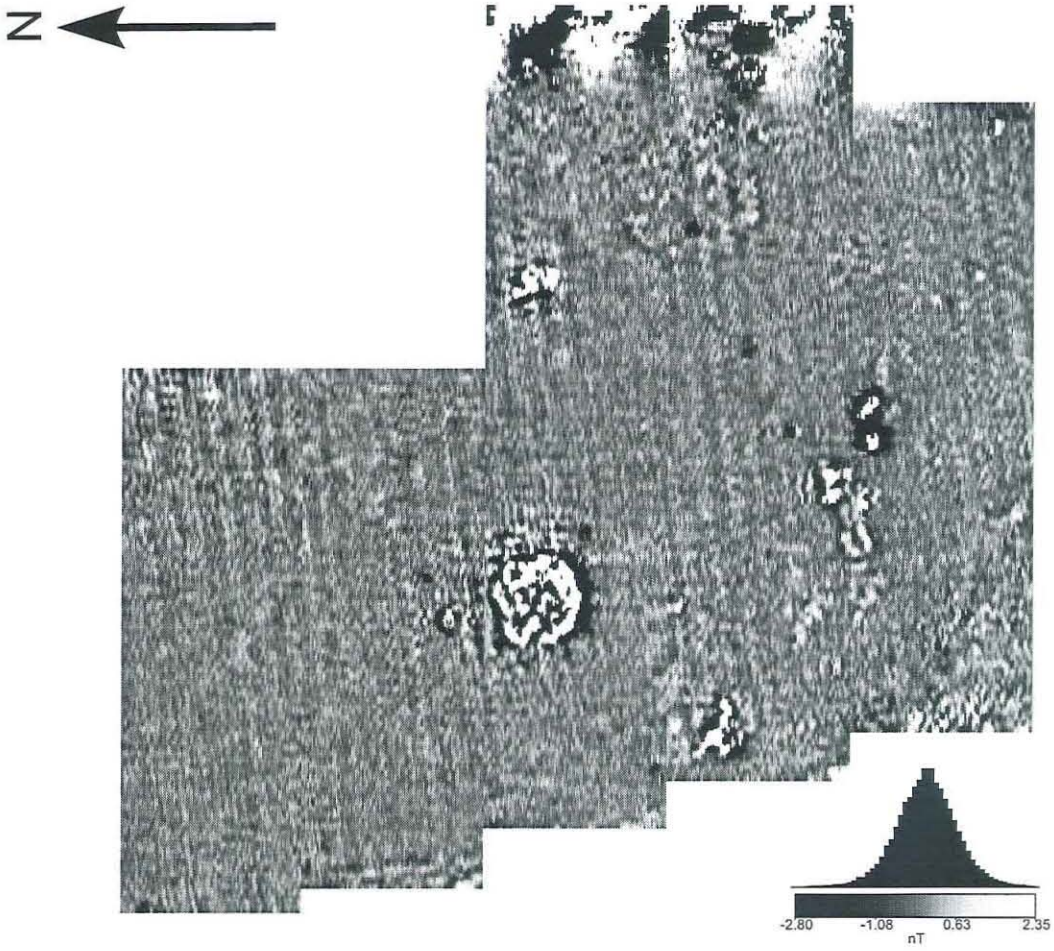
PLAN A

Magnetometer survey, January 2003.

1) Traceplot of magnetometer data.



2) Linear greyscale of magnetometer data.

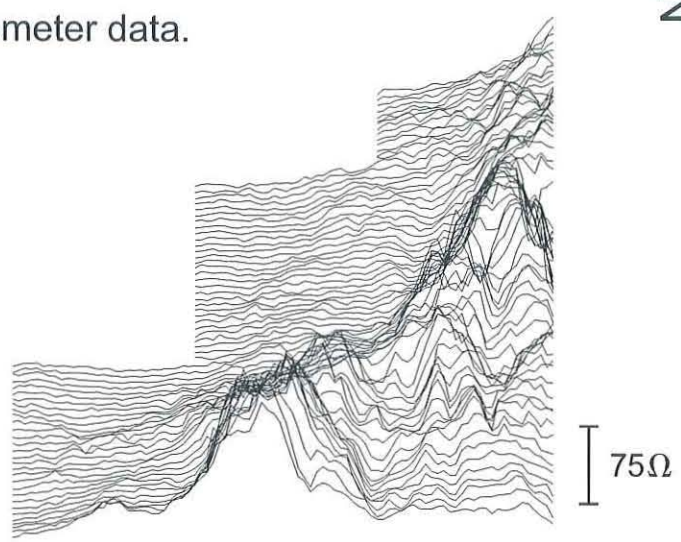


0 90m

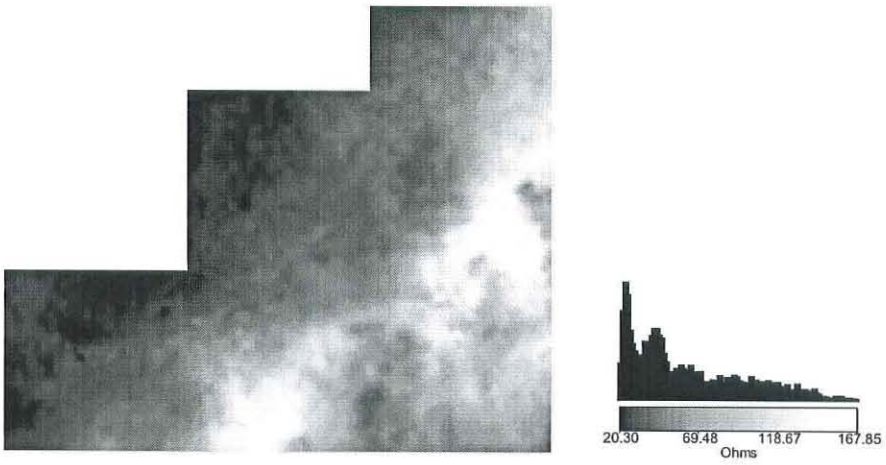
1:1250

WEST FISKERTON, WITHAM VALLEY, LINCOLNSHIRE PLAN B
Earth resistance survey, January 2003.

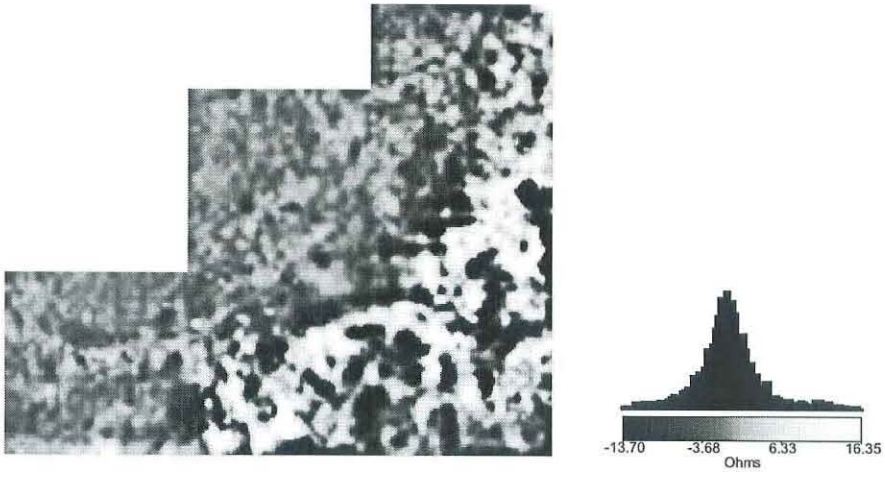
1) Traceplot of magnetometer data.



2) Greyscale of raw earth resistance data.



3) Greyscale of filtered earth resistance data.



0 90m

1:1250