Centre for Archaeology Report 103/2003

Mount Airy Farm, South Cave, East Yorkshire. Report on Geophysical Survey, August – September 2003.

Louise Martin

Summary

Cropmarks on a promontory on the edge of the Yorkshire Wolds in South Cave, East Yorkshire were investigated with magnetometry. The results corroborate the interpretation of the aerial photographic record, indicating a broad enclosure ditch with an entrance-way to the north. Unfortunately few other archaeologically significant anomalies were detected.

Keywords

Geophysical Survey

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MOUNT AIRY FARM, SOUTH CAVE, East Yorkshire.

Report on geophysical survey, August – September 2003.

Introduction

Geophysical surveys of approximately 3.35 hectares were conducted over the site of a possible hillfort, identified through aerial photography at Mount Airy Farm, South Cave, East Yorkshire. Interpretation of cropmarks was conducted by English Heritage's Aerial Survey team based in York, in response to a recent archaeological discovery in the area.

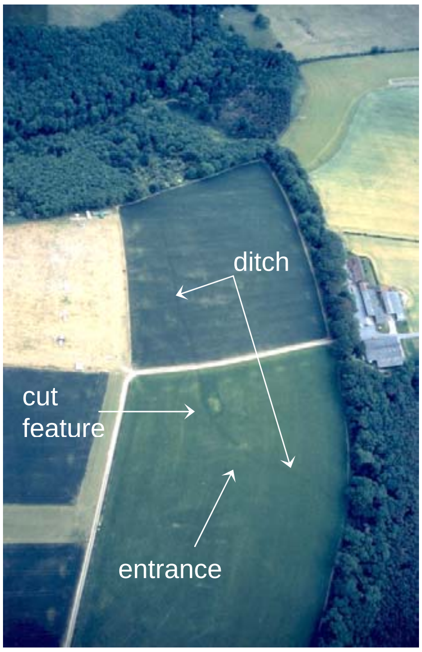

Plate 1: SE 9331/15 03-JUL-1995 NMR 12678/31
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Photographs from the mid 1990's indicated the presence of a 250m long curvilinear ditch spanning two fields, with a 4m wide entrance way to the north (see Plate 1); possible other breaks in the line of the ditch are thought to derive from adverse soil conditions (Horne 2003, 8). No internal details were apparent but a large irregular cut feature aligning with part of the ditch is thought to be indicative of a relatively recent chalk quarry (*ibid*).

The aim of the survey was to attempt to confirm the cropmark evidence and, if possible, locate any further features related to it.

The site (SE 936 313) lies on well drained calcareous silty soils of the Andover 1 and Panholes associations (Soil Survey of England and Wales 1983) developed over Burnhams and Welton Chalk (British Geological Survey 1983). At the time of the survey both fields were under stubble.

Method

Magnetometry has proven to be successful on similar sites in the region, such as Lower Caythorpe, North Humberside (Payne 1991), so this technique was chosen in an attempt to locate the enclosure ditch and any possible internal features. The survey was

was conducted with a Bartington *Grad601* fluxgate gradiometer over all the shaded grid-squares on 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 1:2000 in Plan A. A plot of the data-set is superimposed over the OS base map (1:2500) in Figure 2.

The main corrections made to the measured values displayed in the plots were to zero-mean each instrument traverse to correct for instrument heading errors and to 'despike' the data through the application of a 2m by 2m thresholding median filter (Scollar *et al* 1990; 492). This latter operation reduces the distracting, localised, high-magnitude effects produced by surface iron objects. As the alignment of some linear anomalies in the southern field coincided with the direction of the survey traverses, several grids were treated on an individual basis to ensure such responses were not suppressed. A Butterworth band-reject filter in the frequency domain was also applied to the data from certain grid-squares, to remove periodic artefacts caused by operator gait. Furthermore, for the traceplot representation of the data (Plan A1), the magnitudes of extreme values were truncated to ±15nT/m to improve the visual intelligibility of the plot.

Results

A graphical summary of the significant anomalies discussed below is provided on Figure 3. Numbers in [ ] refer to annotations in this figure.

In areas with an absence of anomalies, the magnitude of the background magnetic response was low, between about ±1nT/m. A number of high magnitude anomalies due to ferrous material are apparent. One extremely large example [1], recorded readings at the limits of the scale of the magnetometer (±3000nT/m). This anomaly correlates with the position of the possible chalk pit identified from the aerial photographs (Horne 2003, 8) and suggests that the fill includes quantities of ferrous material, perhaps relating to a modern dump of rubbish by the farmer (D Evans *pers comm.*). A smaller area [2] to the west could be due to a recent bonfire. The direction of modern ploughing [3] can be seen in the northern field, as well as a deep plough furrow/headland [4]. The lack of a similar response in the southern field may be due to a different ploughing regime for a different crop.

A curvilinear positive magnetic anomaly [5] with a peak response of 8nT/m is indicative of a ditch filled with magnetically enhanced material, and correlates well with the location of the ditch identified from the aerial photographs. The break in the cropmark in the northern field proposed as an entrance is also visible in the magnetometer survey, though without significantly enhanced terminals. No other breaks in the line of the ditch are apparent, lending weight to the interpretation that the interruptions to the line of the cropmark are likely to be due to local soil variations. Several linear responses can be seen running approximately orthogonal to the line of the ditch in the southern field. The longer but fairly weak anomalies at [6] (peak response <3nT/m) appear to cross the ditch anomaly [5]. However, a number of shorter but more enhanced (~5nT/m) linear responses [7] seem to terminate at their junction with it. A similar linear anomaly may be discerned in the northern field at [8] but its intersection with the enclosure ditch anomaly is obscured by the disturbance at [1].

A sporadic distribution of discrete anomalies, possibly representing pits, can be observed across the survey area. The lack of both an obvious correlation of this pattern to the enclosure ditch and the paucity of cropmark and geophysical evidence for permanent occupation structures within it may imply that there was no settlement focus to the site.

Conclusion

The variation in background readings at the site is low and this often indicates a natural soil with a relatively low magnetic susceptibility. In contrast, the fill of the ditch feature detected by aerial photography appears to be well magnetised and it has been clearly defined as a linear magnetic anomaly in the present survey. That only a single break occurs in this anomaly, corresponding with the entrance identified from the cropmark, tends to substantiate the conjecture that other interruptions in the cropmark are due to adverse soil conditions rather than true gaps in the ditch. There appear to be no traces of internal structures within the area enclosed by the ditch and, although some pit type anomalies have been recorded, their relation to the enclosure is uncertain. In addition, the strength of the magnetic signal at [1] substantiates the interpretation that the 'chalk pit' is a modern feature.

Reviewing the cropmark and geophysical evidence as a whole: the limited security of a single ditch, the lack of focus around the entrance and the minimal activity within the enclosure all volunteer the interpretation that, following the Wessex model (Cunliffe 1991, 346-7), this may be the site of a sporadically used early hilltop enclosure rather than a more strongly defended hillfort.

Surveyed by: P Cottrell
L Martin

J Moore
A Payne

Date of survey: 20-22/08/2003

4-5/9/03

Reported by: L Martin

Date of report: 16/12/2003

Archaeometry Branch,
English Heritage,
Centre for Archaeology.

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Soil Survey of England and Wales, 1983, Soils of England and Wales, Sheet 1, Northern 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 earth resistance 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.

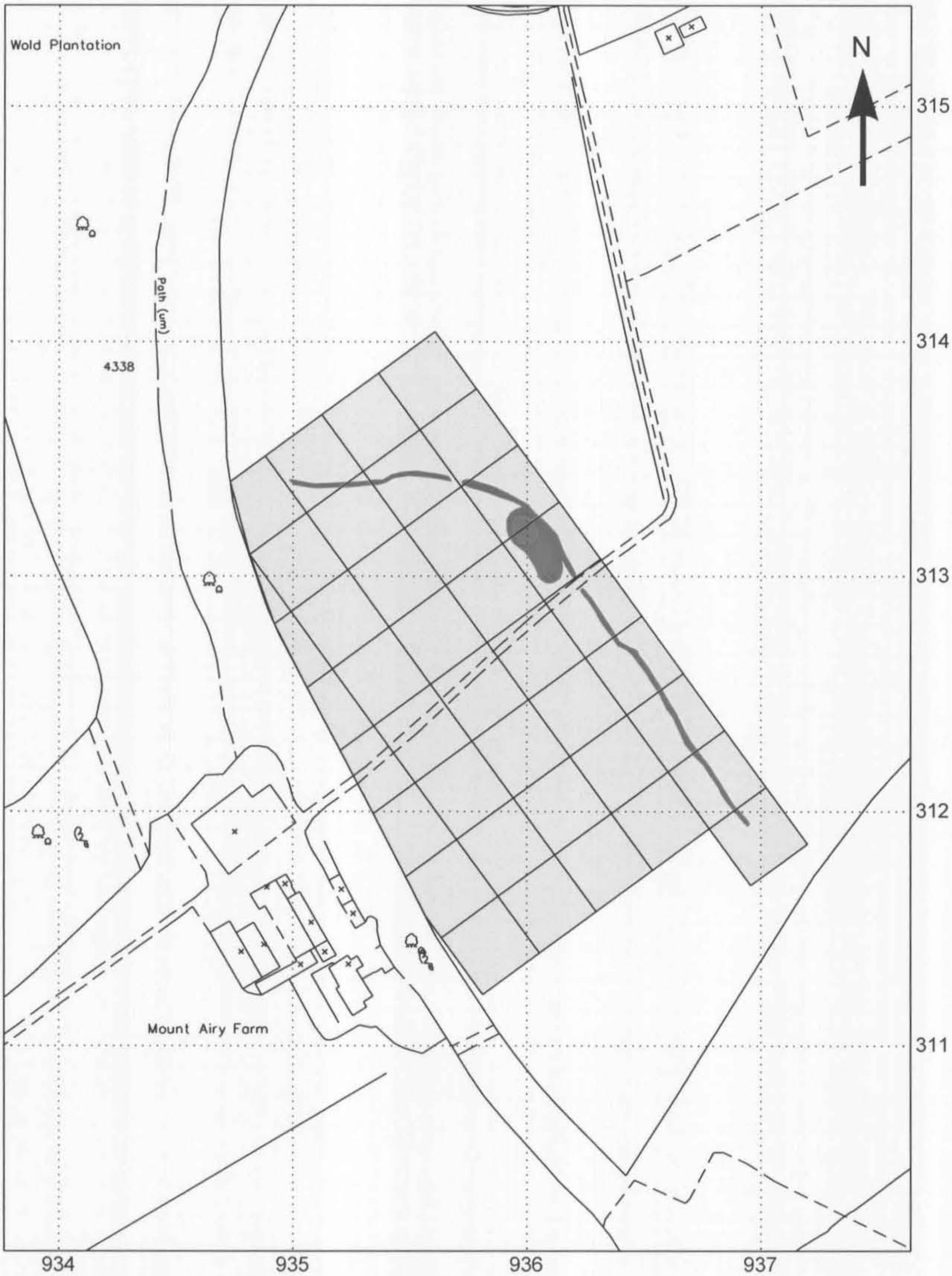
2) **Magnetometer Survey:** Each 30 metre grid square is surveyed by making repeated parallel traverses across it, all parallel to that pair of grid square edges most closely aligned with the direction of magnetic North. Each traverse is separated by a distance of 1 metre from the last; the first and 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. Where possible, the magnetometer is always kept facing in the same direction, regardless of the direction of travel, to minimise heading error. However, this may be dependent on the instrument design in use.

   Unless otherwise stated the measurements are made with either a Bartington *Grad601* or a Geoscan FM36 fluxgate gradiometer which incorporate two vertically aligned fluxgates, one situated either 1.0m or 0.5 metres above the other; the bottom fluxgate is carried at a height of approximately 0.2 metres above the ground surface. Both instruments incorporate a built-in data logger that records measurements digitally; these are subsequently transferred to a

Figure 1

MOUNT AIRY FARM, SOUTH CAVE, EAST YORKSHIRE
Location of Geophysical Survey, August - September 2003



Magnetometer survey

Cropmark interpretation (after Horne 2003)

0 90m
1:2500

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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 2

MOUNT AIRY FARM, SOUTH CAVE, EAST YORKSHIRE
Magnetometer survey, August - September 2003

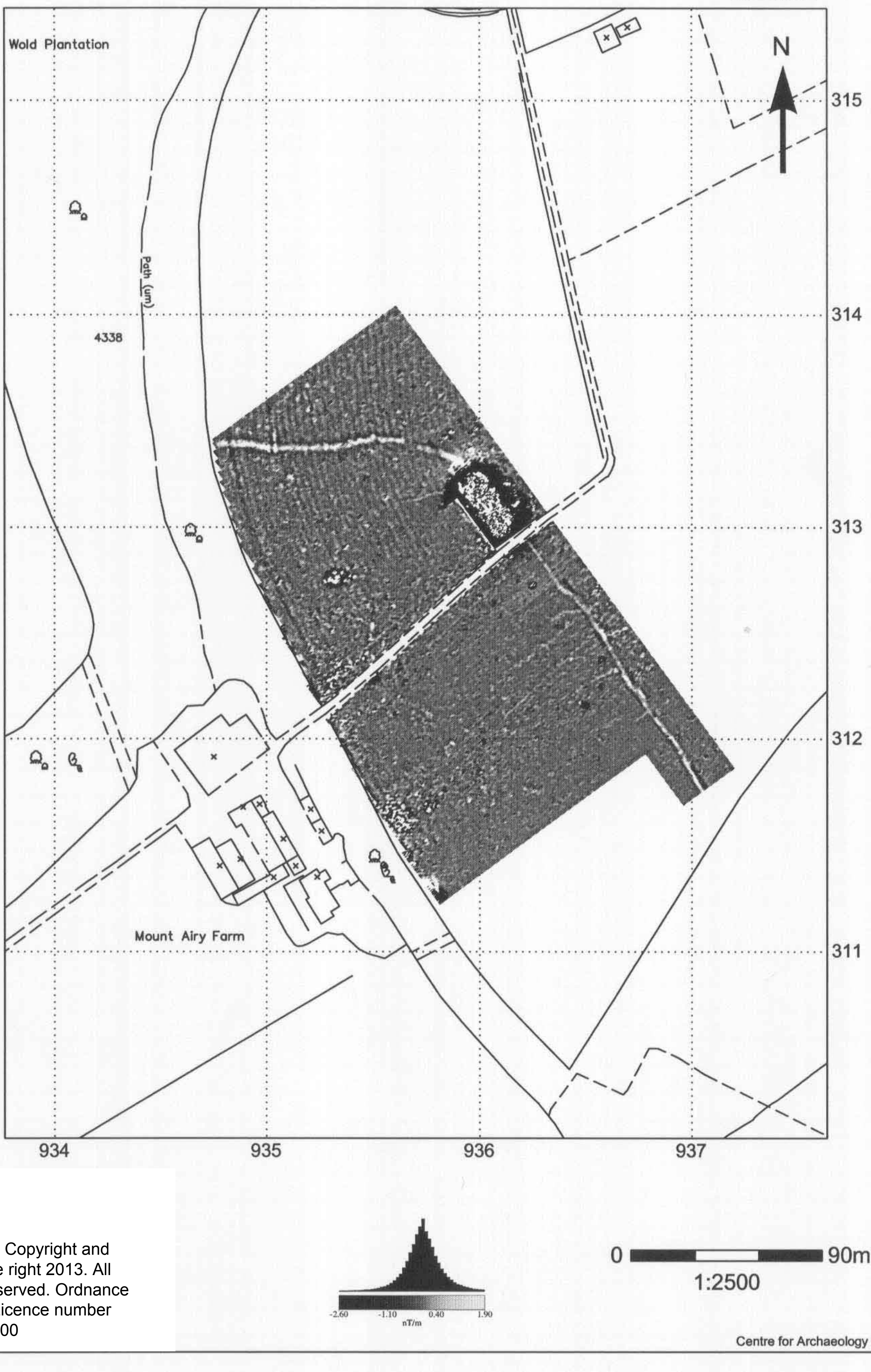

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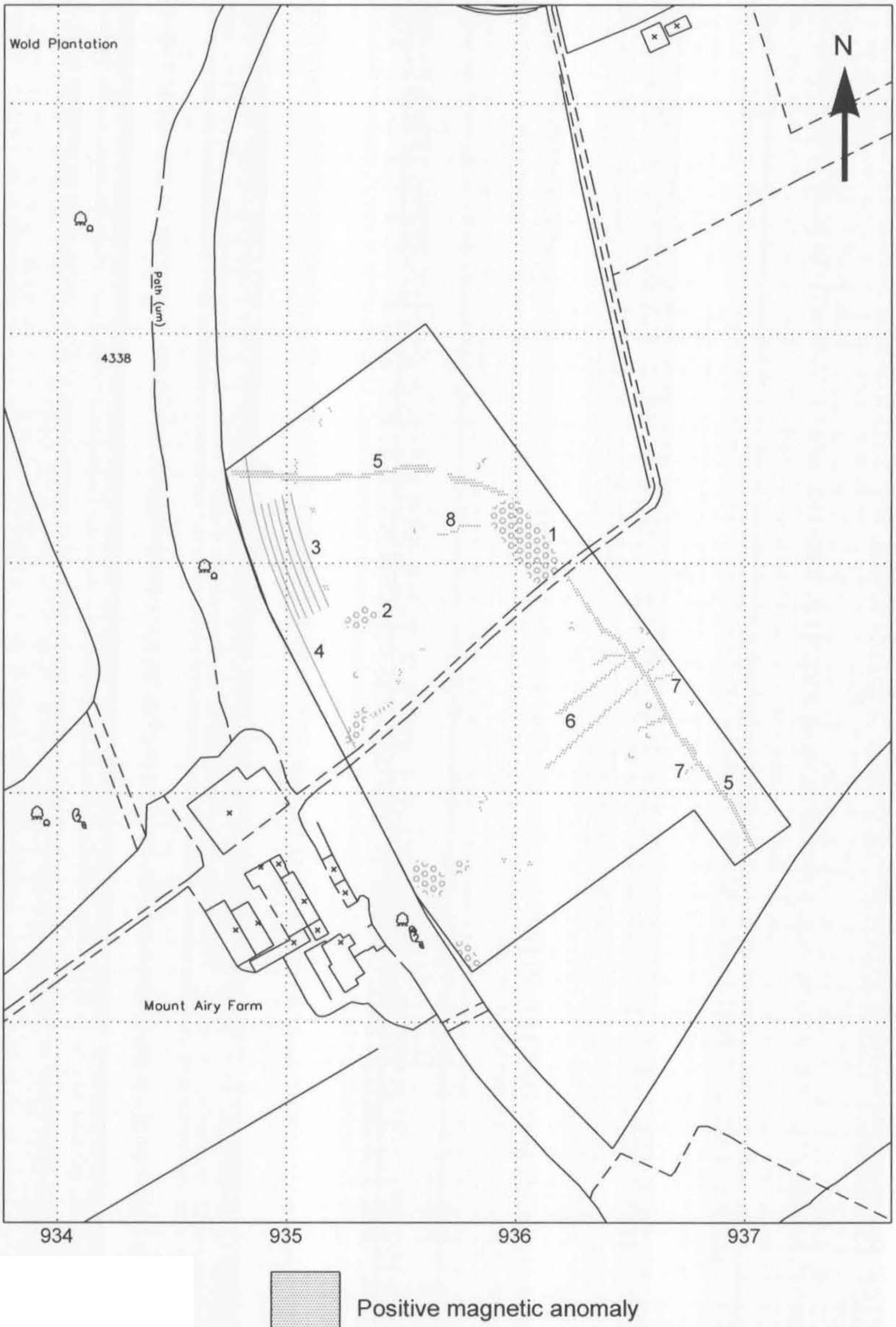
Figure 3

MOUNT AIRY FARM, SOUTH CAVE, EAST YORKSHIRE

Graphical summary of significant geophysical anomalies, August - September 2003

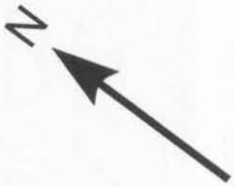
SE9331



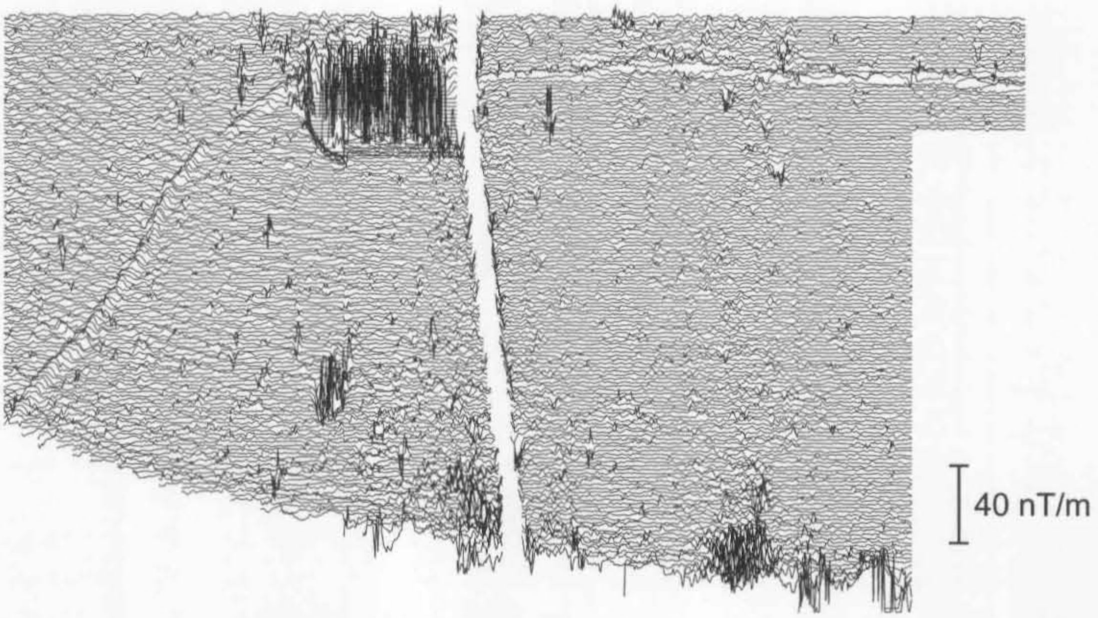
MOUNT AIRY FARM, SOUTH CAVE, EAST YORKSHIRE

Magnetometer survey, August - September 2003.

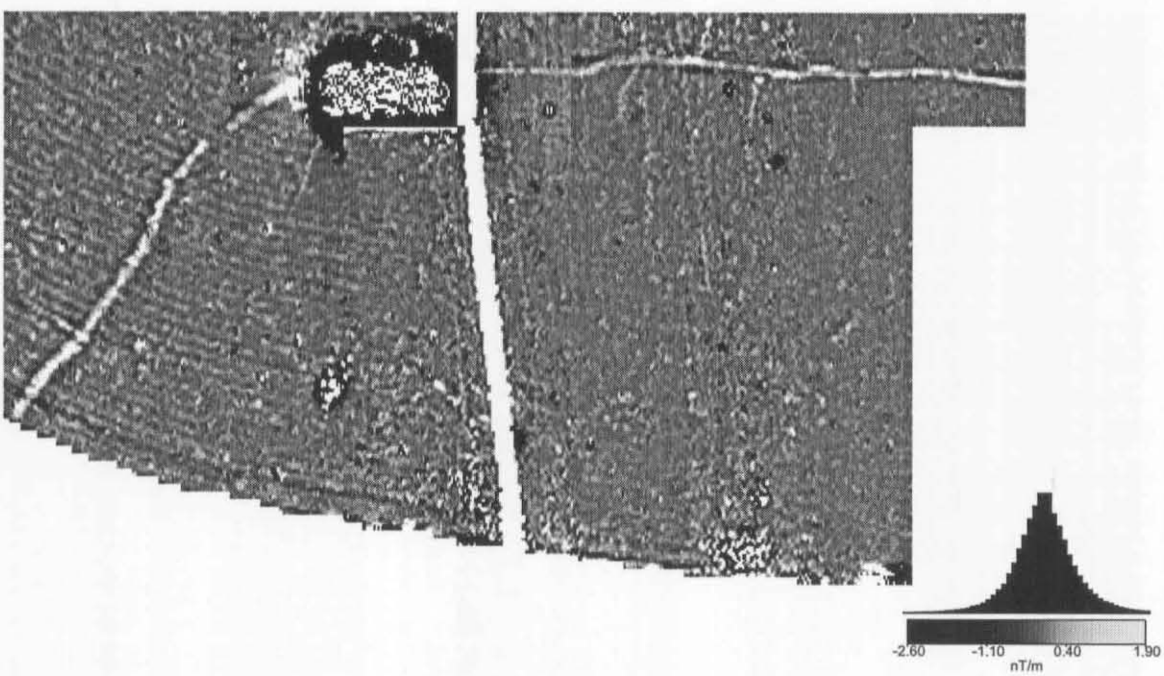
Plan A



1) Traceplot of magnetometer data.



2) Linear greyscale of magnetometer data.



0 90m

1:2000

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