Ancient Monuments Laboratory
Report 15/2000

MARSHCHAPEL, LINCOLNSHIRE. REPORT ON GEOPHYSICAL SURVEY, DECEMBER 1999

L Martin

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Summary

The geophysical survey of two sites near the village of Marshchapel, Lincolnshire, successfully detected the remains of probable occupation and industrial activity. The latter was particularly apparent in the field named Burnt Mound, where evidence for thermoremanent structures and enclosures was detected. The second field exhibited much weaker magnetisation but was nevertheless shown to contain concentrations of buried features near a former palaeo-channel; field walking evidence here implies a Roman date.

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Report on geophysical survey, December 1999

Introduction

A geophysical survey of approximately 4.7ha was conducted over two sites in Marshchapel, Lincolnshire, in support of the ongoing Humber Wetlands archaeological survey. The first area of investigation was undertaken in a field locally known as 'Burnt Mound' (TF 358 983), from which a large amount of 12^{th} – 13^{th}-century AD pottery and building material has been recovered (Van de Noort, *pers comm.*). The second area (TF 357 979), some 500m to the south, was believed to be a Roman settlement, with surface finds of pottery, roof and hypocaust tiles (Van de Noort, *pers comm.*). Both sites were also believed to have been used for the salt making industry, possibly prior to more formal occupation.

The aim of the survey program was to assist the Humber Wetlands project in determining the extent of occupation and industry on these sites, and so to highlight areas for investigative excavation.

Both sites lie on stoneless clayey soils of the Newchurch 2 association (Soil Survey of England and Wales 1983) developed over a drift geology of marine and estuarine alluvium with an underlying solid geology of Burnham Chalk (Institute of Geological Sciences 1990). At the time of the survey the Burnt Mound area was in uncultivated 'set-aside' ground but the second site (Marshchapel) was ploughed and planted with a cereal crop.

Method

Magnetometer survey

Magnetic survey (see Annex 1, note 2) was chosen both because of its rapidity of coverage and because of the favourable magnetic response previously noted on similar sites in the Humber catchment area (Cole and Cottrell 1999). Both a traceplot and linear greyscale of the raw data for each site have been 'de-spiked' (using a median filter to remove single anomalous readings created by ferrous objects); 'un-bunched' (corrected to zero the median of each instrument traverse to remove heading errors); and 'de-staggered' (to remove offsets between adjacent traverses caused by heading error). Plan A depicts the data for Burnt Mound, at a scale of 1:750. Plan B represents the data for Marshchapel at a scale of 1:1250.

Magnetic Susceptibility

Soil samples were collected from each site at 30 metre intervals along a central traverse, orientated along grid square edges (Figure 1). The results are presented as bar charts showing the variation of topsoil mass specific magnetic susceptibility and superimposed upon the location plans in Figure 1.

Results

Burnt Mound

A graphical summary of all significant anomalies discussed in the following text is provided in Plan C.

Magnetometry

The direction of modern ploughing (visible in part on the surface of the field) can be seen over most of the plot but is most noticeable at [1]. Other remnants of agricultural regimes are a possible field system [2], where a series of linear anomalies orientated in a north-south direction can be seen.

The magnetic data is dominated by several linear highly positive magnetic anomalies and clusters of thermoremanent responses.

The thermoremanent features at [3] – [6] have very intense magnetic signatures (~ 75 nT). [4] and [5] are both adjacent to less intense pit-type anomalies. The group as a whole may be related to the adjacent enclosure [7], which possibly also incorporates the line of anomalies at [8]. West of features [3]-[6] at [9] are some less intense linear anomalies suggestive of an associated rectilinear structure. Other anomalies are apparent to the east at [10] and [11] and, to the north is a ditch [12], and at least two pits [13] and [14].

The positive magnetic response at [15] may form part of an enclosure, respecting the corner of the current field system and including the more intense response [16]. Adjacent to [15] are two intense thermoremanent responses [17] and [18], each with a neighbouring pit-type anomaly. Nearby, at [19], some less intense amorphous anomalies might represent associated activity. Just outside and to the north of [15] are two more pit like responses, [20].

Across the north-western edge of the survey grids is an area of more subdued positive magnetic anomalies [21], some of which form linear patterns. Overall, however, these responses are too indistinct to define clearly any specific features.

Magnetic Susceptibility.

Values for mass specific susceptibility (χ) are high, falling within the range of 43 – 176 $\times$ 10^{-8} [m^3kg^{-1}] (Figure 1). As might be expected, the peak value falls close to [4], and there is a fall-off to the east where the gradiometer readings are more subdued.

Marshchapel

A graphical summary of all significant anomalies discussed in the following text is provided in Plan D.

Magnetometry

In contrast to the Burnt Mound field, the magnetic response over Marshchapel is generally more subdued although a wealth of anomalies have been detected. The weaker of these, which underlie most of the survey area are probably geomorphological in origin, but superimposed on this background are localised areas of archaeological activity. Along the north-west part of the survey area a linear zone of relative magnetic inactivity [1] may correspond with the edge of a palaeo-channel.

The archaeologically significant anomalies on this site appear to be grouped into four main areas spanning the field from the south-west to the north-east. There are, however, some more isolated anomalies such as the three pit-type responses at [2] and the more intense anomaly [3].

In the south-west of the survey grids lies an area of increased magnetic response, with the majority of intense readings around [4]. These anomalies mainly consist of pit-type responses and linear features. South of these, at [5] is a more subdued, but nevertheless positive area of readings.

A distinct negative linear anomaly [6] extends from [4] towards the next concentration of significant readings at [7]. The latter includes some suggestion of a rectilinear patterning but no particular structural shapes are apparent.

To the north-east of [7] is another group of intense positive readings [8]. There seem to be less pit-type anomalies at [8] than at [4]. An apparent reduction in magnetic activity within [8], identifying an approximately rectangular central area, may be significant.

To the north of [8] is a further concentration of positive magnetic readings [9] which are noticeably less intense than those recorded over [4], [7] and [8]. It is possible that [9] represents activity taking place on the bank of the palaeo-channel.

Magnetic Susceptibility.

The recorded values for mass specific susceptibility (χ) fall within a range of 11–23 $\times$ 10^{-8} [m^3kg^{-1}], and are very markedly lower than those at Burnt Mound (see above). As at the latter site, however, the peak values coincide with the more intense concentrations of magnetic activity detected by the magnetometer.

Conclusions

The soils in the Marshchapel area have proved suitable for magnetic survey, with archaeological remains being detected clearly at both sites.

The high magnetic susceptibility readings at Burnt Mound suggest that activity involving burning was taking place, as indicated by the field name, and the intense magnetic anomalies here may well be the remains of industrial structures. There is evidence for additional features and enclosures but it is not possible to ascertain whether or not these are indicative of permanent occupation of the site.

On the main Marshchapel field the palaeo-channel has been detected as an absence of the natural patterning of anomalies visible over much of the field. To one side of the channel is evidence for a series of four distinct clusters of activity arranged, in part, along what is possibly a north-south trackway [6]. Magnetic susceptibility readings were lower in this field than at Burnt Mound, possibly suggesting settlement rather than industrial activity on this site. In support of this the gradiometer readings were also less intense than those recorded in the Burnt Mound field. Another explanation, however, may be the possibility of a deeper overburden in this field, reducing the peak anomaly strength. The response here closely resembles that encountered at Adlingfleet during surveys in 1996 and 1998 (Cole and Cottrell 1999).

Surveyed by: N. Linford | Date of survey: 29/11/99 – 3/12/999
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Reported by: L Martin | Date of report: 6/3/2000

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References

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Cole, M. and Cottrell, P. 1999 Adlingfleet, Lincolnshire. Report on Geophysical Survey, December 1996 and September 1998. *Ancient Monuments Laboratory Report Series* **27/99**.

Soil Survey of England and Wales, 1983, Soils of England and Wales, Sheet 4, Eastern England.

List of enclosed figures and plans:

Figure 1 Location plan of survey grid squares over base OS map with results from the topsoil magnetic susceptibility transects (1:2500).

Plan A Traceplot and linear greyscale of magnetometer data from Burnt Mound (1:750).

Plan B Traceplot and linear greyscale of magnetometer data from Marshchapel (1:1250).

Plan C Graphical summary of significant anomalies from Burnt Mound (1:750).

Plan D Graphical summary of significant anomalies from Marshchapel (1:1250).

Annex 1: Notes on standard procedures

1) **Resistivity Survey:** Each 30 metre square is surveyed by making repeated parallel traverses across it, all aligned parallel to one pair of the 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 square edge. Readings are taken along each traverse at 1 metre intervals, the first and last readings being 0.5 metres from the nearest 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 Ancient Monuments Laboratory using desktop workstations.

2) **Magnetometer Survey:** Each 30 metre square is surveyed by making repeated parallel traverses across it, all parallel to that pair of 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 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 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 Ancient Monuments Laboratory 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.

MARSHCHAPEL, LINCOLNSHIRE
Location of Geophysical Surveys, December 1999.

TF3598

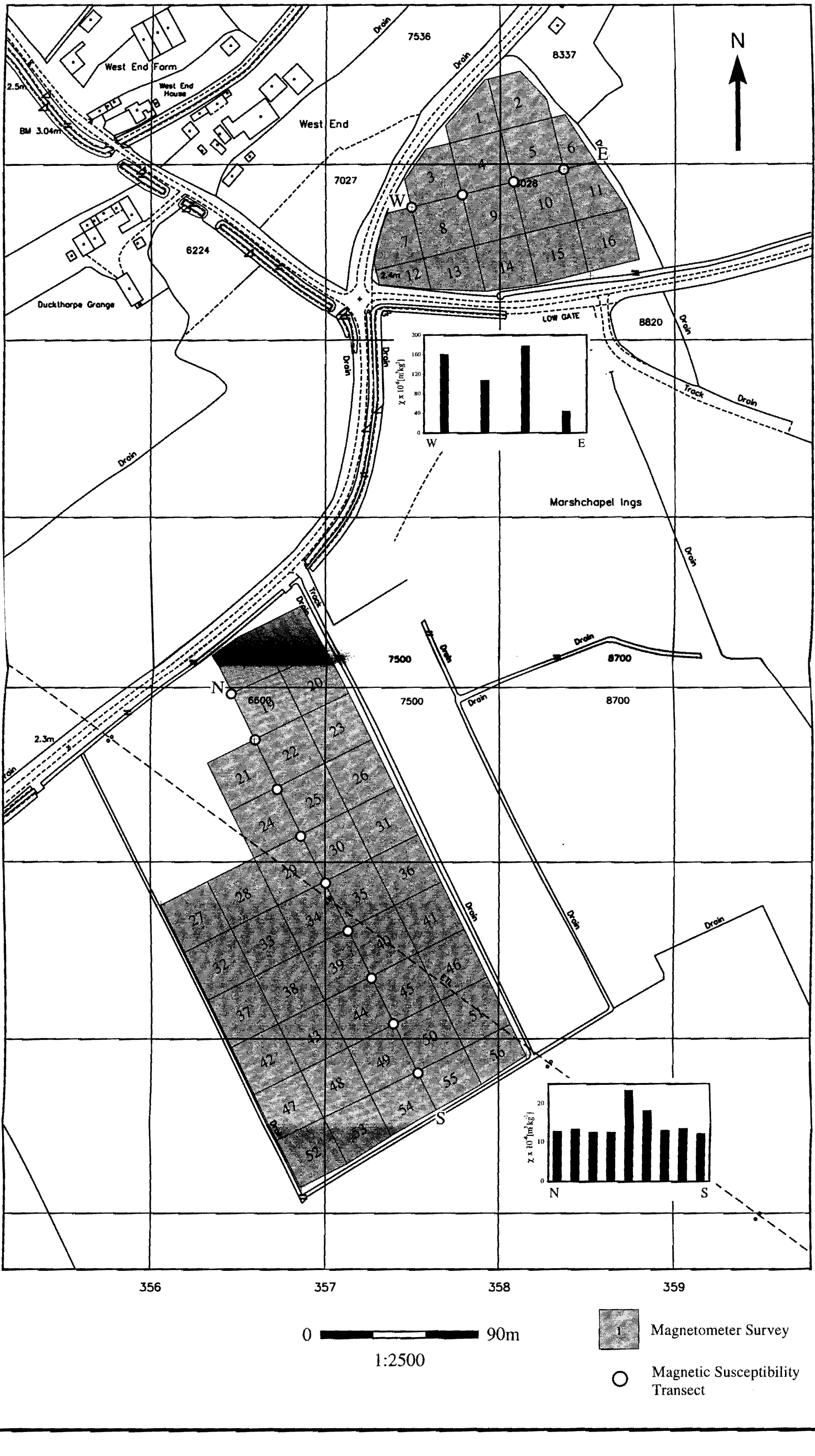
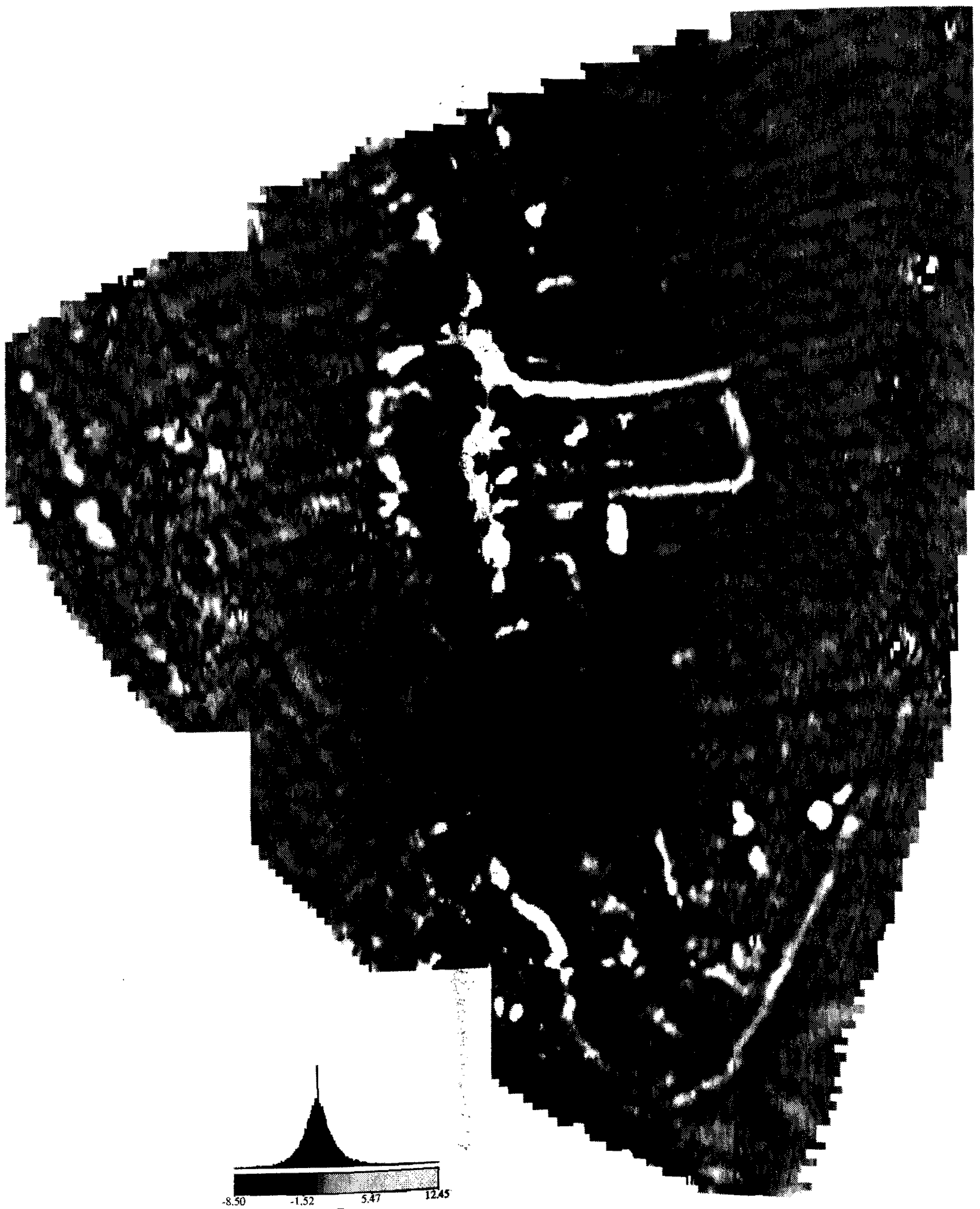


Figure 1; Marshchapel, Lincolnshire, Location of geophysical surveys December 1999.

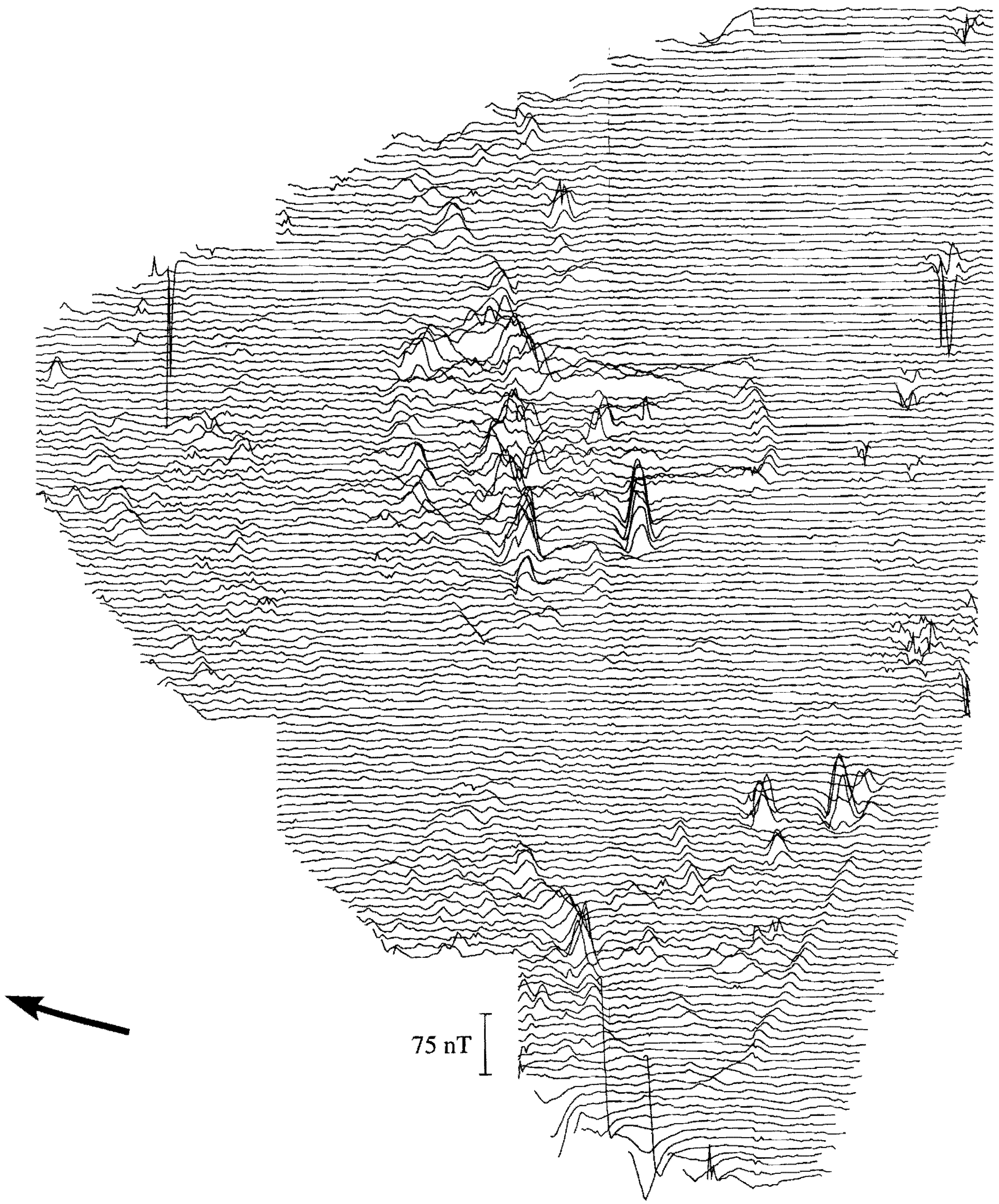
BURNT MOUND, MARSHCHAPEL, LINCOLNSHIRE
Magnetometer Survey, December 1999

PLAN A

a.) Linear greyscale of magnetometer data.



b.) Traceplot of magnetometer data.



0 90m

1:750

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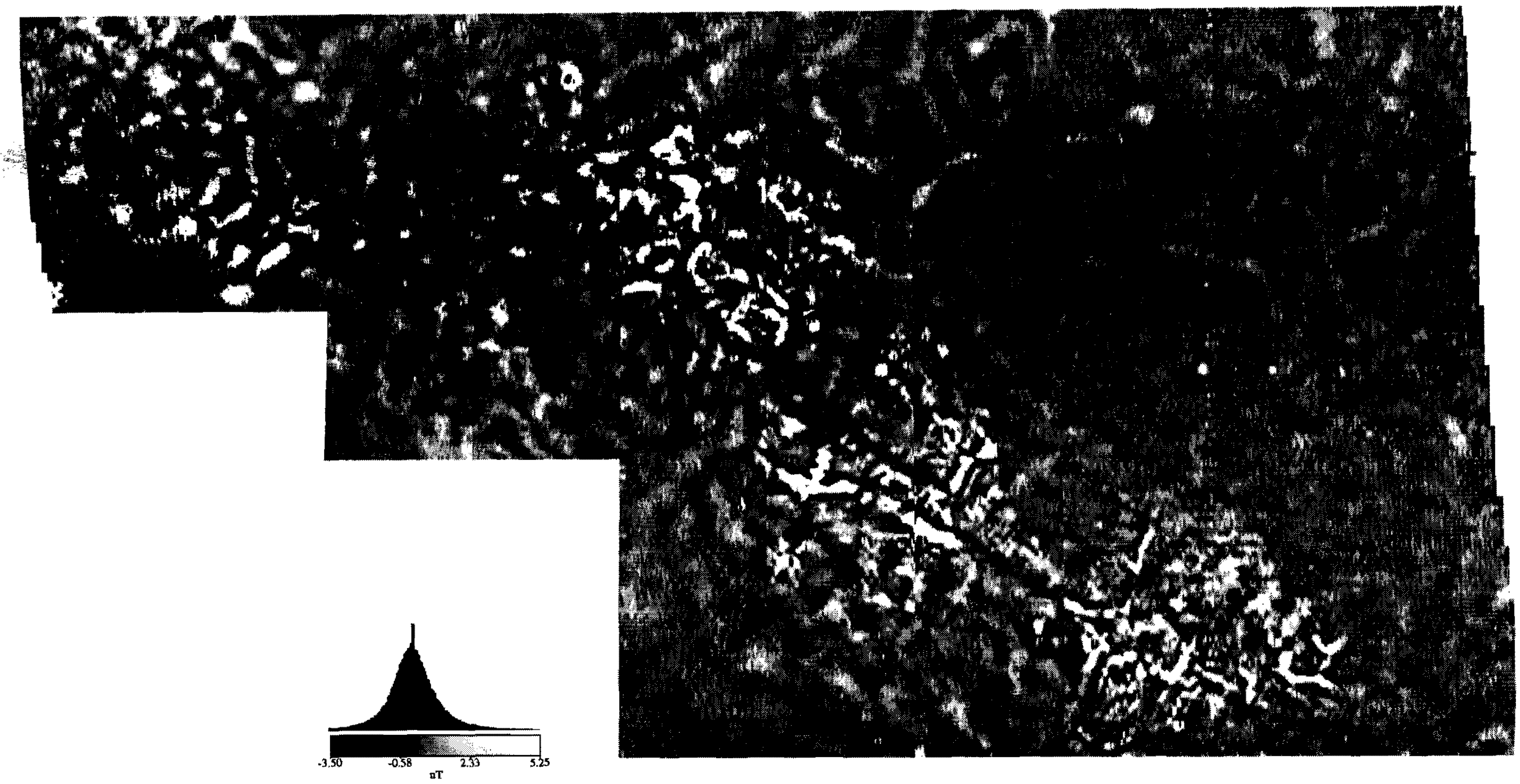
MARSHCHAPEL, LINCOLNSHIRE
Magnetometer Survey, December 1999

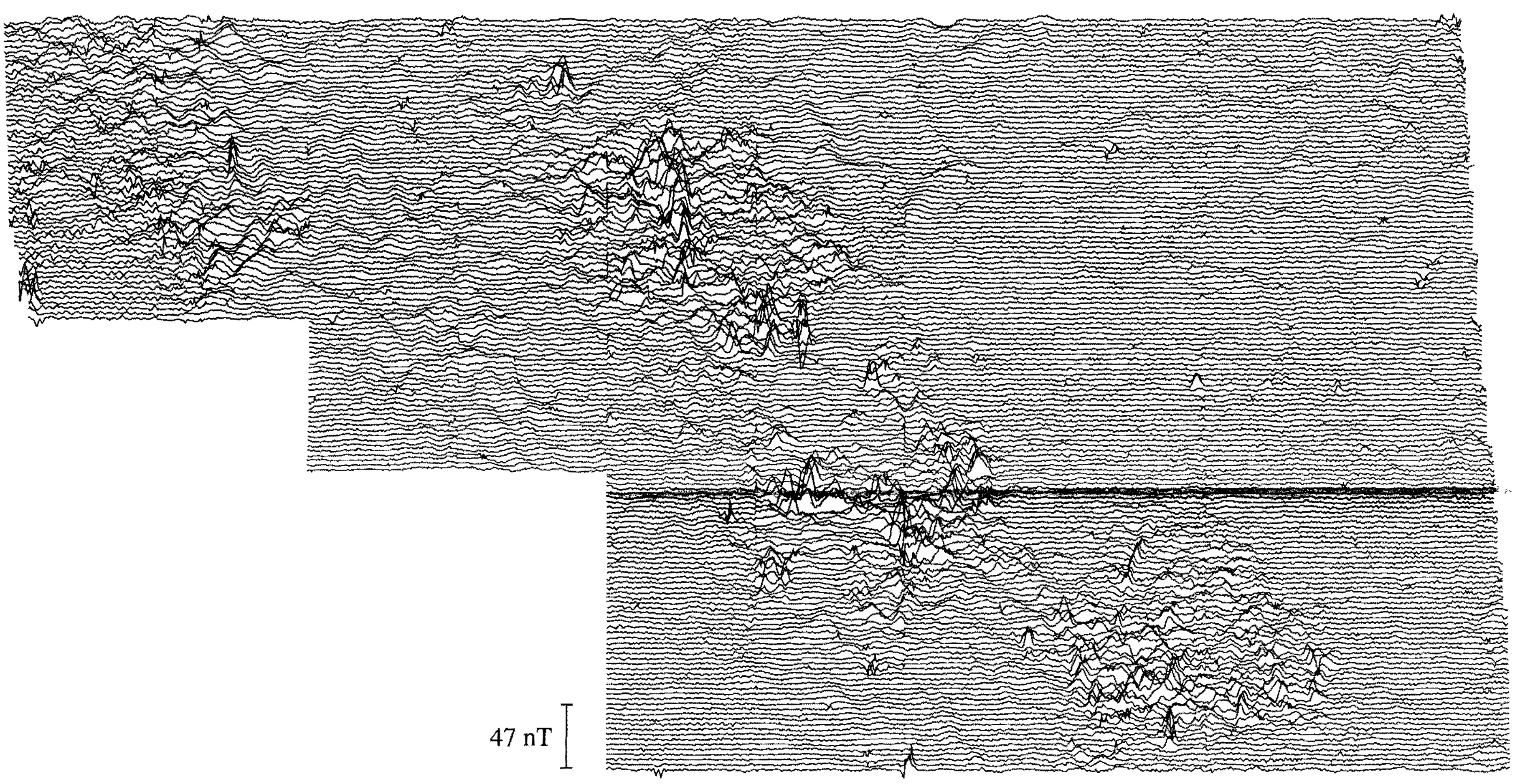
PLAN B

a.) Linear greyscale of magnetometer data.



N

b.) Traceplot of magnetometer data.



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1:1250

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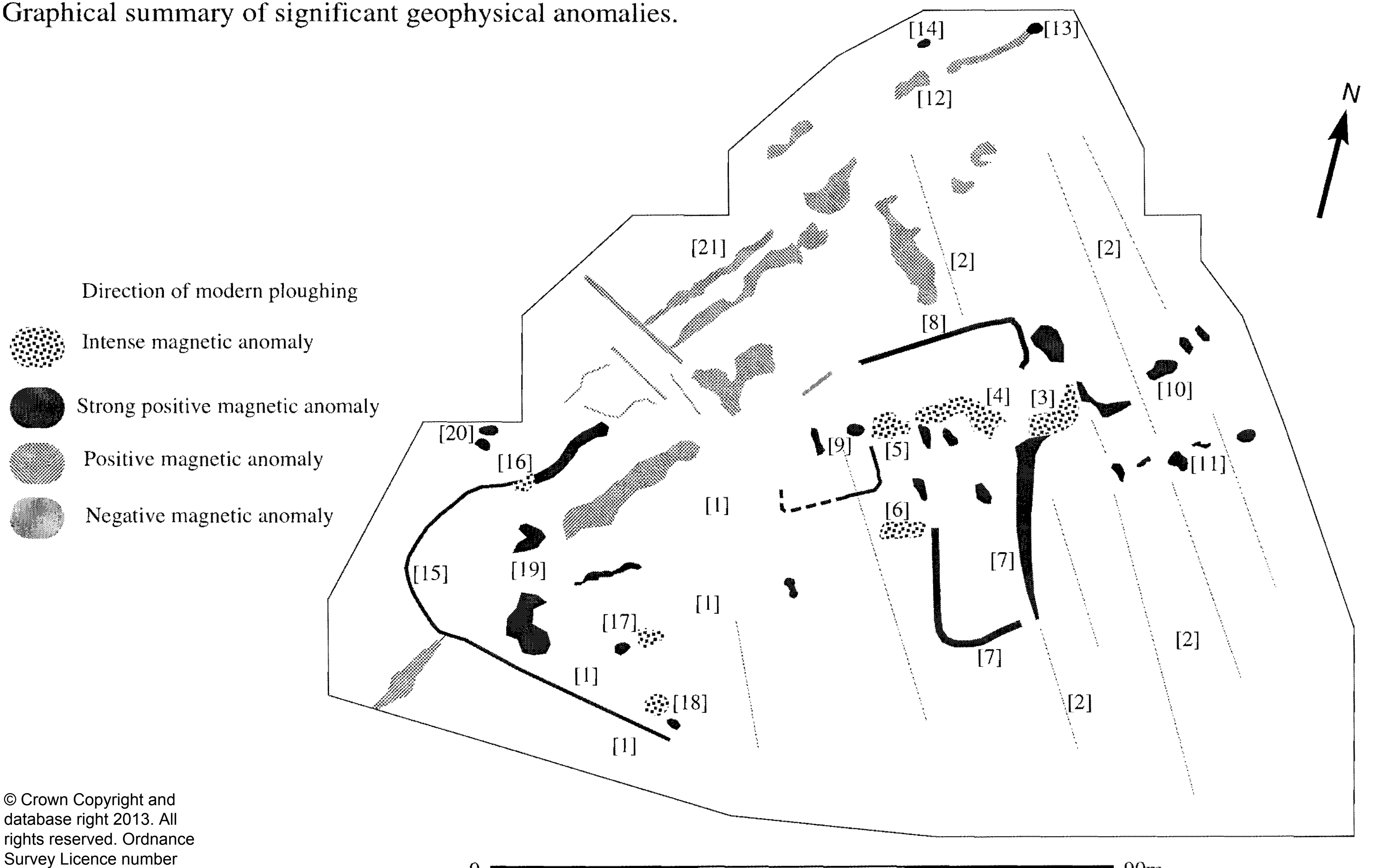
BURNT MOUND, LINCOLNSHIRE

PLAN C

Graphical summary of significant geophysical anomalies.



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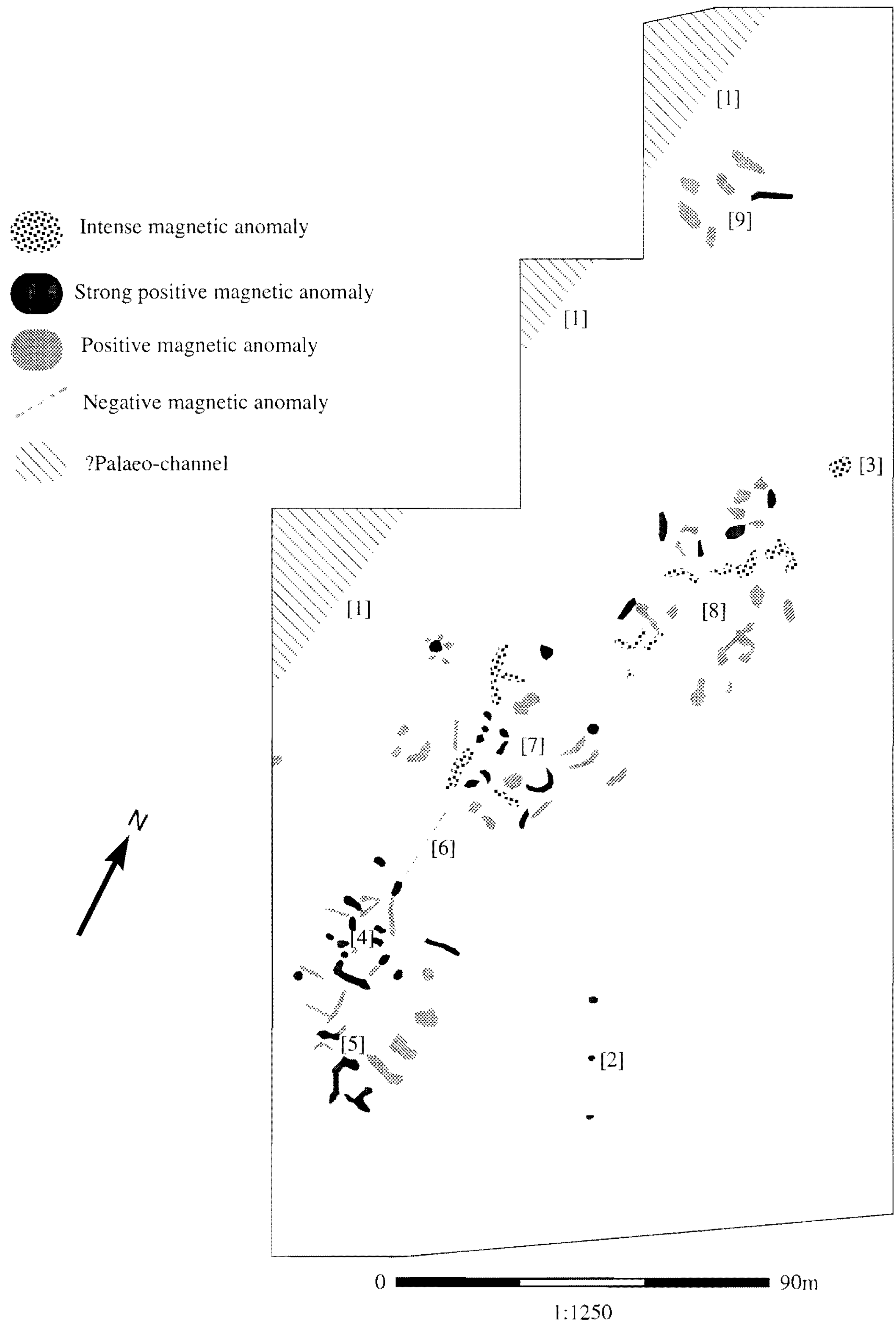
PLAN D

Graphical summary of significant geophysical anomalies.



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