Ancient Monuments Laboratory
Report 27/99

ADLINGFLEET, LINCOLNSHIRE. REPORT ON GEOPHYSICAL SURVEY, DECEMBER 1996 AND SEPTEMBER 1998

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Summary

Magnetometer and resistance surveys were undertaken near Adlingfleet, Lincolnshire, in response to a request from the Humber Wetlands Project (HWP). An extensive spread of Roman material, including some Samian Ware, had been collected during an HWP field walking assessment of the Ancholme and lower Trent valleys near to the confluence of the Rivers Trent and Ouse. The geophysical survey carried out in 1996 successfully located a number of surviving archaeological features, including clear evidence of industrial activity, and thereby assisted the location of HWP assessment trenches. Further survey in 1998, to the north of the original area, located more magnetic anomalies of a similar type and intensity to those detected in the 1996 survey.

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ADLINGFLEET, LINCOLNSHIRE.

Report on the geophysical surveys, December 1996 and September 1998.

INTRODUCTION

Geophysical survey was undertaken near Adlingfleet, Lincolnshire, in response to a request from the Humber Wetlands Project (HWP). Roman pottery had been collected over an area of approximately 300m x 500m to the south-west of Trent Falls (the confluence of the Rivers Trent and Ouse). These finds were of particular significance as they represented the only Roman activity as yet revealed in the area to the west of the Trent and south of the Ouse within a radius of approximately 6 km. The status of the site was also of interest given the presence within the pottery scatter of Samian Ware which is extremely rare in the area (Robert Van de Noort *pers comm*). It was hoped that the geophysical survey would map any surviving archaeological features and thereby shed some light on the function of the site: given its location, the possibility existed that it may have included a port. The survey results would also inform a subsequent programme of trial trenching by the HWP.

Three trenches were excavated in January and August 1997, guided by the results of the geophysical survey. The excavation confirmed that several of the geophysical anomalies were indeed archaeological, some being industrial in nature. As field walking had shown there to be a greater concentration of Samian Ware to the north of the surveyed area, the AML was asked to carry out further geophysical survey in September 1998 to help characterise, and determine the extent of the site.

The site, centred on NGR SE 849 225, is located on Estuarine Alluvium which overlies Mercian Mudstone (British Geological Survey 1983). All of the areas were under arable cultivation at the time of the surveys.

METHOD

For the 1996 survey a grid of 30m squares (Area A) was established towards the southern limit of the pottery scatter by HWP staff (see Figure 1). This location was deliberately chosen so as to encompass an area within the field to the south of the farm track which, due to the crop regime, had not been accessible during the earlier field survey.

For the 1998 survey two separate grids of 30m squares were established: Area C, where high quantities of Samian Ware had been recovered at the northern extreme of the field, bounded to the north and east by Horsegroves Drain, and Area B also abutting the drain to the east but approximately midway between the two other survey areas (see Figure 1). The corner points of these grids were surveyed in by HWP staff, using a GPS system, immediately after the survey. The survey points are indicated on Figure 1 and the coordinates obtained are listed in Annex 1.

Each of the grid squares was surveyed using Geoscan FM36 fluxgate magnetometers. Measurements of the local gradient of the Earth's magnetic field were recorded at 0.25m intervals along traverses spaced 1.0m apart. A number of grid squares in Areas A and C were subsequently resurveyed using a Geoscan RM15 resistance meter. Readings of apparent resistivity were collected at 1.0m intervals along traverses spaced 1.0m apart using the Twin Electrode probe configuration with a mobile probe spacing of 0.5m.

The resulting data is illustrated in this report using both greyscale plots and graphical trace plots.

Presentation of magnetometer data in all three areas has been enhanced by applying suitable filters for each area. The data for Area A has been enhanced by a local median filter to reduce the intense response to ferrous material. The data in Area B has been filtered to remove the effect of an intense magnetic anomaly near the open drain (**A** on Figure 5) by reducing readings over 100nT to a null value. The data in Area C has been filtered to reduce the response from ferrous material, and then convolved using a 4m radius Gaussian high pass filter to sharpen the magnetic anomalies against the background. (For further details about filters see Scollar *et al* 1990)

During the subsequent trial trenching, four soil samples were collected from excavated features and subsoil in order to measure their magnetic susceptibility (MS). The measurements were made in the laboratory using a Bartington MS2 meter and MS2B bench sensor and the results are summarised in Table 1.

Results of the 1996 Survey

Magnetometer survey (Figures 2-4)

The plot of the magnetometer data is divided into roughly equal areas by a pair of parallel broad positive anomalies running southwest-northeast across the survey area (**A** and **B** on Figure 4). The easternmost of these (**A**) is well defined and reaches a peak anomaly strength of 7.5 nT, whilst its western counterpart (**B**) is less distinct and is at its strongest only 1.5 nT. The subsequent excavation of Trench 1 (see Figure 4) confirmed that (**A**) represents a large ditch, although no artifacts were recovered to allow it to be ascribed to any particular period. The magnetic response to both of these features varies along their course. This may be due to some localised infilling of material with strongly enhanced magnetic properties derived from the industrial activity to the east (see below).

The character of the background magnetic signature to either side of these parallel ditches differs greatly. To the west the background is subdued and uniform whilst to the east it is comprised throughout of amorphous positive magnetic anomalies (some up to 2nT in strength) which, due to their form, seem unlikely to be archaeological. This response is unusual but not unprecedented and has been observed elsewhere over former river channels (eg at Hoe Hills, Dowsby, Lincs - Cole 1995). The effect has been interpreted as being due to accumulations of sediment of relatively high MS alongside and within deposits of a lower MS. A similar interpretation is supported in this instance by the excavations (Van der Noort and Ellis 1998) which revealed a palaeochannel and two phases of Roman activity possibly separated by a flooding episode.

Across the centre of the surveyed area, an assortment of much more distinct magnetic anomalies has been detected, which represent both discrete and linear archaeological features (**C**, **D**, and **E** for example). These latter are distinguishable from the background signal due to the strength of the anomalies and their well-defined shape (this is most evident on the trace plot on Figure 3). Those that have been excavated have been shown to be of Roman origin and it would appear that they may form part of a rectilinear pattern which respects the orientation of **A** and **B.**

A number of the responses to archaeological features are conspicuously intense (up to 50 nT: eg **C** and **E,** Figure 3). Anomalies of this strength are frequently associated, either directly or indirectly, with some form of industrial activity and this has been confirmed by the excavations which have revealed burnt and fired clay (including some briquettage), pottery wasters and widespread deposits of charcoal and ash. It is interesting that the background response to the fluvial activity is exaggerated to the northeast (what would have been the downstream direction - eg at **F** and **G**) suggesting that magnetically enhanced material associated with the industrial activity may have been redeposited, possibly during the putative flooding episode.

It is clear from the data that the archaeological activity extends to north and also to the southwest of the surveyed area.

Magnetic Susceptibility Samples (Table 1)

The value of MS for the sample (MS 1A) retrieved from the linear anomaly **C** was more than an order of magnitude higher (at 335.0 $x10^{-8}m^3Kg^{-1}$) than that of the surrounding alluvium (MS 1B at 10.2). By contrast, the sample (MS 2A) taken from the more easterly of the large ditches (**A**) shows an almost negligible difference in MS with the sample of neighbouring alluvium (MS 2B). This result correlates well with the very subdued magnetometer response over **A** in the area where this sample was taken (at the eastern end of Trench 1 - see Fig 4). The values of MS help explain the contrasting magnetometer responses to the different types of feature and demonstrate the great changes in susceptibility that can be brought about by the presence of industrial activity.

Table 1.

Magnetic susceptibility measurements.

Sample	Context	χ_{LF} ($x10^{-8}$ m^3Kg^{-1})
MS 1A	anomaly **C**, figure 4	335.0
MS 1B	'natural' mottled/oxidised alluvial clay next to **C**, Fig. 4	10.2
MS 2A	unoxidised fill of V-shaped ditch (anomaly **A**, Figure 4)	9.8
MS 2B	'natural' mottled/oxidised alluvial clay next to **A**, Fig. 4	8.8

Resistivity survey (Figure 4)

A number of grid squares were resurveyed using the resistance meter in the hope of mapping any buildings associated with the features located by the magnetometer survey. Unfortunately such structures are evident in the data and, the latter is confused by the response to modern cultivation running east-west through the data. However, some archaeologically significant anomalies can be discerned, a number of which correlate well with features detected by the magnetometer survey.

The more easterly of the broad parallel ditches (**A**) has been detected as a low resistance anomaly (**R1**), as would be expected. However, approximately 5m further to the east, there is a further parallel but more narrow low resistance anomaly (**R2**) which is not replicated in the magnetometer data. Running towards the southeast from **R2**, and at right angles to it, are two other linear but very weak low resistance anomalies. These and **R2** are likely to represent ditches which have not been detected by the magnetometer perhaps due to a lack of magnetic contrast between them and the surrounding alluvium (see below).

The resistivity survey has also detected some high resistance linear anomalies which clearly represent the same archaeological features that have been mapped as intense linear magnetic anomalies (eg **D**). The fills of these features (which includes industrial debris) evidently present a less water-retentive environment than the alluvium into which they are cut and therefore give rise to high resistance anomalies.

Results of the 1998 surveys

Area B: Magnetometer Survey (Figure 5)

The magnetic response here is divided between a western area of subdued magnetic readings and an eastern area of amorphous magnetic activity similar to, and presumably continuing, that seen in Area A to the south (Figure 2).

Weakly magnetic parallel linear anomalies cross the area from E-W. Similar anomalies were also detected in Area C, and probably represent cultivation or drainage. The linear anomaly marked **A** has a slightly higher signal and includes a ferrous anomaly (>100nT) at its junction with the open Horsegroves Drain at the eastern edge of the survey area. Another ferrous anomaly is present at **B**. It seems likely that **A** has a modern source connected with the drainage regime.

Area C: Magnetometer Survey (Figures 6 and 7)

A similar magnetic response is apparent in Area C as in Area A. The comparable concentration of amorphous anomalies in the north-west part of Area C might also be interpreted as accumulations of sediments with varying magnetic susceptibilities in a former river channel. The definition of an `edge' separating the amorphous anomalies from the much more subdued magnetic response to the east is complicated by intervening bands of parallel and successively weaker linear anomalies.

A number of distinctive positive magnetic anomalies have been detected in the area of

subdued response in the central part of Area C. These consist of short linear anomalies (15-30 nT) about 10-15m long which often seem to be associated with strong non-linear responses (eg **A** and **B**, 30-40 nT). The width and shape of the latter suggests an industrial origin (although kilns might be expected to produce stronger anomalies). Similar anomalies were detected in the 1996 survey (Area A) and have been shown to be of Roman origin (Van de Noort and Ellis 1998). Some of the more linear of these stronger anomalies (eg at **C**) seem to be arranged parallel and perpendicular to the `edge' of the area of amorphous anomalies.

Much of the very subdued magnetic response in Area C is characterised by weak linear anomalies assumed to relate to cultivation. One such anomaly (**D** on Figure 7) is slightly off-line with the others and may represent the open drain marked on the OS map but no longer visible on the ground (see Figure 2).

Resistivity Results Area C (Figure 7)

An area of 60m x 60m was resurveyed by resistance meter in the centre of Area C to cover a representative sample of the magnetic anomalies. Unfortunately the data appears to have been affected by the wet conditions during the survey and appears noisy. Linear trends in the data seems to reflect only the effects of recent cultivation.

CONCLUSIONS

Site conditions at Adlingfleet have proved suited to geophysical survey, and evidence of archaeological activity has been mapped by both magnetometer and resistance surveys. There is a clear distinction between areas of very uniform response and areas of amorphous magnetic activity which may indicate the presence of former water courses. Apparently superimposed on this background are stronger magnetic responses assumed to be of industrial origin. Limited trial exacavation has confirmed that this latter activity is Roman and is separated into two phases, possibly by a flooding episode.

Roman features clearly extend beyond the limits of the survey areas and the coverage has unfortunately been insufficient to trace their overall distribution and full relationship to the contemporary landscape.

Surveyed by: M Cole
N Linford

Dates: 3-6 December 1996

Surveyed by: E Bray
P Cottrell

29 September - 2 October 1998

Reported by: M Cole and P Cottrell

26 March 1999

Archaeometry Branch
Ancient Monuments Laboratory

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British Geological Survey 1983 Kingston Upon Hull, England and Wales Sheet 80, Drift Geology 1:50 000, Keyworth, Nottingham: British Geological Survey.

Cole, M A, 1995 Hoe Hills, Dowsby, Lincolnshire. Report on Geophysical Surveys October 1994 and March 1995, *Ancient Monuments Laboratory Report Series*, **17/95**.

Scollar, I, Tabbagh, A, Hesse, A, and Herzog, I, 1990 *Topics in Remote Sensing 2: Archaeological Prospecting and Remote Sensing*, Cambridge.

Van de Noort, R, and Ellis, S, (ed.) 1998 *Wetland Heritage of the Ancholme and Lower Trent Valleys: An Archaeological Survey,* Kingston upon Hull: Humber Wetlands Project, University of Hull.

Enclosed Figures

Figure 1 Location of the geophysical surveys, 1996 and 1998. (1:5000).

Figure 2 Magnetometer survey superimposed on Ordnance Survey map (1:5000).

Figure 3 Greyscale and trace plots of magnetometer survey, Area A, 1996 (1:1250).

Figure 4 Interpretation of magnetic anomalies and greyscale of resistivity survey, Area A, 1996 (1:1250).

Figure 5 Greyscale and trace plots of magnetometer survey, Area B, 1998 (1:1250).

Figure 6 Greyscale and trace plots of magnetometer survey, Area C, 1998 (1:1250).

Figure 7 Interpretation of magnetic anomalies and greyscale plot of resistivity survey, Area C, 1998 (1:1250).

Annex 1. GPS Coordinates provided by Humber Wetlands Project Surveyors. (See Figure 1 for locations)

1	484961.38
	422342.25
	South grid southeast peg
2	484871.61
	422347.49
	South grid southwest peg
3	484874.96
	422407.36
	South grid northwest peg
4	484964.75
	422402.08
	South grid northeast peg
5	485004.66
	422580.41
	North grid southeast peg
6	484911.57
	422525.4
	North grid mid-south peg
7	484791.76
	422531.7
	North grid southwest peg
8	484798.35
	422651.4
	North grid northwest peg
9	484918.09
	422645.1
	North grid mid-north peg
10	485007.95
	422640.2
	North grid northeast peg
11	485035.48
	422640
	Northeastern corner of field
12	484510
	422230
	Northeastern corner of Barn

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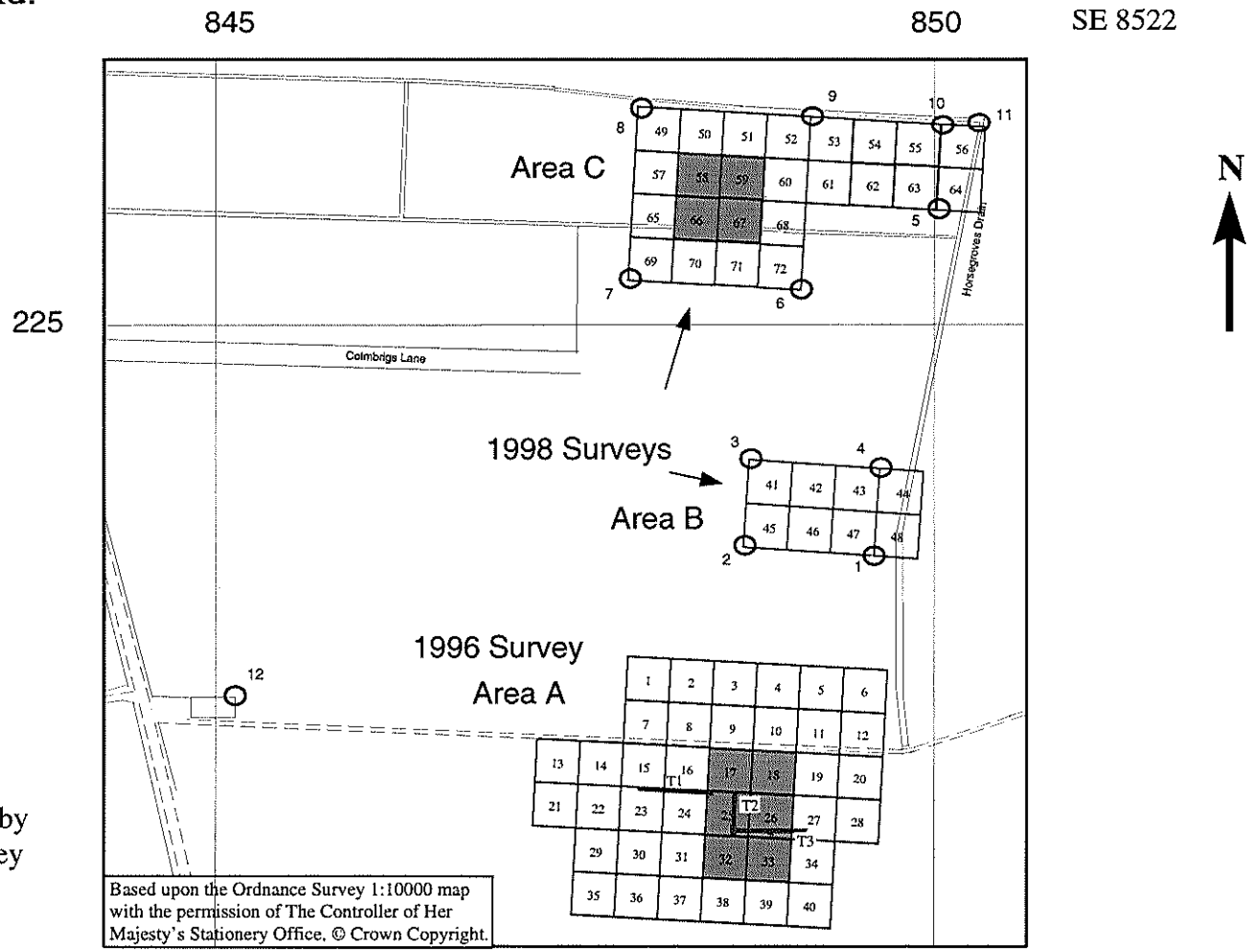
FIGURE 1.

Geophysical Surveys, December 1996 and September 1998.

Location of survey grid.



0 150m

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FIGURE 2.

Geophysical Surveys, December 1996 and September 1998.

Location of magnetometer surveys.

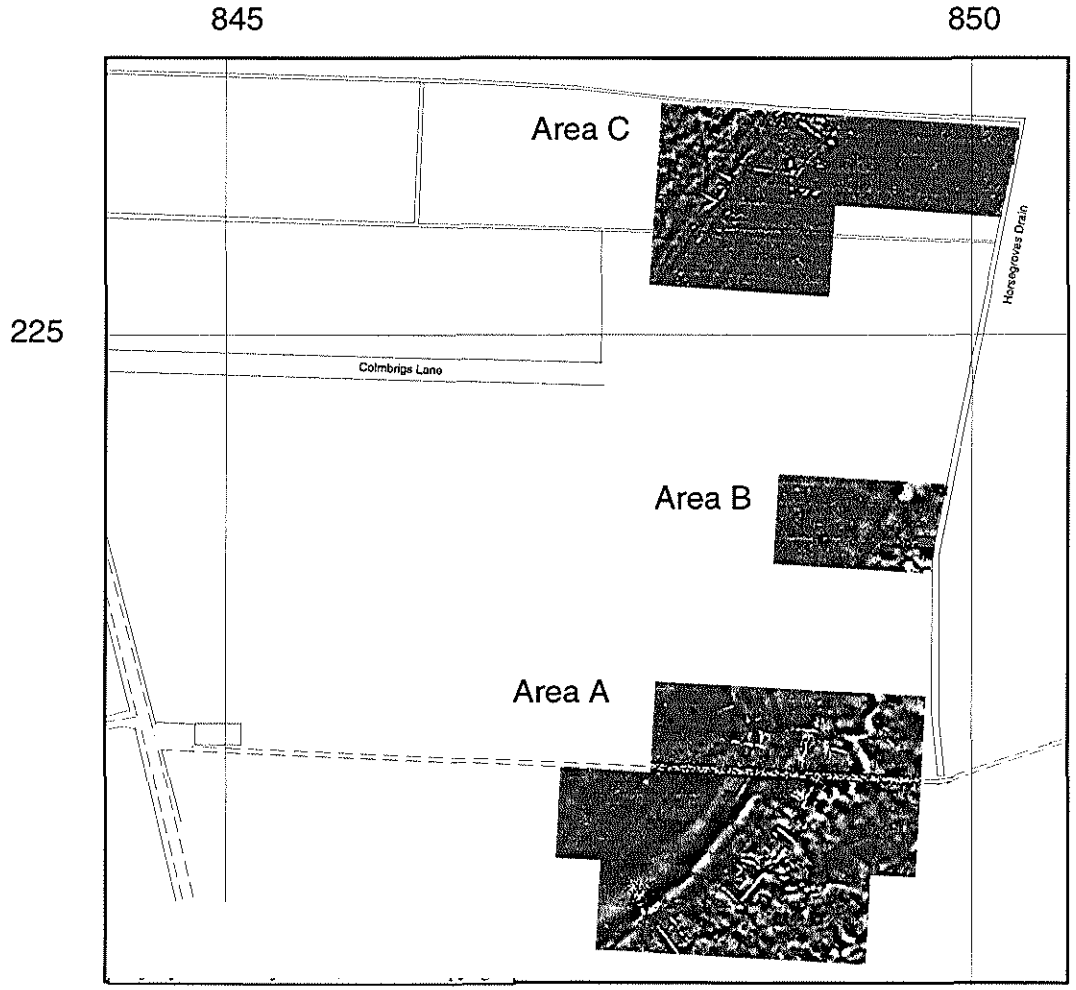

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FIGURE 3.

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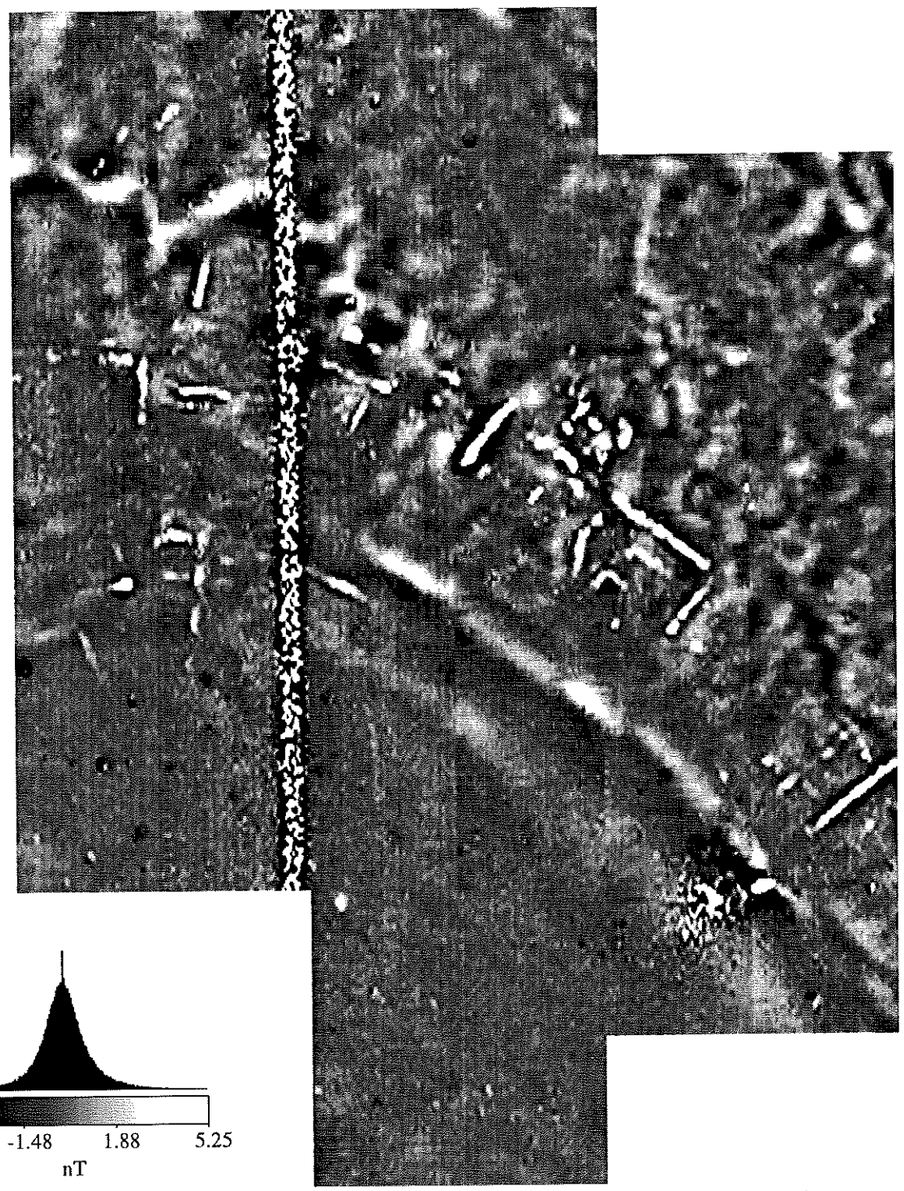
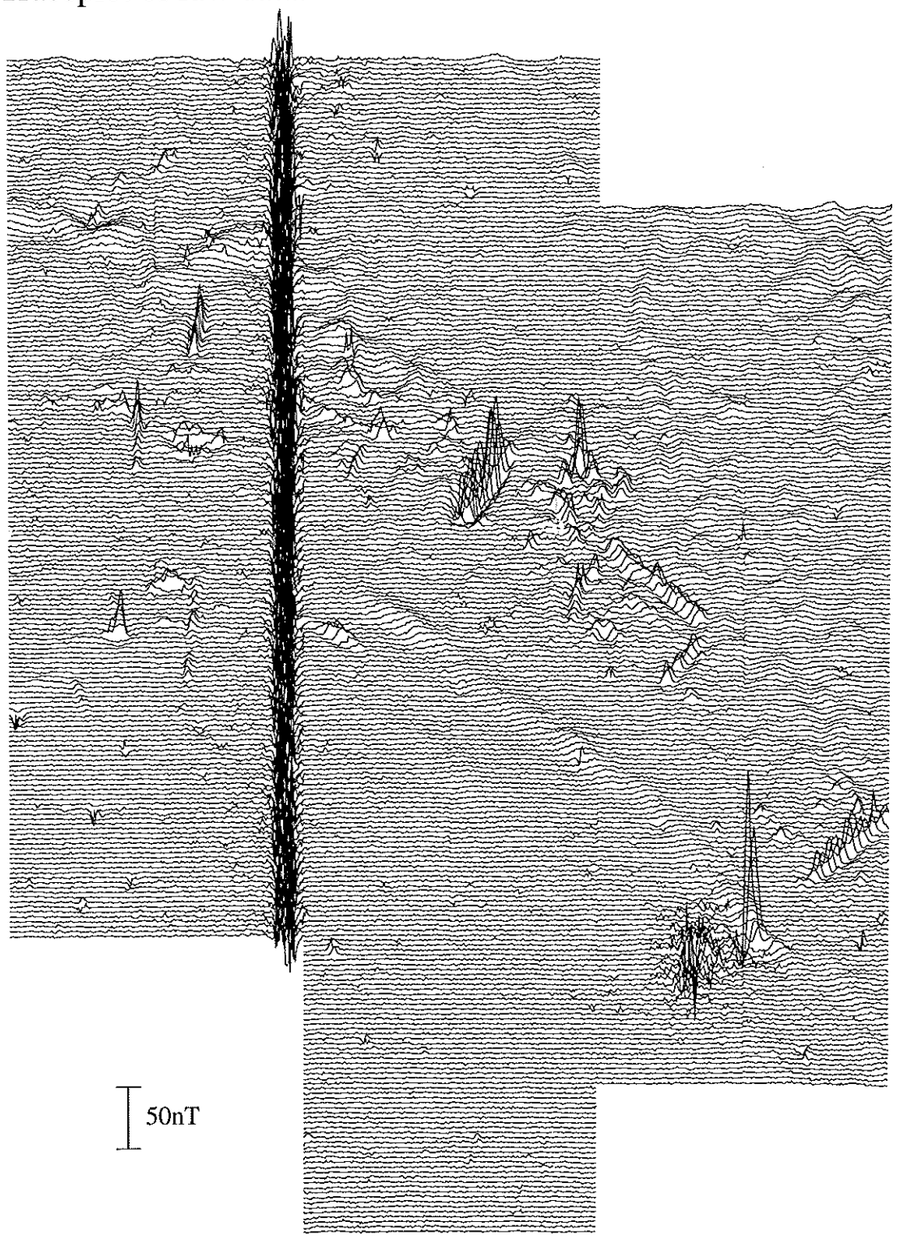
Magnetometer Survey, December 1996.

N

1. Greyscale of smoothed data.



2. Traceplot of raw data.



0 90m

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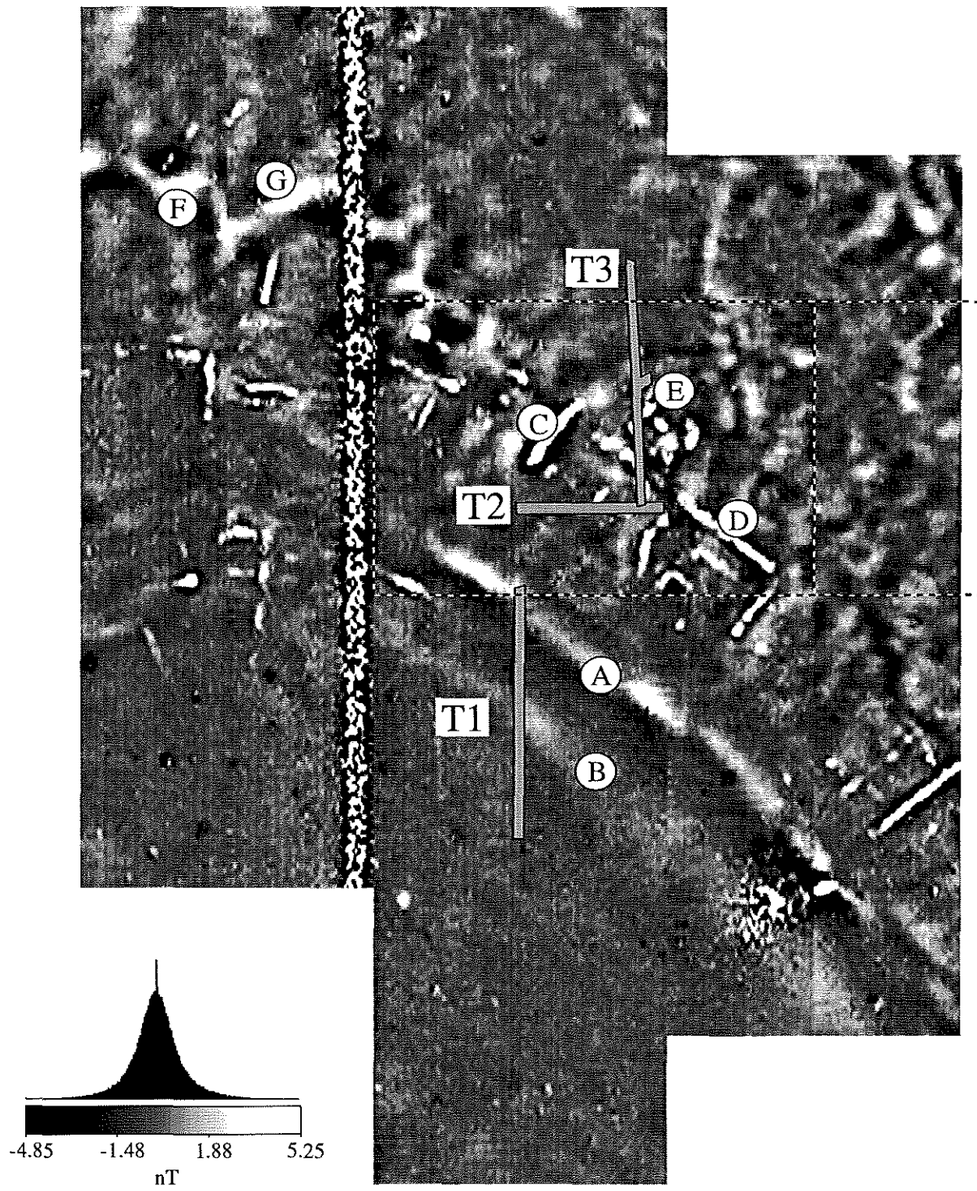
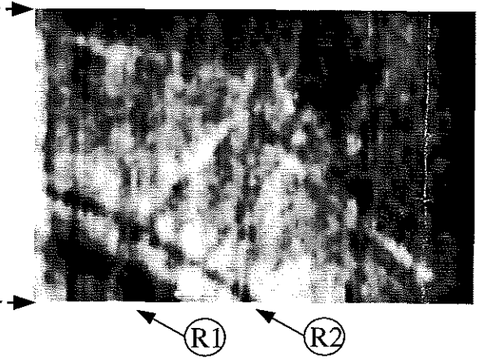
FIGURE 4.

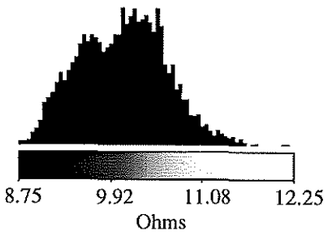
ADLINGFLEET, LINCOLNSHIRE, AREA A.
Geophysical Survey, December 1996.

1. Greyscale of magnetometer data showing locations of resistivity survey and HWP trial trenches.



2.1 Greyscale of raw resistivity data.





2.1 Greyscale of contrast enhanced resistivity data.

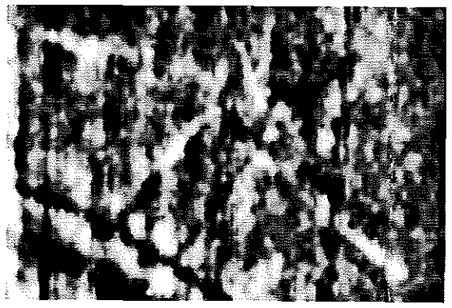


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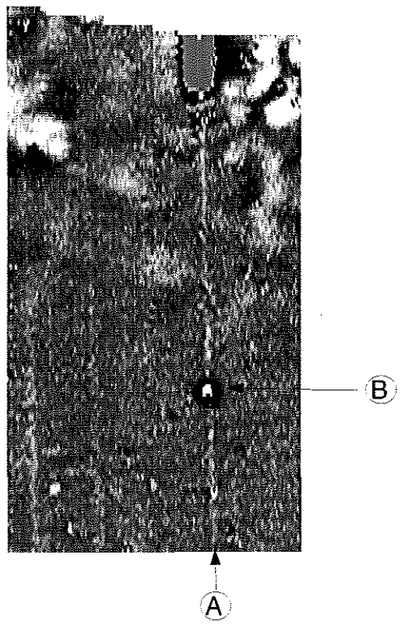
FIGURE 5.

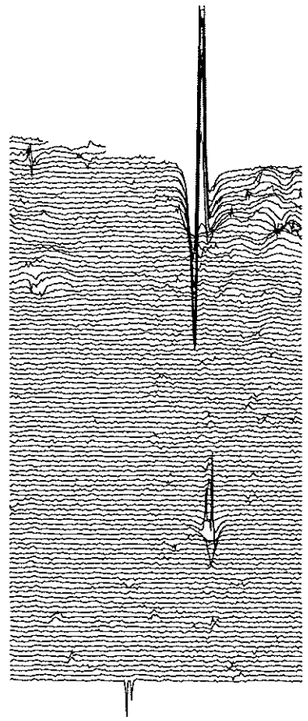
ADLINGFLEET, LINCOLNSHIRE. AREA B
Magnetometer Survey, September 1998.

N

1. Greyscale of smoothed data.



2. Traceplot of raw data.



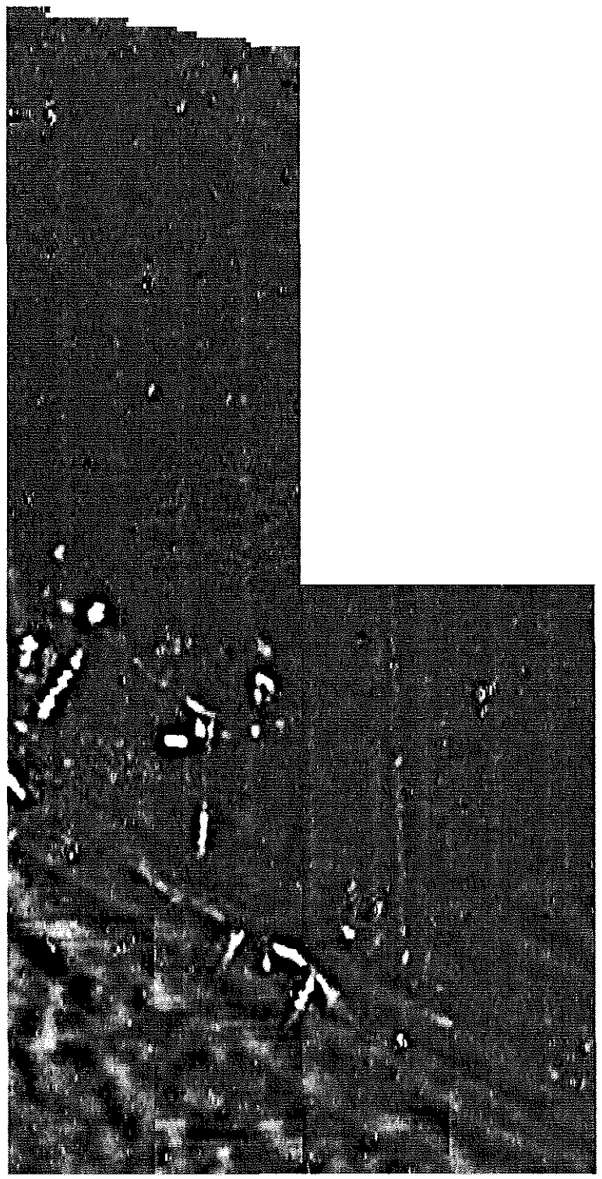
0 90m

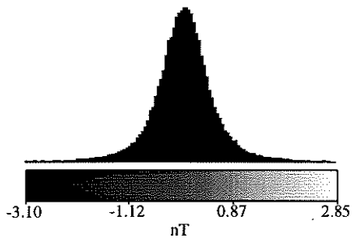
FIGURE 6.

ADLINGFLEET, LINCOLNSHIRE.
Magnetometer Survey, September 1998.

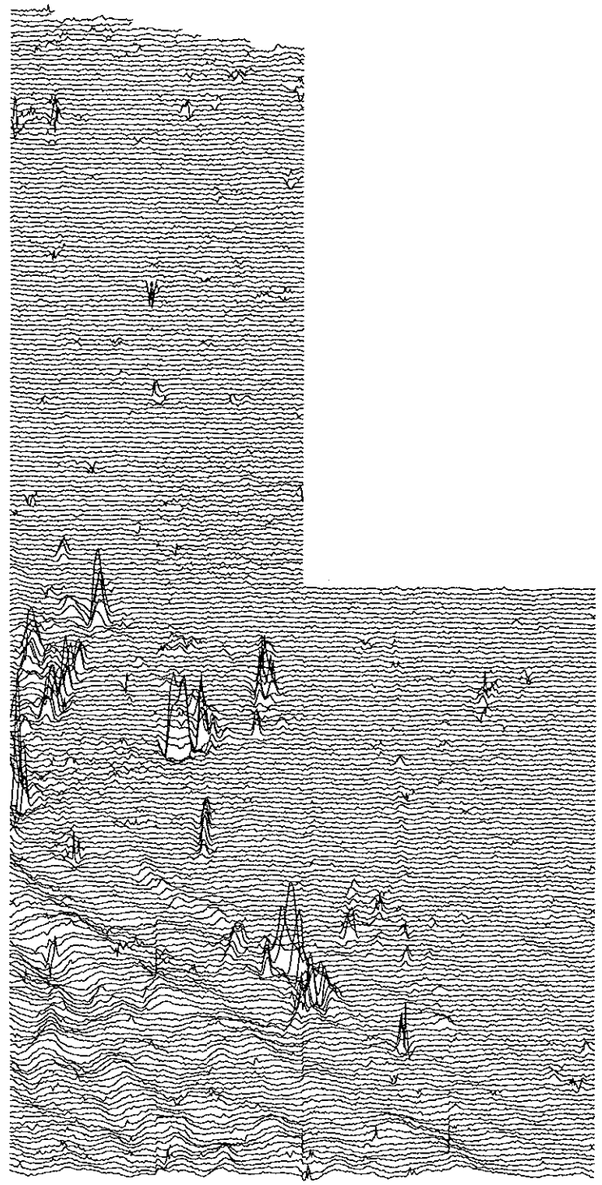
N

1. Greyscale of filtered data.





2. Traceplot of raw data (despiked).



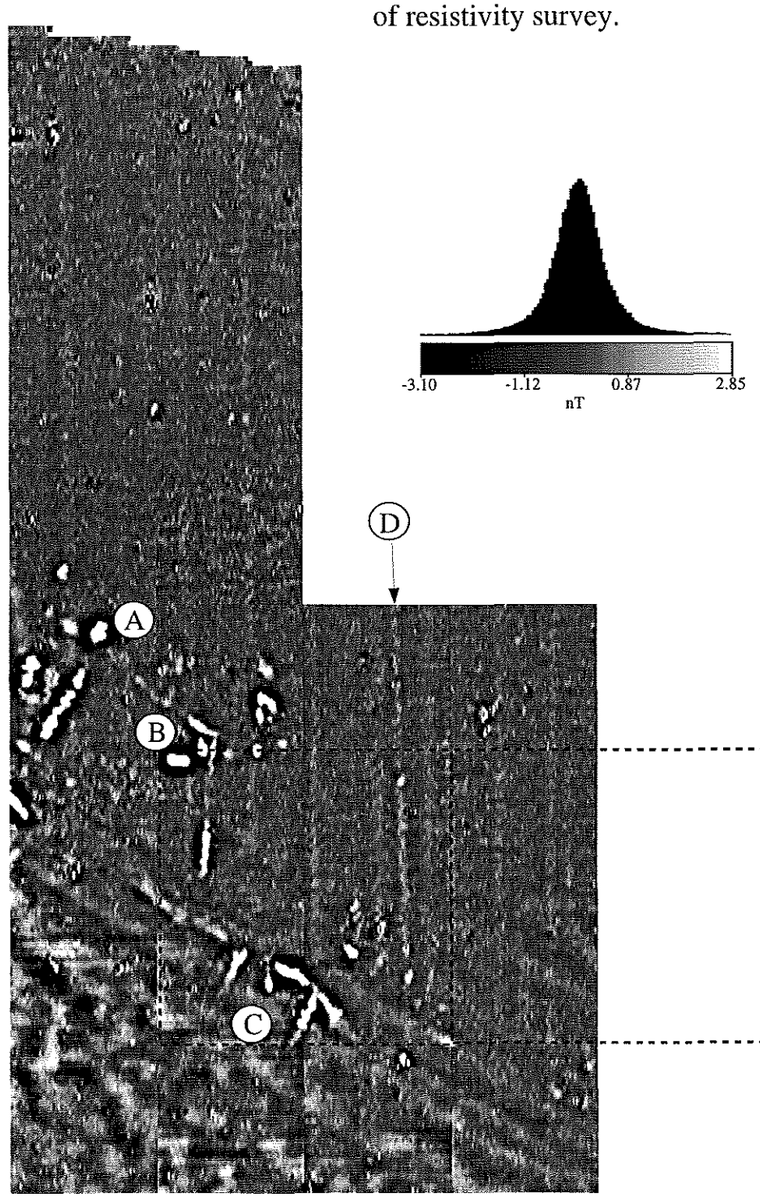
37.5nT

0 90m

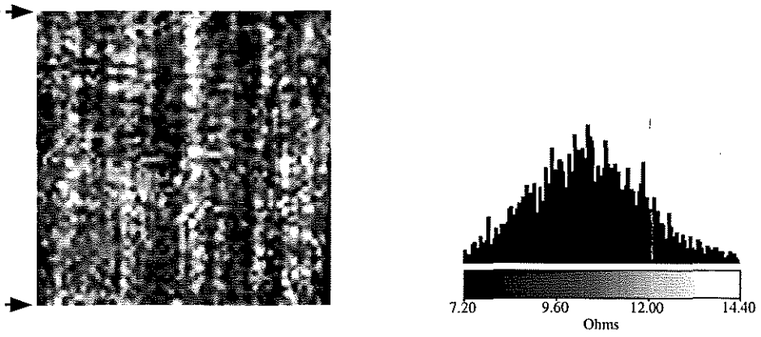
FIGURE 7.

ADLINGFLEET, LINCOLNSHIRE. AREA C
Geophysical Survey, September 1998.

1. Greyscale of smoothed magnetometer data showing location of resistivity survey.



2. Greyscale of raw resistivity data.



0 60m

(B) Anomalies discussed in text