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LING HOWE LONG BARROW, WALKINGTON, HUMBERSIDE, REPORT ON GEOPHYSICAL SURVEY, 1989

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Summary

A geophysical survey was carried out at the site of the long barrow of Ling Howe near Walkington, Humberside to complement information obtained from an excavation by John Dent in 1984. Magnetometer and resistivity surveys successfully detected the long barrow's side ditches which had already been noted as crop marks. Three pit-type anomalies were also detected within the barrow and one of these had a fill that was magnetically similar to the side ditches possibly suggesting that it originated at a similar date in the past.

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LING HOWE LONG BARROW, WALKINGTON HUMBERSIDE

Report on Geophysical Survey, October 1989.

Introduction

The site of Ling Howe long barrow (SE 9651 3581), near Walkington in Humberside is marked on the Ordnance Survey 1" sheet of 1858. At its northwestern end it is cut by the B1230 road where it is apparent as a slight rise in the road with its side ditches visible in the hedgerow. There is no evidence of it continuing to the north of this road but it is visible as a crop mark in the field to the south in a number of air photographs (NMR SE 9635/1/384-5 and 2/391-3, RAF 541/184 3182-3). Although this field is ploughed, the long barrow mound is still just visible as a slight rise. The Humberside sites and monuments record (SMR) states the following (SMR No. 3652):

"The cropmark of parallel ditches 15-20ft (4.6 - 6.1m) wide and some 50ft (15.2m) apart mark the site of the ling barrow which is partly beneath the modern road. There appears to be a large pit at its NW end. The mound was still visible in 1973."

It is also noted that there is some indication that the barrow is wider at its southern end.

In 1984 John Dent supervised a small excavation on this monument (unpublished). Two trenches were cut across the tail of the barrow where it still survived as a visible mound, on opposite sides of the present road. To complement this work, the Ancient Monuments Laboratory were requested in 1989 to carry out a geophysical survey of remains in the field to the south of the road.

Geologically the site is situated on Middle Cretaceous Chalk with little evidence for more recent drift (Geological Survey of Great Britain 1973). The soil association, PANHOLES (511c, Soil Survey of England and Wales, 1983) are well drained calcareous fine silty soils with associated similar shallow soils and deeper non-calcareous fine silty soils. Magnetic anomalies might thus be expected to be fairly weak but easily distinguishable from the background soil response which should exhibit a low 'noise' component. The well drained soils should mean that infilled ditch and pit features will contrast clearly with the surrounding soil response as conductive anomalies in electrical surveys, especially where they cut into the underlying chalk.

Method

Field Procedure

A grid of six 30 metre squares was established over an area covering the location of the long barrow as identified from crop marks. The location of this grid was determined by tape measurement to adjacent field boundaries and is depicted in Figure 1.

All six numbered squares in Figure 1 were surveyed with a Geoscan FM36 fluxgate gradiometer according to the standard technique outlined in Annex 1, note 2. The same area was also surveyed using a Geoscan RM4 earth resistance meter using a mobile electrode separation of 0.5m. This was done according to the technique described in Annex 1.

Data Processing and Presentation

The magnetometer results were corrected for instrument heading errors by subtracting the median value of each traverse from all measurements on the traverse ("unbunching" or "destepping"). These results are depicted as a trace plot at 1:500 scale in Figure 2a. In this plot an extremely intense response from a ferrous object in the field boundary at the top left corner has also been truncated for the purposes of presentation. The results were then additionally processed with an adaptive thresholding median filter to replace measurements of extreme magnitude with a local median calculated over a 2m by 2m rectangular window ("despiking"). Such values are usually caused by modern, near surface, ferrous material and, if not removed, can skew the statistical distribution of the data set. The results after this second processing step are depicted as a linear greyscale plot at 1:500 scale in Figure 3a.

The unprocessed resistivity measurements are depicted as a trace plot in Figure 2b at 1:500 scale. This data set was then also treated with an adaptive thresholding median filter to replace measurements of extreme magnitude, caused by poor electrode contact, with a local median calculated over a 1m by 1m rectangular window. The results after this operation are depicted as a 1:500 scale greyscale plot in Figure 3b.

Results

The anomalies described in this section are all indicated on the interpretation plan in Figure 4, further discussion of this figure is provided in the conclusions below.

The magnetometer survey

As anticipated the peak magnitudes of the features detected in the magnetometer survey are low, with the response to the vast majority of non-surface ferrous material being in the range of -1 to 1nT. Nevertheless, the long barrow ditches have shown up clearly in Figure 3a as two linear anomalies of slightly increased magnetisation, each 5m wide and about 15m apart.

Also apparent between the two ditches at the north-western edge of the survey area is an elliptical response some 10m in diameter along its widest axis, giving a similar magnetic response to the ditch fills. This anomaly has also been detected by the resistivity survey (see below) and may represent a pit feature or an area of burnt soil. An adjacent area of stronger magnetic disturbance is probably due to recent activity.

A number of linear striations running approximately east-west are also apparent in Figure 3a and these have also been detected by the resistivity survey (see below).

The resistivity survey

The resistivity survey has clearly delineated the side ditches of the long barrow as low resistance responses.

Towards the centre of the survey area it has also detected an approximately circular low resistance anomaly some 5m across which has no correlate in the magnetic results. At the extreme north western edge of the survey another low resistance anomaly has been detected in the same position as the magnetic disturbance discussed above. There is also a faint low resistance anomaly corresponding to the pit anomaly detected in the magnetometer survey just southeast of the disturbance.

Immediately to the east of the long barrow, two high resistance anomalies have been detected in an area of generally increased electrical resistance. Whilst an anthropogenic cause cannot be ruled out it is difficult to imagine what these might represent in the context of a long barrow and it is perhaps more likely that they represent a region where the chalk bedrock rises closer to the surface. The east-west linear striations detected by the magnetometer have also been detected. As these do not appear to run straight enough to suggest that they are a response caused by modern agriculture, it is possible that they are natural undulations.

Conclusions

The side ditches of the long barrow have been clearly detected in both the magnetic and resistance surveys and it is the union of the anomalies from both that is depicted in Figure 4. This interpretation correlates well with the description quoted from the SMR and there is indeed some evidence of a slight widening of the barrow towards its southern end.

Within the barrow three possible pit-type features have been detected:

1. At the extreme northwest of the survey area, detected as a low resistance anomaly and as an area of increase magnetic disturbance in the magnetometer survey.

2. Just to the south of the above, an elliptical feature detected faintly as a low resistance anomaly but with a magnetic response similar to that of the long barrow ditches.

3. In the centre of the survey area near the southern end of the long barrow a 5m wide feature showing only as a low resistance anomaly in the resistivity survey.

It is likely that one or both of the first two represent the large pit described in the SMR entry. It is not clear whether these pit-like anomalies represent undocumented excavation of the barrow or activity contemporary with its original use. However, it is interesting to note that the second of pits has a fill that is magnetically similar to that of the barrow ditches, perhaps suggesting that it is an archaeological feature that originated at the same date. The low resistance anomaly nearer the southern end of the barrow may also be a large pit (or undocumented excavation?), although the lack of magnetic contrast makes this interpretation uncertain.

Surveyed by: A. Payne
P. Linford

Dates: 23rd-25th October 1989

Report by: P. Linford

Date: 19th May 2000

References

Geological Survey of Great Britain, 1968,
1:50,000 Drift Edition, Sheet 72, Beverley.

Soil Survey of England and Wales, 1983,
Legend for the 1:250,000 Soil Map of England and Wales.

Enclosed Figures and plans

Figure 1 Location of the geophysical survey, 1989 (1:2500).

Figure 2 Trace plots of magnetometer and resistivity survey results, 1989 (1:500).

Figure 3 Greyscale plots of magnetometer and resistivity survey results, 1989 (1:500).

Figure 4 Interpretation diagram of magnetometer and resistivity results (1:500).

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.

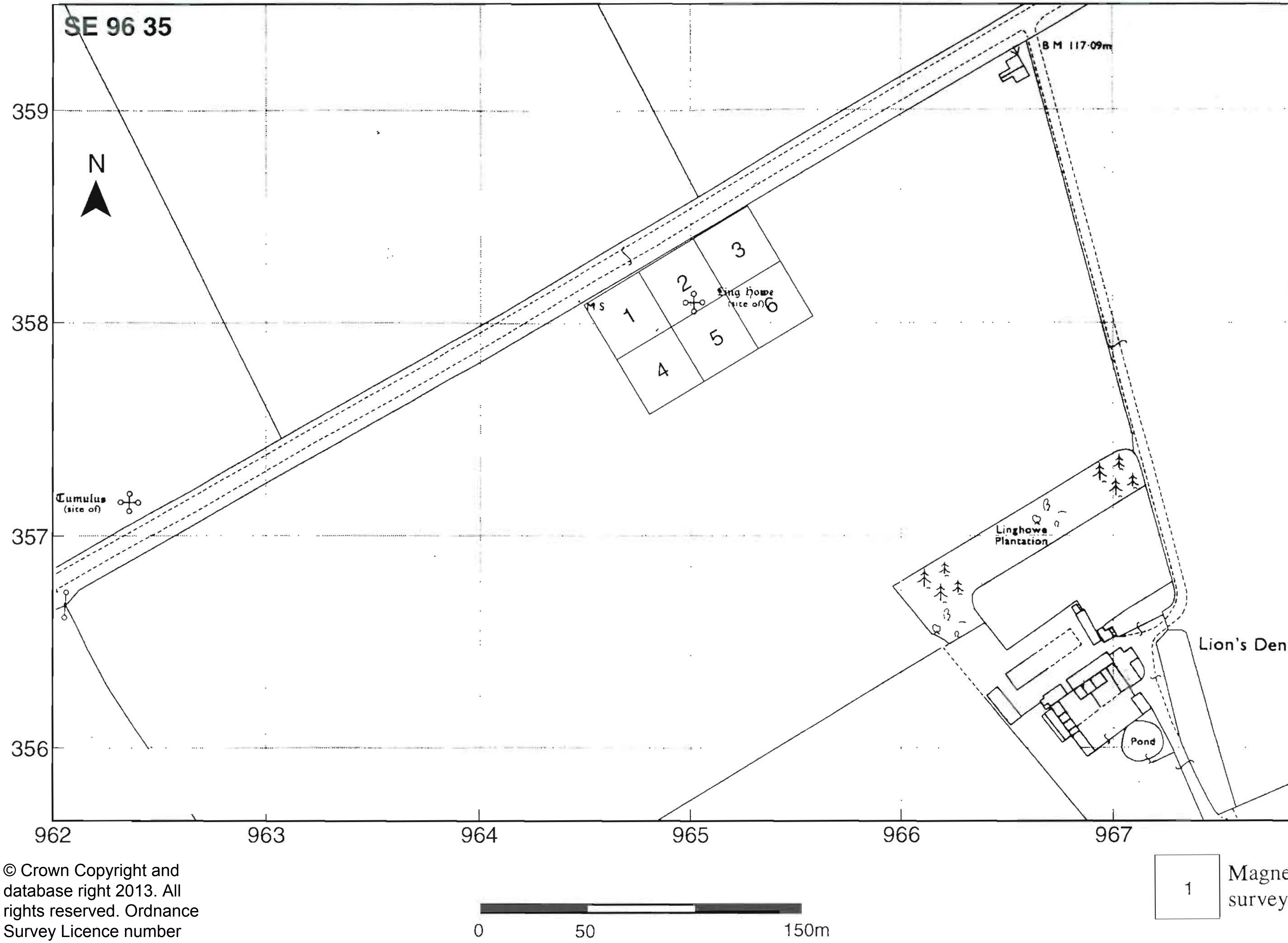
   Unless otherwise stated the measurements are made with a Geoscan FM36 fluxgate gradiometer which incorporates two vertically aligned fluxgates, one situated 0.5 metres above the other; the bottom fluxgate is carried at a height of approximately 0.2 metres above the ground surface. The FM36 incorporates 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.

Figure 1) LING HOWE LONG BARROW, WALKINGTON, HUMBERSIDE: Location of Geophysical Survey, 1989.



1	Magnetometer and resistivity survey grid.

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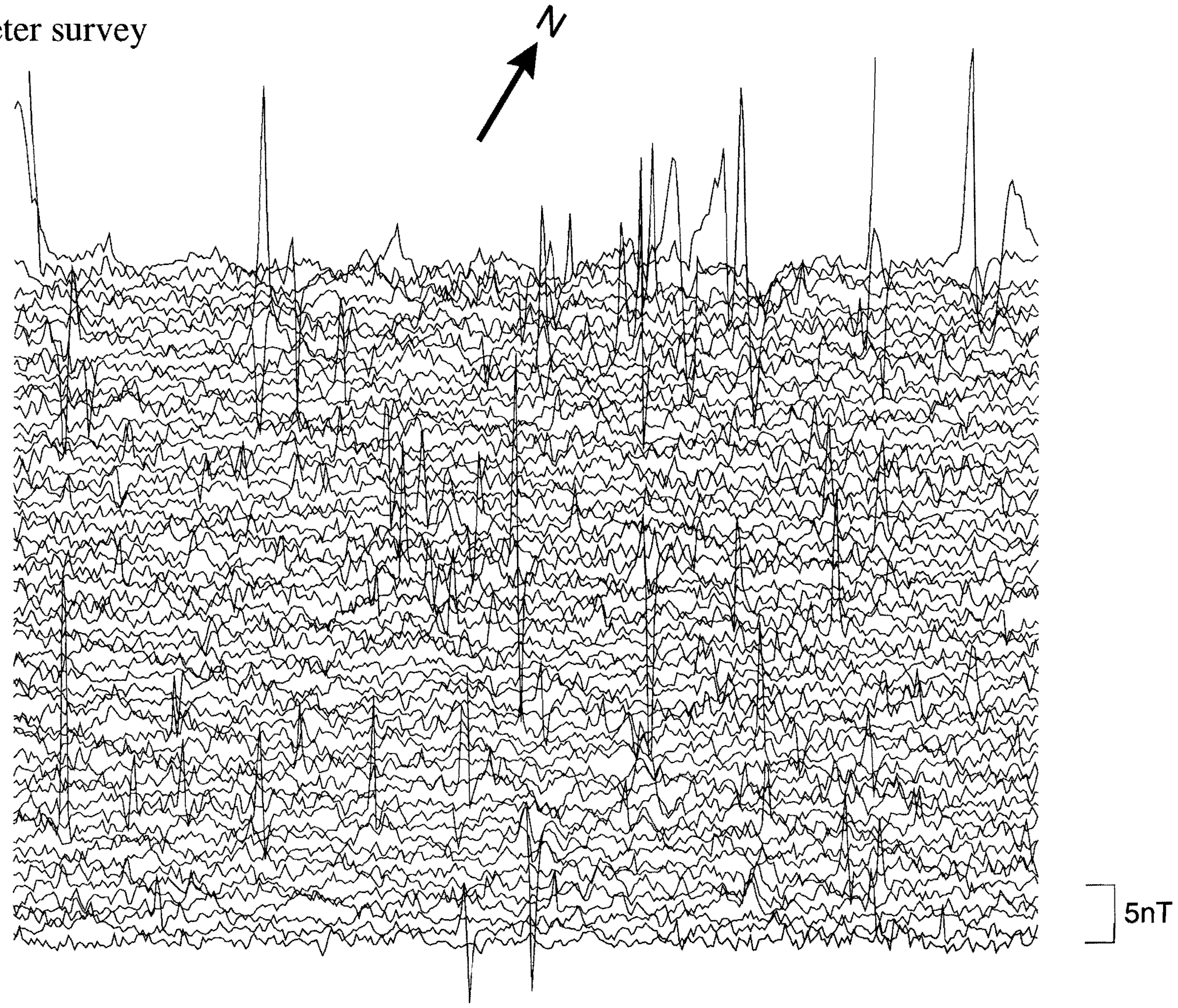
Figure 2) LING HOWE LONG BARROW, WALKINGTON, HUMBERSIDE: Trace plots of unprocessed magnetometer and resistivity surveys, 1989.

a) Magnetometer survey



b) Resistivity survey

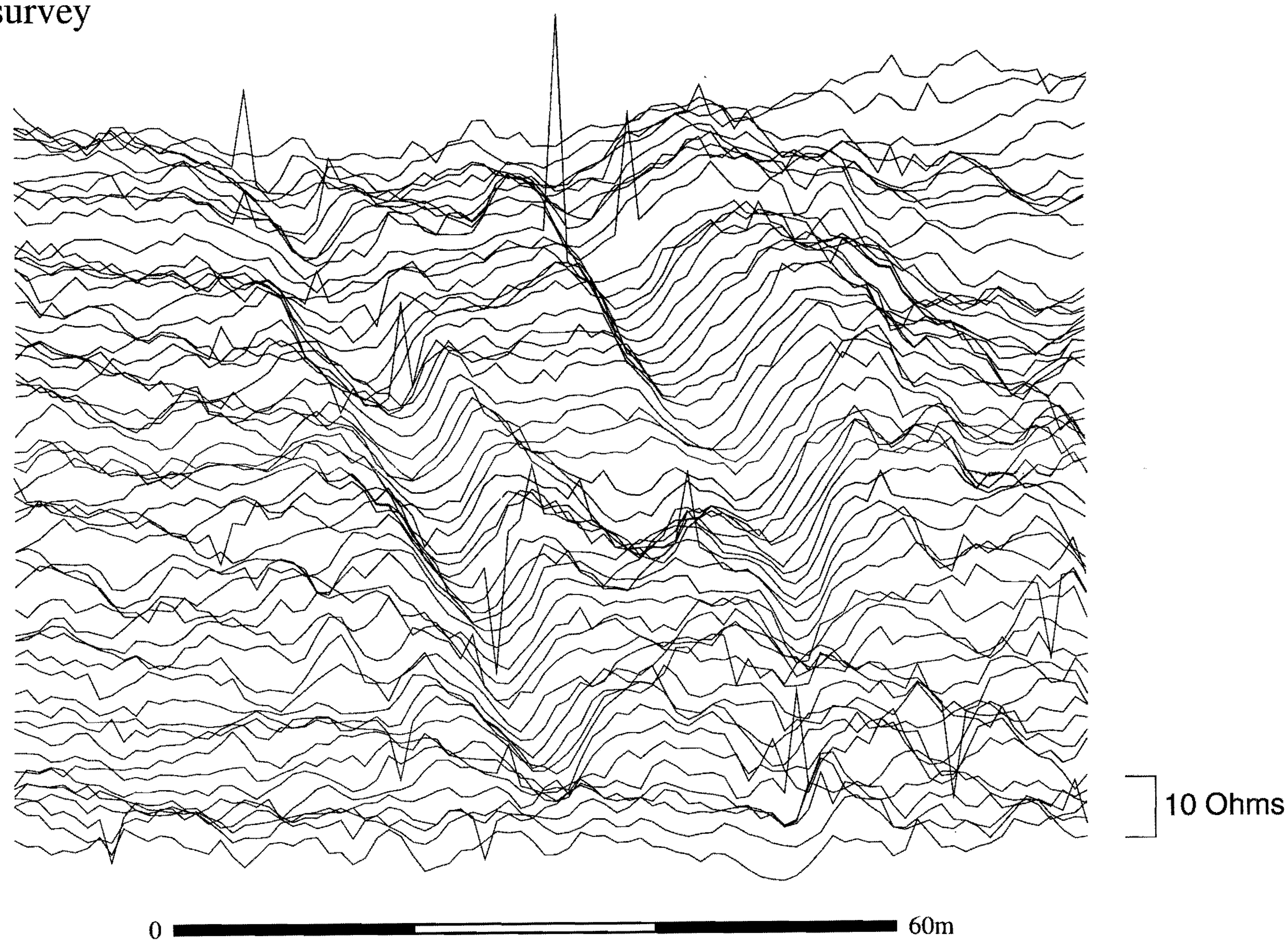


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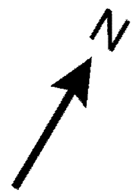
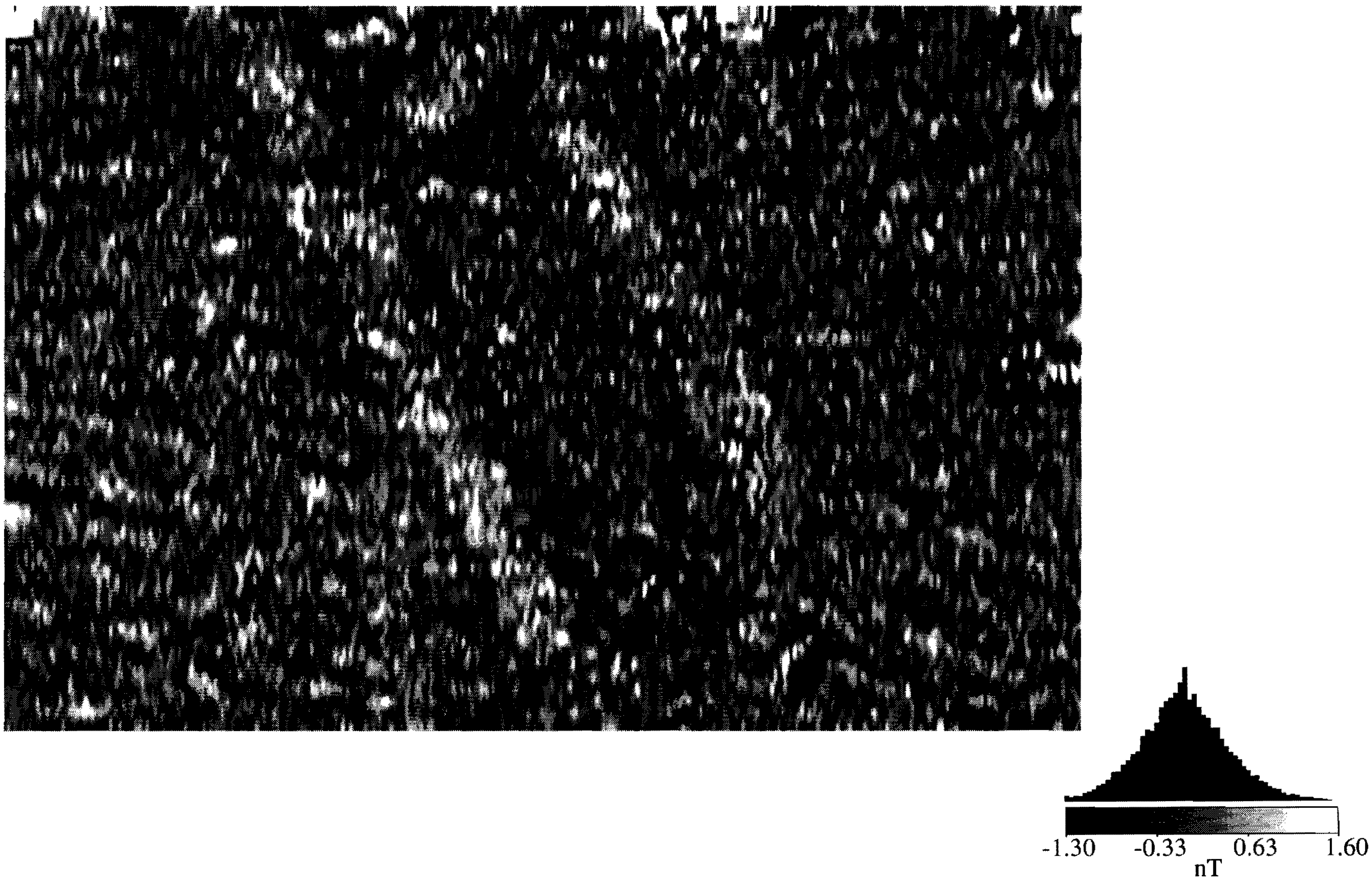
Figure 3) LING HOWE LONG BARROW, WALKINGTON, HUMBERSIDE: Greyscale plots of magnetometer and resistivity surveys, 1989.



a) Magnetometer survey



b) Resistivity survey

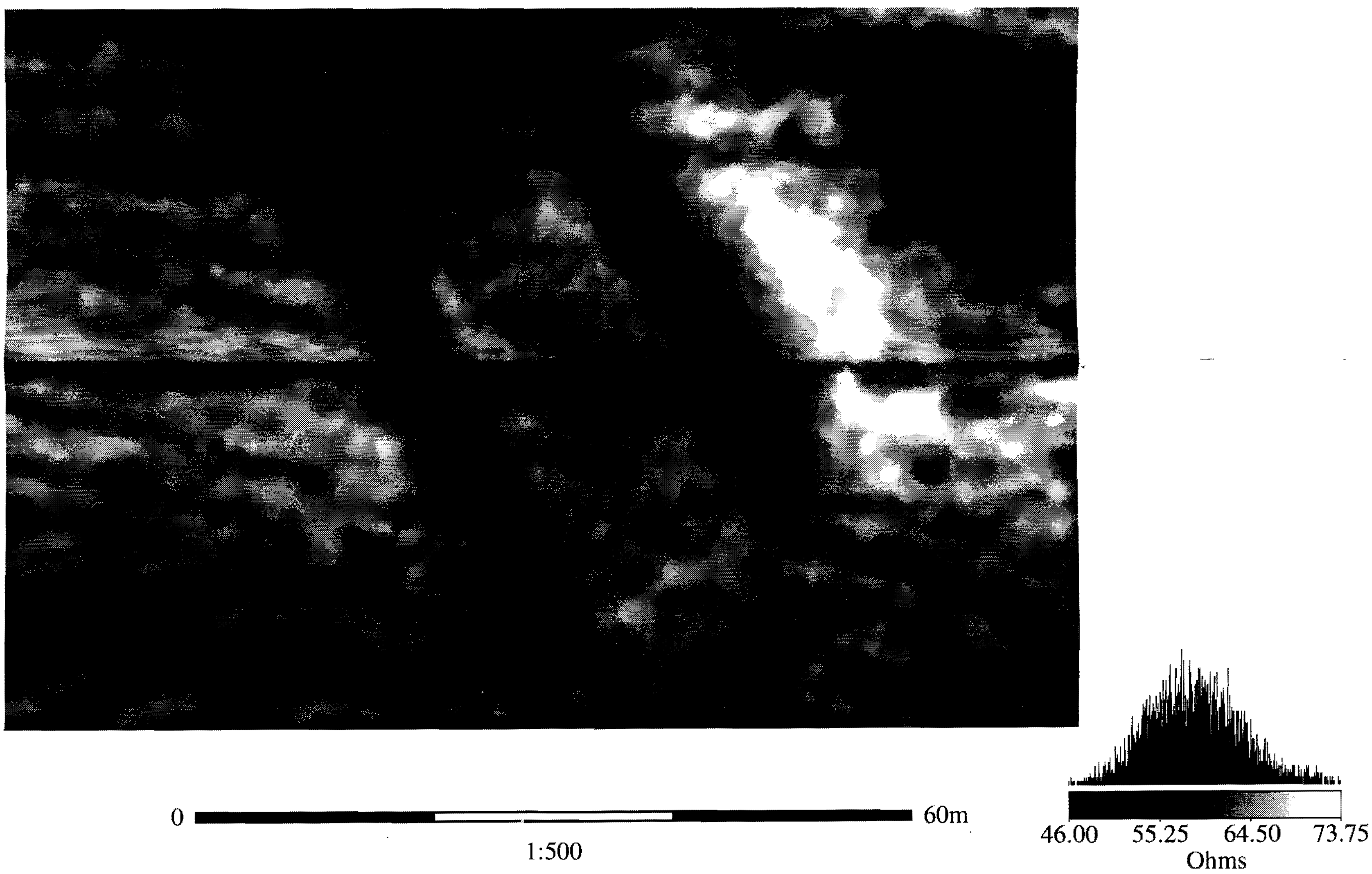


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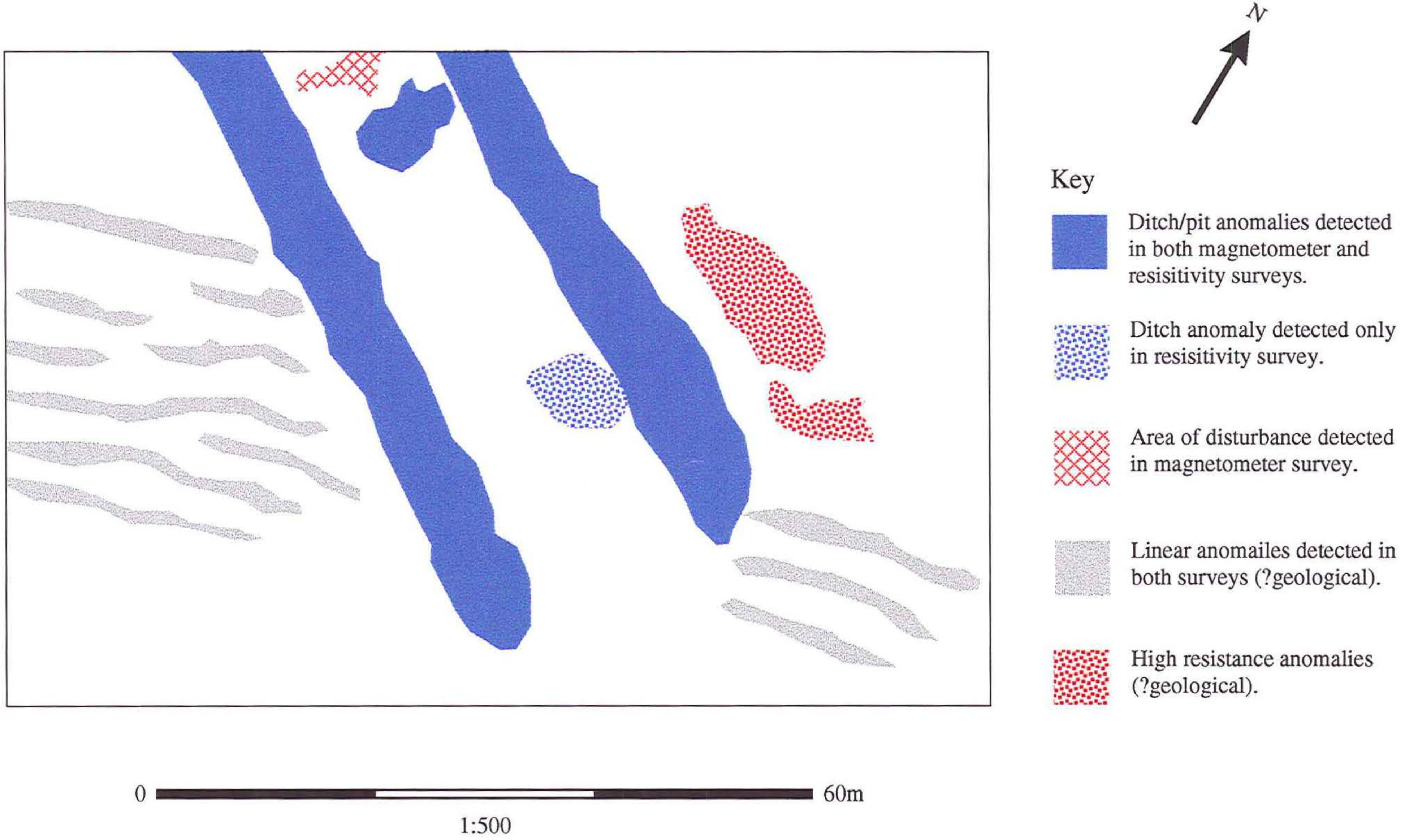
Figure 4) LING HOWE LONG BARROW, WALKINGTON, HUMBERSIDE: Interpretation plan of geophysical surveys, 1989.



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