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Land at Skipwith Common,
Skipwith,
North Yorkshire.

Gradiometer Survey

by

Mark Whittingham BSc MA

Contents

Land at Skipwith Common,

Skipwith

(SE 6345 3785 site centred)

Gradiometer Survey

1. Summary

Client

Mike Griffiths & Associates
Consulting Archaeologists
57 Langholm Crescent
Darlington
County Durham
DL3 7SX

Objectives

To determine whether gradiometry was a suitable technique for evaluating the archaeology on a site of suspected high archaeological potential and if so to determine the extent of any sub-surface remains in the survey area.

Methodology

A detailed magnetometer survey using a Geoscan FM36 fluxgate gradiometer was carried out over a 1ha site 1.5km south-west of Skipwith.

Results & Conclusions

Several very weak, ephemeral anomalies were detected which did not appear to relate to the position of the known cropmarks being for the most part on different alignments. They might be caused by features which do not show as cropmarks.

It would appear either that there is no contrast between the fill of the cropmark features and the topsoil or that the contrast is so weak that the response is masked by the depth of windblown sand overlying the features.

Given the amount of features visible as cropmarks and the weak responses exhibited by the possible features identified from the survey it appears that gradiometry is not an effective method of evaluating the archaeology in this case.

2. Introduction & Archaeological Background

2.1 Archaeological Services (WYAS) were commissioned by Mike Griffiths & Associates to undertake a gradiometer survey over an area of 1ha south-west of Skipwith (see Figs 1 & 2).

2.2 The site lies in a region in which there is very extensive cropmark evidence for settlements and field systems. Aerial photographic evidence indicates the presence of a settlement, trackways, square barrows and a hut circle adjacent to the survey area, with several linear features and a square barrow lying directly within the survey area.

2.3 It was known that there was a substantial cover of Aeolian sands across the site which, due to the depth of soil cover and the relatively high, homogenous background magnetic noise, could mask magnetic responses from sub-surface features. It was determined, therefore, to conduct a test survey over an area which aerial photography had indicated would contain archaeological features in order to assess the suitability of gradiometry as a method for evaluating the archaeology under these circumstances.

2.4 In consultation with Mike Griffiths & Associates a linear strip measuring 40m by 240m, adjacent and parallel to the northern edge of Skipwith Common, was selected to be the test area.

2.5 The survey was carried out on October 20th 1997. At this time the site was under a recently planted cereal crop.

3. Results & Discussion (Figs 2 & 3)

3.1 The gradiometer data is presented as a greyscale plot on an Ordnance Survey 1:2500 base map in Figure 2. This data is interpreted in Figure 3. Large scale (1:500) dot density and X-Y trace plots are included as Appendix 3.

3.2 Two major types of anomaly can be observed in the data. The first of these are the isolated positive/negative (dipolar) responses ("iron spikes") which are ubiquitous across the site. These are indicative of ferrous material on the ground surface and in the topsoil and are not normally archaeologically significant.

3.3 The second type of anomaly are the weak, positive linear anomalies (<1nT) which can be observed across the site. Although they are very faint their linearity indicates that they are of possible archaeological origin. There is no preferred orientation and they do not form regular geometric shapes, making identification of features impossible.

3.5 It is noticeable that none of the magnetic anomalies detected correspond with those features detected by aerial photography. One explanation is that the magnetic anomalies detected are not representative of true sub-surface features and that the features visible on the aerial photographs are not detectable by a gradiometer survey due to the soil cover.

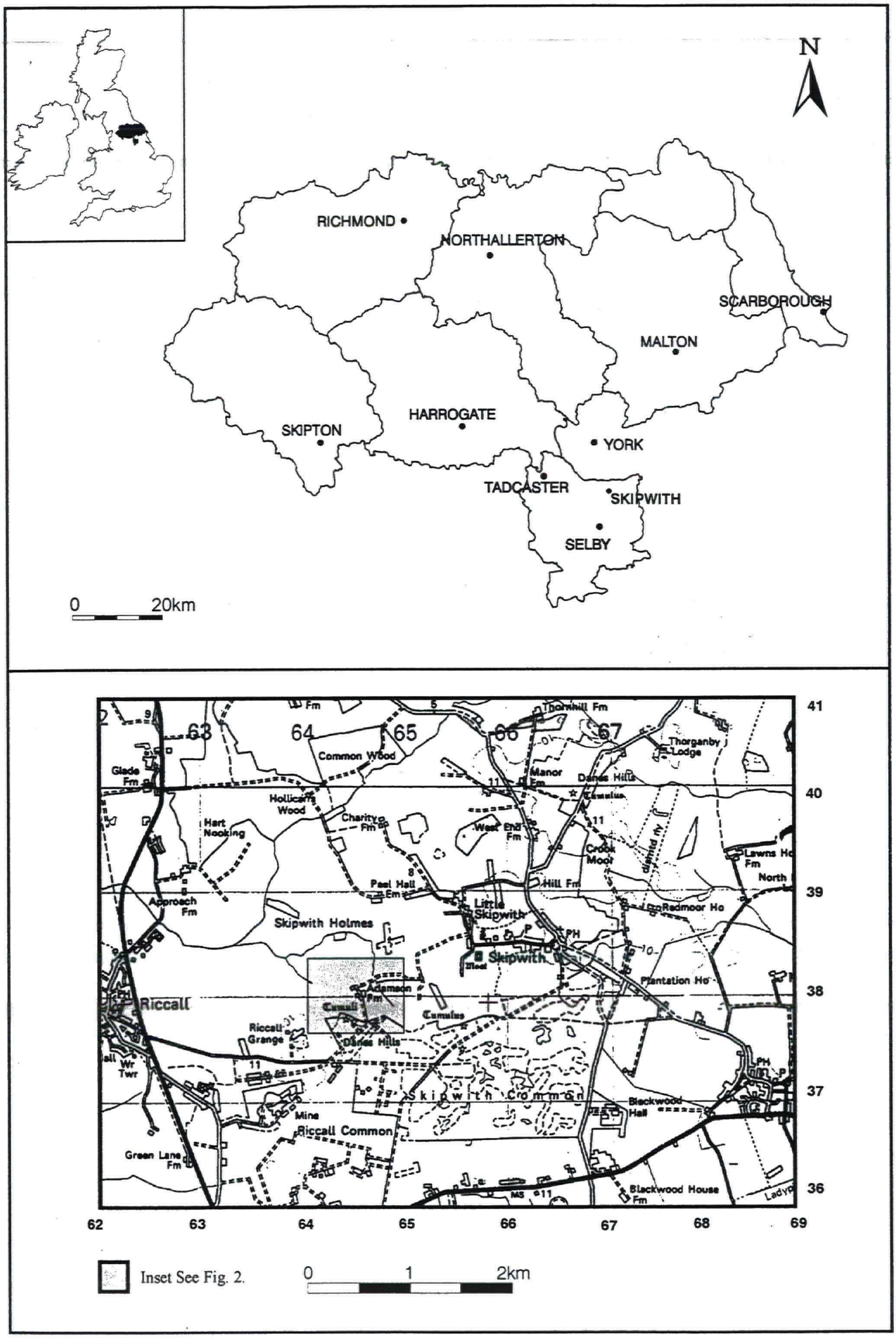


Fig. 1. Site Location

However, this does not preclude the fact that the magnetic anomalies may be of archaeological origin and that there are, therefore sub-surface features present which have a moisture contrast (those visible as cropmarks on the aerial photographs) and features which have a magnetic contrast (those detected by the gradiometer survey).

The aerial photographs show that there is a complex and diverse range of archaeological features within the survey area and so it is quite possible that there are other features present, of a different geophysical composition, that are not revealed in the photographs but which are detected in the gradiometer survey.

3.6 It should be noted that the interpretation diagram (Fig. 3) is an amalgamation of responses observed using a range of contrast settings to analyse the data, and so shows some anomalies which are not readily visible in the data plots presented in this report.

4. Conclusions

4.1 Despite the low contrast, between the background soil magnetism and the magnetic anomalies, anomalies have been detected which are thought might be of archaeological origin.

4.2 None of these anomalies correspond with features identified from aerial photography. This may be due to the depth of soil cover over the features. It is also possible that there are a range of archaeological features present, with differing geophysical compositions, some of which can be detected by aerial photography and others by gradiometry.

4.3 If there are features present which can only be detected by their moisture contrast a resistance survey could be useful to fully evaluate the geophysical responses of features within the survey area.

4.4 The cropmark features are so apparent and diverse that given the low contrast of the possible features detected it would seem on balance that geophysical survey could add little to the known archaeology in the evaluation areas.

The results and subsequent interpretation of geophysical surveys should not be treated as an absolute representation of the underlying archaeology. It is normally only possible to prove the archaeological nature of anomalies through intrusive means such as by trial excavation.

Acknowledgements

Project Management:	A. Webb BA
Geophysical Survey:	A. Webb BA, M. Whittingham BSc MA
Report:	M. Whittingham BSc MA
Graphics:	M. Whittingham BSc MA
	October 1997

Appendices

Appendix 1 Gradiometer Survey: technical information and methods
Appendix 2 Survey location information
Appendix 3 Gradiometer data plots

Appendix 1

Gradiometer Survey: technical information and methods

1. Technical Information

1.1 Iron makes up about 6% of the Earth's crust and is mostly dispersed through soils, clays and rocks as chemical compounds. These compounds have a weak, measurable magnetic response which is termed its magnetic susceptibility. Human activities can redistribute these compounds and change (enhance) others into more magnetic forms. These anthropogenic processes result in small localised anomalies in the Earth's magnetic field which are detectable by a gradiometer.

1.2 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for the more magnetic compounds to concentrate in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. Less magnetic material such as masonry or plastic service pipes which intrude into the topsoil will tend to give a negative magnetic response relative to the background level.

1.3 The magnetic susceptibility of the soil can also be enhanced significantly by heating. This can lead to the detection of features such as hearths, kilns or burnt areas.

1.4 High, sharp responses are usually due to iron objects in the topsoil. These produce a rapid change from positive to negative readings ("iron spikes").

1.5 The types of response mentioned above can be divided into five main categories which are described below:

1. **Iron Spikes (Dipolar Anomalies)**
   These responses are referred to as dipolar and are caused by buried or surface iron objects. Little emphasis is usually given to such responses as iron objects of recent origin are common on agricultural sites. Occasionally, however, iron spikes can indicate the presence of smithing activity by detecting hammerscale.

2. **Rapid, strong variations in magnetic response**
   Also referred to as areas of magnetic disturbance, these can be due to a number of different types of feature. They are often associated with burnt material, such as industrial waste or other strongly magnetised material. It is not always easy to determine their date or origin without supporting information.

3. **Positive, linear anomalies**
   The strength of these responses varies depending on the underlying geology. They are commonly caused by ancient ditches or more recent agricultural features.

4. **Isolated positive responses**
   These usually exhibit a magnitude of between 2nT and 300nT and, depending on their response, can be due to pits, ovens or kilns. They can also be due to natural features on certain geologies. It can, therefore, be very difficult to establish an anthropogenic origin without an intrusive means of examining the features.

5. **Negative linear anomalies**
   These are normally very faint and are commonly caused by features such as plastic water pipes which are less magnetic than the surrounding soils and geology. They too can be caused by natural features on some geologies.

2. Methodology

2.1 There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as *scanning* and requires the operator to visually identify anomalous responses whilst covering the site in widely spaced traverses, typically 10-15m apart. The instrument logger is not used and there is therefore no data collection. This method is used as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be surveyed. Scanning can also be used to map out the full extent of features located during a detailed survey.

2.2 The second method is referred to as *detailed survey* and employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.5m intervals, on zig-zag traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

2.3 During this survey a Geoscan FM36 fluxgate gradiometer and ST1 sample trigger were used to take readings at 0.5m intervals on zig-zag traverses 1m apart within 20m x 20m square grids. 800 readings were therefore taken in each grid and in-house software (Geocon Version 9) was used to interpolate the “missing” line of data so that 1600 readings in total were obtained for each complete grid. The instrument was held pointing north-west.

2.4 The grey scale and dot density plots were produced using the Contors programme and the X - Y trace plots using Geoplot software.

Appendix 2

Survey location information

A survey baseline was laid out parallel to the northern edge of Skipwith Common and from this the site grid was laid out using an optical square. On the completion of the survey the site grid and boundaries were surveyed in using a Geotronics Geodimeter 600 series theodolite.

Using the Ordnance Survey 1:2500 series map base National Grid co-ordinates were obtained for the two points indicated on the plan on the following page. These are accurate to +/- 1m at a scale of 1:2500 and are given below.

A	**E64362**	**N37850**
B	**E64583**	**N37758**

Appendix 3

Gradiometer data plots

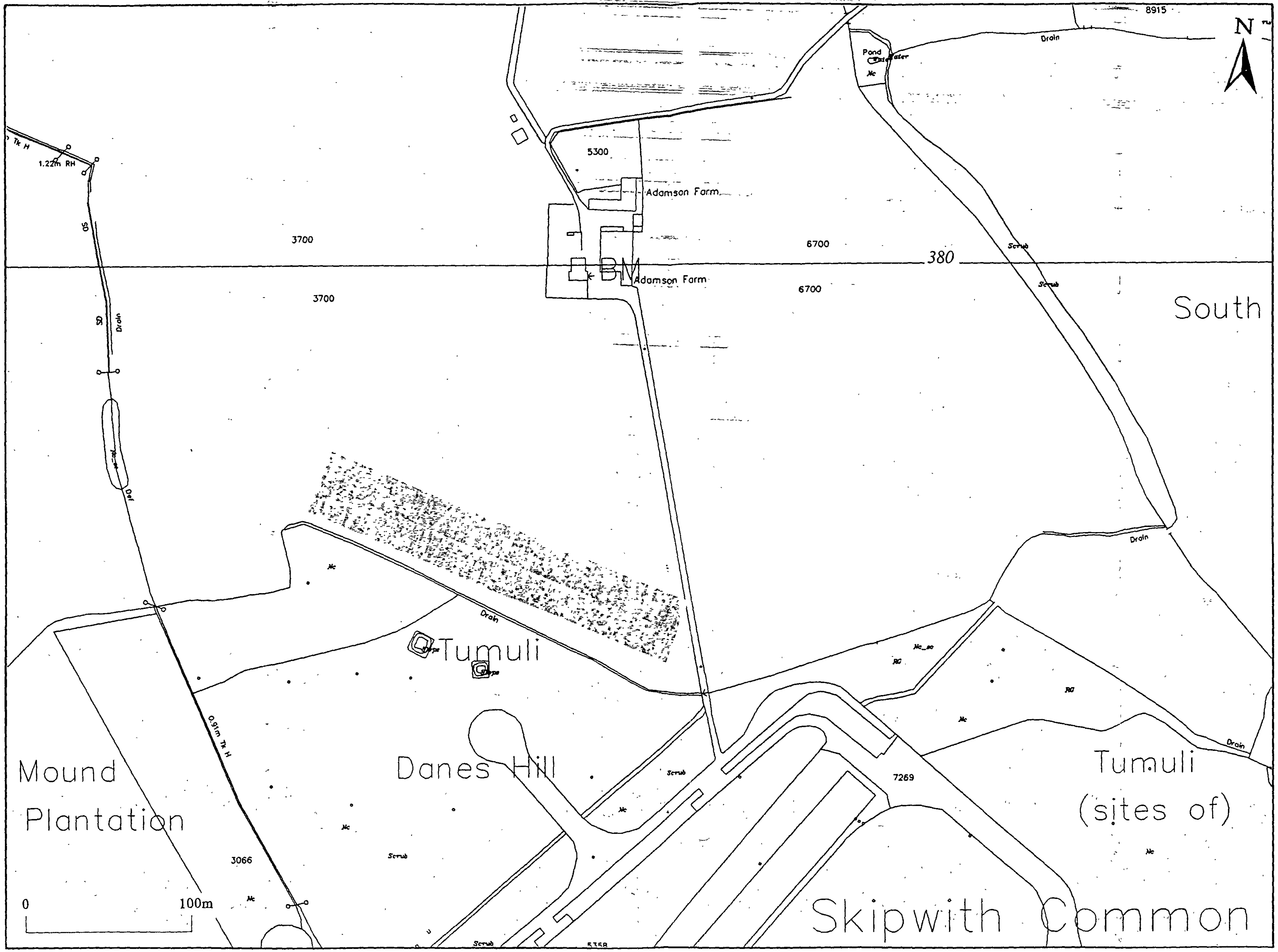


Fig. 2 Site location showing gradiometer data

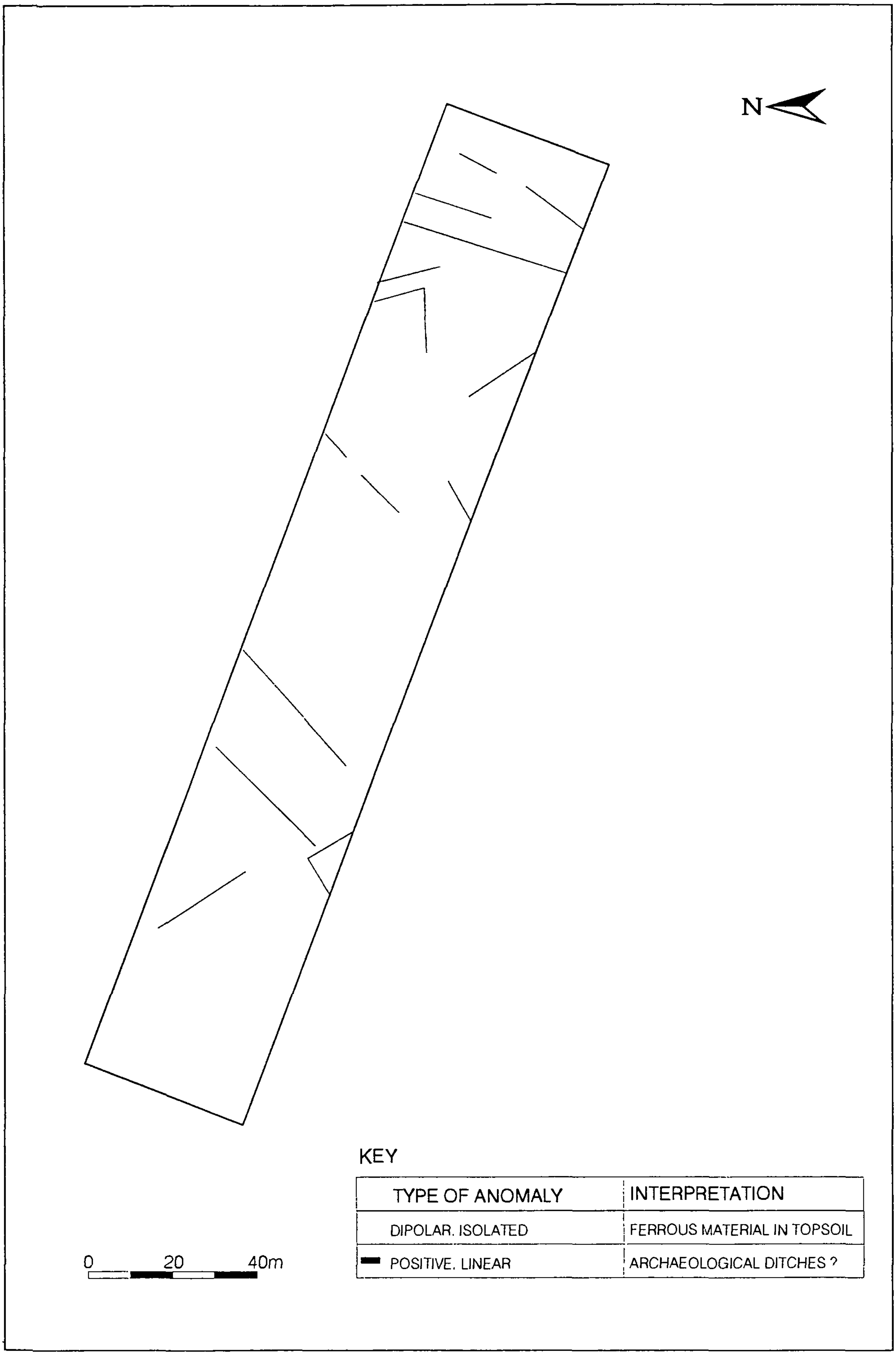
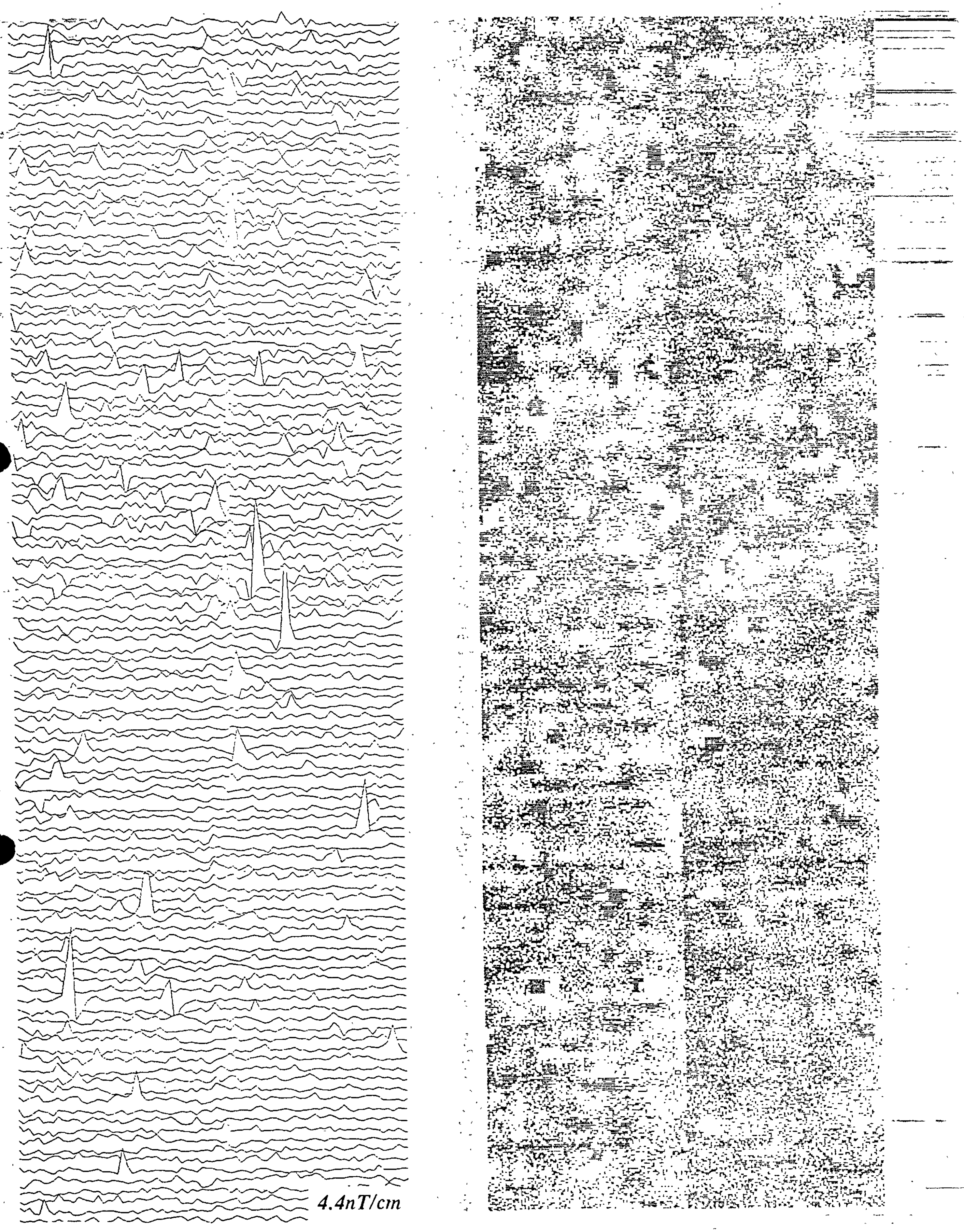
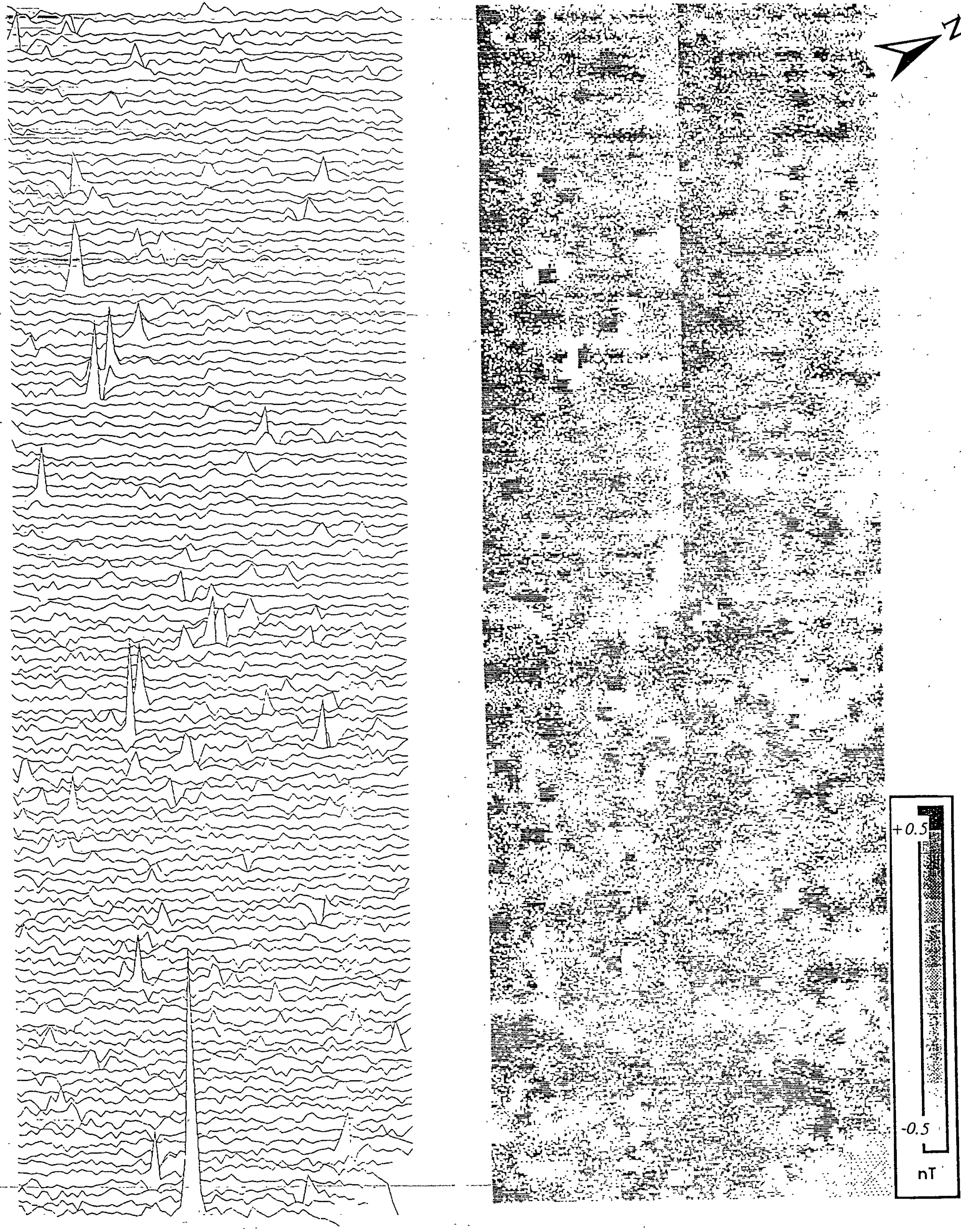


Fig. 3. Interpretation of gradiometer data



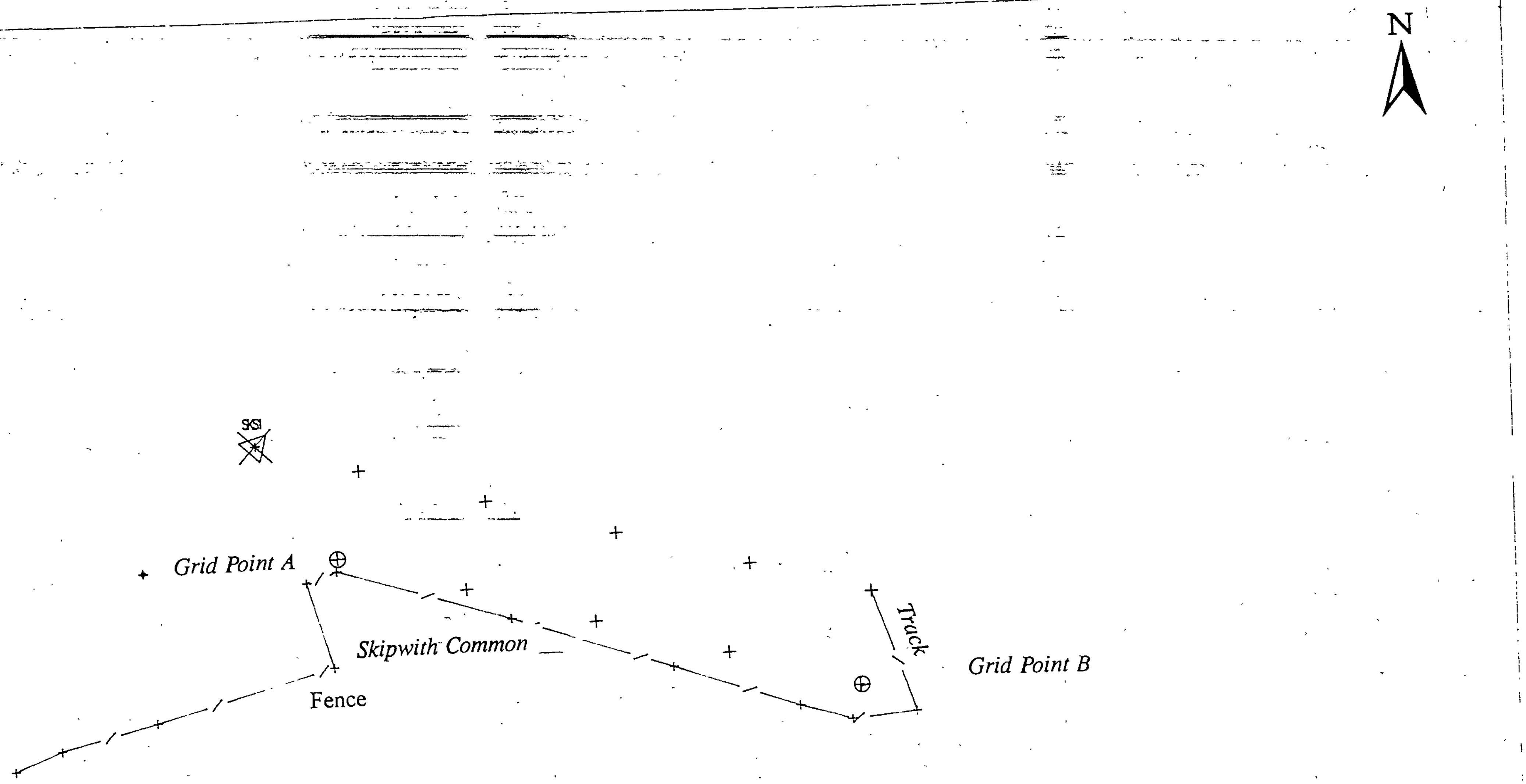
Skipwith, Selby

Gradiometer data: X - Y trace plot



Skipwith, Selby

Gradiometer data: dot density plot



Survey location information (Geodimeter plan)