ARCHAEOLOGICAL SERVICES WYAS

Aston House Farm
Sudbury
Derbyshire

Geophysical Survey

Report no. 2655

October 2014

Client: Cotswold Archaeology

REGISTERED ORGANISATION IA

Aston House Farm
Sudbury
Derbyshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 45 hectares was carried out at Aston House, near Sudbury, Derbyshire, to support a planning application for a proposed solar park development. Many of the anomalies are due to agricultural activity, locating former field boundaries, field drains and cultivation trends. Most of the remaining anomalies are interpreted as having a natural origin being due to variations in the composition of the upper soil horizons and superficial deposits (river terrace sands and gravels to the north of the site and alluvium to the south). No anomalies of obvious archaeological origin have been identified. However, a linear anomaly, which might be caused by a soil-filled ditch, and an adjacent cluster of pit-type anomalies have been identified on the river terrace deposits to the east of the site. These anomalies are interpreted as of possible archaeological potential although non-archaeological causes are considered equally plausible. Therefore, on the basis of the survey the site is considered to have a low archaeological potential.

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Report Information

Client:	Cotswold Archaeology
Address:	Building 11, Kemble Enterprise Park, Kemble, Cirencester, GL7 6BQ
Report Type:	Geophysical Survey
Location:	Aston House Farm
District:	Sudbury
County:	Derbyshire
Grid Reference:	SK 17400 31575
Period(s) of activity:	prehistoric/Romano-British?
Report Number:	2655
Project Number:	4293
Site Code:	AST14
OASIS ID:	archaeol11-193349
Museum Accession No.:	n/a
Date of fieldwork:	September 2014
Date of report:	October 2014
Project Management:	Alistair Webb BA MIfA
Fieldwork:	Mark Evans BA
	Tom Fildes BA
	Alex Schmidt BA
	Dan Waterfall BA MA
Report:	Alistair Webb
Illustrations:	Dan Waterfall BA
Photography:	Site Staff
Research:	n/a

Authorisation for distribution: --

PO Box 30, Nepshaw Lane South, Morley, Leeds
LS27 0UG
Telephone: 0113 383 7500.
Email: admin@aswyas.com

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Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Cotswold Archaeology (CA), to undertake a geophysical (magnetometer) survey of land at Aston House Farm, Sudbury, Derbyshire (see Fig. 1), in order to support a planning application for a proposed solar park development. The work was undertaken in accordance with a Project Design (Harrison 2014) supplied to and approved by CA, with guidance contained within the National Planning Policy Framework (2012) and in line with current best practice (David *et al.* 2008). The survey was carried out between September 22nd and October 1st 2014 in order to provide additional information on the archaeological potential of the site.

Site location, topography and land-use

The Proposed Development Area (PDA) is located approximately 1km south-east of the village of Sudbury, centred at SK17400 31575, and comprises an irregular block of agricultural land that covers 45 hectares. The A50 bounds the site to the north and Leathersley Lane to the south. Farmland extends to the east and west. Dale Brook traverses the site from the north-western corner to the western boundary. The site comprises eleven fields formerly under arable cultivation – the fields were all fallow (see plates) following recent harvest.

The PDA is situated on a slight south facing slope in the valley of the River Dove, rising from 62m above Ordnance Datum (aOD) in the south to approximately 70m aOD on the northern site boundary.

Soils and geology

The solid geology comprises mudstone of the Mercia Mudstone Group overlain to the northern end of the site by River Terrace Deposits (sand and gravel), and to the south by alluvial deposits of clay, silt, sand and gravel (British Geological Survey 2014).

To the west of the site the soils are classified in the Wharfe association which are described as deep, stoneless fine loams. To the east they are classified in the Wigton Moor association, being characterised as permeable fine and coarse loams (Soil Survey of England and Wales 1983).

2 Archaeological Background

A Heritage Desk-Based Assessment (Cotswold Archaeology 2014) established that the only known archaeological remains within the site boundary are associated with ploughed out ridge and furrow earthworks which are likely to be of only local historical interest. The assessment also determined that the valley of the River Dove was exploited in the later prehistoric and Roman periods but that no cropmarks which might indicate activity from this period have been recorded within the site.

3 Aims, Methodology and Presentation

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of the proposed development on potential sub-surface archaeological remains and for further evaluation or mitigation proposals, if appropriate, to be recommended. To achieve this aim a magnetometer survey covering all parts of the PDA currently accessible was carried out.

The general objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). Bartington Grad601 magnetic gradiometers were used during the survey, taking readings at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 is a survey location plan displaying the processed greyscale magnetometer data at a scale of 1:4000. The overall data interpretation, also at a scale of 1:4000, is shown as Figure 3. Figure 4 depicts the superficial geology and former field boundaries. Detailed data plots (‘raw’ and processed) and full interpretative figures are presented at a scale of 1:1000 in Figures 5 to 28 inclusive.

Further technical information on the equipment used, data processing and survey methodologies is given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the site archive.

The survey methodology, report and any recommendations comply with the Project Design (Harrison 2014) and guidelines outlined by English Heritage (David *et al.* 2008) and by the Institute for Archaeologists (IfA 2013). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty’s Stationery Office (© Crown copyright).

The figures in this report have been produced following analysis of the data in ‘raw’ and processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion (see Figs 5 to 28 inclusive)

Although the background magnetic variation is very low across the site there is slightly more variation between the data recorded to the north of Dale Brook and that recorded to the south. On the lower lying ground to the south of the brook the superficial deposits comprise alluvial deposits of sand, silt, clay and gravel. To the north, on the slightly higher ground of the river terrace, sands and gravels predominate. Against this generally low magnetic background only a few anomalies are recorded and these fall into several different types and categories according to their origin. These are discussed below and cross-referenced to specific examples and locations within the site, where appropriate.

Ferrous Anomalies

Ferrous responses, either as individual ‘spike’ anomalies or more extensive areas of magnetic disturbance, are typically caused by modern ferrous (magnetic) debris, either on the ground surface or in the plough-soil, or are due to the proximity of magnetic material in field boundaries, buildings or other above ground features. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as ferrous debris or material is common on most sites, often being introduced into the topsoil as a consequence of manuring or deliberate tipping or infilling. Throughout the PDA individual iron ‘spike’ anomalies are common but there is no obvious pattern or clustering to their distribution to suggest anything other than a random background scatter of ferrous debris in the soil.

Four clusters of ferrous responses are identified, **A**, **B**, **C** and **D**. These clusters almost certainly represent deliberate infilling or dumping, perhaps of small extraction pits. These anomalies are not considered to be of any archaeological significance.

Several large ‘spike’ responses are identified, including **E**, **F** and **G**. There is no obvious cause for these anomalies but a modern origin is considered likely.

Rows of ferrous (‘spike’) responses, **H** and **I**, in the north-eastern corner of Field 2 are along the line of former field boundaries (see below).

Agricultural Anomalies

Analysis of historical mapping indicates that over the past 220 years the division and layout of land within the PDA has been altered by the removal of several field boundaries to create larger open fields. However, there is virtually no trace in the magnetic data of these former boundaries, with the exception of two lines of ‘spike’ anomalies (see above) which correlate with two former boundaries in Field 2. It is noted that the former field boundary in the north-eastern corner of Field 5 followed the boundary between the river terrace and alluvial deposits (see Fig. 4).

Very faint linear trend anomalies are identified at several locations across the site. In the northern half of Field 1 the anomalies are probably indicative of ridge and furrow ploughing. This method of cultivation is not previously recorded here although it is recorded in the southern half of the field and at several other locations within the site (Hyder 2014). No evidence of ridge and furrow ploughing is recorded anywhere else within the site.

Closely spaced parallel trends are identified in Field 4 and Field 8 aligned north/south. Potatoes were recently harvested from these two field (see Plate 4 and Plate 8) and the anomalies reflect the alignment of the rows.

Several other vague trends are identified across the site, including around field edges. These anomalies are also interpreted as agricultural in origin being indicative of recent cultivation.

Field drains have been identified in two locations and it is considered probable that there are more that have not been detected. The most obvious are the two intersecting anomalies, **J** and **K**, in the south-eastern corner of Field 10 with a third, **L**, aligned south-west/north-east at the northern end of the site in Field 3. It is worth noting that the south-west/north-east aligned anomaly, **J**, correlates with one of the two parallel linear cropmarks recorded on the Derbyshire Historic Environment Record (see Fig. 4).

Geological Anomalies

As noted at the head of this section the superficial deposits vary across the site (see Fig. 4). On the alluvium to the south of the site several broad anomalies of enhanced magnetic response, most prominently **M**, **N**, **O** and **P**, are recorded in fields 5, 9 and 11. These anomalies are interpreted as geological in origin being caused by discrete pockets of material with elevated magnetic susceptibility. A cluster of geological anomalies, **Q**, are also noted immediately west of the field drains in Field 10.

Across all parts of the site numerous very small discrete anomalies are identified. These anomalies are also interpreted as geological in origin probably being caused by small pockets of magnetic gravel.

Possible Archaeological Anomalies

One area of possible archaeological interest have been identified in Field 8, towards the eastern edge of the site. A weak linear T-shaped anomaly, **R**, possibly indicative of a soil filled ditch, is identified with the long axis aligned north/south. About 20m to the east are at least four pit-type anomalies, **S**, **T**, **U**, and **V**, with at least four more similar anomalies, **W**, **X**, **Y** and **Z**, approximately 40m to the south. It should be noted, however, that an archaeological origin is far from certain and that the linear anomaly may have an agricultural origin and that the discrete anomalies could be due to changes in the superficial deposits.

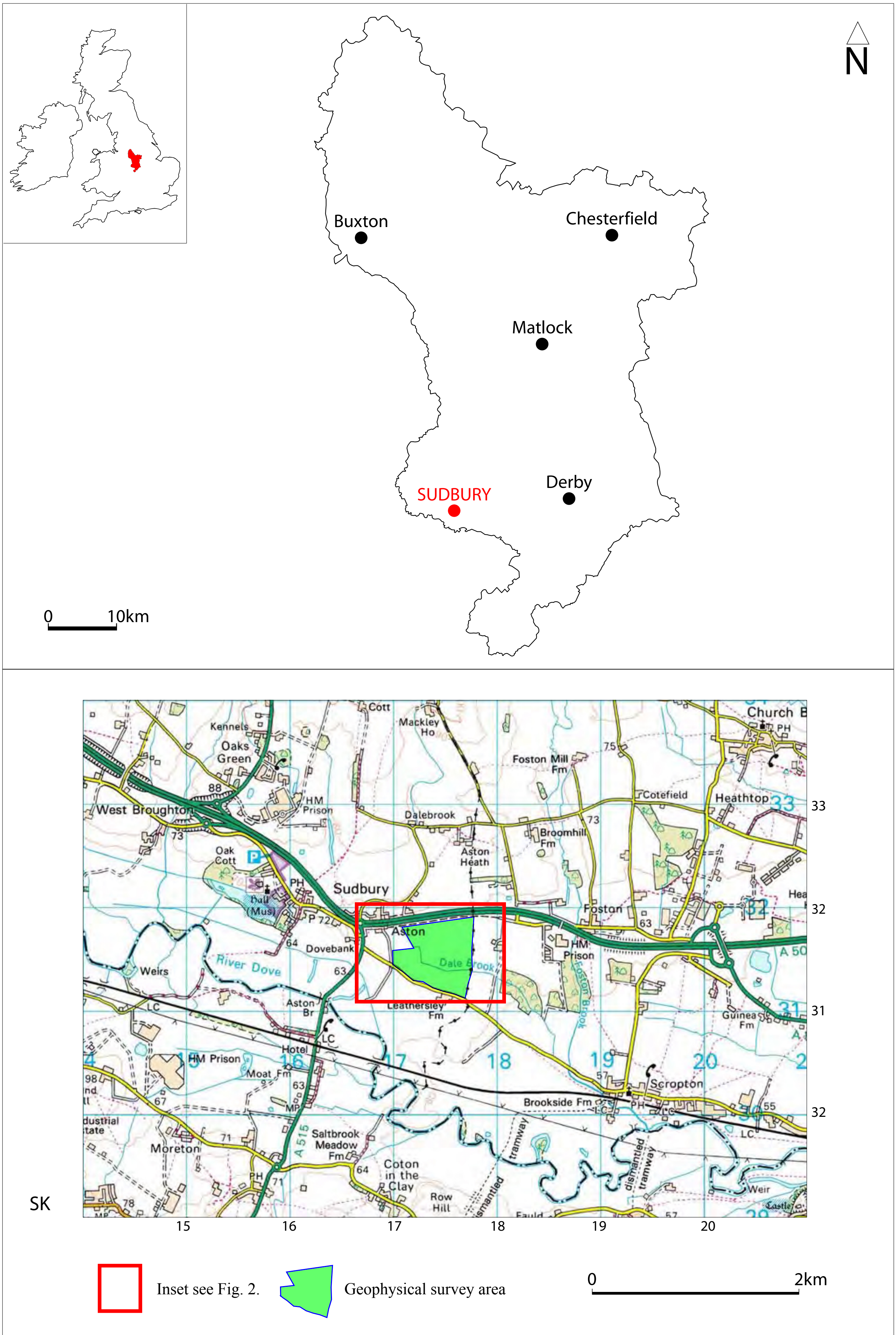


Fig. 1. Site location

Fig. 2. Survey location showing greyscale magnetometer data (1:4000 @ A3)

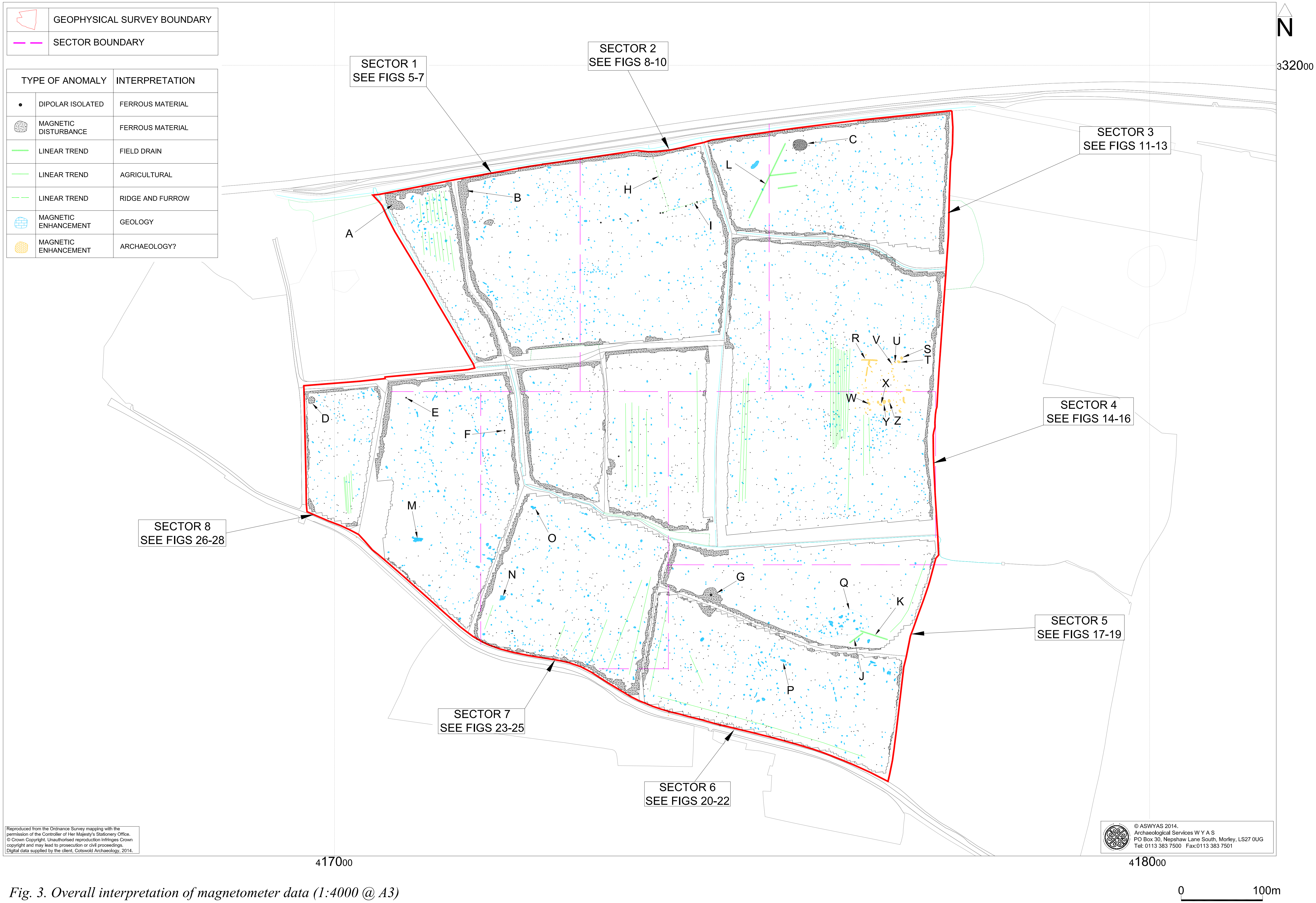


Fig. 3. Overall interpretation of magnetometer data (1:4000 @ A3)

Fig. 4. Magnetometer data showing superficial deposits and former field boundaries (1:4000 @ A3)

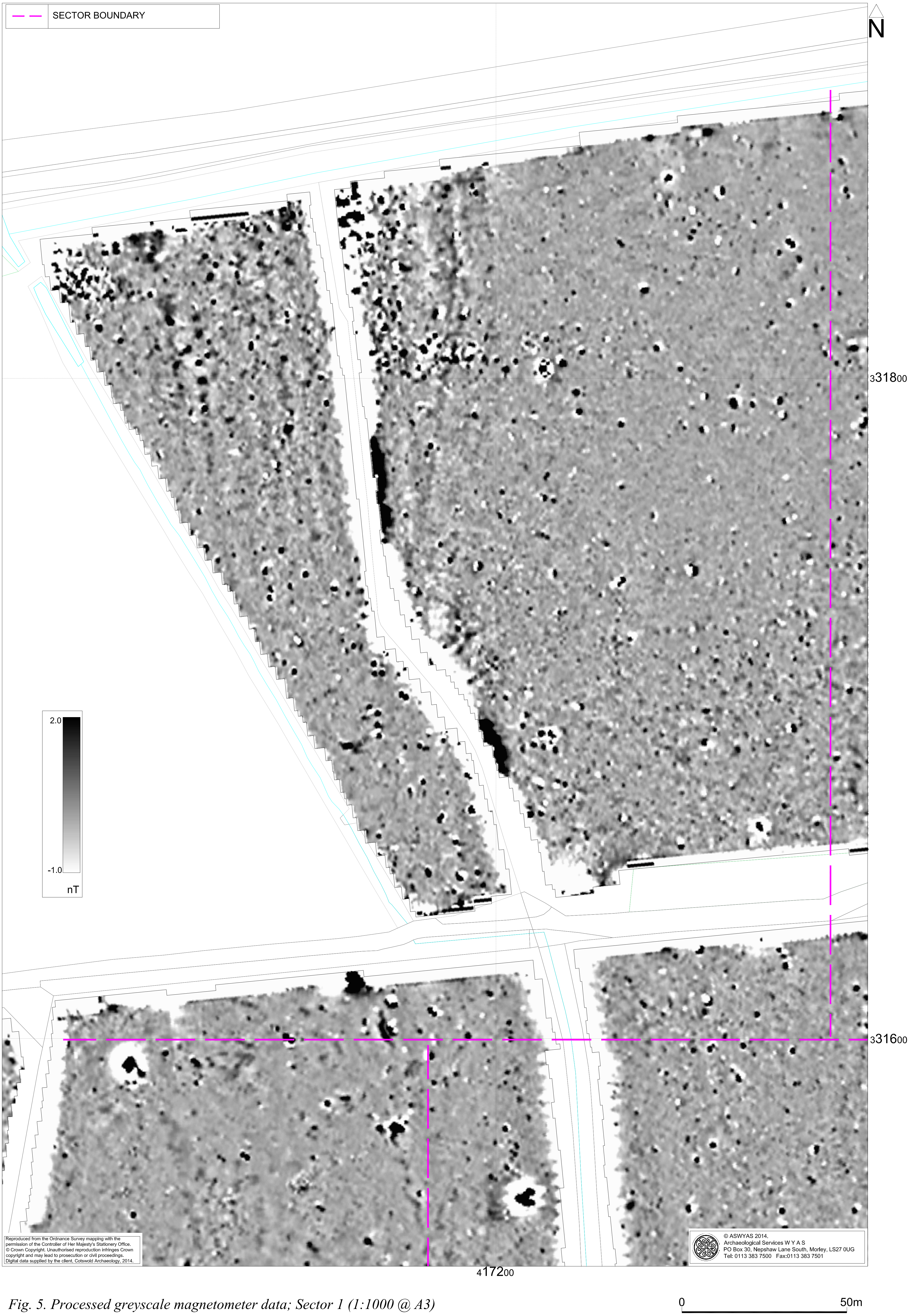


Fig. 5. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

Fig. 6. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)

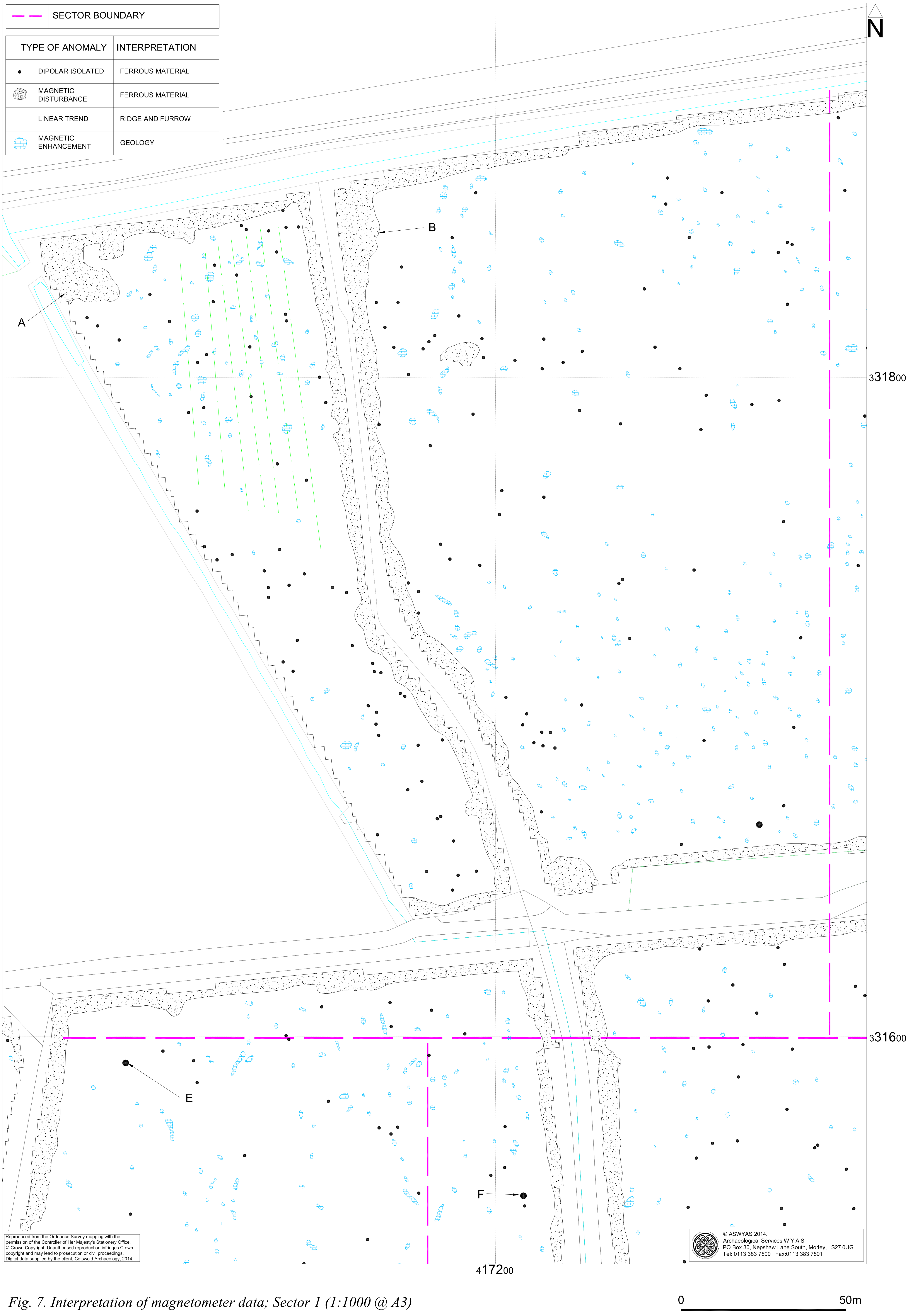


Fig. 7. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

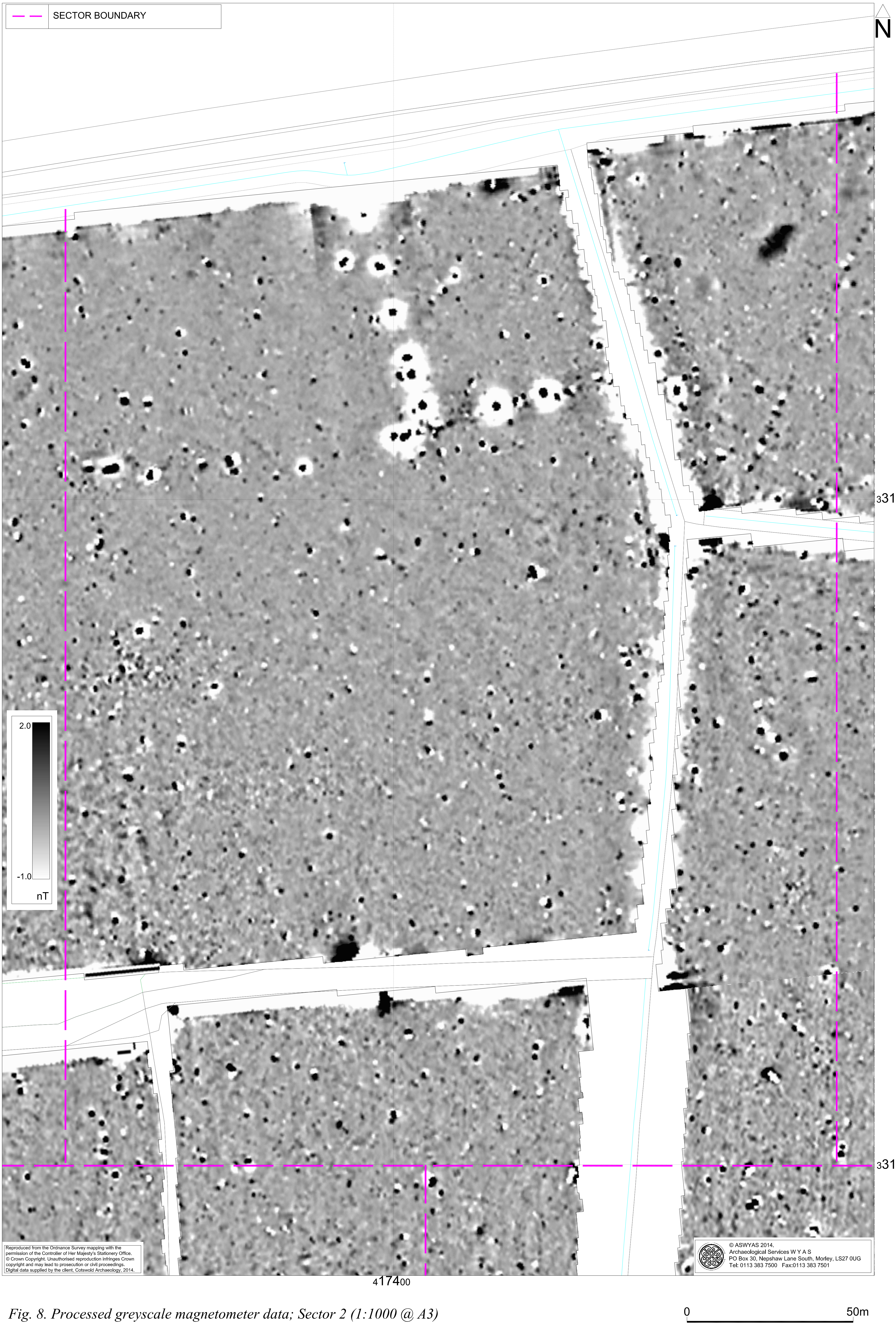


Fig. 8. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

Fig. 9. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

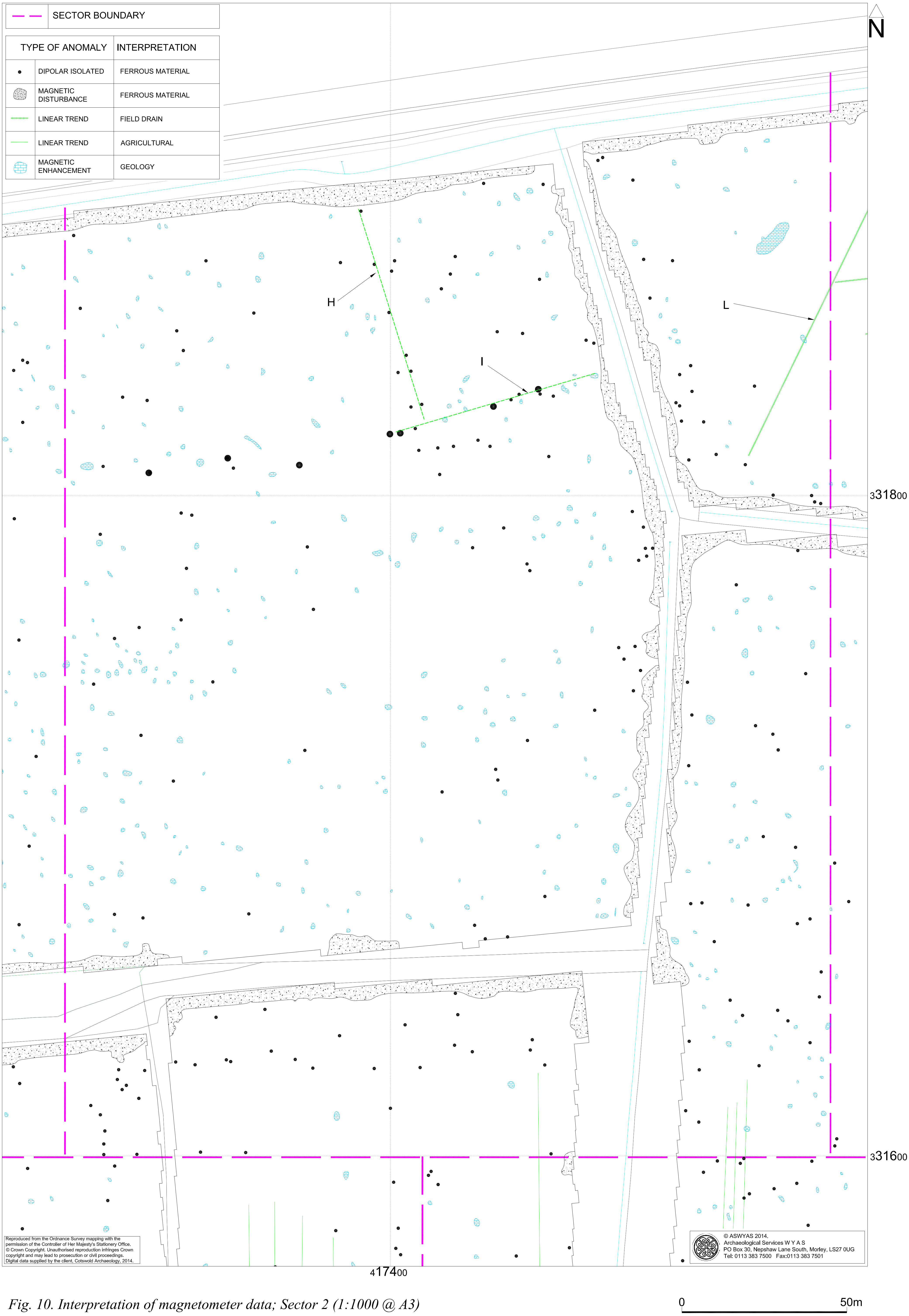


Fig. 10. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

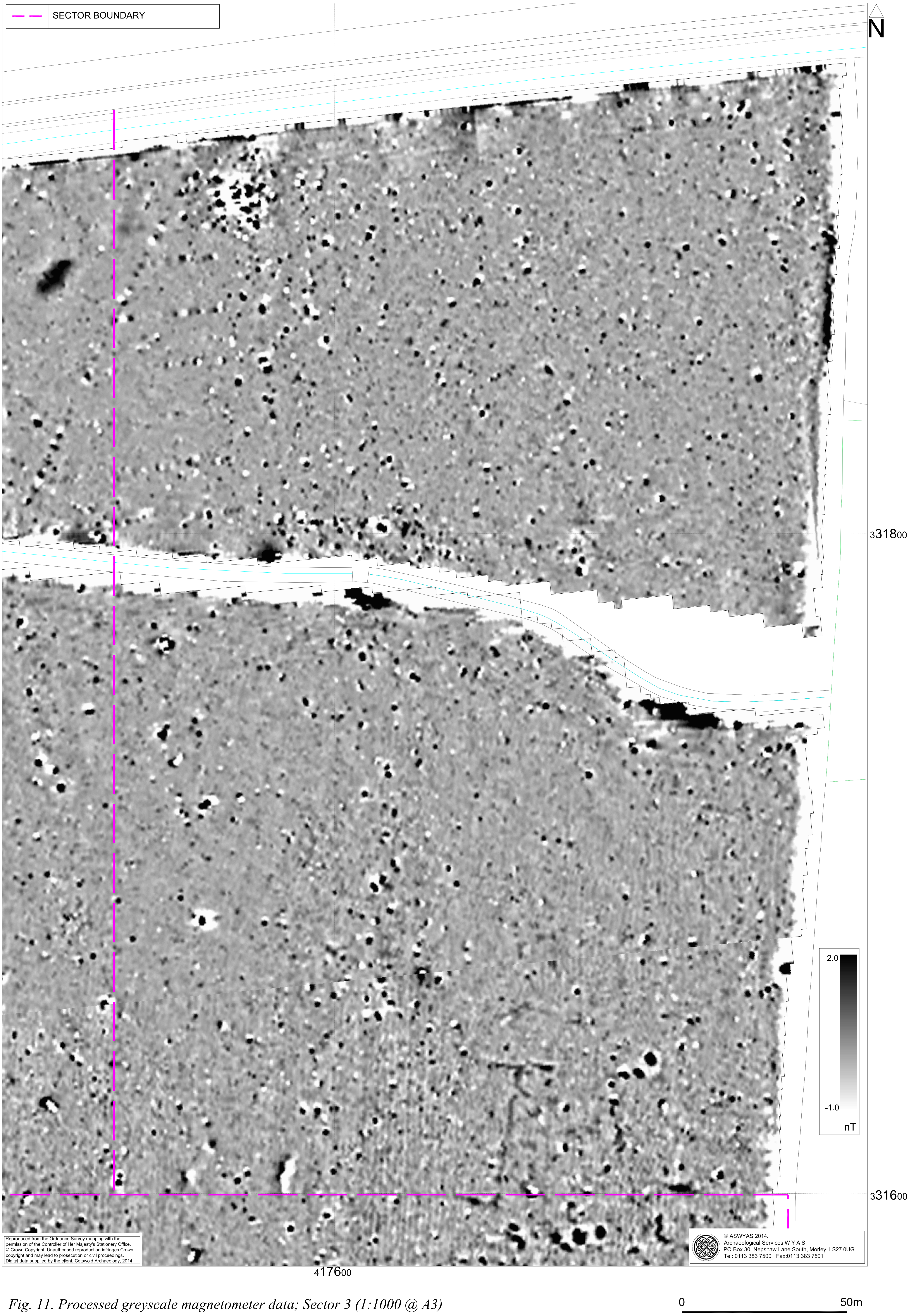


Fig. 11. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

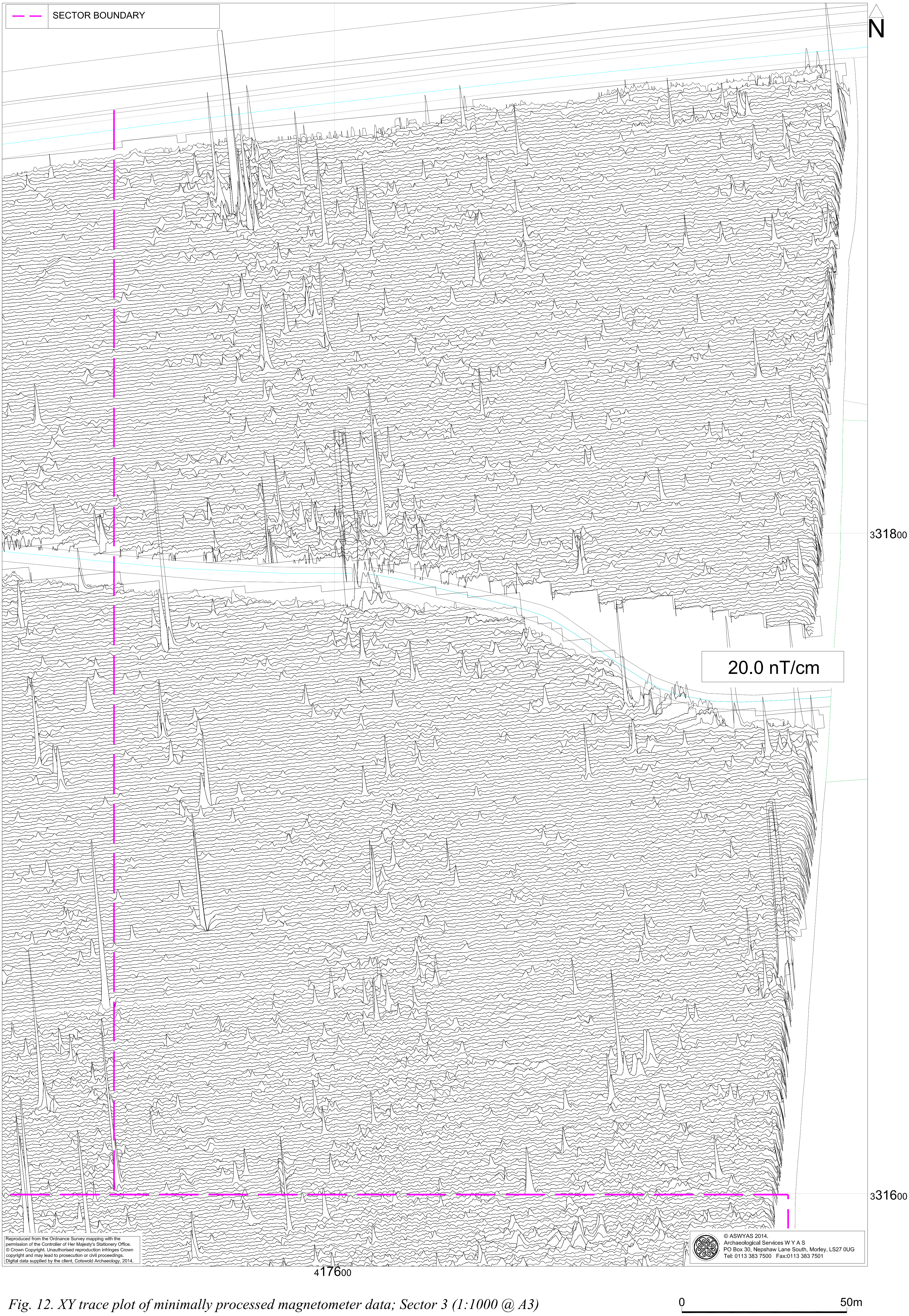


Fig. 12. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A3)

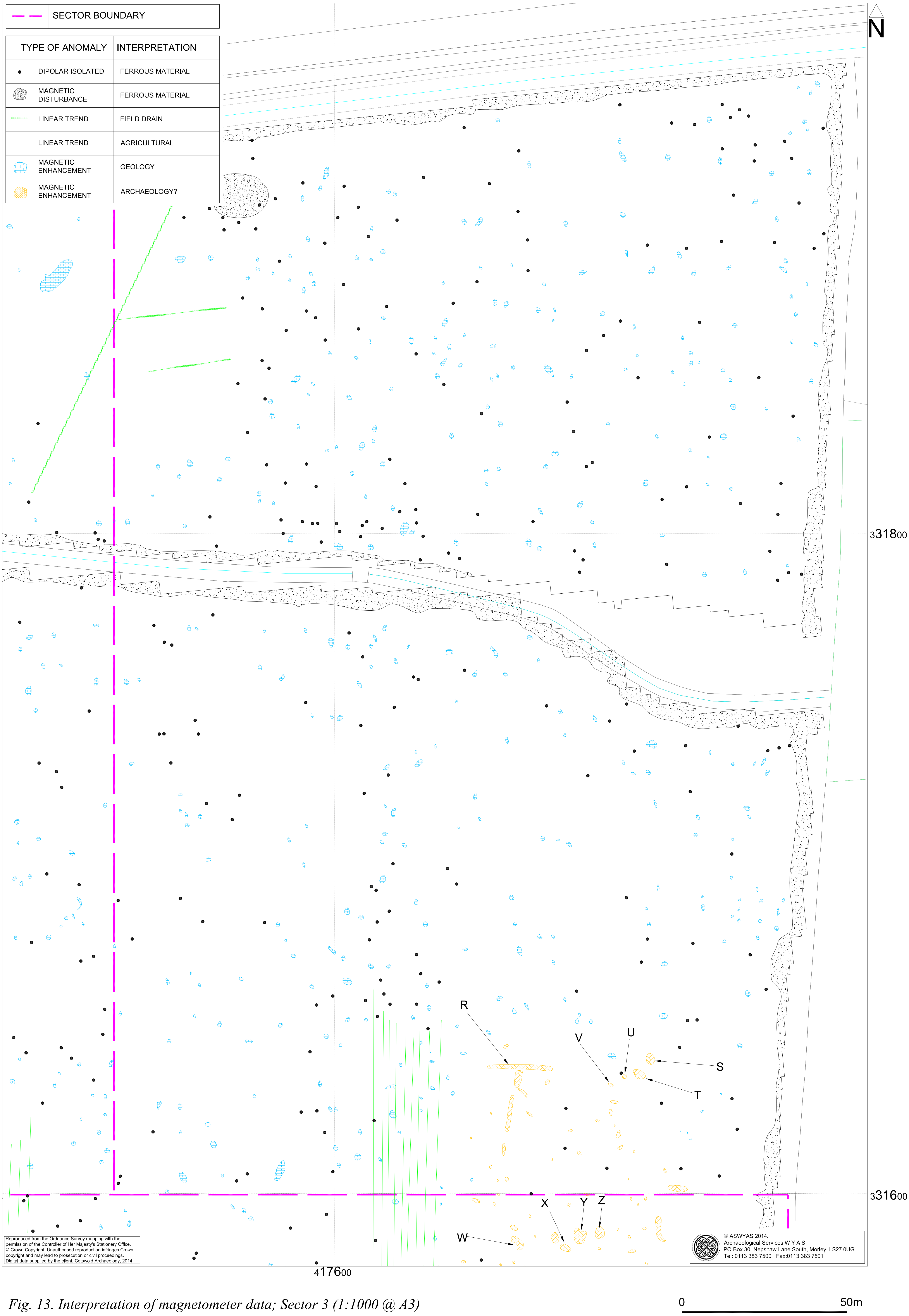


Fig. 13. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)

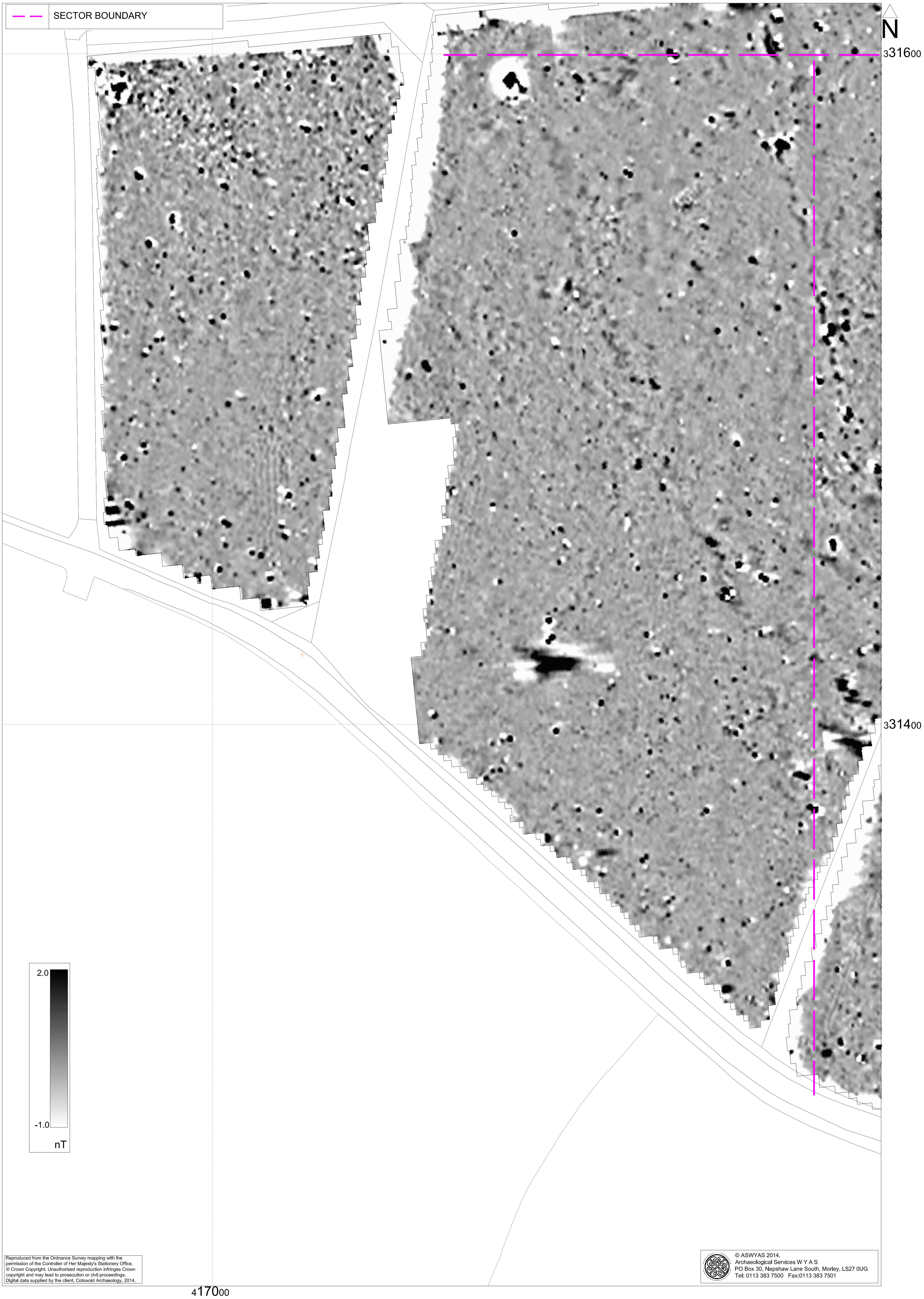


Fig. 14. Processed greyscale magnetometer data; Sector 4 (1:1000 @ A3)

Fig. 15. XY trace plot of minimally processed magnetometer data; Sector 4 (1:1000 @ A3)

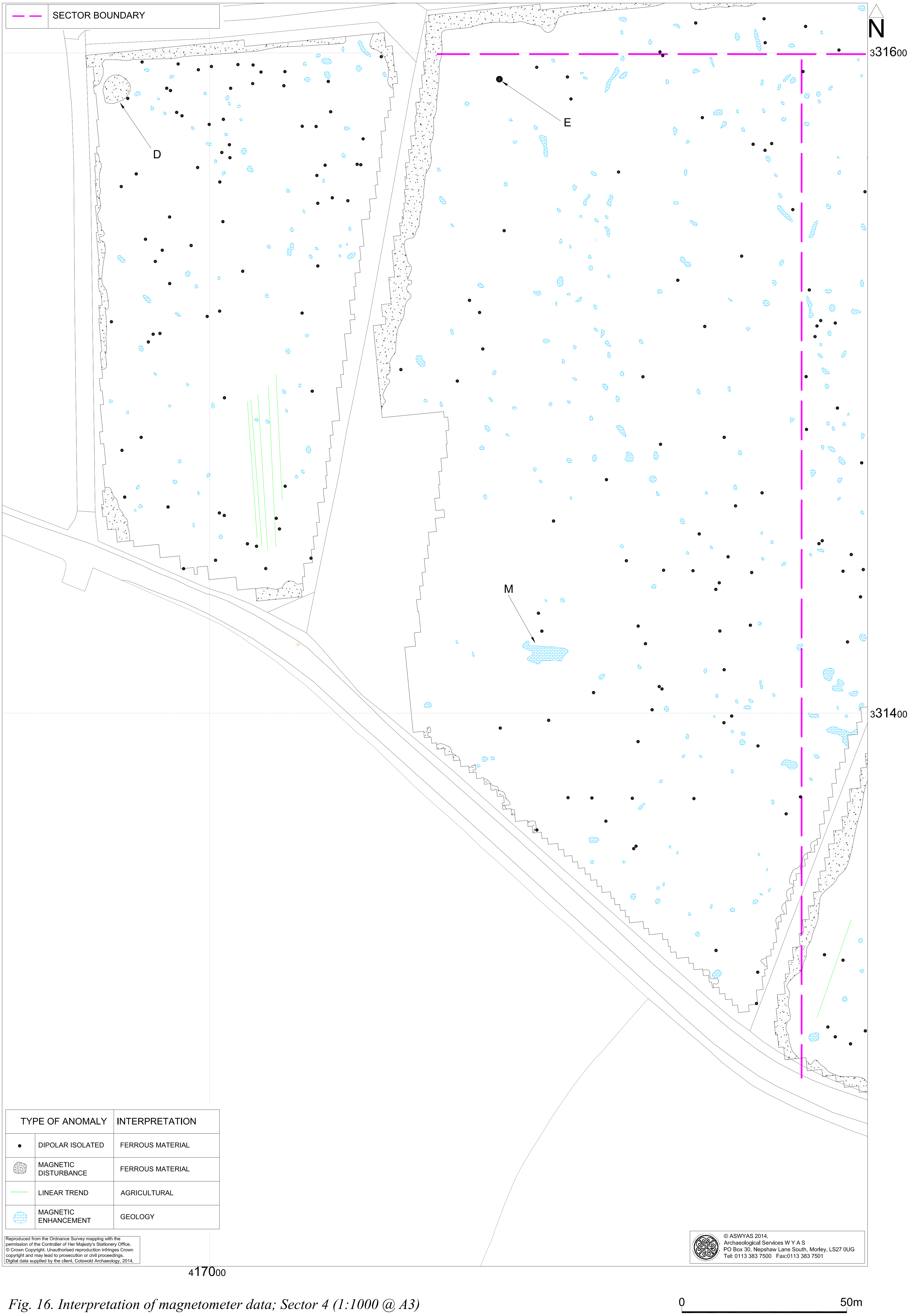


Fig. 16. Interpretation of magnetometer data; Sector 4 (1:1000 @ A3)

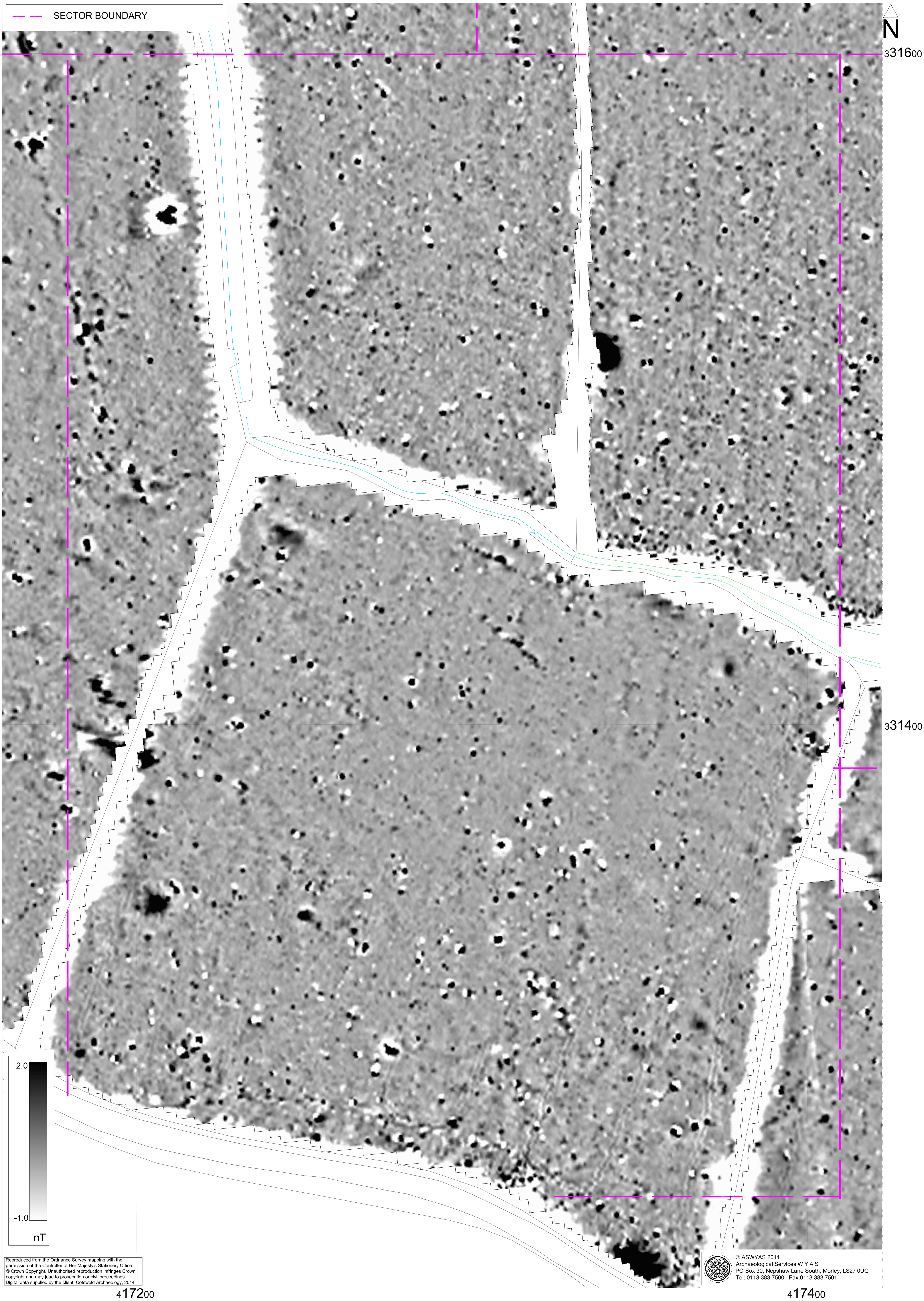


Fig. 17. Processed greyscale magnetometer data; Sector 5 (1:1000 @ A3)

Fig. 18. XY trace plot of minimally processed magnetometer data; Sector 5 (1:1000 @ A3)

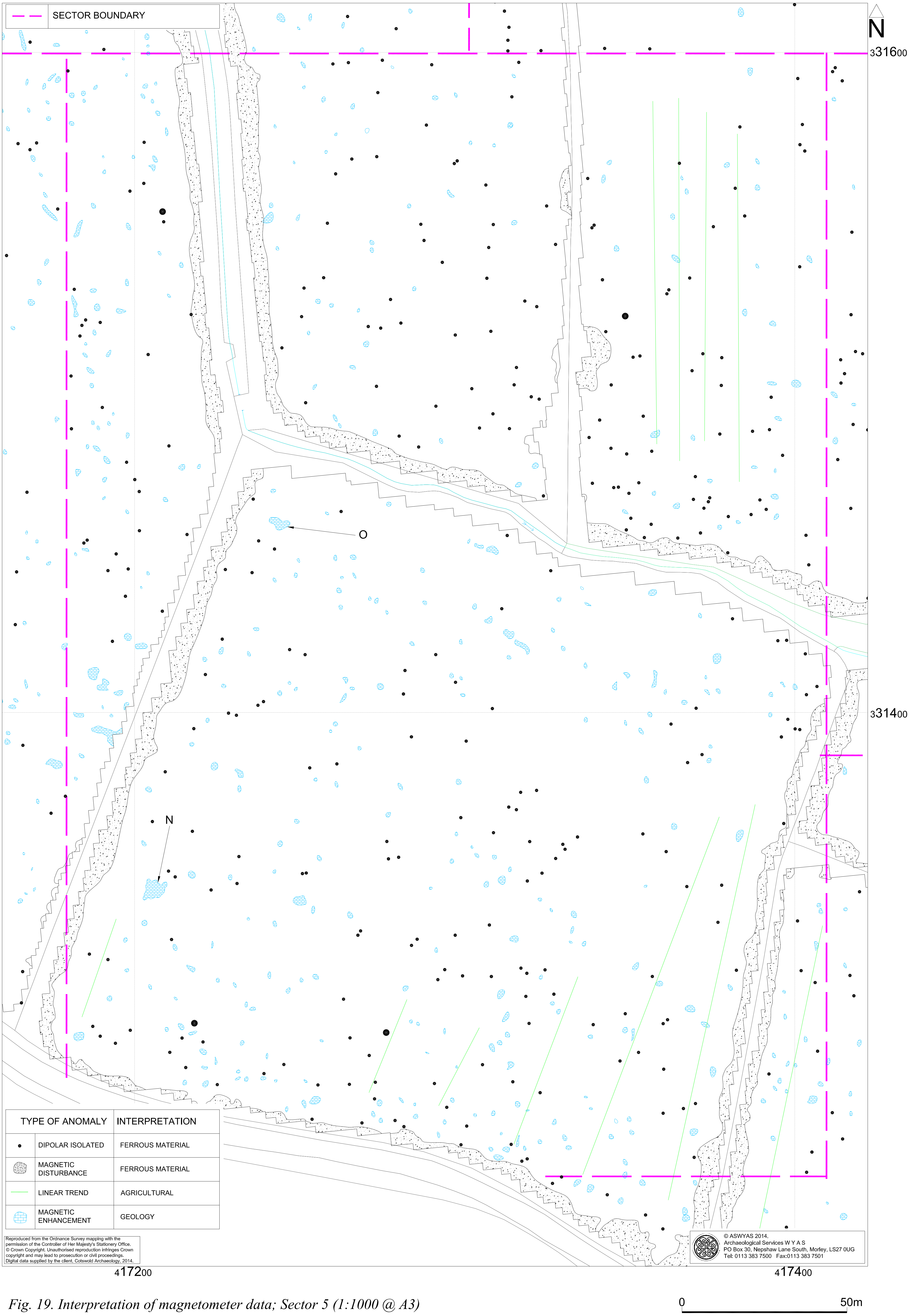


Fig. 19. Interpretation of magnetometer data; Sector 5 (1:1000 @ A3)

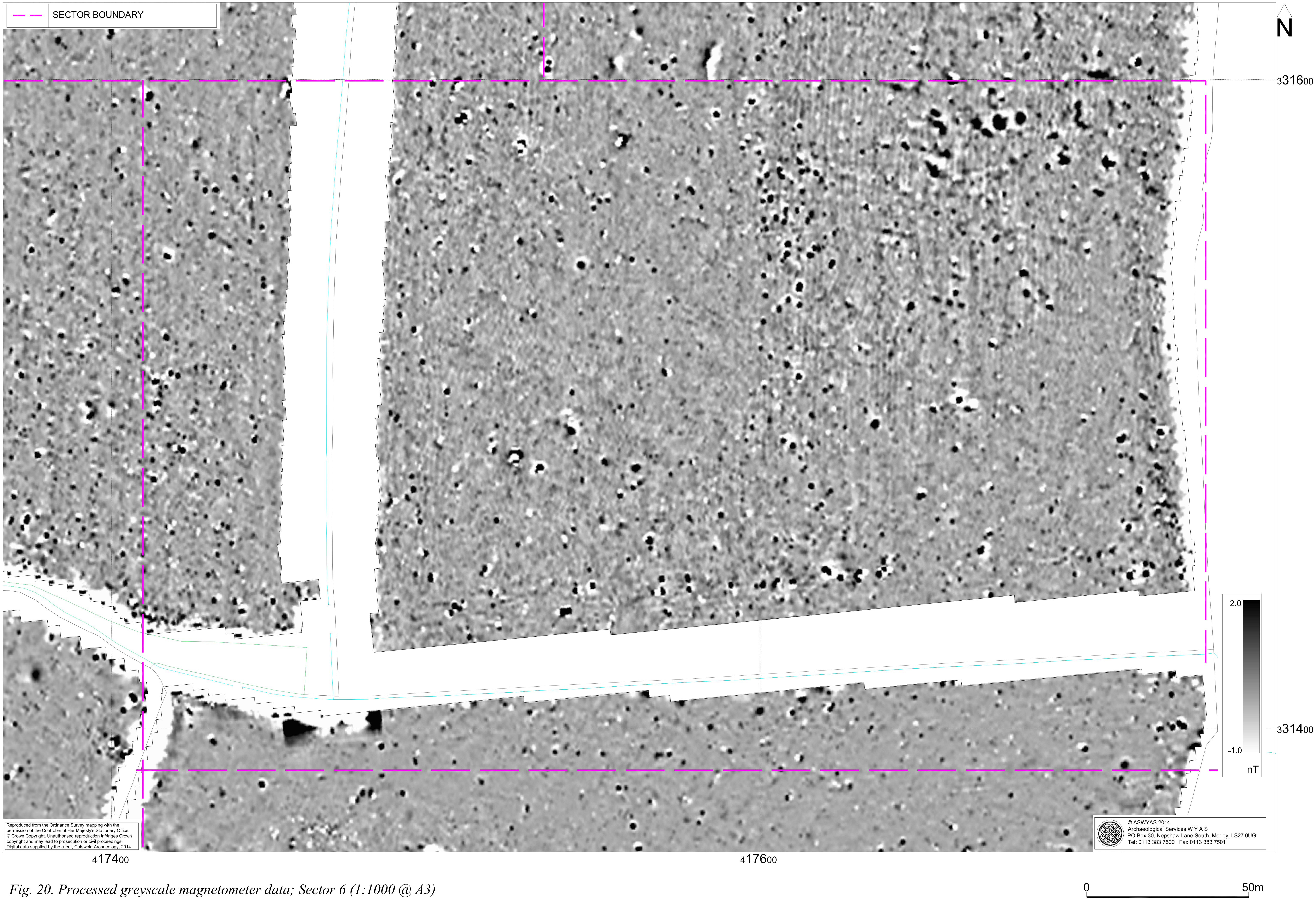
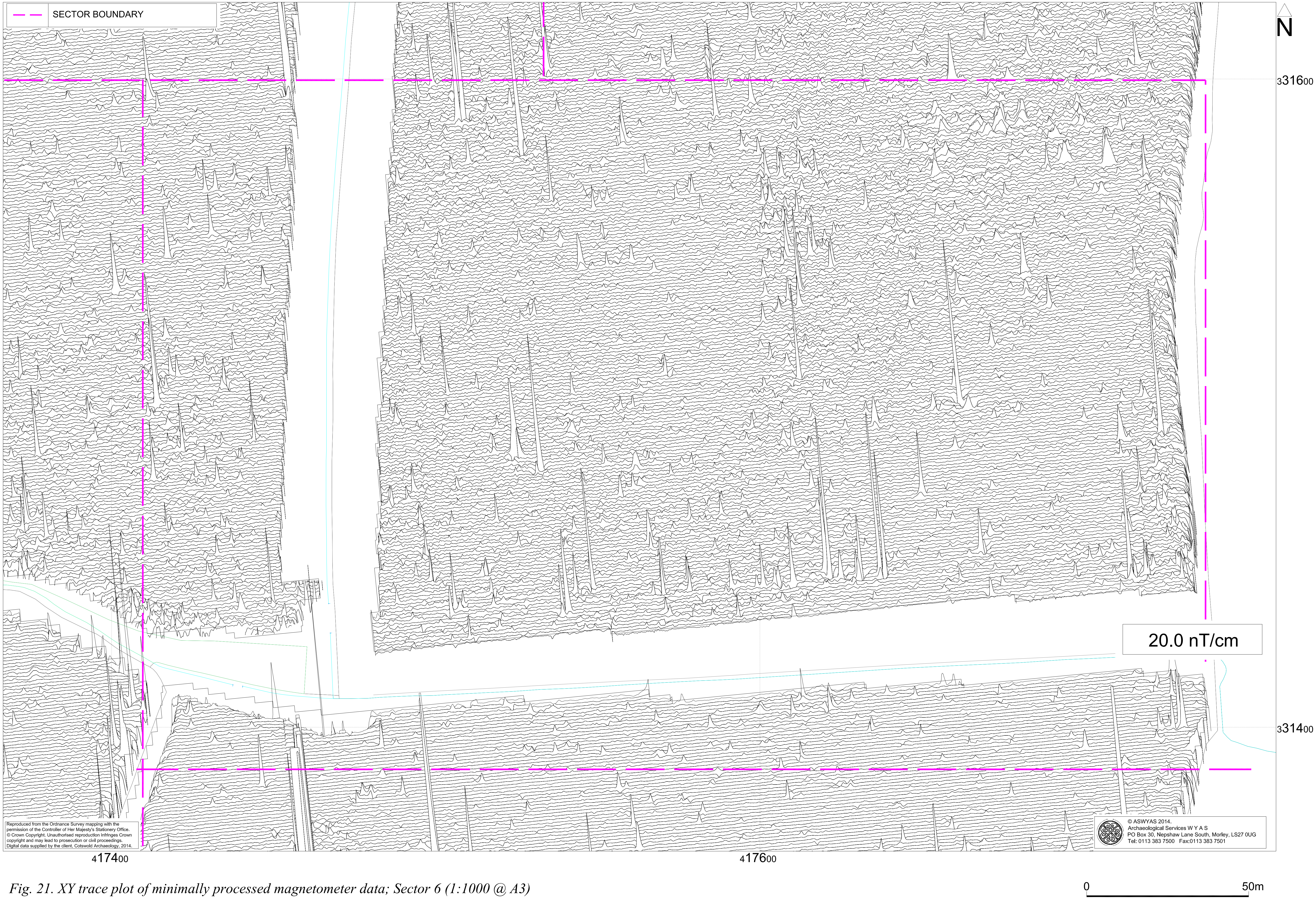


Fig. 20. Processed greyscale magnetometer data; Sector 6 (1:1000 @ A3)



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PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

Fig. 21. XY trace plot of minimally processed magnetometer data; Sector 6 (1:1000 @ A3)

Fig. 22. Interpretation of magnetometer data; Sector 6 (1:1000 @ A3)

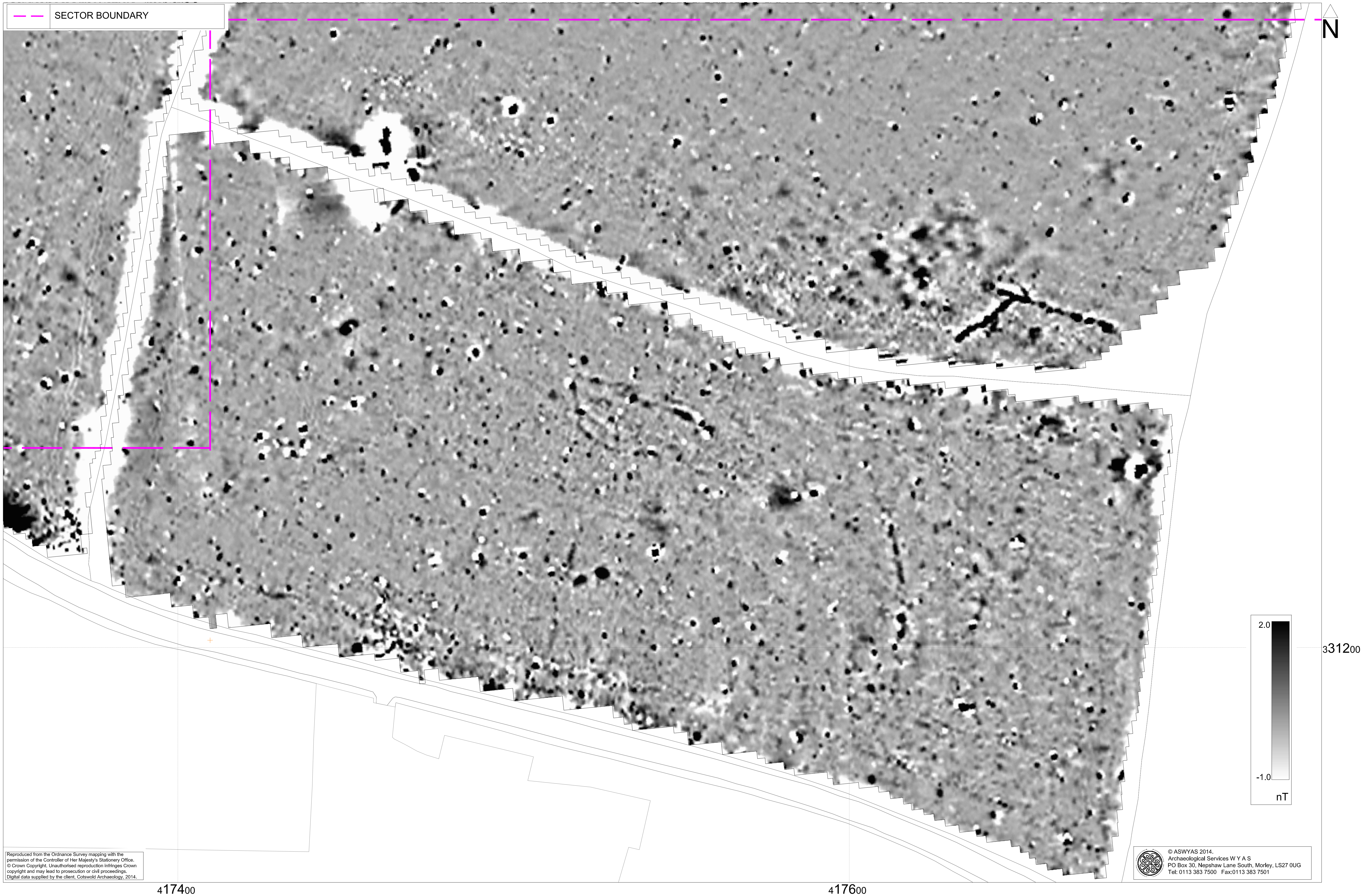

Fig. 23. Processed greyscale magnetometer data; Sector 7 (1:1000 @ A3)

0 50m

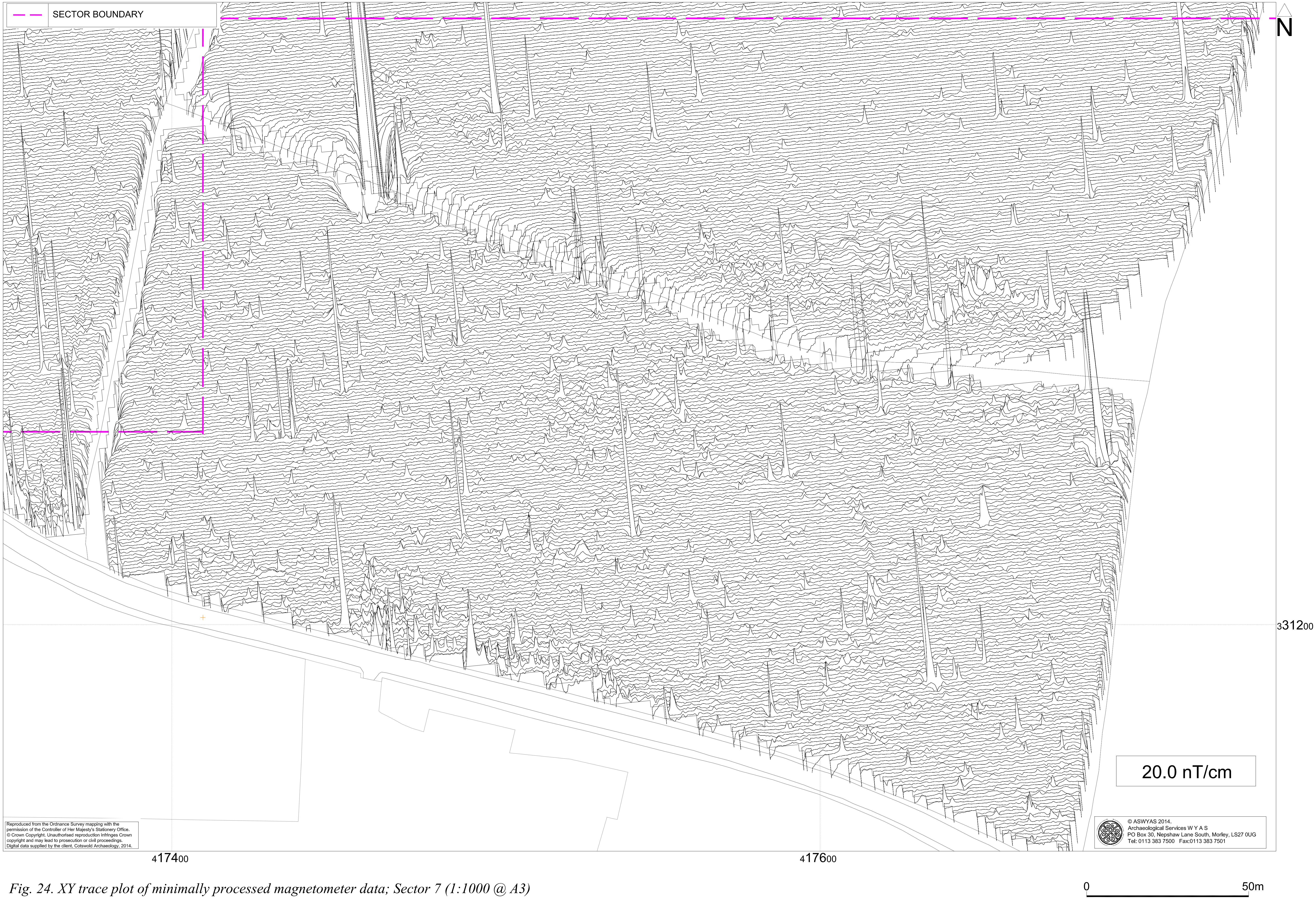

Fig. 24. XY trace plot of minimally processed magnetometer data; Sector 7 (1:1000 @ A3)

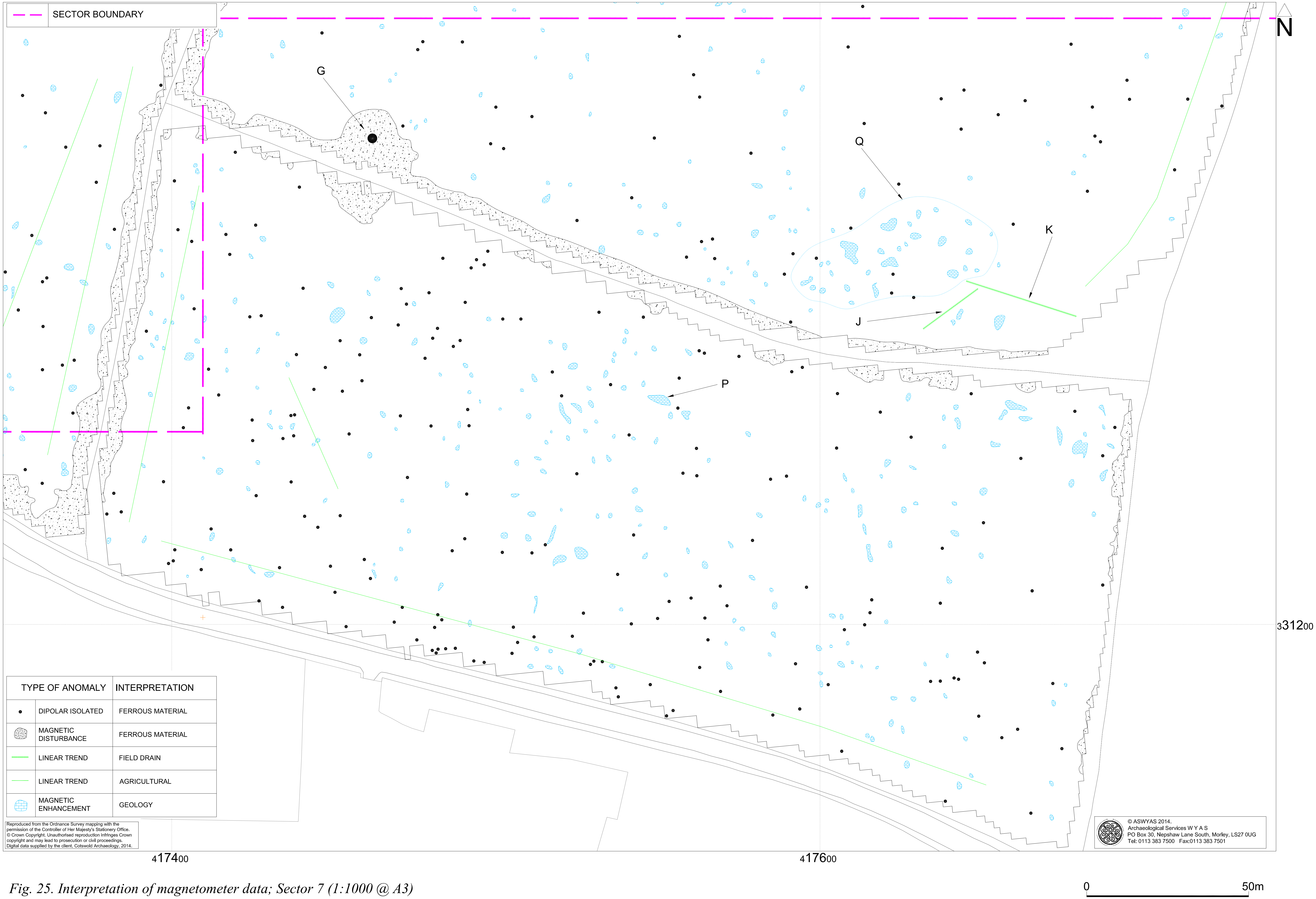

Fig. 25. Interpretation of magnetometer data; Sector 7 (1:1000 @ A3)

Plate 1. General view of Field 1, looking north-west

Plate 2. General view of Field 2, looking east

Plate 3. General view of Field 3, looking east

Plate 4. General view of Field 4, looking north

Plate 5. General view of Field 5, looking south-east

Plate 6. General view of Field 6, looking north-west

Plate 7. General view of Field 7, looking south

Plate 8. General view of Field 8, looking north-west

Plate 9. General view of Field 9, looking south-east

Plate 10. General view of Field 10, looking west

Plate 11. General view of Field 11, looking south-east

5 Conclusions

Against a very 'flat' magnetic background the magnetometer survey has identified relatively few anomalies given the size of the site, perhaps as a consequence of the low susceptibility of the superficial deposits which cover the site. Anomalies indicative of recent agricultural activity are identified with ploughing trends and the occasional field drain being recorded, one of which may correlate with a linear cropmark. Of the six boundaries shown on the 1794 tithe map that are no longer extant only two boundaries, identified by a line of ferrous responses, can be seen in the data. Evidence of tipping or infilling (possibly of small extraction pits) are also noted as are anomalies caused by variation within the soils and river terrace and alluvial superficial deposits.

A handful of anomalies of uncertain origin are identified in Field 8, including a cluster of anomalies including a linear anomaly which may be indicative of a soil-filled ditch and a cluster of pit-type anomalies. These anomalies have been interpreted as of possible archaeological origin. However, it is acknowledged that non-archaeological causes are equally plausible for all these anomalies.

Overall, no anomalies of obvious or definite archaeological potential have been identified and consequently, on the basis of the survey, the site is assessed as being of low archaeological potential, confirming the conclusions of an earlier desk-based assessment.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

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 magnetic ferrous compounds to become concentrated 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. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Magnetic Susceptibility Survey

There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. For field surveys a Bartington MS2 meter with MS2D field loop is used due to its speed and simplicity. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

Methodology: Magnetometer (gradiometer) Survey

The main method of using a magnetometer (gradiometer) for archaeological evaluations is referred to as ***detailed (recorded) survey***. The magnetometer is carried manually by the surveyor along traverses usually 1m apart within grids that are typically 30m by 30m. A sample trigger on the instrument automatically takes readings at predetermined intervals, typically 0.25m apart, and these readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

Data Processing and Presentation

The detailed gradiometer data has been presented in this report in XY trace and greyscale formats. In the former format the data shown is 'raw' with no processing other than grid biasing having been done. The data in the greyscale images has been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a 'stacked' plot. A hidden line algorithm has been employed to block out lines behind major 'spikes' and the data has been clipped. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. Geoplot 3 software was used to create the XY trace plots.

Geoplot 3 software was used to interpolate the data so that 3600 readings were obtained for each 30m by 30m grid. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

Appendix 2: Survey location information

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). The accuracy of this equipment is better then 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 3: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the Derbyshire Historic Environment Record).

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