ARCHAEOLOGICAL SERVICES WYAS

Crab Hill
Wantage
Oxfordshire

Geophysical Survey

Report no. 2420

December 2012

Client: WSP Environment and Energy

REGISTERED IA ORGANISATION

Crab Hill
Wantage
Oxfordshire

Geophysical Survey

Summary

A geophysical (magnetometer) covering approximately 83 hectares was carried out on agricultural land on the north-eastern edge of Wantage in advance of the proposed development of the site for housing. The survey has defined the extent of part of a small settlement to the north-west of the site that probably dates to between the late 2nd to 4th century AD (as indicated by pottery recovered during fieldwalking), confirming and enhancing the cropmark data. Anomalies due to enclosures and round-houses are clearly visible in the data. In addition part of a second, and previously unknown, settlement has also been identified 250 metres to the south. Here the anomalies are less readily interpreted but are undoubtedly of archaeological potential. Elsewhere across the site anomalies due to recent and post-medieval agricultural activity have been identified. Overall the majority of the site is considered to have a low archaeological potential but with two, well-defined, areas of high potential.

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Report Information

Client:	WSP Environment and Energy
Address:	Mountbatten House, Basing View, Basingstoke, Hampshire, RG21 4HJ
Report Type:	Geophysical survey
Location:	Wantage
County:	Oxfordshire
Grid Reference:	SU 410 890
Period(s) of activity: represented	Romano-British/post-medieval
Report Number:	2420
Project Number:	3994
Site Code:	WOX12
OASIS ID:	archaeol11-139875
Planning Application No.:	pre-planning
Museum Accession No.:	n/a
Date of fieldwork:	November – December 2012
Date of report:	December 2012
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1 Introduction

Archaeological Services WYAS was commissioned by Ian Barnes of WSP Environment and Energy to carry out a programme of non-intrusive geophysical (magnetometer) survey on a block of land covering approximately 90 hectares on the north-eastern fringe of Wantage (see Fig. 1). The work was undertaken in accordance with guidance contained within the National Planning Policy Framework (2012), in line with current best practice and in compliance with a Project Design submitted to and approved by Oxfordshire County Council prior to the commencement of the survey. The survey was carried out in advance of the proposed submission of a planning application for a mixed use development of the site. The survey was carried out between November 7th and December 7th 2012. The results of the survey will be incorporated into the Cultural Heritage chapter of an Environmental Impact Assessment which will be submitted to support any future planning application.

Site location, topography and land-use

The proposed development area (PDA) is located on the north-eastern periphery of Wantage, approximately 1km from the historic core of the town, and immediately to the north and east of the village of Charlton (see Fig. 2). The site is bounded to the west by the A338, to the south by the edge of Wantage and Charlton and to the south-east by the A417. Field boundaries delimit the site to the north and north-east.

The land within the PDA is predominantly flat situated on a plateau at about 100m above Ordnance Datum (aOD). There is, however, a gradual slope to the west and south-west into the Letcombe Brook valley, with the lowest point being the western edge beside the A338 at approximately 82m aOD.

The PDA comprises eleven fields predominantly under arable production but with several smaller fields under permanent pasture. A small area of woodland (unsurveyed) and a cricket pitch (partially surveyed) were also within the PDA boundary.

Geology and soils

The underlying bedrock geology comprises calcareous siltstone and sandstone of the Upper Greensand Formation. There are no recorded superficial deposits (British Geological Survey 2012). The soils are classified in the Harwell association which are described as well-drained loams over sandstone (Soil Survey of England and Wales 1980).

2 Archaeological background

Research undertaken as background for a desk-based assessment (Beamish 2009) demonstrated that the site contains one known Romano-British site (a cropmark complex) that has the appearance of a later prehistoric farming settlement. In addition the assessment concluded that the site 'has some potential to contain deposits from other periods'.

3 Aims, Methodology and Presentation

The general objective of the geophysical survey was to provide information about the presence/absence, character, and extent of any archaeological remains within the PDA that will be impacted by the proposed development and to help inform further strategies should they be required.

In order to achieve these aims detailed (recorded) magnetometer survey was carried out over the whole of the PDA that was suitable for survey, an area of approximately 83 hectares.

Magnetometer survey

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 map is shown in Figure 1. A large scale (1:5000) plan showing the magnetometer data and field numbers is presented in Figure 2 with an overall interpretation of the data at the same scale as Figure 3. The data are presented in greyscale, XY trace plot and interpretation formats in Figures 4 to 42 inclusive at a scale of 1:1000.

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

The geophysical survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Institute for Archaeologists (IfA 2010). 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 4 to 42 inclusive)

A plethora of anomalies have been identified across the whole of the site that has been surveyed. These can be divided into several categories and their origin and extent are discussed below.

Ferrous anomalies

Ferrous anomalies, either as individual ‘spikes’ or more extensive areas of magnetic disturbance, are typically caused by ferrous (magnetic) debris, either on the ground surface or mixed in with the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as ferrous debris is common on rural sites, often being present as a consequence of manuring or tipping/infilling. On this site there is no apparent clustering to these anomalies and they are therefore assumed to be due to the random distribution of ferrous debris.

A series of regularly spaced much stronger ‘spikes’ on a north-west/south-east alignment in Field 3 reflect the presence of a line of electricity poles, the anomalies being due to metal cladding around the base of the pole. Several other similar anomalies in the eastern half of the site are also due to the presence of electricity poles.

Strong linear dipolar anomalies in Fields 2, 3, 6, 8, 9 and 10 are due to buried pipes or drains.

Agricultural anomalies

Parallel linear trend anomalies have been identified on varying alignments throughout the site and in virtually every single one of the fields.

The majority of these anomalies are caused by ridge and furrow ploughing and stand out as being slightly curving in nature. They are shown as dashed green lines on the interpretation figures. The ridge and furrow is on two basic alignments being orientated north/south in the western half of Field 2 and broadly east/west across the remainder of the site. The variation in alignment generally reflects the alignment of the long axis of the fields as mapped on the Charlton Hamlet enclosure map of 1883 (Beamish 2012). The characteristic striped appearance of the data is due to the magnetic contrast between the soil comprising the former ridges and that filling the former furrows. Other linear trend anomalies perpendicular to the ridge and furrow ploughing probably reflect internal boundaries within the enclosed fields and these are also indicated on the 1883 enclosure map.

Other much straighter and more regularly spaced trend anomalies either locate field drains, such as those aligned south-west/north-east in the western half of Field 3, or are due to modern ploughing, such as those aligned north/south in the south-western corner of Field 7.

Geological anomalies/modern activity

Throughout the site the small discrete areas of enhanced magnetic response have been identified. These anomalies are either interpreted as geological in origin, being due to variation in the composition of the soils.

Archaeological and possible archaeological anomalies

Along the northern edge of Field 2 a series of magnetic anomalies have been identified that correspond with the location of the cropmark complex identified on air photographs (Oxford Archaeology gazetteer number 103). Linear and curvilinear anomalies caused by infilled ditch features are clearly distinguishable in the data which together comprise several rectilinear enclosures, **A**, **B**, **C** and **D**, with internal, angular sub-divisions, **E** and **F**. At least two circular features, **G** and **H**, are also clearly defined which might be described as ring ditches or possible eaves-drip gullies. The complex is aligned on a broad south-east/north-west axis. Numerous discrete anomalies within the enclosures hint at occupational activity. The anomalies become weaker to the east and disappear completely close to the eastern edge of the field although it is not clear whether this reflects the actual limit of the archaeological activity or whether modern ploughing has truncated the archaeological remains in this part of the field.

A second possible area of archaeological activity has been identified in the south-eastern corner of Field 2. Here the many anomalies are fragmentary and with no coherent pattern distinguishable although the possible outline of a small enclosure, **I**, and a possible ring ditch/eaves-drip gully, **J**, have been picked out.

5 Conclusions

The geophysical survey has successfully confirmed the presence and extent (within the boundary of the PDA) of the likely plough-damaged remains of a late prehistoric/early Roman agricultural settlement as exemplified by a series of small enclosures and possible round-houses and previously identified as a cropmark. In addition part of a second possible settlement is identified 250m to the south. This area of archaeological activity was previously unknown. Over the remainder of the site only anomalies indicative of post-medieval and more recent agricultural activity have been identified.

Overall the survey has identified two areas of high archaeological potential which are considered likely to be of local and possibly regional importance. The remainder of the site is considered to have a low archaeological potential.

Disclaimer

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.

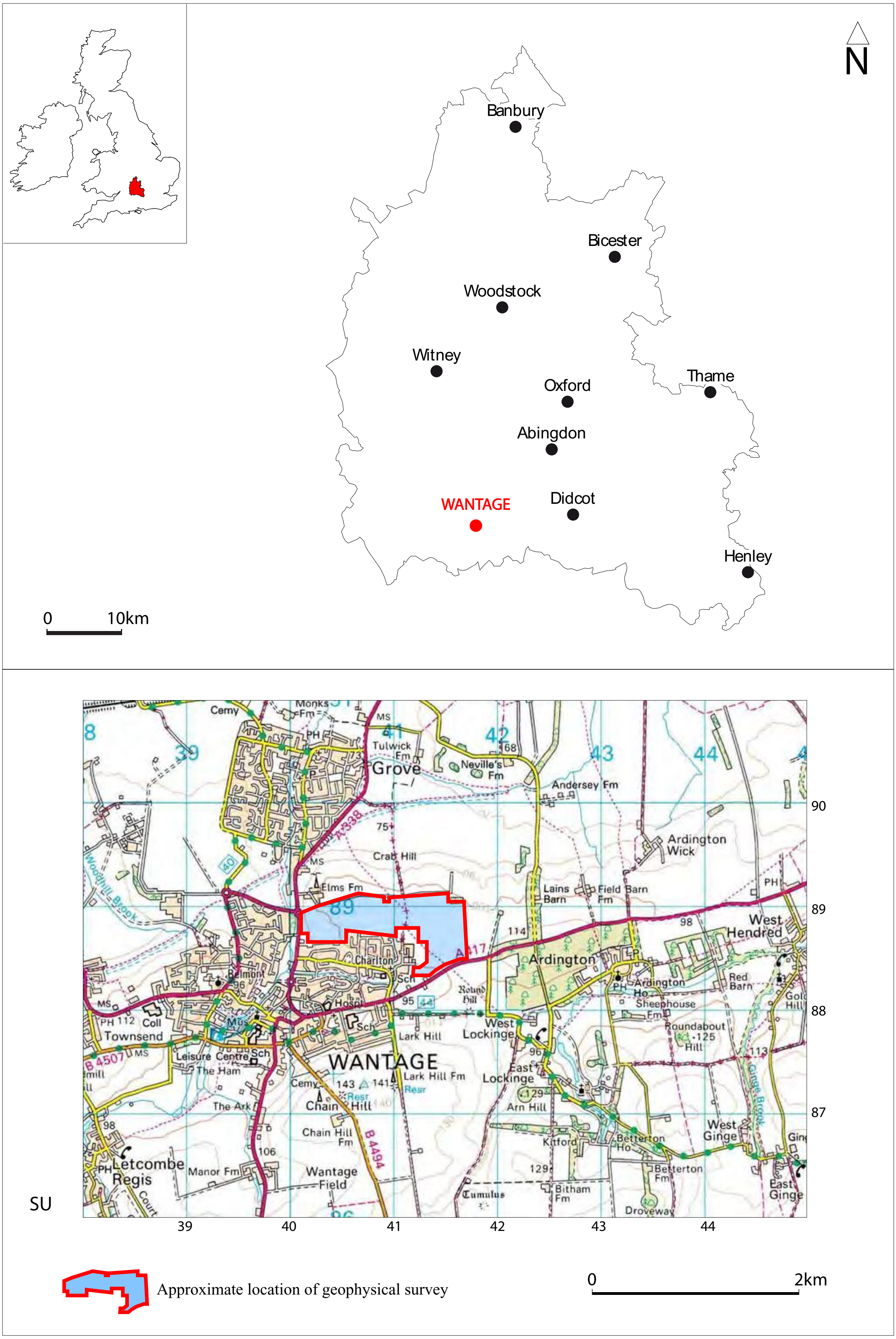

Fig. 1. Site location

Fig. 2. Site location showing greyscale magnetometer data (1:5000 @ A3)

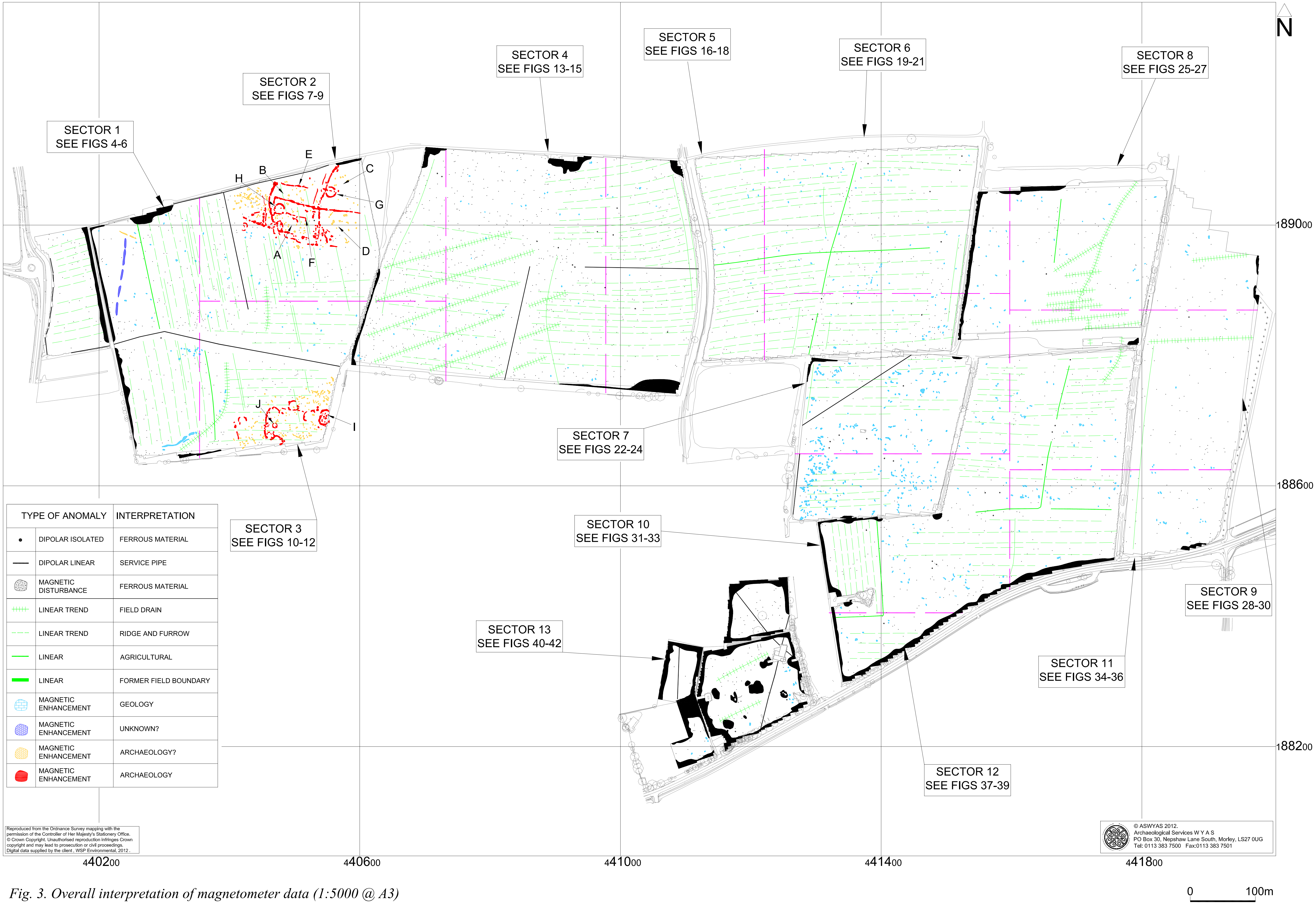

Fig. 3. Overall interpretation of magnetometer data (1:5000 @ A3)

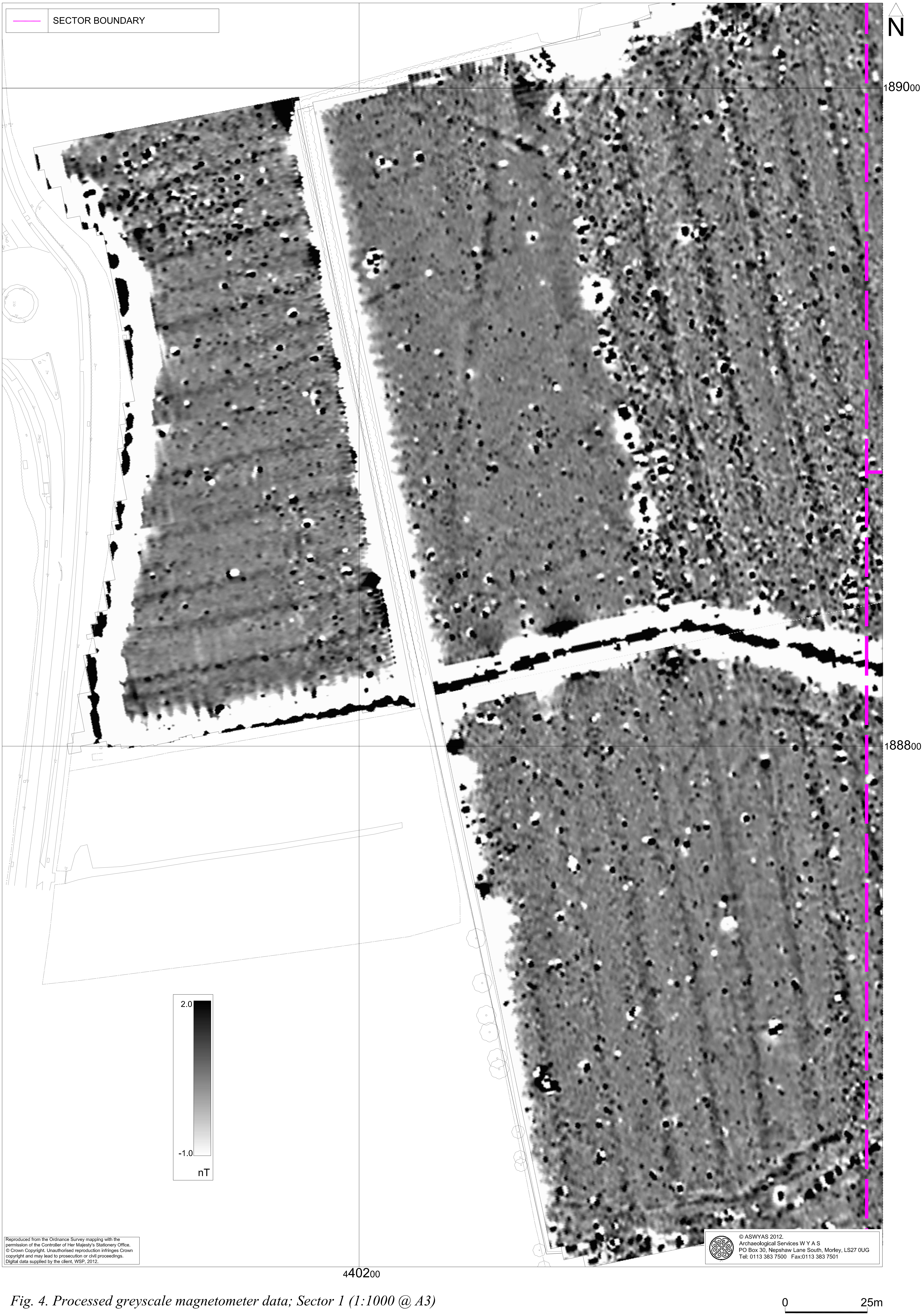

Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

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

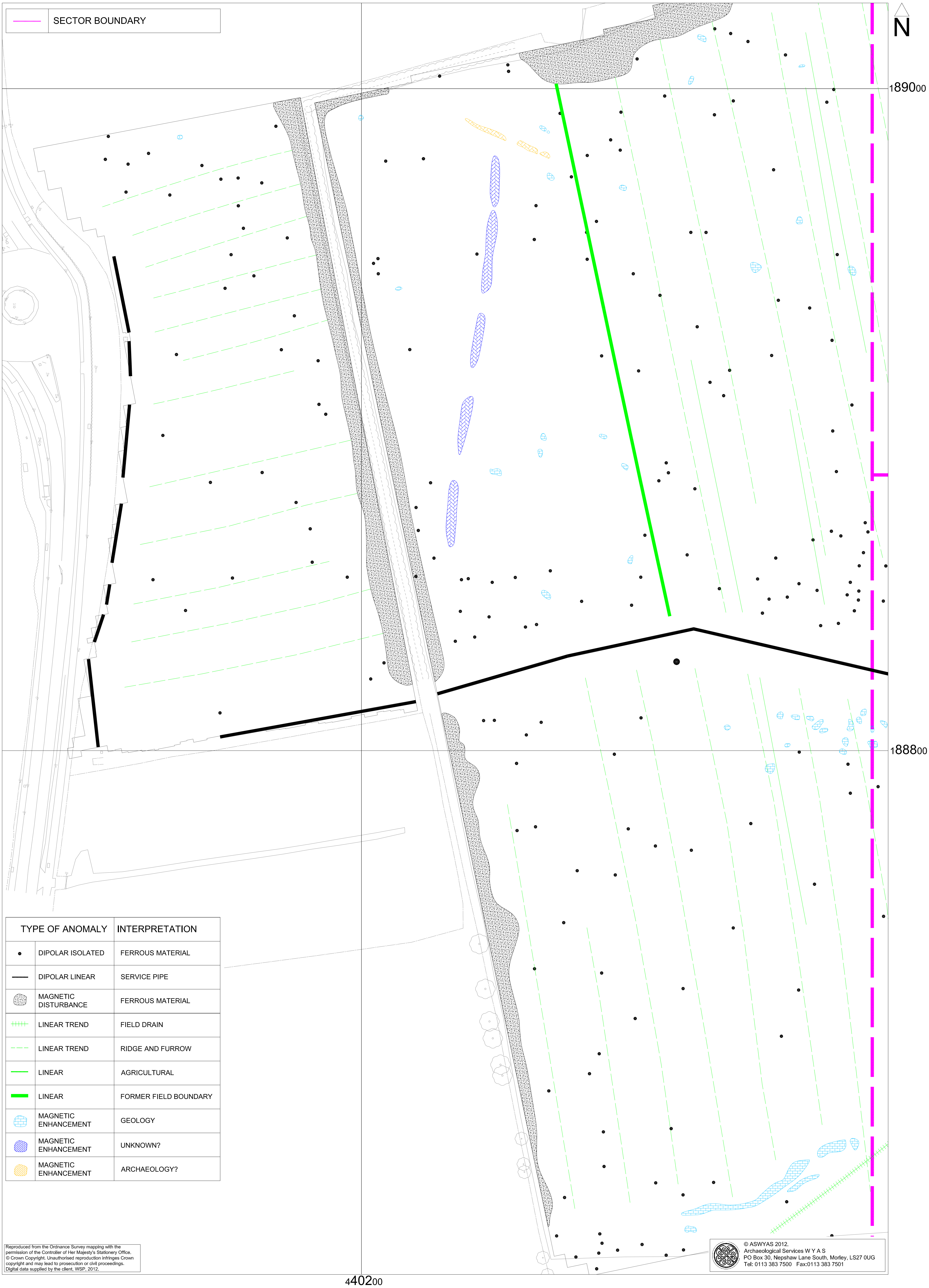

Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

0 25m

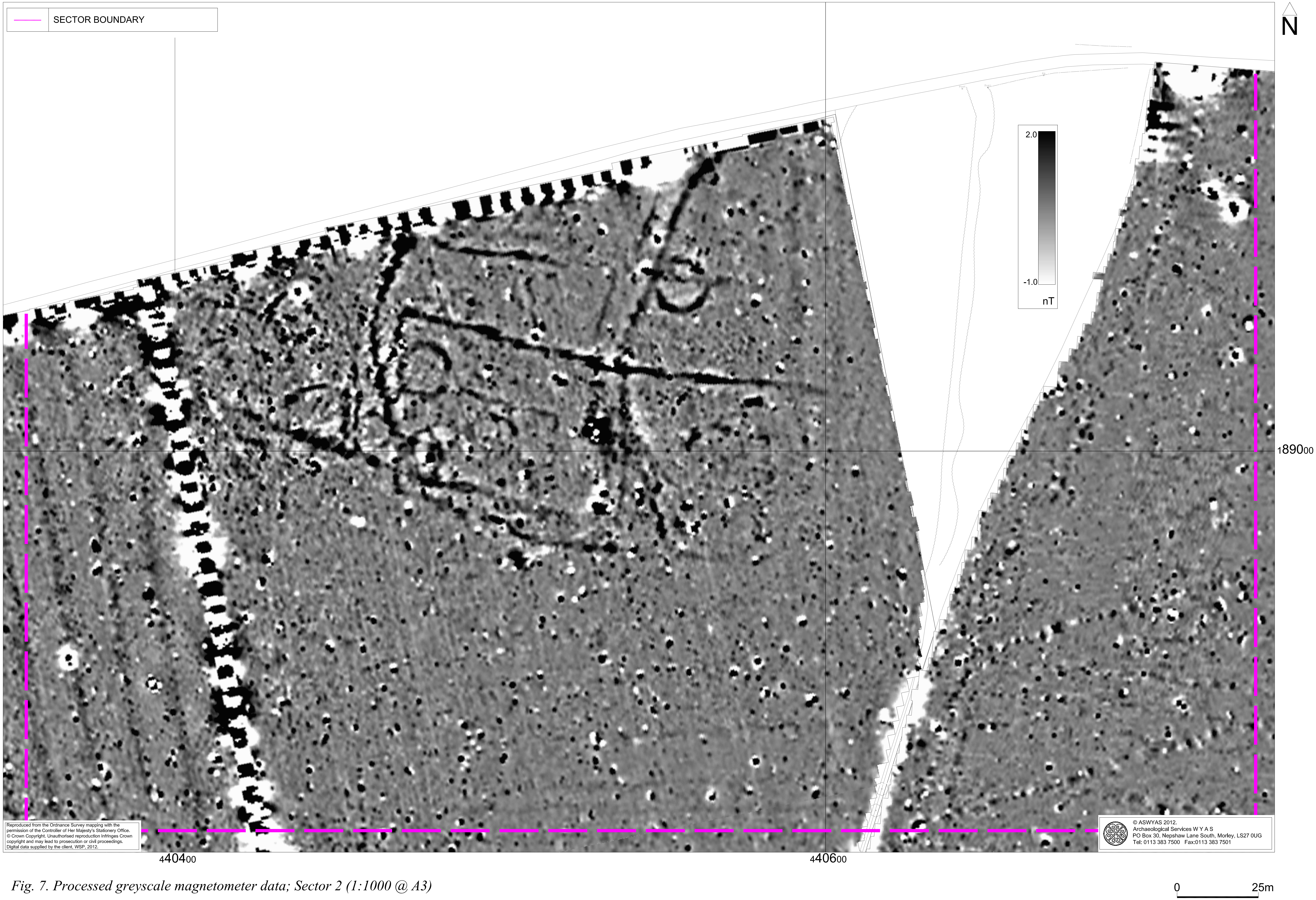

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Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

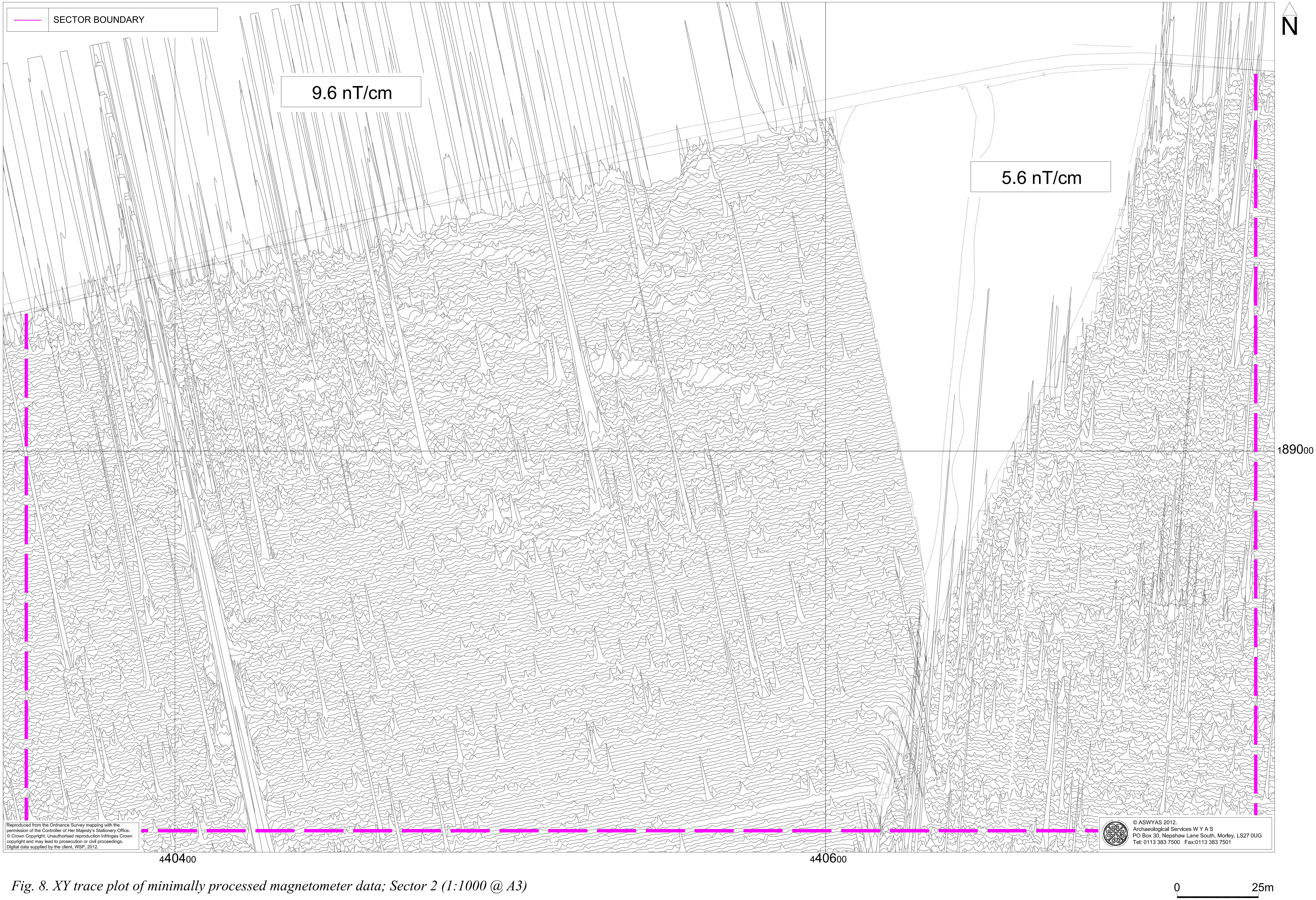

Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

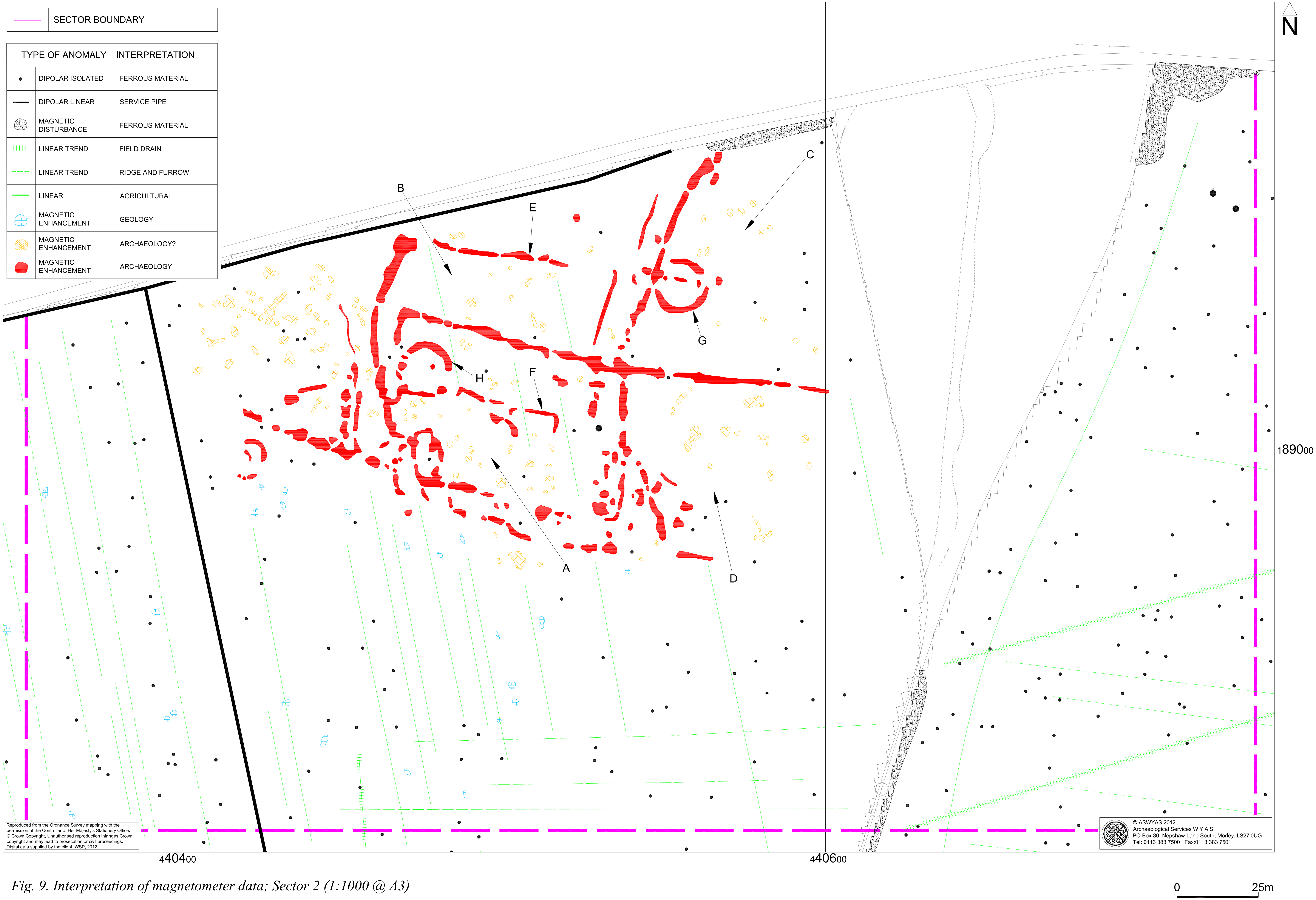

Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

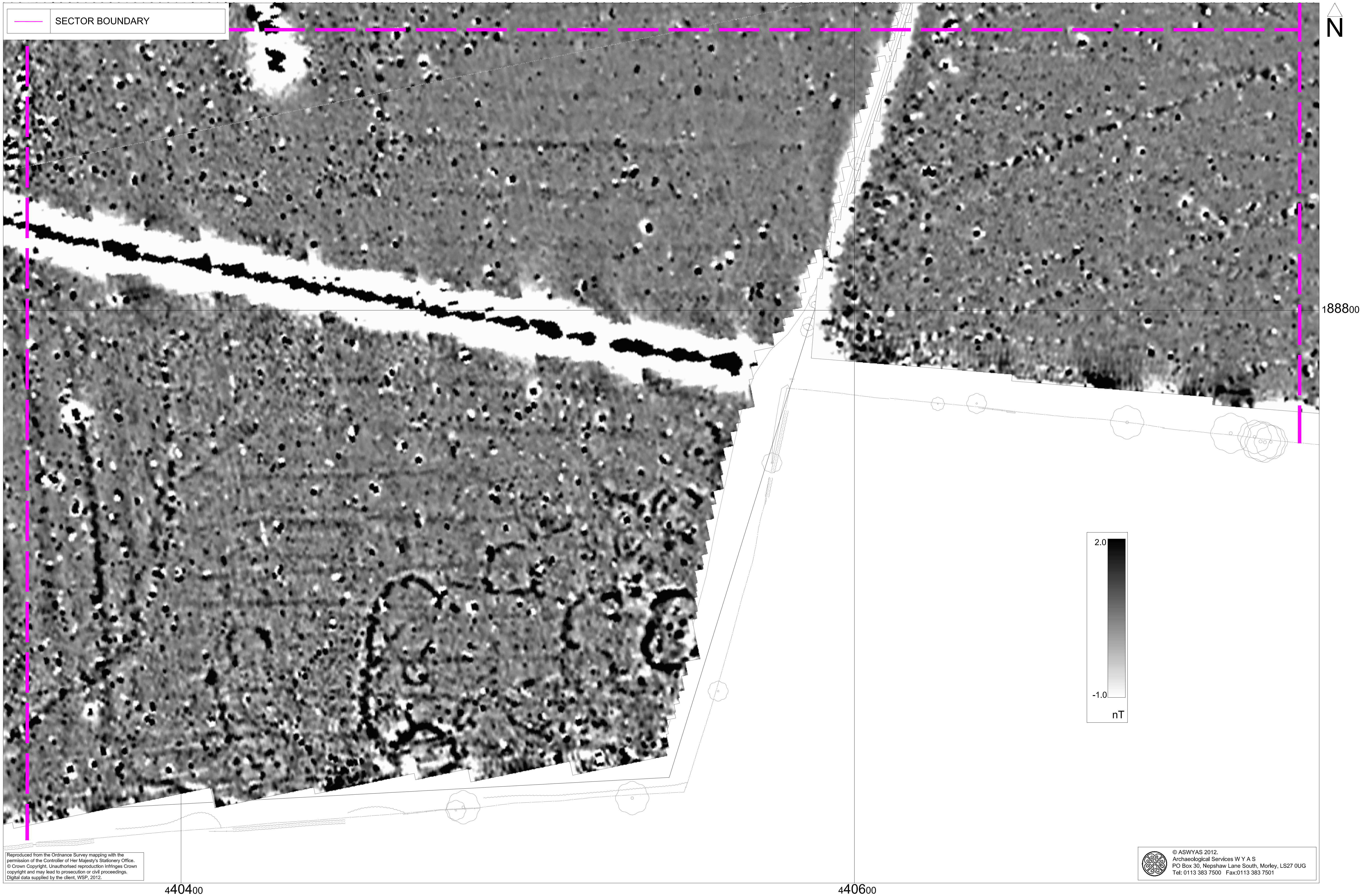

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Fig. 10. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

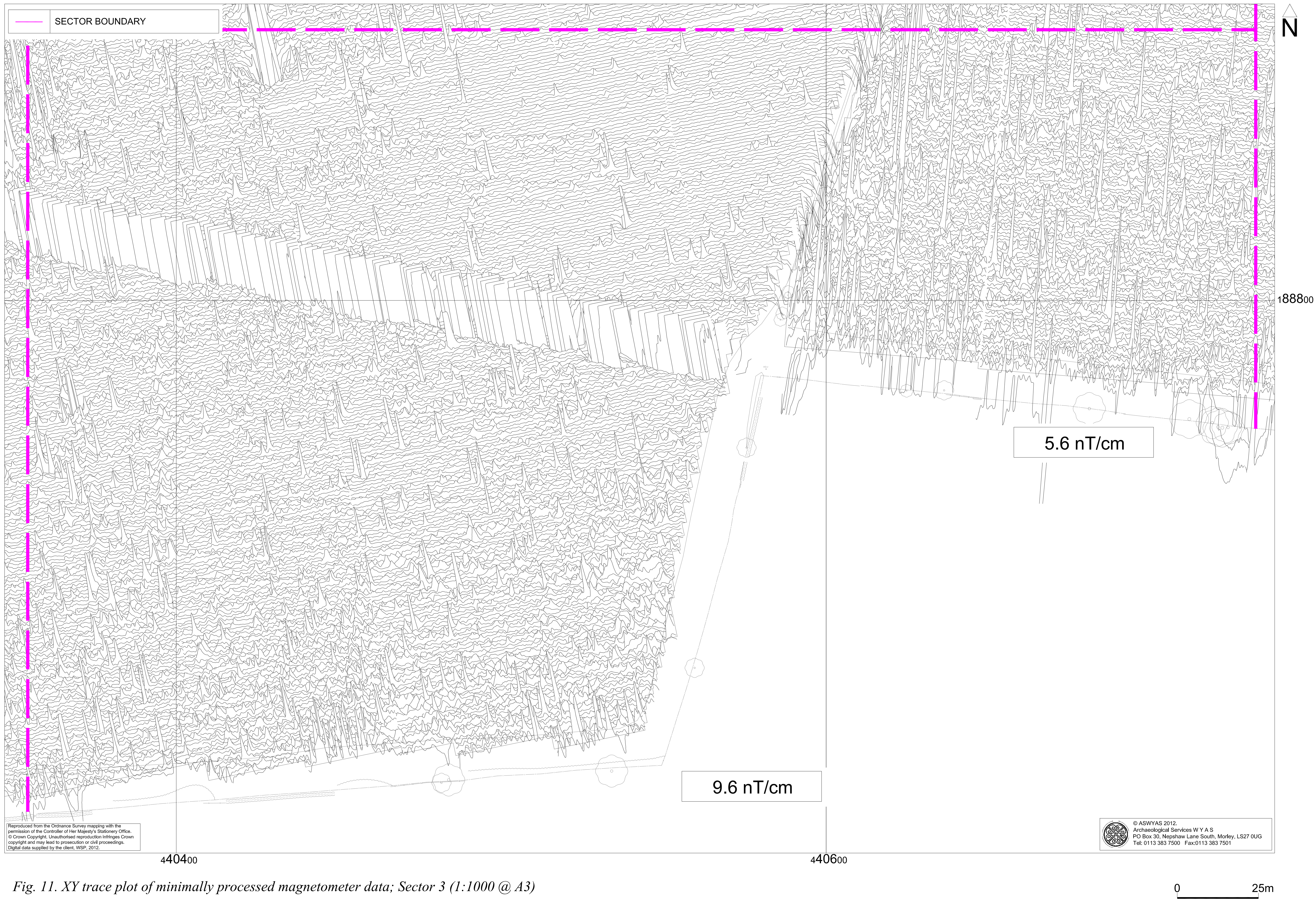

Fig. 11. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A3)

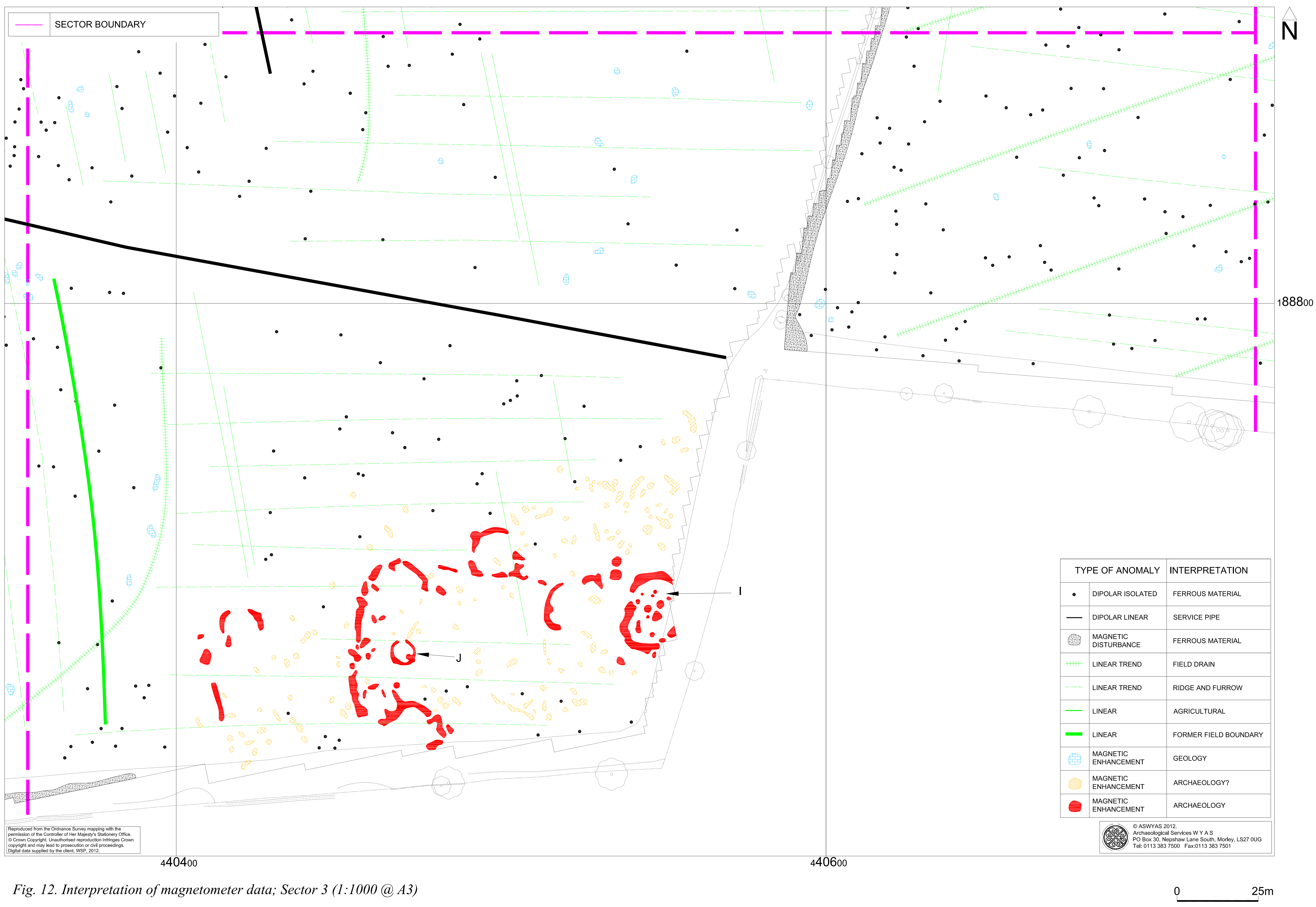

Fig. 12. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)

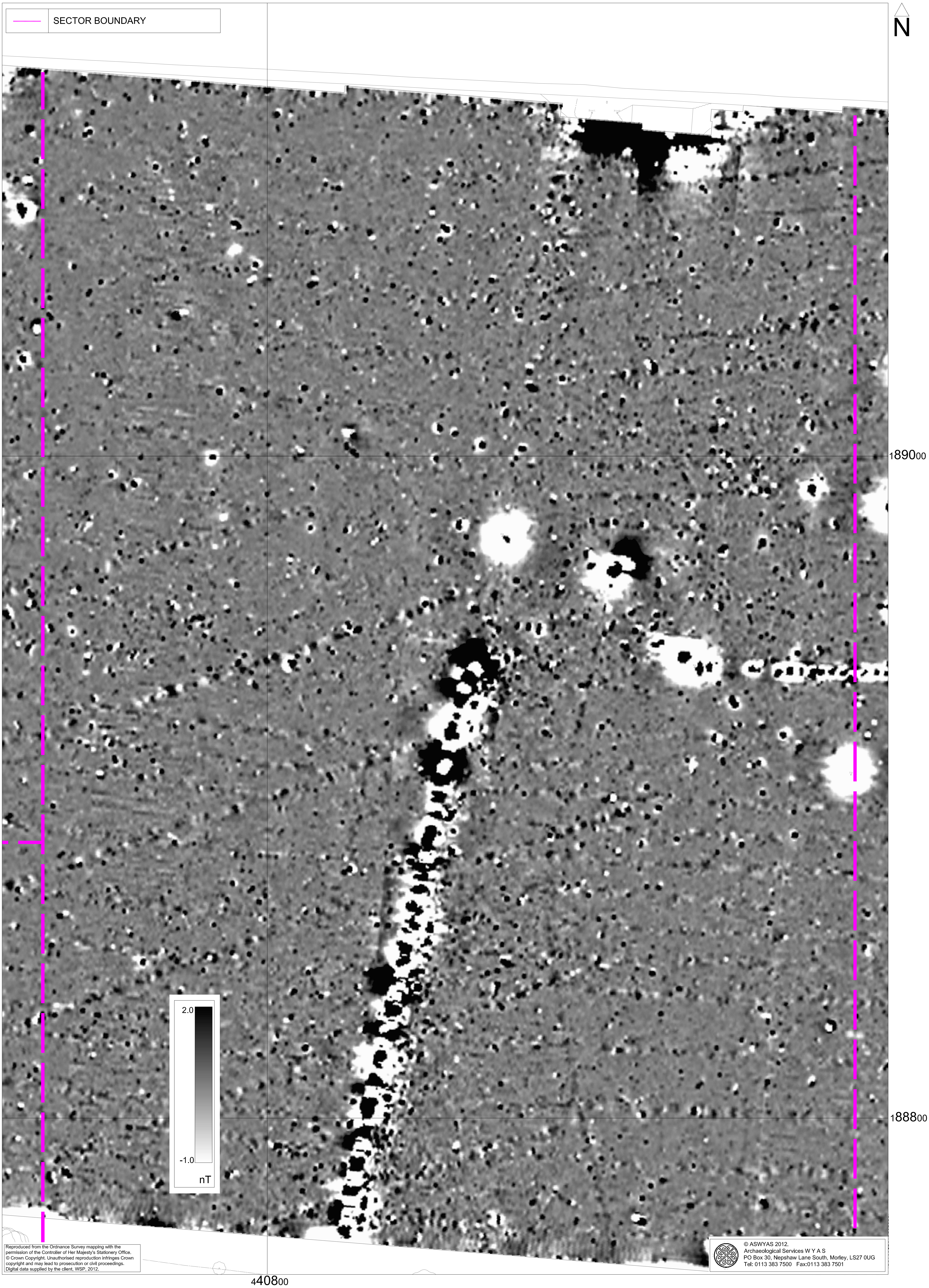

Fig. 13. Processed greyscale magnetometer data; Sector 4 (1:1000 @ A3)

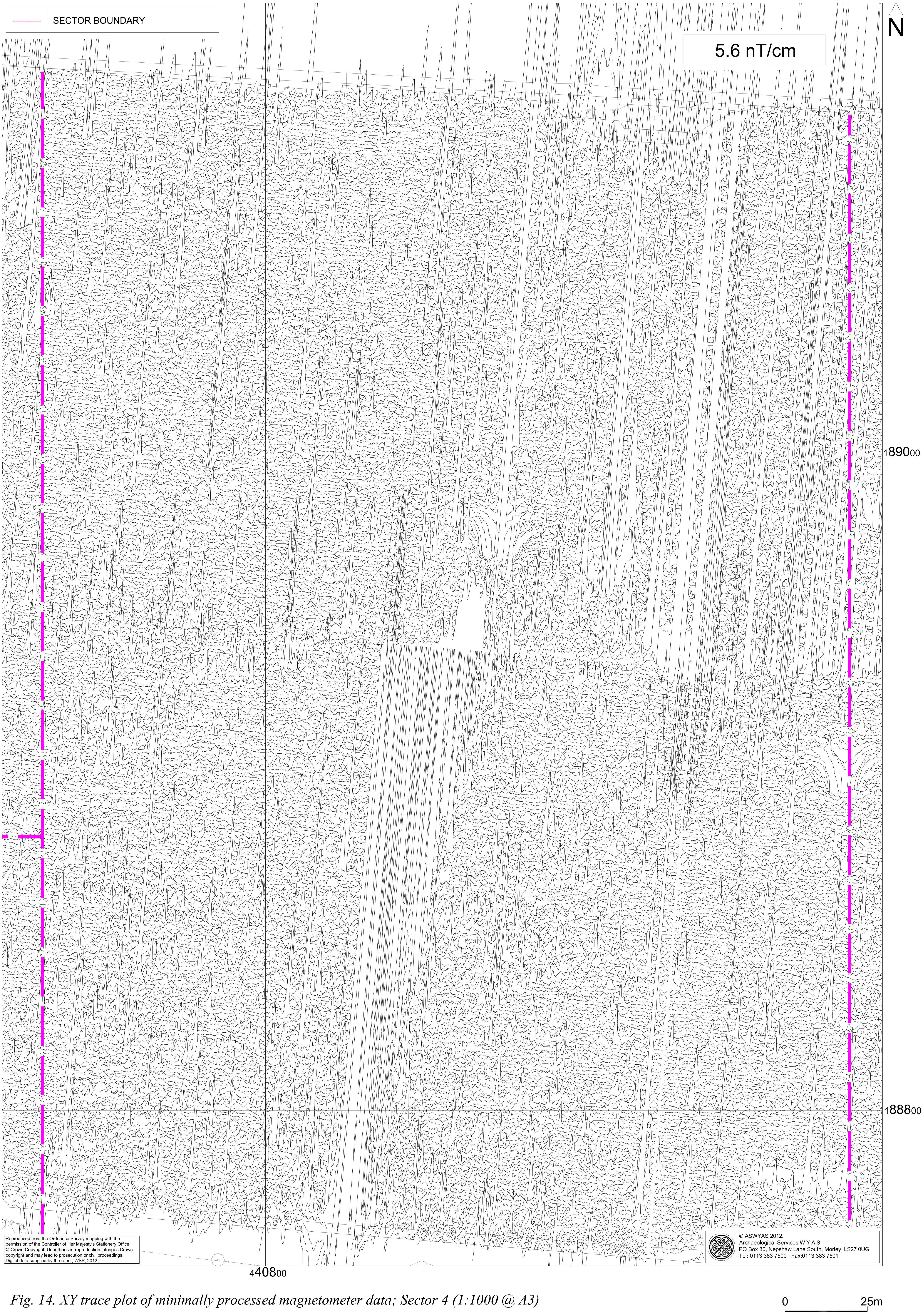

Fig. 14. XY trace plot of minimally processed magnetometer data; Sector 4 (1:1000 @ A3)

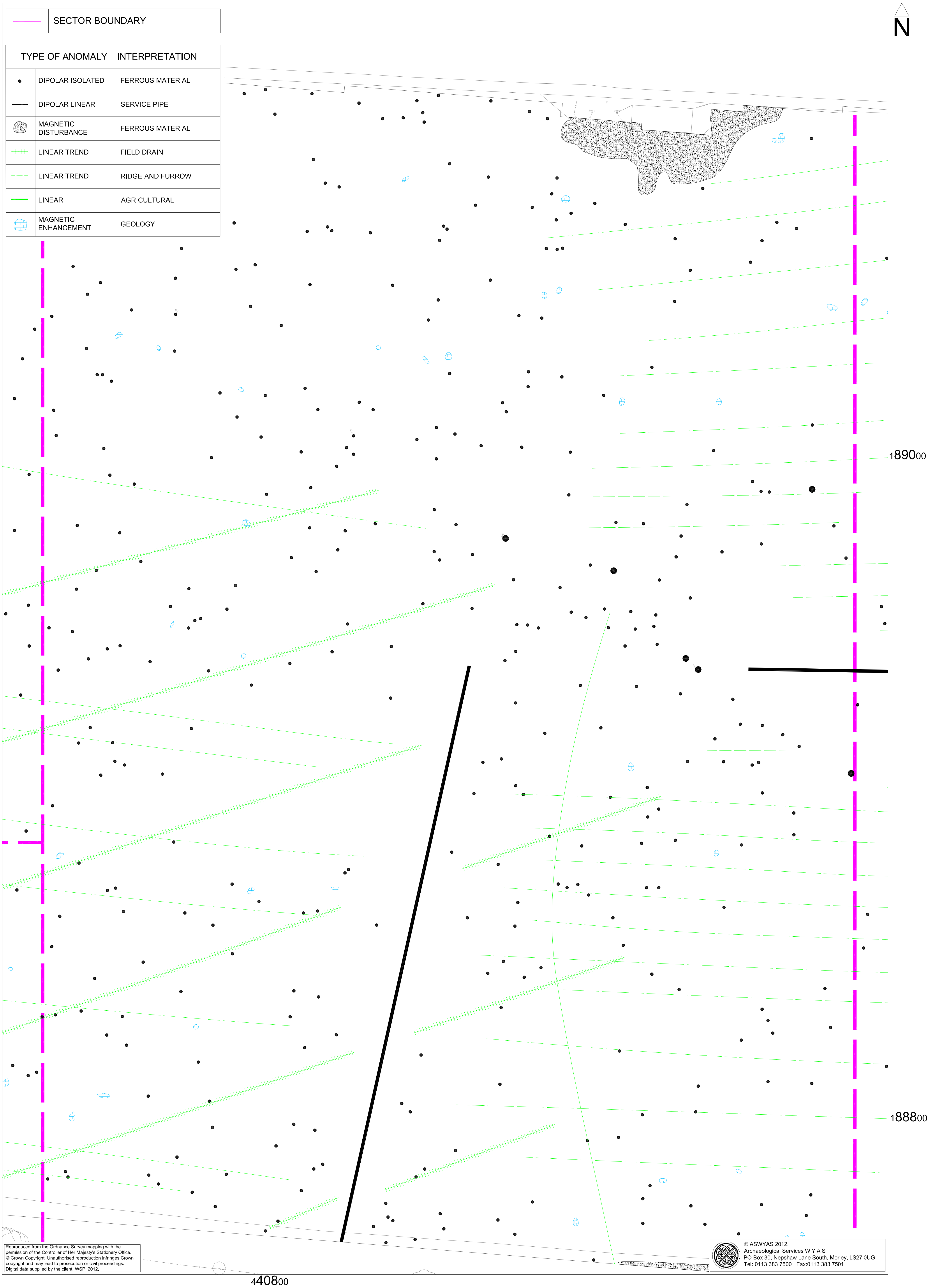

Fig. 15. Interpretation of magnetometer data; Sector 4 (1:1000 @ A3)

0 25m

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Fig. 16. Processed greyscale magnetometer data; Sector 5 (1:1000 @ A3)

Fig. 17. XY trace plot of minimally processed magnetometer data; Sector 5 (1:1000 @ A3)

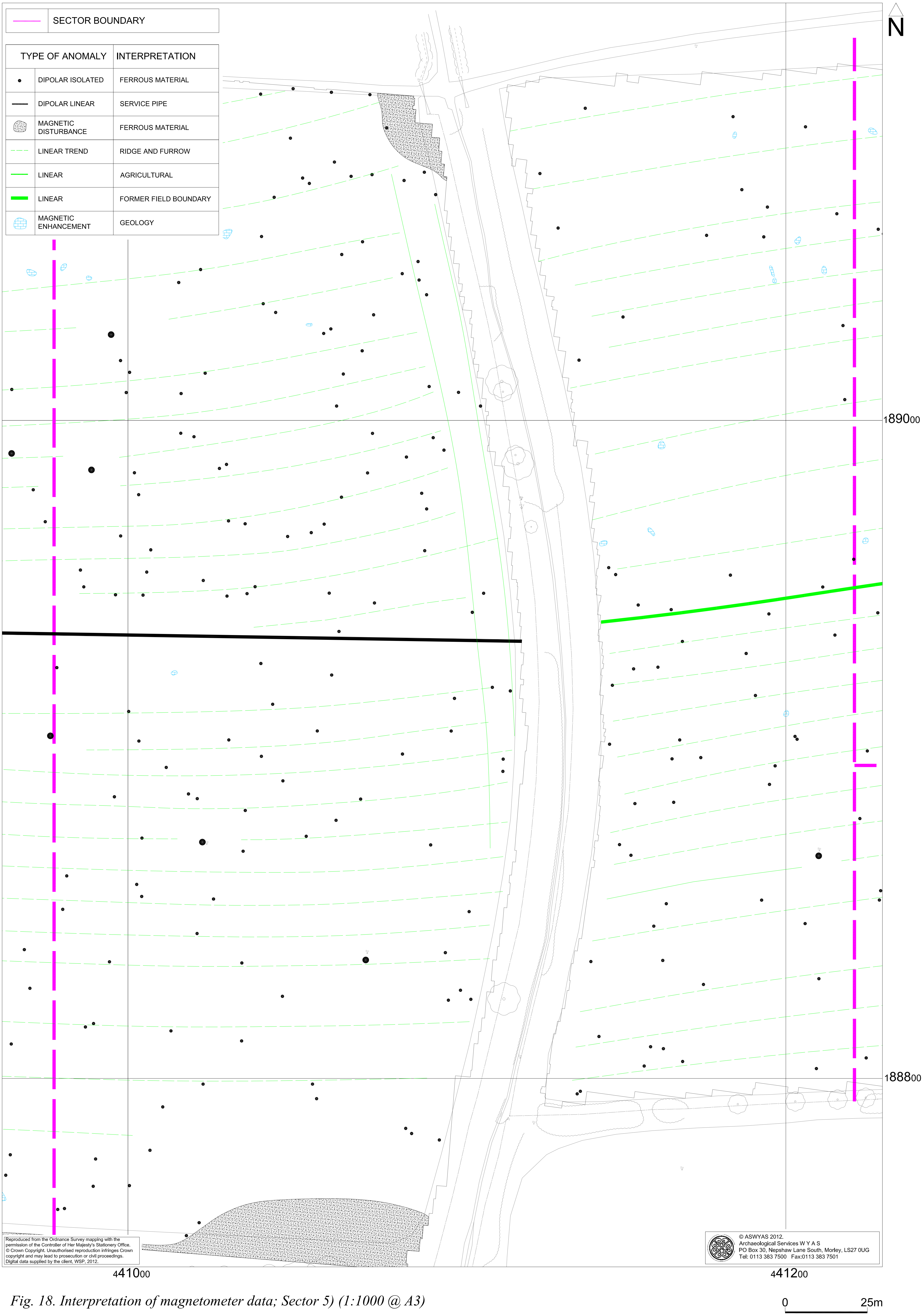

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Fig. 18. Interpretation of magnetometer data; Sector 5) (1:1000 @ A3)

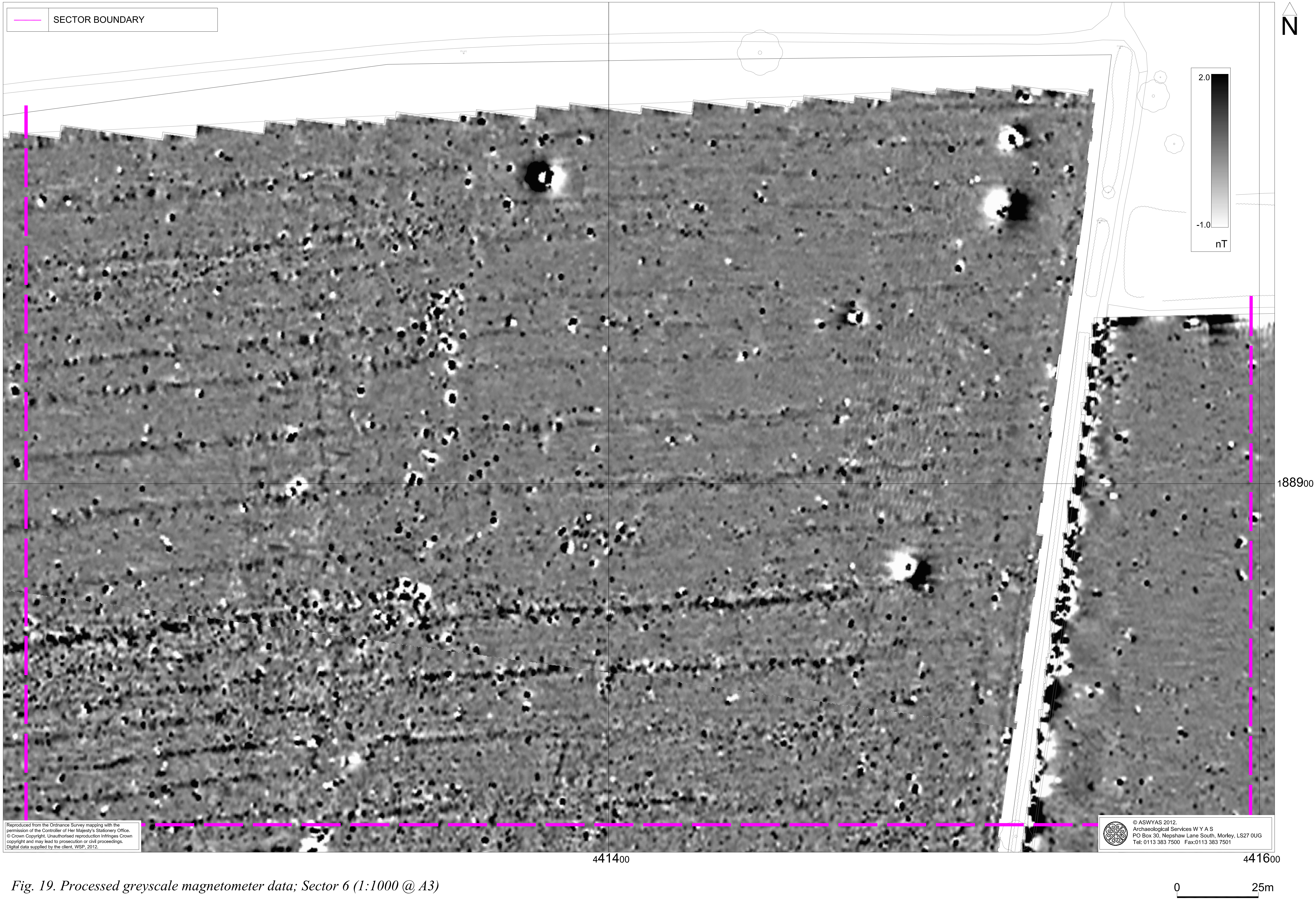

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Fig. 19. Processed greyscale magnetometer data; Sector 6 (1:1000 @ A3)

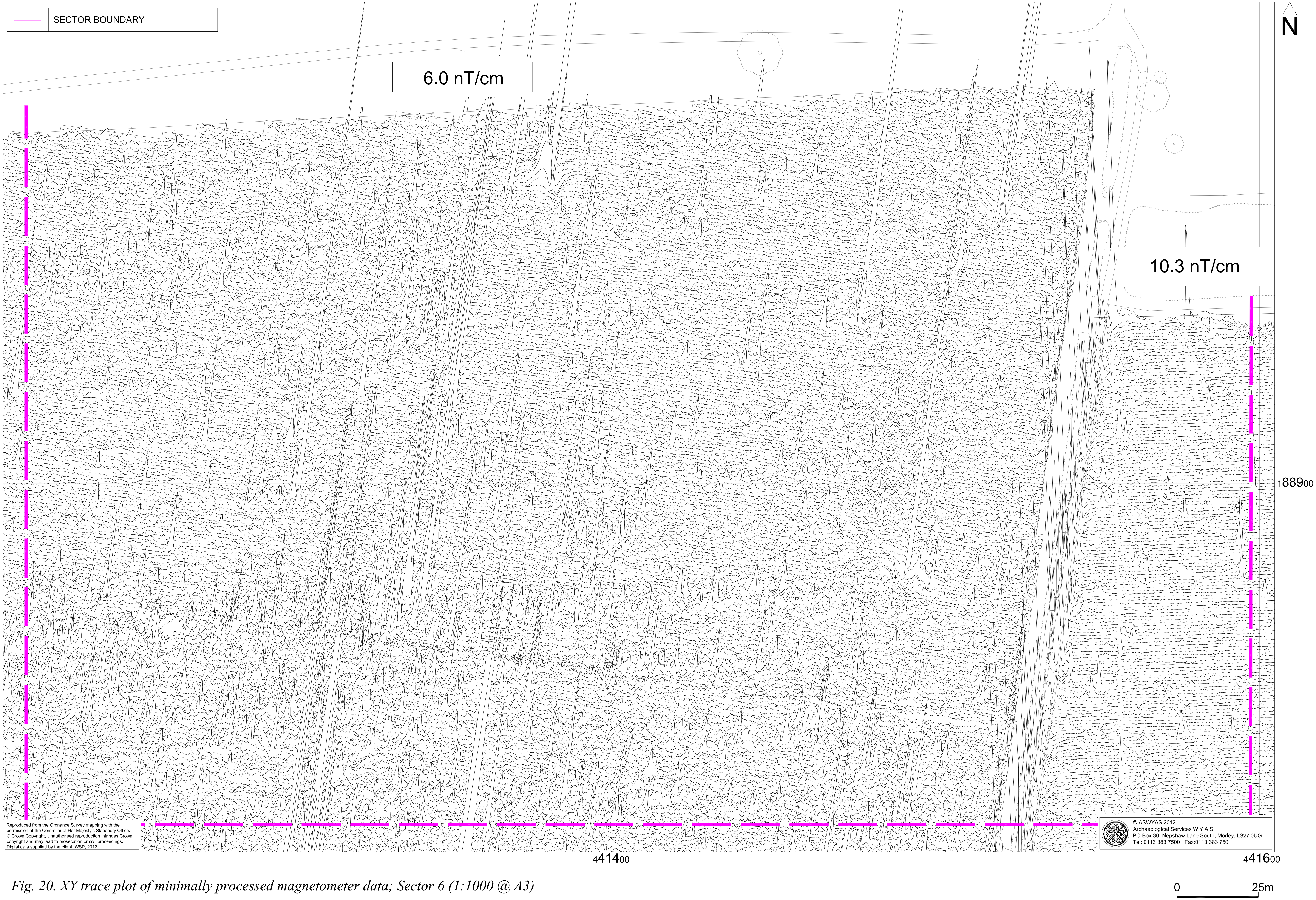

Fig. 20. XY trace plot of minimally processed magnetometer data; Sector 6 (1:1000 @ A3)

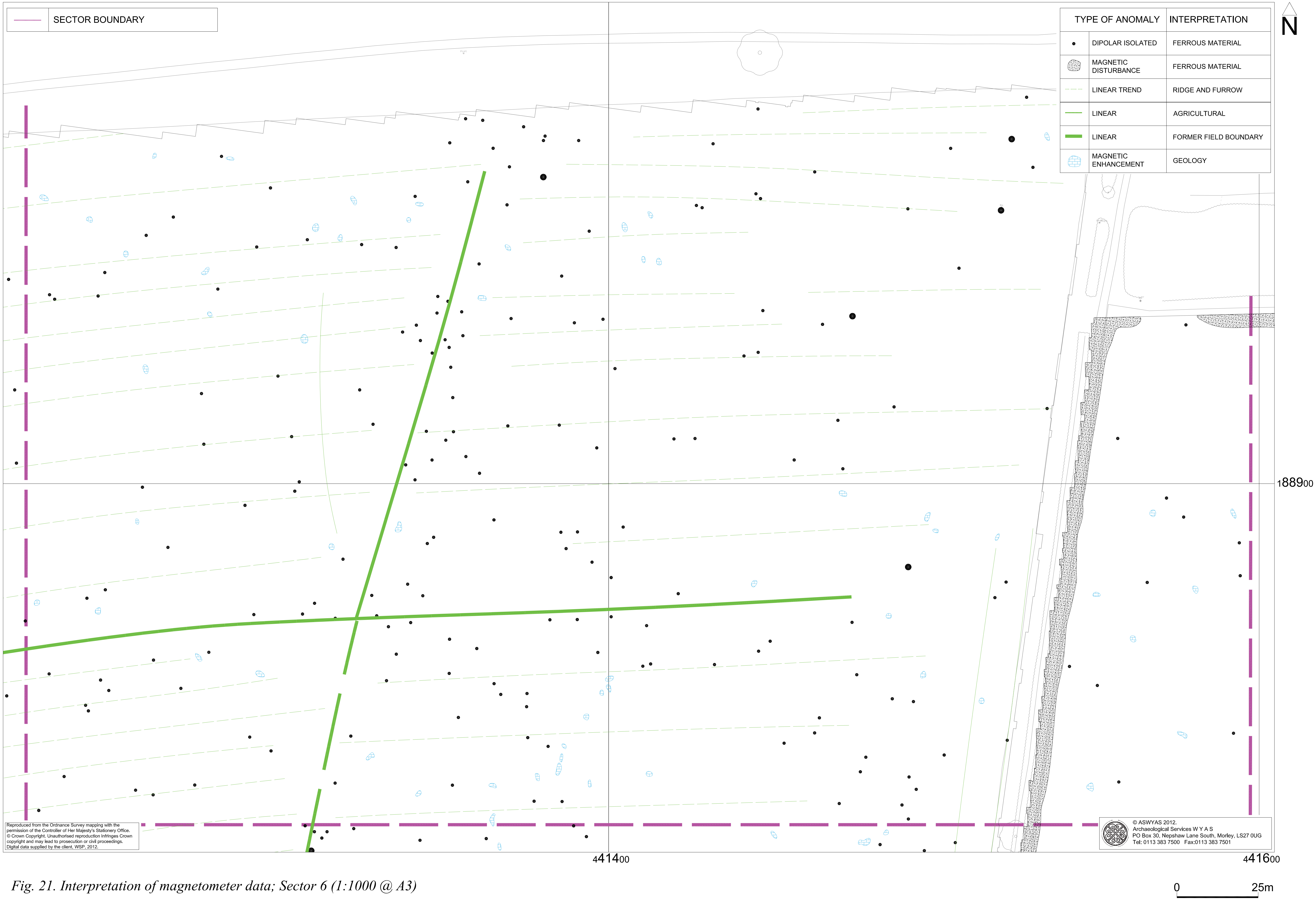

Fig. 21. Interpretation of magnetometer data; Sector 6 (1:1000 @ A3)

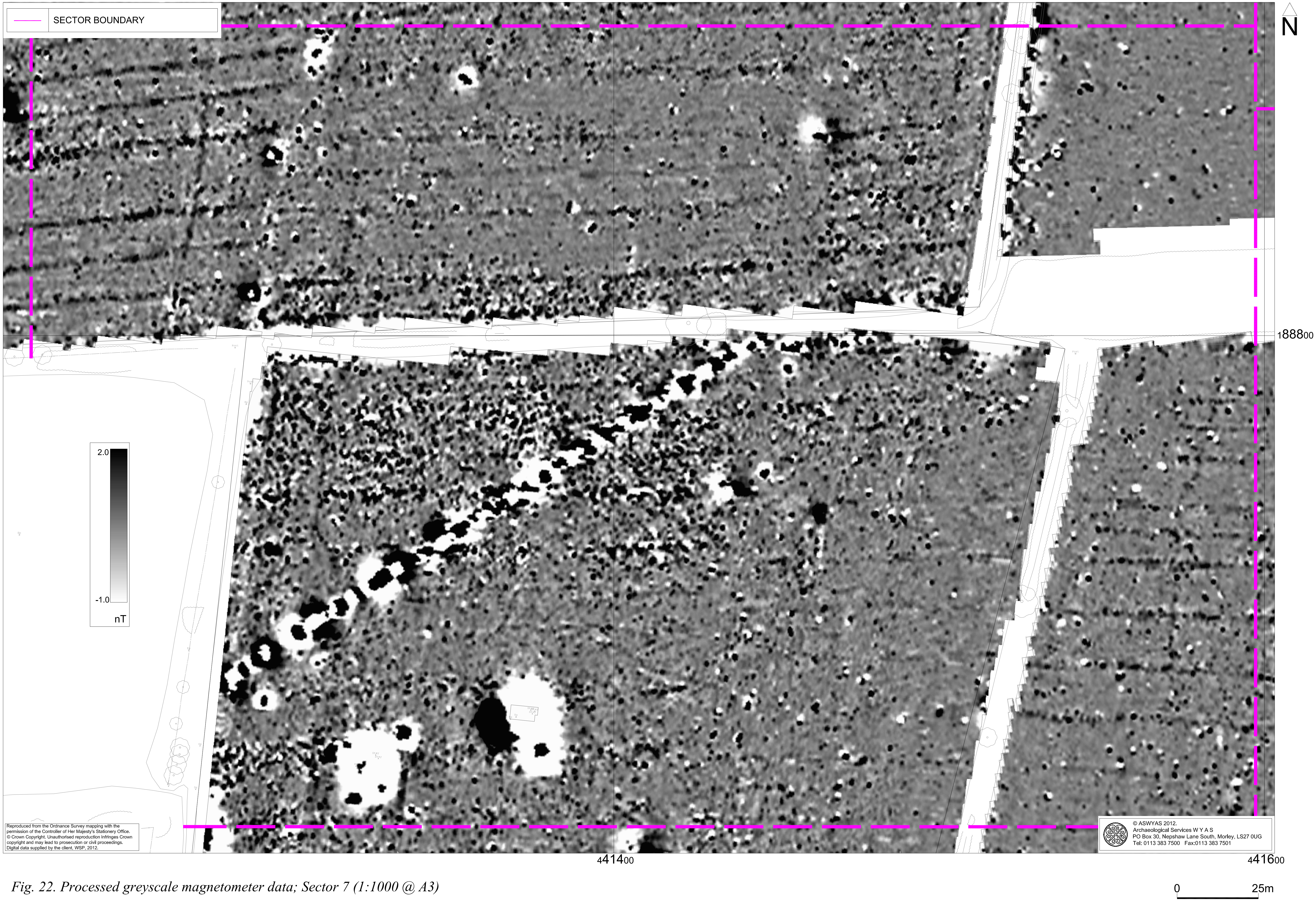

Fig. 22. Processed greyscale magnetometer data; Sector 7 (1:1000 @ A3)

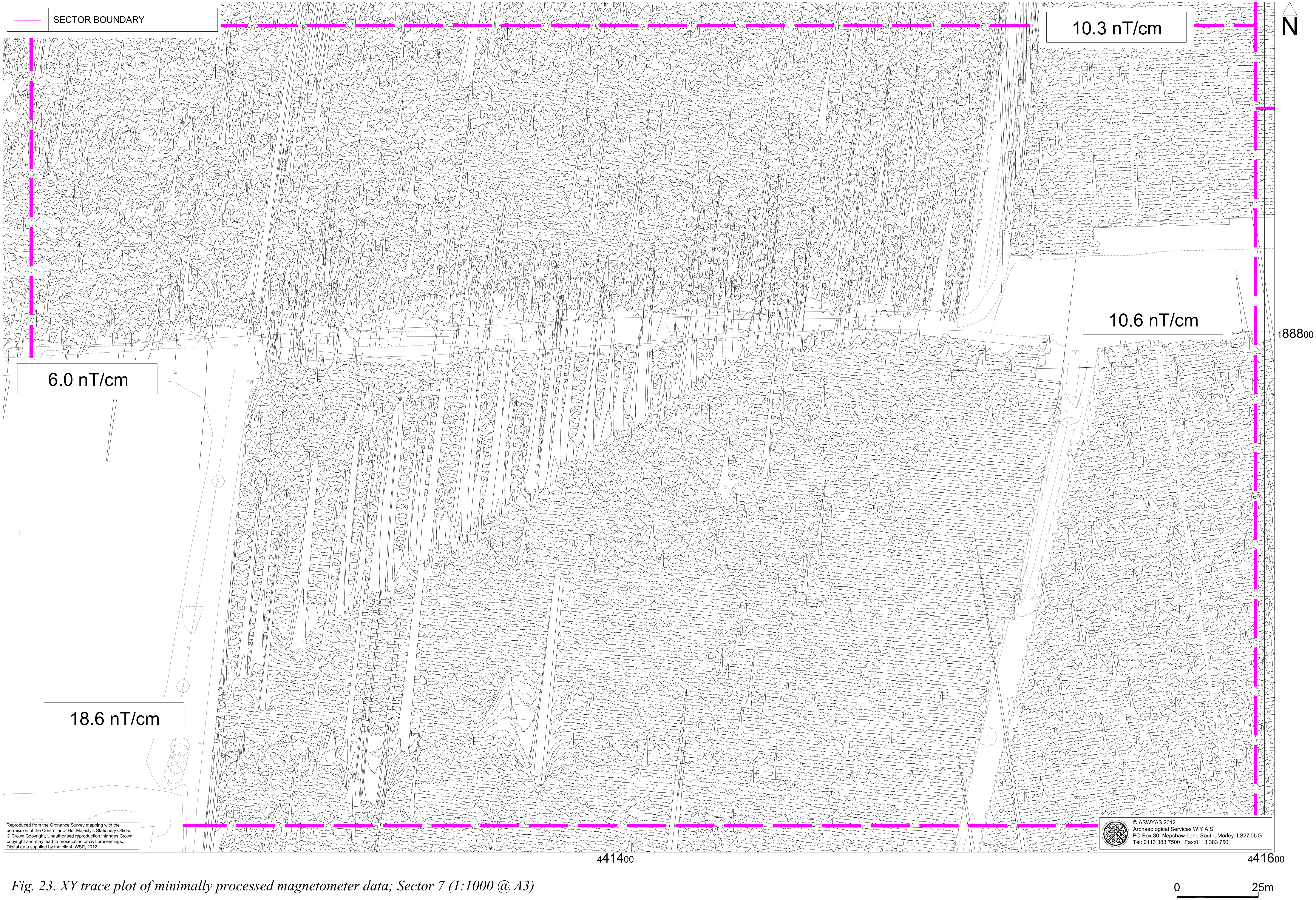

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Fig. 23. XY trace plot of minimally processed magnetometer data; Sector 7 (1:1000 @ A3)

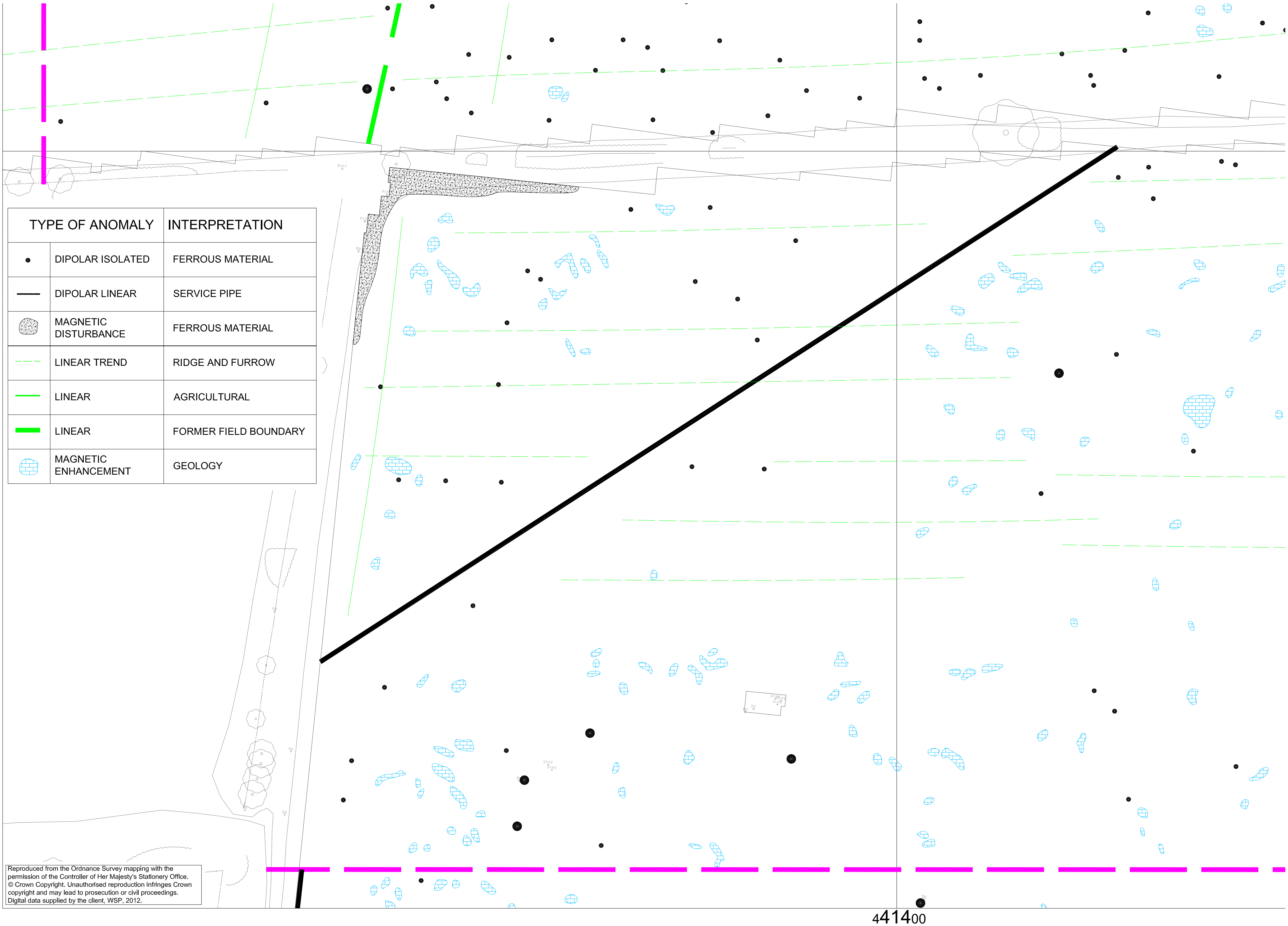

Fig. 24. Interpretation of magnetometer data; Sector 7 (1:1000 @ A3)

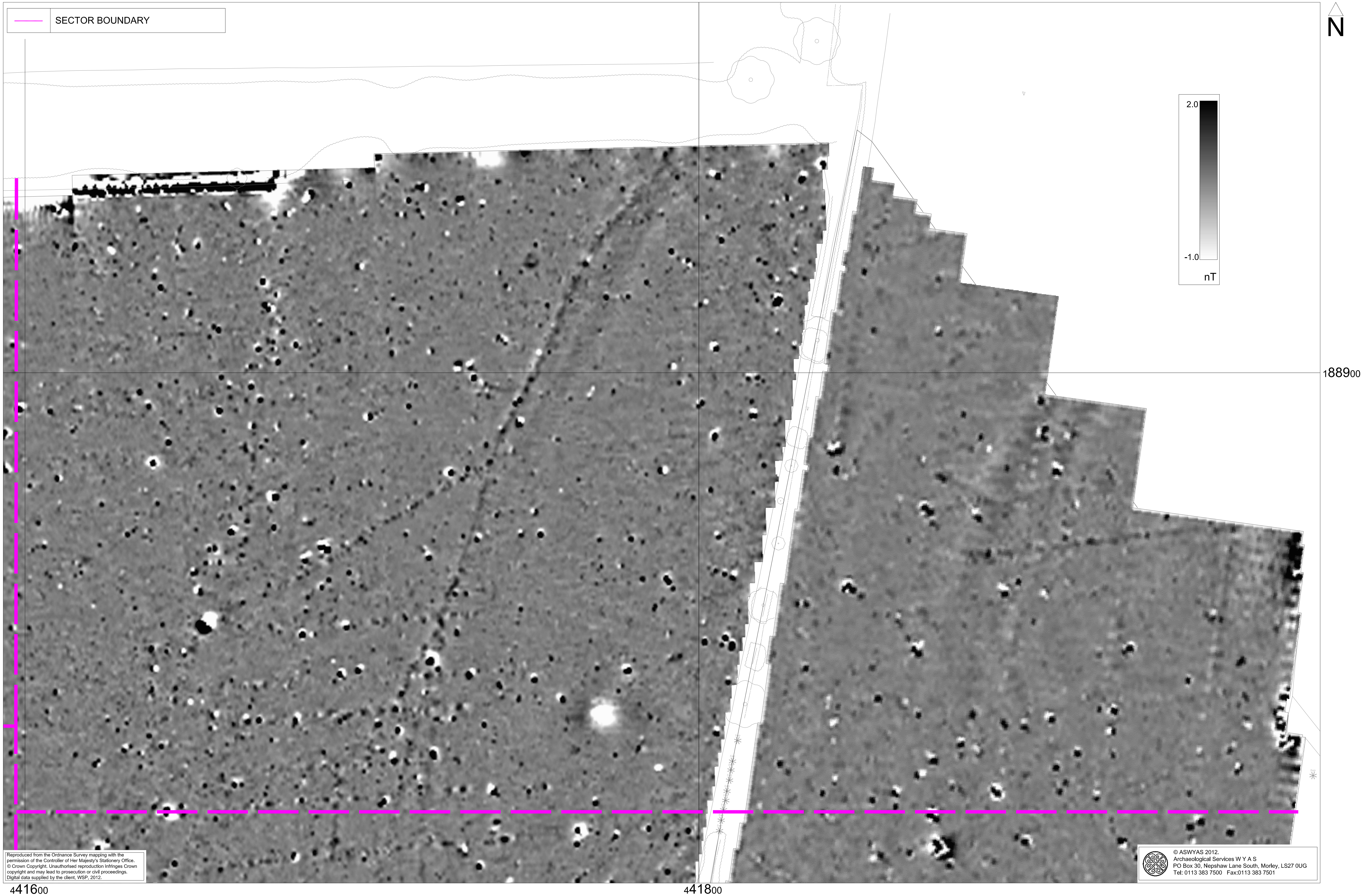

Fig. 25. Processed greyscale magnetometer data; Sector 8 (1:1000 @ A3)

0 25m

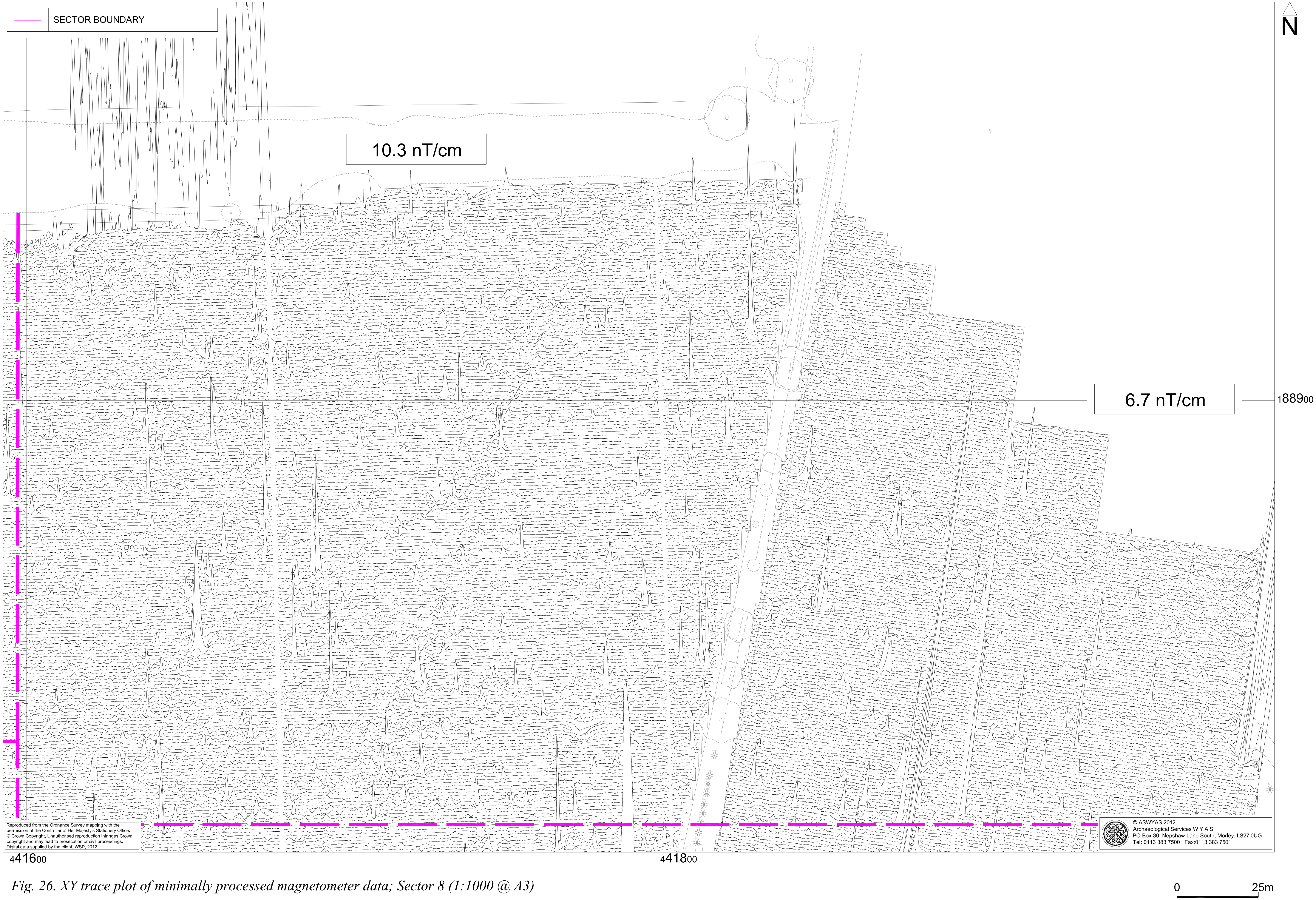

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Fig. 26. XY trace plot of minimally processed magnetometer data; Sector 8 (1:1000 @ A3)

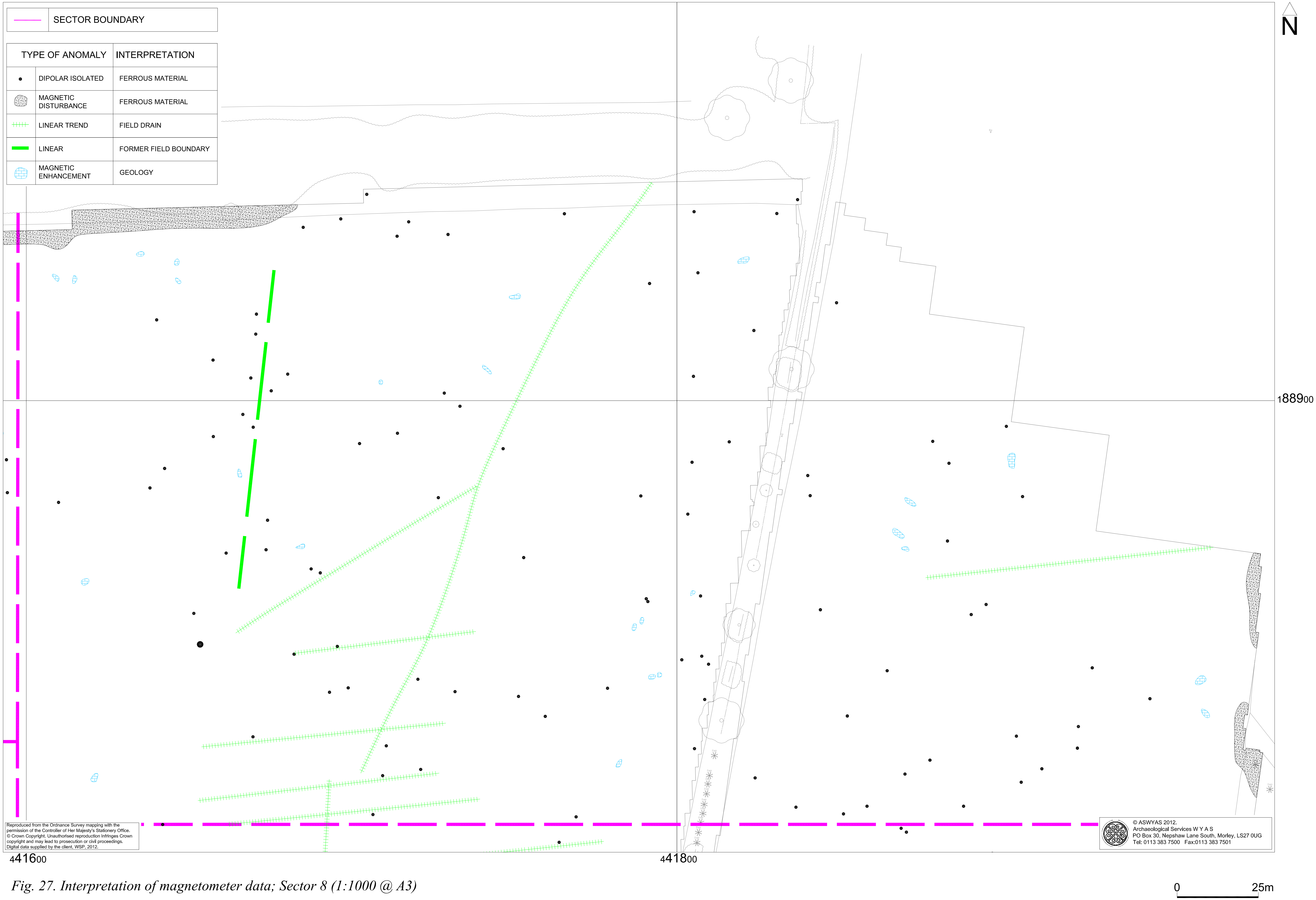

Fig. 27. Interpretation of magnetometer data; Sector 8 (1:1000 @ A3)

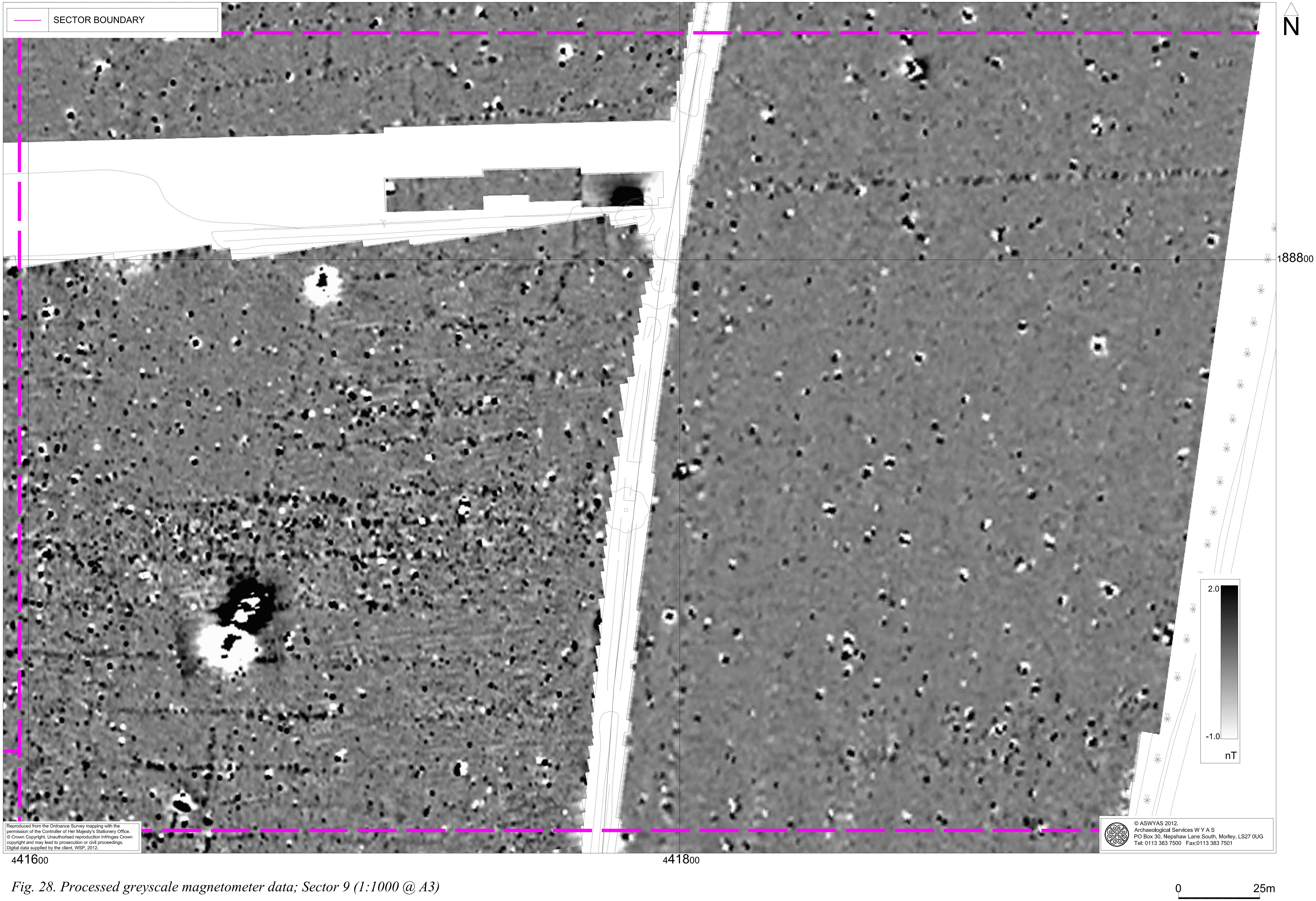

Fig. 28. Processed greyscale magnetometer data; Sector 9 (1:1000 @ A3)

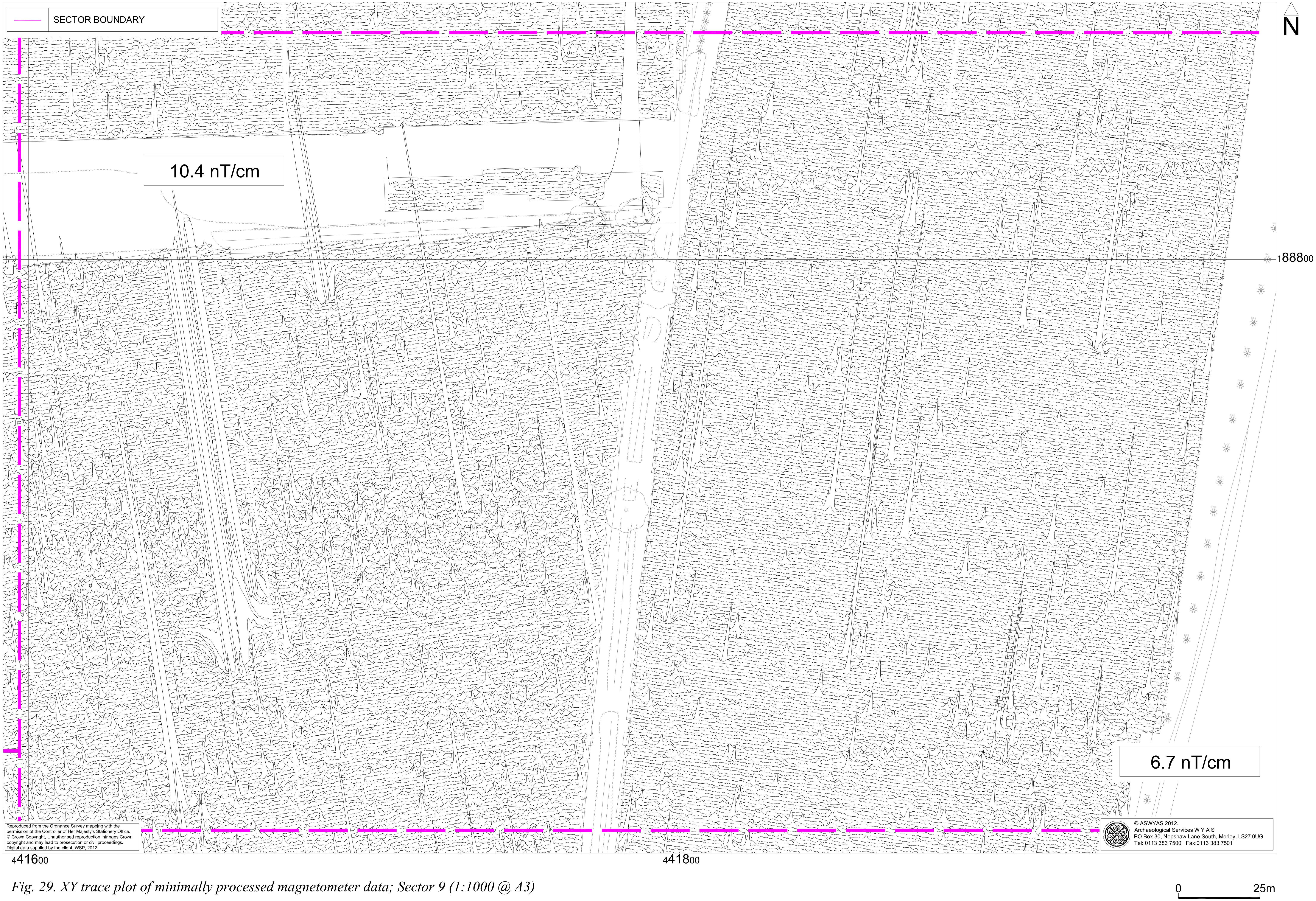

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Fig. 29. XY trace plot of minimally processed magnetometer data; Sector 9 (1:1000 @ A3)

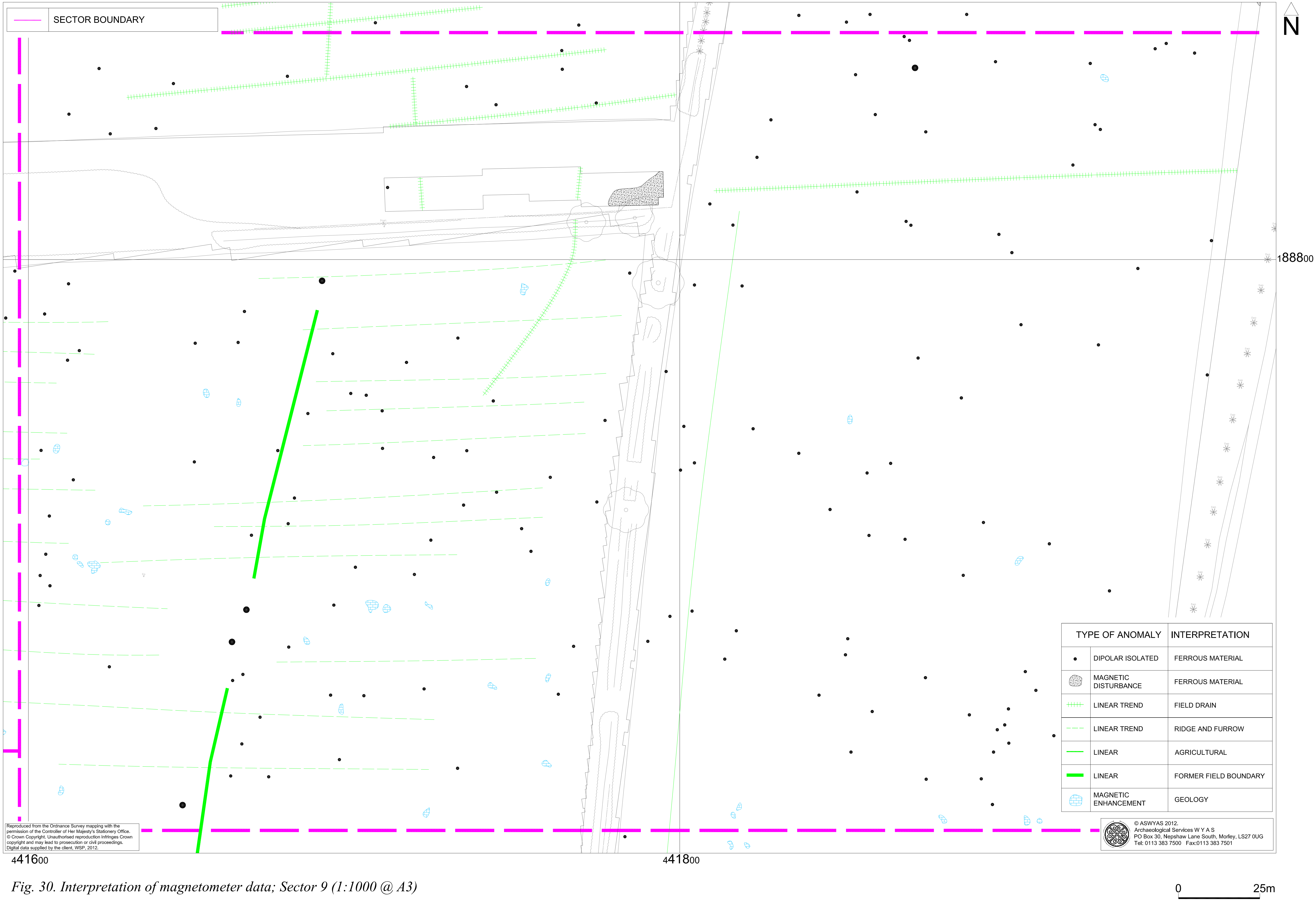

Fig. 30. Interpretation of magnetometer data; Sector 9 (1:1000 @ A3)

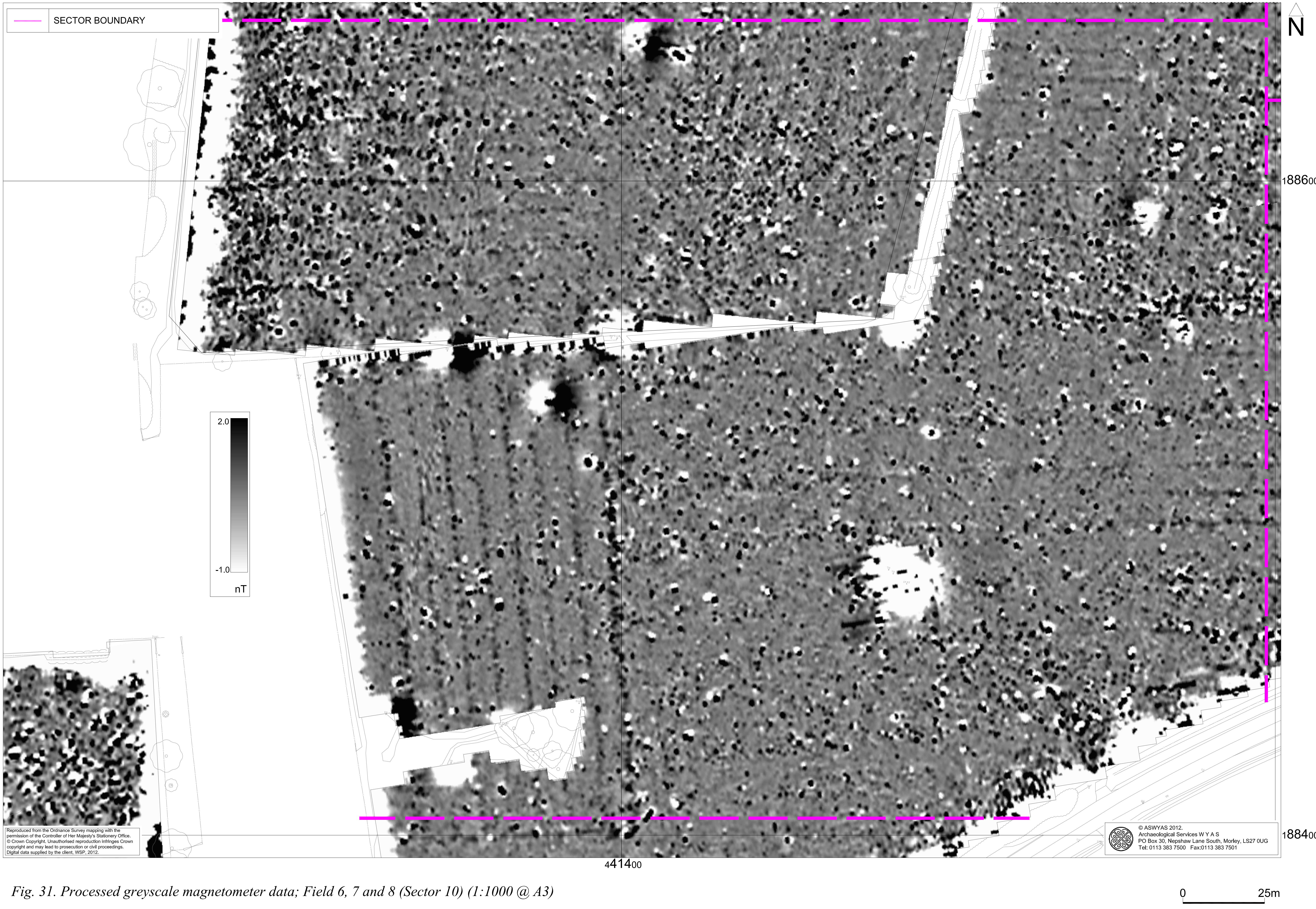

Fig. 31. Processed greyscale magnetometer data; Field 6, 7 and 8 (Sector 10) (1:1000 @ A3)

Fig. 32. XY trace plot of minimally processed magnetometer data; Field 6, 7 and 8 (Sector 10) (1:1000 @ A3)

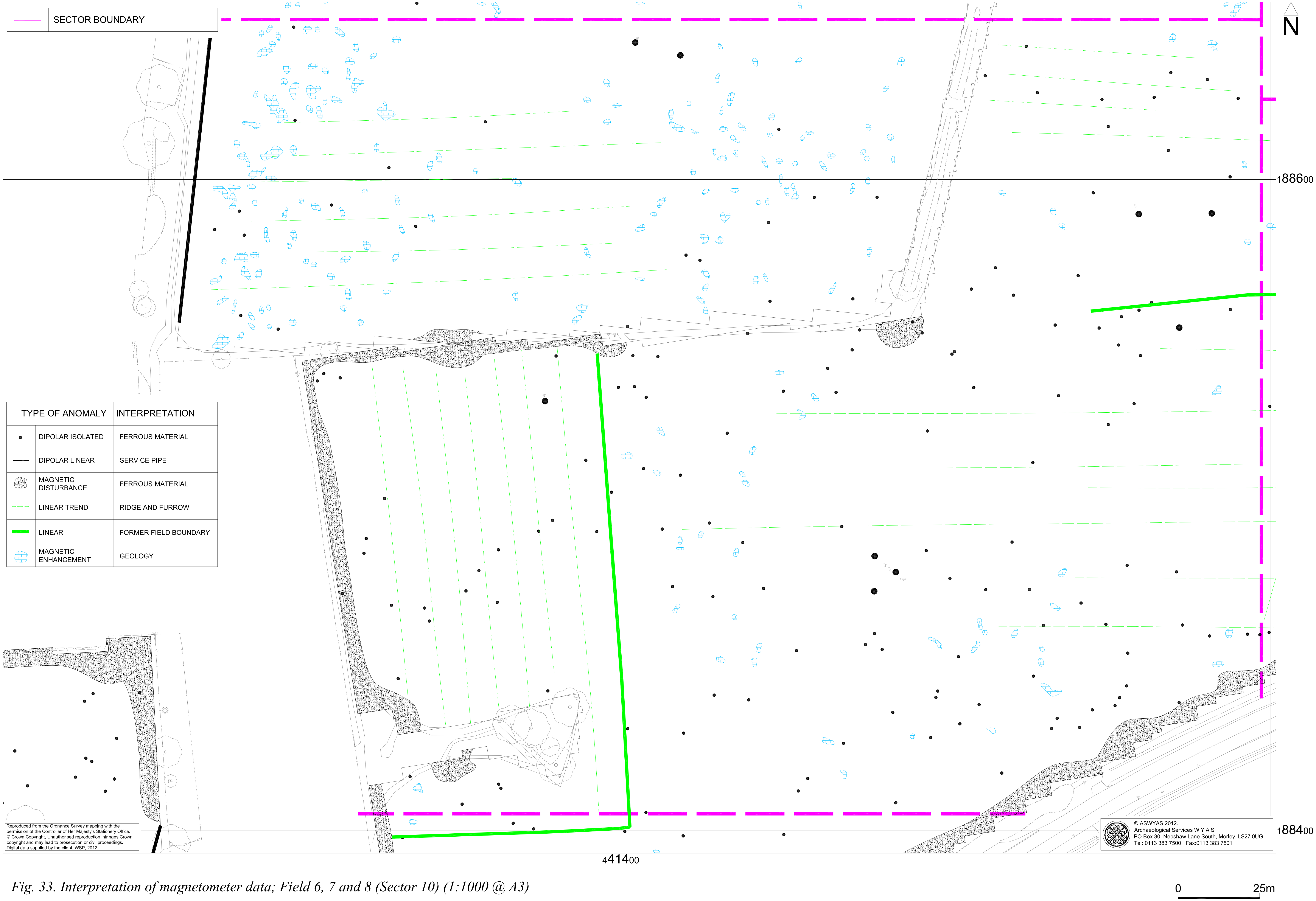

Fig. 33. Interpretation of magnetometer data; Field 6, 7 and 8 (Sector 10) (1:1000 @ A3)

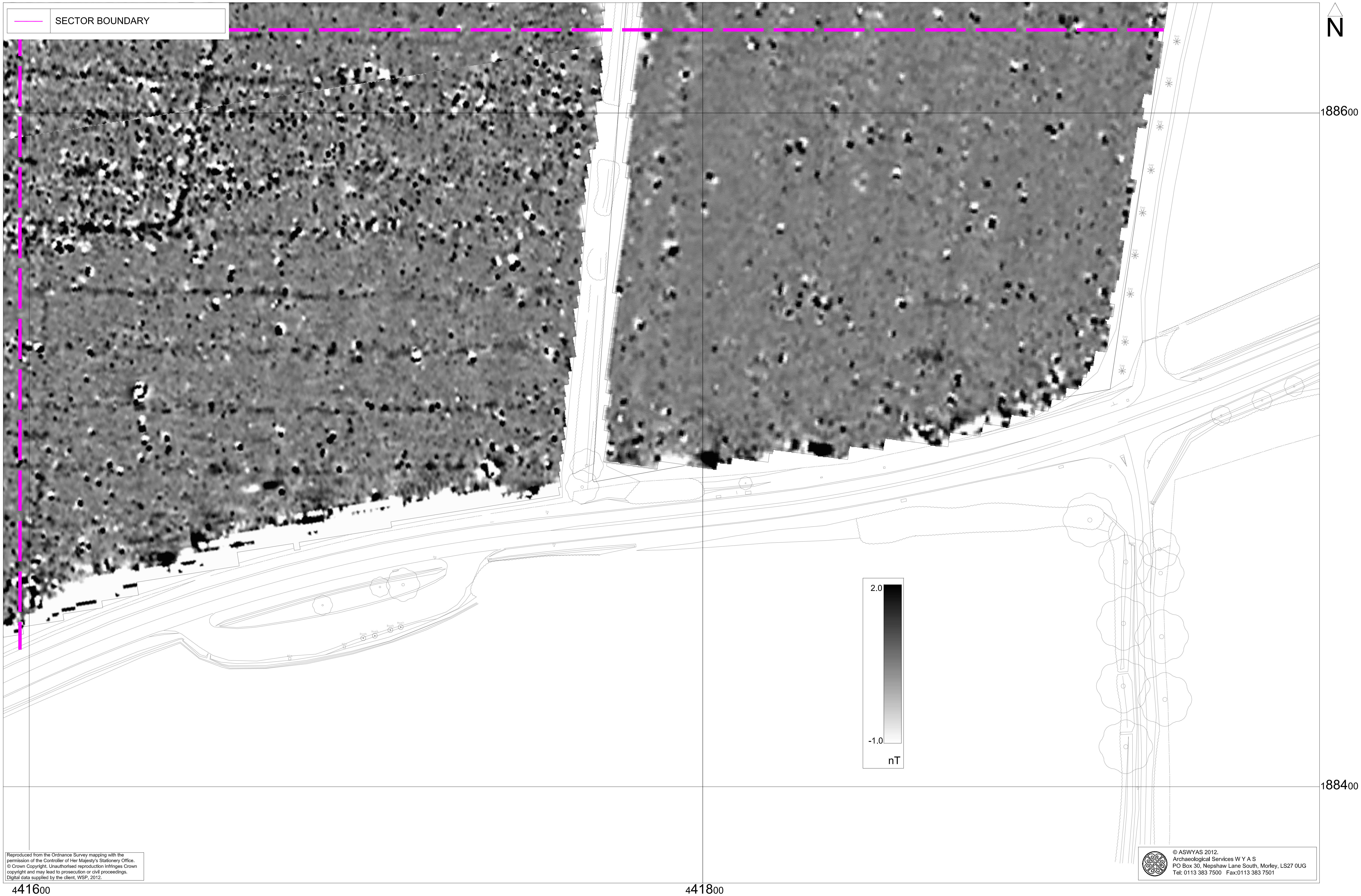

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Fig. 34. Processed greyscale magnetometer data; Field 7 and Field 12 (Sector 11) (1:1000 @ A3)

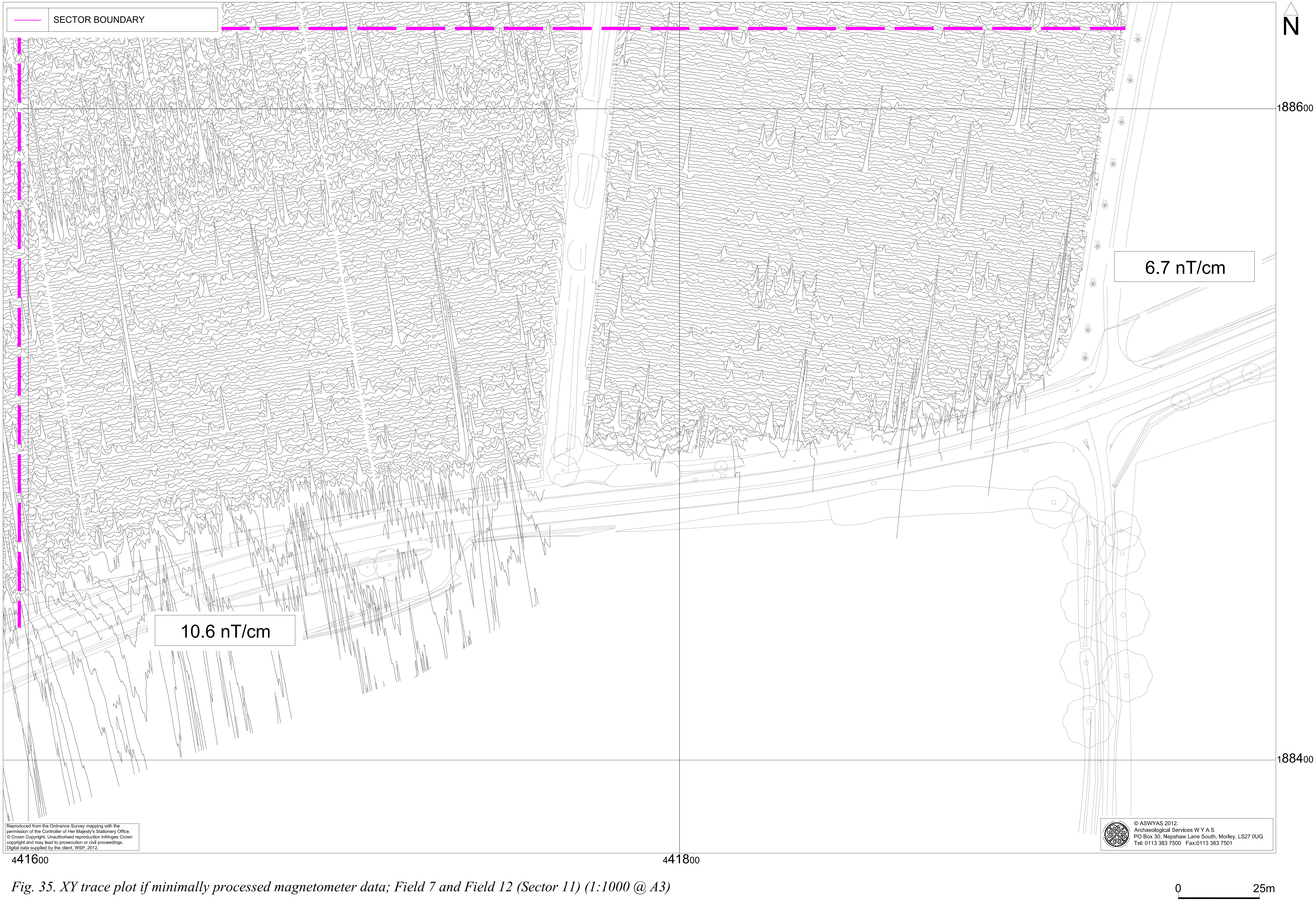

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Fig. 35. XY trace plot if minimally processed magnetometer data; Field 7 and Field 12 (Sector 11) (1:1000 @ A3)

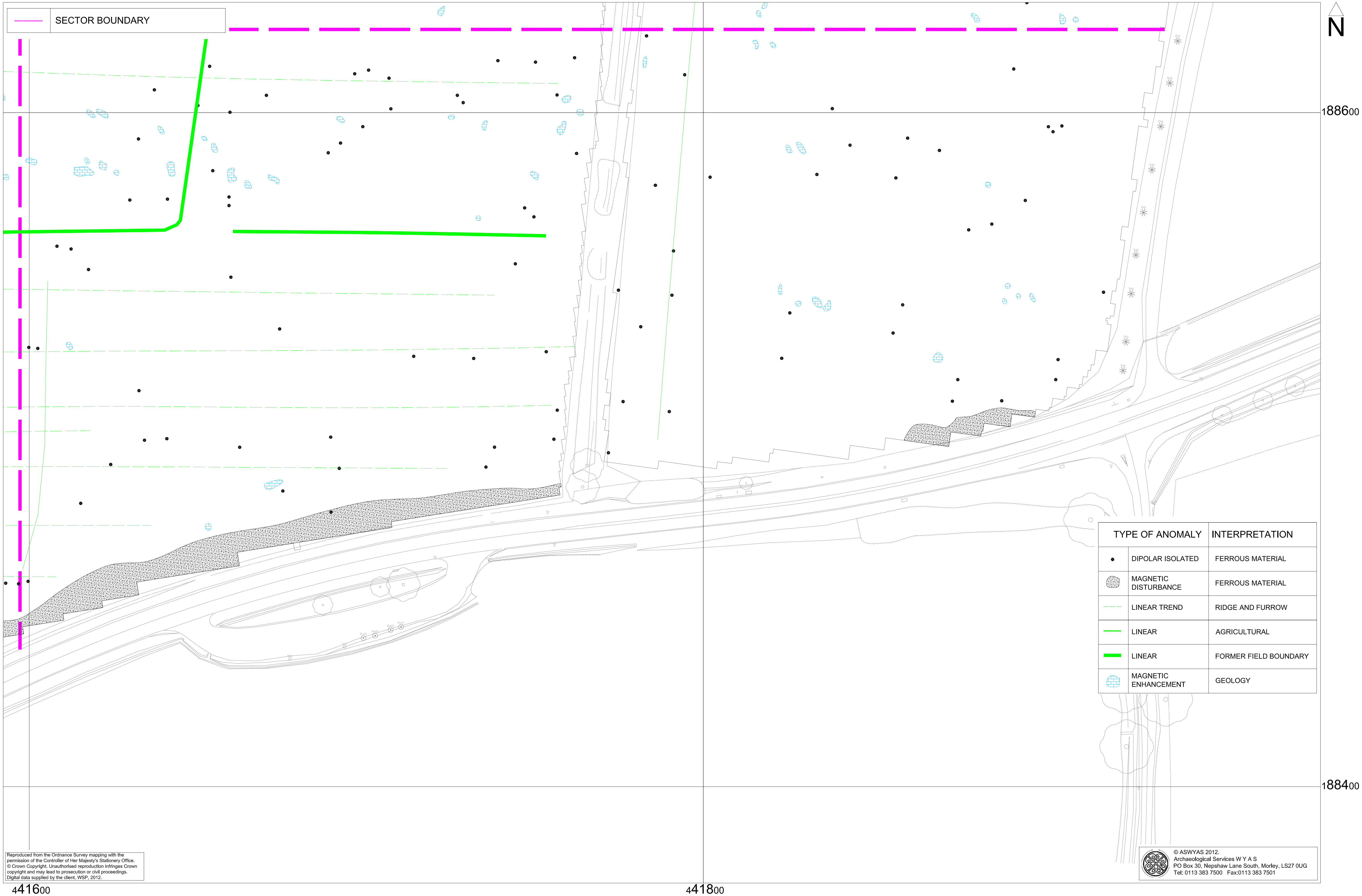

Fig. 36. Interpretation of magnetometer data; Field 7 and Field 12 (Sector 11) (1:1000 @ A3)

0 25m

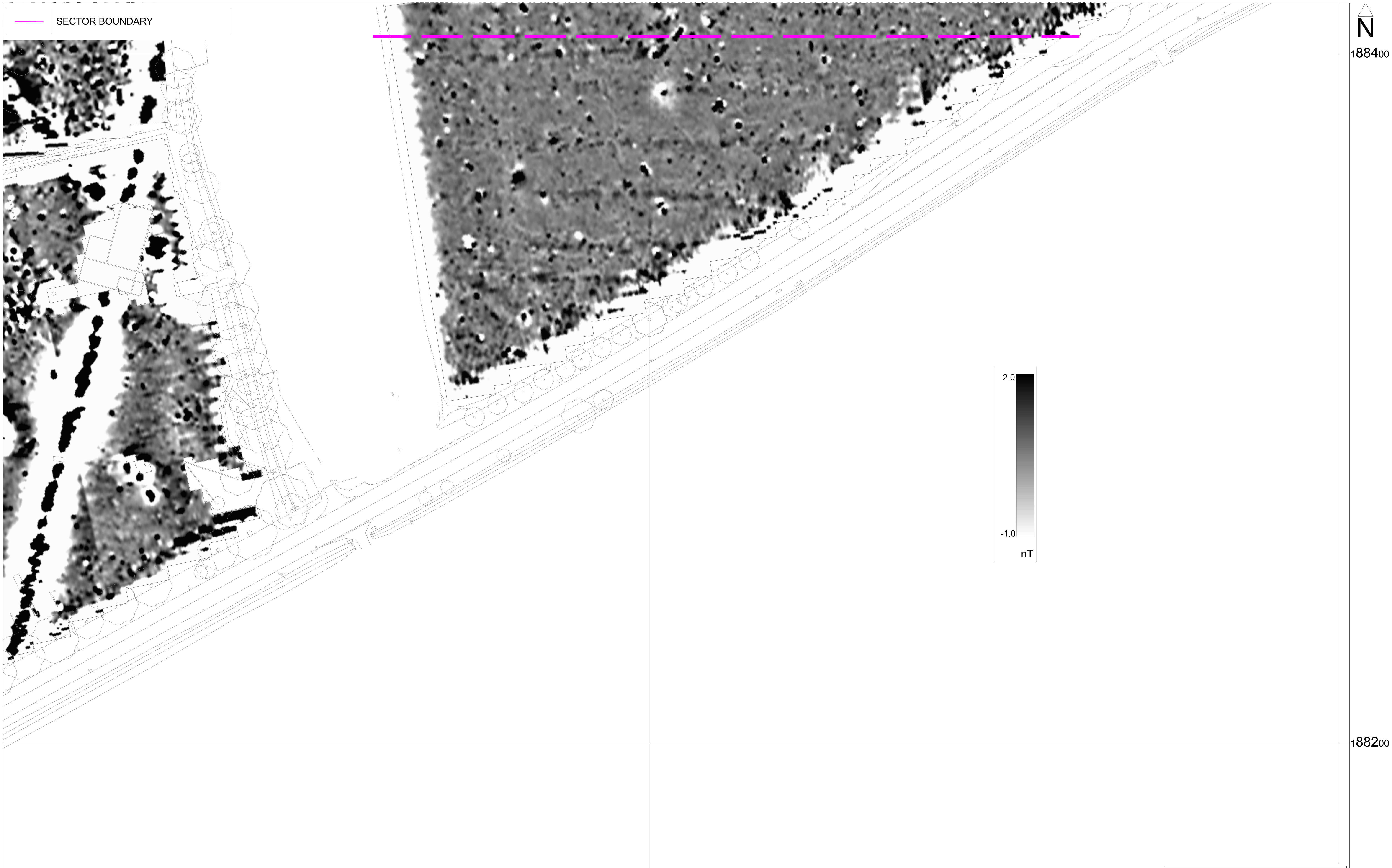

Fig. 37. Processed greyscale magnetometer data; Field 7, 8 and 10 (Sector 12) (1:1000 @ A3)

0 25m

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Fig. 38. XY trace plot of minimally processed magnetometer data; Field 7, 8 and 10 (Sector 12) (1:1000 @ A3)

Fig. 39. Interpretation of magnetometer data; Field 7, 8 and 10 (Sector 12) (1:1000 @ A3)

Fig. 40. Processed greyscale magnetometer data; Field 8, 9, 10 and 11 (Sector 13) (1:1000 @ A3)

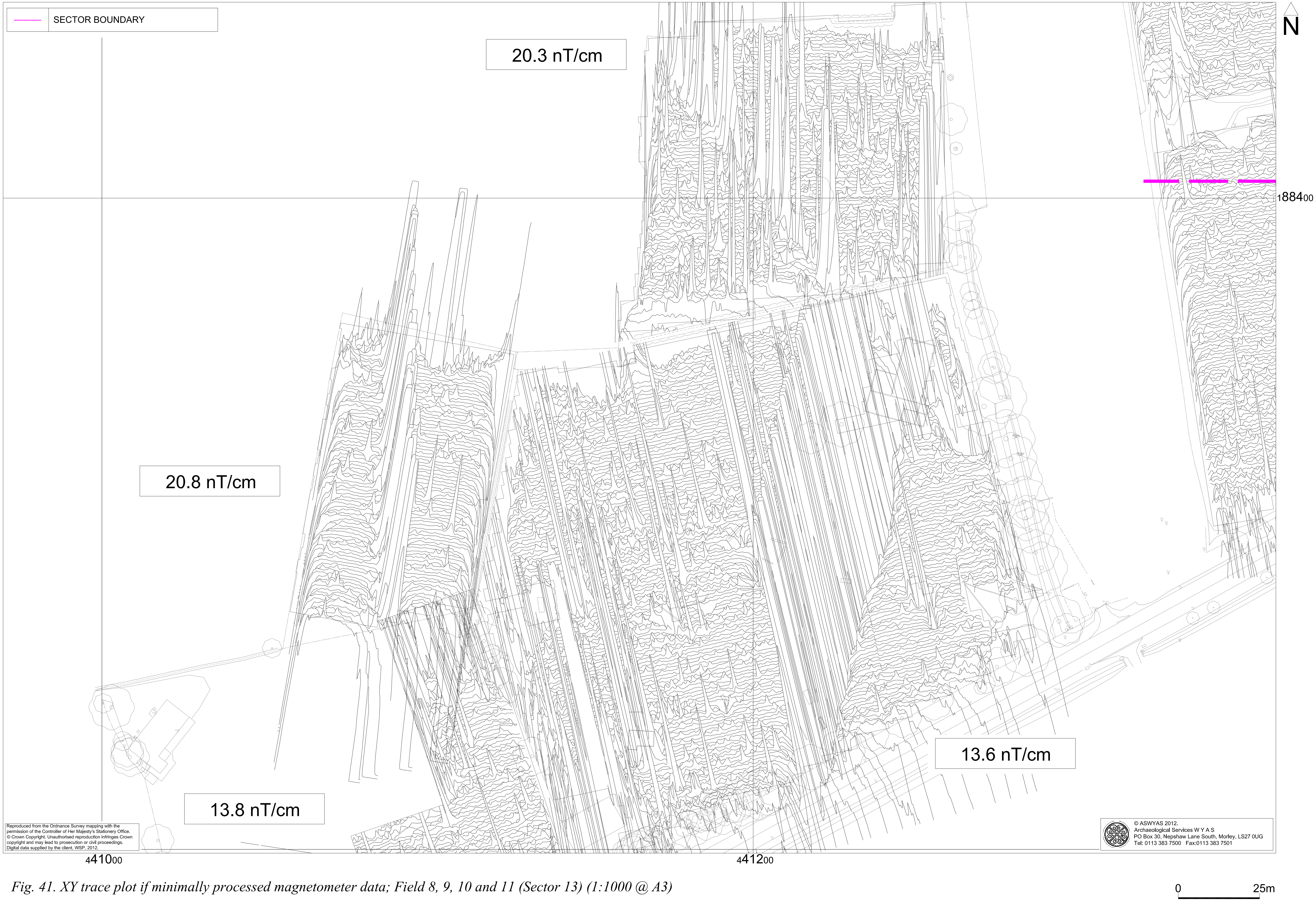

Fig. 41. XY trace plot if minimally processed magnetometer data; Field 8, 9, 10 and 11 (Sector 13) (1:1000 @ A3)

Fig. 42. Interpretation of processed magnetometer data; Field 8, 9, 10 and 11 (Sector 13) (1:1000 @ A3)

Plate 1. General view of Sector 13, looking north

Plate 2. General view of Sector 2 showing recently backfilled trial trenches, looking south-east

Plate 3. General view of Sector 4, looking south-east

Plate 4. General view of Sector 4, looking west

Plate 5. General view of Sector 10, looking north-west

Plate 6. General view of Sector 7, looking north-east

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: Gradiometer Survey

There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as ***magnetic scanning*** and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and approximately located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey.

The disadvantages of magnetic scanning are that features that produce weak anomalies (less than 2nT) are unlikely to stand out from the magnetic background and so will be difficult to detect. The coarse sampling interval means that discrete features or linear features that are parallel or broadly oblique to the direction of traverse may not be detected. If linear features are suspected in a site then the traverse direction should be perpendicular (or as close as is possible within the physical constraints of the site) to the orientation of the suspected features. The possible drawbacks mentioned above mean that a 'negative' scanning result should be validated by sample detailed magnetic survey (see below).

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 0.25m 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. Detailed survey allows the visualisation of weaker anomalies that may not have been detected by magnetic scanning.

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 or for the removal of any of the survey reference points.

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 Oxfordshire Historic Environment Record).

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