Archaeological Services WYAS

Wroughton Airfield Solar Park
Swindon
Wiltshire

Geophysical Survey

Report no. 2553

November 2013

Client: Cotswold Archaeology Ltd

Registered Organisation IfA

Wroughton Airfield Solar Park
Swindon
Wiltshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 65 hectares, was carried out on agricultural land at the southern end of Wroughton Airfield in advance of the determination of a planning application for a proposed solar park. The data from the northern part of the site are dominated by strong magnetic anomalies caused by former airfield facilities and infrastructure, including a former runway and access road, indicating that the site was only superficially remediated before being brought back into agricultural production. There is also significant magnetic disturbance caused by the spreading of material from Wroughton Down Farm which was demolished prior to the construction of the airfield. In the southern half of the site the magnetic background is extremely 'quiet' with the only anomalies due to 19th century boundaries and possible extraction pits. No anomalies of obvious archaeological potential have been identified. Nevertheless, it is recognised that a previous trenching evaluation did identify a single feature of late prehistoric date and possible Roman quarry pits within the site boundary which have not been located by the current survey. In general there is a good magnetic contrast between the fill of archaeological features and chalk bedrock. Therefore, the absence of any obvious archaeological anomalies suggests a low potential for the presence of currently unidentified significant archaeological features or deposits, confirming the conclusions of the Environmental Statement. However, the possibility of isolated discrete features or shallow linear features cannot be completely discounted.

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Report Information

Client:	Cotswold Archaeology Ltd
Address:	Building 11, Kemble Enterprise Park, Cirencester, Gloucestershire, GL7 6BQ
Report Type:	Geophysical Survey
Location:	Wroughton Airfield, Swindon
County:	Wiltshire
Grid Reference:	SU 135 785
Period(s) of activity:	post-medieval/modern
Report Number:	2553
Project Number:	4144
Site Code:	WAF13
OASIS ID:	archaeol11- 166768
Planning Application No.:	n/a
Museum Accession No.:	n/a
Date of fieldwork:	October - November 2013
Date of report:	November 2013
Project Management:	Sam Harrison BSc MSc MIfA
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Research:	n/a

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Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Richard Morton of Cotswold Archaeology Ltd (the Client), on behalf of Swindon Commercial Services, to undertake a geophysical (magnetometer) survey of agricultural land within the south of Wroughton Airfield, Wiltshire (see Fig. 1), prior to the determination of a planning application for a proposed solar park. The work was undertaken in accordance with a Written Scheme of Investigation produced by the Client (Cotswold, 2013a) and a Project Design (Harrison, 2013) supplied to and approved by the Client, 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 October 23rd and November 6th 2013 in order to provide additional information on the archaeological potential of the site.

Site location, topography and land-use

The Proposed Development Area (PDA) comprises the southern half of Wroughton Airfield and the agricultural land between the existing runways (see Fig. 2), and covers an area of approximately 90 hectares, centred at SU 135 785. The survey covered only the agricultural land between the runways, and excluded the tree screening areas around the perimeter of the site, a total area of approximately 65 hectares. A triangular area (most of Sector 2 – see Fig. 2) was under permanent pasture with the remainder of the survey area having just been re-seeded. The west of Sector 2 contained a circular earthwork, part of an experimental project being undertaken by Reading University. No survey could be undertaken over the earthwork.

The PDA is situated on the Lower Chalk Plain which extends to the north and west of the Marlborough Downs. The site is gently undulating ranging in height between 210m above Ordnance Datum (aOD), at the north-west boundary, to 185m aOD in the south-eastern corner of the site.

Soils and geology

The underlying bedrock geology comprises West Melbury Marly Chalk Formation and Zig Zag Chalk Formation. There are no recorded superficial deposits. (British Geological Survey 2013). The soils in this area are classified in the Wantage 1 association, characterised as well-drained calcareous silts (Soil Survey of England and Wales 1983). A previous archaeological evaluation (see below) recorded a silty clay sub-soil which varied in depth between 0.2m and 1.7m, the deeper areas of sub-soil resulting from landscaping associated with the construction of the airfield.

2 Archaeological Background

The information below is abstracted from the Archaeology and Cultural Heritage chapter of the Environmental Statement (ES) of the PDA and immediate vicinity (Cotswold Archaeology, 2013b).

Research undertaken for the statement revealed that a limited scheme of trial trenching, which covered the current PDA and an area to the north, had been undertaken as part of an earlier development proposal (Bashford, 2006). The majority of the trenches (within the PDA) were blank but archaeological features were recorded in four trenches. Three contained deep buried features, interpreted as possible Roman quarry pits (see Fig. 2 – heritage asset no. 25), whilst a ditch terminus dated to the Early Iron Age was recorded in the fourth (see Fig. 2 – heritage asset no. 24). Features indicative of a settlement, also dating to the Early Iron Age, were recorded approximately 0.5km to the north of the current PDA. On the basis of the trial trenching the ES stated that '*the excavated results do not suggest a potential for any archaeological remains of greater than a low heritage value within the site*', concluding that '*due to the limited physical impact of the development proposals no further mitigation measures are proposed*' (Cotswold Archaeology, 2013b).

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 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 available parts of the PDA was carried out, an area of 65 hectares.

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 large scale (1:7500) location plan displaying the processed magnetic data. Figure 3 is an overall data interpretation plot at a scale of 1:4000. Detailed data plots ('raw' and processed) and full interpretative figures are presented at a scale of 1:1000 in Figures 4 to 36 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 2013) and 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 36 inclusive)

Numerous anomalies have been identified by the survey. The anomalies fall into a number of different types and categories according to their origin and these are discussed below and cross-referenced to specific examples and locations within the site.

Ferrous and Modern 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 rural sites, often being present as a consequence of manuring or tipping/infilling.

On this site there is a huge amount of ferrous contamination, predominantly in the northern part of the PDA, but also with a significant cluster on the eastern edge of the site. In all cases the magnetic disturbance is either directly or indirectly associated with the airfield and is caused by magnetic material (such as bricks, concrete or any other strongly magnetic material) which still remains in the topsoil following remediation of the site back into agricultural production.

In Sector 2 and Sector 3 a well-defined rectangular zone, **A**, characterised by dense and extensive high magnitude anomalies, clearly locates the position of a former runway or area of hard-standing (see Figs 7 to 12). This zone is approximately 225m in length and 45m in width and aligned south-west/north-east parallel with an extant runway. The large ferrous spike, **B**, towards the south of **A** is caused by an existing windsock at this location. Two clear alignments of ferrous spike anomalies, **C** and **D**, are visible within this area, traversing the site on an east/west orientation, roughly parallel with the existing runway to the north. These anomalies are likely to be due to linear airfield installations, perhaps relating to airfield lighting. A third alignment of spike anomalies, **E**, within the north-east of the PDA, appears to be on the same east/west alignment and is likely to be caused by the same installations. A second well-defined zone of disturbed readings, **F**, in the north-west corner of the site, in Sector 1, probably locates a former trackway or road around the perimeter of the airfield (see Figs 4, 5 and 6). Six linear dipolar anomalies, **G** – **L**, caused by ferrous service/utility pipes are identified criss-crossing this area.

The third main area of magnetic disturbance, **M**, resulting from airfield activity, is on the eastern edge of the site (see Figs 25 to 36). The disturbance is broadly constrained to the west by a rectilinear alignment of ferrous spike anomalies, **N**, which corresponds to a former fence shown on current Ordnance Survey mapping. The ‘spike’ anomalies are thought to be caused by steel-reinforced foundations and fencing debris. It is difficult to decipher any coherent pattern within such a dense concentration of magnetic anomalies other than to note the high-magnitude linear anomalies, **O**, **P** and **Q**, which are likely to result from the magnetic fill of service trenches. On the periphery of the magnetic disturbance however, two areas of airfield infrastructure can be discerned. To the south, a large ferrous spike, **R**, is visible and linear trends can be seen radiating from it. This is likely to be due to an airfield installation. Recent mapping (1980s) shows that the circular anomaly, **S**, corresponds to a former turning area in this part of the site which has presumably been remediated but with some magnetic debris still present within the upper soil horizons. In the north-eastern corner of the site, in Sector 9, a cluster of five high magnitude anomalies, **T**, arranged in the shape of a pentagon stand out. These ‘spike’ anomalies probably locate the bases for former airfield infrastructure. Several other individual ‘spike’ anomalies, particularly close to the northern edge of the site are also interpreted as locating structures/bases of airfield infrastructure.

Several linear anomalies are visible within the east of the PDA. Within Sector 8 and Sector 9, a fragmented linear anomaly, **U**, can be seen on a roughly east-west alignment. This anomaly is thought to form a continuation of the trackway which is visible to the east of the PDA on current Ordnance Survey maps. Other linear trends and faint linear anomalies, **V** – **Z**, within this part of the site are likely to be due to service pipes/cables/utilities and the magnetic material (such as sand and gravel) used to backfill their trenches. It is notable, that a number of these linear anomalies are orientated towards the north-west, the centre of the existing airfield, where a scatter of amorphous high magnitude anomalies, **AA**, has been identified. No clear pattern is visible within this scatter and it is likely that it represents further, localised areas of magnetic material which still remains in the topsoil following remediation of the former airfield back into agricultural production.

A further obvious modern anomaly has been identified within Sector 4 and Sector 5 in the south of the PDA (see Figs 13 to 18). A regularly-spaced alignment of ferrous spikes, **AB**, is likely to relate to a buried pipe, the spikes being caused by ferrous fixtures along the pipe length.

To the east of the former runway feature, **A**, a well-defined area, characterised by a dense and evenly spread area of high magnitude ferrous 'spike' anomalies, **AC**, is identified. This magnetically disturbed area, approximately 270m by 260m, is constrained by linear anomalies, **AD** – **AG** (see below), which demarcate the boundaries of a former field immediately south of Wroughton Down Farm. This farm and the boundaries are depicted on the first (and second) edition Ordnance Survey mapping but the farm itself was demolished when the airfield was built. The disturbance is almost certainly caused by the distribution of the demolition material contained by the former field boundaries. Few anomalies are decipherable within this broad area of magnetic disturbance although higher magnitude amorphous anomalies, **AH**, correspond closely to perimeter walls and outbuildings associated with the former farm itself. To the south of this area, two short linear dipolar anomalies, **AI** and **AJ**, indicate ferrous pipes, probably associated with a circular feature depicted on the first and second edition Ordnance Survey maps.

Three further dipolar linear anomalies, **AK** – **AM**, have been identified within the west of the PDA. These all indicate buried service pipes.

Magnetic disturbance at the perimeters of the survey areas is due to ferrous material within the adjacent boundaries, fences and runways.

Agricultural Anomalies

Analysis of historical Ordnance Survey mapping has established that the division and layout of fields within the PDA has altered over the past 130 years, with several boundaries having been removed. These 19th century former boundaries are shown on Figure 2 but not all of them are identified as magnetic anomalies. As mentioned above, linear anomalies **AD** – **AG**, and the extent of magnetic disturbance adjacent to the former runway, defines the field immediately south of Wroughton Down Farm. Immediately south of the former farm a north/south aligned boundary is defined by a line of 'spike' anomalies, **AN** (see Figs 13 –

18). A weak east/west aligned linear anomaly, **AO**, that crosses Sector 8 but has not been recorded in Sector 9, also partially locates a former boundary (see Figs 25 – 30); evidence from the trial trenching indicates that the north-eastern corner of the site has been truncated (see Fig. 2), possibly accounting for the discontinuous identification of this former boundary. Two other former boundaries, one aligned north/south and the other east/west, in the eastern half of the site do not manifest as magnetic anomalies.

Very weak, parallel, linear trend anomalies have been identified in Sector 1 and Sector 4. These anomalies are caused by ploughing.

Extraction? anomalies

Several very weak, mostly rectangular shaped anomalies, **AP**, have been identified, most notably in Sector 5 and Sector 10. The anomalies seem to be between 10m and 15m in length but do not correspond either the position or alignment of the trial trenches excavated in 2006. It is considered most likely that these anomalies may be caused by infilled chalk extraction pits.

Unknown Anomalies

Several faint linear trends, **AQ** – **AU**, weak amorphous anomalies, **AU**, and isolated areas of magnetic enhancement of unknown origin have been identified across the survey area. An archaeological origin for these anomalies cannot be discounted but, on balance, a modern cause is considered more likely.

6 Conclusions

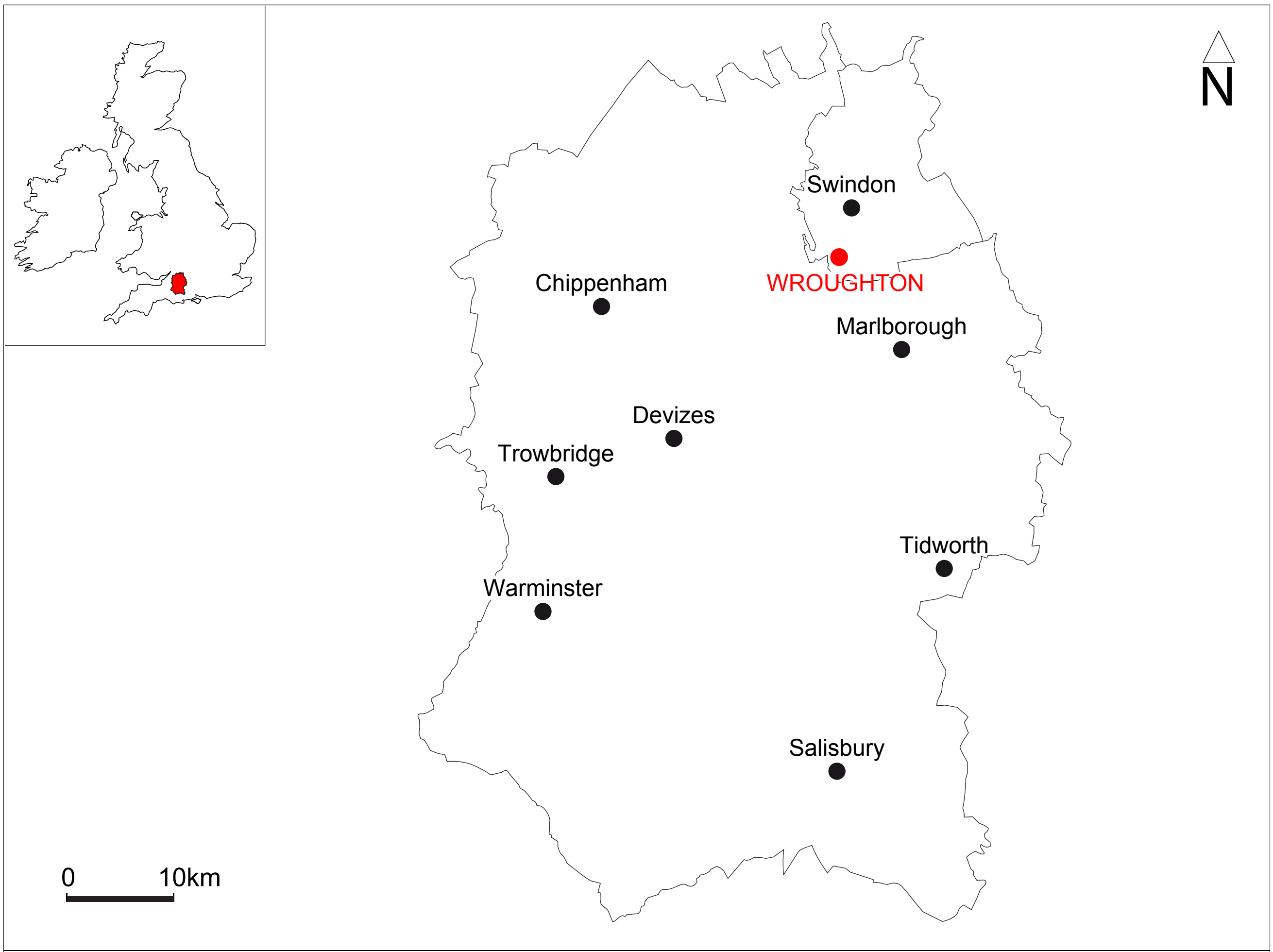
The magnetometer survey has clearly demonstrated that much of the northern half of the site and a large area on the eastern edge of the site has been affected by the development and later remediation of activities and infrastructure associated with Wroughton Airfield. Whilst the airfield is no longer as extensive as when it was in operation during World War II, the remediation of parts of it has resulted in large areas where the strong magnetic readings clearly locate former features, such as a runway and access track, as well as areas where material from former airfield structures/features has been mixed in with topsoil when the land was returned to agricultural production. It is possible that these very strong readings could be masking much weaker responses from archaeological features, if present, although there is no evidence from the trial trenching carried out in 2006 that this might be the case.

By contrast the magnetic background in southern part of the site is extremely quiet. Against this ‘quiet’ background very few anomalies are identified. Some of the field boundaries removed over the last 130 years do manifest as magnetic anomalies but others do not. Several sub-circular and rectangular anomalies have been identified in this part of the site and their cause remains unclear. They are clearly not caused by the backfilled trial trenches. It is postulated that they may be chalk extraction pits of unknown date but this interpretation is tentative. Another possibility is that they may be natural, possibly water worn, depressions in the chalk bedrock.

No anomalies of obvious archaeological potential have been identified by the survey. A few linear trends and isolated anomalies have been noted for which there is no obvious non-archaeological origin but in the absence of any other archaeological evidence these anomalies are considered more likely to be of recent agricultural or modern origin.

Soil filled features cut into chalk bedrock generally result in a strong magnetic contrast between the archaeological feature and the solid geology. On this site there are no recorded superficial deposits to mask any potentially archaeological response. Therefore it would be expected that a magnetometer survey would identify any linear features on this site, unless the features were very shallow or badly truncated. Therefore it is considered likely that the absence of obvious archaeological anomalies on this site is almost certainly due to an absence of such features, a statement that supports the conclusion of the environmental statement.

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.



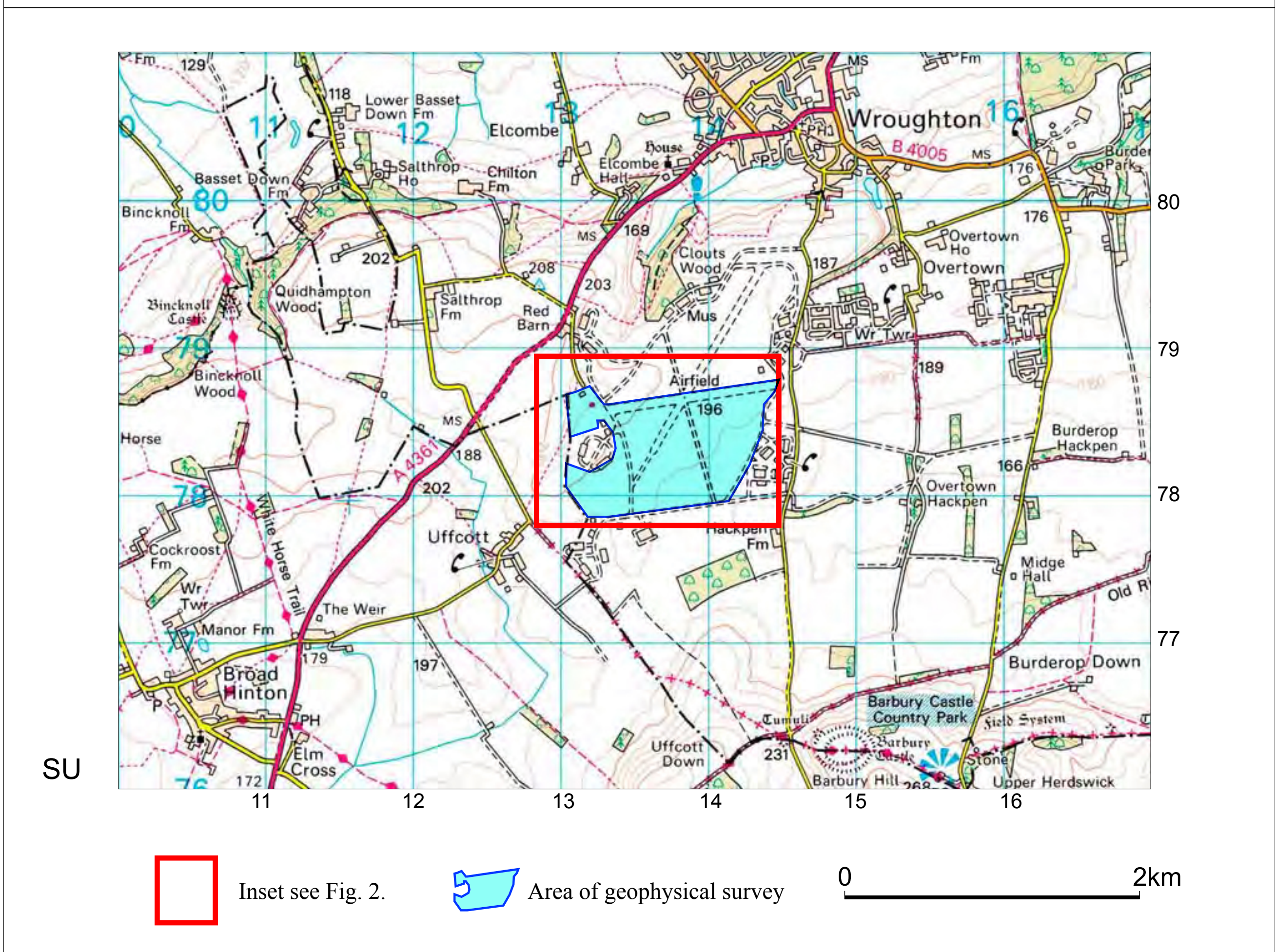


Fig. 1. Site location

Fig. 2. Site location showing greyscale magnetometer data (1:7500 @ A3)

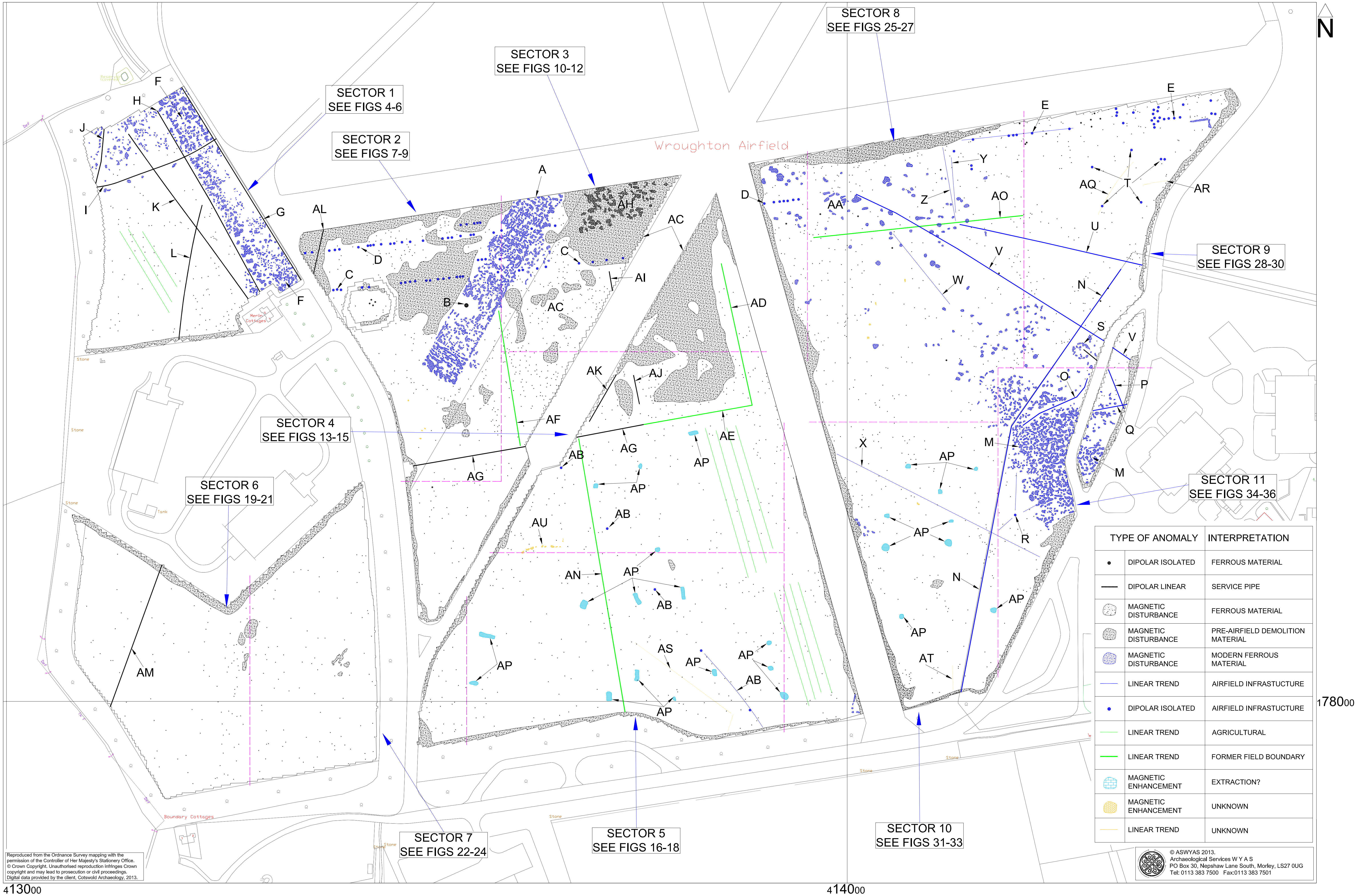


Fig. 3. Overall interpretation of magnetometer data (1:4000 @ A3)

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

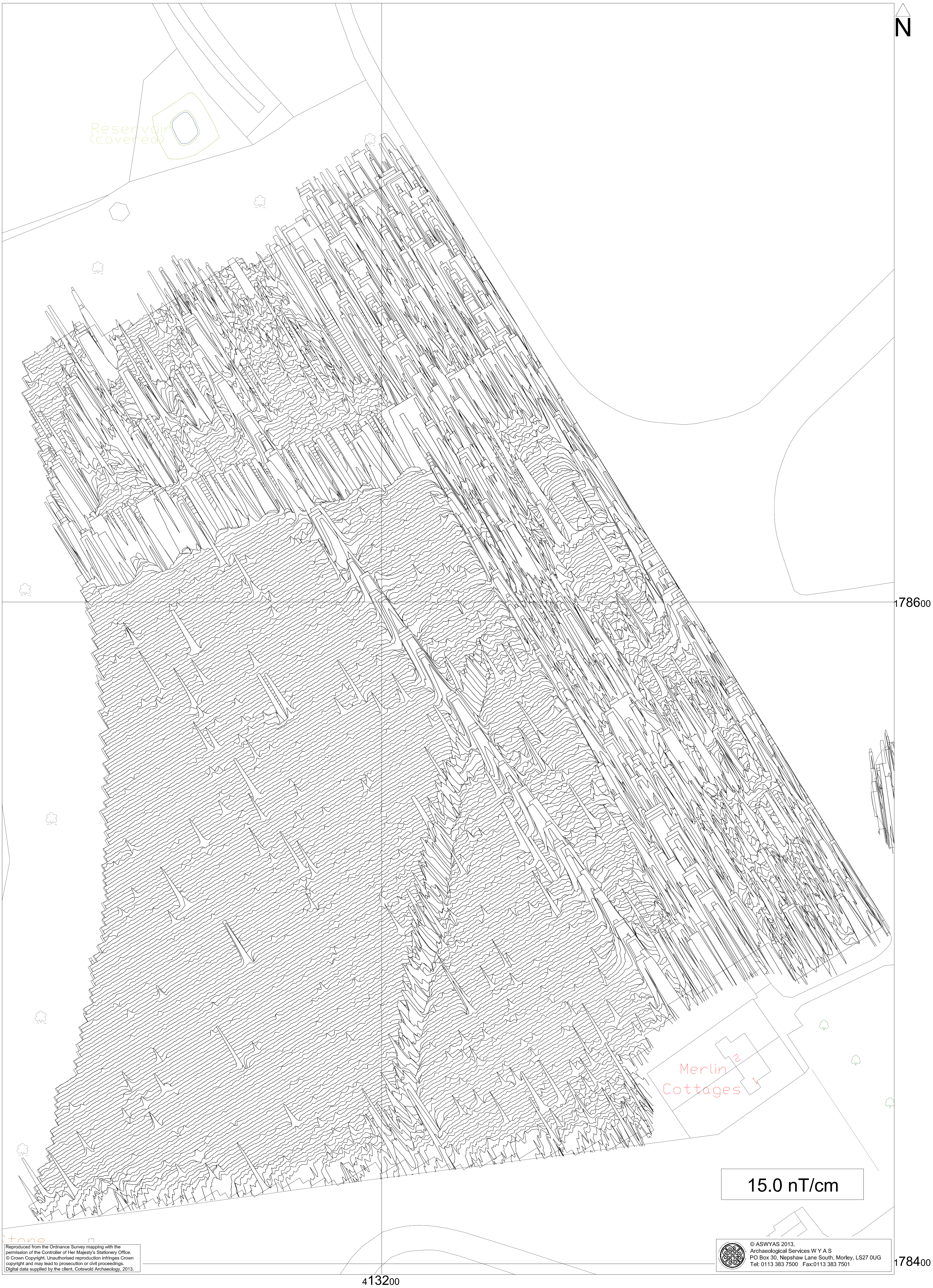


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Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)

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

0 20m

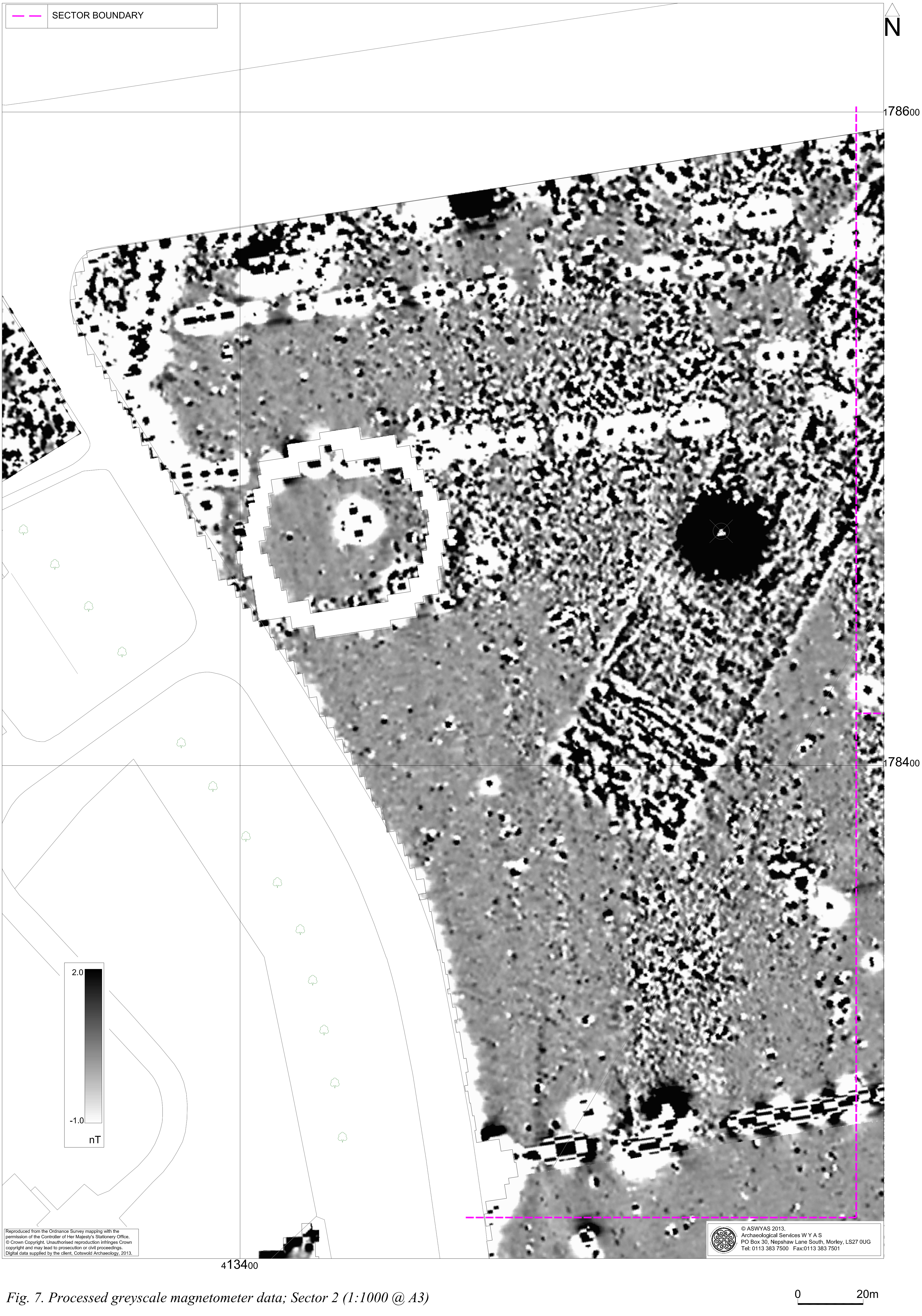

Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

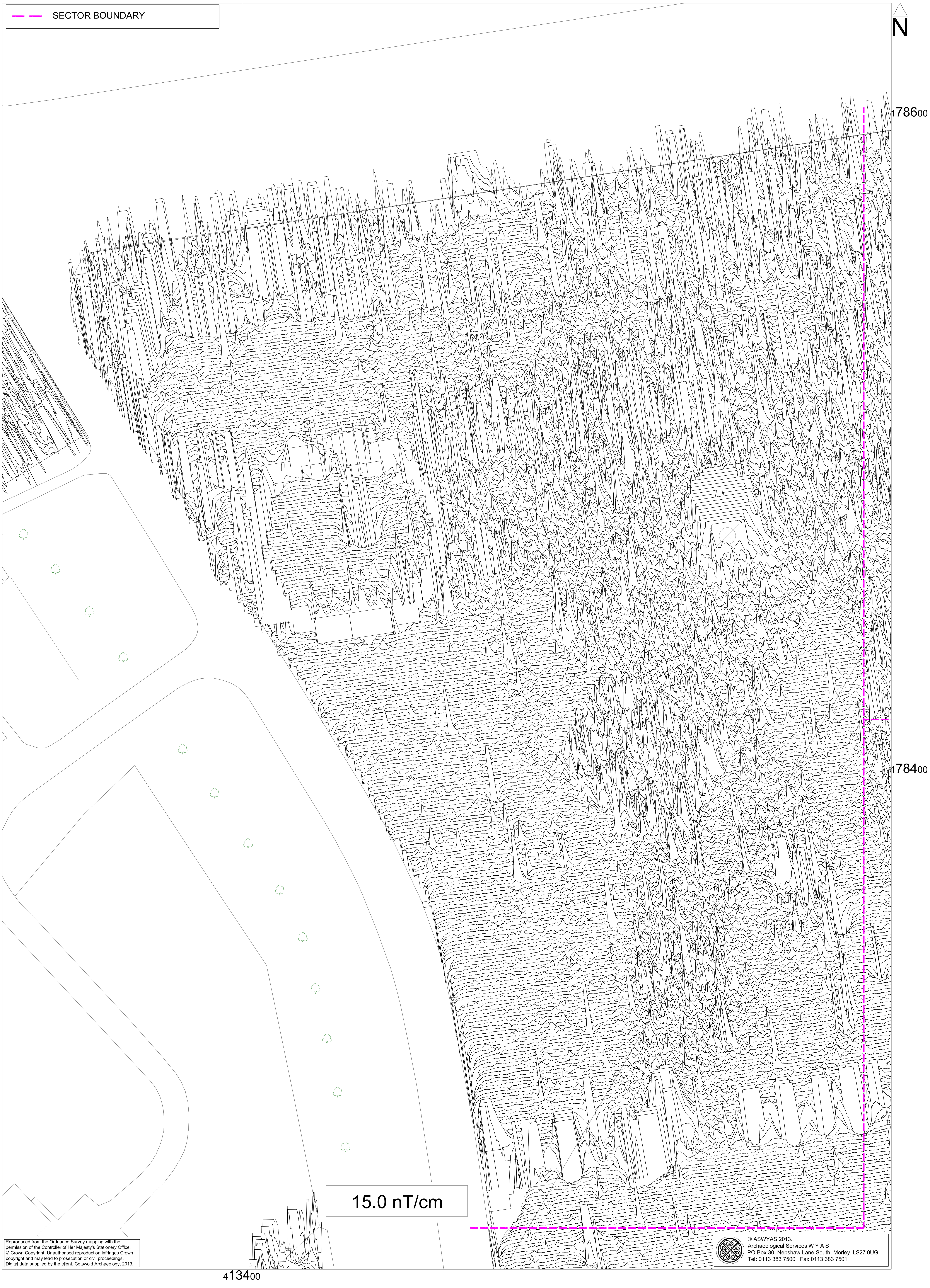

Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

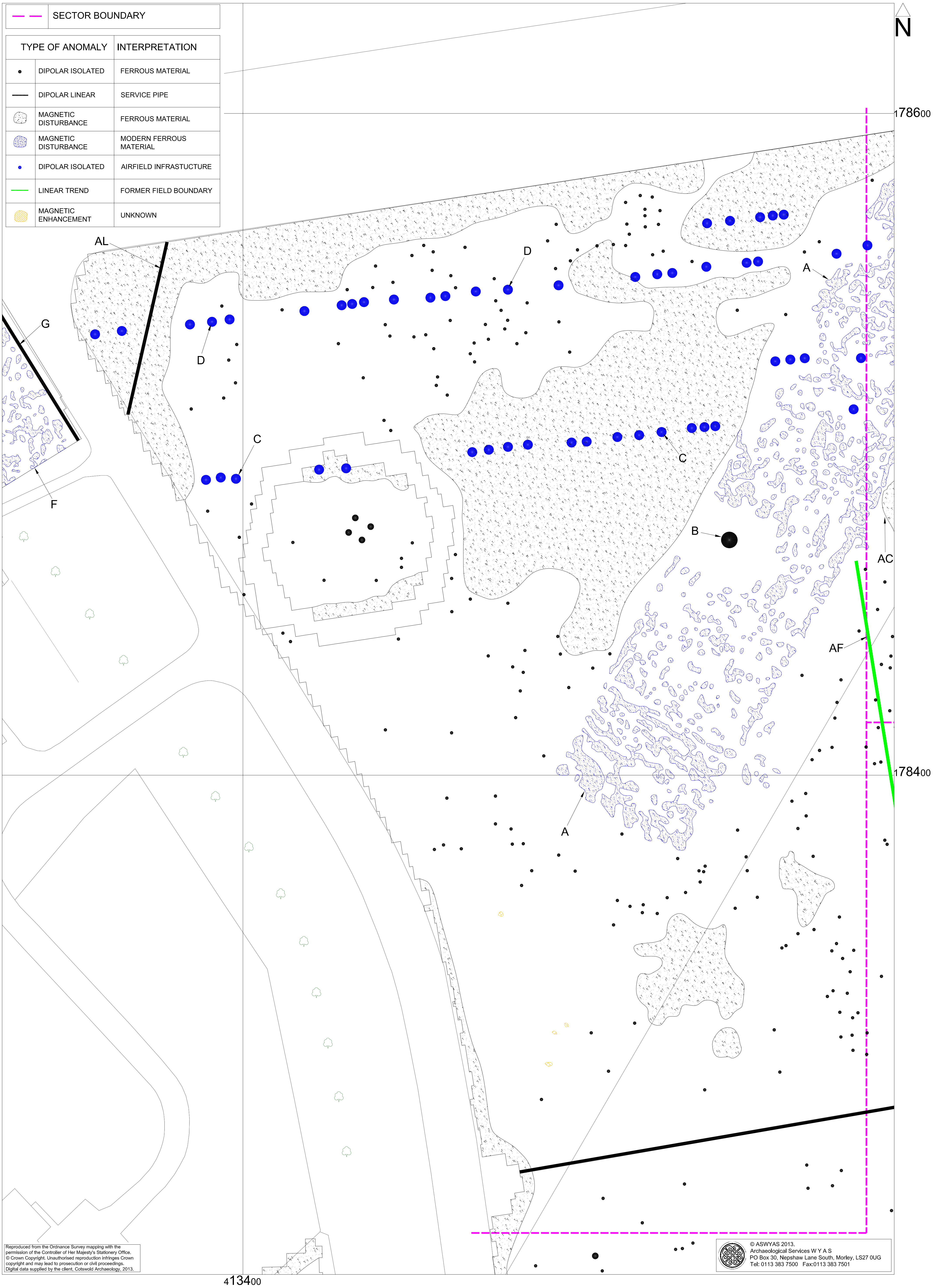

Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

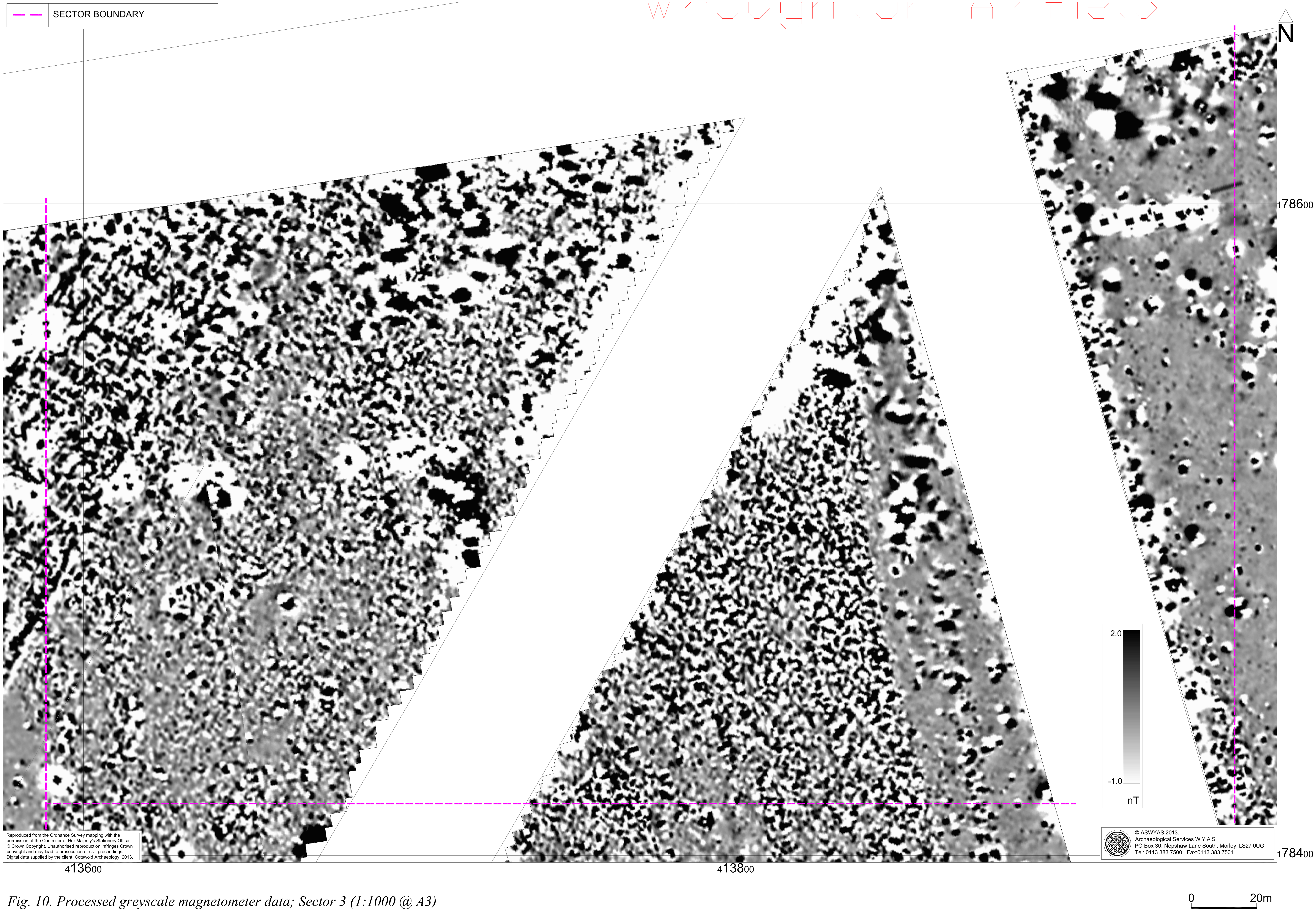

Fig. 10. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

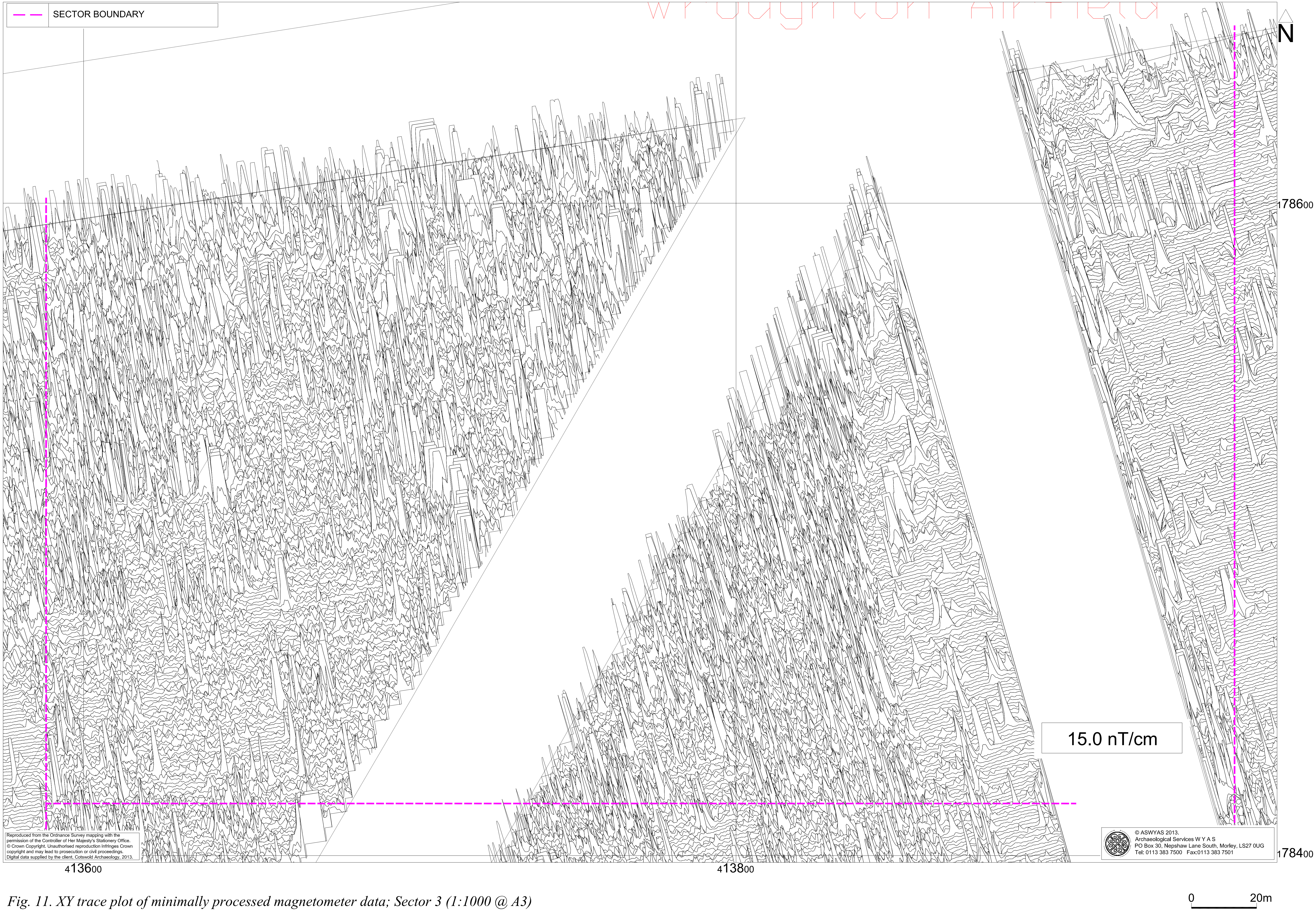

Fig. 11. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A3)

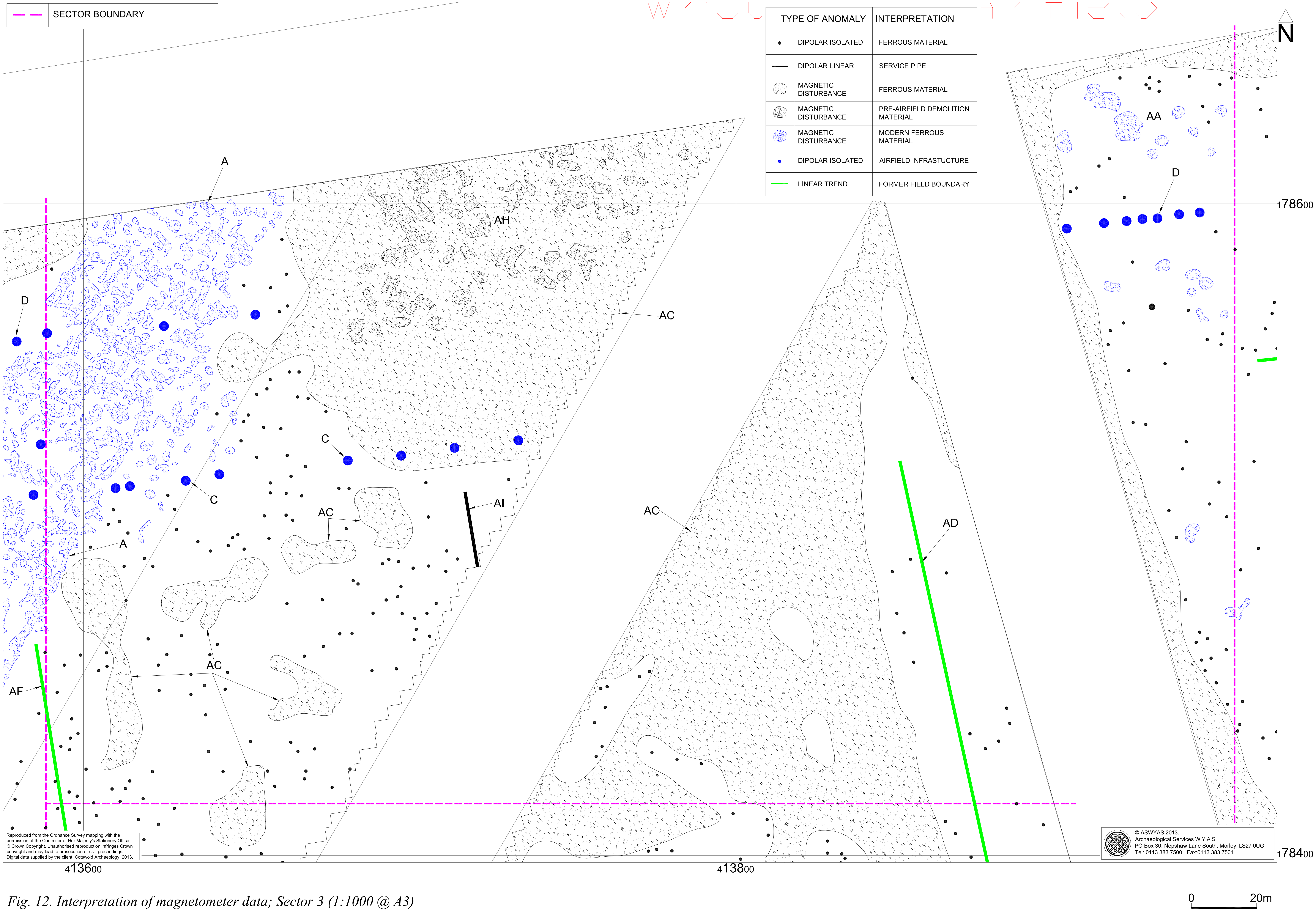

Fig. 12. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)

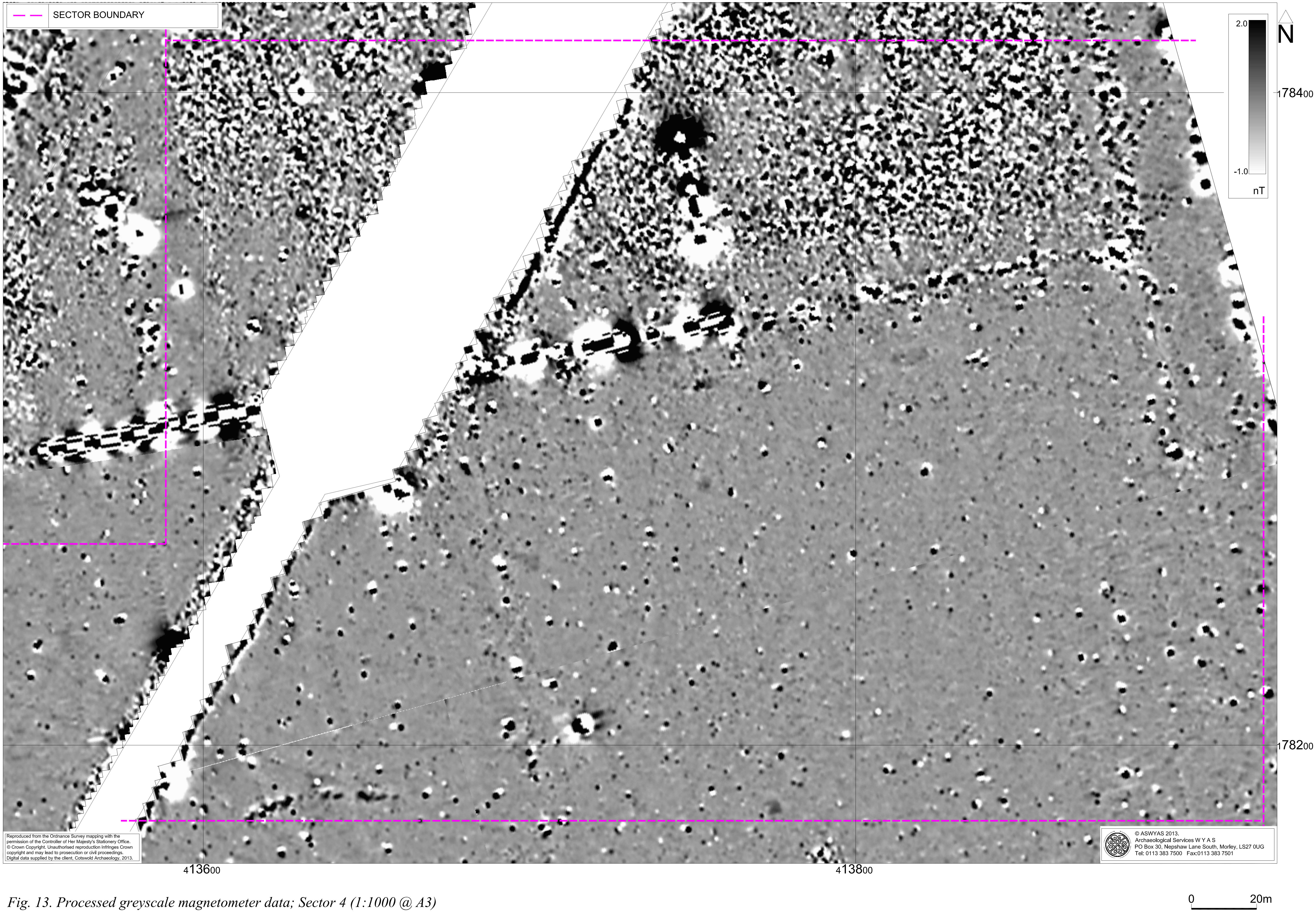

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Fig. 13. Processed greyscale magnetometer data; Sector 4 (1:1000 @ A3)

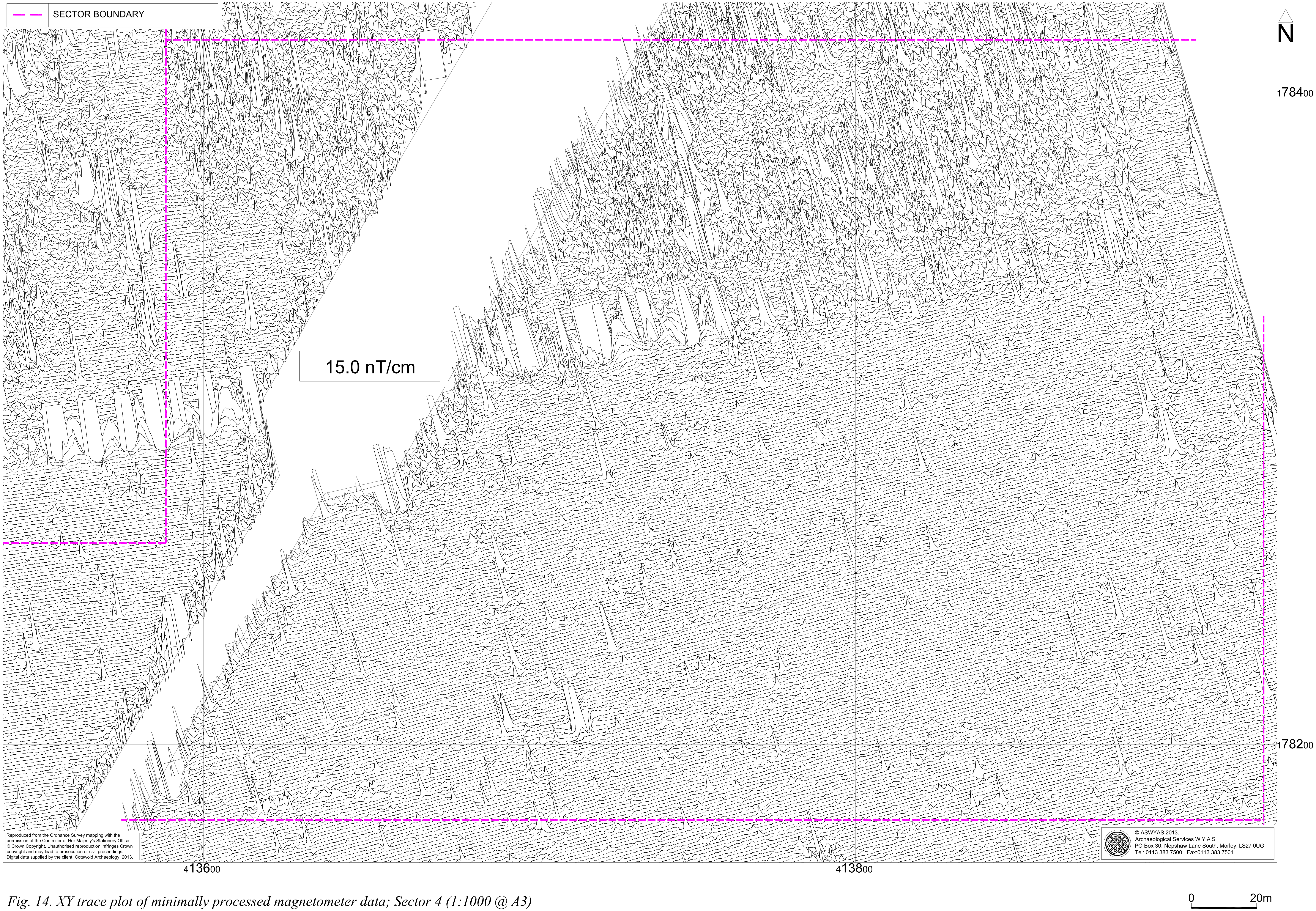

Fig. 14. XY trace plot of minimally processed magnetometer data; Sector 4 (1:1000 @ A3)

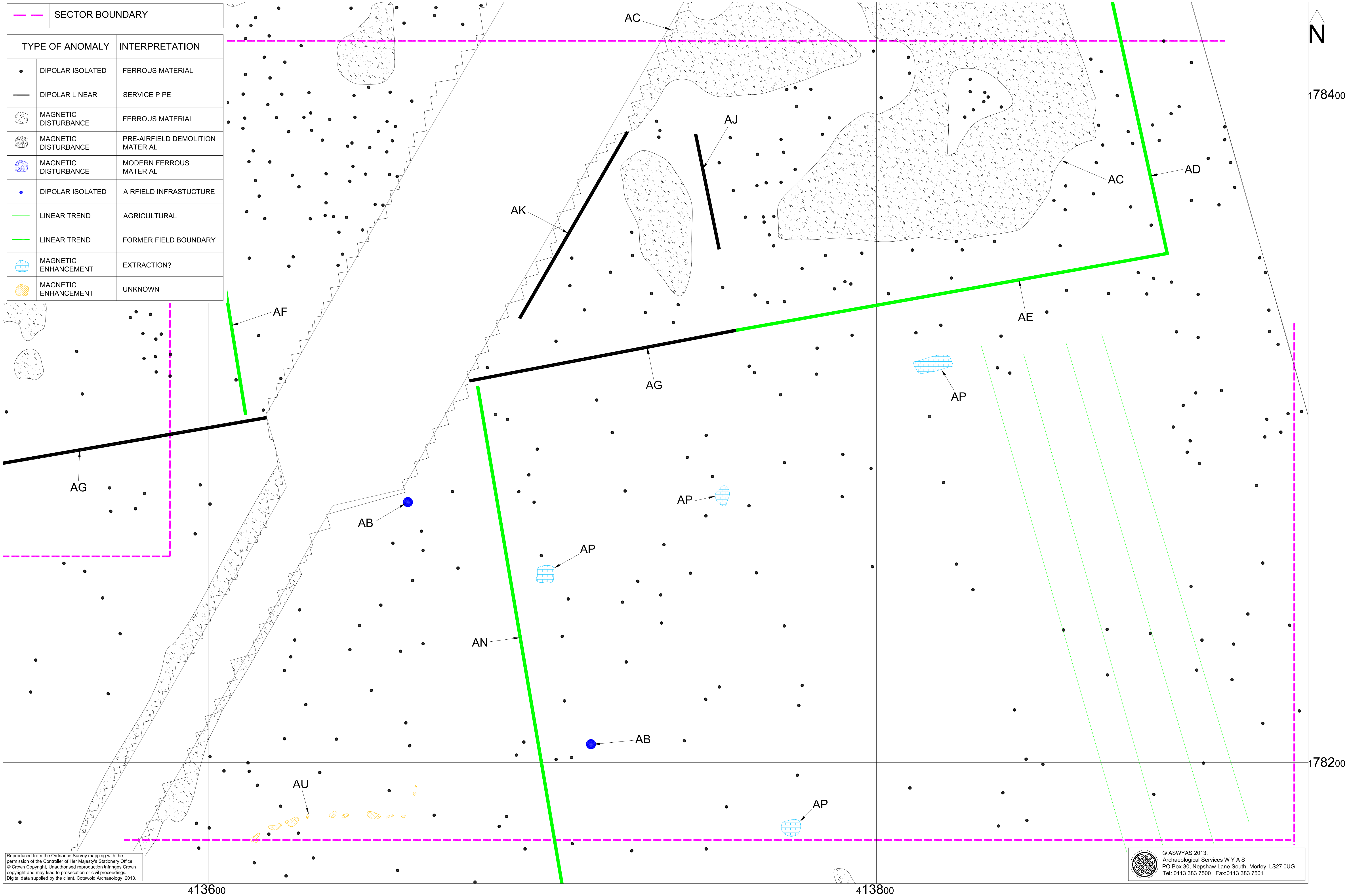

Fig. 15. Interpretation of magnetometer data; Sector 4 (1:1000 @ A3)

0 20m

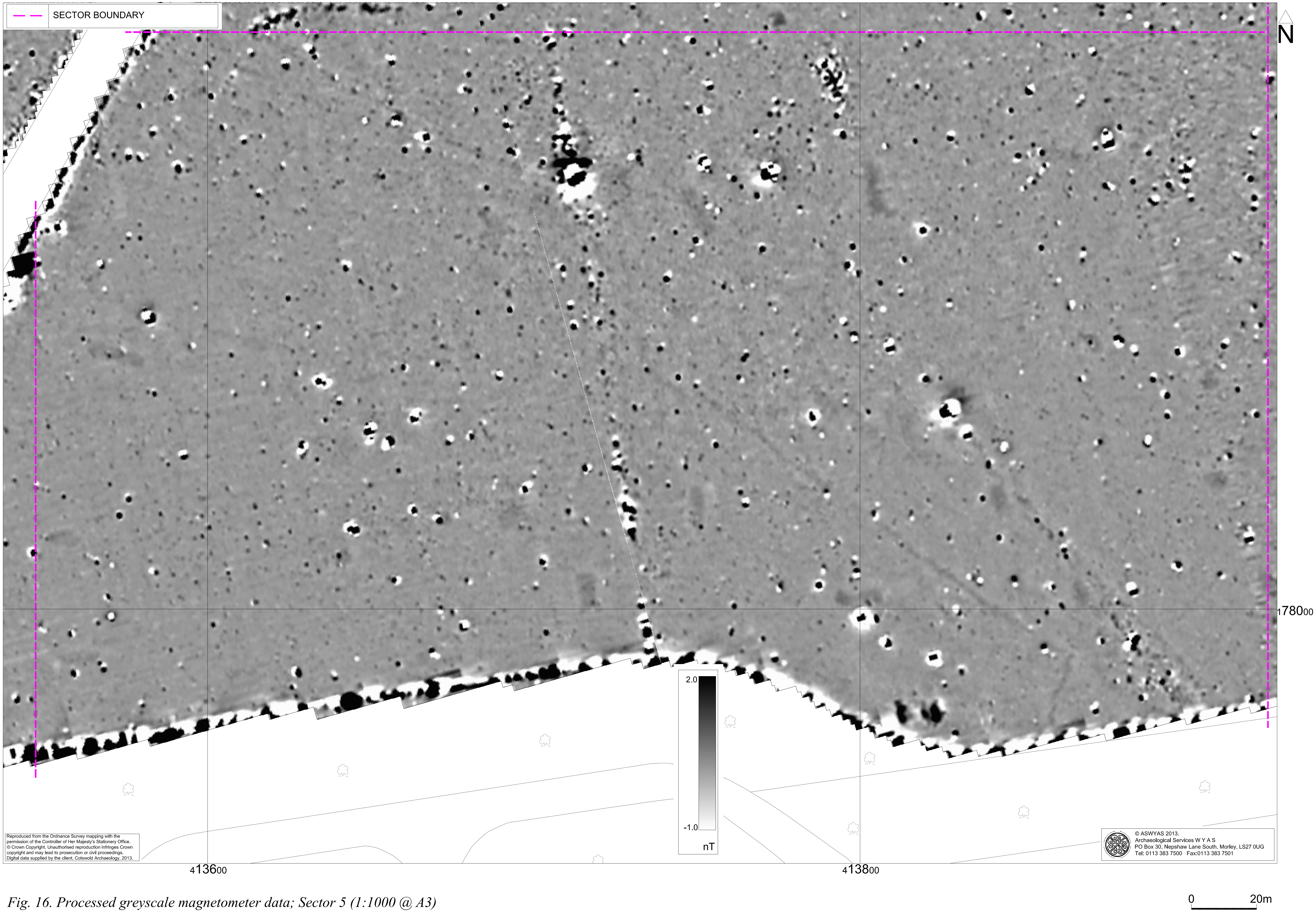

Fig. 16. Processed greyscale magnetometer data; Sector 5 (1:1000 @ A3)

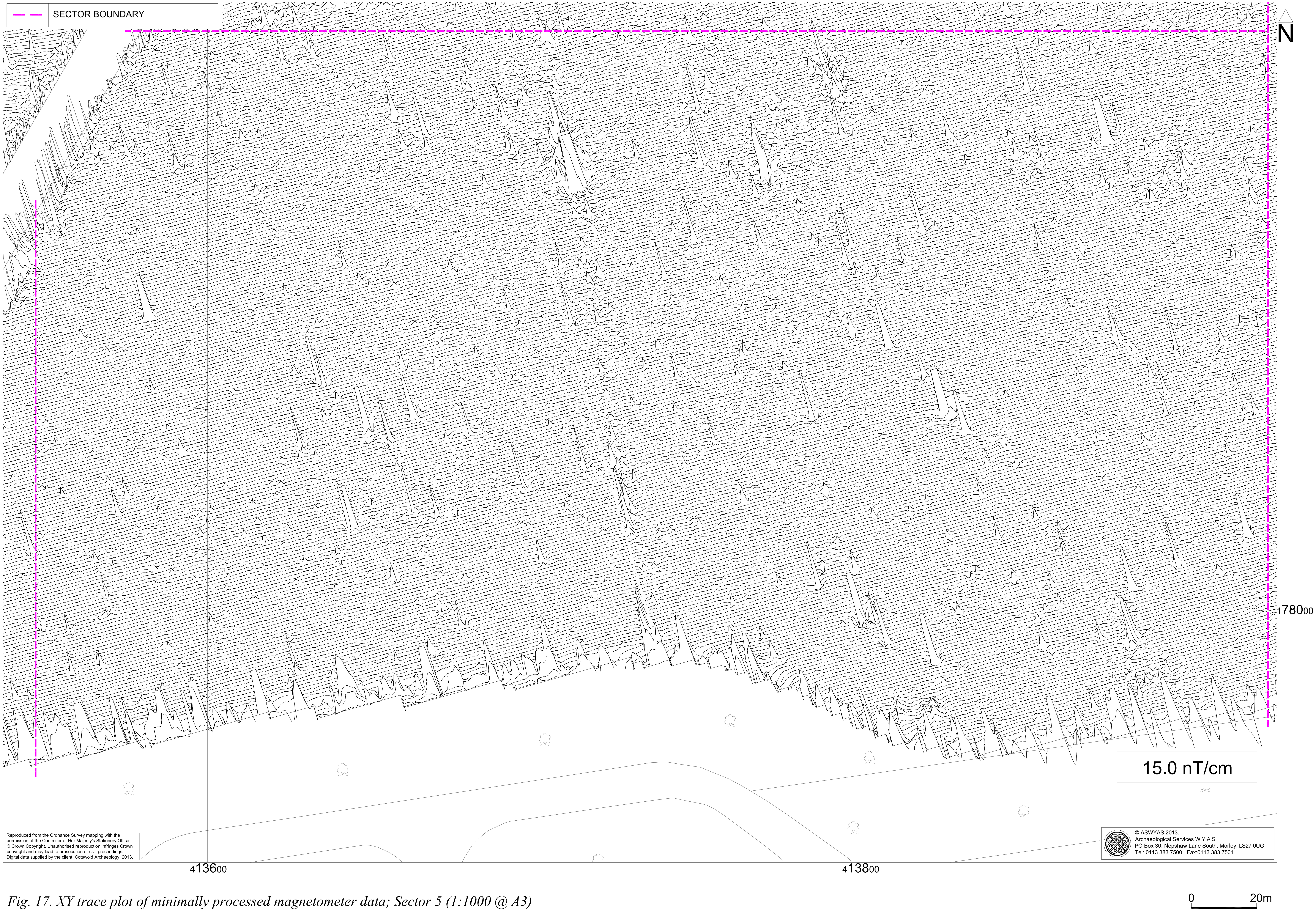

Fig. 17. XY trace plot of minimally processed magnetometer data; Sector 5 (1:1000 @ A3)

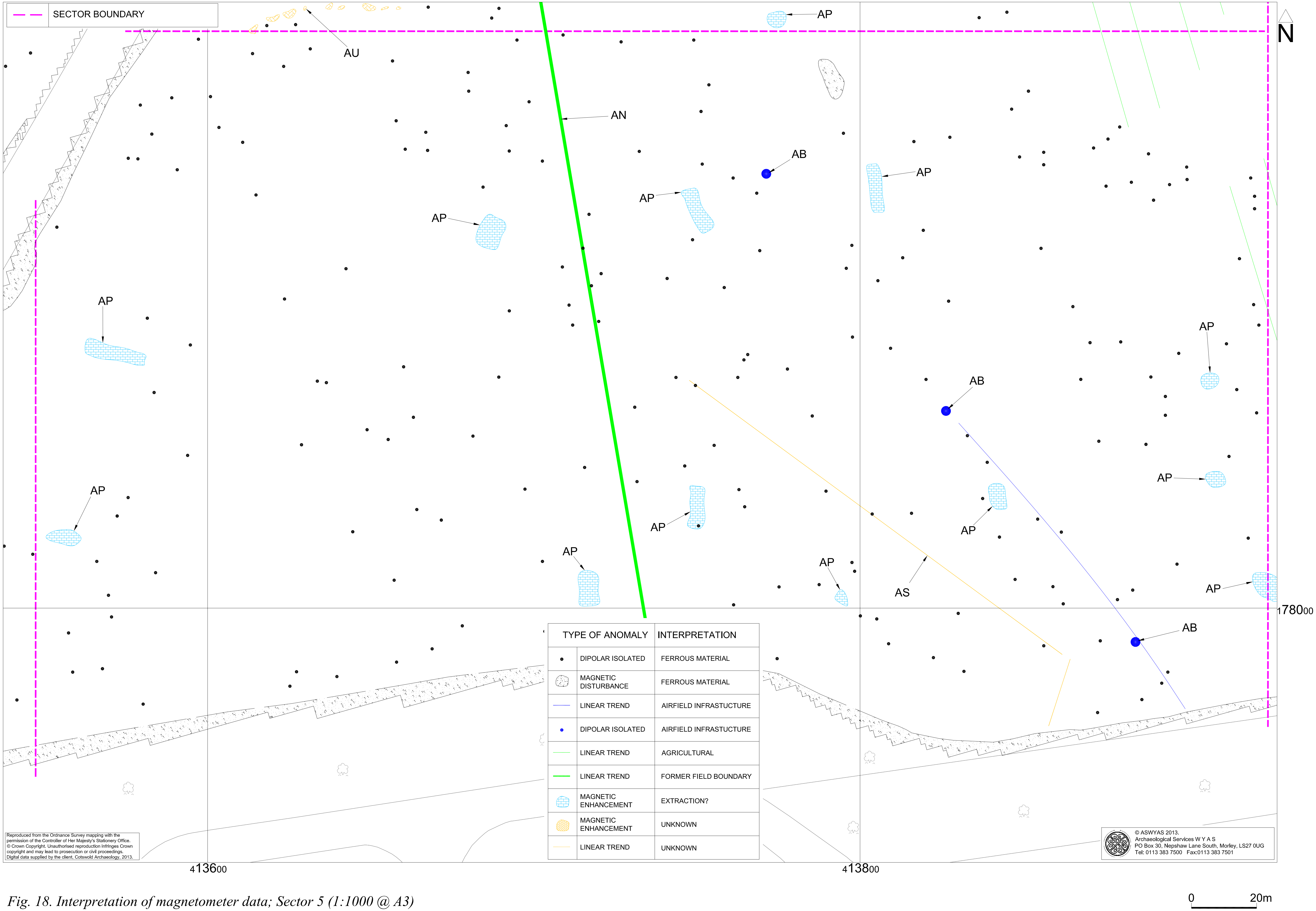

Fig. 18. Interpretation of magnetometer data; Sector 5 (1:1000 @ A3)

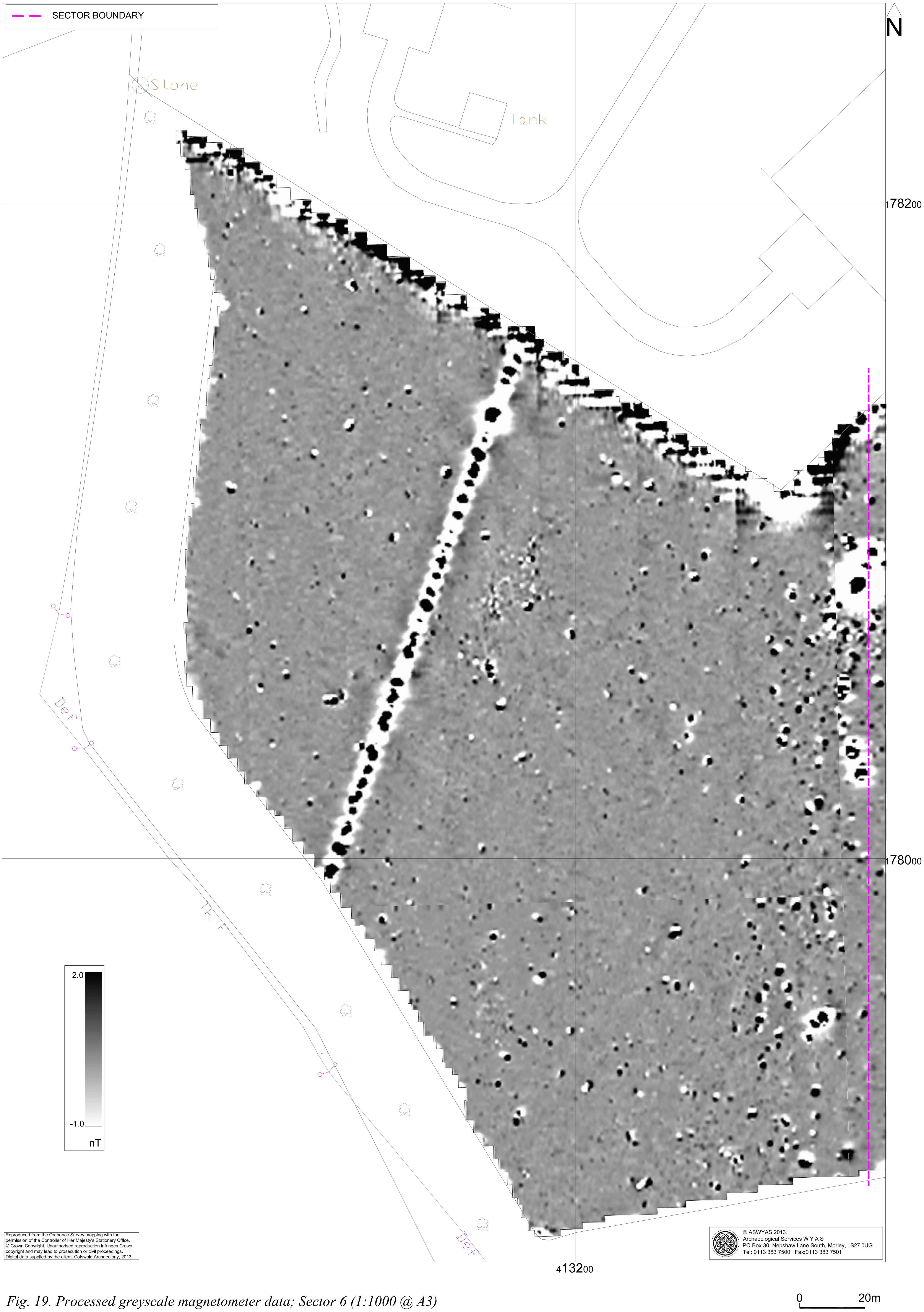

Fig. 19. Processed greyscale magnetometer data; Sector 6 (1:1000 @ A3)

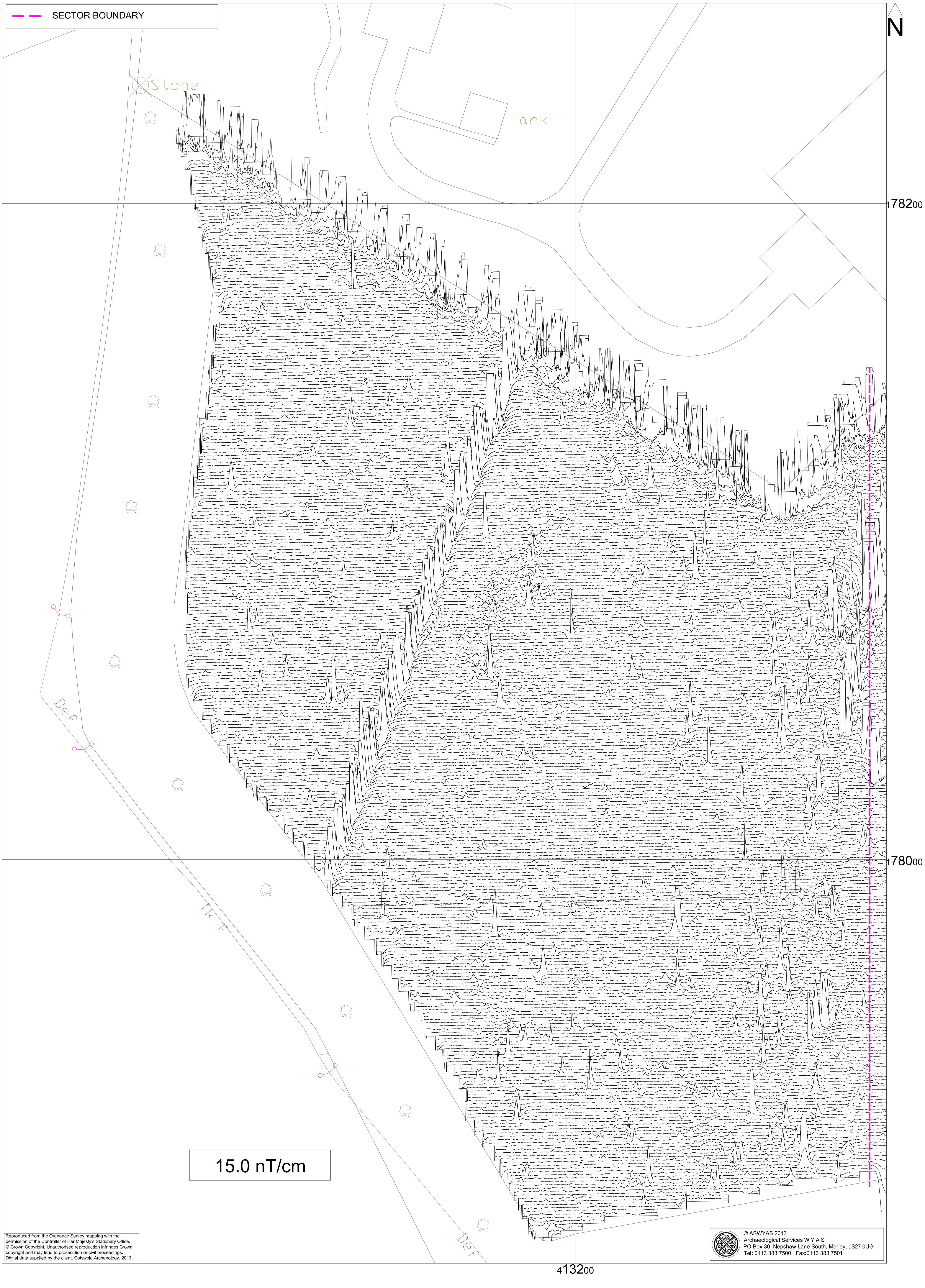

Fig. 20. XY trace plot of minimally processed magnetometer data; Sector 6 (1:1000 @ A3)

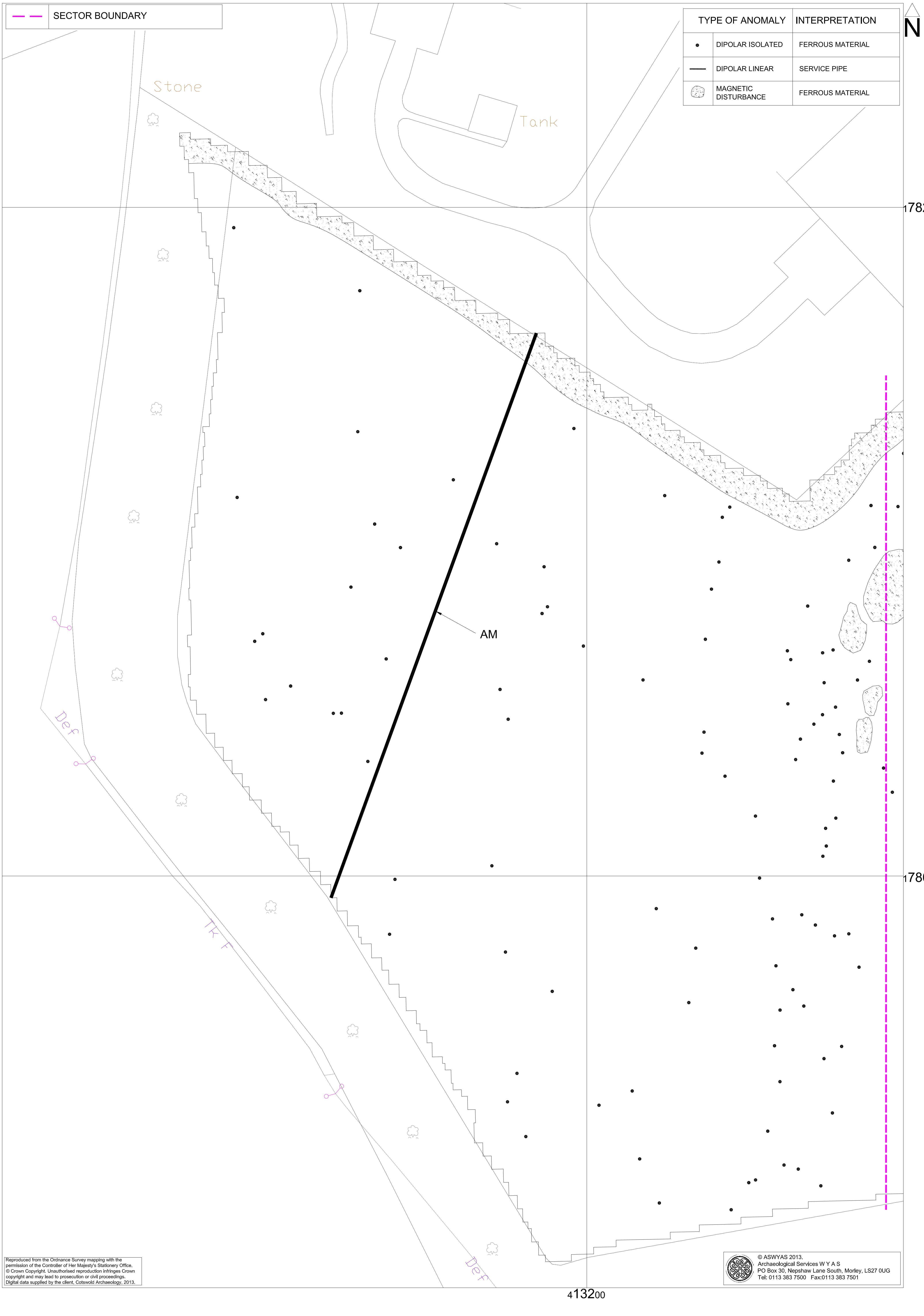

Fig. 21. Interpretation of magnetometer data; Sector 6 (1:1000 @ A3)

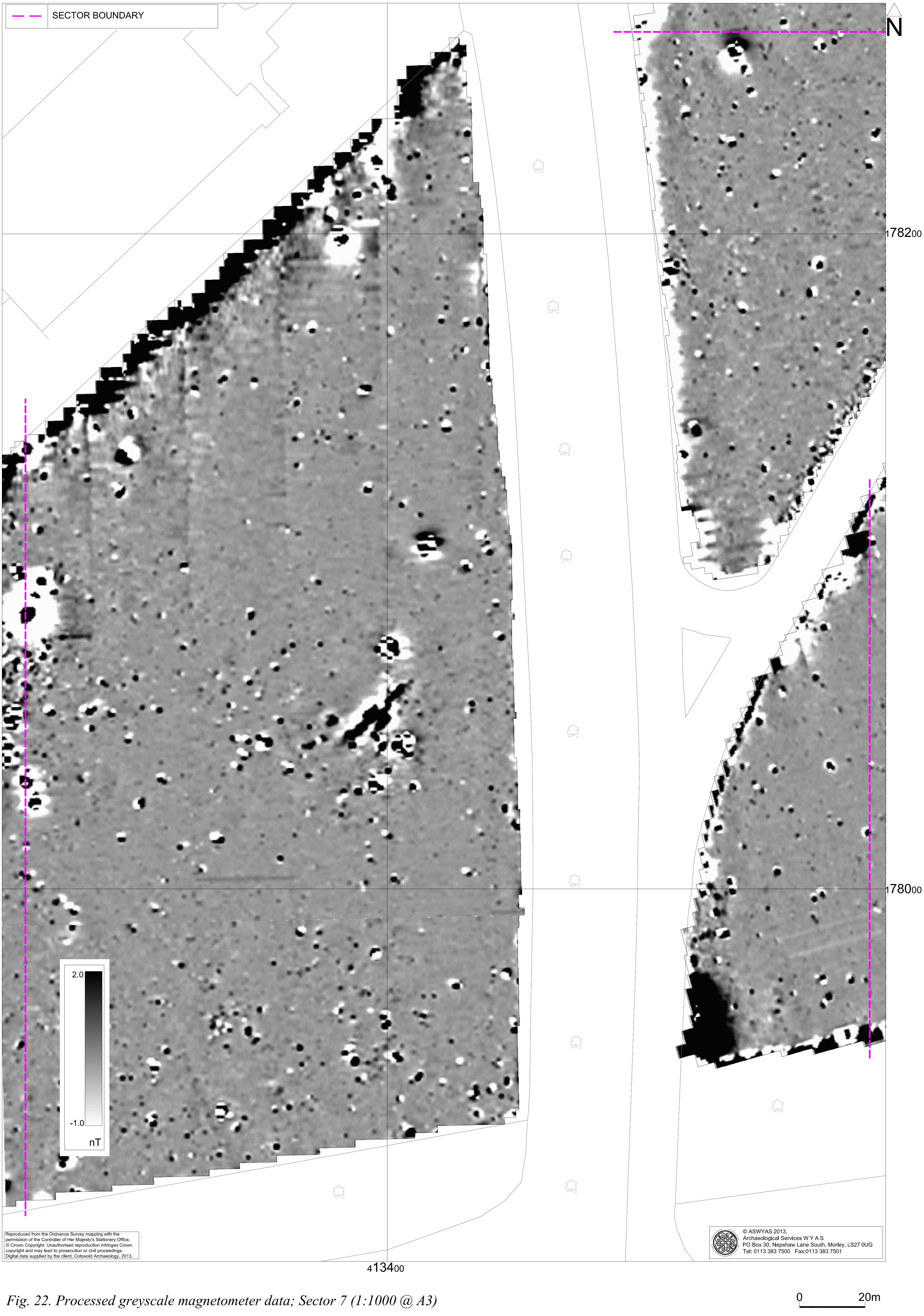

Fig. 22. Processed greyscale magnetometer data; Sector 7 (1:1000 @ A3)

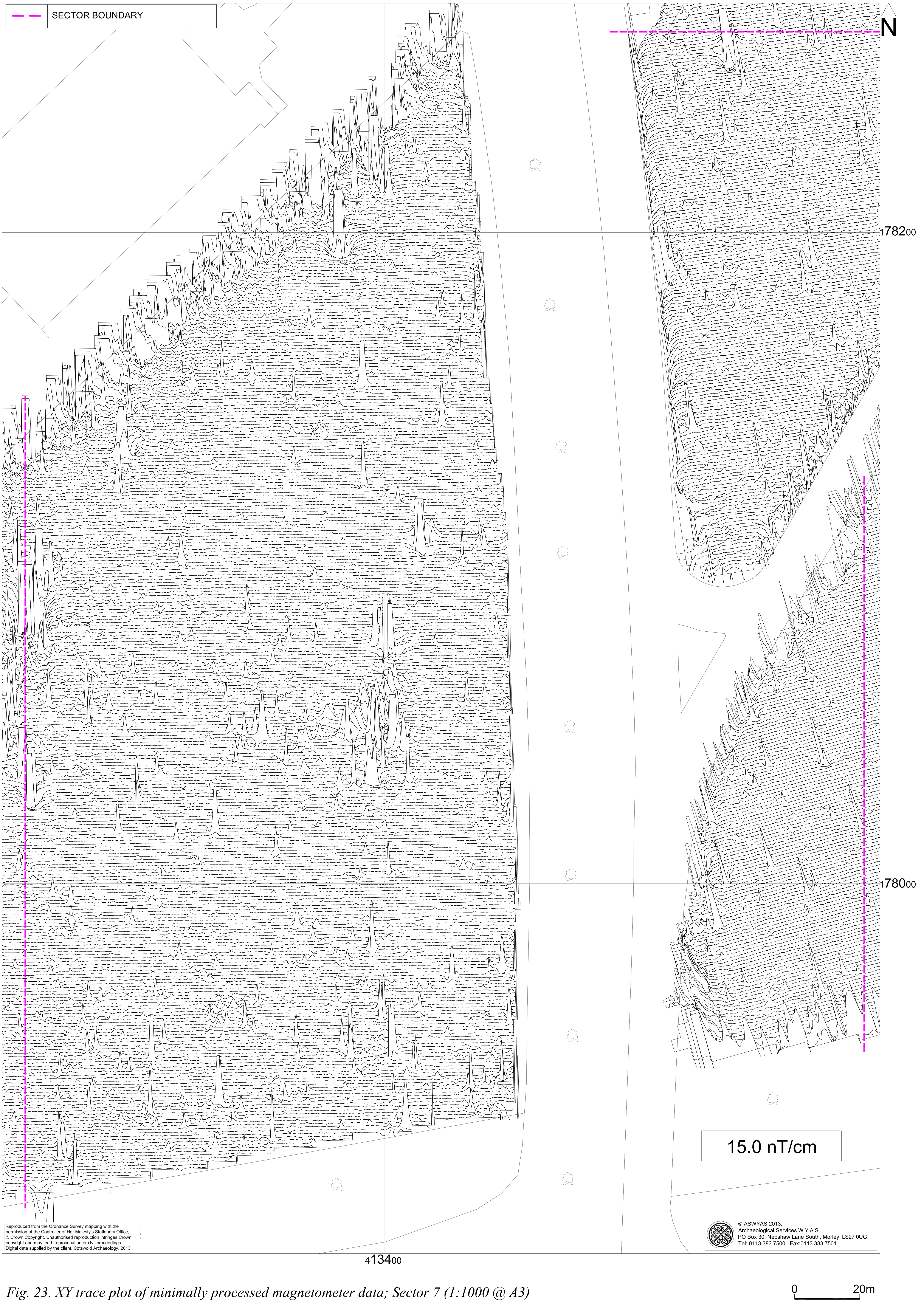

Fig. 23. XY trace plot of minimally processed magnetometer data; Sector 7 (1:1000 @ A3)

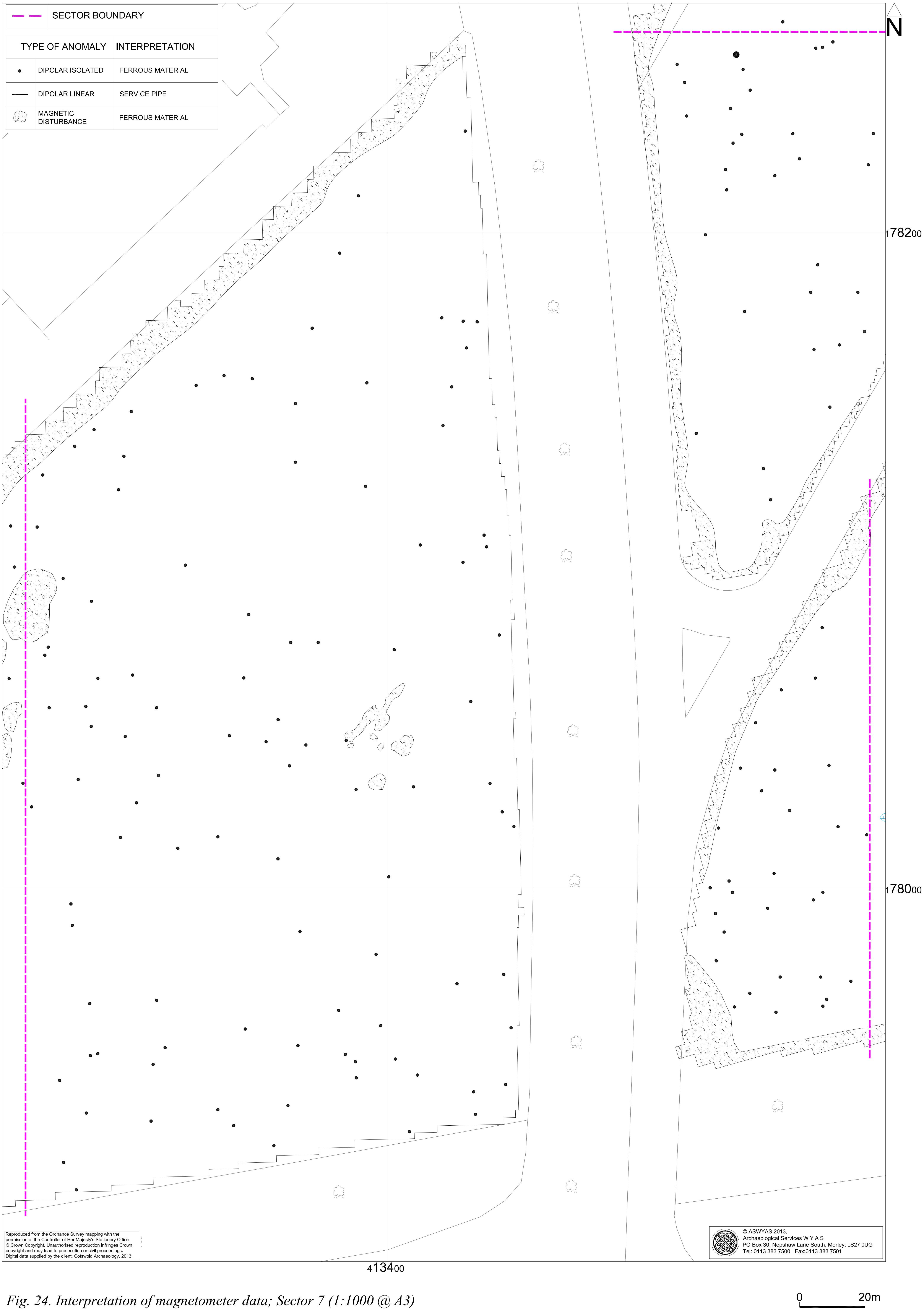

Fig. 24. Interpretation of magnetometer data; Sector 7 (1:1000 @ A3)

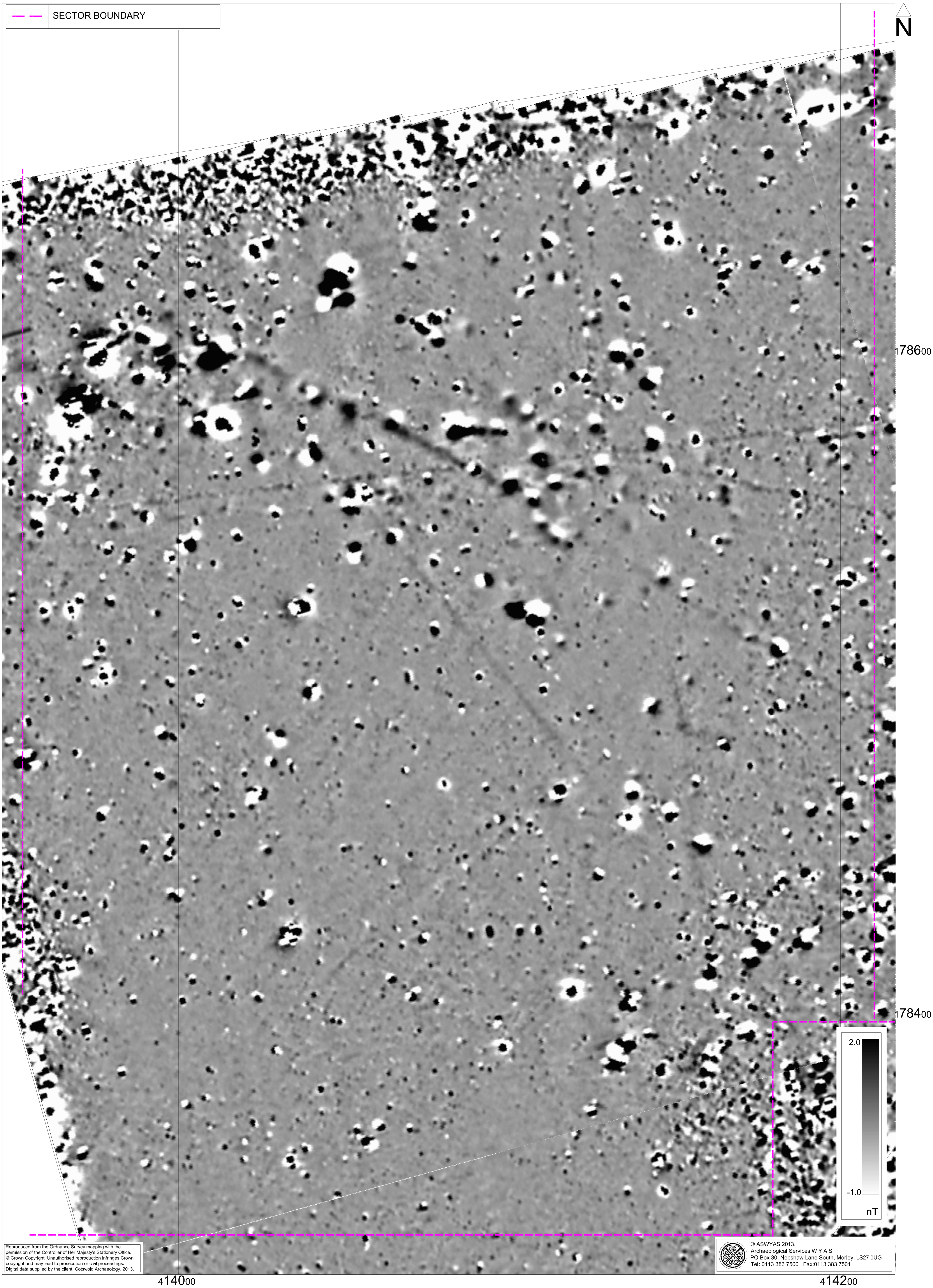

Fig. 25. Processed greyscale magnetometer data; Sector 8 (1:1000 @ A3)

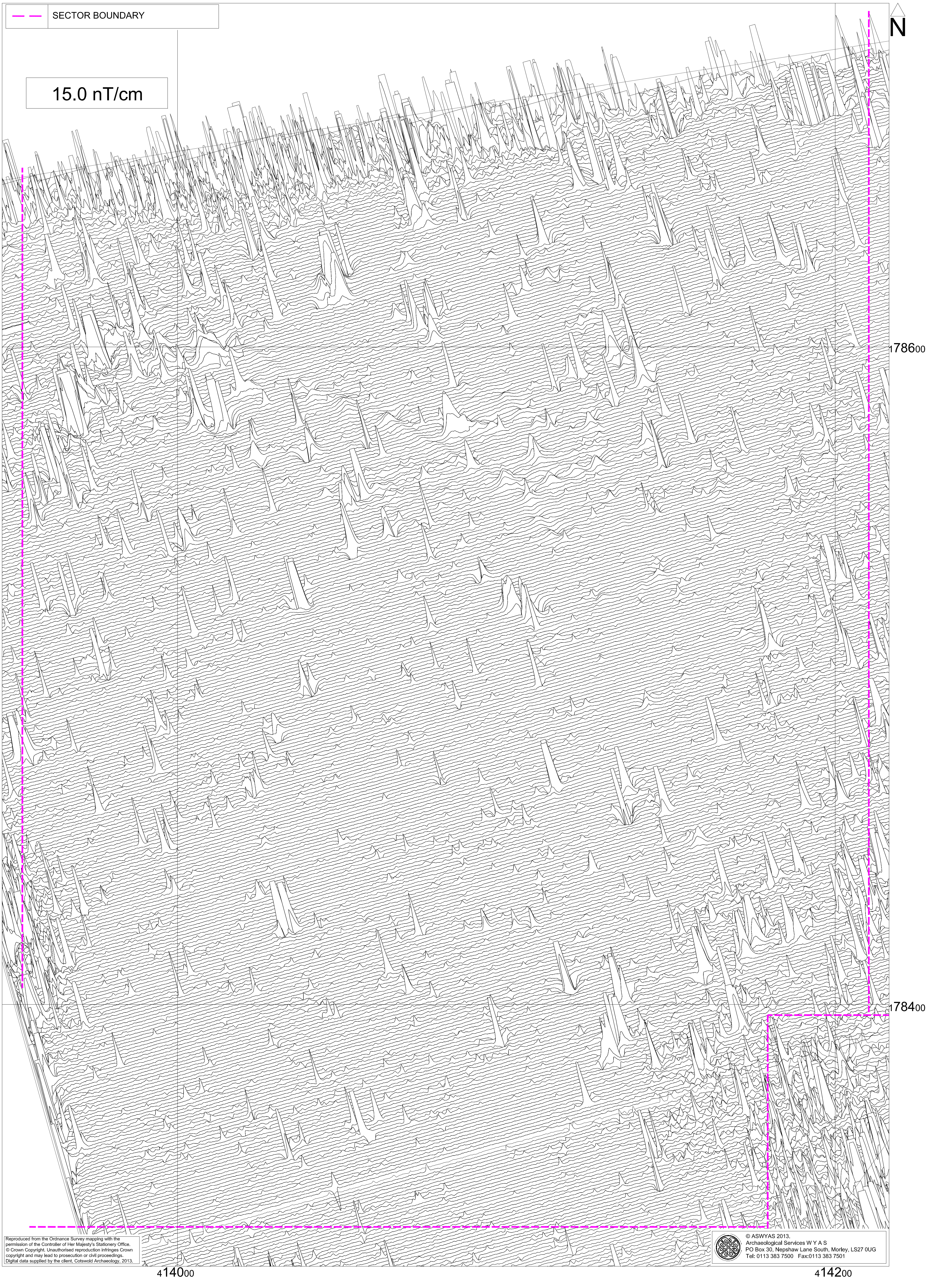

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Fig. 26. XY trace plot of minimally processed magnetometer data; Sector 8 (1:1000 @ A3)

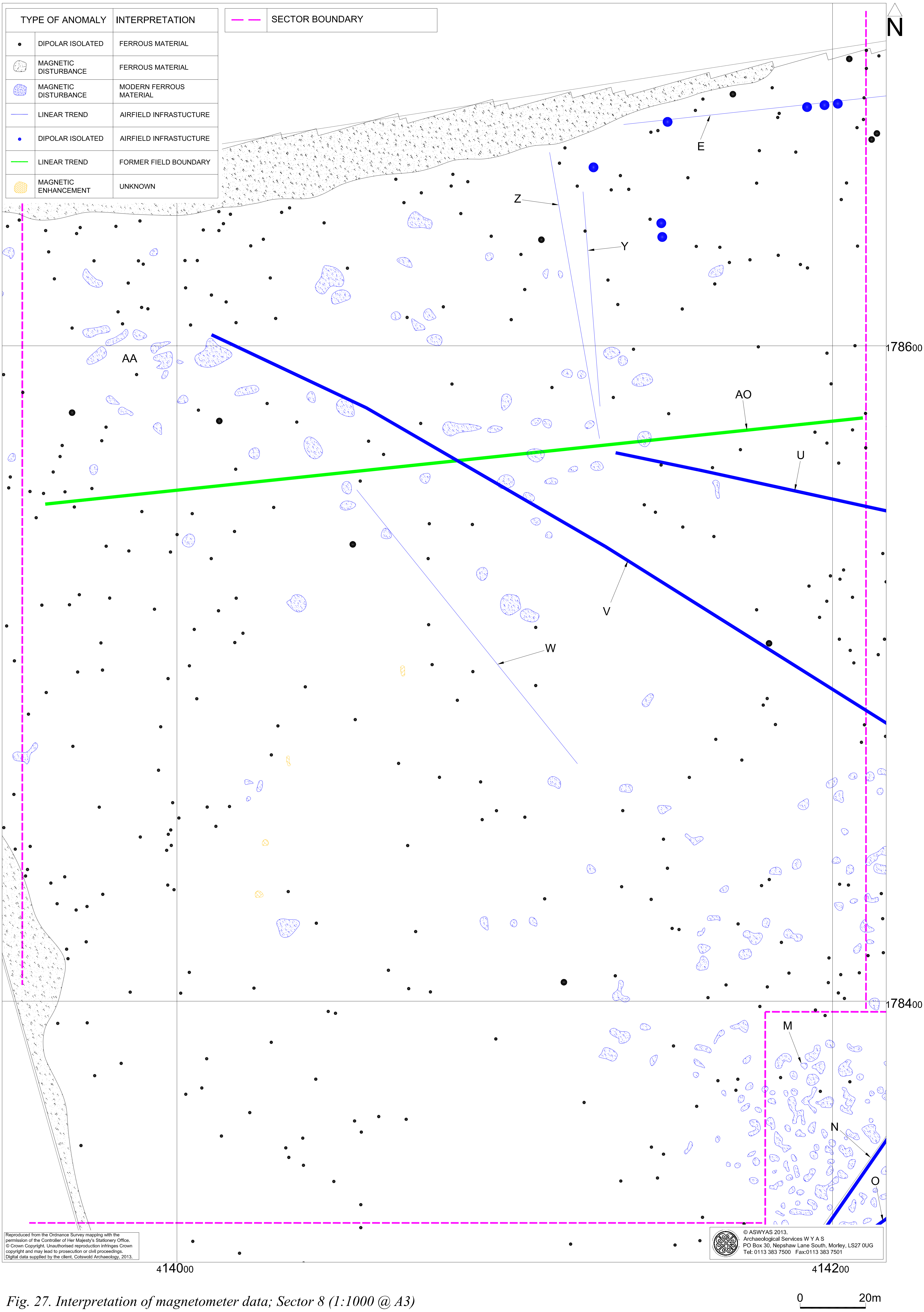

Fig. 27. Interpretation of magnetometer data; Sector 8 (1:1000 @ A3)

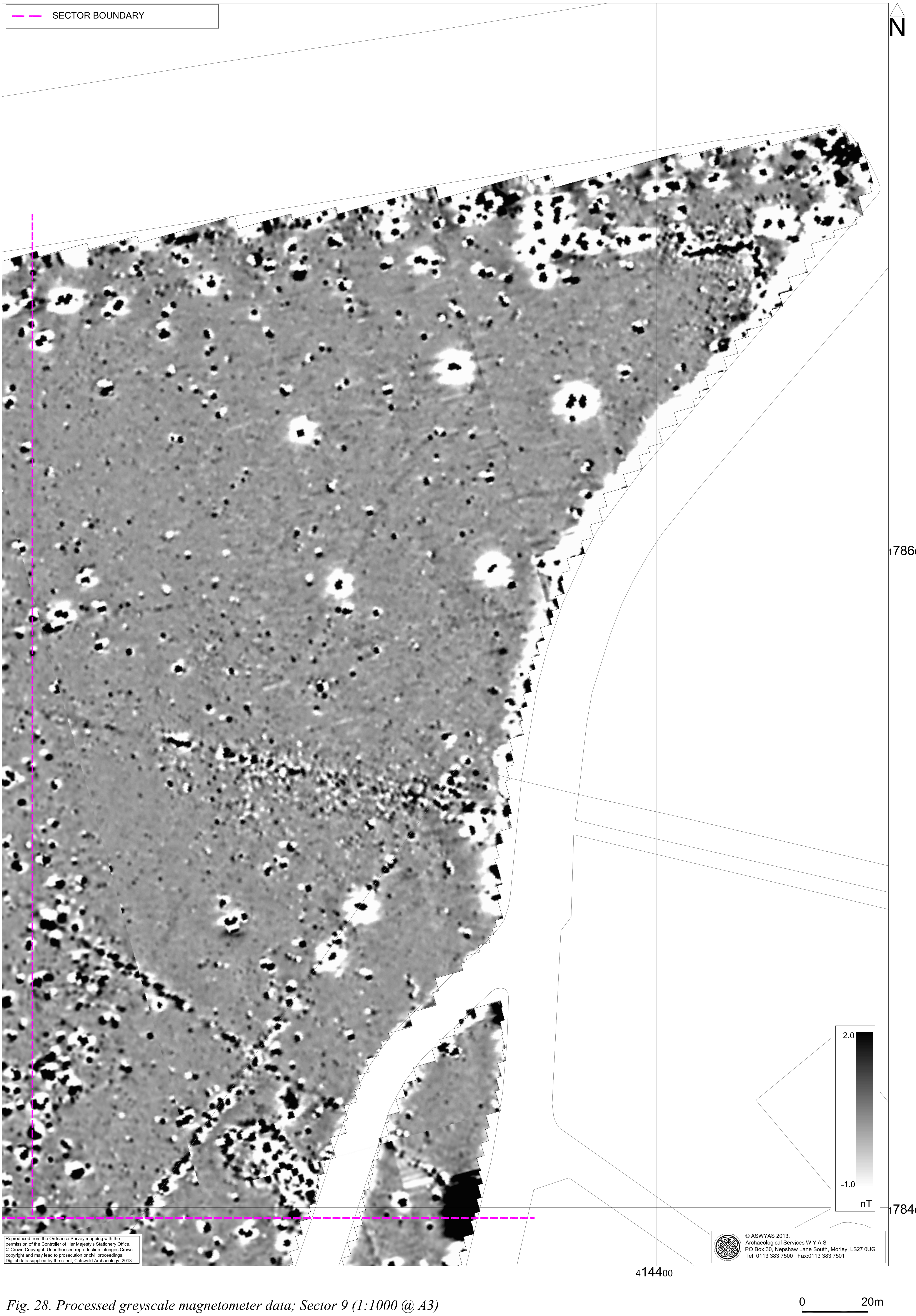

Fig. 28. Processed greyscale magnetometer data; Sector 9 (1:1000 @ A3)

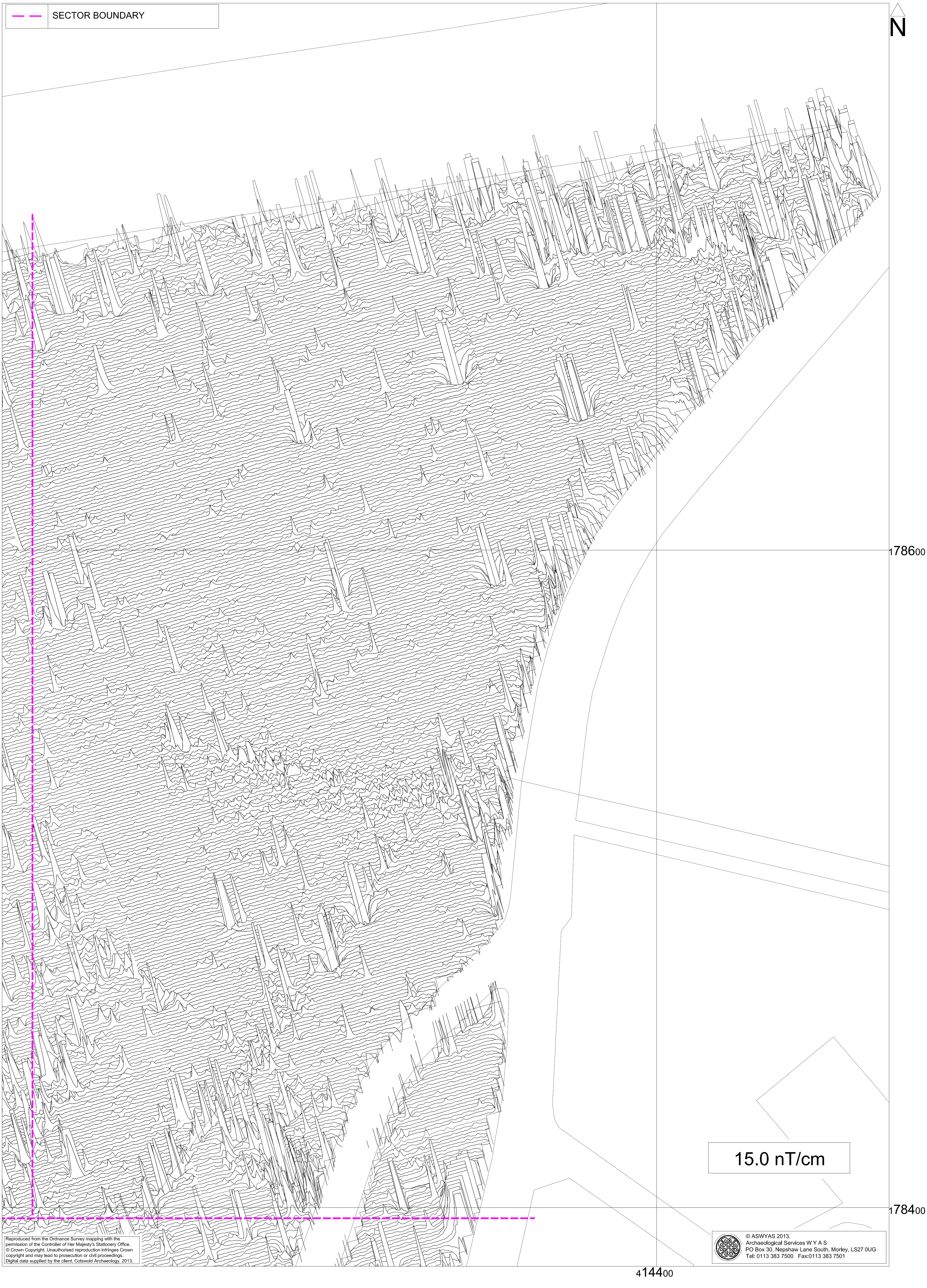

Fig. 29. XY trace plot of minimally processed magnetometer data; Sector 9 (1:1000 @ A3)

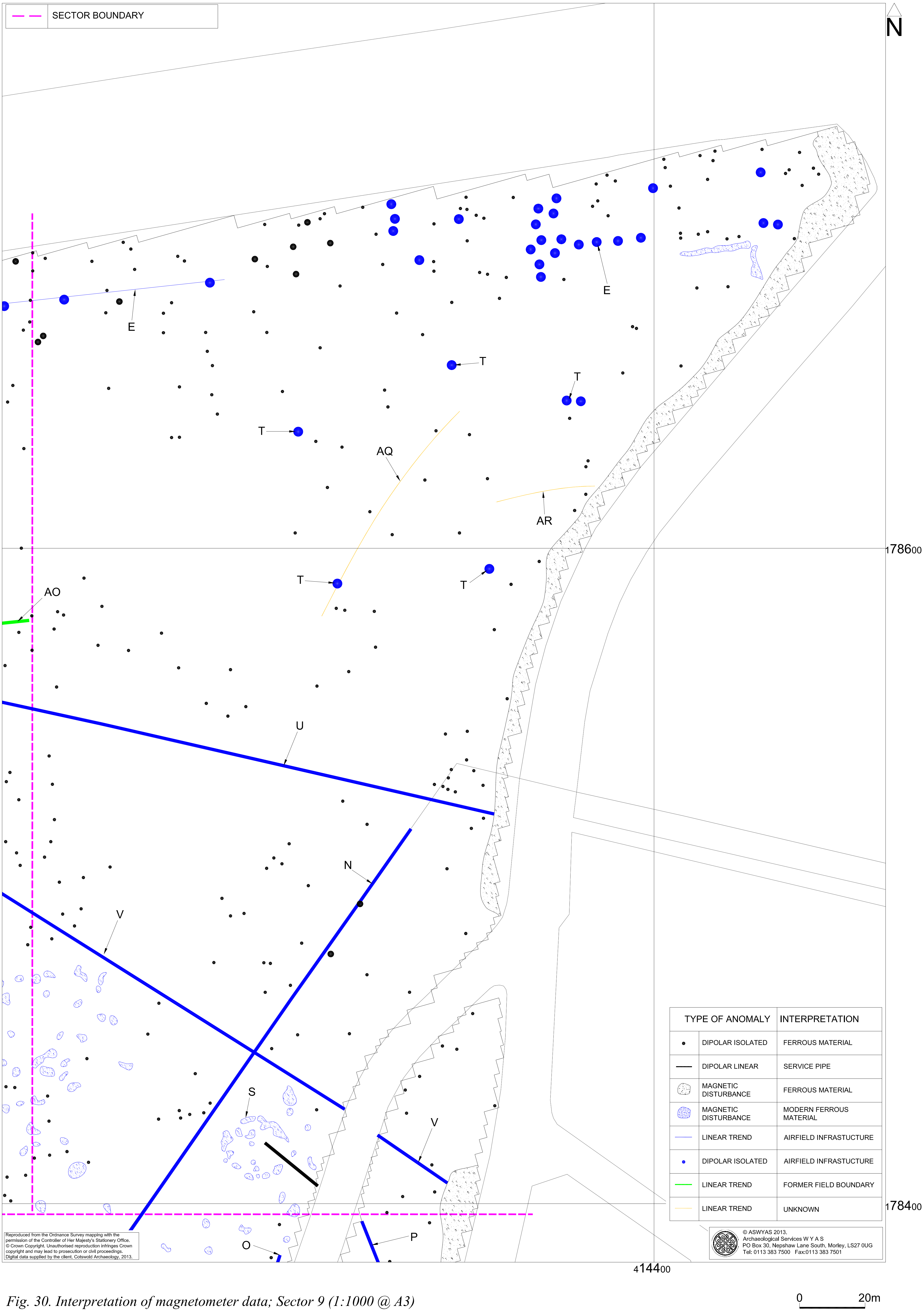

Fig. 30. Interpretation of magnetometer data; Sector 9 (1:1000 @ A3)

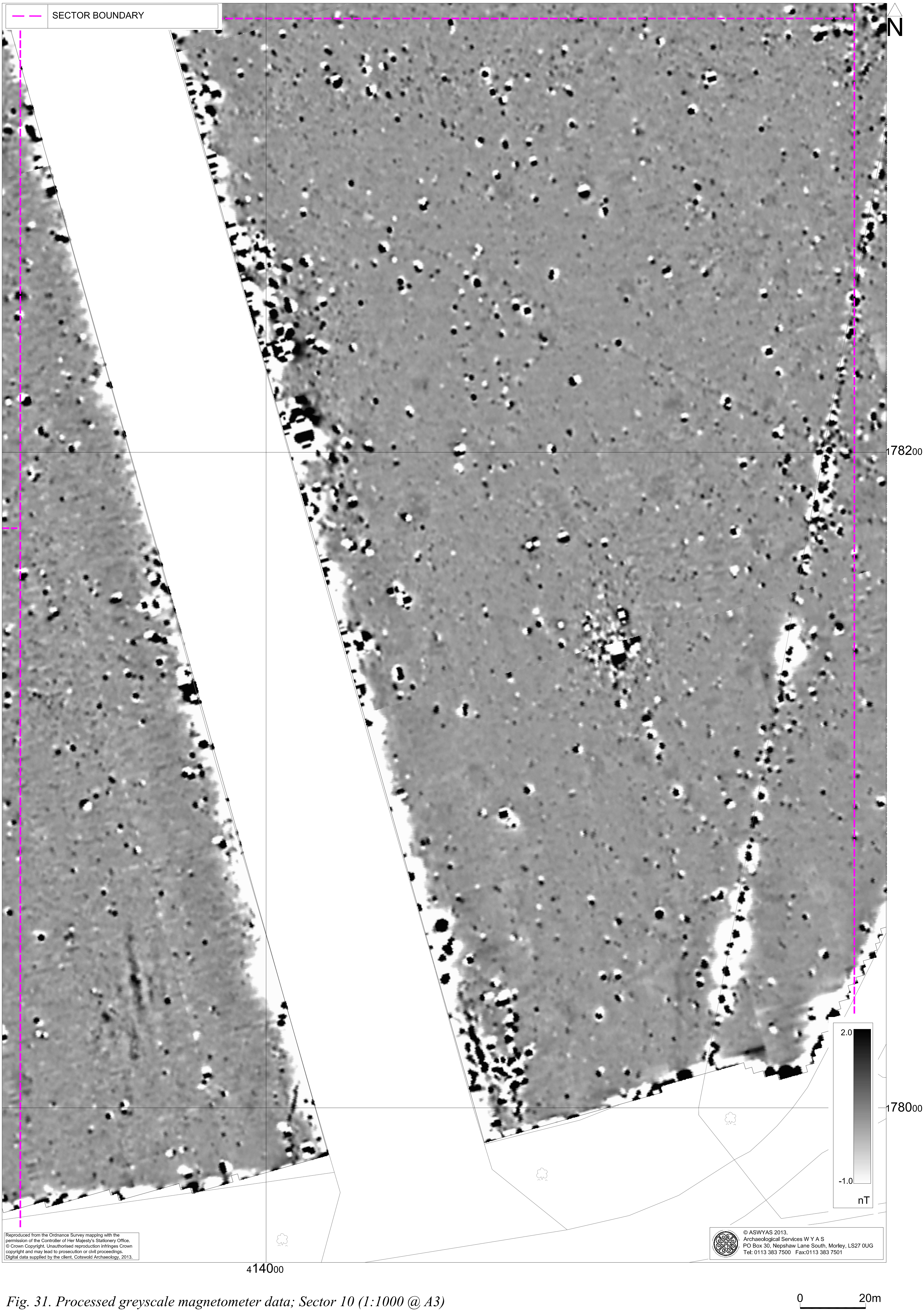

Fig. 31. Processed greyscale magnetometer data; Sector 10 (1:1000 @ A3)

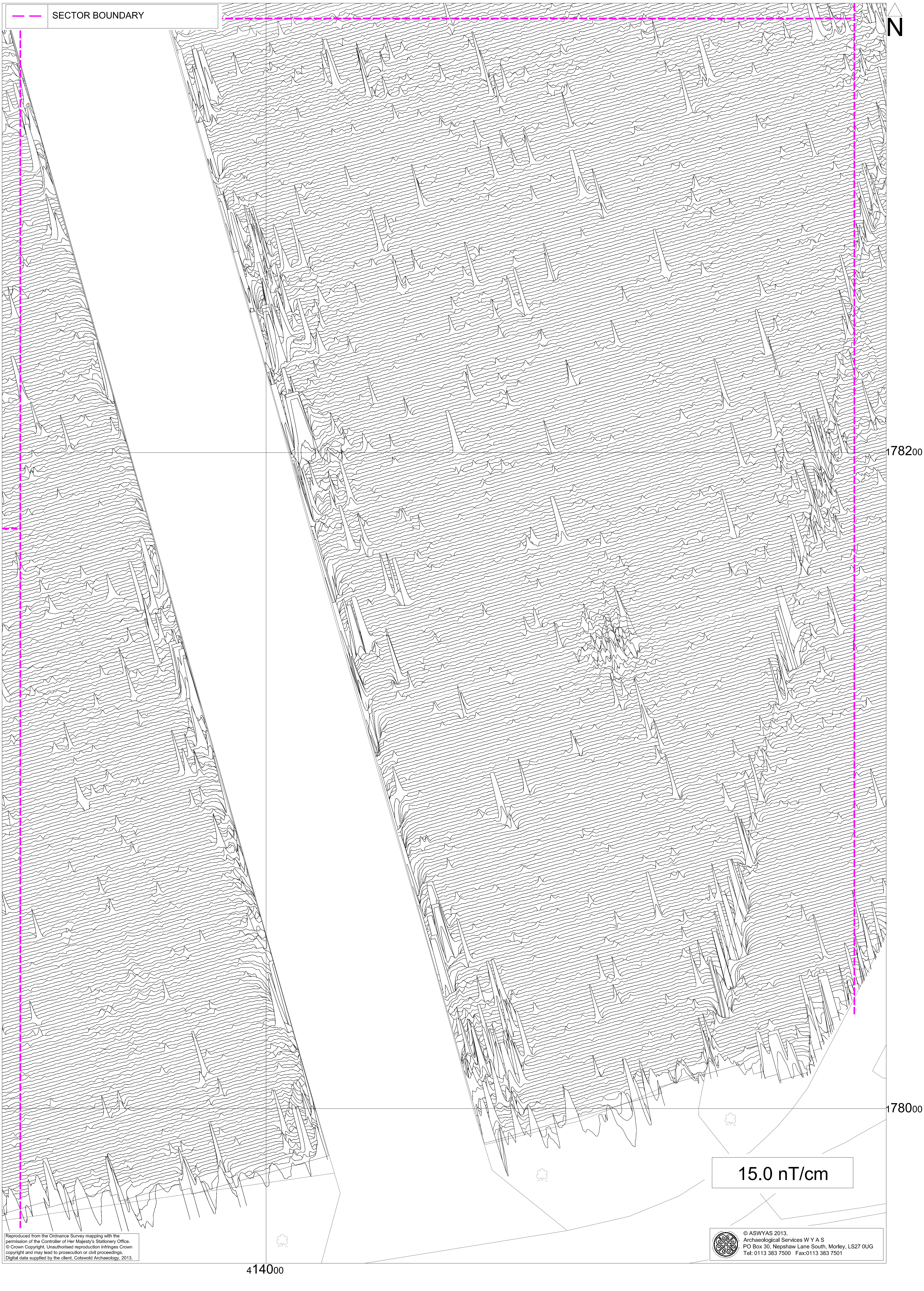

Fig. 32. XY trace plot of minimally processed magnetometer data; Sector 10 (1:1000 @ A3)

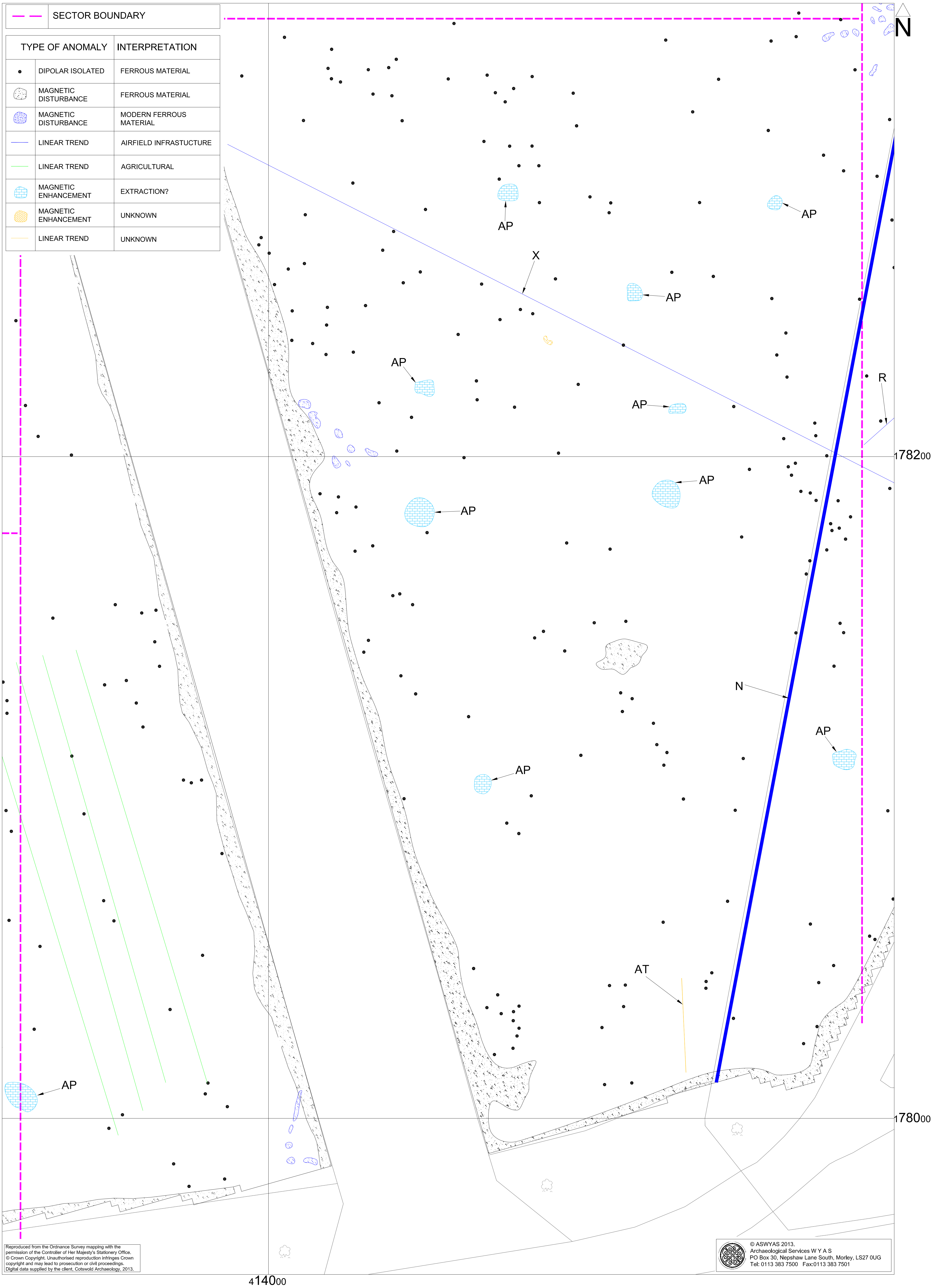

Fig. 33. Interpretation of magnetometer data; Sector 10 (1:1000 @ A3)

0 20m

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

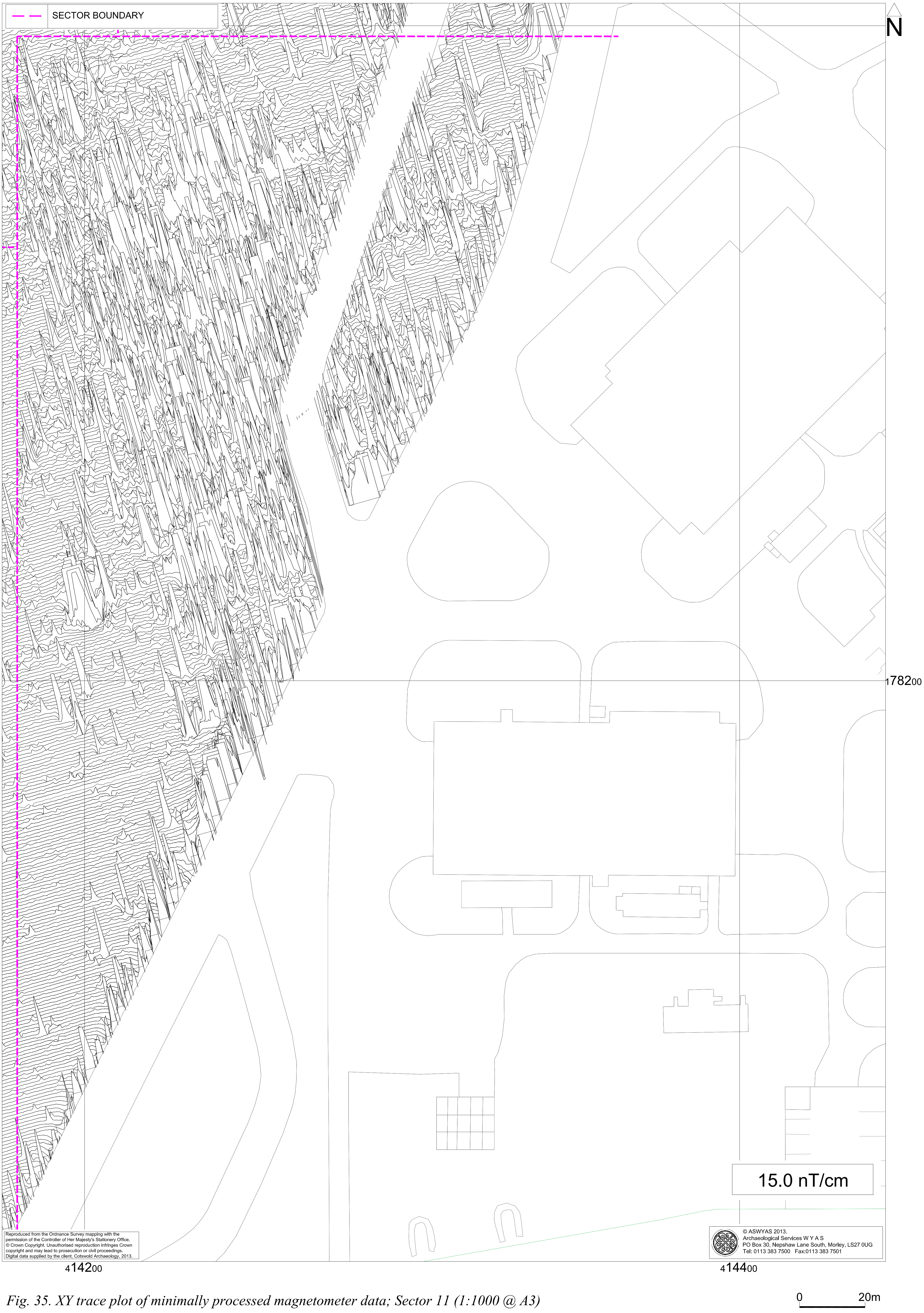

Fig. 35. XY trace plot of minimally processed magnetometer data; Sector 11 (1:1000 @ A3)

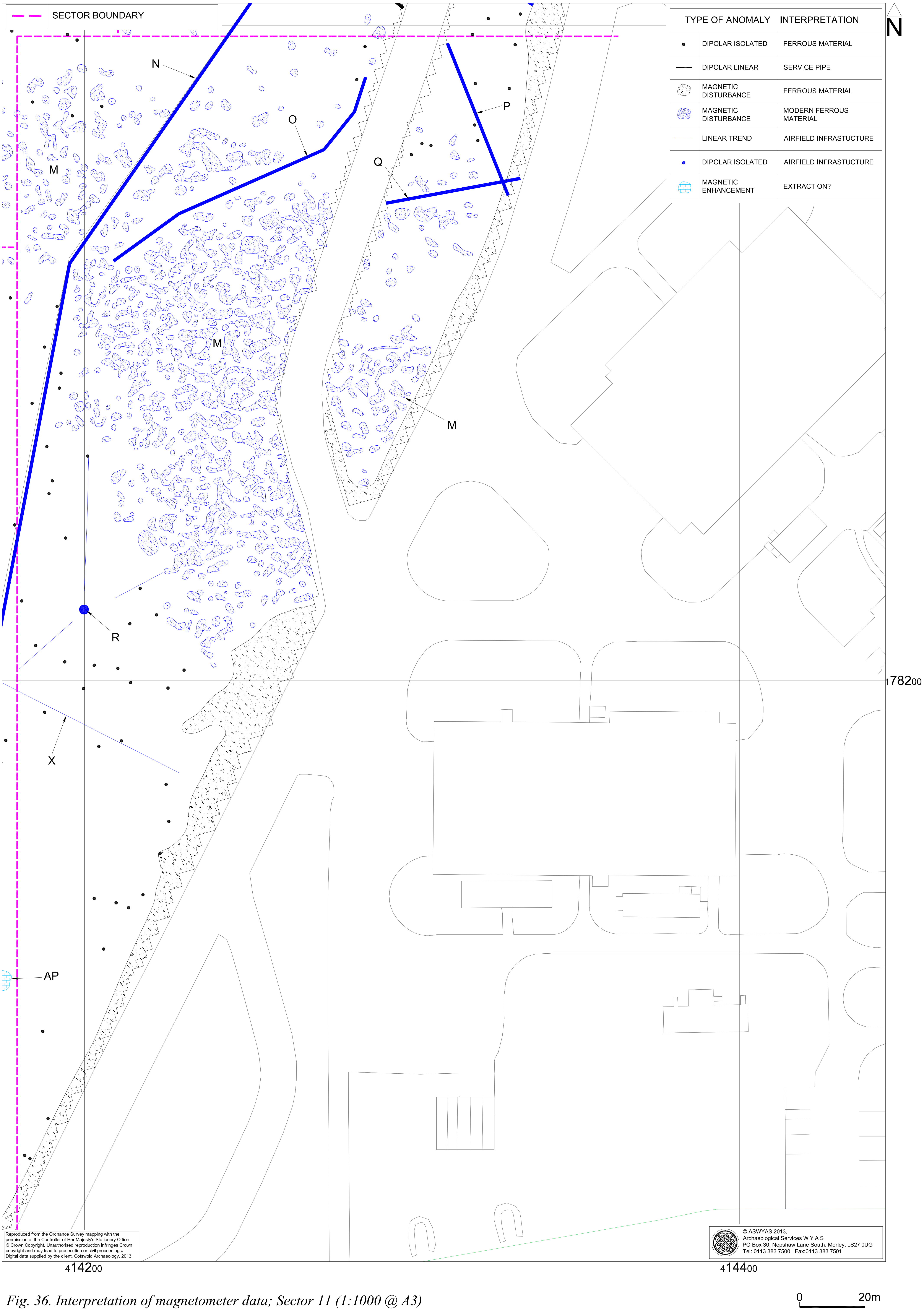

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Fig. 36. Interpretation of magnetometer data; Sector 11 (1:1000 @ A3)


Plate 1. General view of Sector 3, looking south-west


Plate 2. General view of Sector 8 and Sector 8, looking south


Plate 3. General viewof Sector 8 and Sector 9, looking east


Plate 4. General view of Sector 5, looking 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.

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 Wiltshire Historic Environment Record).

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