GEOPHYSICAL SURVEY REPORT
2009/41

Cunetio, Wiltshire

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Specialising in Shallow and Archaeological Geophysics

GSB Survey No. 2009/41

Cunetio, Wiltshire
SAM: 224765

Time Team Series XVII Programme X

NGR	SU 217 693
Location	Black field, an area of land near Forest Park Farm, Marlborough, Wiltshire.
County	Wiltshire.
District	Wiltshire.
Parish	Mildenhall CP.
Topography	Gently undulating.
Current land-use	Arable.
Soils	Frome association: Shallow calcareous and non-calcareous loamy soils over flint gravel affected by ground water (SSEW 1983).
Geology	Chalky and gravely river alluvium (BGS Sheet 266).
Archaeology	Roman Town of *Cunetio* (Monument no. 224765). Aerial photography and excavations in the 1950's and 60's have revealed evidence of a street system and several stone buildings enclosed by defences (Scheduling entry as cited in *Mower 2009**).
Survey Methods	Detailed Magnetometry, Ground Penetrating Radar.

Aims

The geophysical survey at *Cunetio* was undertaken as part of a wider archaeological assessment being carried out by Channel 4's **Time Team**; the broader research aims are defined in the Project Design (Mower 2009).

Summary of Results

The results of the gradiometer and GPR surveys show a complexity of features related to the Roman Town of *Cunetio,* including both the earlier and later defences, buildings, streets and other anomalies associated with occupation. The results have added considerable detail to the crop mark plan of the town.

Project Information

Project Co-ordinators: J. Adcock & E. Wood
Project Assistants: G. Attwood, Dr. J. Gater, C. Stephens & J Anderson (*GSB)*
M Langton, M Todd (*LTU Ltd*) Jesper Emilsson (Mala)
Date of Fieldwork: 2nd - 4th September 2009
Date of Report: 15th December 2009

Survey Specifications

Method

The 20m survey grid was set out and tied in to the Ordnance Survey (OS) grid using a Trimble R8 Real Time Kinematic (RTK) GPS system by **Dr Henry Chapman**.

Technique	Traverse Separation	Reading Interval	Instrument	Survey Size
Detailed Magnetometry (Appendix 1)	1m	0.25	Bartington Grad 601-2	c. 11ha
Resistance – Twin Probe (Appendix 1)	-	-	-	-
Ground Penetrating Radar (GPR) (Appendix 1)	0.5m / 1.0m	0.05m	Sensors & Software Noggin SmartCart*plus* 250MHz	c. 0.25ha
Ground Penetrating Radar (GPR)	0.08	0.08	Mala MIRA 400MHz	c.0.5ha

Data Processing

	Magnetic	Resistance	GPR
Zero Mean Traverse	Y	-	-
Step Correction	Y	-	N
Interpolate	Y	-	Y
Filter	N	-	As indicated

Presentation of Results

Report Figures (Printed & Archive CD):	Location, data plots and interpretation diagram on base map (Figures 1-8).
Reference Figures (Archive CD):	Data plots at 1:500 / 1:1000 for reference and analysis. (See List of Figures).
Plot Formats:	See Appendix 1: Technical Information, at end of report.

General Considerations

Conditions for survey were good as the ground cover at the time consisted of stubble. A Malå MIRA 400MHz GPR system was trialled as part of the investigation and used to survey a large block over part of the presumed *Mansio*. Equipment and expertise were kindly supplied by **LTU Surveys**.

Smaller scale ferrous anomalies ("iron spikes") are present in the survey area, their form best illustrated in the XY trace plots. These responses are characteristic of small pieces of ferrous debris in the topsoil and are commonly assigned a modern origin. While the most prominent of these are highlighted on the interpretation diagram, they are not discussed in the text below unless considered relevant.

Depths referred to in the interpretation of GPR data *are only ever an approximation*. The conversion from delay time to depth depends upon the propagation velocity of radar waves through the ground; this can vary significantly both laterally and vertically on sites such as this. A velocity of 0.79m/ns has been used. Where there is a strong electromagnetic contrast, the GPR signal can be inter-reflected or reverberated, producing a delay in the reflection of the signal. This is termed ringing and happens to some extent with all reflections, resulting in a greater apparent depth than actually exists. As a result, it is often not possible to detect the base of features; only the tops of buried deposits are detected with any kind of certainty (A.P.Annan, 1996).

GPR interpretation is based on the combined analysis of both radargrams and the time-sliced data.

Results of Survey

1. Magnetic Survey

1.1 The results show a plethora of archaeological anomalies, including two phases of the town's defences, the street plan and numerous buildings. The interpretation of the geophysical results is difficult due to the complex nature of the anomalies (and their sheer number), however, aerial photography of the site has helped in identifying some of the responses.

1.2 The later town defences of *Cunetio* are shown as bands of decreased response – typical of those normally associated with buried wall foundations. Approximately at the mid point of the southern section a break (A) can be seen which relates to the south gate. These defences cover a slightly greater area than the earlier earthen defences which can be seen as both positive (ditch) and negative (bank) responses. Clear breaks on both the eastern and western sides can be seen, in which a street into the town is visible (see Paragraph 1.7).

1.3 Anomalies (B) correspond to 'Building 8' (Corney 1997), identified as a probable Mansio and having at least twenty-four rooms. Although the majority of responses from this area simply form a zone of increased magnetic readings, suggesting demolition spread, a number of wall lines / rooms can be seen. Clearly such a building would benefit from a resistance survey, but this was not possible in the timescales available.

1.4 Another response associated with buildings can be seen at (C), although not as clearly defined as (B). A large enclosure appears to be surrounding, measuring approximately 48m by 60m and is aligned with the street plan; the enclosure is not visible on the crop marks.

1.5 In the northwest section of the data, a series of negative linear responses (D) relate to a villa building, with an apse on the north side, which is clearly visible in the data. This building is likely to be associated with the later defences of the town as the villa appears to cut through the earlier ones.

1.6 A number of other responses such as (E), again indicating building remains, can be seen within the data; these are also seen in the crop mark photographs. As with response (C) some of these buildings are aligned with the roads.

1.7 The street plan of *Cunetio* is shown as bands of low magnetic readings. The east-west street cuts through the defences as already mentioned in Paragraph 1.2. Although a clear grid layout is visible, it is not strictly on a rectilinear axis; note for example the alignment of anomaly (F) which indicates another building.

1.8 The northern section of the data has proved more difficult to interpret and as a result some of the responses have been given an *'Uncertain'* category; it is likely that they have an archaeological background although a modern or natural source cannot be dismissed.

1.9 Apparently bisecting the northern part of the town, there is a ditch-like anomaly (G) which follows a curving east-west alignment. It is possible that this is an earlier feature but such an interpretation is tentative.

1.10 Outside the town plan, a number of anomalies have been recorded, the majority of which are pit-like in nature, although a few ditch features have been detected. In addition, it is possible that some of the anomalies could indicate small-scale industrial activity. An enclosure (H) is also present, which seems to be appended to the earlier town defences. On the southern section of this enclosure a building is shown, this relates to building 12 (Corney 1997). Although Building 13 is also recorded in this enclosure, unfortunately the 'finds tent' precluded any survey.

2. Ground Penetrating Radar Survey

2.1 Two instruments were utilised on this site; a more traditional single-channel cart system (Sensors & Software SmartCart*plus* 250MHz) and a multiple-array system (Mala MIRA 400MHz, courtesy of LTU Ltd.) utilising 9 transmitting and 8 receiving antennas allowing for the collection of 16 traverses of data at 0.08m separation simultaneously. The antenna array is mounted on a small vehicle and positional information recorded with either an RTK GPS or robotic Total Station. Data collection is very fast and the resultant dataset exceedingly large and dense. The Mala system is new to the field of archaeology and, as such, the best way to handle, process and interpret the resultant intricate datasets is still under investigation. For this reason only an example of the data has been included in the summary diagrams. A full set of basic time-slices are included on the Archive CD as well as a short animation of those slices. Further work is ongoing and will hopefully be published at a later date, whilst the remainder of this report relates solely to the single-channel data.

Mansio

2.2 This small block of survey was to serve as a comparison between the Mala and Sensors & Software equipment. The main walls of the Mansio are clearly defined, whilst a series of lower amplitude linear anomalies and trends seem to denote less substantial, or more degraded wall lines. The interpretation of the shallower deposits is hampered slightly by the ploughing striations which are in a similar orientation to the archaeology. Zones of increased response and high amplitude anomalies between the wall lines are likely to be a combination of demolition spreads, floor surfaces and perhaps hypocaust systems.

West Field - North

2.3 Survey over the southwest corner of the later town defences showed, very clearly, the line of the large stone wall (1) and the bastioned corner. Few strong reflectors were recorded through the centre of the bastion and up the centre of the wall line. This may be a facet of the construction or simply differential robbing of the construction material.

2.4 The shallowest slices show much disturbance from agriculture and this has made the classification of certain anomalies difficult. The zones of increased response (2), west of the main town wall, could be simply the effects of cultivation in this arable field. That said, the southern most zone tracks a similar orientation to the adjacent trend (3) which is, in turn, coincident with a band of increased response (4) which could be a metalled road surface contemporaneous with the latter defences. If this band of weak reflections is a road line, then the increased response levels immediately adjacent may be of significance; there are numerous crop marks recorded is this area.

2.5 Two negative features have been transcribed from crop marks which are coincident with the low amplitude trends (6) seen crossing the survey area. These would appear to be cut features but, at 14m apart, they seem too far apart to be a pair of roadside ditches. They possibly pre-date the defensive wall (1) as the northernmost ‘ditch’ crosses the southwest corner but does not appear to have cut through the construction material.

2.6 Conversely, the pair *do* cut the spread of increased response and high amplitude anomalies (7), seen from around a metre below ground level. It is unclear as to whether these are purely natural responses or reflections from an earlier phase of occupation. Looking at the time-slices in sequence (see Figure A20 or the AVI animation on the Archive CD), the spread of responses shifts progressively southeast; this is an effect of the horizontal slices cutting through a dipping surface which is clearly visible in the radargrams (see Figure A20, Archive CD). This dipping surface is likely to be either the top of a geological unit or a palaeosurface. If the latter were to be the case, it is plausible that archaeological deposits sit above this surface and could thus explain the somewhat rectilinear nature seen to the deeper responses, for example around (8). It seems more likely however that this distribution is purely coincidence; further survey, over a larger area, should be able to provide a more definitive answer.

West Field - South

2.6 A small pilot survey, at a broader line spacing (1.0m) was conducted over a second area of activity identified through aerial photography. Whilst a number of anomalies have been recorded, the time available has not allowed for a large enough survey area to produce a definitive interpretation. That said, the central band of responses (9) displays a reasonable depth extent (beyond what one might expect from purely agricultural effects as seem to dominate in the shallower slices) and even some suggestion of rectilinearity. However, without any corroborating techniques or a more expansive survey it would be difficult to be any more specific.

3. Conclusions

3.1 The majority of the town of *Cunetio* was surveyed magnetically; some 11ha was investigated during the course of three days on site – only the western defences could not be tackled in the time available. However, the work has clearly demonstrated that the site responds extremely well to geophysical investigation. Anomalies associated with the earlier and later defences have been detected along with many responses which represent buildings. The internal street plan can also be seen and outside the town a number of responses have been recorded, relating to further buildings and possible industrial activity.

3.2 The GPR surveys have highlighted detail within the *Mansio* and over the southwest corner of the later, stone defences of the town. A good correlation has been demonstrated with the crop mark evidence.

References

Annan, A 1996 *Ground Penetrating Radar: Workshop Notes.* Sensors & Software, Canada.

BGS British Geological Survey 266. 1:50000. Marlborough.

Corney, M 1997 *The Origins and Development of the 'Small Town' of Cunetio, Mildenhall, Wiltshire.* In Britannia, Vol. 28 pp. 337-350. Society for the Promotion of Roman Studies.

Mower, J 2009 *Proposed Archaeological Evaluation Cunetio, Wiltshire.* Unpublished Report.

SSEW 1986 *Soils of England and Wales. Sheet 6, South East England*. Soil Survey of England and Wales.

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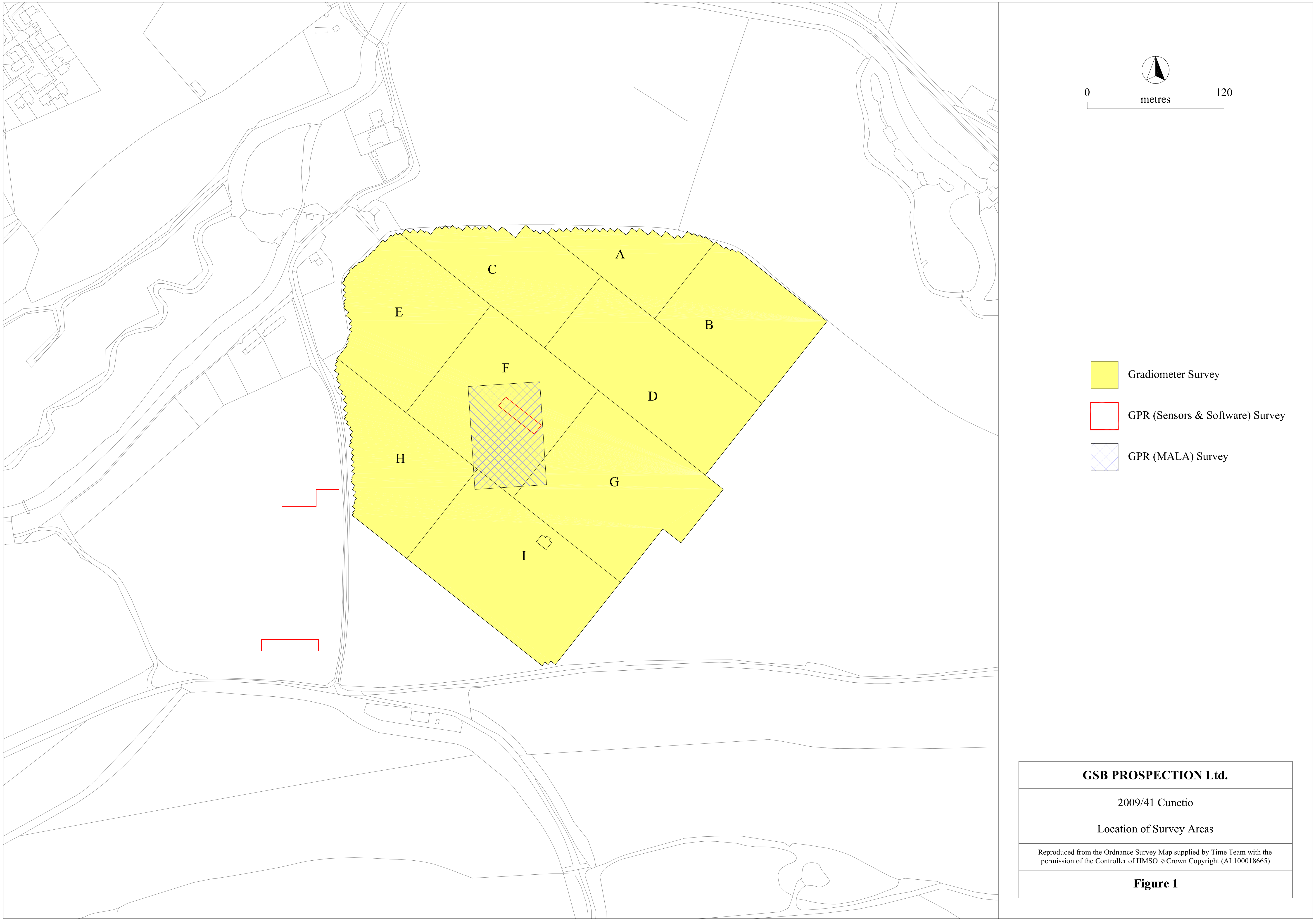
Archive Media

Mansio: Sensors & Software Animated Time-slices:
Archive CD\Report Figures\Mansio_Animated_Time-slices.avi

Mansio: MALA Time-sliced Data:
Archive CD\Mala Data\cunetio_final000.jpg – cunetio_final230.jpg

Mansio: MALA Animated Time-slices:
Archive CD\Mala Data\MALA_Cunetio_Data.avi



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Location of Survey Areas

Figure 1

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Summary Gradiometer Greyscale

Figure 2

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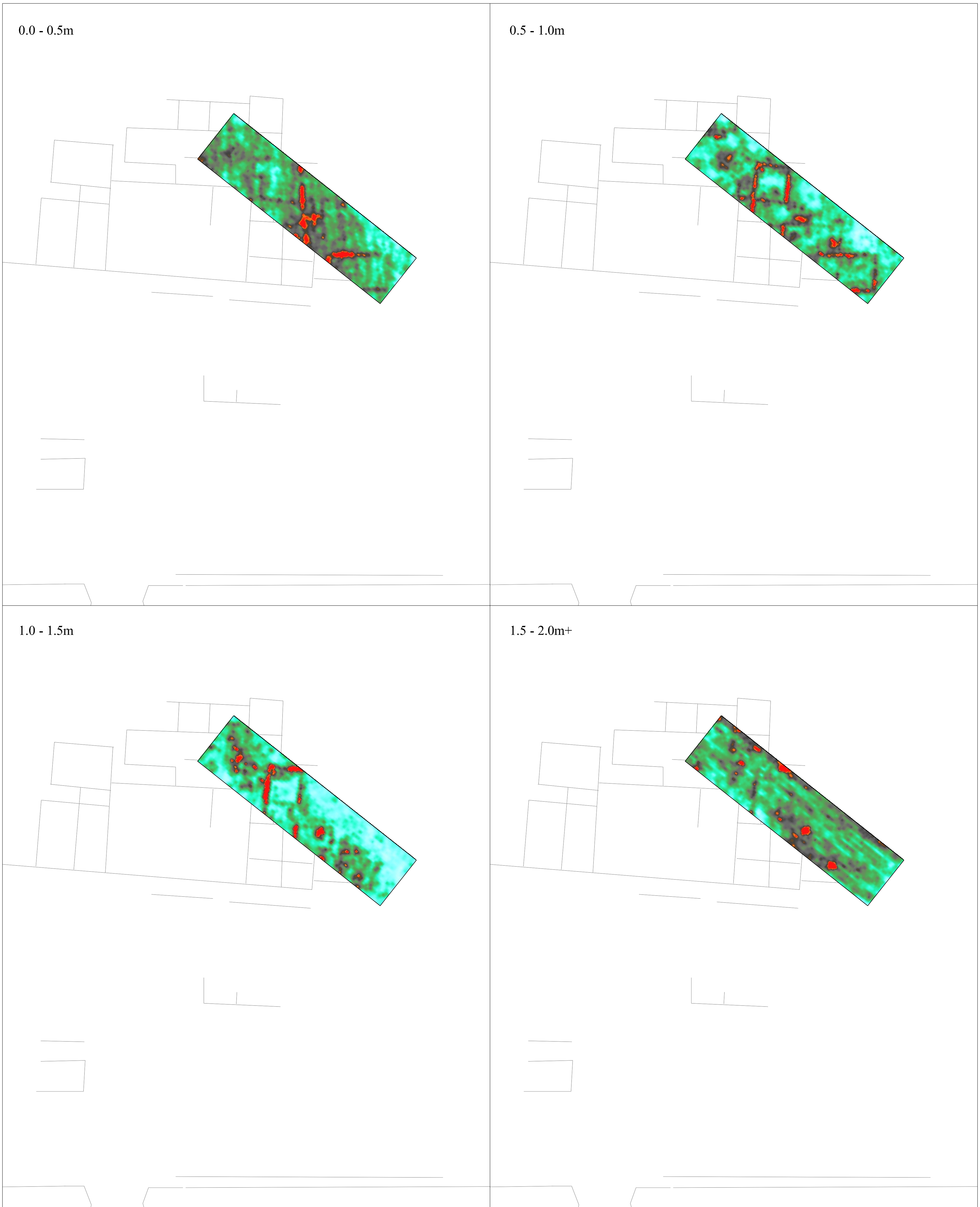
Summary Gradiometer Interpretation

Figure 3



0 metres 25

High
Amplitude
Low

Cropmark Transcriptions

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Summary GPR Interpretations - Mansio

Figure 4

0 metres 25

High Amplitude - Wall Foundations	High Amplitude - ?Archaeology
Increased Response - Wall Foundations	Increased Response - ?Archaeology
Trend - Wall Foundations	Trend - ?Archaeology
Increased Response - Uncertain	?Ploughing
Cropmark Transcriptions	

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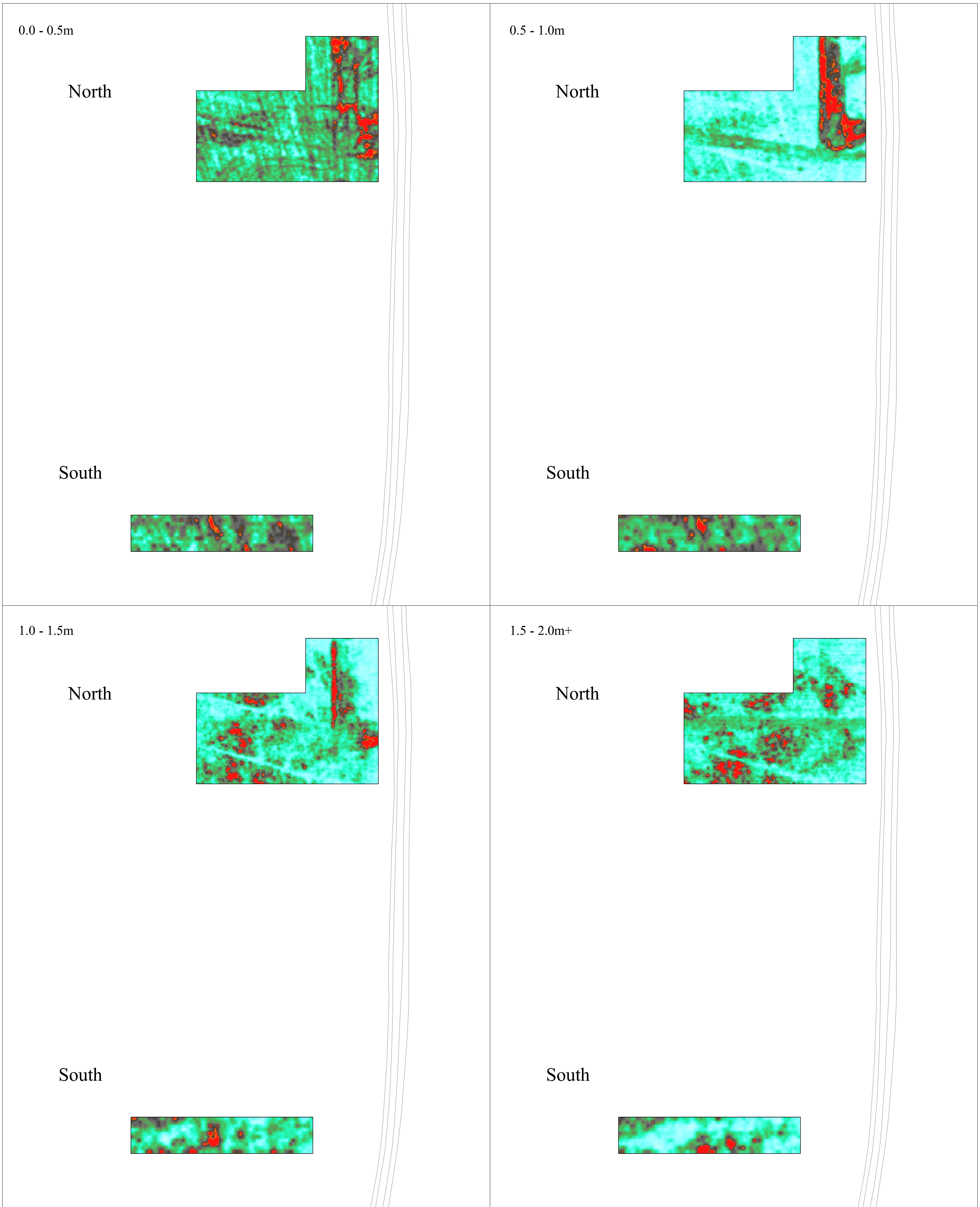
2009/41 Cunetio

Summary GPR Interpretations - Mansio

Figure 5



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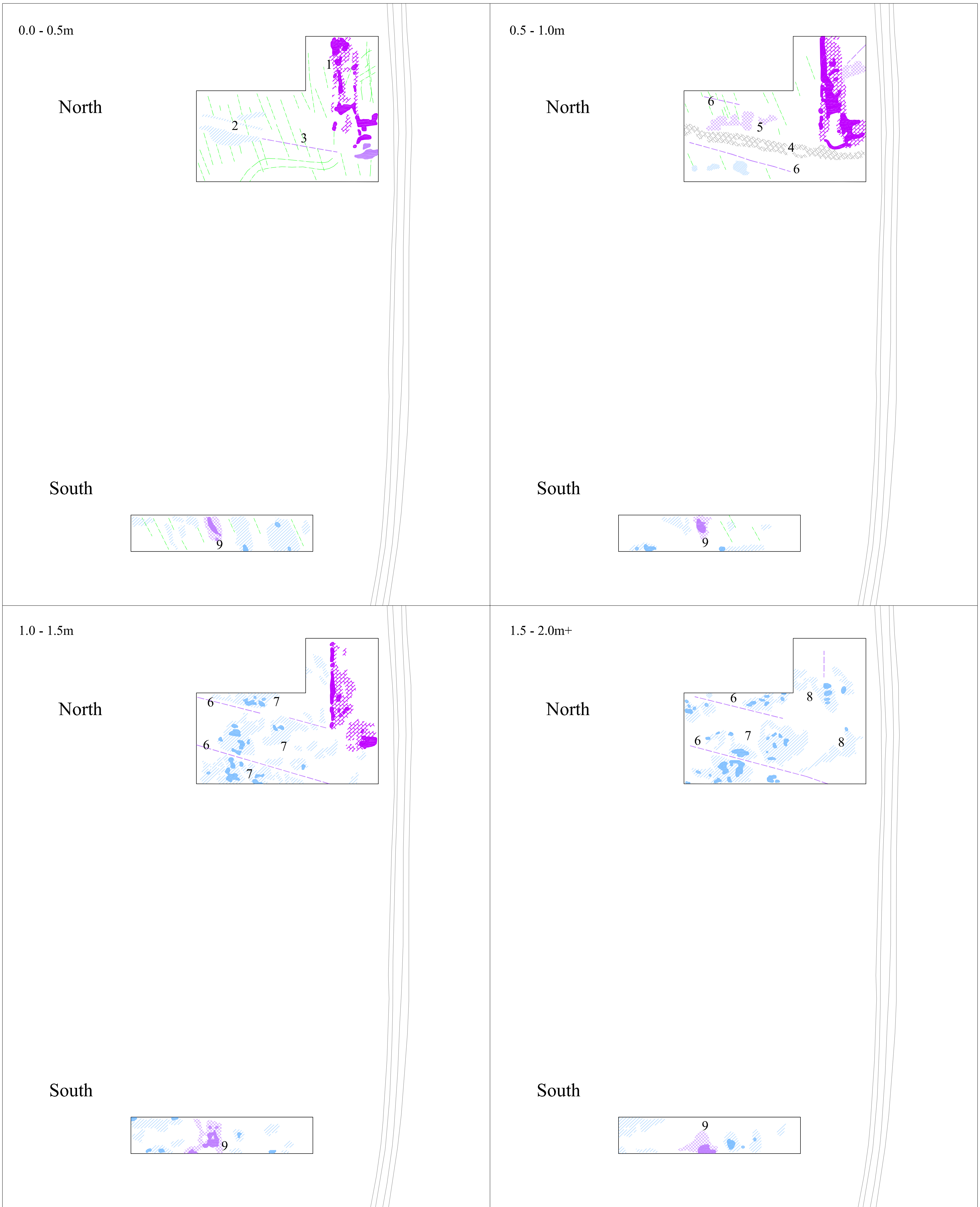
Summary GPR Time-slices - West Field

Figure 6



0 metres 40

High Amplitude - Wall Foundations	Increased Response - Wall Foundations
High Amplitude - ?Archaeology	Increased Response - ?Archaeology
High Amplitude - Uncertain	Increased Response - Uncertain
Increased Response - ?Road	Trend - ?Archaeology
?Ploughing	

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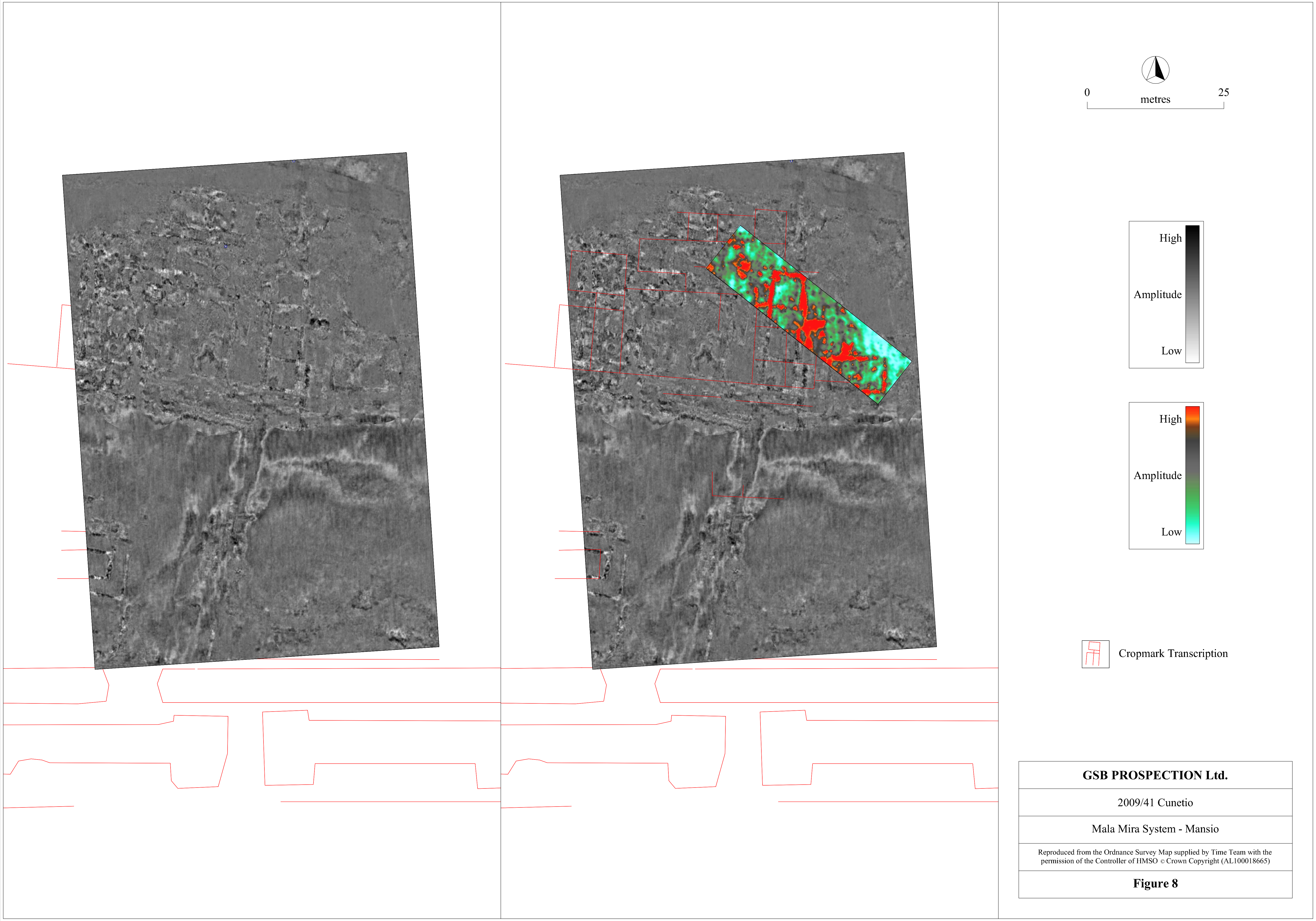
Summary GPR Interpretations - West Field

Figure 7



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Mala Mira System - Mansio
Reproduced from the Ordnance Survey Map supplied by Time Team with the permission of the Controller of HMSO © Crown Copyright (AL100018665)
Figure 8

Appendix 1: Technical Information

Instrumentation

Fluxgate Gradiometer: Geoscan FM36/256 and Bartington *Grad*601-2

Both the Geoscan and Bartington instruments comprise two fluxgate sensors mounted vertically apart; the distance between the sensors on the former is 500mm, on the latter 1000mm. The gradiometers are carried by hand, with the bottom sensor approximately 100-300mm from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. The fluxgate gradiometer suppresses any diurnal or regional effects. Generally, features up to 1m deep may be detected by this method. Having two gradiometer units mounted laterally with a separation of 1000mm, the Bartington instrument can collect two lines of data per traverse.

Resistance Meter: Geoscan RM15

This instrument measures the electrical resistance of the earth, using a system of four electrodes (two current and two potential.) Depending on the arrangement of these electrodes an exact measurement of a specific volume of earth may be acquired. This resistance value may then be used to calculate the earth resistivity. The most common arrangement is the Twin Probe configuration which involves two pairs of electrodes (one current and one potential): one pair remain in a fixed position, whilst the other measures the resistance variations across a grid. The resistance is measured in ohms and, when calculated, resistivity is in ohm-metres. The resistance method as used for standard area survey employs a probe separation of 0.5m, which samples to a depth of approximately 0.75m. The nature of the overburden and underlying geology will cause variations in this depth.

GPR: Sensors & Software Noggin Smartcart

The Noggin system includes an onboard digital video logger (DVL III), 250 MHz or 500MHz antenna, an odometer wheel and battery. It is, therefore, a fully integrated system. The built-in software uses the integrated odometer to provide an accurate distance measurement to the response. The data are recorded in digital format and can be processed to produce depth slice maps, 2D sections or 3D cubes.

Display Options

XY Trace

This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane. The output may be either colour or black and white.

Greyscale

This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Relief Plot

This is a method of display that creates a three dimensional effect by directing an imaginary light source on a given data set. Particular elements of the results are highlighted depending on the angle of strike of the light source. This display method is particularly useful when applied to resistance data to highlight subtle changes in resistance that might otherwise be obscured.

3D Surface Plot

This is similar to the XY trace, but in 3 dimensions. Each data point of a survey is represented in its relative position on the x and y axes and the data value is represented in the z axis. This gives a digital terrain, or topographic effect.

Radargram

Radar data comprise a record of reflection intensity against the time taken for the emitted energy to travel from the transmitter down to the reflector and back to the receiver. The resultant plot is effectively a vertical section through the ground along the line of the traverse, with time (depth) on the vertical axis, displacement on the horizontal axis and reflection intensity as a grey or colour scale.

Time Slice

If a number of radargrams are collected over a grid, or in conjunction with GPS data, it is possible to reconstruct the entire dataset into a 3D volume. This can then be resampled to compile 'plan' maps of response strength at increasing time offsets (typically converted to show approximate depth), thus simplifying the visualisation of how anomalies vary beneath the surface across a survey area.

Volume Plot

Rather than looking at discrete slices of data from the 3D volume, it is possible to strip away all reflections with intensity below a user-defined threshold, leaving just the strongest anomalies. This serves to create a rendered 3D model of the most substantial subsurface deposits which can then be rotated or enlarged/reduced to either animate the display or view it from any perspective.

Data Processing

Zero Mean Traverse	This process which sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set. It is usually only applied to gradiometer data.
Step Correction	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors
Interpolation	When geophysical data are presented as a greyscale, each data point is represented as a small square. The resulting plot can sometimes have a 'blocky' appearance. The interpolation process calculates and inserts additional values between existing data points. The process can be carried out with points *along* a traverse (the *x* axis) and/or *between* traverses (the *y* axis) and results in a smoother greyscale image.
Despike	In resistance survey, spurious readings can occasionally occur, usually due to a poor contact of the probes with the surface. This process removes the spurious readings, replacing them with values calculated by taking the mean and standard deviation of surrounding data points. It is not usually applied to gradiometer data.
High Pass Filter	Carried out over the whole a resistance data-set, the filter removes low frequency, large scale spatial detail, such as that produced by broad geological changes. The result is to enhance the visibility of the smaller scale archaeological anomalies that are otherwise hidden within the broad 'background' change in resistance. It is not usually applied to gradiometer data.
GPR Filters	There are a wide range of GPR filters available and their application will vary from project to project. The most commonly used are: Dewow (removes low frequency, down-trace instrument noise); DC-Shift (re-establishes oscillation of the radar pulse around the zero point); Bandpass Filtering (suppresses frequencies outside of the antenna's peak bandwidth thus reducing noise); Background Removal (can remove ringing, instrument noise and minimize the near-surface 'coupling' effect); Migration (collapses hyperbolic tails back towards the reflection source).

Tie-in Techniques and Information

Tapes

A number of points on each survey grid are recorded by triangulating to at least two fixed points on the base map. If there is a lack of 'hard detail' in the mapping, some form of survey marker will be left *in-situ* for reference.

NOTE: When re-establishing the grid (for excavation or other post-survey work) only data from the supplied tie-in diagram should be used and NOT the report figures.

Electronic Distance Measurers (EDM) / Total Stations (TST)

This type of instrument measures the distance and angle to features with reference to a fixed point. Where possible the EDM will be set up over a point that can be re-established with relative ease, e.g. over map detail, a survey marker or at a point measureable by tapes. Distances and angles to permanent points of reference and/or map detail are recorded as well as at least two points per survey grid.

NOTE: When re-establishing the grid (for excavation or other post-survey work) only data from the supplied tie-in diagram should be used and NOT the report figures.

Global Positioning Systems (GPS)

Using a roving receiver unit, these systems record the longitude, latitude and altitude of a given point by triangulating between a network of satellites. For survey-grade measurements, the accuracy is refined by integrating data from a fixed base station or local reference network. In addition to grid points, elements of map detail are collected to assess the existing base-map accuracy and, in worst-case scenarios, use the data on a non-georeferenced map. If the supplied mapping is found to be inaccurate, it is sometimes necessary to shift the position of GPS points (keeping their relative positions fixed) within the site plan to correlate cartographic features with the 'real-world' co-ordinates; this should be considered when using GPS to re-establish an existing survey grid (see note below). It should be noted that the accuracy of any GPS-positioned point is dependent upon both the system and the satellite geometry at the time of survey. On projects where multiple contractors have used GPS, the possibility of compound errors between original survey grid creation, tie-in information and grid re-establishment should be borne in mind when positioning trenches over recorded anomalies.

NOTE: If re-establishing the grid with a GPS (for excavation or other post-survey work), use only the co-ordinates recorded on the tie-in diagram or, if supplied, the GPS data file included on the Archive CD; relative positions in the report diagrams may be correct but absolute co-ordinates can vary if discrepancies in the base mapping have been encountered.

Terms Commonly used in the Interpretation of Results

Magnetic

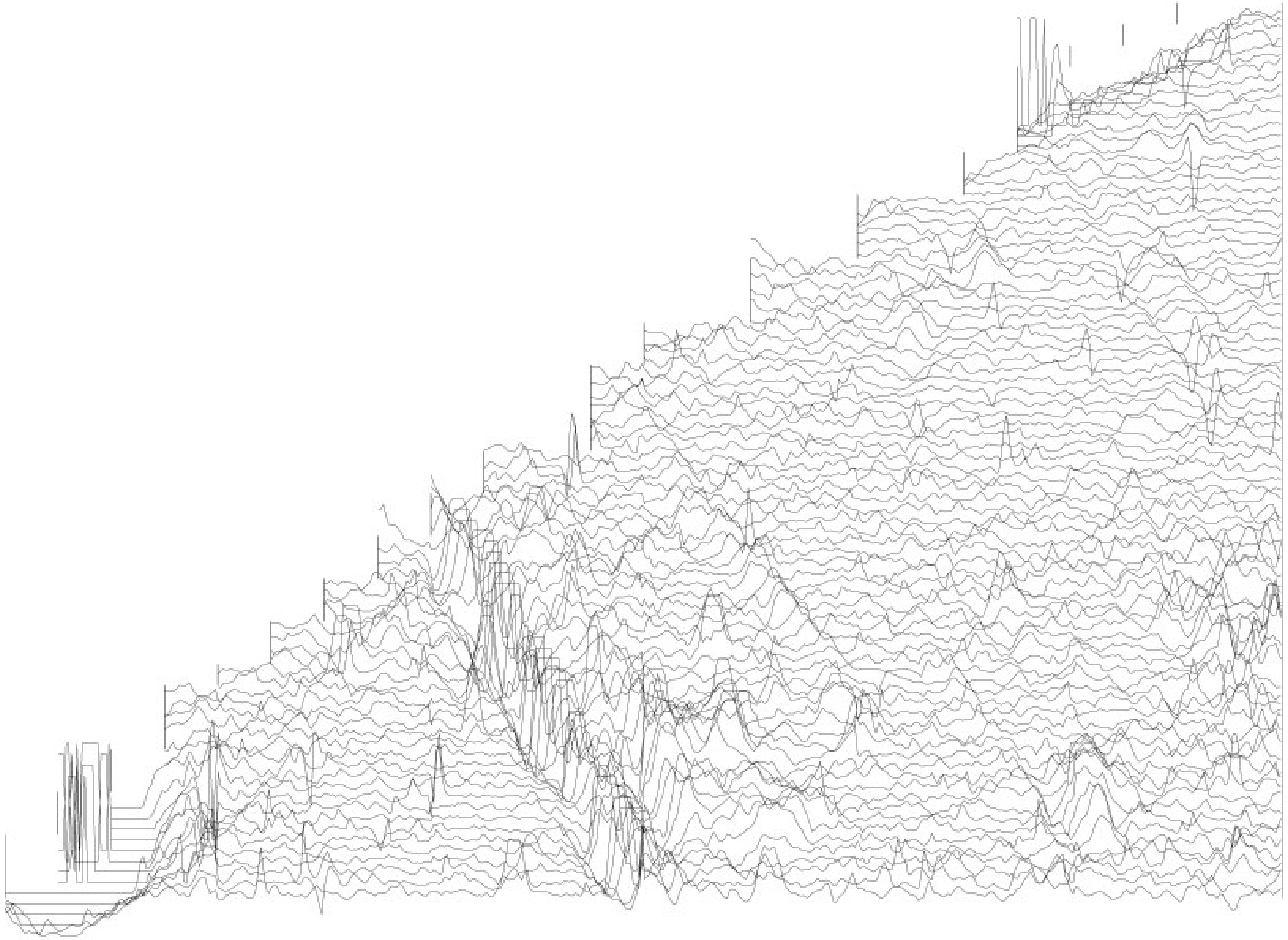
Archaeology	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological These anomalies, whilst considered anthropogenic, could be of any age.
? Archaeology	The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Areas of Increased Magnetic Response	These responses show no visual indications on the ground surface and are considered to have some archaeological potential.
Industrial	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.
? Natural	These are anomalies that are likely to be natural in origin i.e. geological or pedological.
Ridge and Furrow	These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.
Ploughing Trend	These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.
Uncertain Origin	Often, anomalies (both positive and negative) will be recorded which stand out from the background magnetic variation yet show little to suggest an exact origin. This may be because the characteristics and distribution of the responses straddle the categories of "*?Archaeology*" and "*?Natural*" or that they are simply of an unusual form.
Trend	This is usually an ill-defined, weak, isolated or obscured linear anomaly of unknown cause or date.
Areas of Magnetic Disturbance	These responses are commonly found in places where modern ferrous or fired materials are present e.g. brick rubble. They are presumed to be modern.
Ferrous Response	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

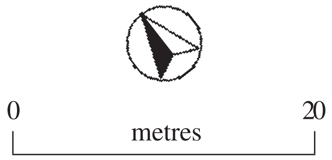
Resistance

Archaeology	High or low res responses are clearly or very probably archaeological These anomalies, whilst considered anthropogenic, could be of any age.
? Archaeology	The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.
? Natural	These are anomalies that are likely to be natural in origin i.e. geological or pedological.
? Landscaping / topography	These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.
Vegetation	These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.
Trend	This is usually an ill-defined, weak, isolated or obscured linear anomaly of unknown cause or date.

GPR

Wall /Foundation/ /Vault /Culvert etc.	High amplitude anomaly definitions used when other evidence is available that supports a clear archaeological interpretation.
Archaeology	Anomalies whose form, nature and pattern indicate archaeology but where little or no supporting evidence exists. If a more precise archaeological interpretation is possible, for example the responses appear to respect known local archaeology, then this will be indicated in the accompanying text. As low amplitude responses are less obvious features it is unlikely that they would have a definitive categorisation.
? Archaeology	When the anomaly could be archaeologically significant, given its discrete nature, but where the distribution of the responses is not clearly archaeological. Interpretation of such anomalies is often tentative, exhibiting either little contrast or forming incomplete archaeological patterns.
Historic	Responses showing clear correlation with earlier map evidence.
?Historic	Responses relating to features not directly recorded on earlier maps but which appear to respect features that are. May form patterns suggestive of formal gardens, landscaping or footpaths.
Area of Anomalous Response	An area in which the response levels are very slightly elevated or diminished with respect to the 'background'. Where no obvious surface features or documentary evidence can explain this spread of altered reflectivity it is assumed to denote some kind of disturbance, though the origins could be of any age and either anthropogenic or natural. Possible explanations are changes in subsurface composition and groundwater 'ponding'.
Natural	Anomalies relating to natural sub-surface features as indicated by documentary sources, local knowledge or evidence on the surface.
?Natural	Responses forming patterns akin to subsoil/geological variations either attenuating or reflecting greater amounts of energy. An archaeological origin such as rubble spreads or robbed out remains cannot be dismissed.
Trend	An ill defined, weak or isolated linear anomaly of unknown cause or date.
Modern	Reflections that indicate features such as services, rebar or modern cellars correlating with available evidence (maps, communications with the client, alignment of drain covers etc.).
?Modern	Reflections appearing to indicate buried services but where there is no supporting evidence. Also applies to responses which form patterns, or are at a depth which suggests a modern origin. An archaeological source cannot be completely dismissed.
Surface	Responses clearly due to surface discontinuities, the effects of which may be seen to 'ring' down through radargrams and so incorrectly appearing in the deeper time-slices.





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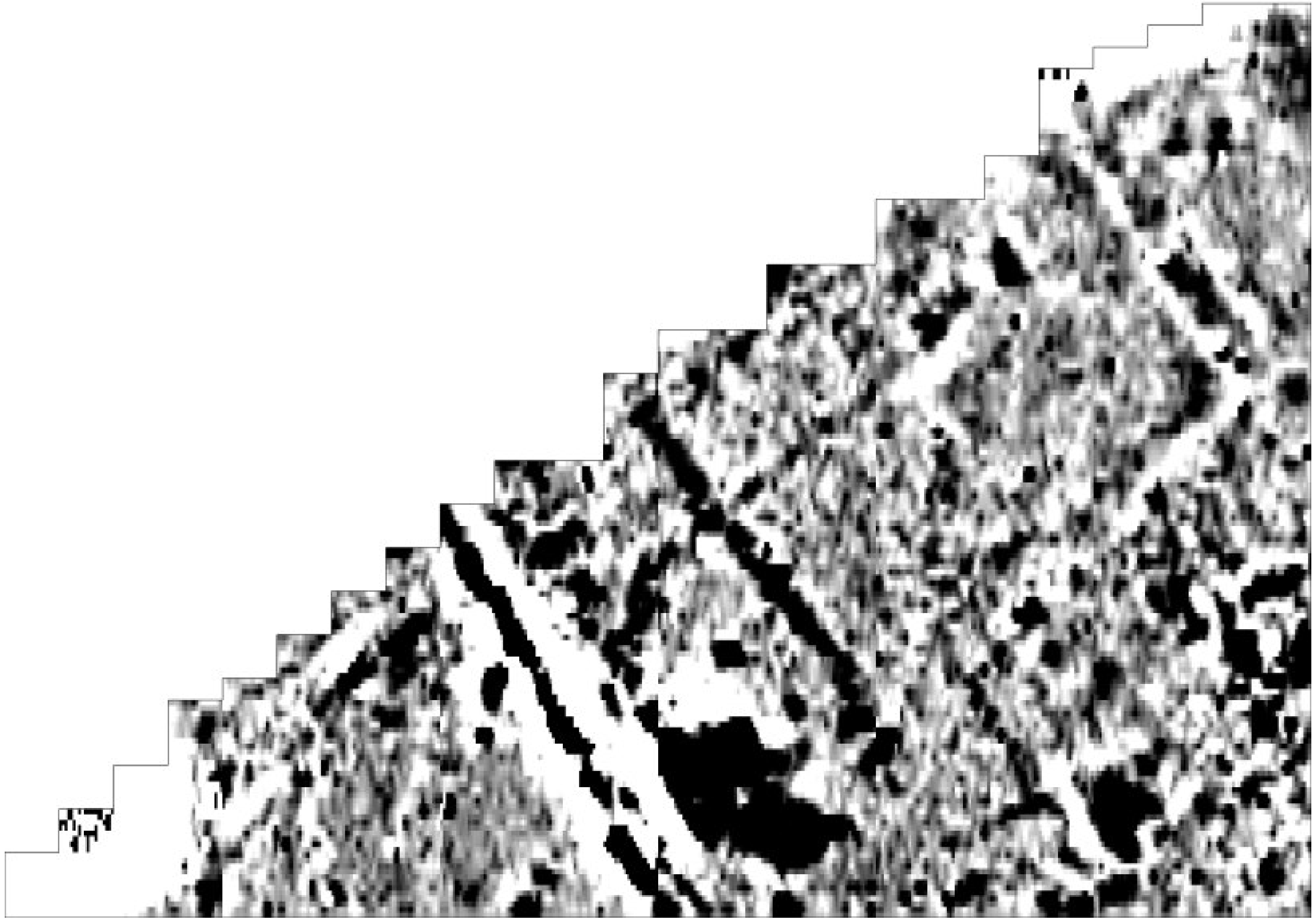
Magnetic Data - Area 1A

Figure A1



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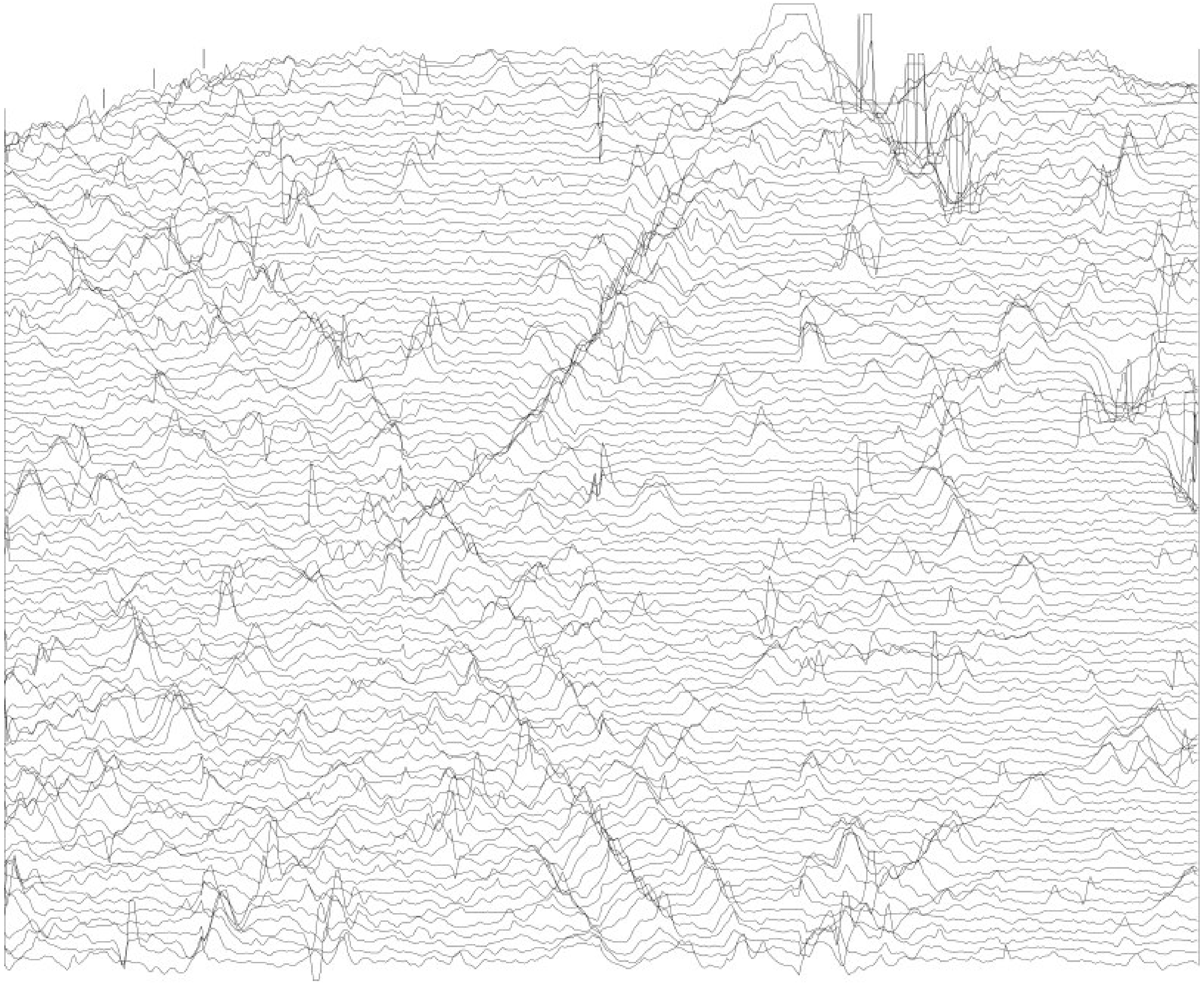
Magnetic Data - Area 1A

Figure A2



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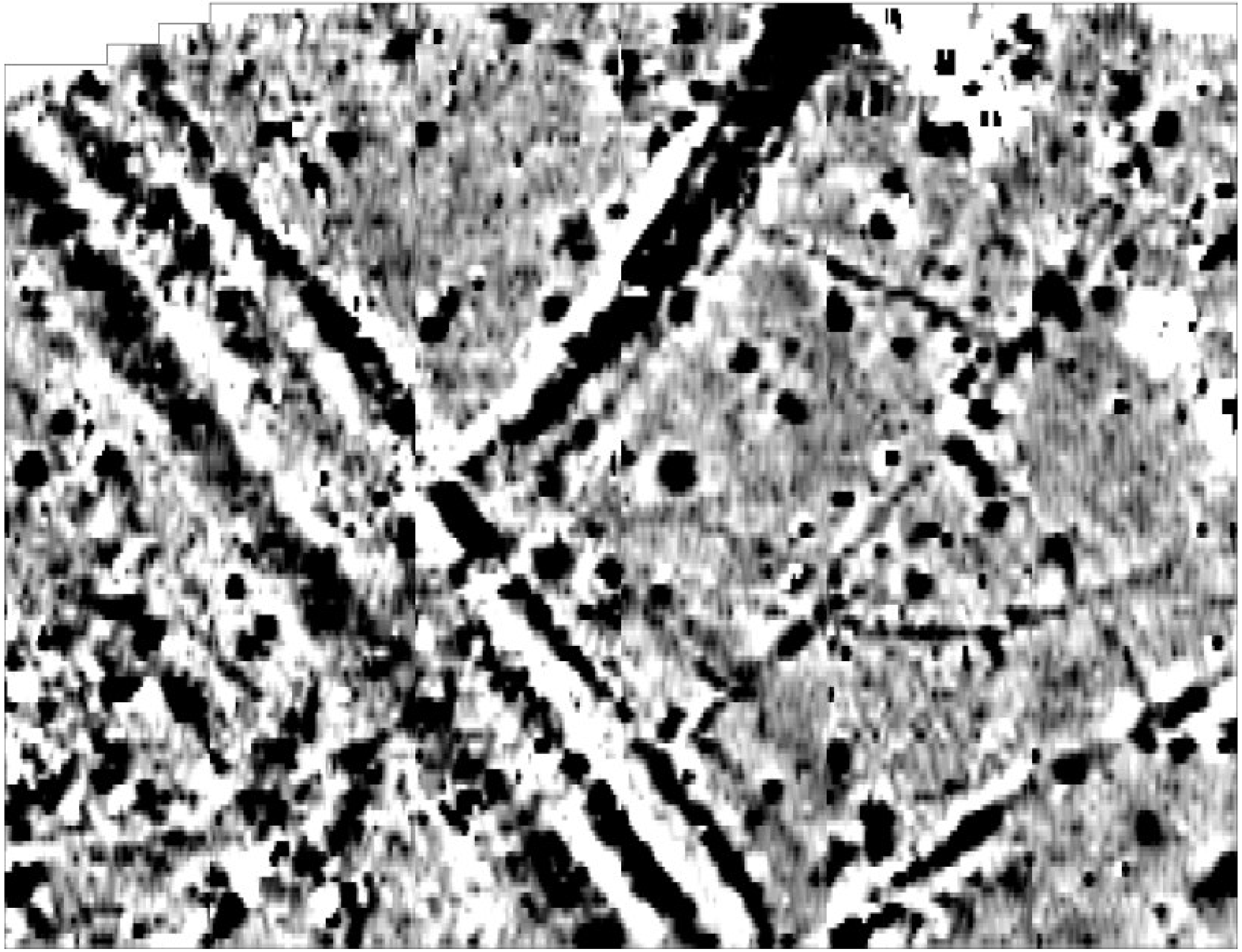
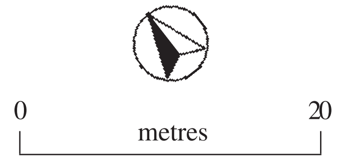
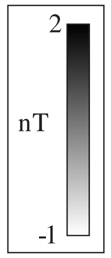
Magnetic Data - Area 1B

Figure A3







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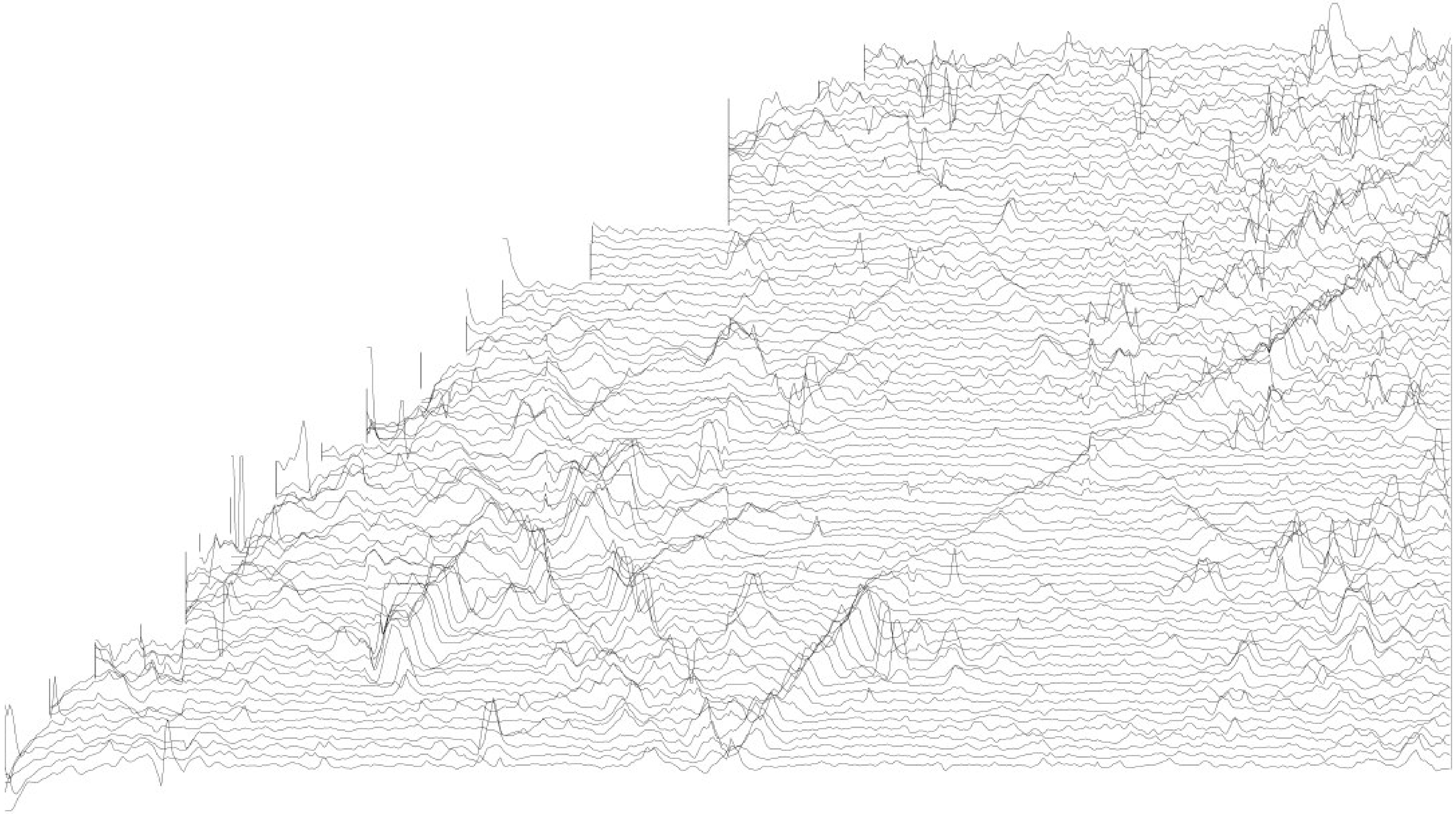
Magnetic Data - Area 1B

Figure A4



0 metres 20

15 nT

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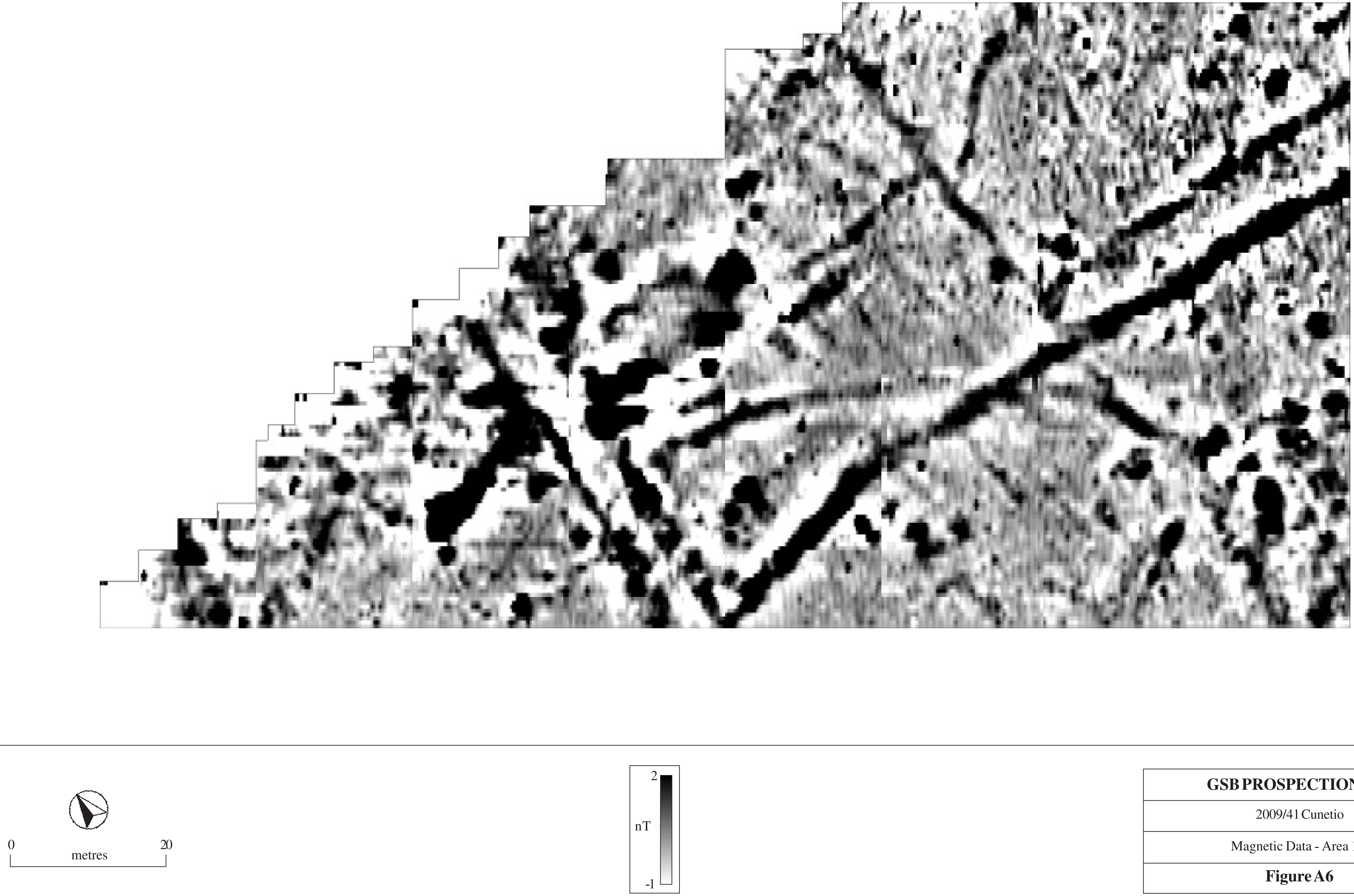
Magnetic Data - Area 1C
Figure A5



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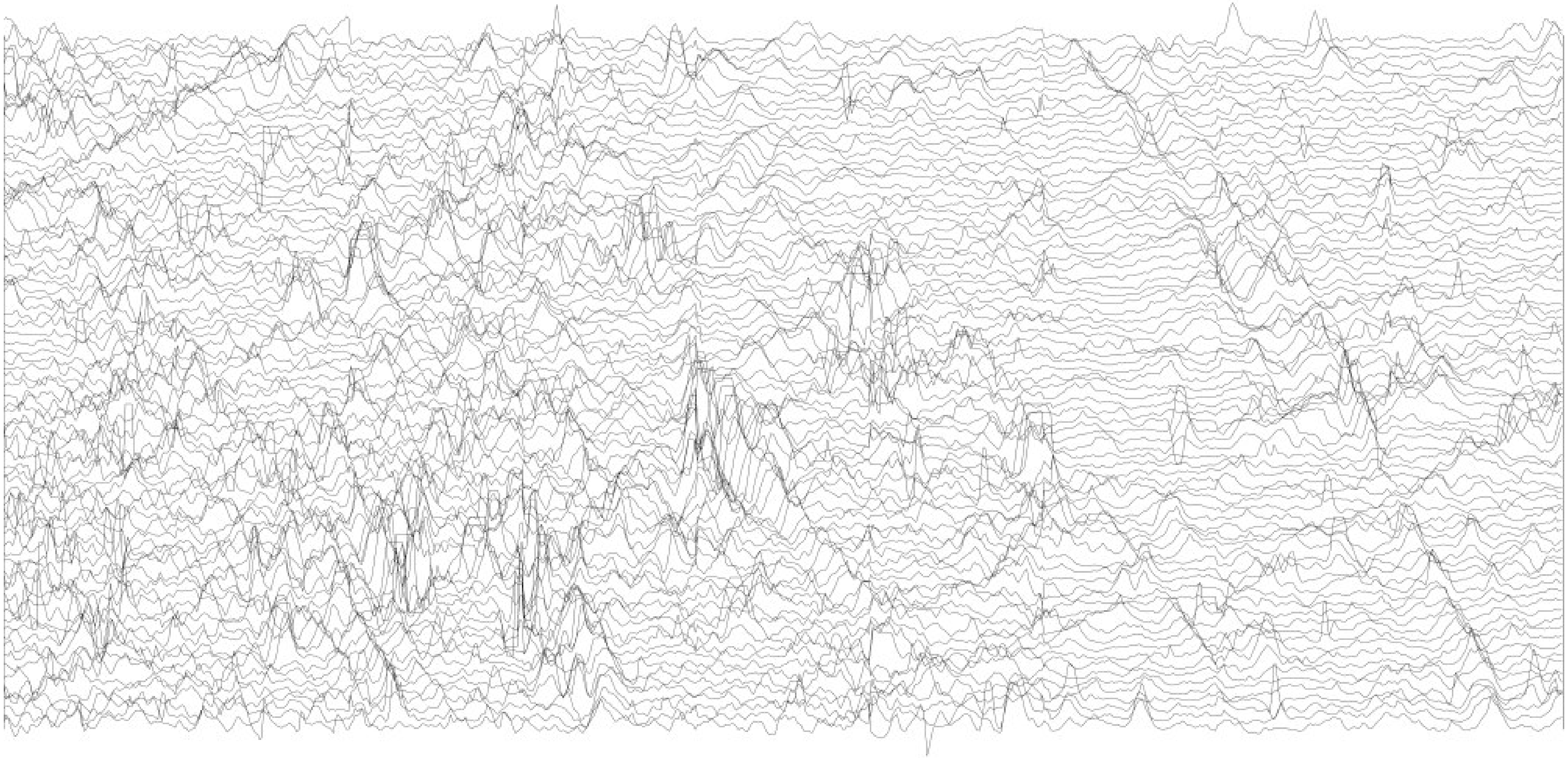
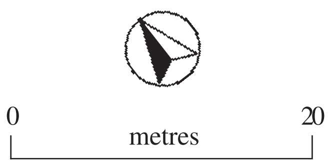
Magnetic Data - Area 1C

Figure A6





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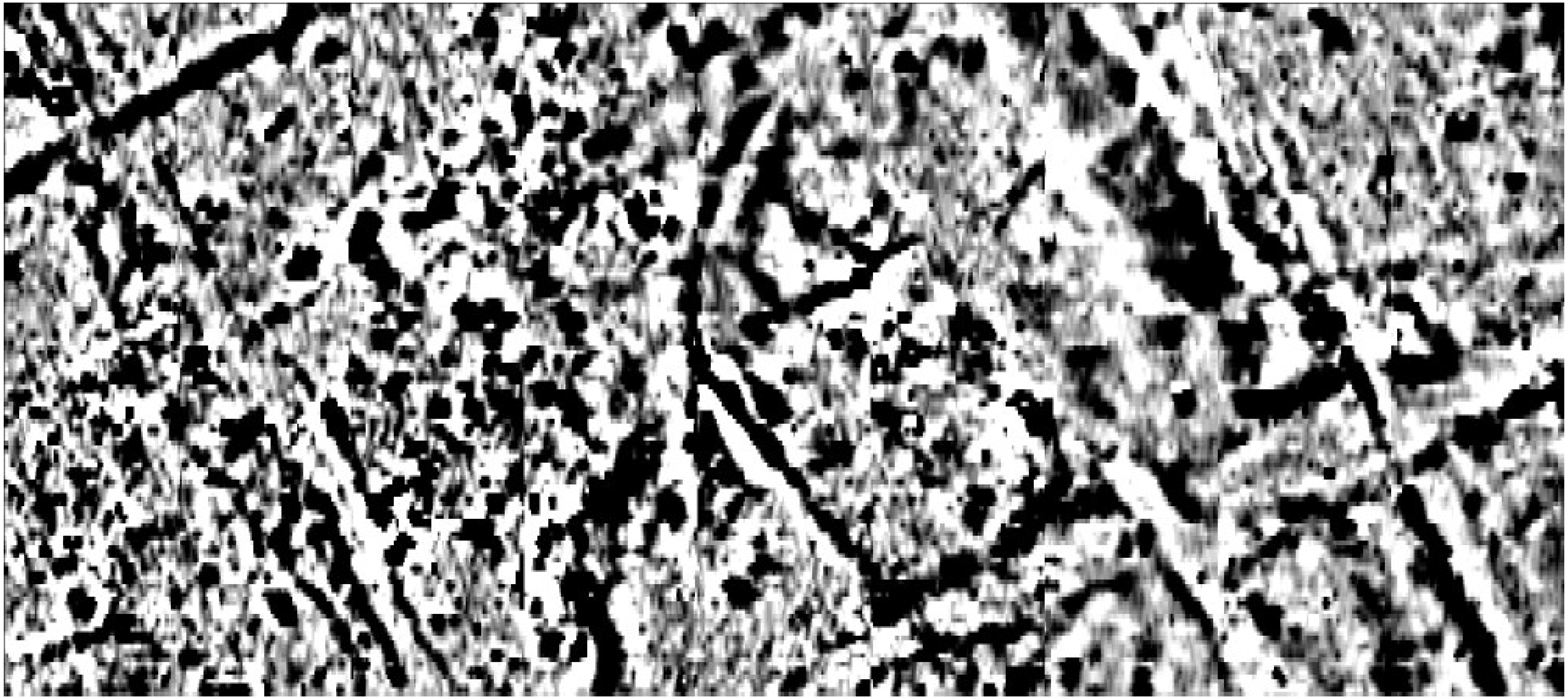
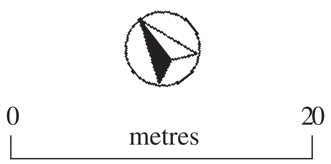
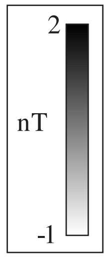
Magnetic Data - Area 1D
Figure A7







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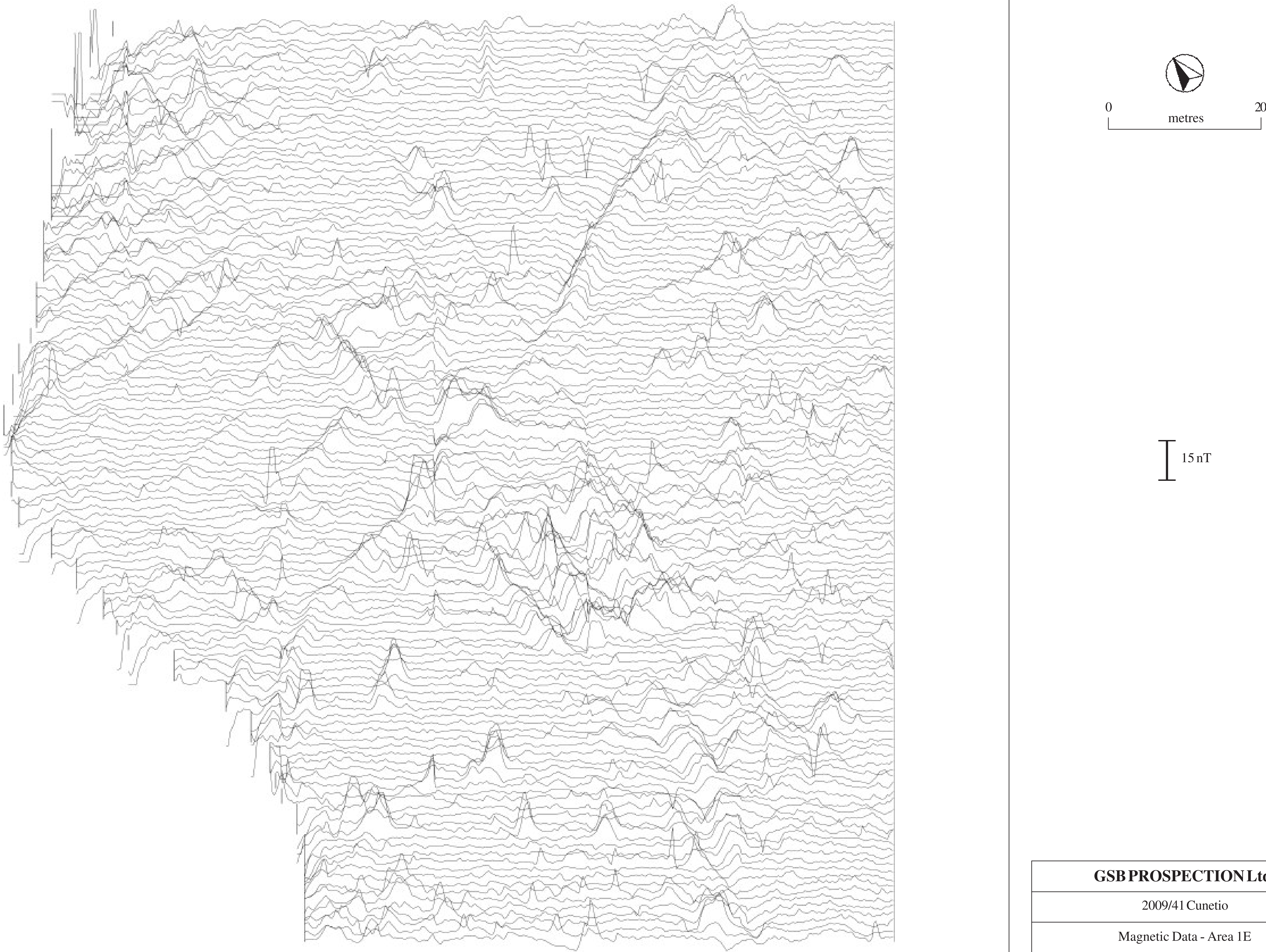
Magnetic Data - Area 1D

Figure A8



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Magnetic Data - Area 1E

Figure A9

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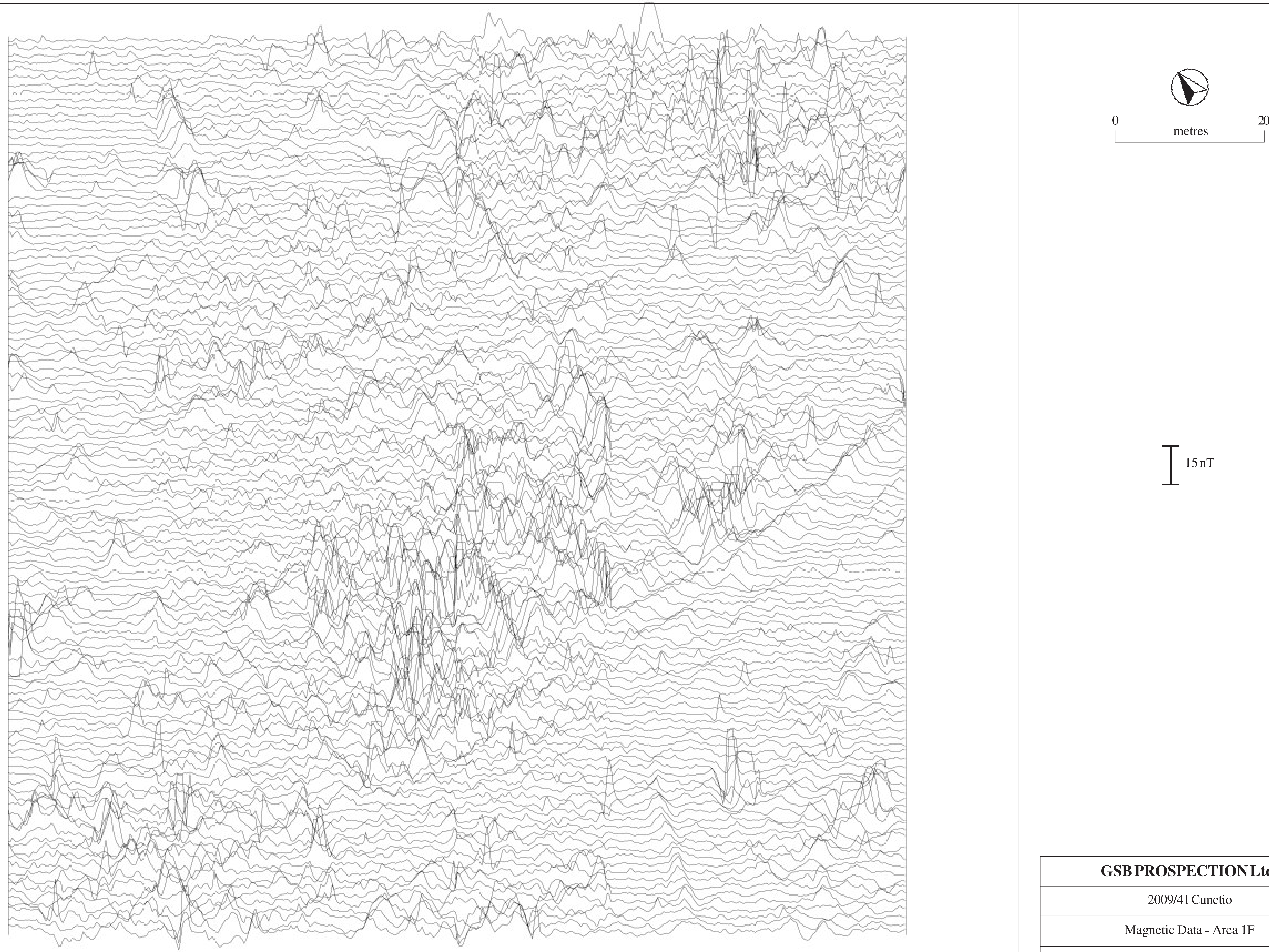
Magnetic Data - Area 1E

Figure A10



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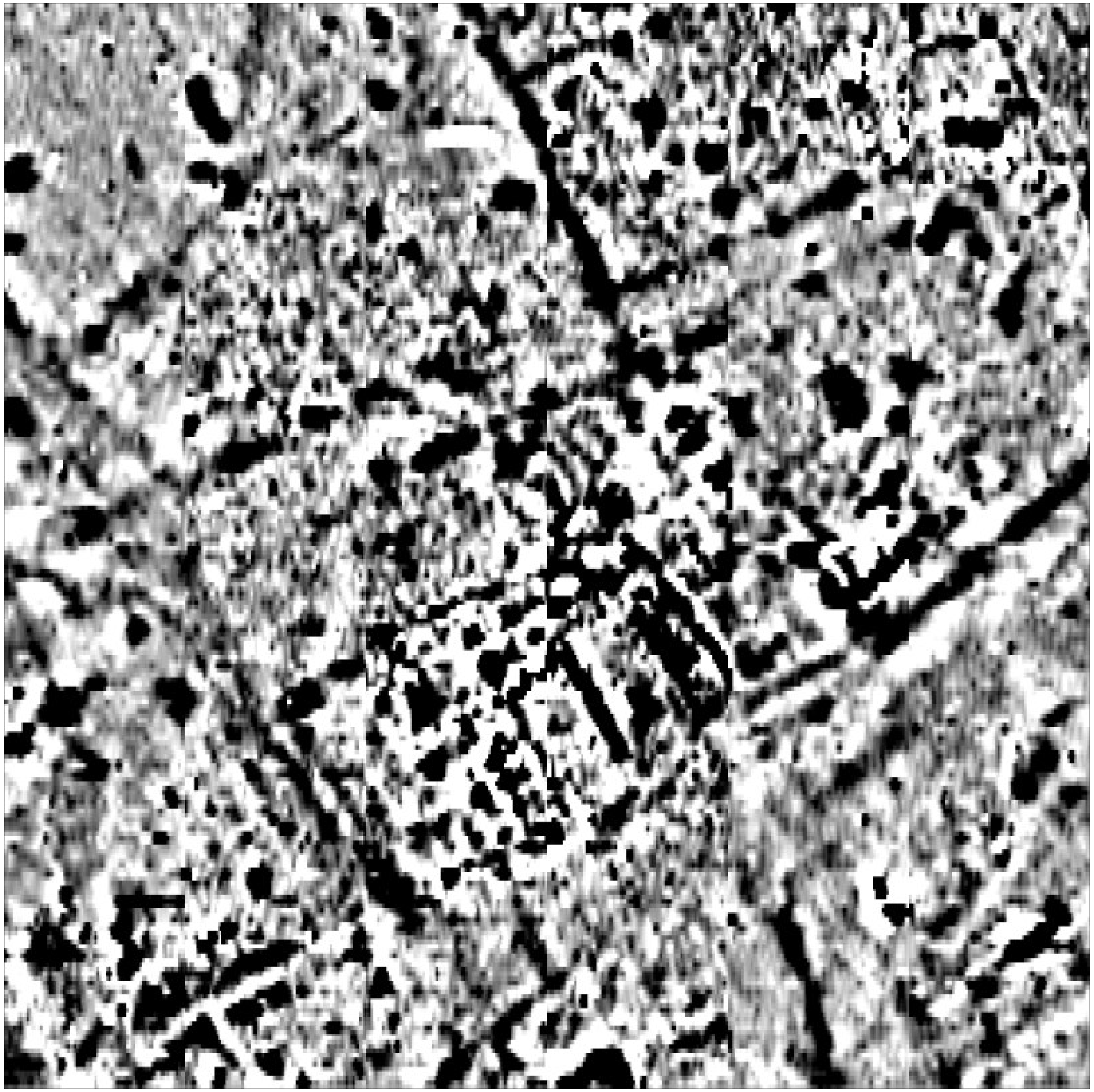
Magnetic Data - Area 1F

Figure A11



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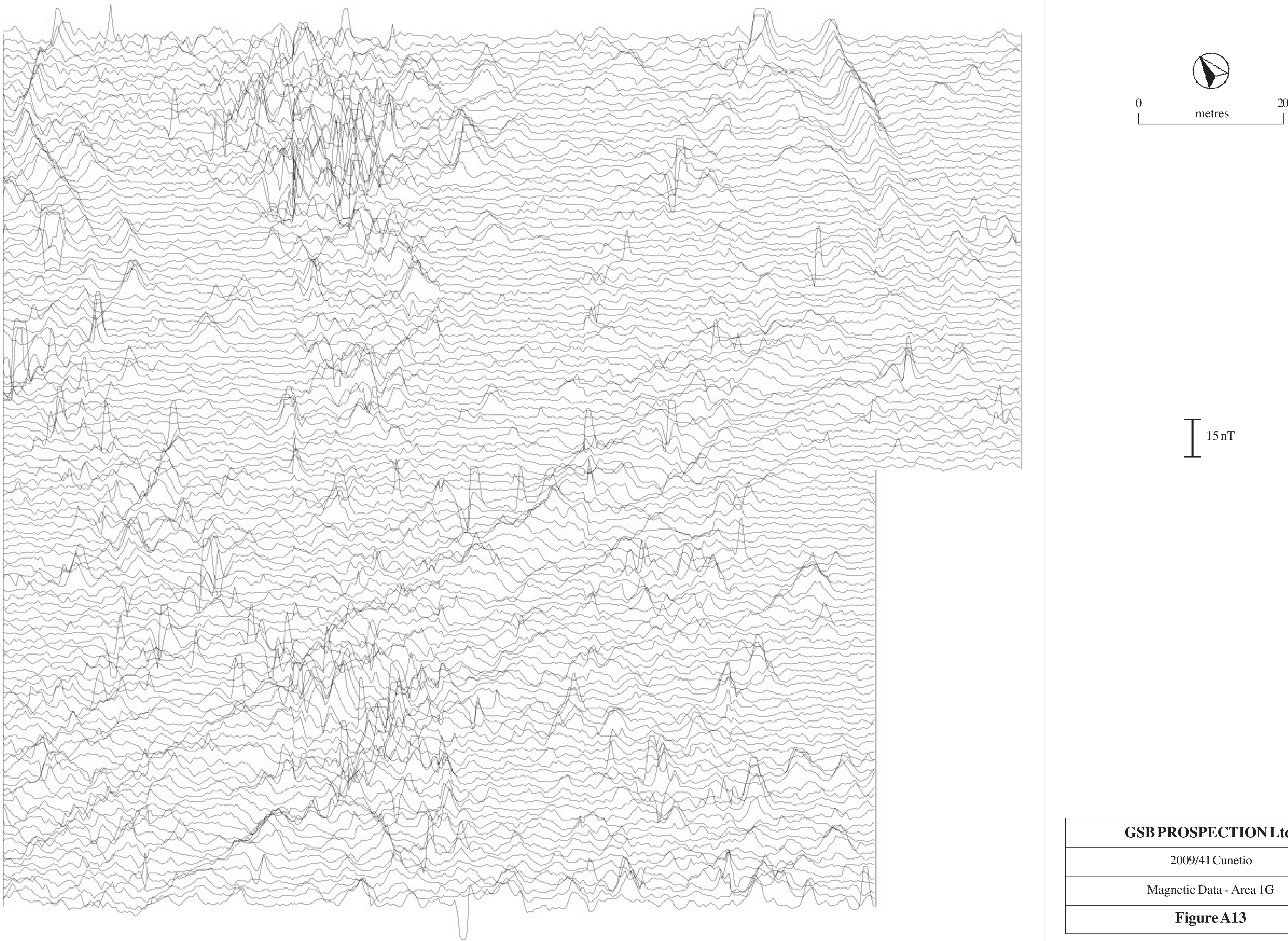
Magnetic Data - Area 1F

Figure A12



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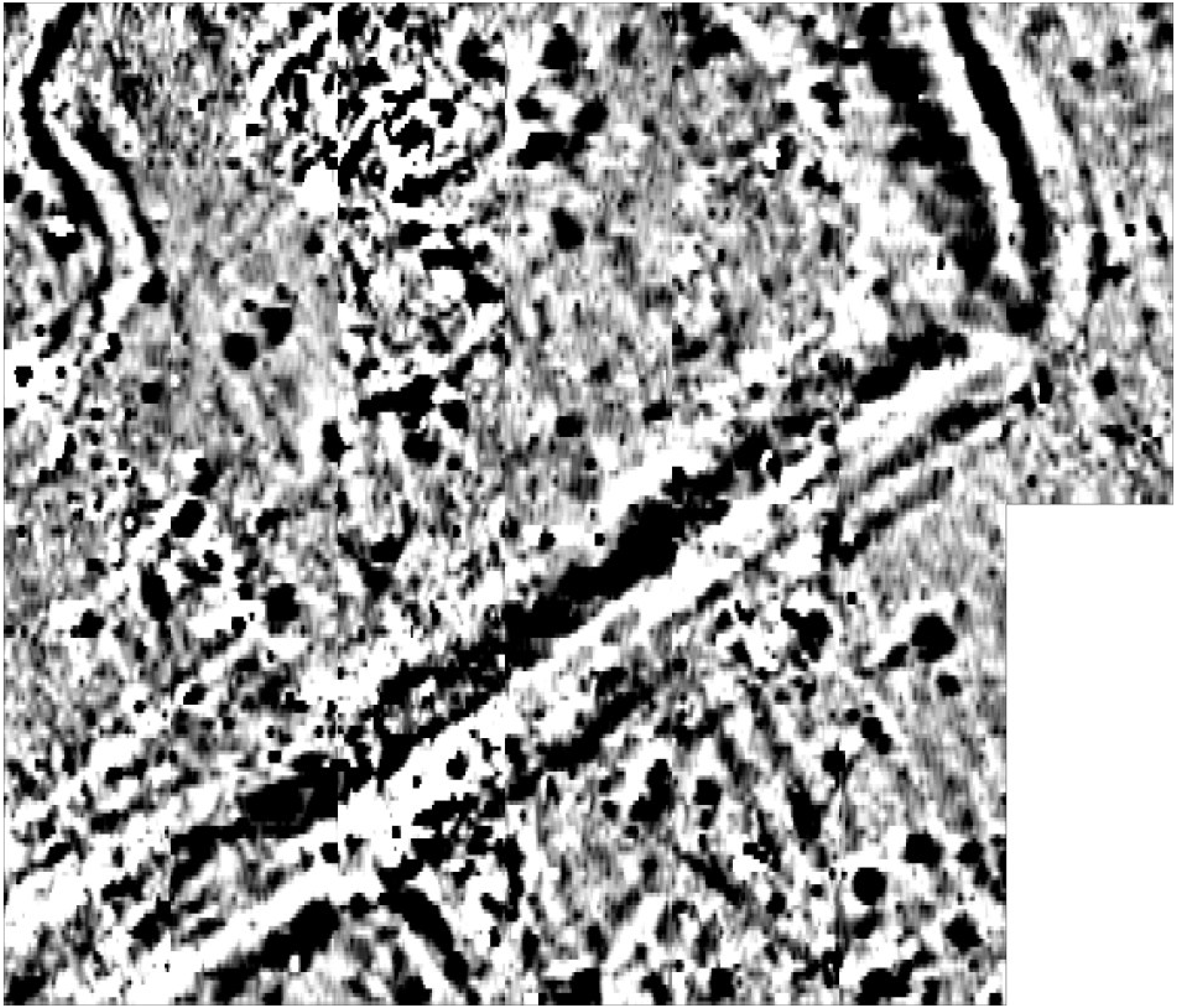
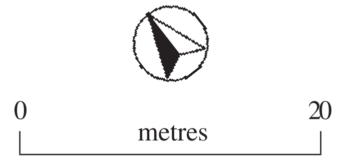
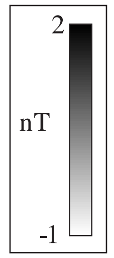
Magnetic Data - Area 1G

Figure A13







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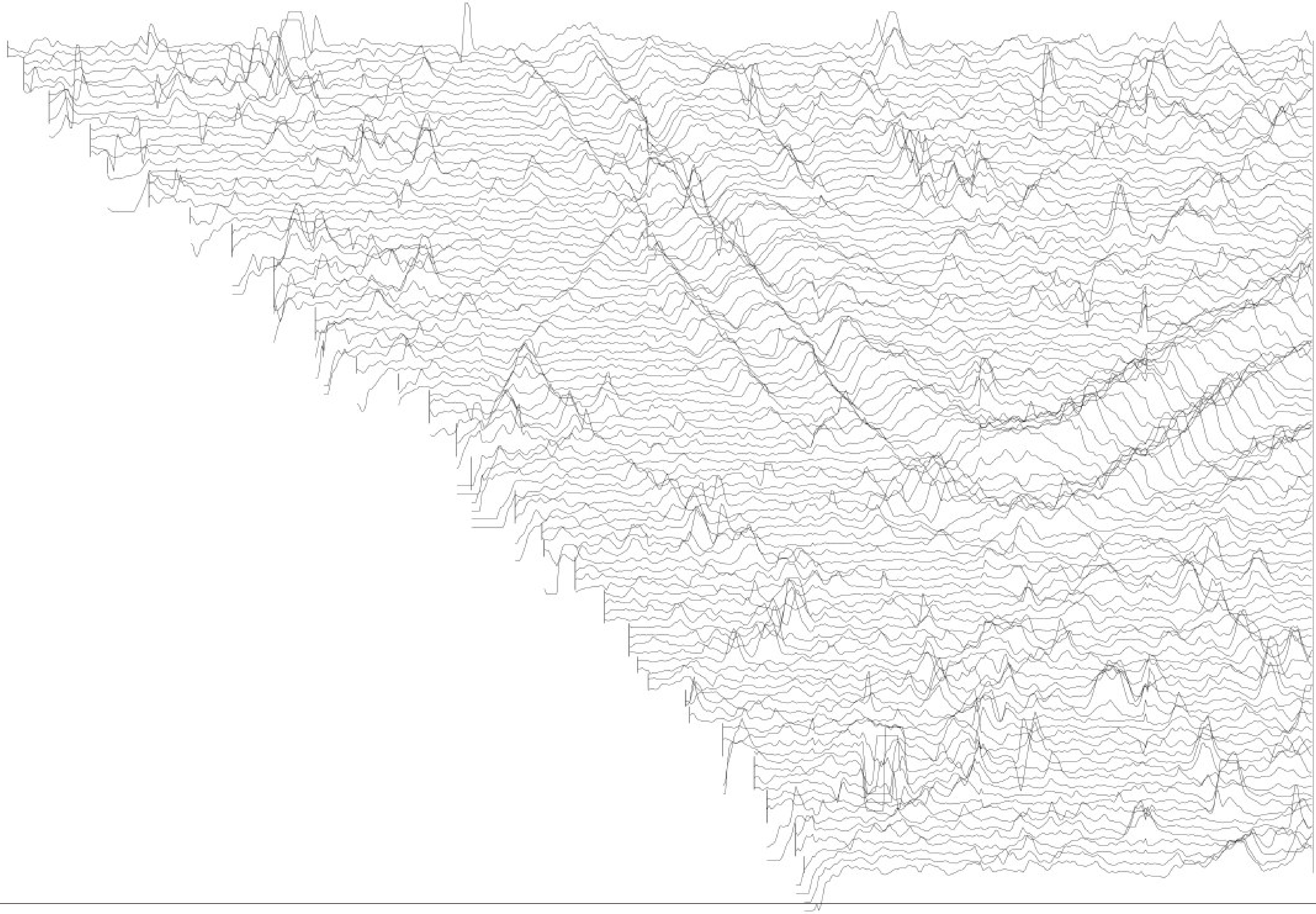
Magnetic Data - Area 1G

Figure A14



0 metres 20

15 nT

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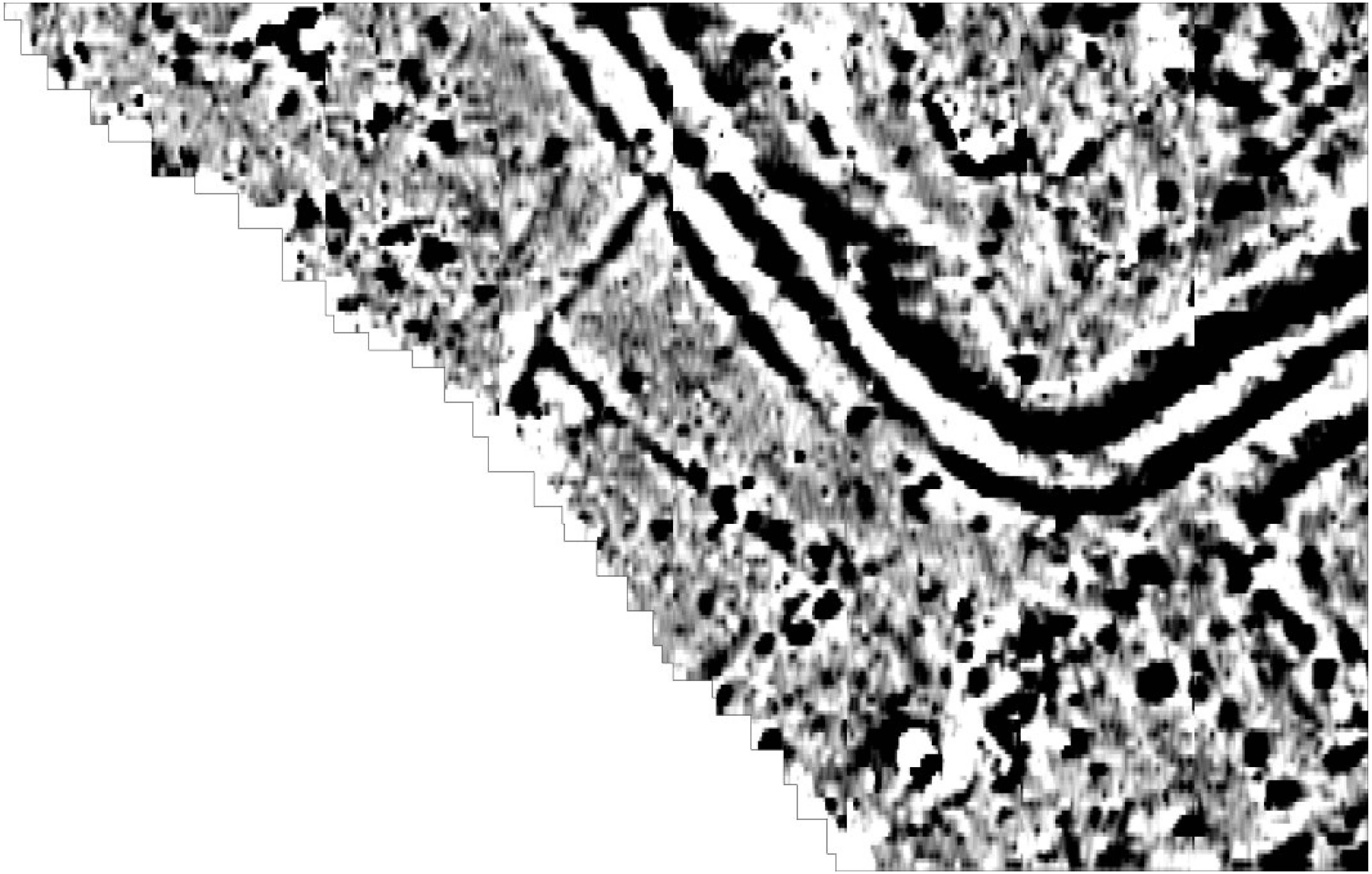
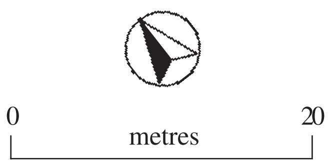
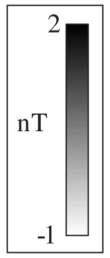
Magnetic Data - Area 1H

Figure A15







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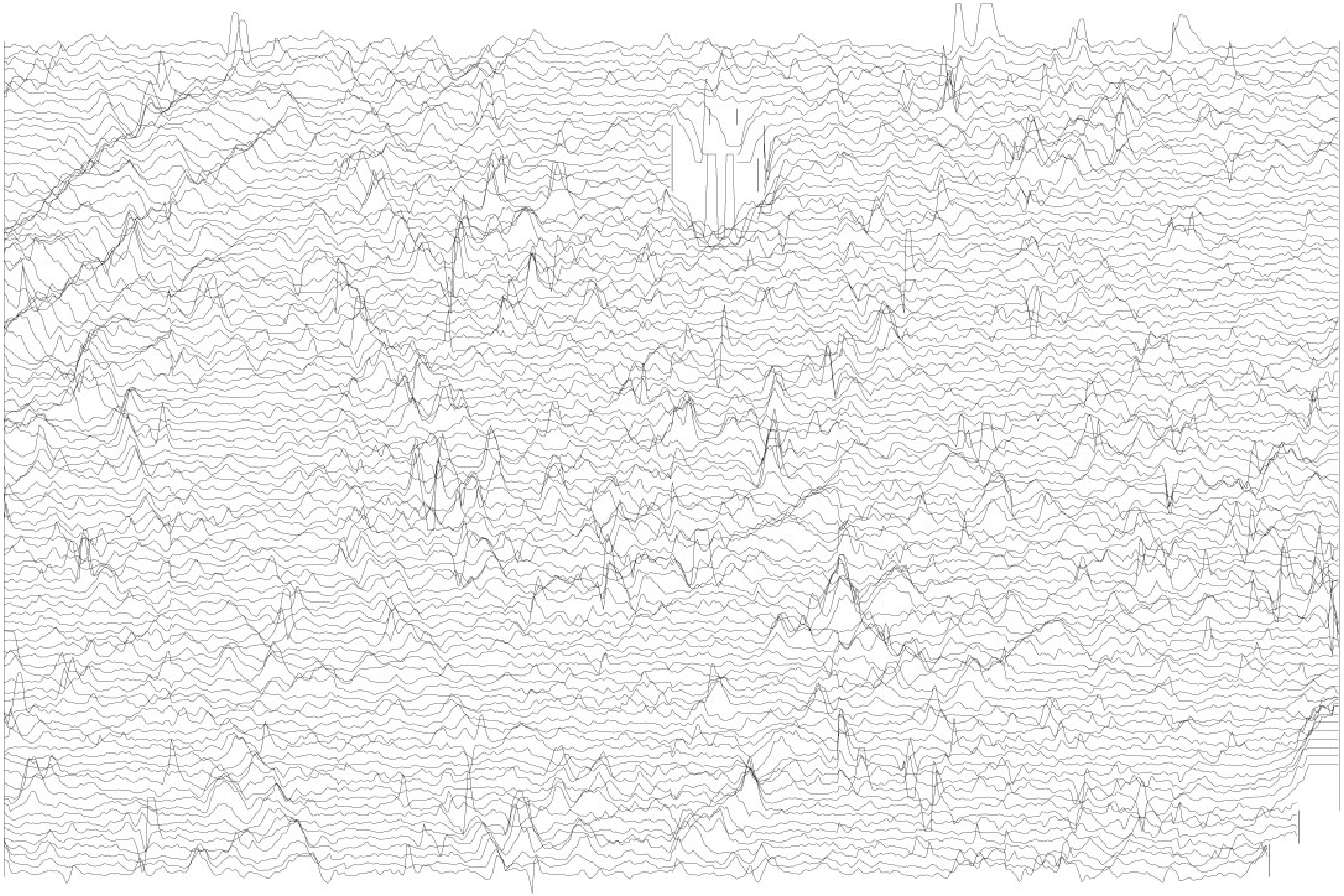
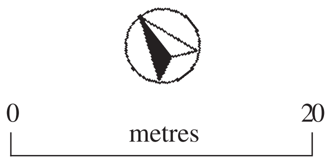
Magnetic Data - Area 1H

Figure A16





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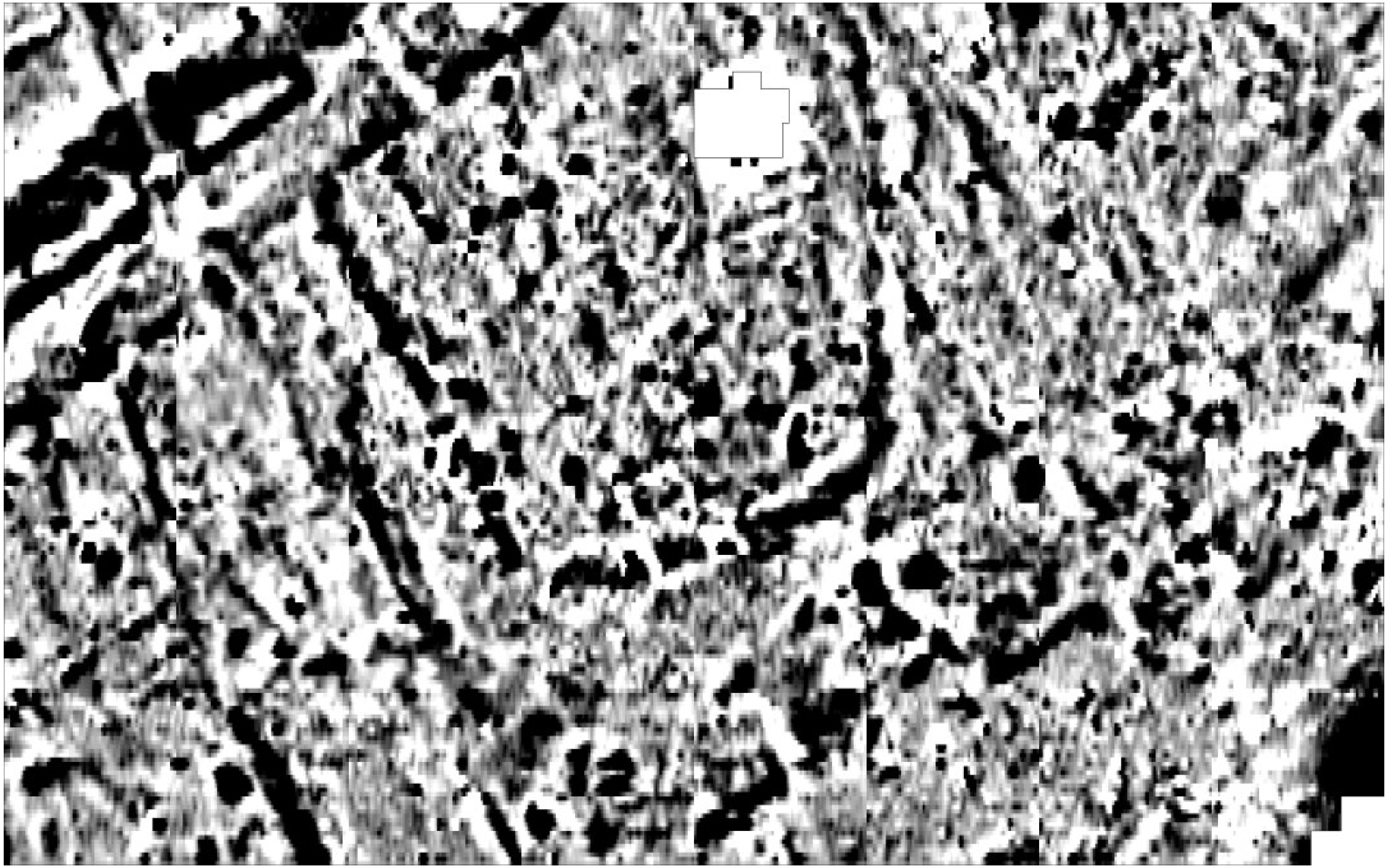
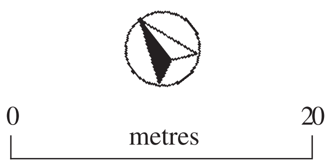
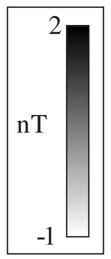
Magnetic Data - Area 1I

Figure A17







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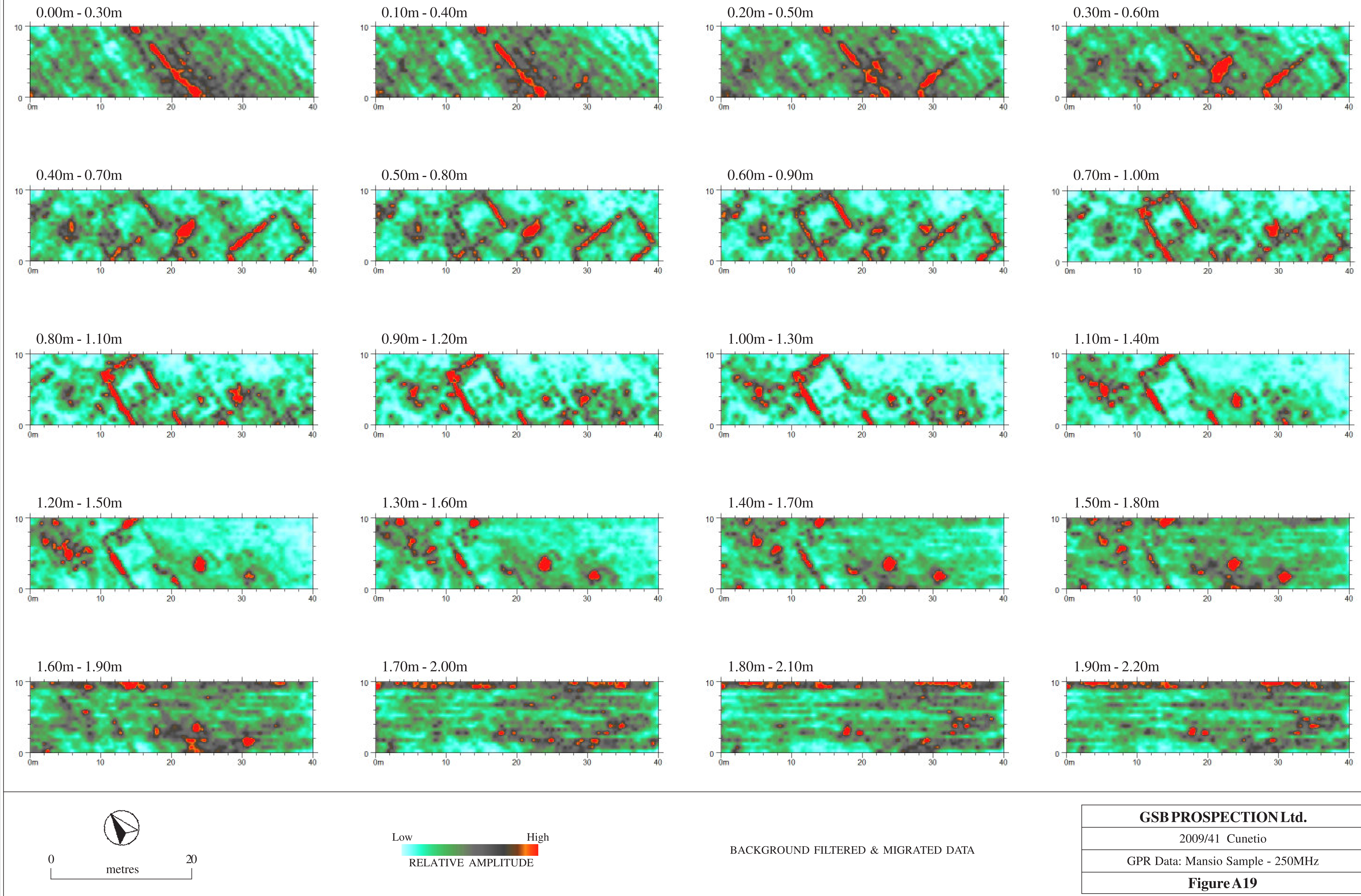
Magnetic Data - Area 1I

Figure A18



BACKGROUND FILTERED & MIGRATED DATA

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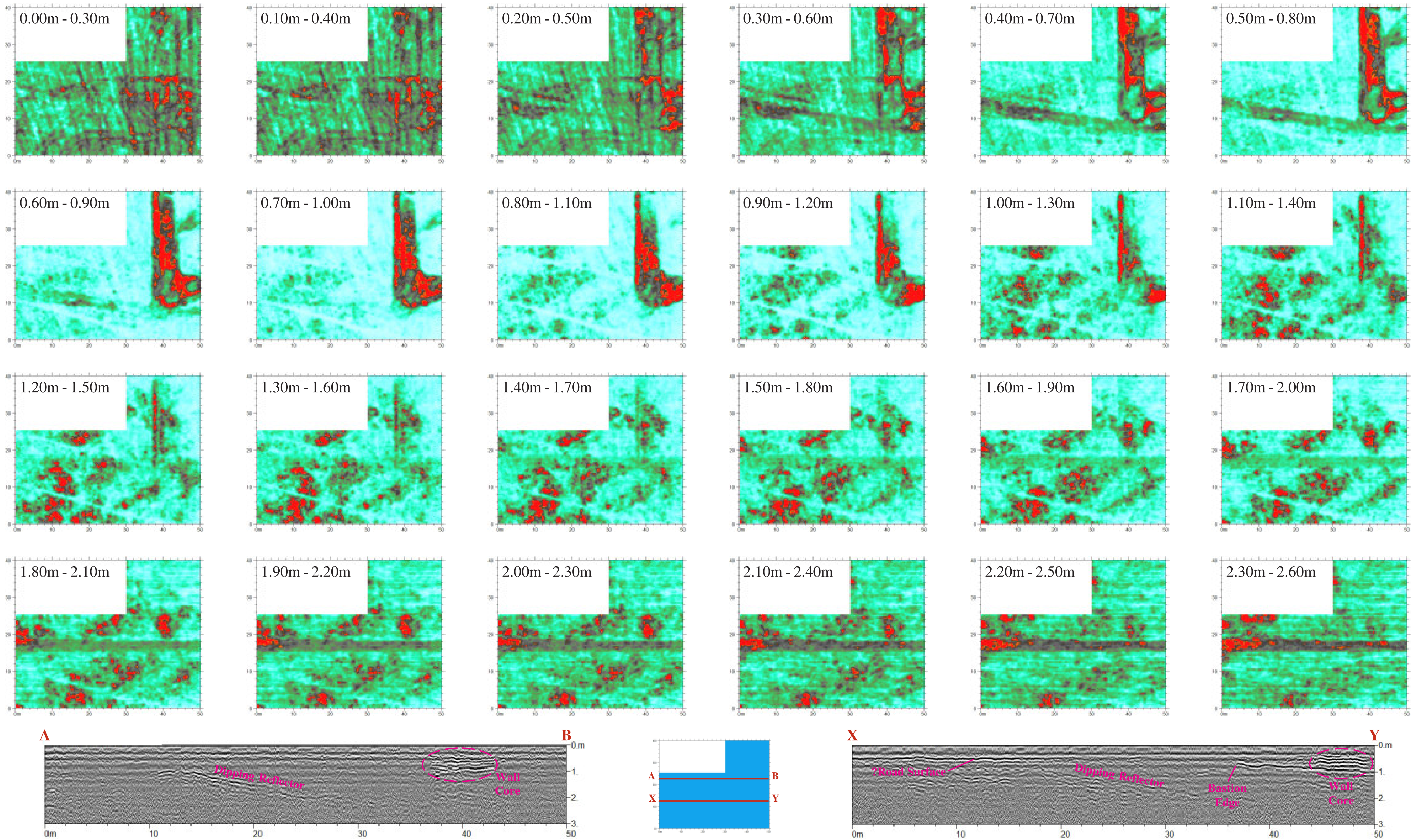
GPR Data: Mansio Sample - 250MHz

Figure A19



0 metres 40

Low High
RELATIVE AMPLITUDE

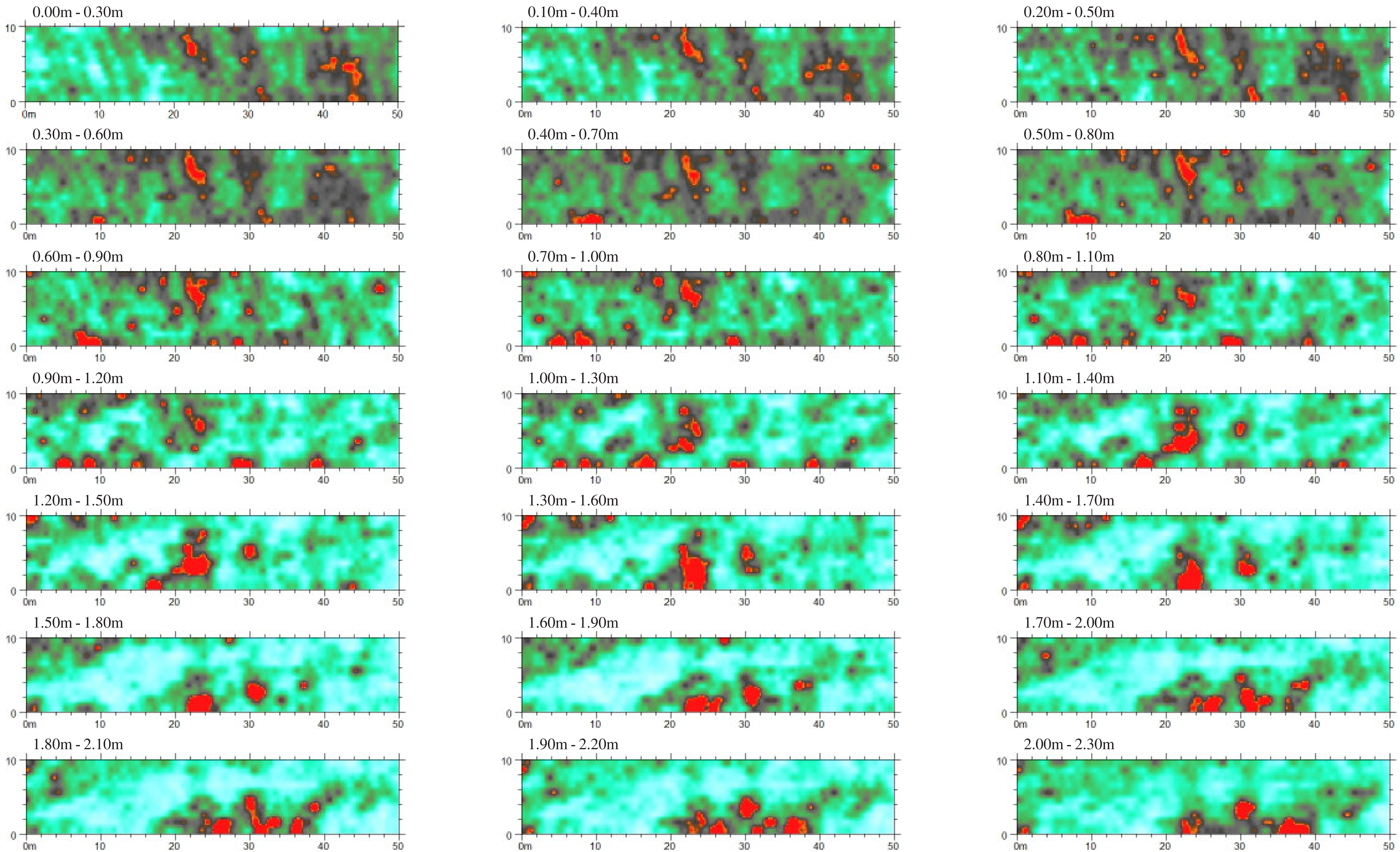
BACKGROUND FILTERED & MIGRATED DATA

GSB PROSPECTION Ltd.

2009/41 Cunetio

GPR Data: West Field - North

Figure A20



0 metres 20

Low High
RELATIVE AMPLITUDE

BACKGROUND FILTERED & MIGRATED DATA

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2009/41 Cunetio
GPR Data: West Field - South
Figure A21