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LAKES AND DALES NAIS, GOWREY FARM, HIGH CASTERTON, CUMBRIA
REPORT ON GEOPHYSICAL SURVEY, AUGUST 2013

Neil Linford, Paul Linford and Andrew Payne

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SUMMARY

A caesium magnetometer survey was conducted at Gowrey Farm, High Casterton, Cumbria as part of the National Archaeological Identification Surveys: Upland Pilot (RASMIS 6304) to recover evidence for the continuation of the well preserved coaxial field boundaries found in the adjacent upland area of High Park. It was hoped that rapid, large scale magnetic survey may help determine whether the coaxial field systems once extended further towards the Lune valley, and still survive as detectable geophysical anomalies in areas of improved pasture where any surface expression has been removed. The geophysical response over a survey area of 9.7ha, encompassing a 0.92km N-S transect bordering the upland area, was dominated by networks of land drains related to land improvement. Despite these limitations a number of very tentative linear magnetic trends may correlate with the possible continuation of the coaxial boundaries.

CONTRIBUTORS

The field work was conducted by Neil Linford, Paul Linford and Andy Payne from the English Heritage Geophysics Team.

ACKNOWLEDGEMENTS

The authors wish to express their thanks to the land owners, Mr Stephen Woodhouse and his father at Gowrey Farm, for granting access to their farmland to allow the survey to take place and for supporting the fieldwork while it was in progress.

ARCHIVE LOCATION

Fort Cumberland.

DATE OF FIELDWORK AND REPORT

The fieldwork was conducted between 7th and 8th August 2013. The report was completed on 9th December 2013. The report cover shows a view of the survey in progress in Area C adjacent to the Eller Beck with the well preserved upland archaeological landscape of High Park visible in the background.

CONTACT DETAILS

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CONTENTS

INTRODUCTION

Caesium magnetometer survey was conducted over four separate pasture fields at Gowrey Farm (centred on NGR SD 633780) as part of the Upland pilot of the National Archaeological Identification Survey (NAIS) programme (NAIS Upland, Lakes and Dales; NHPP Project Number 3A4.312, RaSMIS 6304). The NAIS Upland pilot project covers the Arnside & Silverdale AONB together with parts of the proposed extensions to the Yorkshire Dales and Lake District National Parks, and aims to improve both the understanding of known sites and also include areas where the current archaeological record is sparse (Oakey 2013). The results of the project will directly feed into the management of these protected landscapes.

Geophysical survey was included in the project to complement the initial aerial investigation on selected sites in the Lune Valley, where ground-based methods could potentially enhance the assessment of the archaeological evidence (Linford *et al* 2013a, 2013b; 2013c). The aim of the geophysical survey at Gowrey Farm was to test whether rapid, vehicle towed magnetic survey could provide a means to investigate the possible continuation of well preserved coaxial field boundaries, found in the upland to the east around High Park (SAM 1019016; Jecock 1998), down towards the Lune Valley. Agricultural land improvement together with other processes of soil erosion or deposition question the survival of the coaxial field systems in the areas of improved pasture, where the NAIS project hopes to establish whether these were, perhaps, once more extensive.

The land at Gowrey is situated on Carboniferous Mudstone, Siltstone and Sandstone of the Millstone Grit Group overlain by shallow well drained fine loamy and fine silty soils of the 541j Denbigh 1 association (Soil Survey of England and Wales 1983; British Geological Survey (NERC) 2013). No superficial deposits are mapped in the area, although the local near surface geology has probably been influenced by fluvio-glacial processes. At the time of the survey the land was down to grass and weather conditions during the field work were generally warm, dry and sunny.

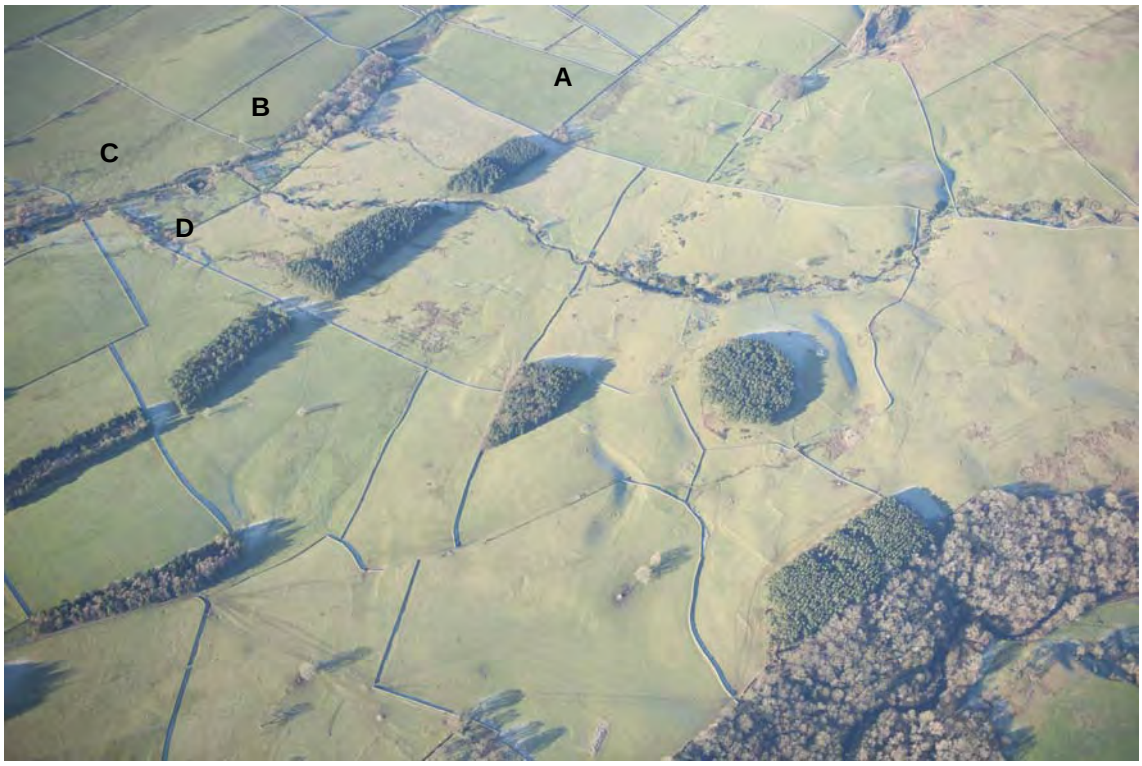

Figure 1: Aerial photograph of the well preserved upland archaeological landscape of the High Park area (right side of photograph) where numerous coaxial linear boundaries survive as visible surface features. The areas (A-D) selected for geophysical survey lie beyond the belts of woodland in the top-left portion of the photograph (28364/029 11-DEC-2012 © English Heritage)

METHOD

The survey was conducted over an approximately 1km long N-S linear transect located in accessible fields as close as possible to the projected line of the coaxial field systems trending down off the adjacent upland (Figures 2 and 9). Access was restricted, in part, due to the presence of hay crops and the unsuitable nature of the terrain in some areas.

Magnetic Survey

The magnetometer data was collected along the instrument swaths shown on Figure 2 using an array of six high sensitivity Geometrics G862 caesium vapour magnetometer sensors mounted on a non-magnetic sledge. This sledge was towed behind a low impact, all-terrain vehicle (ATV) which also provided the power supply and housed the data logging electronics. Five of the sensors were mounted in a linear array transverse to the direction of travel 0.5m apart and, vertically, ~0.2m above the ground surface. The sixth was fixed 1.0m directly above the central magnetometer in the array to act as a gradient sensor. The sensors were set to sample at a rate of 16 Hz based on the typical average travel speed of the ATV (3.2m/s) giving a sampling density of ~0.2m by 0.5m along successive swaths. Each swath was separated from the last by approximately 2.5m,

navigation and positional control being achieved using a Trimble 4700 series Global Positioning System (GPS) receiver mounted on the sensor platform 1.75m in front of the central sensor. Sensor output and survey location was monitored during acquisition to ensure data quality and minimise the risk of gaps in the coverage due to the use of a grid-less system.

After data collection the corresponding readings from the gradient sensor were subtracted from the measurements made by the other five magnetometers to remove any transient magnetic field effects caused by the towing ATV. The median value of each instrument traverse was then adjusted to zero by subtracting a running median value calculated over a 60m 1D window. This operation corrects for slight biases added to the measurements owing to the diurnal variation of the Earth's magnetic field and any slight directional sensitivity of the sensors. A linear greyscale image of the combined magnetic data is shown superimposed over the base Ordnance Survey (OS) mapping on Figure 3 and minimally processed versions of the range truncated data (±50nT) are shown as traceplots and linear greyscale images in Figures 4 to 7.

RESULTS

Magnetic survey

A graphical summary of the significant magnetic anomalies, [m1-26], discussed in the following text, superimposed on the base OS map data, is provided in Figure 8.

General response

The background response appears to be quieter and more uniform than at the other selected sites surveyed in the project area suggesting less natural magnetic variation from the underlying Millstone Grit geology (Linford *et al* 2013a, 2013b; 2013c).

Area A

This was the most easterly field where survey could be attempted bordering the adjacent High Park scheduled area, but was only partially covered due to the uneven nature of the terrain.

Two networks of diagonal ceramic field drains are found to the north [m1] and south [m2] of Area A, together forming a herring-bone pattern that most probably fall through a central drain [m3], that flows through a brick structure causing an intense magnetic disturbance [m4] into the pond to the west. A number of very weak positive and negative linear trends [m5-9] follow similar alignments to the extant coaxial field boundaries on the higher ground to the east (*cf* Figure 9), but the significance of these extremely tentative anomalies is difficult to assess. Only one of these anomalies, [m8], correlates with the

projected orientation of one of earthworks from the upland, and may possibly be associated with a very weak curvilinear response [m10], but this remains a highly tentative interpretation given the low magnitude of the response (~0.5 to 0.7 nT/m).

Area B

A further system of ceramic field drains [m11] are found in the north of Area B, probably drawing water down towards the stream to the east, and maybe associated with a similar, orthogonal anomaly [m12]. Areas of slightly raised positive [m13] and negative [m14] response may be evidence of former natural drainage patterns or a reflection of variable soil depth. Two weak positive linear anomalies [m15 and m16] may, tentatively, be associated with the continuation of the coaxial field systems, due to their WSW-ENE orientation, but they are not well resolved. Large areas of intense magnetic disturbance associated with near surface ferrous material of recent origin occur at [m17-19]. Finally, a cluster of strong positive anomalies (up to 15 nT/m in magnitude) at [m20] may, tentatively, be indicative of more significant occupation activity potentially consisting of pits, hearths and possible circular gullies.

Areas C and D

The network of N-S aligned ceramic field drains [m21] found to the west of Area C is possibly associated with a double linear anomaly [m22] that may carry water down from the higher ground. A second network of field drains [m23] to the east has a different geophysical response to [m21], possibly indicating they were laid in two distinct phases, alternative construction materials or, perhaps, a varying state of survival. Strongly magnetic material, likely to be of relatively recent origin, occurs at [m24] close to the banks of the Eller Beck. A very weak group of linear parallel trends [m25] may, possibly, represent a continuation of the coaxial field systems, although this is again based largely on the coincidental alignment of the magnetic anomalies with the extant earthworks found further to the east (*cf* Figure 9). The curvilinear bank or scarp-type earthwork mapped by aerial photography in Area C has produced a weak negative response [m26], but does not suggest any definitive interpretation.

CONCLUSION

Land improvement at Gowrey Farm through the widespread introduction of ceramic field drains has had a strong effect on the magnetic survey and, possibly, also the preservation of any surviving archaeological features. Linear earthworks (probable lynchets) mapped by aerial photography in the survey areas have only been partially replicated in the magnetic data, although it is unclear whether this is due to disturbance from the introduction of the land drains, the efficacy of the geophysical technique at the site or the nature of the underlying causative features (*cf* Figure 9). Some limited evidence for the continuation of the coaxial field systems from the upland to the east has been found through a number of

very weakly resolved linear magnetic trends. However, further investigation would be required to confirm this interpretation and assess the extent to which magnetic survey has proved effective for detecting significant archaeological remains. The use of a vehicle towed caesium magnetic array has allowed a substantial area available at the time of the survey to be covered and has proved effective at other sites within the project area (Linford *et al* 2013a, 2013b; 2013c). Other geophysical techniques, for example earth resistance survey, could be tested at the site although they are likely to meet with similar problems due to the terrain and would be unable to cover the large areas required to be confident of covering a sufficient sample of the coaxial field systems extending from the adjacent scheduled area of upland at High Park.

LIST OF ENCLOSED FIGURES

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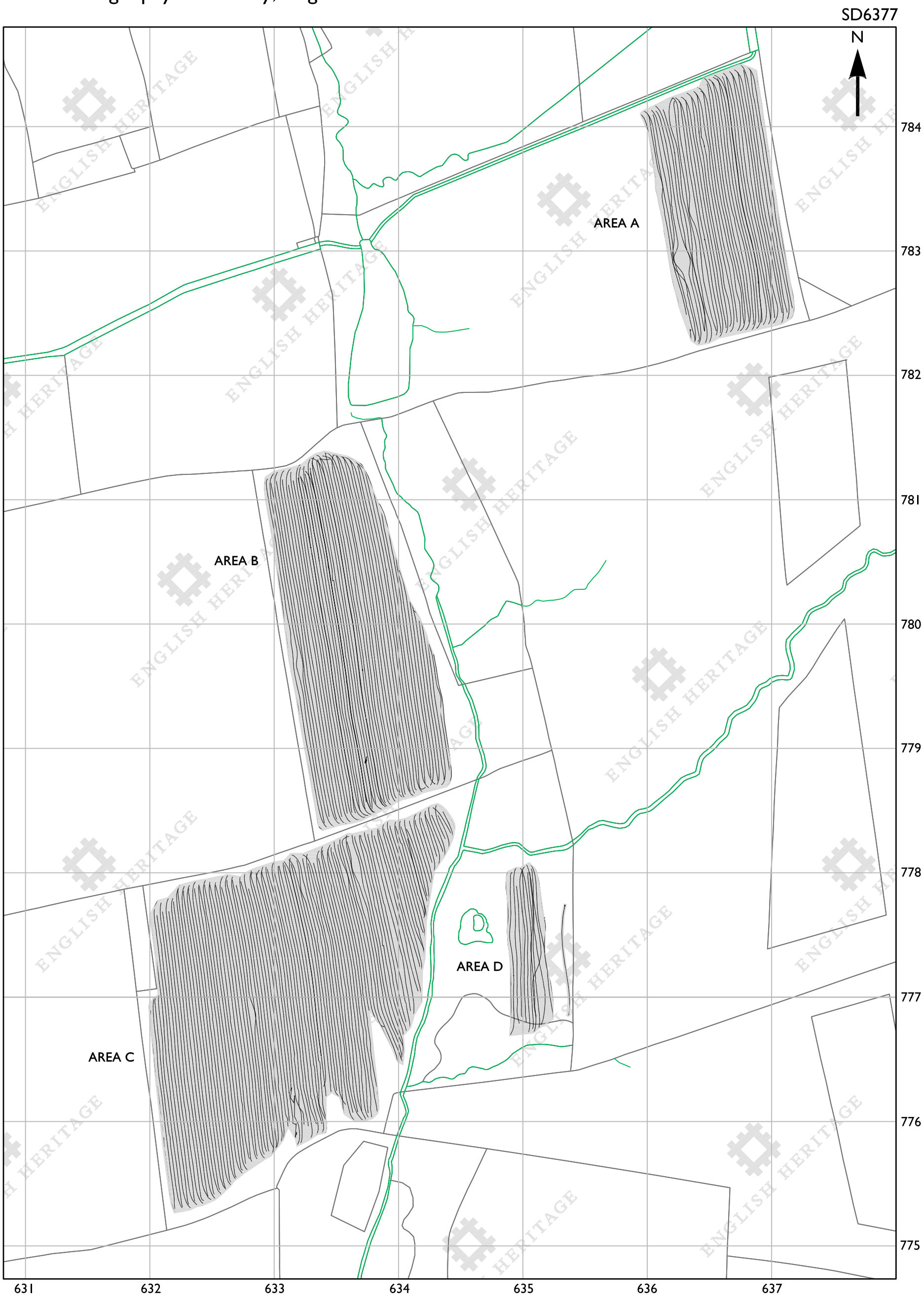
Figure 2

LAKES AND DALES NAIS, GOWREY FARM, HIGH CASTERTON, CUMBRIA

Location of geophysical survey, August 2013



0 90m

1:3000

magnetometer survey swaths

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Figure 3

LAKES AND DALES NAIS, GOWREY FARM, HIGH CASTERTON, CUMBRIA

Location of caesium magnetometer survey, August 2013

0 90m

1:3000

-1.50 -0.50 0.50 1.50

nT/m

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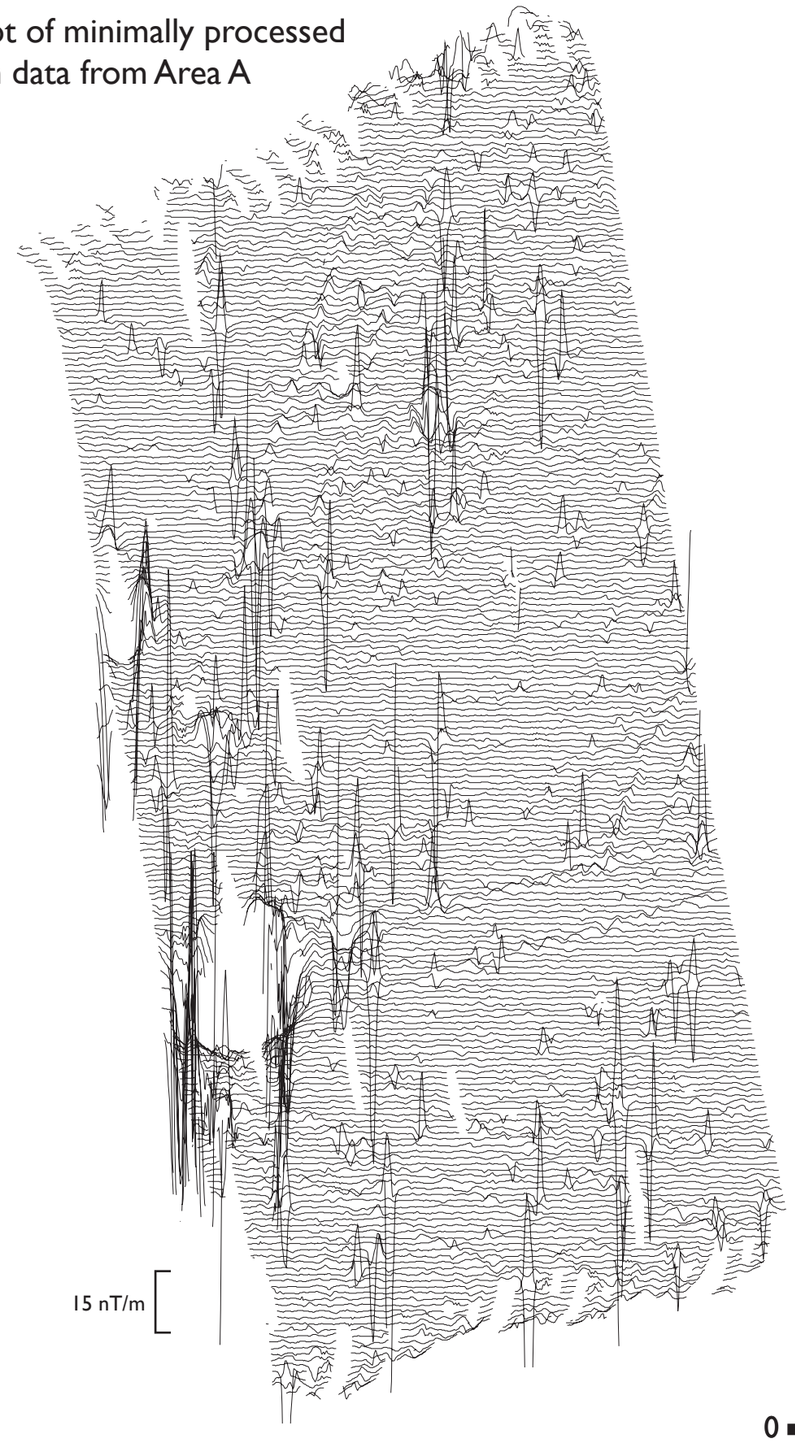
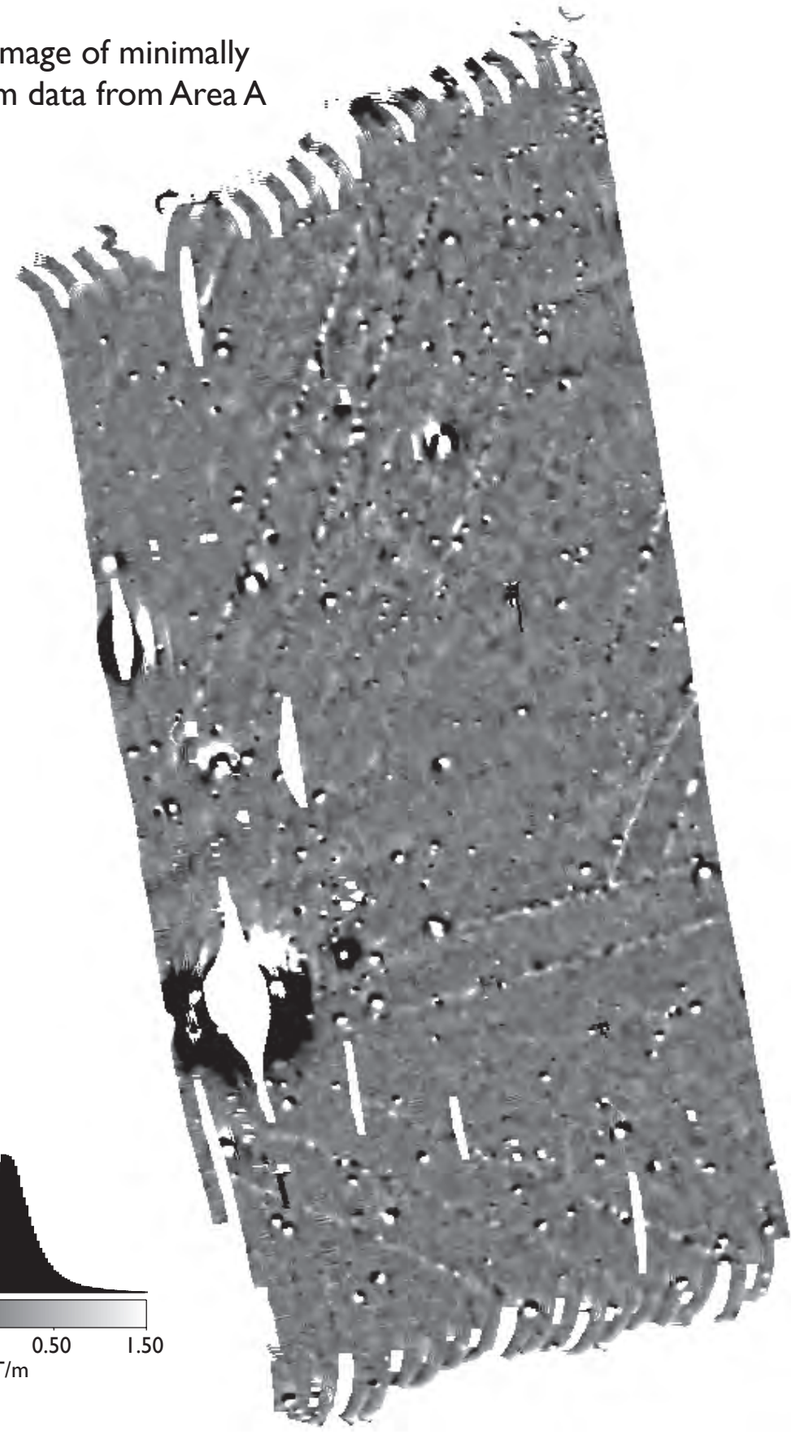
Figure 4

LAKES AND DALES NAIS, GOWREY FARM, HIGH CASTERTON, CUMBRIA
Magnetometer surveys, August 2013

(A) Traceplot of minimally processed caesium data from Area A



(B) Linear greyscale image of minimally processed caesium data from Area A



N

0 60m

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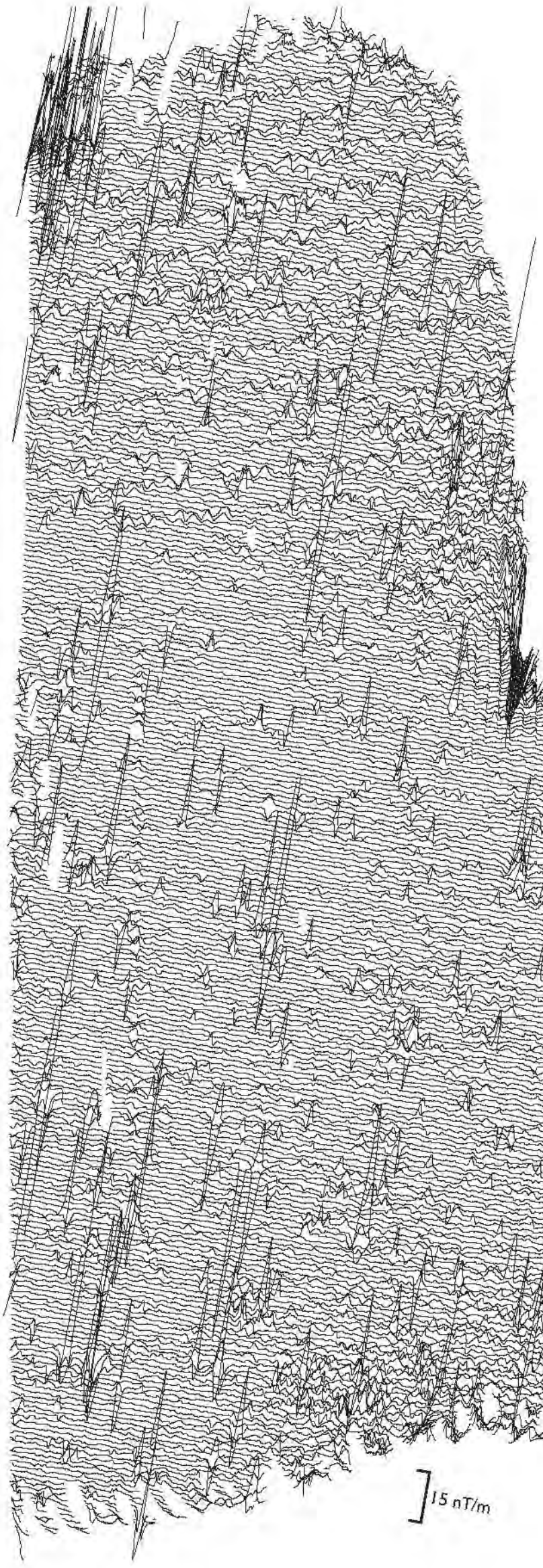
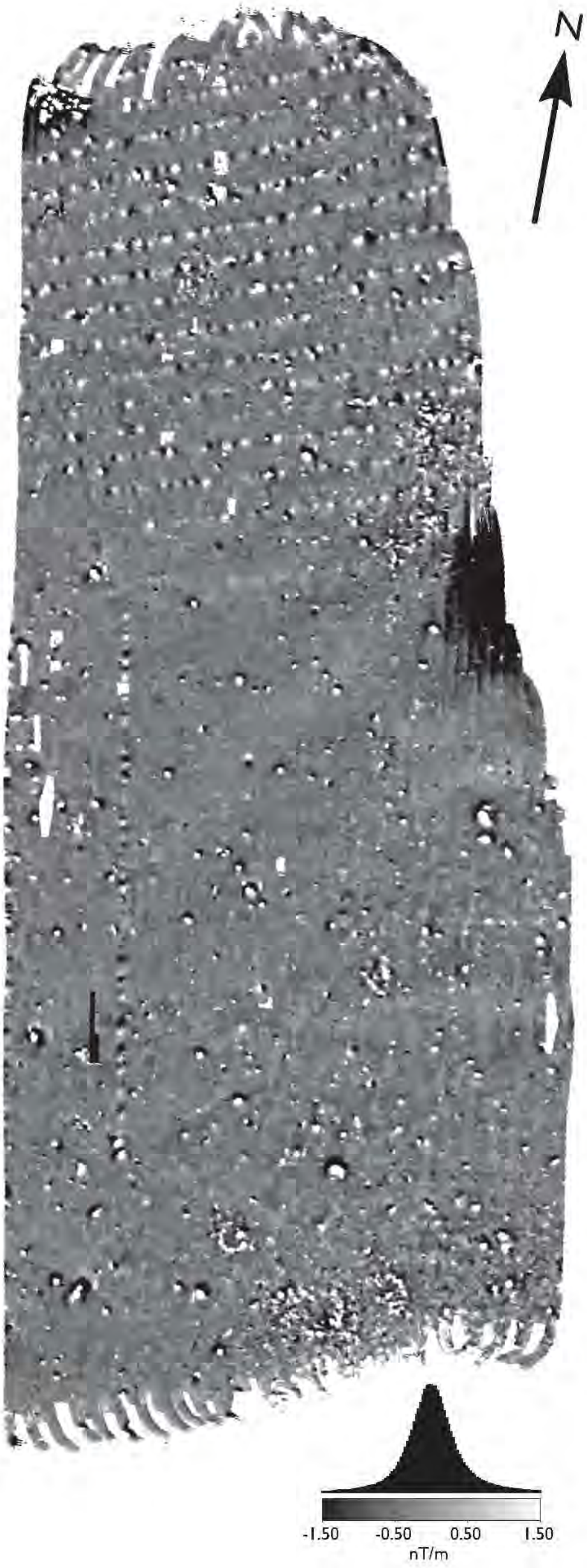
Figure 5

LAKES AND DALES NAIS, GOWREY FARM, HIGH CASTERTON, CUMBRIA
Magnetometer surveys, August 2013

(A) Traceplot of minimally processed caesium data from Area B



(B) Linear greyscale image of minimally processed caesium data from Area B



0 60m
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Figure 6

Magnetometer surveys, August 2013

Traceplot of minimally processed caesium data from Areas C and D

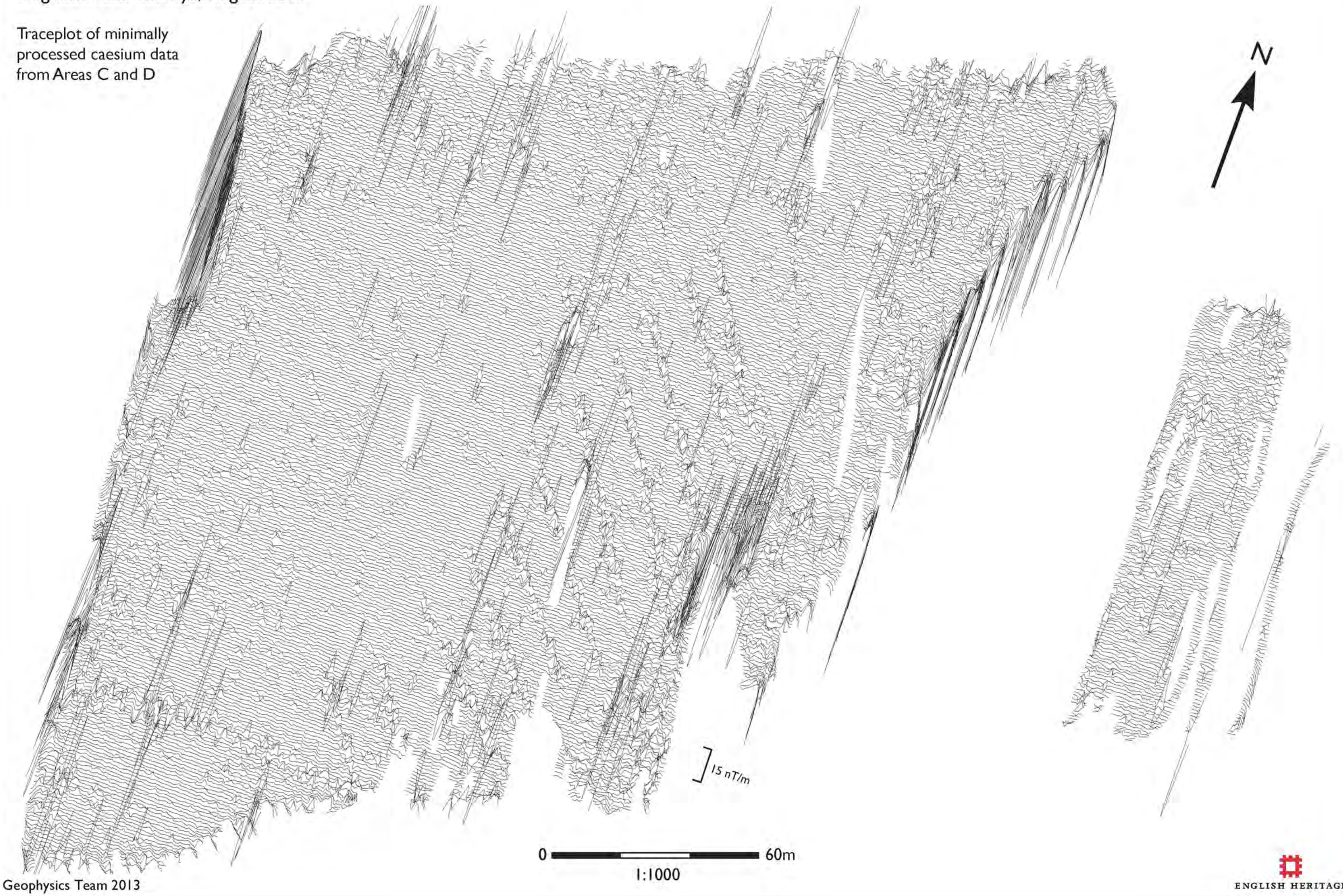

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Figure 7

LAKES AND DALES NAIS, GOWREY FARM, HIGH CASTERTON, CUMBRIA
Magnetometer surveys, August 2013

Linear greyscale plot of minimally processed caesium data from Areas C and D

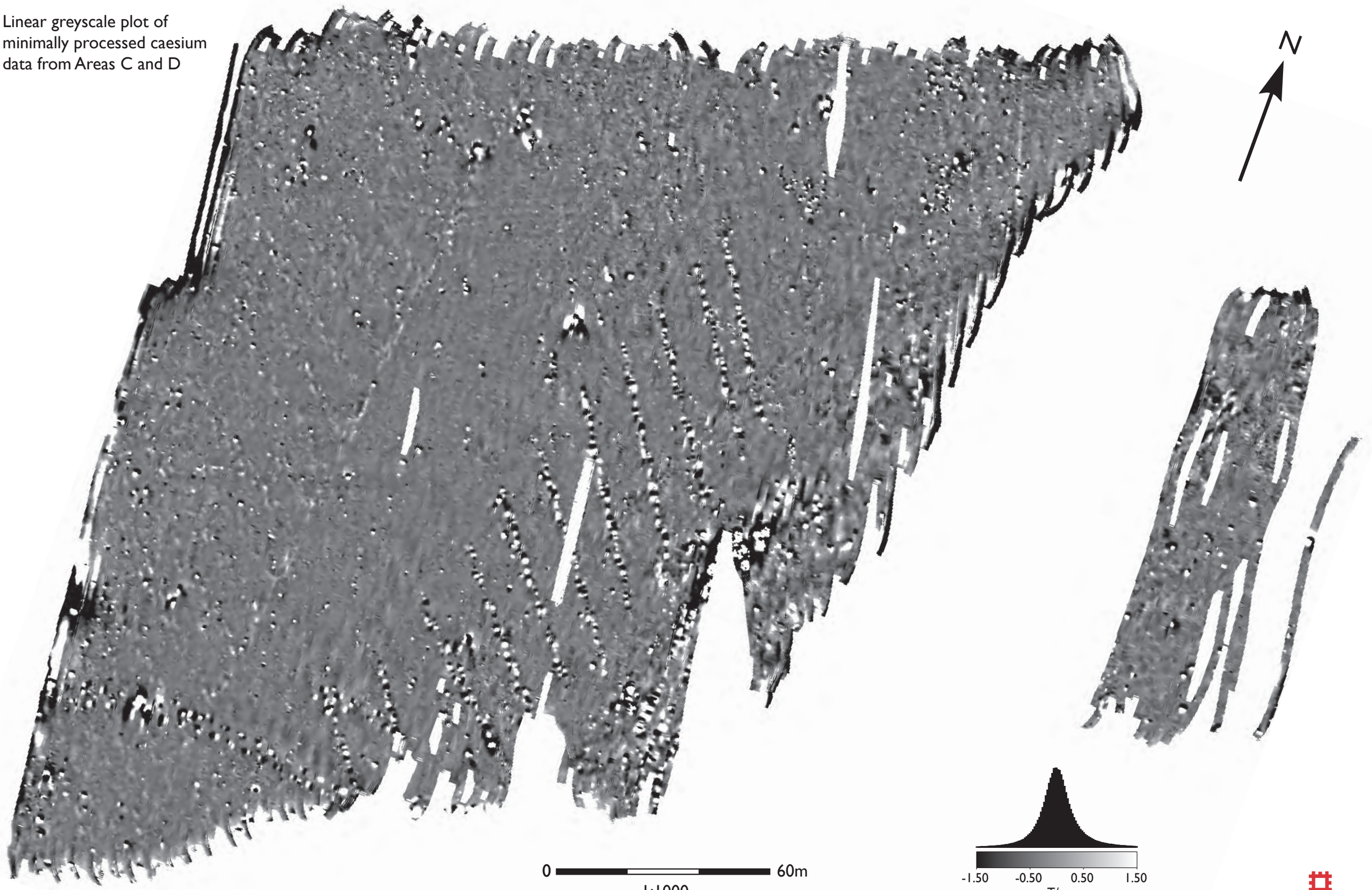

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Figure 8

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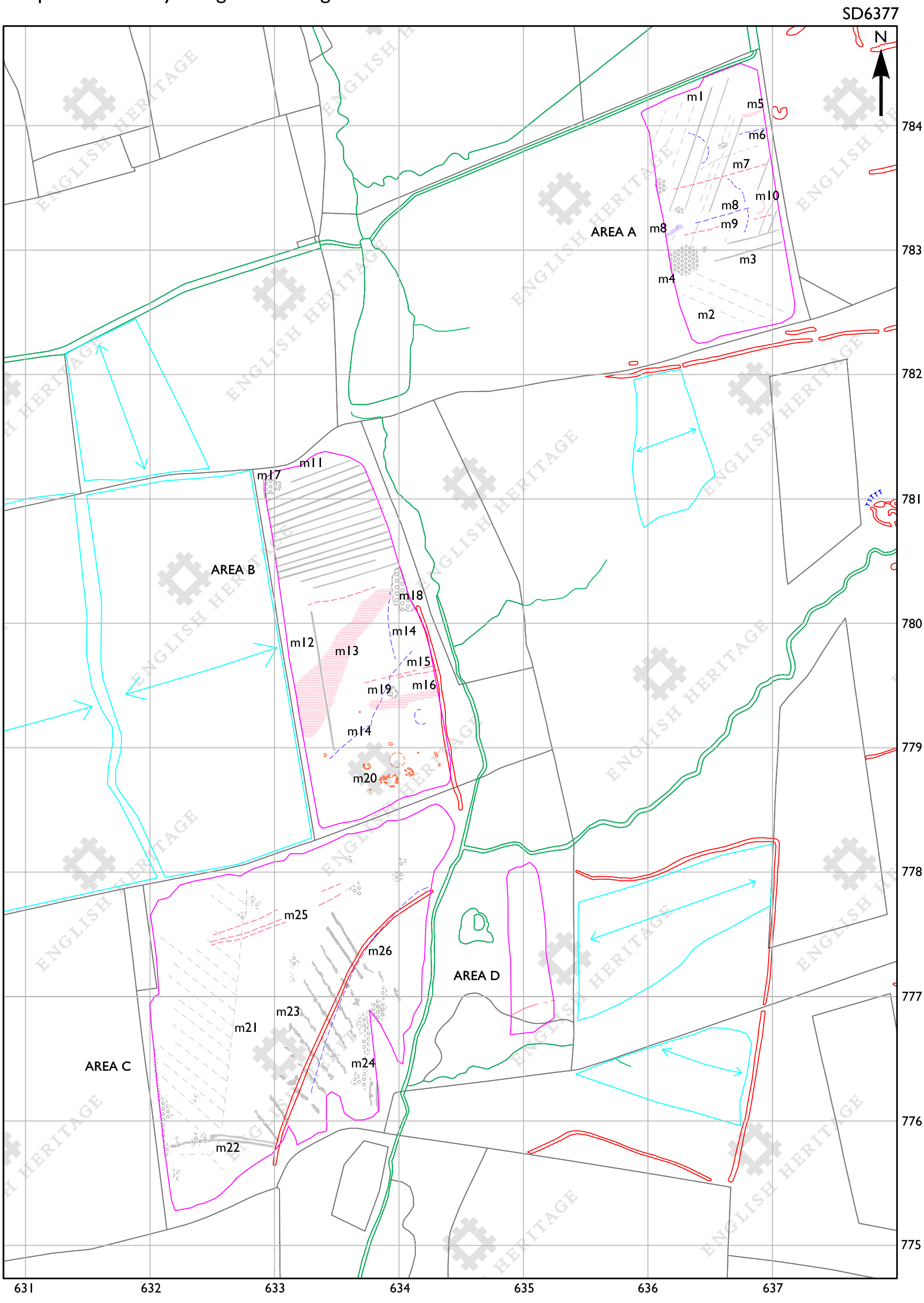
Graphical summary of significant magnetic anomalies



0 90m

1:3000

positive magnetic

negative magnetic

weak positive magnetic

magnetic / ferrous noise

earthwork bank or scarp on aerial mapping

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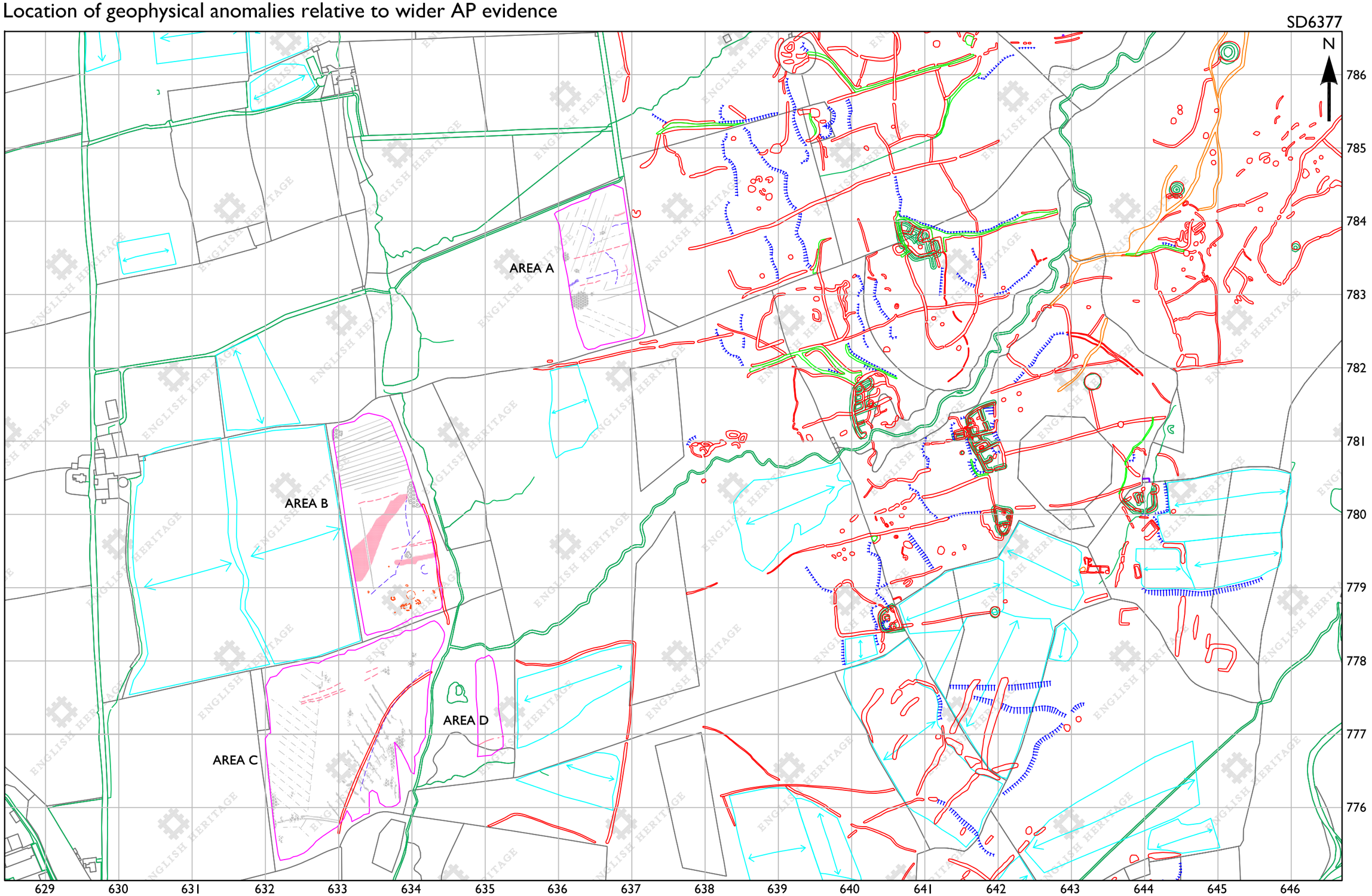
Figure 9

LAKES AND DALES NAIS, GOWREY FARM, HIGH CASTERTON, CUMBRIA

Location of geophysical anomalies relative to wider AP evidence



0 150m
1:5000

magnetometer survey areas (A-D):

aerial mapping evidence:
- rig and furrow alignment
- bank
- scarp
- ditch

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