Archaeological Services
University of Durham

Land at Innsworth, Gloucestershire

geophysical surveys - Phase II

on behalf of
CgMs Consulting

Report 1386
January 2006

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Contents

1. Summary

The project

1.1 This report presents the results of a second phase of geophysical surveys conducted in advance of a proposed development on land at Innsworth, Gloucestershire.

1.2 The works were commissioned by CgMs Consulting and conducted by Archaeological Services in accordance with a project design provided by Archaeological Services.

Results

1.3 The remains of palaeochannels have been detected in Area 1. Other features reflecting recent course-straightening of the stream along the northern boundary of Area 1 are also in evidence.

1.4 Two possible ditches have been detected in Area 2, one of which may be the remains of a ring-ditch.

1.5 A change in the magnetic texture between the northern and southern halves of Area 3 may reflect a change in soil conditions, possibly as a result of differing cultivation practices in the past, or it may be indicative of the presence of alluvial silts associated with the floodplain.

2. Project background

Location (Figure 1)

2.1 The study area was located at Innsworth, Gloucestershire (NGR: SO 852 217). It measured approximately 9ha in total, which comprised pasture and arable fields bounded by hedgerows.

Development proposal

2.2 The surveys have been carried out in advance of a development proposal for residential housing, with associated services and access roads.

Objective

2.3 The principal aim of the surveys was to investigate the potential for the presence of the remains of past settlement, activity and land-use and to test for the survival of associated buried archaeological features, to enable an informed assessment of the archaeological impact of the development proposals.

Dates

2.4 Fieldwork was undertaken between the 19th and 22nd December 2005. This report was prepared between the 3rd and 20th January 2006.

Personnel

2.5 Fieldwork was conducted by Graeme Attwood, Louise Robinson and Sam Roberts (Supervisor). This report was prepared by Sam Roberts, with illustrations by Martin Railton. The Project Manager was Duncan Hale.

Archive/OASIS

2.6 The site code is **IWG05(2)**, for **I**nns**w**orth, **G**loucestershire 20**05,** Phase **2**. The paper and data archive is currently held by Archaeological Services. Archaeological Services is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (OASIS). The OASIS ID number for this project is **archaeol3-12427**.

3. Archaeological and historical background

3.1 Little is known of the archaeological resource in the present study area. Geophysical surveys completed on land to the south during Phase I identified three separate foci of features representing multi-phase occupation and exploitation of the landscape (Archaeological Services 2005). The features included ring-ditches, curvilinear and rectilinear enclosures, trackways, ditches and pits. Traces of ridge and furrow cultivation were found across the majority of the Phase I survey area, indicating intensive agricultural exploitation of the land from the medieval period until the present.

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised one arable field and two pasture fields.

4.2 The survey area was predominantly level at a mean elevation of *c*.10m OD.

4.3 The study area lies within a postglacial alluvial plain that is dominated by the Rivers Severn and Avon. The solid and drift geology comprise mainly sand and mudstones of the Triassic and Jurassic periods that are overlain by a variety of postglacial alluvial deposits

5. Geophysical survey methods

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage (1995) Research and Professional Services Guideline No.1, *Geophysical survey in archaeological field evaluation*; the Institute of Field Archaeologists (2002)Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations*; and the Archaeology Data Service (2001) *Geophysical Data in Archaeology: A Guide to Good Practice*.

Technique selection

5.2 Geophysical surveying enables the relatively rapid and non-invasive identification of potential archaeological features within landscapes and can involve a variety of complementary techniques such as magnetometry, electrical resistivity, ground-penetrating radar and electromagnetic survey. Some techniques are more suitable than others in particular situations, depending on a variety of site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, based on previous work in the area (Archaeological Services 2004 & 2005), it was considered likely that cut features, such as ditches and pits, might be present on the site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) might also be present.

5.4 Given the shallowness of the targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate. This technique involves the use of a hand-held magnetometer to detect and record minute perturbations, or 'anomalies', in the vertical component (i.e. gradient) of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect each of the types of feature mentioned above.

Field methods

5.5 The study area was divided into three separate areas for survey purposes (Figure 1).

5.6 A 30m grid was established across each survey area and tied-in to known, mapped Ordnance Survey points using a Leica GS50 global positioning system (GPS).

5.7 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601 fluxgate gradiometers with automatic datalogging facilities. A zig-zag traverse scheme was employed and data were logged in 30m grid units. The instrument sensitivity was set to 0.1nT, the sample interval to 0.25m and the traverse interval to 1.0m, thus providing 3600 sample measurements per 30m grid unit.

5.8 Data were downloaded on-site into laptop computers for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.9 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw data. The greyscale images and interpretations are presented in Figures 2-7; the trace plots are provided in Appendix I. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla.

5.10 The following basic processing functions have been applied to each dataset:

Clip – clips, or limits data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic.

Zero mean traverse – sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities.

Destagger – corrects for displacement of anomalies caused by alternate zig-zag traverses.

Despike – locates and suppresses random iron spikes in gradiometer data.

Low pass filter – is useful for smoothing data or for enhancing larger weak features.

Interpolate – increases the number of data points in a survey; to match sample and traverse intervals and so create a smoother appearance to the data. In this instance the gradiometer data have been interpolated to 0.25 x 0.25m intervals.

Anomaly types

5.11 Colour-coded geophysical interpretation plans are provided for each survey area. Two types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches.
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths.

6. Geophysical survey results

6.1 A compilation of the individual survey area greyscales is presented in Figure 2. Colour-coded geophysical and archaeological interpretation plans are provided for each survey area.

Area 1 (Figures 2-4)

6.2 The sinuous positive magnetic anomalies crossing the survey area almost certainly reflect remains of palaeochannels crossing the floodplain.

6.3 Two concentrations of dipolar magnetic anomalies on the northern boundary, one in the northwest corner and the other towards the northeast, correspond to bends of the river shown on the basemap and probably reflect more recent infilling of the river channel to straighten its course.

6.4 A chain of dipolar magnetic anomalies traversing the northern half of the survey area from east to west is likely to reflect the former location of a fenceline, now removed.

6.5 A row of four large circular dipolar magnetic anomalies reflects the electricity pylons within the field, whilst a fifth anomaly to the north reflects a modern water trough. A scatter of small, discrete dipolar magnetic anomalies reflects fired and ferrous debris within the topsoil.

Area 2 (Figures 5-7)

6.6 Two very weak positive magnetic anomalies, one linear and one curvilinear (with an approximate diameter of 12m), have been detected in the western half of the survey area. These may reflect shallow ditches or gullies.

6.7 The only other anomalies in this area are dipolar magnetic anomalies along the periphery of the survey area reflecting wire fences along the field boundaries and a scatter of dipolar magnetic anomalies reflecting soil litter.

Area 3 (Figures 5-7)

6.8 A difference in magnetic texture is apparent between the northern and southern halves of the survey area. This change corresponds to the location of a previous field boundary and could result from different farming regimes practiced to either side of the boundary. It also closely matches the limit of the floodplain (as defined by the outline of the Phase I study area) and may arise from the change to alluvial silts. Similar textural changes have been detected in other surveys over land either once subject to flooding or made up of drier and wetter areas in the past.

6.9 Dipolar magnetic anomalies along the western edge of the survey area reflect a wire fence, and a scatter of discrete dipolar magnetic anomalies again reflects the fired and ferrous debris within the topsoil. The larger dipolar magnetic anomaly is likely to reflect a larger ferrous object within the topsoil.

7. Conclusions

7.1 A second phase of geophysical survey has been carried out on land at Innsworth, Gloucestershire.

7.2 The remains of palaeochannels have been detected in Area 1. Other features reflecting recent course-straightening of the stream along the northern boundary of Area 1 are also in evidence.

7.3 Two possible ditches have been detected in Area 2, one of which may be the remains of a ring-ditch.

7.4 A change in the magnetic texture between the northern and southern halves of Area 3 may reflect a change in soil conditions, possibly as a result of differing cultivation practices in the past, or it may be indicative of the presence of alluvial silts associated with the floodplain.

8. Sources

Archaeological Services 2004 *Land at Longworth, near Gloucester, Gloucestershire: geophysical surveys,* unpublished report **1115** for CgMs Consulting, Archaeological Services Durham University

Archaeological Services 2005 *Land at Innsworth, Gloucester: geophysical surveys,* unpublished report **1359** for CgMs Consulting, Archaeological Services Durham University

Archaeology Data Service 2001 *Geophysical Data in Archaeology: A Guide to Good Practice,* Arts and Humanities Data Service

English Heritage 1995 *Geophysical survey in archaeological field evaluation,* Research and Professional Services Guideline **1**

Institute of Field Archaeologists 2002 *The use of geophysical techniques in archaeological evaluations*, Technical Paper **6**

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Figure 1

Location map

on behalf of
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0 300m

scale 1:7500 - for A3 plot

Phase 1 study area

Phase 2 study area

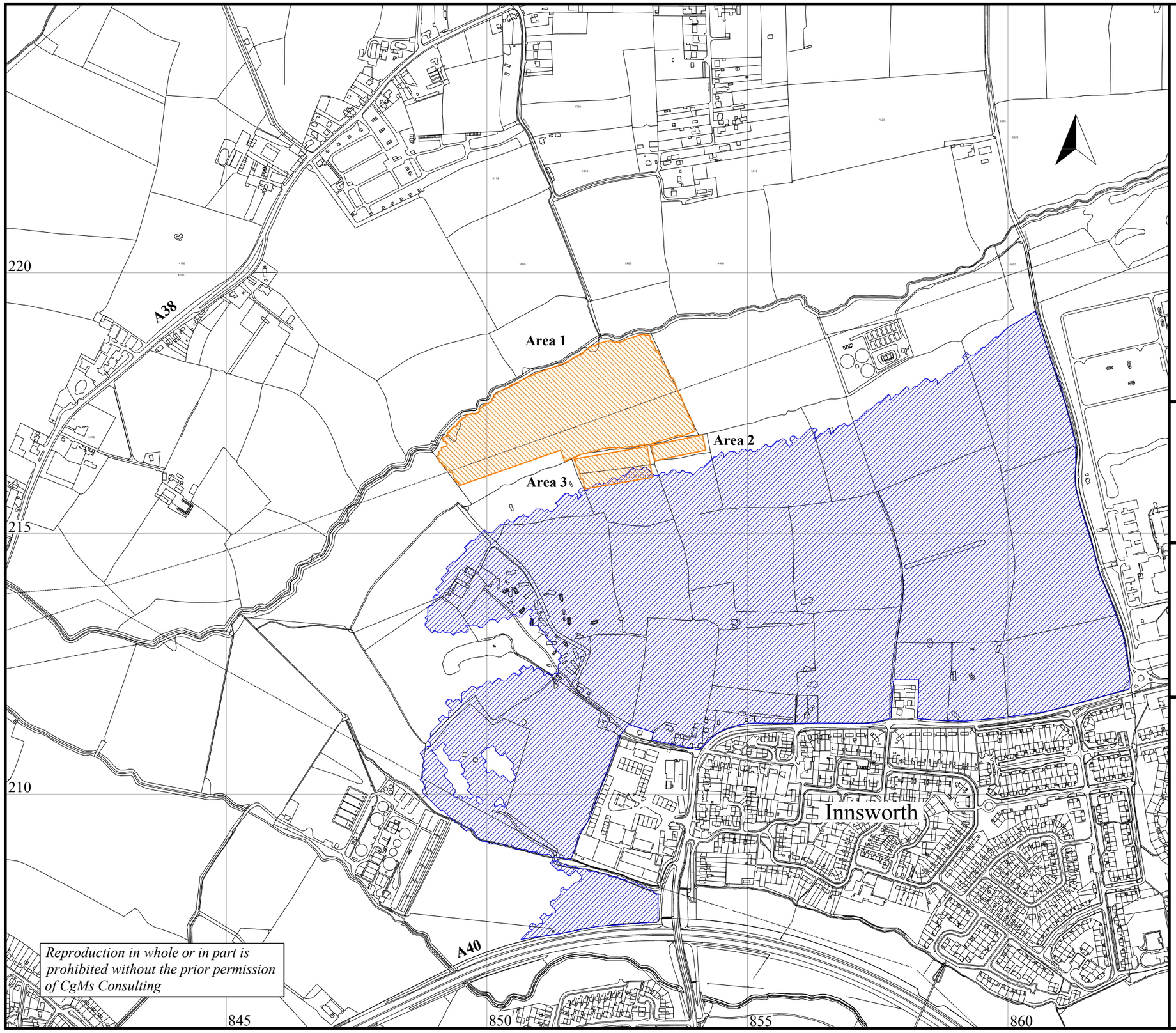

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Figure 2

Geophysical survey of Area 1

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0 100m
scale 1:2000 - for A3 plot

outline of Phase 1 study area

outline of survey area

5.00
4.20
3.30
2.50
1.70
0.80
0
-0.80
-1.70
-2.50
-3.30
-4.20
-5.00 nT

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Figure 3

Geophysical interpretation of Area 1

on behalf of
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0 100m
scale 1:2000 - for A3 plot

outline of Phase 1 study area

outline of survey area

positive magnetic anomalies

dipolar magnetic anomalies

219
218
217
216
215
849
850
851
852
853
854

Area 1
Area 2
Area 3

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Figure 4

Archaeological interpretation of Area 1

on behalf of
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0 100m
scale 1:2000 - for A3 plot

- outline of Phase 1 study area
- outline of survey area
- soil-filled features
- former fence line
- electricity pylon

Area 1
Area 2
Area 3
water tank

219
218
217
216
215
849
850
851
852
853
854

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Figure 5

Geophysical surveys of Area 2 and Area 3

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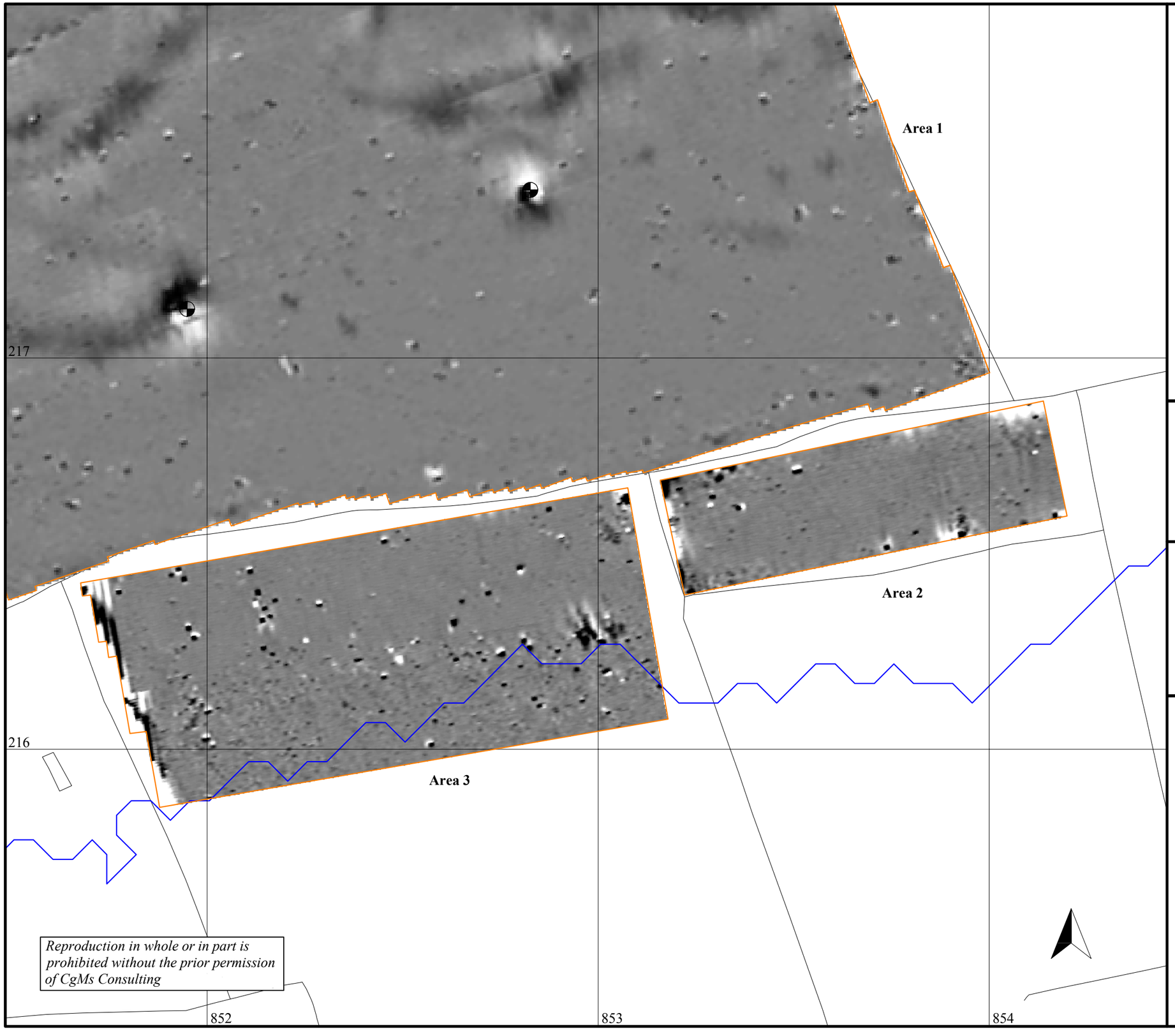

0 50m

scale 1:1000 - for A3 plot

outline of Phase 1 study area

outline of survey area

Area 3	Area 2
5.00	2.00
4.20	1.70
3.30	1.30
2.50	1.00
1.70	0.70
0.80	0.30
0	0
-0.80	-0.30
-1.70	-0.70
-2.50	-1.00
-3.30	-1.30
-4.20	-1.70
-5.00 nT	-2.00 nT

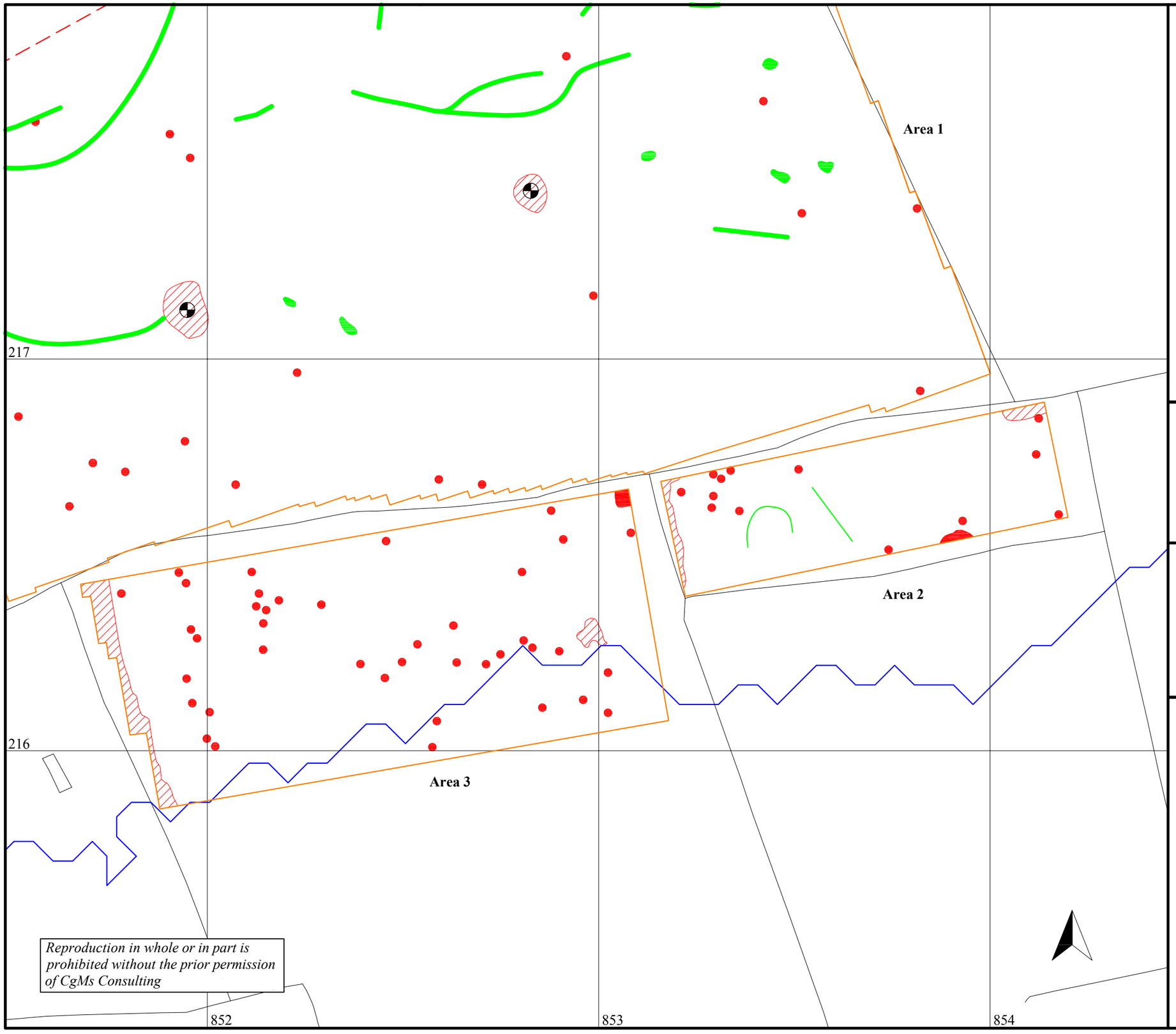

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Figure 6

Geophysical interpretation of Area 2 and Area 3

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0 50m

scale 1:1000 - for A3 plot

outline of Phase 1 study area

outline of survey area

positive magnetic anomalies

dipolar magnetic anomalies

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Figure 7

Archaeological interpretation of Area 2 and Area 3

on behalf of
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0 50m
scale 1:1000 - for A3 plot

- outline of Phase 1 study area
- outline of survey area
- soil-filled features
- former fence line
- electricity pylon

Area 1

Area 2

Area 3

217

216

852

853

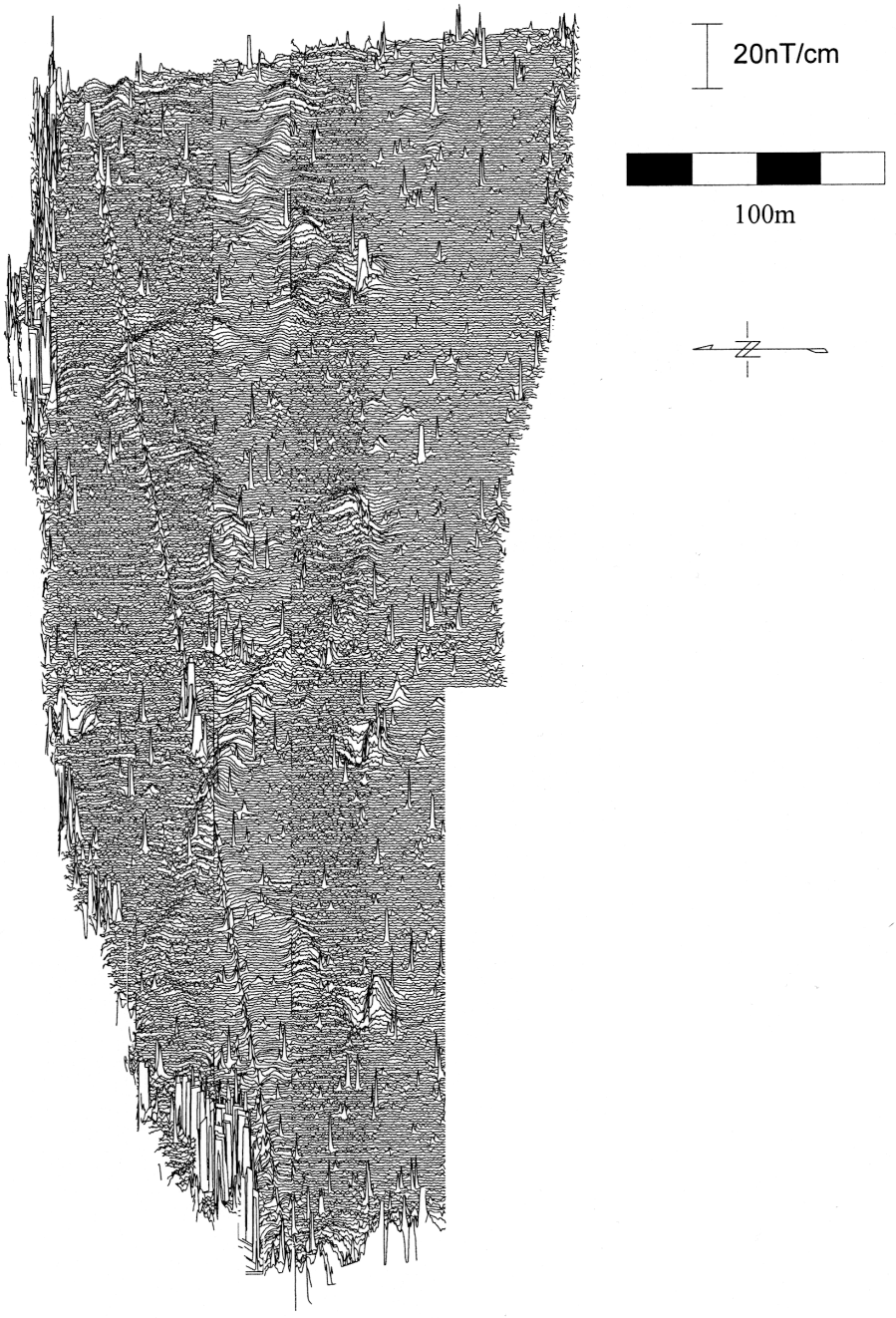
854

Appendix I: Trace plots of geophysical data

Land at Innsworth, Gloucester

Phase 2, Area 1 geomagnetic data

1:2500 @ A4



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Phase 2, Area 2 geomagnetic data

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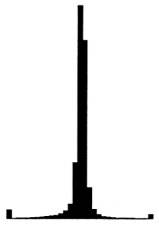
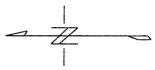
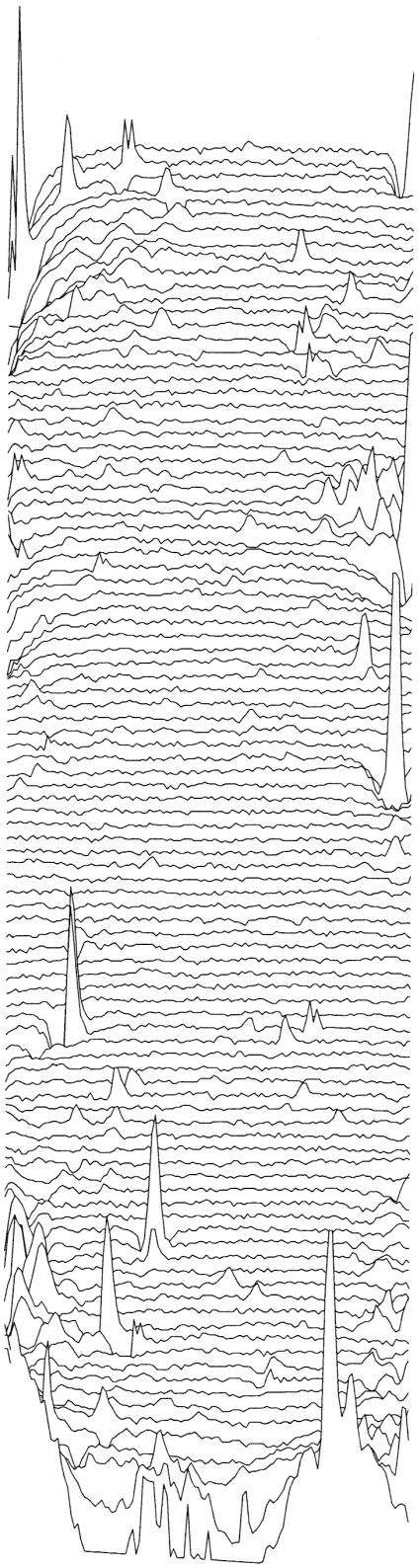


4nT/cm

20m





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Phase 2, Area 3 geomagnetic data

1:750 @ A4