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GEOPHYSICAL SURVEY REPORT 2005/16

RED BARN QUARRY

Lincolnshire

Client:

Northern Archaeological Associates

EVENT L16080 INTERVENTION: L1 10123. MS/5

PRN 36565 undated.

SITE SUMMARY SHEET

2005/16 Red Barn Quarry, Lincolnshire

NGR: SK 985 195

Location, topography and geology

The proposed extension of Red Barn Quarry occupies an arable field to the northwest of Castle Bytham, Lincolnshire. Geophysical survey was carried out in two predefined blocks at the eastern end of the evaluation area; here the land slopes towards a stream and was under a short crop at the time of survey. The site soils are of the Ragdale Association (712g) and comprise seasonally waterlogged clayey and loamy over clayey soils formed from a parent of chalky till.

Archaeology

The entire evaluation area has undergone fieldwalking and this recovered two concentrations of slag which were considered to indicate that bloom smithing had been carried out in the immediate vicinity. The Domesday Book records the presence of *fabri ferrari* in Castle Bytham and it is possible that the slag finds relate to this medieval ironworking. Other fieldwalking finds suggest a more limited possibility of prehistoric remains within the application area.

Aims of Survey

Two predefined blocks, covering the slag concentrations, were investigated by detailed magnetometry in order to determine whether the surface finds do in fact indicate an industrial working site. The work forms part of a wider evaluation undertaken by **Northern Archaeological Associates** (**NAA**) in advance of a proposed extension of the existing quarry.

Summary of Results *

Area 1 (covering the small concentration of slag) has produced very few anomalies of archaeological interest and none that would suggest in situ industrial features. By contrast, Area 2 (over the larger concentration) yielded a band of very strong responses which suggests a number of intact or partially intact ironworking features together with an extensive area of strong magnetic enhancement thought to reflect a spread of industrial debris/slag. The extent of these responses suggests the presence of a major ironworking site. Adjacent to this industrial activity is a rectilinear enclosure (that extends beyond the survey area) though this may relate to a different phase of activity on the site.

*** It is essential that this summary is read in conjunction with the detailed results of the survey.**

SURVEY RESULTS

2005/16 Red Barn Quarry, Lincolnshire

1. Survey Area

1.1 Gradiometer survey was initially carried out in two predefined areas (1 and 2), totalling 1ha and the survey was expanded to clarify the nature of several anomalies of possible interest. The total area surveyed was 1.64ha. The location of the survey areas is shown in Figure 1 at a scale of 1:2500.

1.2 The survey grid was set out by **GSB Prospection Ltd** and tied in to existing field boundaries using an EDM system. The tie-in information is included in the report (Figure T1).

2. Display

2.1 Figures 2 and 3 present the data as greyscale images at different plotting levels, superimposed on the basemap, at 1:1000. Figure 4 is a summary interpretation at the same scale.

2.2 Figures 5 to 11 present the results of each block as XY trace plots, a greyscale images and digitised interpretations, all at a scale of 1:500.

2.3 Letters in parentheses in the text below refer to anomalies highlighted in the relevant interpretation diagram.

3. General Considerations - Complicating Factors

3.1 Conditions for survey were good, the ground being gently undulating, free from obstructions and under a young crop.

3.2 The soils of the site present no hindrances to magnetic survey, particularly given the nature of the potential features of interest: anomalies associated with industrial activity would be strongly magnetic and thus easily detectable.

3.3 A number of small scale ferrous anomalies, or 'iron spikes' have been detected by the survey. These would normally be attributed to modern debris in the topsoil. In this case, it is possible that some of these responses could reflect small pieces of slag of greater antiquity, although it is perhaps unlikely that this material will be in context.

4. Results of Survey

Area 1

4.1 This area is relatively magnetically quiet, with no clear indications of industrial activity and few anomalies of archaeological potential. The noisy response at (A) could indicate the remains of an industrial feature *in situ*; however it is several orders of magnitude weaker than industrial type anomalies recorded elsewhere and also some distance away from the apparent core area of ironworking (see paragraph 4.4 below), making this interpretation cautious. Other smaller strong anomalies may indicate fragments of burnt/fired material, but they form no patterns suggesting discrete features.

4.2 A pair of broad sinuous anomalies (B) is most probably natural in origin, possibly reflecting former watercourses.

4.3 Parallel linear trends in the data are attributed to modern ploughing.

Area 2

4.4 A band of extremely strong, relatively discrete anomalies (C) divides this survey area. The negative magnetic 'shadow' around these responses makes it difficult to define their exact shape but many are oval or circular and in the region of 6m in diameter. They suggest a region of industrial working, combining individual ore processing features surviving intact and large scale slag / debris, spreading down the break of slope. The northern limit of this band appears to have been defined; immediately to the south is the existing field boundary, so any southern continuation of these features lies outside the application area.

4.5 The lower lying ground to the east of (C) displays strong magnetic enhancement, becoming slightly less pronounced towards the northern edge of the grid. Within this area of noise several strong parallel anomalies can be seen which follow the line of the slope and also the current ploughing. It appears that modern cultivation has cut through a spread of enhanced material associated with the putative ironworking site. Some of this material is likely to be industrial debris that has migrated downslope but the possibility that the ploughing has damaged/disturbed intact features cannot be discounted. The anomalies at (D) are broader and could indicate remnants of archaeological ditches filled with enhanced debris, or former water channels, but both these interpretations are speculative. An alternative (albeit tentative) interpretation for the pair of anomalies (E) is that they reflect a former trackway.

4.6 West of (C) the ground rises and the levels of background magnetic fluctuation drop to virtually nothing. Three sides of an enclosure (F) have been identified; it is on roughly the same alignment as the band of industrial responses and the putative ploughing trends, with the eastern arm measuring approximately 45m. The anomalies are significantly weaker than those to the east, suggesting an absence of industrial debris in the fill and there is no evidence for internal subdivisions. Four pit type anomalies and one strong, possibly industrial type response (G) are visible within the enclosure but none of these would tend to suggest occupation. Despite the commonality of alignment, it is possible that the enclosure represents a different phase of activity at the site. Anomaly (G), although well defined, is isolated and smaller than those in band (C) and could equally reflect a modern ferrous object.

4.7 A weak linear anomaly (H) could indicate section of ditch or possible former field division associated with the enclosure (F) but could equally be an enhanced ploughing trend cutting into the edge of the band of industrial features.

5. Conclusions

5.1 The aim of the survey was to identify any anomalies that might be associated with spreads of surface slag recovered by fieldwalking. Area 1 has yielded little evidence for industrial workings; the slag collection in this block is comparatively small and seemingly does not reflect in situ features. By contrast, a large spread of slag was collected in Area 2 and this corresponds to an area of increased magnetic response detected by the gradiometer, suggesting more industrial material is present beneath the surface. A band of very strong discrete anomalies represent the features that produced this slag and there are indications that some of the ore processing features may survive intact. The band of industrial type anomalies extends for some 120m, suggesting a large scale ironworking site.

5.2 Three sides of a rectangular enclosure have been detected lying immediately to the west of the industrial area. The relative weakness of the responses and the absence of definitive internal occupation or industrial features, suggests at the very least a different function and possibly a different phase of activity at the site.

Project Co-ordinator: C Stephens
Project Assistant: B Urmston

Date of Survey: 21st & 22nd March 2005
Date of Report: 8th April 2005

References:

SSEW 1983. *Soils of England and Wales. Sheet 4, Eastern England.* Soil Survey of England and Wales.

TECHNICAL INFORMATION

The following is a description of the equipment and display formats used in **GSB Prospection Ltd (GSB)** reports. It should be emphasised that whilst all of the display options are regularly used, the diagrams produced in the final reports are the most suitable to illustrate the data from each site. The choice of diagrams results from the experience and knowledge of the staff of **GSB.**

All survey reports are prepared and submitted on the basis that whilst they are based on a thorough survey of the site, no responsibility is accepted for any errors or omissions.

Instrumentation

(a) Fluxgate Gradiometer - Geoscan FM36 / FM256 and Bartington *Grad*601-2

Both the Geoscan and Bartington instruments comprise of two fluxgate magnetometers mounted vertically apart at a distance of 500mm and 1000mm, respectively. 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 conventionally measured in nanoTesla (nT), or gamma. The fluxgate gradiometer suppresses any diurnal or regional effects. Generally features up to one metre deep may be detected by this method. Readings are logged at 0.25 intervals along traverses 1.0m apart, unless stated otherwise in the report. Having two gradiometer units mounted laterally with a separation of 1.0m, the Bartington instrument can collect two lines of data per traverse. The *Grad*601-2 has marginally greater sensitivity afforded by the increased fluxgate separation, unfortunately this also increases the instrument's susceptibility to external sources of interference.

(b) Resistance Meter - Geoscan RM15

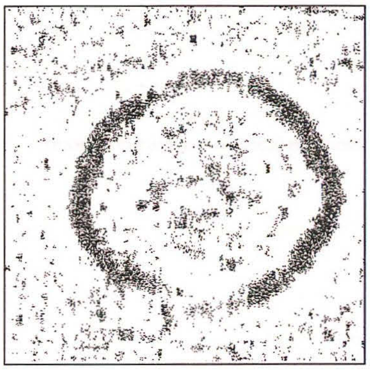
This measures the electrical resistance of the earth, using a system of four electrodes (two current and two potential.) Depending on the arrangement of these electrodes an exact measurement of a specific volume of earth may be acquired. This resistance value may then be used to calculate the earth resistivity. The "Twin Probe" arrangement involves the paring of electrodes (one current and one potential) with one pair remaining in a fixed position, whilst the other measures the resistance variations across a fixed grid. The resistance is measured in Ohms and the calculated resistivity is in Ohm-metres. The resistance method as used for area survey has a depth resolution of approximately 0.75m, although the nature of the overburden and underlying geology will cause variations in this generality. The technique can be adapted to sample greater depths of earth and can therefore be used to produce vertical "pseudo sections". In area survey readings are logged at 1.0m x 1.0m intervals, unless stated otherwise in the report.

(c) Magnetic Susceptibility

Variations in the magnetic susceptibility of subsoils and topsoils occur naturally, but greater enhanced susceptibility can also be a product of increased human/anthropogenic activity. This phenomenon of susceptibility enhancement can therefore be used to provide information about the "level of archaeological activity" associated with a site. It can also be used in a predictive manner to ascertain the suitability of a site for a magnetic survey. Sampling intervals vary widely but are often at the 10m or 20m level. The instrument employed for measuring this phenomenon is either a field coil or a laboratory based susceptibility bridge. The field coil measures the susceptibility of a volume of soil. The laboratory procedure determines the susceptibility of a specific mass of soil. For the latter 50g soil samples are collected in the field. These are then air-dried, ground down and sieved to exclude the coarse earth (>2mm) fraction. Readings are made using an AC-coil and susceptibility bridge, with results being expressed either as SI/kg x 10^{-8} or m^3/kg.

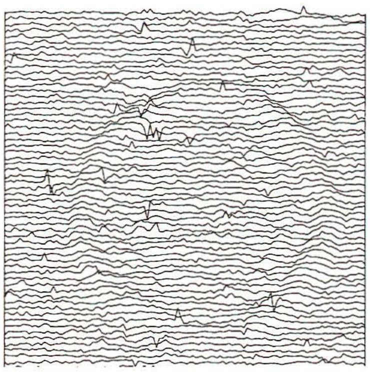
Display Options

The following is a description of the display options used. Unless specifically mentioned in the text, it may be assumed that no filtering or smoothing has been used to enhance the data. For any particular report a limited number of display modes may be used.



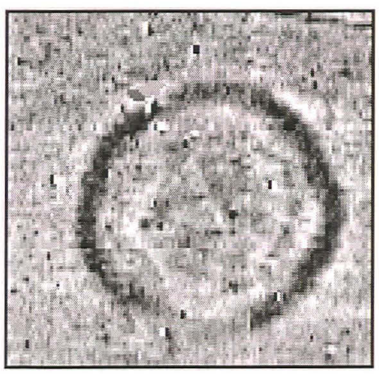
(a) Dot Density

In this display minimum and maximum cut-off levels are chosen. Any value that is below the minimum will appear white, whilst any value above the maximum will be black. Values that lie between these two cut-off levels are depicted with a specified number of dots depending on their relative position between the two levels. Assessing a lower than normal reading involves the use of an inverse plot that reverses the minimum and maximum values, resulting in the lower values being presented by more dots. In either representation, each reading is allocated a unique area dependent on its position on the survey grid, within which numbers of dots are randomly placed. The main limitation of this display method is that multiple plots have to be produced in order to view the whole range of the data. It is also difficult to gauge the true strength of any anomaly without looking at the raw data values. However, this display is favoured for producing plans of sites, where positioning of the anomalies and features is important.



(b) XY Plot

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.



(c) Greyscale

This format divides a given range of readings into a set number of classes. These classes have a predefined arrangement of dots or shade of grey, the intensity increasing with value. This gives an appearance of a toned or grey-scale. 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. While colour plots can look impressive and can be used to highlight certain anomalies, greyscales tend to be more informative.

Terms commonly used in the graphical interpretation of gradiometer data

Ditch / Pit
This category is used only when other evidence is available that supports a clear archaeological interpretation e.g. cropmarks or excavation.

Archaeology
This term is used when the form, nature and pattern of the response is clearly or very probably archaeological but where no supporting evidence exists. These anomalies, whilst considered anthropogenic, could be of any age. If a more precise archaeological interpretation is possible then it will be indicated in the accompanying text.

? 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.

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 fencelines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

NB This is by no means an exhaustive list and other categories may be used as necesssary.

List of Figures

GSB PROSPECTION Ltd.

PROJECT: 2005/16 RED BARN QUARRY

TITLE: Location Diagram

Area of slag recovered from fieldwalking

Gradiometer Survey

0 metres 100

Figure 1

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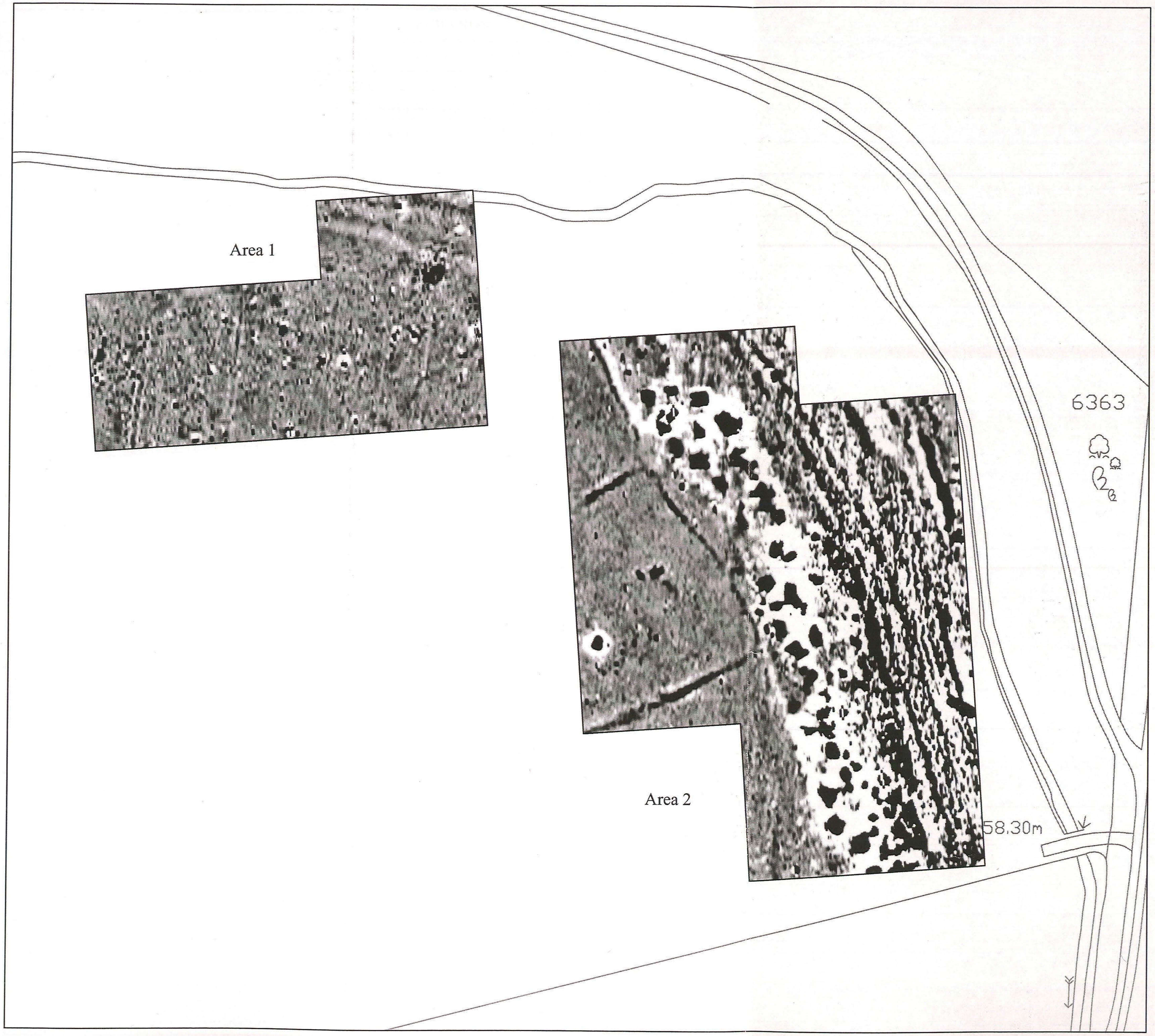
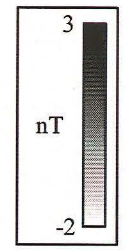
PROJECT: 2005/16 RED BARN QUARRY

TITLE: Summary Greyscales





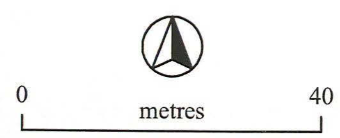


Figure 2

GSB PROSPECTION Ltd.

PROJECT: 2005/16 RED BARN QUARRY

TITLE: Summary Greyscales

Figure 3


GSB PROSPECTION Ltd.
PROJECT: 2005/16 RED BARN QUARRY
TITLE: Summary Interpretation
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Area 1
Area 2
A
B
C
D
E
F
G
H
6363
BM 58.30m
Area of Industrial Activity
Industrial Feature
?Industrial/Burnt Material
Area of Strong Magnetic Enhancement
Archaeology
?Archaeology
Trend
?Natural
Ploughing
Ferrous
0
metres
40

Figure 4

RED BARN QUARRY
Area 1

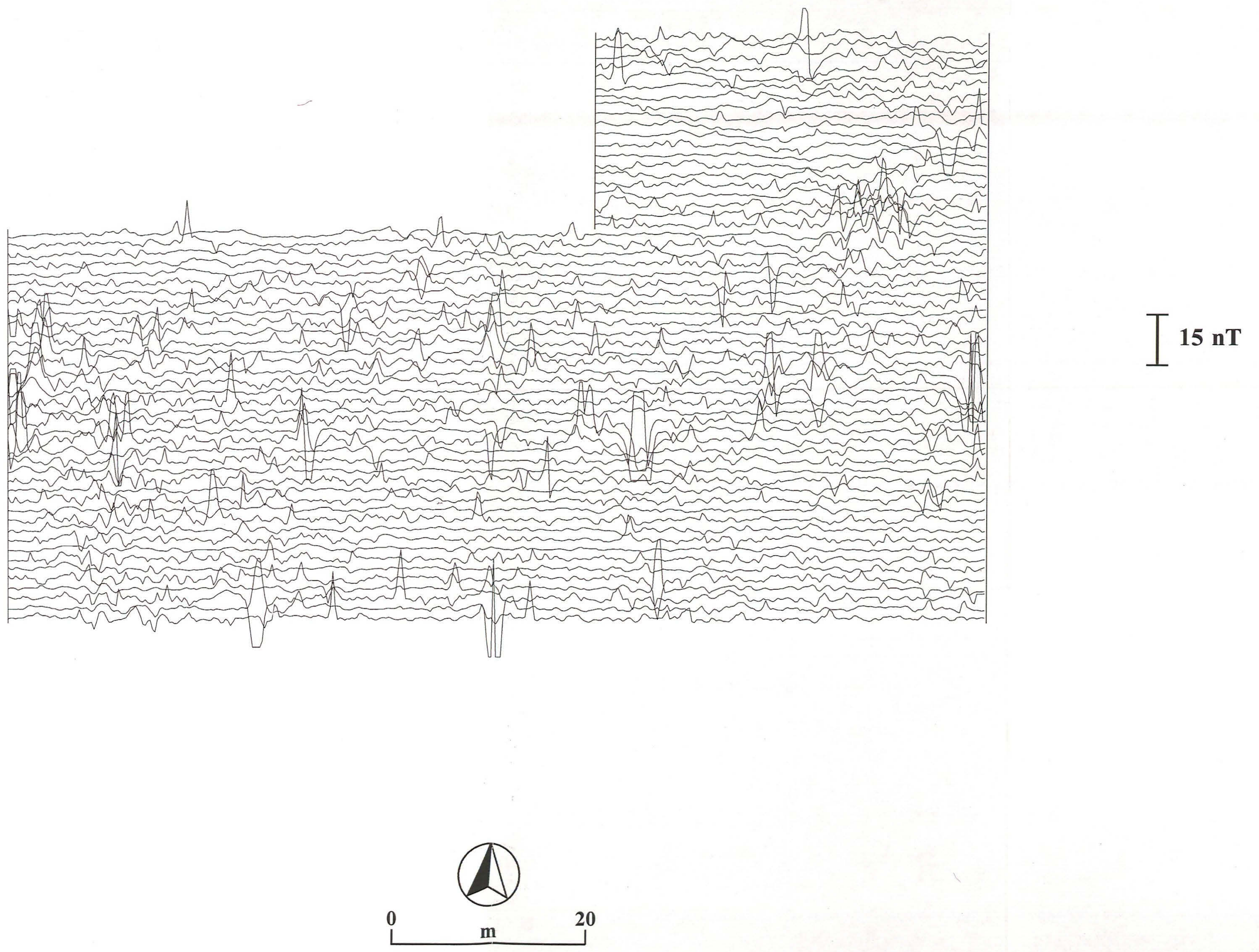

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Figure 5

RED BARN QUARRY
Area 1

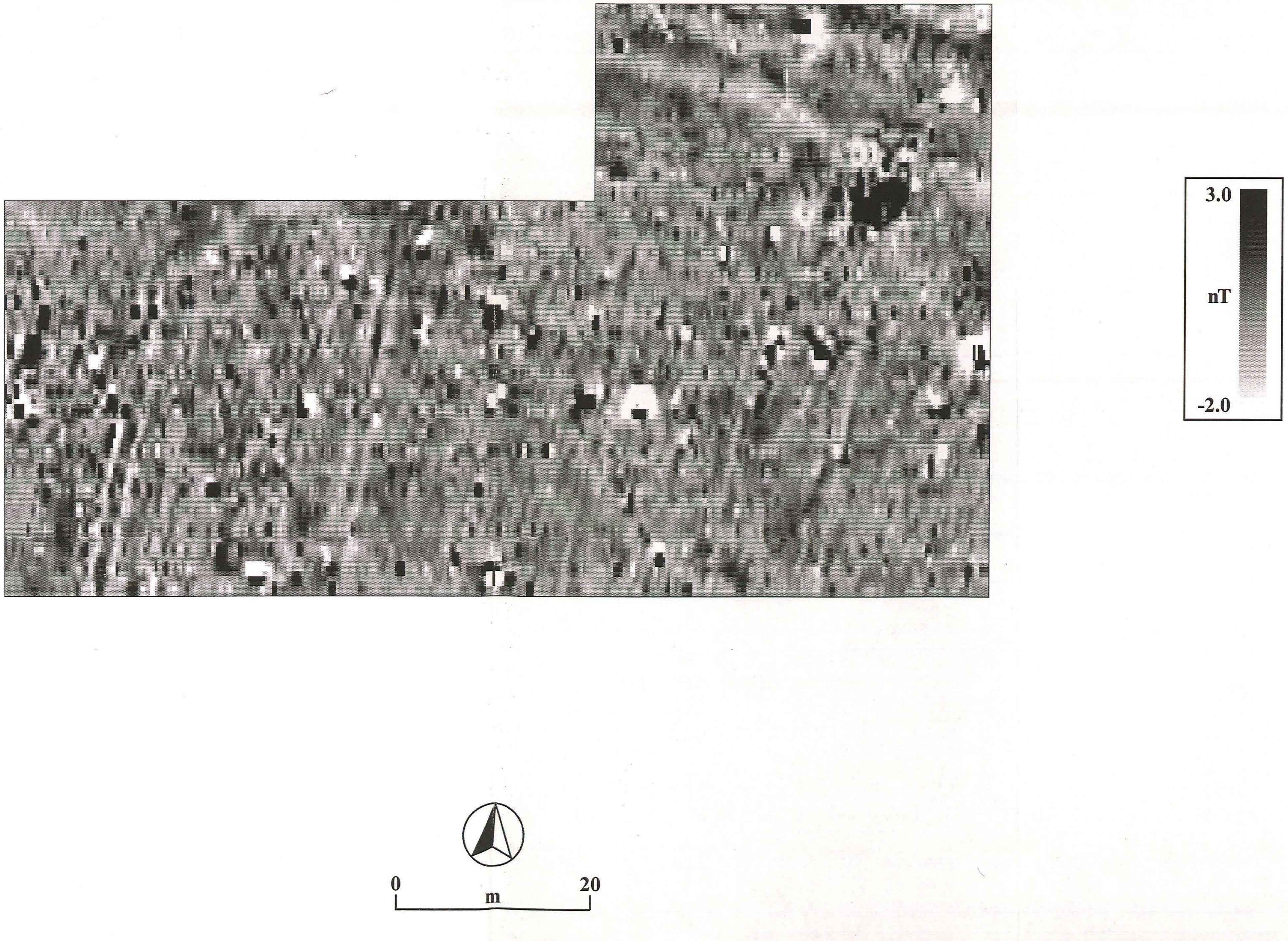

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Figure 6

RED BARN QUARRY
Area 1

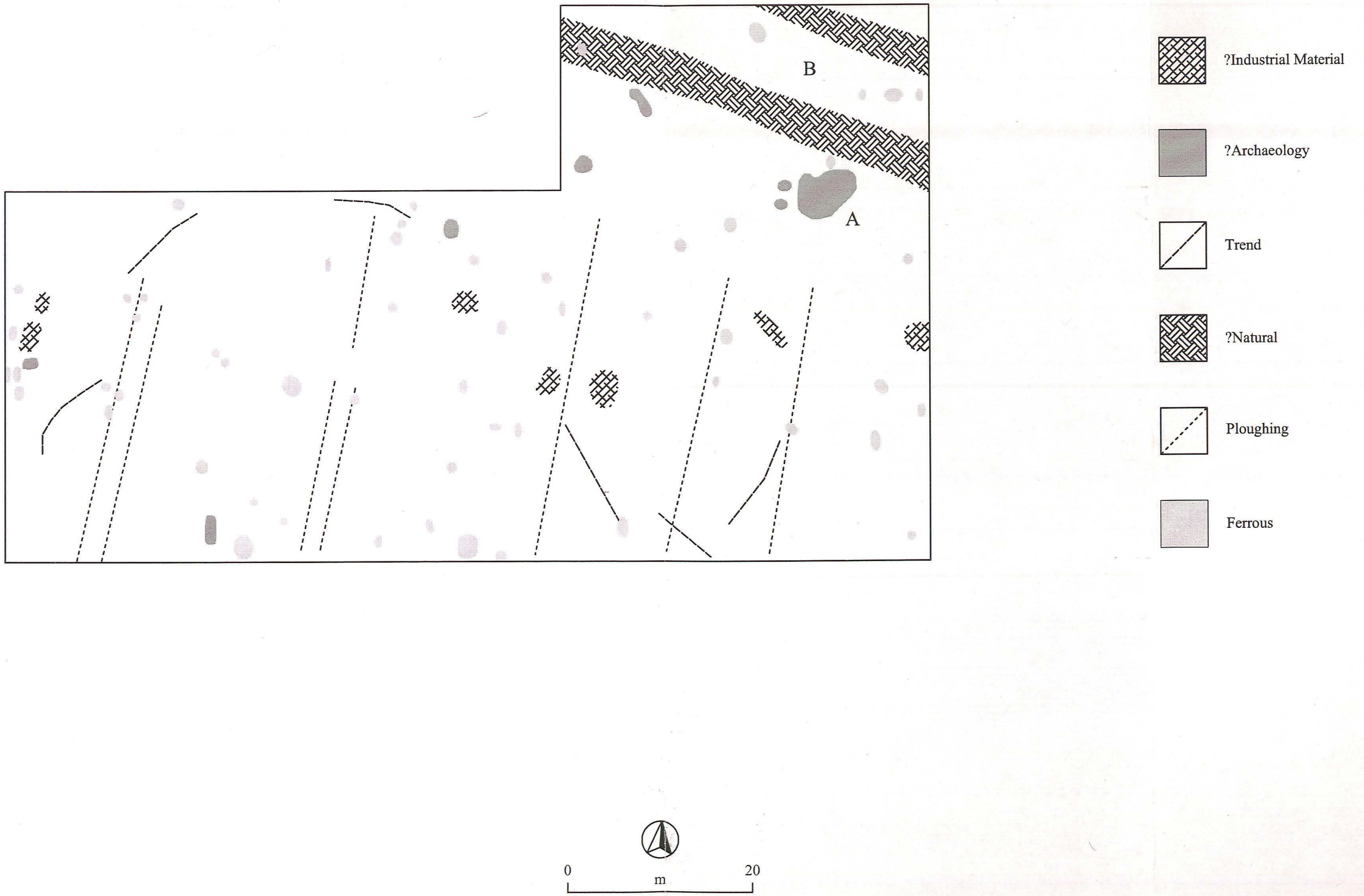

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Figure 7

RED BARN QUARRY
Area 2

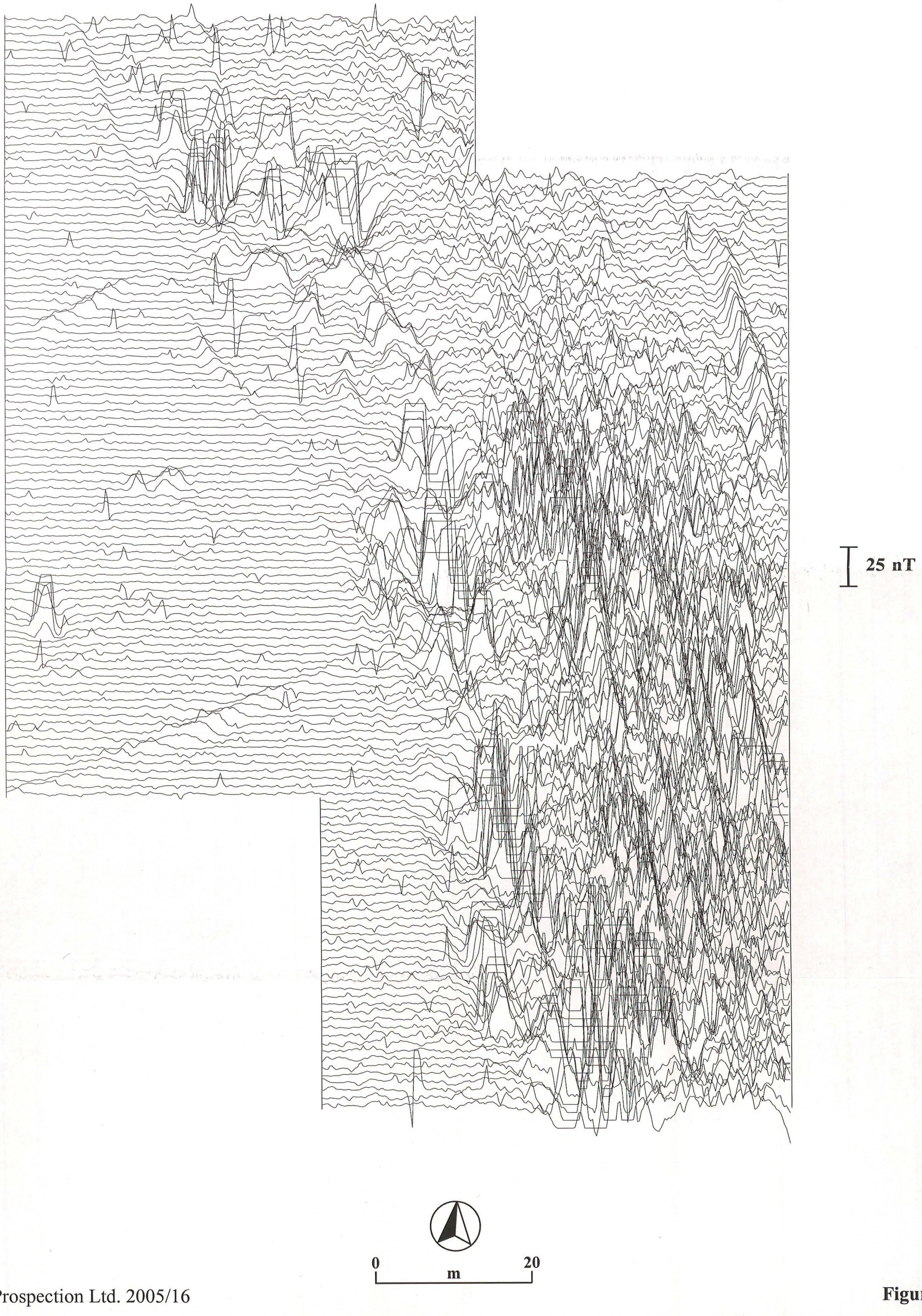

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Figure 8

RED BARN QUARRY
Area 2

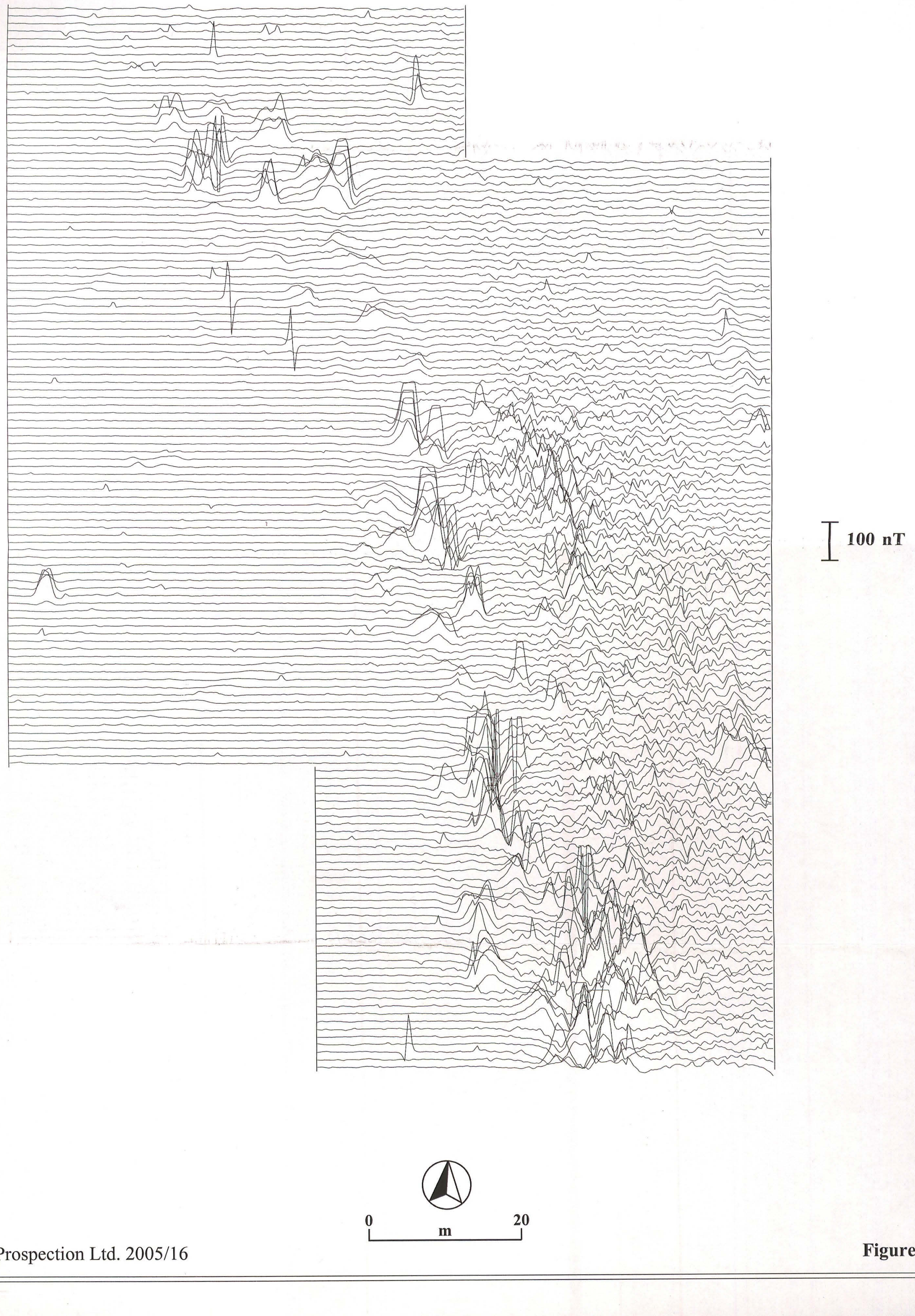

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Figure 9

RED BARN QUARRY
Area 2

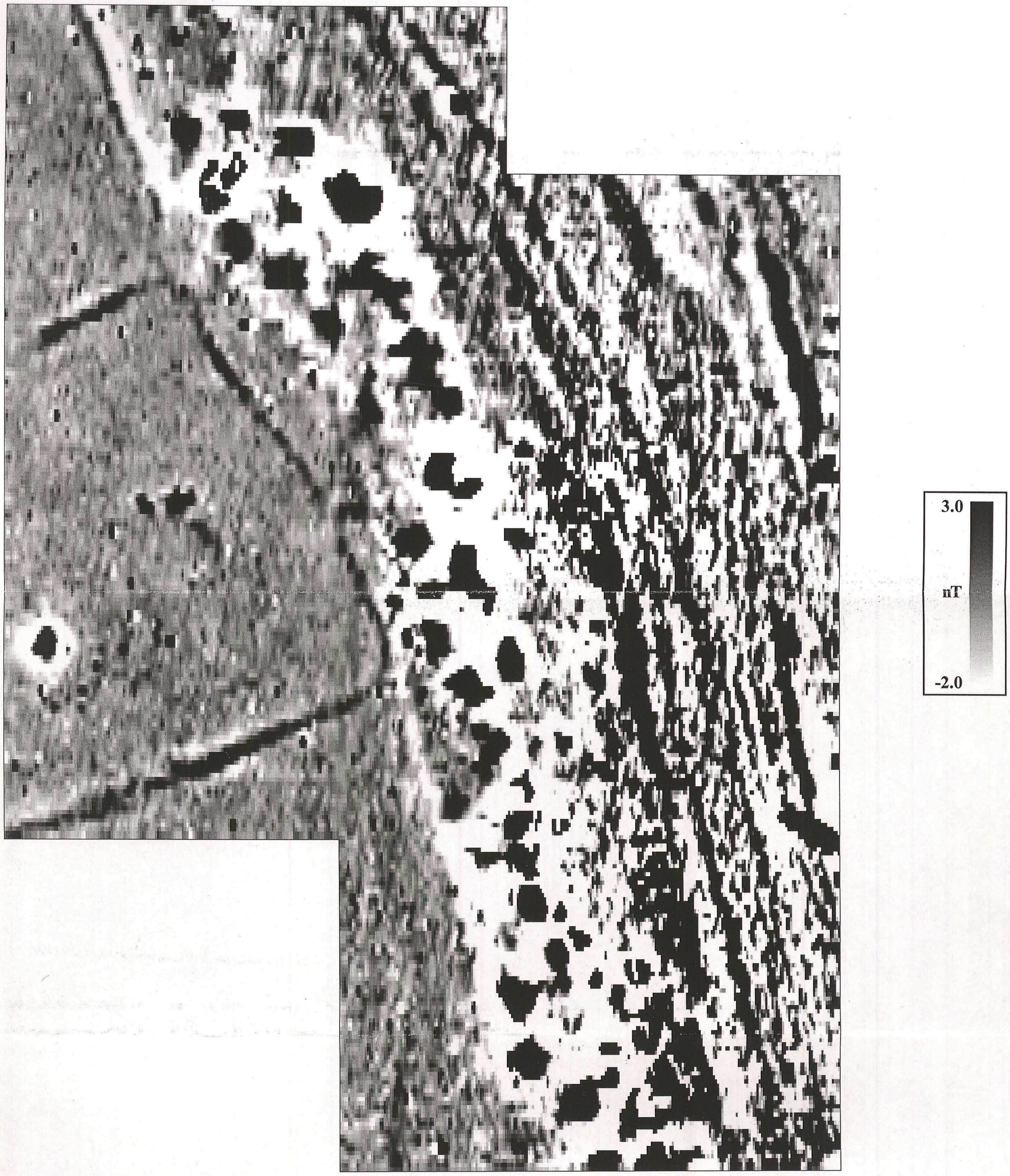

Figure 10

RED BARN QUARRY
Area 2

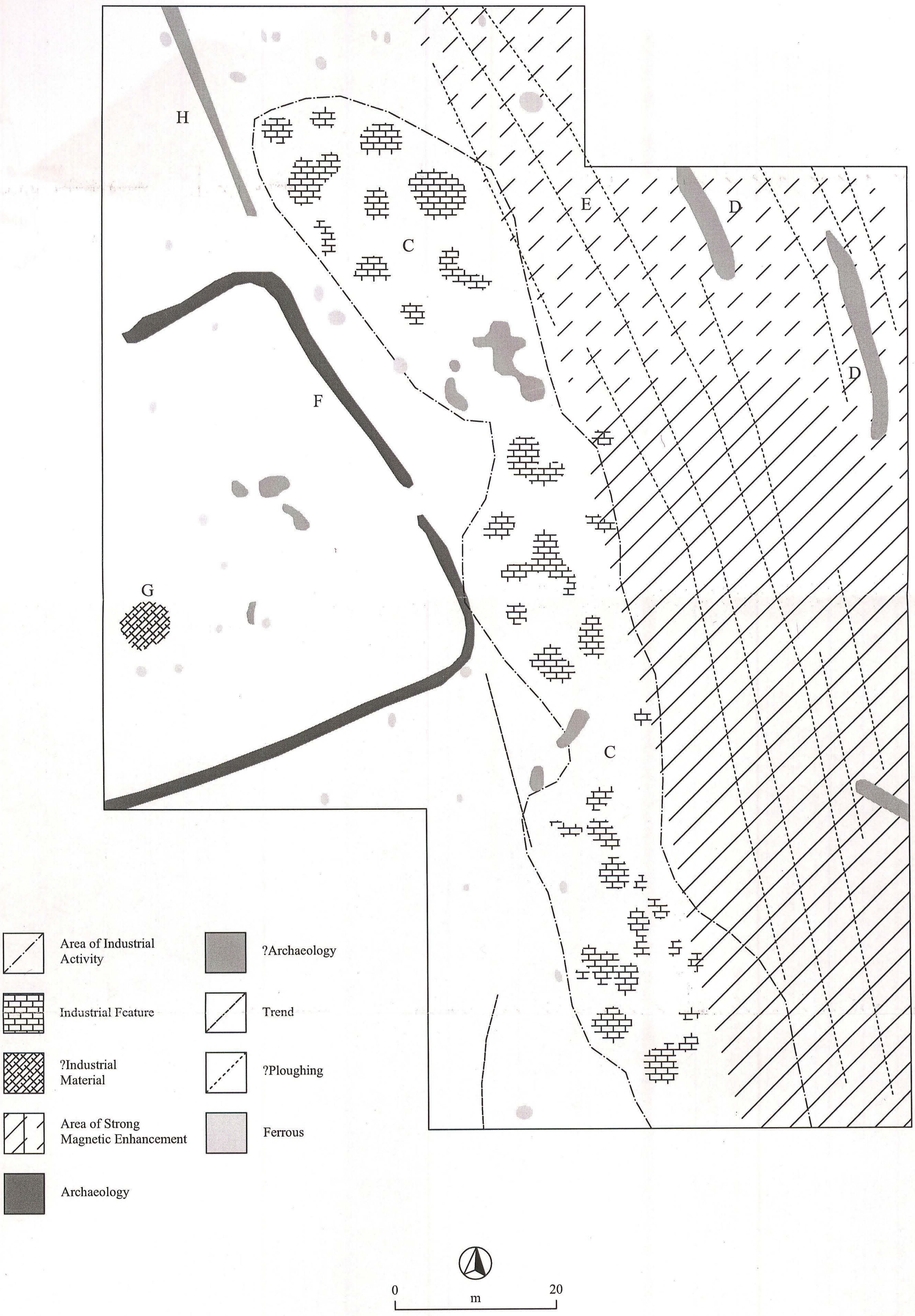

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Figure 11

RED BARN QUARRY
Area 2

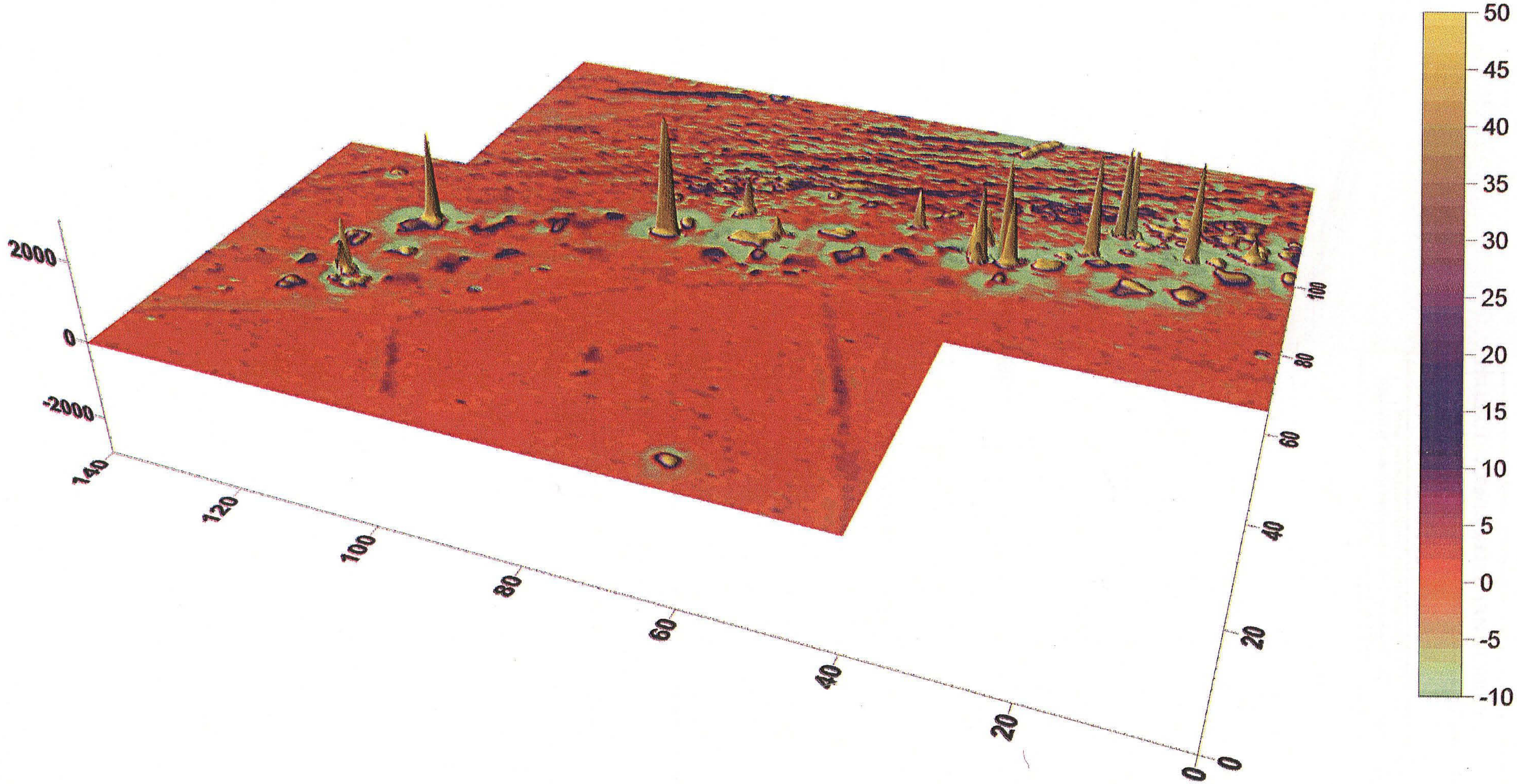

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Figure 12

GSB PROSPECTION Ltd.

PROJECT: 2005/16 RED BARN QUARRY

TITLE: Tie-in Diagram

Point	Angle (°)	Distance (m)	Notes
1	0	193.497	Field Corner
2	66.8665	63.407	Grid Corner Area 1
3	183.2470	54.059	Grid Corner Area 1
4	207.3015	167.012	Grid Corner Area 2
5	246.4905	186.630	Grid Corner Area 2
6	242.3710	201.828	Bridge Corner
7	241.3330	206.428	Bridge Corner
8	241.9825	213.849	Field Corner - Gatepost
9	234.0230	214.663	Junction of Track and Road

Stakes at points 4 and 5

not to scale

Figure T1