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HAM HILL, STOKE SUB HAMDON, SOMERSET
REPORT ON GEOPHYSICAL SURVEYS, MARCH, MAY AND DECEMBER 2011

Andrew Payne, Neil Linford and Paul Linford

REMOTE SENSING

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Research Report Series 22-2012

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SUMMARY

Ham Hill is an unusually large Iron Age hillfort extending over 80 hectares rich in the remains of later prehistoric and Roman activity. Parts of the site have been quarried for Ham Hill Stone since the Roman period and two active quarries continue in operation, with the remainder utilised as a country park managed by South Somerset District Council. Caesium magnetometer survey was undertaken in the unthreatened north eastern area of the hillfort to complete the geophysical coverage of the monument and augment intrusive investigations taking place in advance of renewed quarry expansion. The surveys have provided detailed evidence for activity within the hillfort interior from the Bronze Age to Roman periods, together with later quarrying sites that have obscured traces of earlier occupation in some areas. Combined with the earlier geophysical surveys a near complete archaeological map of the internal character of the hillfort is now available, resulting in an enhanced understanding of an important monument under continued pressure from mineral resource exploitation.

CONTRIBUTORS

The geophysical fieldwork was carried out by Neil Linford, Paul Linford and Andrew Payne.

ACKNOWLEDGEMENTS

The geophysics team would like to thank Jon Marshman and the South Somerset District Council team of countryside rangers responsible for the management of Ham Hill Country Park for facilitating access to the site and supporting our field work. We are grateful to Rob Iles for assistance with developing the project design for the survey and Niall Sharples for useful discussion on the interpretation of the geophysical results and suggested tentative phasing of the various anomalies detected in relation to the excavation evidence. The cover image shows the eastern of the two large fields investigated by the geophysical survey with extensive ground disturbance from former quarrying visible to the centre right of the photograph.

ARCHIVE LOCATION

Fort Cumberland, Portsmouth.

DATE OF SURVEY

The geophysical fieldwork was undertaken in three stages over the 28th March to the 1st April, 2011, 25-27th May 2011 and 5-7th December 2011. The report was completed on 27th April 2012.

CONTACT DETAILS

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CONTENTS

INTRODUCTION

Ham Hill (NGR ST 484 165, Scheduled Monument SO 100, Somerset SMR No. 55103) is located approximately 6km west of Yeovil on the northern scarp of the Jurassic limestone hills of south Somerset. It is the largest hillfort in Britain, enclosing an area of approximately 88.1hectares, defined by two ramparts and ditches characteristic of developed hillforts spanning the Early to Middle Iron Age periods (Forde-Johnston 1976; RCHME 1997). The main body of the hillfort encloses a roughly rectangular area, the plateau, with a narrower promontory to the north-west, known as the spur, that has been subject to significant small-scale quarrying and re-working. Some 31.1 ha of the hillfort's interior is estimated to have been destroyed by quarrying, a process that continues to this day (Sharples and Evans 2010).

Archaeological excavations at the site have revealed that settlement dates from the Neolithic and Bronze Ages, together with a Roman corridor type villa discovered in the early part of the 20th century (Walker 1907; Gray 1924; 1925; 1926). In the 1990s magnetometer survey was conducted over a substantial proportion of the hillfort in conjunction with a study of the earthworks (Geophysical Surveys of Bradford 1992; 1993; 1994; RCHME 1997). These surveys indicated the presence of extensive field systems and settlement evidence and also confirmed the location of the previously excavated Roman villa in the south-east portion of the hillfort (Geophysical Surveys of Bradford 1992). Further magnetometer survey undertaken in the south-west of the hillfort in response to a renewed phase of quarry expansion (GSB Prospection 2001) provided evidence for archaeological activity in the threatened area including a large rectangular enclosure subsequently investigated by excavation (Slater 2009).

A more comprehensive three year programme of excavation in mitigation of the final quarry extension followed this work (Sharples and Evans 2010), supported by a request from the Inspector of Ancient Monuments for the Geophysics Team to complete the magnetometer survey of the hillfort in areas beyond any planned future quarrying. The purpose of the geophysical investigation was to provide context for the on-going excavations within the wider overall settlement pattern of the hillfort interior and inform the management of the less well understood parts of the monument.

The current survey covers a relatively flat area which has been used for arable agriculture since the 17th century and is divided into fields by stone dykes in existence from 1825 (RCHME 1997, 11-12). Most of this area was added to the local authority managed country park in 2000 and is now used for pasture. The site encloses a plateau of Upper Lias Shelly Limestone (Ham Hill Stone) rising to a maximum height of 139 metres OD and has extensive views, across the Somerset Levels (Geological Survey of Great Britain (England and Wales) 1973), with well drained, silty soils of the South Petherton (541m) association (Soil Survey of England and Wales 1983). Weather conditions were fine and dry for all of the field work.

METHOD

The magnetometer survey was conducted over the two fields indicated in Figure 1 using an array of four specially modified high sensitivity Scintrex SM4 caesium vapour sensors mounted on a non-magnetic cart system (Linford *et al.* 2005). Readings were collected at intervals of 0.5m x 0.125m along traverses orientated approximately north-south. The caesium survey adjoins areas of clearly defined archaeological activity revealed by the previous fluxgate gradiometer results to the south and west (Geophysical Surveys of Bradford 1992; 1993; 1994).

A temporary 60m x 100m grid was established over the site using a Trimble 4700/4800 series real-time kinematic Global Positioning System (GPS) to provide guidance lines for the March 2011 survey. Subsequent surveys used a GPS receiver mounted on the cart array to simultaneously record positional information together with the signal from the magnetometer sensors.

Post acquisition data processing involved the adjustment of each instrument traverse to a zero median value for the correction of slight biases added to the measurements owing to the diurnal variation of the earth's magnetic field and any directional sensitivity of the sensors. A windowed median filter was applied with a radius of 20m or 30m parallel to the survey lines, depending on the rate of drift evident, and a cross-line width of 5m or 10m to preserve anomalies running parallel to the traverse direction. If necessary, a polynomial of best fit was subtracted from the ends of each line of readings to remove the effects of ferrous fencing near the field edges. Extreme values with absolute magnitudes greater than 50 nT were then attenuated so that no value had an absolute magnitude greater than 100 nT using an algorithm similar to that described by Scollar (Scollar *et al.* 1990, p504), but employing the hyperbolic tangent function for the non-linear reduction of values. Any mismatch between adjacent blocks of data was corrected by applying a 1D high-pass median filter of window width 10m to columns parallel and in close proximity to the grid edge, original values were then replaced with a linearly weighted combination between these and the edge-matched version.

The resulting dataset was converted to its Fourier transform which was then reduced to the pole and transformed to the values that would have been measured using a 1.0m vertical gradiometer (both algorithms described in Blakely 1996). The Fourier domain operations enhance the visibility of small discrete pit-like responses where they occur in close proximity to larger and more strongly magnetised ditch anomalies.

A linear greyscale image of the combined reduced to pole magnetic data is presented at a scale of 1:2500 superimposed over the base Ordnance Survey (OS) mapping on Figure 2. Larger scale (1:1500) traceplots of the data from the two separate fields are shown in Figures 3 and 4 together with greyscale images of the reduced to pole (Figures 5 and 6) and pseudo-gradiometer transform (Figures 7 and 8) data. Alternate survey lines have been removed from the traceplots in Figures 3 and 4 to avoid loss of clarity.

RESULTS

A graphical summary of the anomalies discussed in the following text, superimposed on the base OS map data is provided in Figure 9.

Background response

A dense pattern of anomalies has been detected throughout the survey coverage with few parts of the area investigated devoid of significant archaeological activity. Linear ditch systems enclosing probable occupation areas are widespread and consistent in character and orientation when compared to the previous geophysical coverage of adjacent fields, thus helping to fill in the gaps remaining from the earlier surveys.

The varied background magnetic response may reflect soil differentiation across the hill-top as observed in the recent excavations in the south-west part of the site (Sharples *et al.* 2012) where a clear geological transition from brashy limestone soils with near surface bed-rock to sandier deposits was observed. A broad linear band of positive magnetic response [m1] running from east to west across the southern half of the two fields appears to mark a significant geological trend.

Modern ferrous disturbance is limited to effects of fences and roads around the margins of the survey areas. Linear negative anomalies not associated with the buried walls of the Roman villa structure probably represent near surface erosion effects such as modern paths and vehicle tracks around the perimeter of the site [m2] and the former presence of a recently removed field boundary [m3] present at the time of the geophysical surveys conducted in the 1990s (Geophysical Surveys of Bradford 1992).

Field 1, Area A

A series of enclosure ditches and clusters of pit-type anomalies indicates intense occupation activity in this area. Several of the enclosures have associated concentrations of pits, for example at [m4] and [m5], and there are suggestions of possible earlier circular structures at [m6] and one partially defined, but appearing to consist of a series of post pits at [m7]. The overall complexity of the anomalies in this area suggests a plethora of multiple phased occupation activity. One distinct polygonal enclosure [m8] is on a different alignment to the general trend here and appears to have less interior activity compared to the other enclosures in this group. The enclosure at [m8] possibly has an entrance facing south where a group of weakly defined negative magnetic anomalies [m9] may indicate the presence of two small rectangular masonry structures possibly associated with the entrance to [m8] or the villa to the east.

Whilst the ground plan of the villa building was mapped in greater detail by the previous earth resistance survey (Geophysical Surveys of Bradford 1992), the same rectilinear outline is visible as a series of regular weak negative linear anomalies [m10] in the caesium magnetometer data improving on the detection of this structure in the earlier fluxgate results. The earth resistance survey suggested a single rectangular range indicative of a corridor type building with additional walls running off it to the west and a spread of high resistance material to the east, corresponding to further less well defined structural debris. Stronger positive and negative magnetic anomalies in the current data may indicate deposits of brick and tile building material, heated structures and stone rubble deposits enclosed within the building. An area to the east characterised by a high background of magnetic noise [m11], is likely to reflect a spread of stone rubble and ceramic building materials associated with the villa remains. The lack of clear definition in the geophysical data of the fine detail of the room layout known from the earlier excavation may reflect the impact of plough damage over the century following the discovery of the villa. The geophysical results from this area clearly show that the villa shares the same orientation as many of the surrounding ditch and enclosure anomalies.

The major arterial roadway running to the south of the villa from the eastern entrance of the hillfort is visible as a series of broad positive linear magnetic anomalies [m12], suggesting gradual widening or re-alignment of the road due to extended or intense use.

Field 1, Area B

Immediately north of the probable geological transition [m1] and villa complex [m10] there is an extensive area of quarrying [m13] (visible on the ground as large surface depressions and in the magnetic data as a large area of amorphous disturbance covering almost 2 hectares), that appears to have disrupted the underlying pattern of earlier Iron Age or Roman occupation. There are clear indications on the north-west side of [m13] that it has obscured traces of earlier activity as several of the ditches and enclosures mapped in the adjacent areas appear to be abruptly truncated here. Further west from [m13] there are indications at [m14] and [m15] of two additional, but more localised, quarries or possibly pockets of variable soils giving rise to a contrasting magnetic response.

Field 1, Area C

This area is primarily occupied by a series of conjoined sub-rectangular enclosures defined as positive linear anomalies [m16 to m18]. The enclosures appear to contain a significant concentration of narrow annular anomalies, likely to be indicative of Iron Age dwellings (ring gullies). These anomalies are not confined exclusively to within the enclosures and, therefore, may not represent contemporary occupation. The enclosure systems represented by [m16-18] are one of the few groups of activity indicated by the very limited cropmark record from Ham Hill (RCHME 1997).

The enclosure at [m18] is constructed against the inner face of the north rampart of the hillfort and has a clear entrance gap in the west side at [m19]. Running across the same area as [m18] is a linear distribution of at least 5 ring gullies [m20-24] arranged at well spaced intervals. There are also some large but relatively localised quarries or geological disturbances [m25 and m26] within and around the large enclosures in this area.

A probable trackway defined by parallel ditches appears to run into the corner of one of the large regular enclosures at [m27] approaching from the north-east. The trackway may continue to the western side of the large central regular enclosure [m17] as a series of double ditched anomalies at [m28], although this is unclear due to the complex concentration of anomalies in this area. A number of irregular enclosures lie to the east associated with a considerable density of pits and areas of more general disturbance that may be indicative of smaller scale quarries [m29-m31] or localised geological variation. Further ring gully anomalies at [m32 to m36] of slighter form to [m20-24] are visible running in an approximate line from east to west, with several apparently contained within small enclosures.

Despite the presence of the internal ring gullies associated with many of the enclosures in the far northern extremity of the hillfort there is a notable absence of pit-type anomalies in these areas. Much higher concentrations of pits are found in the enclosure systems to the west around [m34] where there is a much closer association with ring gully anomalies. There is a suggestion of zones of fairly intensive occupation activity to the east and west of the central enclosures [m16-17] in this part of the site.

The larger more regular square and rectangular enclosures are possibly superimposed over an earlier series of boundaries or a field system layout on a SSW-NNE orientation represented, for example, by anomalies at [m37] and [m38] identified on Figure 9 by lighter shading.

A significant, but intermittently defined linear boundary [m39] is aligned on a different SSW-NNE orientation compared with the adjacent system of rectilinear enclosures [m16-18]. A series of further parallel narrow ditches [m40] running perpendicular to [m39] at regularly spaced intervals may represent an earlier phase of co-axial fields to the west perhaps predating the later enclosures as known from excavation in other areas of the fort (Sharples *et al.* 2012). There is a suggestion of a similar pattern in Field 2, Area F.

Field 2, Area D

This area contains a distinctive rectangular "playing card shaped" enclosure [m41], south of the major road corridor [m12], on a distinctly different orientation to the general trend. There is evidence for a probable entrance gap in the north-east corner of [m41] facing towards the roadway and a possible associated pit alignment approaching from the south [m42]. A further small enclosure, only partially mapped in the far south-west of Field 2 [m43], appears to share a similar orientation and size to [m41].

Also present in this area are two ring gullies [m44 and m45], large pits (concentrated in the area west of enclosure [m41]) and the continuation of the major arterial roadway [m12]. In general, occupation activity appears less intense in this area of the hillfort.

Field 2, Area E

This area is dominated by a large region of increased magnetic disturbance containing dense clusters of localised anomalies centred on [m46], although it is not directly comparable with the more obvious quarrying in Field 1[m13]. This zone of disturbance does appear to disrupt the pattern of enclosures towards the east cutting the ditches of [m47-48] where they extend to the west, but [m46] also appears to respect a weaker linear trend to the west [m49], suggesting that the response may be associated with occupation or, perhaps, an early phase of quarrying activity. If the area does represent occupation the spread of very intense anomalies here would be suggestive of a major concentration of pits and small quarries. The response to the lines of remnant modern ploughing is enhanced in this area suggesting elevated levels of magnetic susceptibility which would also be compatible with intense occupation.

A curvilinear ditch [m50] on an unusual alignment occurs north-east of the intense magnetic spread [m46] and is possibly seen continuing as a similar anomaly [m51] in Field 1. Given the unusual alignment of [m50/51] this anomaly may represent an earlier phase of enclosure, perhaps associated with [m46] or the route of a trackway.

To the south and east of [m46] a pattern of interlocking sub-rectangular enclosures [m52-54] are similar to those at [m4-8] directly west of the villa building in Field 1, and possibly represents an extension of the same phase of activity. These enclosures contain a moderate density of pit-type responses and evidence of localised quarrying disturbance (or perhaps localised natural soil variation). The response to these enclosures is significantly enhanced towards [m46], but becomes much weaker progressing south towards the road, perhaps reflecting a change in the underlying geology indicated by [m1]. Two adjacent weakly defined ring gullies [m55 and 56] are found together with a cluster of pit-type anomalies associated with two further partially defined enclosures [m57 and 58].

To the west of [m49] and [m46] the general trend of sub-rectangular enclosure systems with internal pits is repeated, but the orientation of the layout changes to more of a north-south/east-west alignment (for example at [m59]) a pattern which continues in the field to the west based on the earlier fluxgate gradiometer coverage (Geophysical Surveys of Bradford 1993; 1994). A number of curvilinear ditch anomalies are present at [m60 and m61] in an area otherwise relatively devoid of activity.

Field 2, Area F

Activity in this area is less intensive in comparison to the south and the response is more mixed, suggesting a greater influence of more variable soils and geological deposits. A pattern of more weakly defined linear anomalies [m62-64] in the area west of [m49] is similar to the activity found at [m39-40] in Field 1and may represent the remnants of an earlier field system or a series of parallel land divisions.

This area also contains linear positive magnetic responses possibly indicative of quarrying running in a strip immediately inside the hillfort rampart [m65] and an intermittently defined curvilinear positive anomaly [m66], suggestive of a ditched enclosure partially constructed against a section of the rampart where it turns sharply to the north. A small rectilinear enclosure [m67] is of a size (5.5m by 4m) more in keeping with the presence of the foundation trenches for a small building and two further ring gully anomalies have been identified at [m68] and [m69]. Two areas of generally much quieter response to the east contain evidence of weakly defined curvilinear enclosures [m70] with several internal pit or localised quarry-type responses but very little other activity.

Discussion

Detailed studies of the spatial organisation and occupation sequences of major hillforts, such as Ham Hill, are comparatively rare due to both the scale of the undertaking and the protected status of the majority of sites. The comprehensive geophysical coverage combined with the selective excavation of the threatened areas inside Ham Hill contributes to a number of priorities within the Iron Age research agenda (Haselgrove *et al.* 2001), including revealing the organisation and divisions of settlement space and the regional distinctiveness of such patterns. The enhanced interpretation of the geophysical data based on the excavation programme allows a better understanding of how the hillfort was inhabited over time including evidence for pre-enclosure activity.

The majority of the ditched enclosures in the north plateau area appear to be aligned approximately in relation to the major road corridor [m12] crossing through the southern part of both fields on an ESE-WNW alignment. However, there is a gradual veering of the axis of the enclosure alignment towards the west with increasing distance north from the road and west from the villa This would also appear to be the case for the enclosure layout in the westernmost of the three large fields on the north plateau area (Geophysical Surveys of Bradford 1993) where the northern enclosures are less obviously aligned on the south-central roadway, but perhaps begin to respect a northern branch road running across the central northern area of the fort on an arcing course.

One significant exception to the general trend of the layout of the enclosure systems is the isolated rectangular "playing card shaped" ditched enclosure [m41]. This enclosure is approximately 40m by 30m in extent with the long and short sides aligned WSW-ENE and NNW-SSE respectively. Superimposition of several sets of enclosures on different alignments in Area C may also indicate a succession of different phases of enclosure layout.

The magnetometer survey also suggests a variable distribution of ring gully type anomalies, although it is possible that some more ephemeral traces of dwellings are too slight to be detected by geophysical means. The most notable concentrations of probable habitation structures occur in two bands in the northern half of Field 1 and in the immediate vicinity of the major roadway in Field 2.

The possible land divisions defined by the intermittent linear trends at [m38] and [m49] are orthogonal to the major E-W arterial routeway, suggesting an overall unity to the layout of some of the weaker and less distinct linear anomalies detected in the hillfort (those indicated by lighter shading on Figure 9). Sharples and Evans (2010) note the striking systematic division of the interior of Ham Hill into a coaxial field system defined by ditches revealed by the 1990s geophysical coverage, and further evidence for this phase may now be provided by [m38] and [m49]. Excavated features associated with this early phase of activity on the hilltop are truncated by the central road running between the two known entrances. Enclosures adjacent to this road appear to be realigned toward its axis suggesting they post-date the establishment of the road. The alignment created by the central road is also favoured by large enclosures in the southern and eastern part of the surveyed area, and by the Roman villa (though this is perpendicular to the axis).

CONCLUSIONS

The current geophysical survey, combined with the earlier coverage, now provides a near complete map of the archaeological activity across the significant proportion of the hillfort interior outside the major areas of quarrying. Many smaller anomalies such as ring gullies, storage pits and former areas of quarrying have been revealed interspersed among enclosure and ditch systems throughout the survey area, although particularly dense settlement activity is apparently concentrated in Field 2, Area E. From the recent excavation evidence it appears that some enclosures previously thought to be Romano-British may now be Iron Age in origin (perhaps in the form of small farmstead enclosures that may have persisted into the later Iron Age unlike in the conventional model of abandonment in the first century BC prevalent at so many hillforts in southern England). This could equally apply to much of the activity now mapped in the central northern part of the fort and if these large enclosures prove to be an integral part of the Iron Age occupation of Ham Hill then this would challenge existing perceptions of fort interiors.

The geophysical survey has enhanced the context of the Roman villa in the eastern extremity of the hillfort indicating that it is surrounded by a complex series of enclosures with a substantial quarried area to the north-west which although as yet undated may have originated in the Roman period (Sharples *et al.* 2012).

LIST OF ENCLOSED FIGURES

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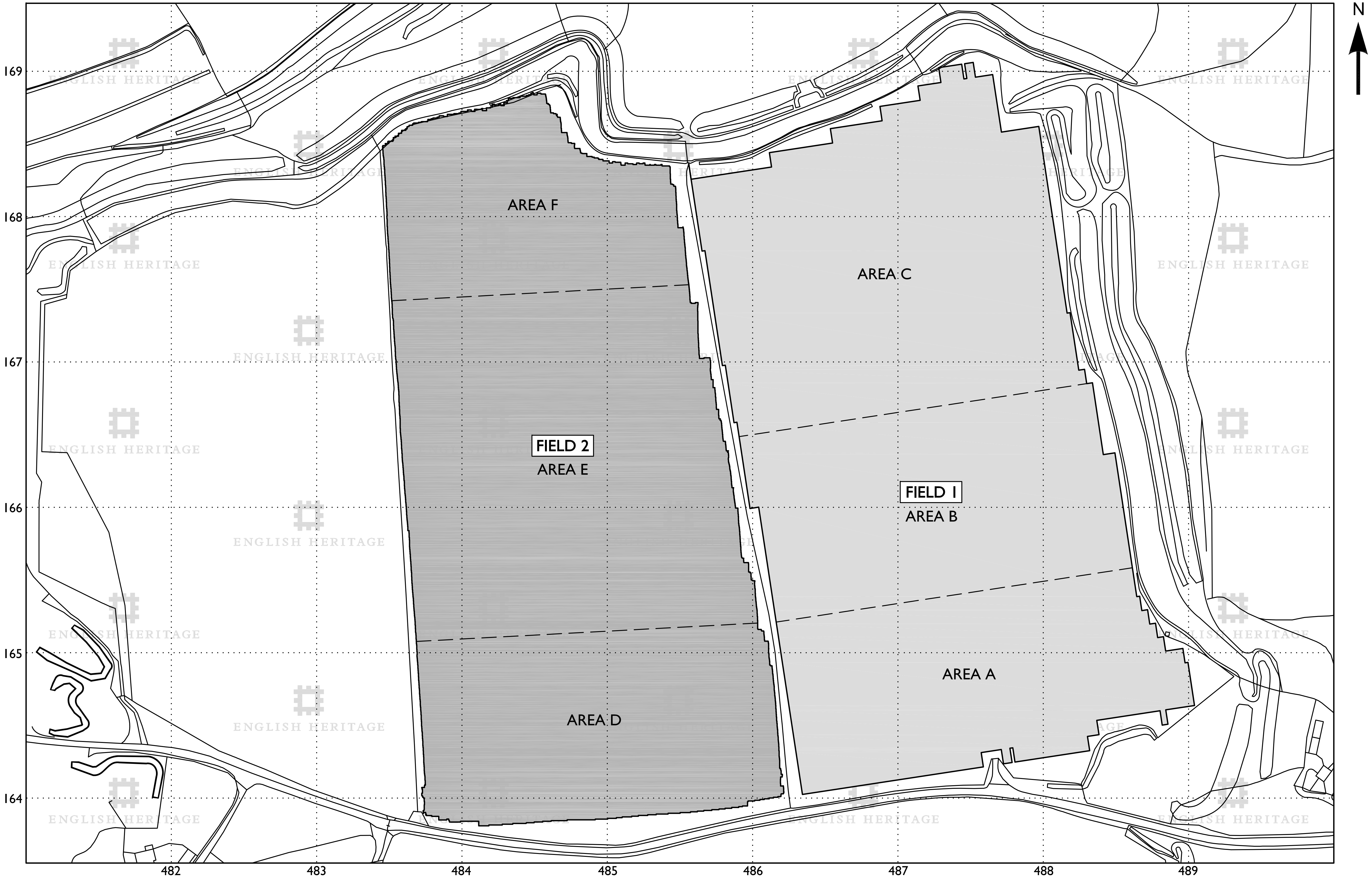
Figure 1

HAM HILL, STOKE SUB HAMDON, SOMERSET

Location of caesium magnetometer surveys, March, May and December 2011

ST4816



Caesium magnetometer survey area: Field 1

Caesium magnetometer survey area: Field 2

0 90m

1:2500

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Figure 2

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Location of caesium magnetometer surveys, March, May and December 2011

ST4816

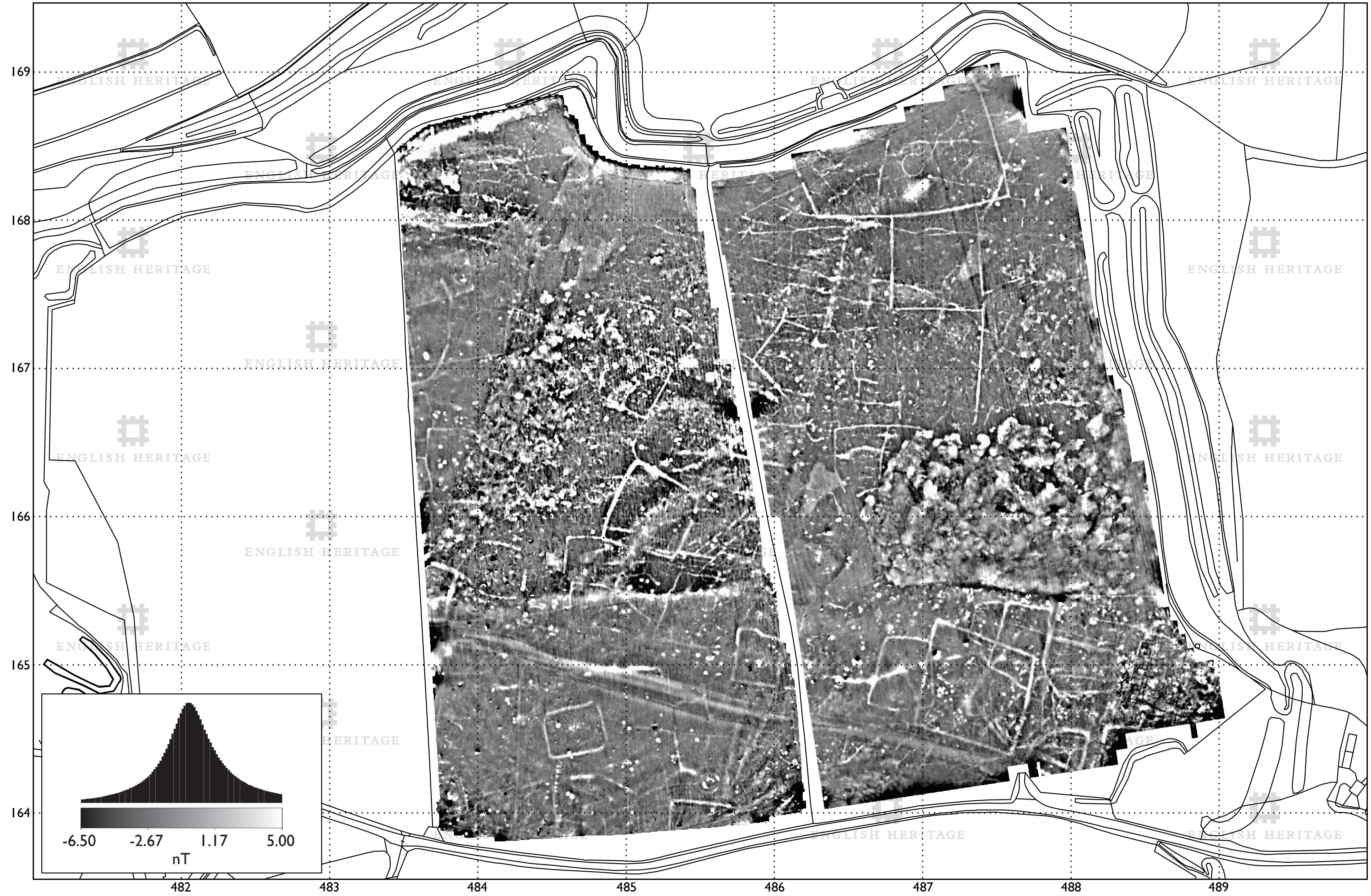

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Figure 3

HAM HILL, STOKE SUB HAMDON, SOMERSET
Caesium magnetometer survey of Field 1, March 2011

Traceplot of total field data

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Figure 4

HAM HILL, STOKE SUB HAMDON, SOMERSET
Caesium magnetometer survey of Field 2, May and December 2011

Traceplot of total field data

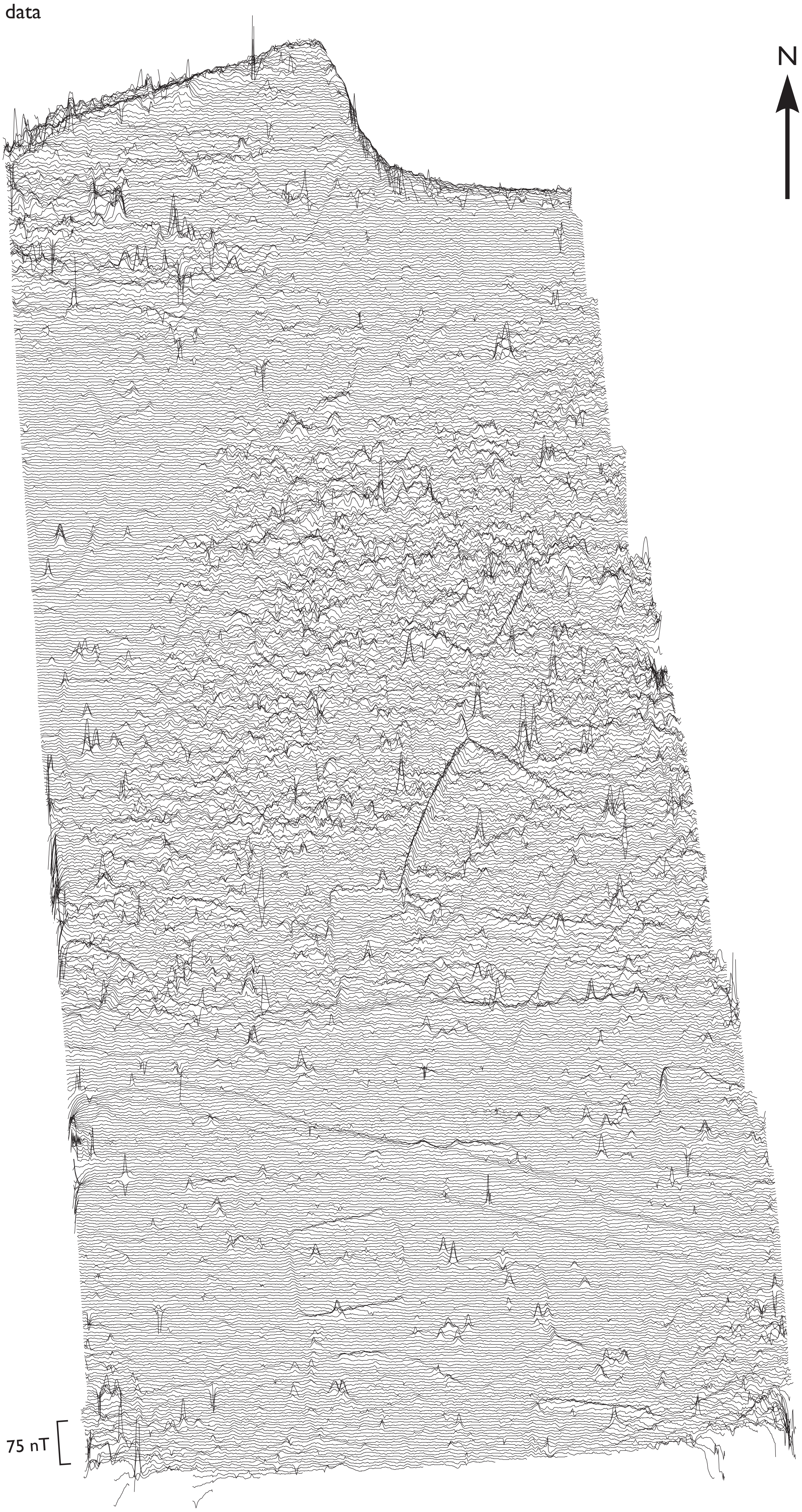

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Figure 5

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Caesium magnetometer survey of Field 1, March 2011

Greyscale image of total field data reduced to pole

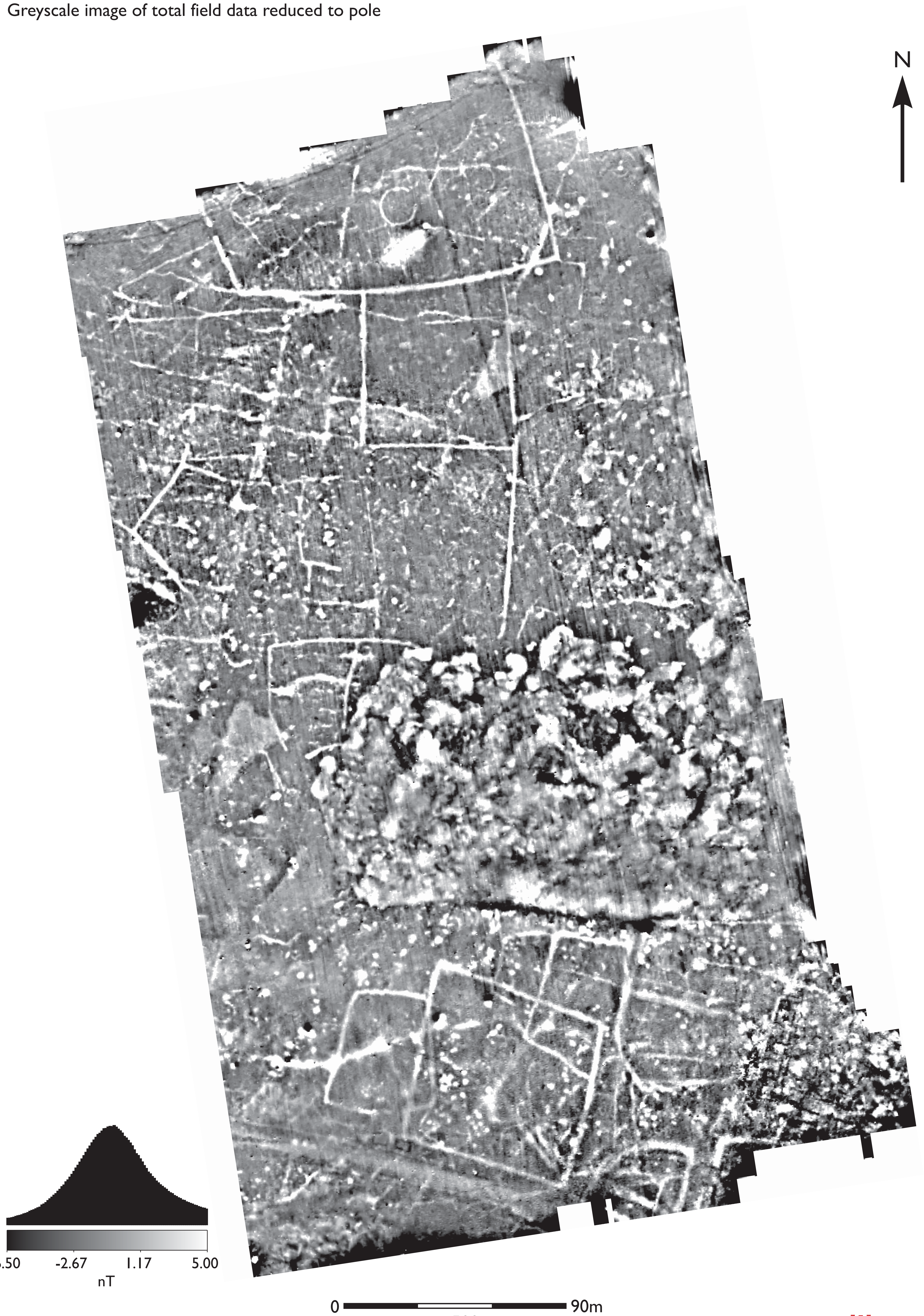

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Figure 6

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Caesium magnetometer survey of Field 2, May and December 2011

Greyscale image of total field data reduced to pole

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Figure 7

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Caesium magnetometer survey of Field 1, March 2011

Greyscale image of vertical 1.0m pseudo-gradiometer transform data

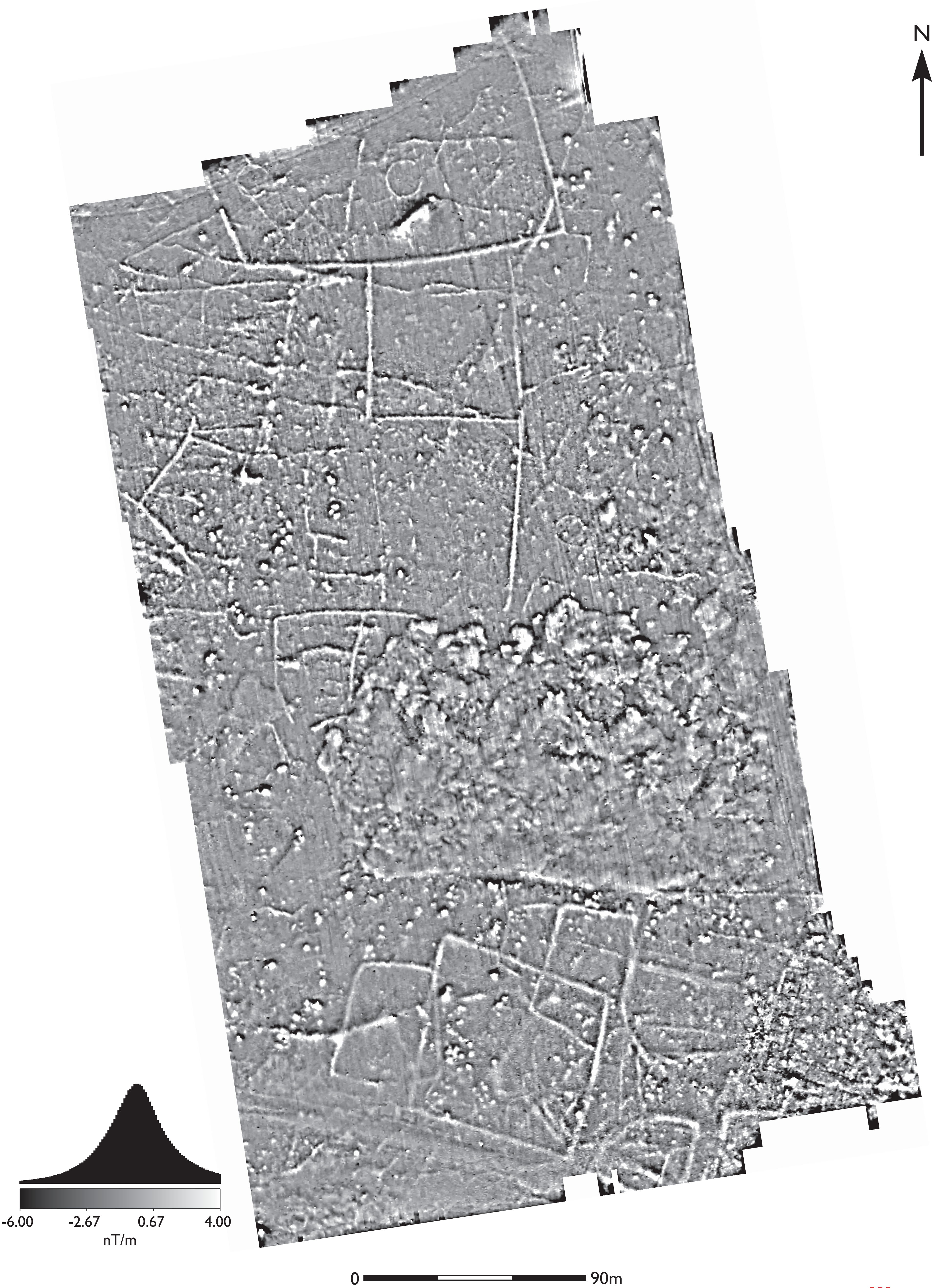

Figure 8

HAM HILL, STOKE SUB HAMDON, SOMERSET
Caesium magnetometer survey of Field 2, May and December 2011

Greyscale image of vertical 1.0m pseudo-gradiometer transform data

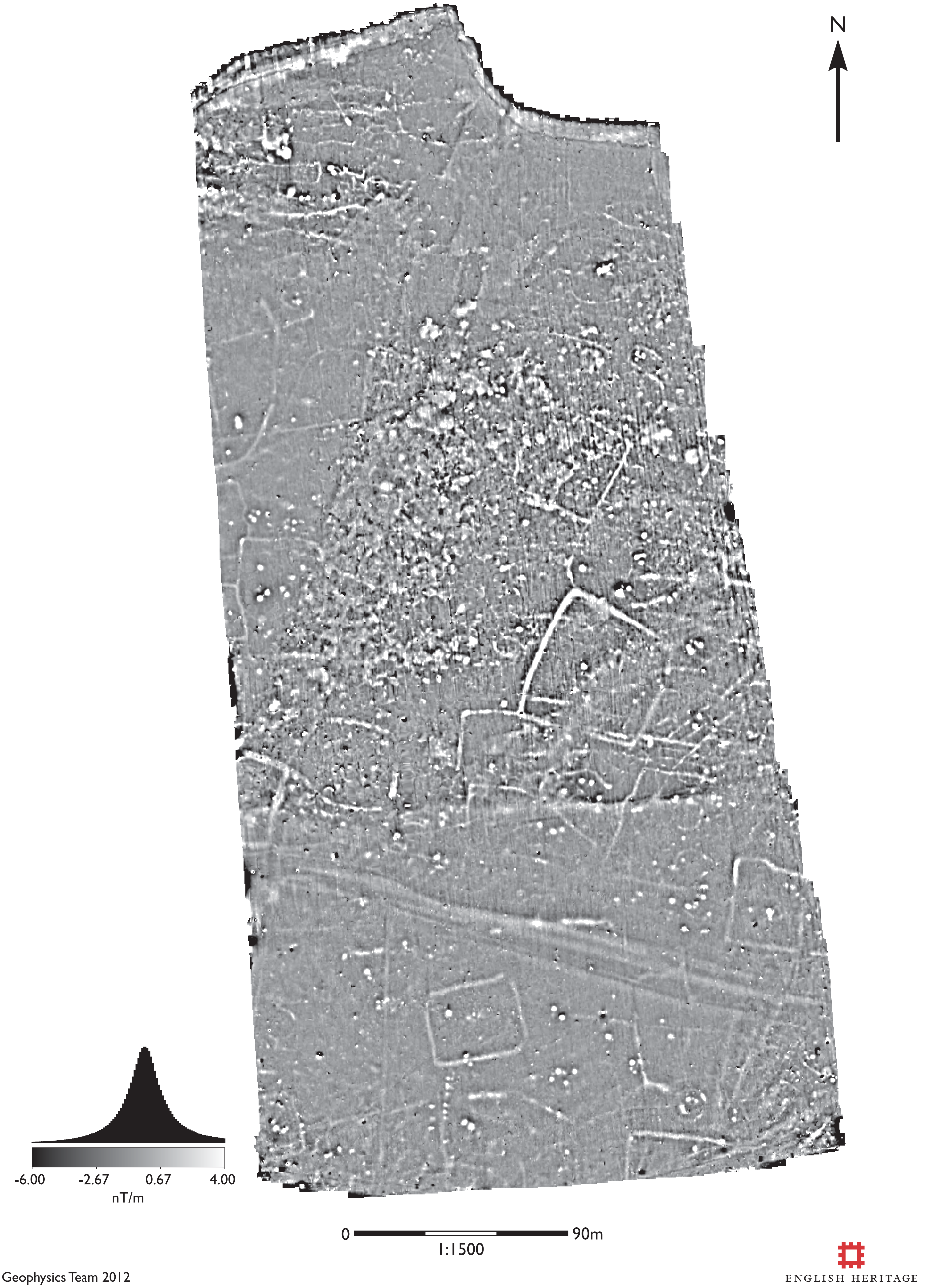

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Figure 9

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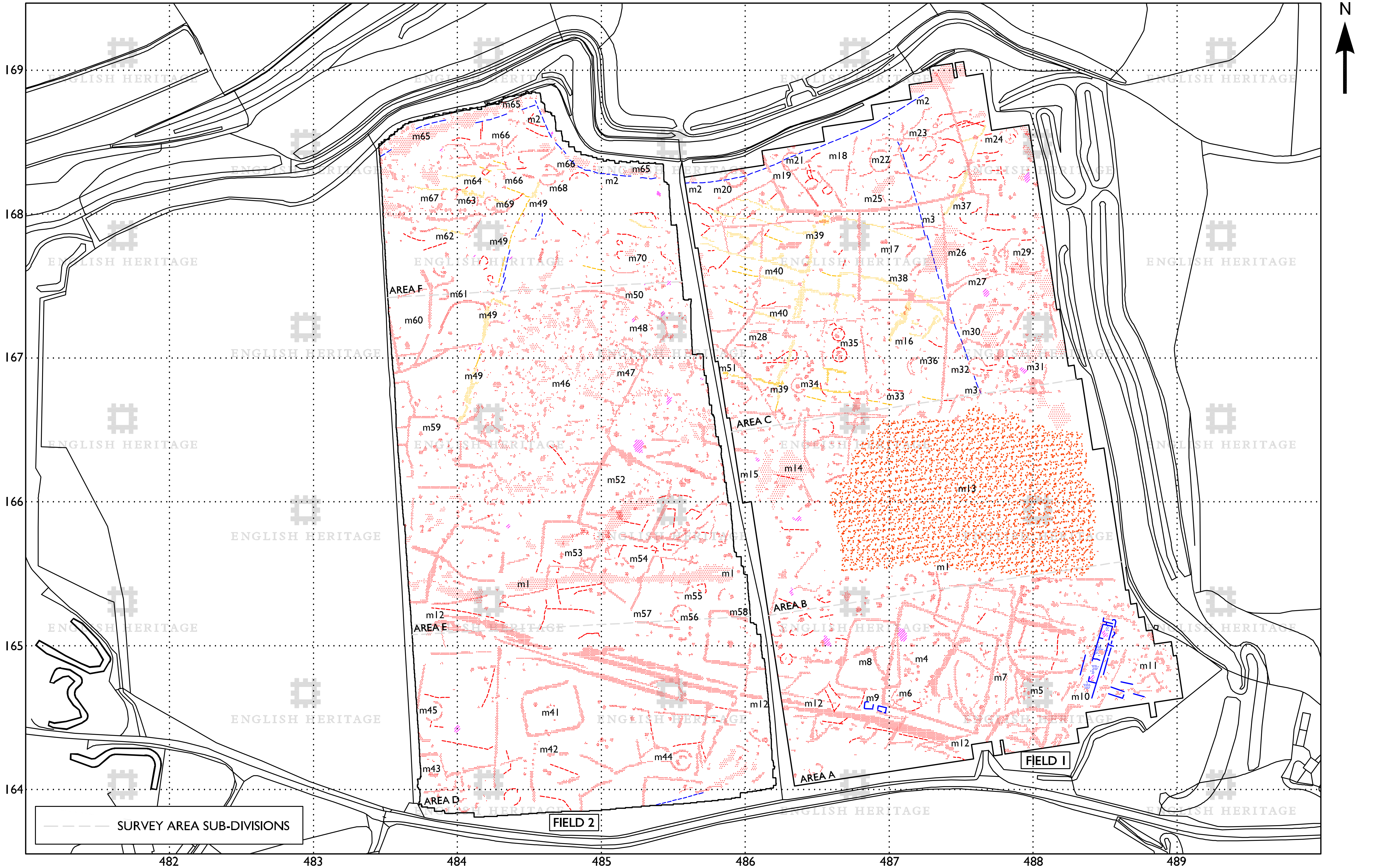
Graphical summary of significant magnetic anomalies, March, May and December 2011

ST4816



Positive magnetic: e.g. ditches, pits, ring-gullies

Positive magnetic: weakly defined linear ditch systems

Positive magnetic: localised quarrying or geological response

mixed magnetic response: large scale quarrying

negative magnetic: e.g. masonry structures

ferrous response

weak positive linear

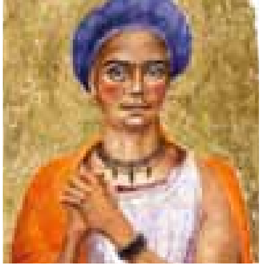
weak negative linear

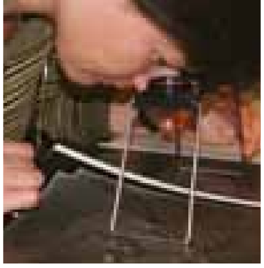
0 90m

1:2500

Geophysics Team 2012

ENGLISH HERITAGE


ENGLISH HERITAGE RESEARCH AND THE HISTORIC ENVIRONMENT

English Heritage undertakes and commissions research into the historic environment, and the issues that affect its condition and survival, in order to provide the understanding necessary for informed policy and decision making, for the protection and sustainable management of the resource, and to promote the widest access, appreciation and enjoyment of our heritage. Much of this work is conceived and implemented in the context of the National Heritage Protection Plan. For more information on the NHPP please go to http://www.english-heritage.org.uk/professional/protection/national-heritage-protection-plan/.

The Heritage Protection Department provides English Heritage with this capacity in the fields of building history, archaeology, archaeological science, imaging and visualisation, landscape history, and remote sensing. It brings together four teams with complementary investigative, analytical and technical skills to provide integrated applied research expertise across the range of the historic environment. These are:

* Intervention and Analysis (including Archaeology Projects, Archives, Environmental Studies, Archaeological Conservation and Technology, and Scientific Dating)
* Assessment (including Archaeological and Architectural Investigation, the Blue Plaques Team and the Survey of London)
* Imaging and Visualisation (including Technical Survey, Graphics and Photography)
* Remote Sensing (including Mapping, Photogrammetry and Geophysics)

The Heritage Protection Department undertakes a wide range of investigative and analytical projects, and provides quality assurance and management support for externally-commissioned research. We aim for innovative work of the highest quality which will set agendas and standards for the historic environment sector. In support of this, and to build capacity and promote best practice in the sector, we also publish guidance and provide advice and training. We support community engagement and build this in to our projects and programmes wherever possible.

We make the results of our work available through the Research Report Series, and through journal publications and monographs. Our newsletter *Research News*, which appears twice a year, aims to keep our partners within and outside English Heritage up-to-date with our projects and activities.

A full list of Research Reports, with abstracts and information on how to obtain copies, may be found on www.english-heritage.org.uk/researchreports

For further information visit www.english-heritage.org.uk

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