Historic England

Geophysics

Clun Castle, Clun, Shropshire
Report on Geophysical Surveys, March 1998

Neil Linford, Paul Linford and Andrew Payne

Discovery, Innovation and Science in the Historic Environment

Research Report Series no. 205-2020

Research Report Series 205-2020

CLUN CASTLE, CLUN, SHROPSHIRE

REPORT ON GEOPHYSICAL SURVEYS, MARCH 1998

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NGR: SO 29870 80910

ISSN 2059-4453 (Online)

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SUMMARY

Earth resistance, magnetic and Ground Penetrating Radar (GPR) surveys were conducted at Clun Castle, Clun, Shropshire, to demonstrate geophysical techniques for archaeological prospection as part of a Science Engineering and Technology week organised in March 1998. Due to the limited success and coverage of the surveys the results were not formally reported at the time, but have been completed now following a request to include these in a wider publication summarising all research conducted at the site. The earth resistance survey (0.4 ha) suggests tentative evidence for some structural remains within both of the outer baileys covered with this technique, and there is some correlation with the fluxgate gradiometer results (0.3 ha) in the South East Bailey, despite the presence of ferrous interference. Results from the trial GPR profiles were of limited use due to the shallow penetration depth of the higher centre frequency antenna used over the South East Bailey and the 2 m wide spacing between the parallel profiles. Some more useful results were obtained from the North East Bailey with a lower centre frequency antenna, although these could not be used to confidently confirm the presence of structural remains suggested by the earth resistance survey.

CONTRIBUTORS

The geophysical fieldwork was conducted by Emma Bray, Peter Cottrell, Andrew David, Neil Linford, Paul Linford and Andrew Payne.

ACKNOWLEDGEMENTS

The authors are grateful to our colleagues who manage Clun Castle and the Bowling club for granting access and assistance to allow the survey to take place, and to the organisers of the SET event and members of the public who visited the site during the field work demonstration.

ARCHIVE LOCATION

Fort Cumberland, Portsmouth.

DATE OF SURVEY

The fieldwork was conducted during the 14-15th March 1998 and the report completed on 24th April 2020. The cover image shows an aerial view of Clun Castle from the north west with the smaller North East Bailey platform housing the bowling pavilion to the left of the keep, and the larger South East Bailey behind the motte to the right (Historic England Archive: © Skyscan K930935).

CONTACT DETAILS

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INTRODUCTION

Earth resistance, magnetic and Ground Penetrating Radar (GPR) surveys were undertaken at Clun Castle, Clun, Shropshire (NHLE List Entry Number 1011021) as a contribution to a series of public outreach events conducted in March 1998 organised in association with Science Engineering and Technology week (SET98). The results were also intended to contribute to improved visitor information and inform future conservation and management of the site, although the main focus of the work was to demonstrate the geophysical survey techniques to visitors. Given the limited coverage and success of the surveys, the results were not reported at the time but now form a contribution to a forthcoming publication summarising all research conducted at the site.

The castle consists of a motte and two baileys that occupy a small but strategically strong prominence of high ground contained around the west and south sides within a meander of the River Clun (Renn 1968; Munby and Summerson 2002). Clun was the seat of the Honour of Clun, a border barony believed to have been founded between 1090 and 1110 by the Norman knight Picot de Say who fought with William the Conqueror in 1066. Buildings were originally of timber but these were destroyed by fire in 1196 when the castle fell to the Welsh Prince Rhys ap Gruffydd, though by 1233 these had been rebuilt and withstood a second attack by the Welsh. In the second half of the 13th century the castle was rebuilt in stone by the FitzAlan family. At its greatest extent it included inner and outer baileys with a tower and keep, domestic buildings, a water garden and fishpond (located west of the river) and a bridge linking the two baileys. By 1300 Clun was no longer a permanent residence but continued to function as a centre for the administration of the border barony and as a hunting lodge until its desertion by 1540.

The surveys were over the larger South East Bailey and the smaller North East Bailey, the latter used as a bowling green at the time of the survey. The main castle motte to the north and west of the two baileys was not included in the survey due to time constraints and accessibility issues. A trial GPR survey was undertaken as part of this survey collecting a series of parallel profiles to test the suitability of the technique at the site.

Clun Castle is situated on Silurian siltstone sedimentary deposits of the Clun Forest Formation overlain by superficial Devensian Diamicton glacial deposits (British Geological Survey 2019). The local soils consist of deep stoneless, fine silty and clayey soils of the Conway (811b) association (Soil Survey of England and Wales 1983). Both survey areas were under grass with steep slopes impractical for survey surrounding the relatively flat enclosed areas of the two bailey earthwork platforms. Weather conditions were dry but overcast with sunny intervals and average temperatures for the time of year.

METHOD

Earth resistance survey

Earth resistance survey was carried out over both outer baileys using a series of 30m grids (Figure 1) established with a Nikon DTM01 Total Station theodolite, measured in to nearby landmarks. Each 30m grid-square was then surveyed using a Geoscan RM15 resistance meter with an internal multiplexer and a PA5 frame with three electrodes in the parallel Twin-Electrode configuration. This arrangement allowed two separate surveys, with electrode separations of 0.5m and 1.0m, to be collected simultaneously. The 0.5m electrode separation coverage was designed to detect near-surface anomalies in the upper 0.5m of the subsurface whilst the 1.0m separation survey allowed anomalies to a depth of about 1-1.25m to be detected. For the 0.5m electrode separation survey readings were taken at a density of 1.0m x 0.5m whilst for the 1.0m separation survey they were taken at a density of 1.0m x 1.0m.

Extreme values caused by high contact resistance were suppressed in both datasets using a thresholded median filter with radius 1m (Scollar et al. 1990) and replacing any value differing from the local median by more than 10Ω. The results for the near-surface 0.5m electrode separation survey are depicted as a linear greyscale image in Figure 2 superimposed on the OS map. Minimally processed data from the South East Bailey are shown in Figures 5(A)-(C) for the 0.5m electrode separation dataset and Figures 5(E)-(G) for the 1.0m dataset. Corresponding plots for the North East Bailey are shown in Figures 6(A)-(C) and 6(E)-(G) respectively. Further linear greyscale images created by overlaying the two electrode spacing datasets to accentuate near-surface and more deeply buried anomalies are also included in Figures 5 and 6, plots (D) and (H) in both cases.

Magnetometer survey

Magnetometer coverage was limited to the South East Bailey. The series of 30m grids previously set out with the total station theodolite was surveyed using a Geoscan FM36 fluxgate gradiometer (Figure 1). Measurements were taken at 0.25 m intervals along parallel traverses separated by 1.0m. Post- acquisition, the median value of each traverse was subtracted from all measurements on that traverse (Zero Median Traverse) to correct for heading errors and instrument drift. A linear greyscale image of the magnetometer data is presented in Figure 3 superimposed on the OS base map. Trace plots of the raw and minimally processed magnetometer data are presented in Figure 7 together with linear and histogram equalised greyscale images of the minimally processed data.

Ground Penetrating Radar survey

The Ground Penetrating Radar survey was conducted with a Sensors and Software Pulse Ekko PE1000 console using both 900MHz (South East Bailey) and 225MHz (North East Bailey) centre frequency antennas. An average subsurface velocity of ~0.07 m/ns was determined from analysis of a common mid-point (CMP) gather. This velocity was adopted as a reasonable average value for both processing the data from the site and for the estimation of depth to reflection events in the recorded profiles.

Data were collected along parallel traverses separated by 2.0m with individual traces along each profile separated by ~0.025m for the 900 MHz antenna and ~0.1m for the 225 MHz antenna (Figures 4 and 8). Reflections were recorded through a two-way travel time of 100ns using a time based trigger and fiducial marks added at 1m intervals along each profile. Post-acquisition processing involved the adjustment of time zero to coincide with the true ground surface, removal of any low frequency transient response (dewow), noise suppression and the application of a suitable gain function to enhance late arrivals.

The sample interval for the survey was not designed at the time with the intention of producing amplitude time slices. Representative time slices are presented on Figure 4 following the application of a 2D-migration algorithm and averaging data within a 1 ns (two-way travel time) window, equating to an approximate ~0.04m interval through the ground surface for the 900 MHz antenna and a 3 ns (two-way travel time) window, equating to an approximate ~0.1m interval through the ground surface for the 225 MHz antenna (e.g. Linford 2004).

RESULTS

Earth resistance survey

A graphical summary of the significant earth resistance anomalies [**r1-18**] discussed below is shown superimposed on base OS mapping in Figure 9.

South East Bailey

A modern surfaced trackway [**r1**] is visible in the north west of the bailey where the perimeter earthworks are breached by a vehicle access route indicated on the OS mapping. More weakly defined high resistance anomalies forming a cellular pattern [**r2-4**] to the south and west of [**r1**], may tentatively be suggested as former masonry structures, possibly buildings constructed with respect to the western edge of the bailey earthwork, and a more open area to the east with less evidence of activity.

Weaker high resistance anomalies [**r5-7**] show a similar trend to [**r2-4**] parallel to the north edge of the bailey platform and these may again relate to internal structures,

perhaps fragmentary traces of timber buildings that would not be expected to leave substantial traces easily detectable by earth resistance survey. A high resistance anomaly [**r8**] may indicate more substantial structural remains at a junction between the possible building ranges [**r5-7**] and a weaker high resistance linear response [**r9**] to the south. It is possible that [**r9**] may also be related to an earthwork bank crossing the eastern edge of the bailey interior, which may represent a boundary, defensive work or, perhaps, building ranges. A further response to the earthwork bank may be found to the east at [**r10**], although this may also be a response to the steep break in slope along the eastern scarp of the bailey platform here.

A series of low resistance anomalies [**r11**] to the north may be associated with [**r5-7**], perhaps quarrying disturbance and back-filling possibly resulting from attempts to remove material from former structures in this area. Similar quarrying activity may explain more extensive areas of low resistance [**r12**] and [**r13**] to the south, although these may also relate to the construction of the bailey platform or, perhaps, ponds used to capture water. A pit-type anomaly [**r14**] may also be associated with water storage or supply, perhaps to the tentative building range at [**r8**] and [**r9**]. There are few high resistance responses to the south of the bailey beyond a linear anomaly [**r15**], possibly a short stub of masonry walling heading north-west into the survey area that terminates at [**r12**]. The purpose of this section of wall is obscure, but it may represent a sub-division of the bailey.

North East Bailey

A pronounced rectilinear high resistance anomaly [**r16**], immediately west of the bowling green pavilion, is partially described within the survey area and may, possibly, correspond with the post-medieval court house depicted on the 1731 engraving by Samuel and Nathaniel Buck, later demolished in 1789 when Clun Town Hall was built. Arcing around the western side of the bailey a broad curvilinear high resistance anomaly [**r17**] may indicate traces of a defensive earthwork bank or wall foundation constructed to screen the approach to the North East Bailey from the main castle. There is also a possibility that [**r17**] could be geological response or, perhaps less likely, a later pathway. An extensive area of low resistance at [**r18**] to the south east may indicate stone-robbing, quarrying or slumping of the mound deposits or perhaps in-filling and levelling to create the bowling green.

Magnetometer survey

A graphical summary of the significant magnetic anomalies [**m1-11**] discussed below is shown superimposed on base OS mapping in Figure 10.

South East Bailey

The modern access road [**r1**] in the northwest of the survey is replicated as an area of intense ferrous response [**m1**], with three other similar anomalies [**m2-4**] due to strong disturbance also probably related to modern activity, perhaps visitor signage and earthwork erosion repair.

A series of approximately parallel, very tentative linear trends [**m5-7**] to the north are found in the vicinity of possible timber building remains [**r5-7**], although the two sets of anomalies do not precisely align. There is also a broadly square arrangement of strong, thermoremanent anomalies [**m8**], which may represent an industrial working area such as a smithy or bake-house located away from the main castle residence. A further scatter of possible pit and hearth type anomalies [**m9**] are found across the bailey, partially associated with the tentative building ranges identified from the resistance data.

A short linear negative anomaly [**m10**] to the south corresponds with the stub of buried wall [**r15**], and there is tentative evidence in the magnetic data for a continuation of the wall further to the north. A more slightly defined linear negative anomaly [**m11**] may relate to the raised linear bank or tentative indications of a building range corresponding with [**r9**].

Ground Penetrating Radar survey

A graphical summary of the significant GPR anomalies, [**gpr1-8**] discussed below, superimposed on the base OS mapping, is provided in Figure 11.

South East Bailey

The profiles collected with the 900MHz centre frequency antenna have limited signal penetration beyond approximately 25ns (~0.9m) and, due to the 2m line separation, are too sparsely sampled to allow a confident interpretation through amplitude time slices. There is some highly tentative evidence for two near-surface linear anomalies [**gpr1**] between 3.0 and 4.0ns (0.11 to 0.14m) on a similar alignment to [**r6**] and [**r7**], although the GPR response is more likely to represent field drains, tree roots or even animal burrows. A high-amplitude anomaly [**gpr2**] between 16.0 and 22.0ns (0.6 to 0.8m) correlates with fragments of [**r5**] and [**m5**], but again the GPR does not suggest a structural response. To the north [**gpr3**] appears to correspond with the modern material associated with the trackway [**r1**] and [**m1**]. Other dipping reflectors found in the

profiles [**gpr4**] on Figure 8 seem most likely to represent variation in soil depth or a response to the underlying geology.

North East Bailey

The lower 225MHz centre frequency antenna has proved more suitable over the playing surface of the bowling green and the signal has recorded reflections through approximately 50ns (1.75m). Despite the lower centre frequency the 2 m line spacing between profiles is still too sparsely sampled to allow a confident interpretation of the data through amplitude time slices, although there is some general agreement between two areas of high amplitude response, [**gpr5**] and [**gpr6**], and areas of high resistance at [**r16**] and [**r17**]. When viewed as individual profiles [**gpr5**] and [**gpr6**] appear to suggest rubble deposits composed of a number of distinct point reflectors. There is also evidence for an undulating basal layer [**gpr7**] across the bowling green and a central area of low amplitude [**gpr8**]. Unfortunately, it is difficult to suggest whether these anomalies are due to more significant structural remains or landscaping works associated with the construction and maintenance of the bowling green.

CONCLUSIONS

The earth resistance and magnetic surveys have successfully identified variations in response over both of the outer baileys but their interpretation is highly tentative due to the absence of any clearly defined geophysical anomalies and the considerable reworking and landscaping often encountered at castle sites. This is a particular concern over the playing surface of the bowling green in the North East Bailey. Results from the trial GPR survey were more equivocal and confirmed that this would be better conducted with a mid-centre frequency antenna over a more densely sampled grid to allow visualisation of the data as amplitude time slices.

While both the earth resistance and magnetic surveys have identified anomalies consistent with interpretation in terms of typical structures present on medieval castle sites, it should be borne in mind that the contrasts are weak and on a subsurface that has seen much modification over time. No characteristic ground plans have been identified and the GPR survey, although primarily directed towards testing the response of different antenna frequencies, has not provided any corroborating evidence for structural elements such as wall footings. Further invasive investigation of the anomalies may therefore be necessary to confirm the reliability of the geophysical survey results.

LIST OF ENCLOSED FIGURES

Figure 11 Graphical summary of significant of GPR anomalies superimposed over the base OS mapping (1:500).

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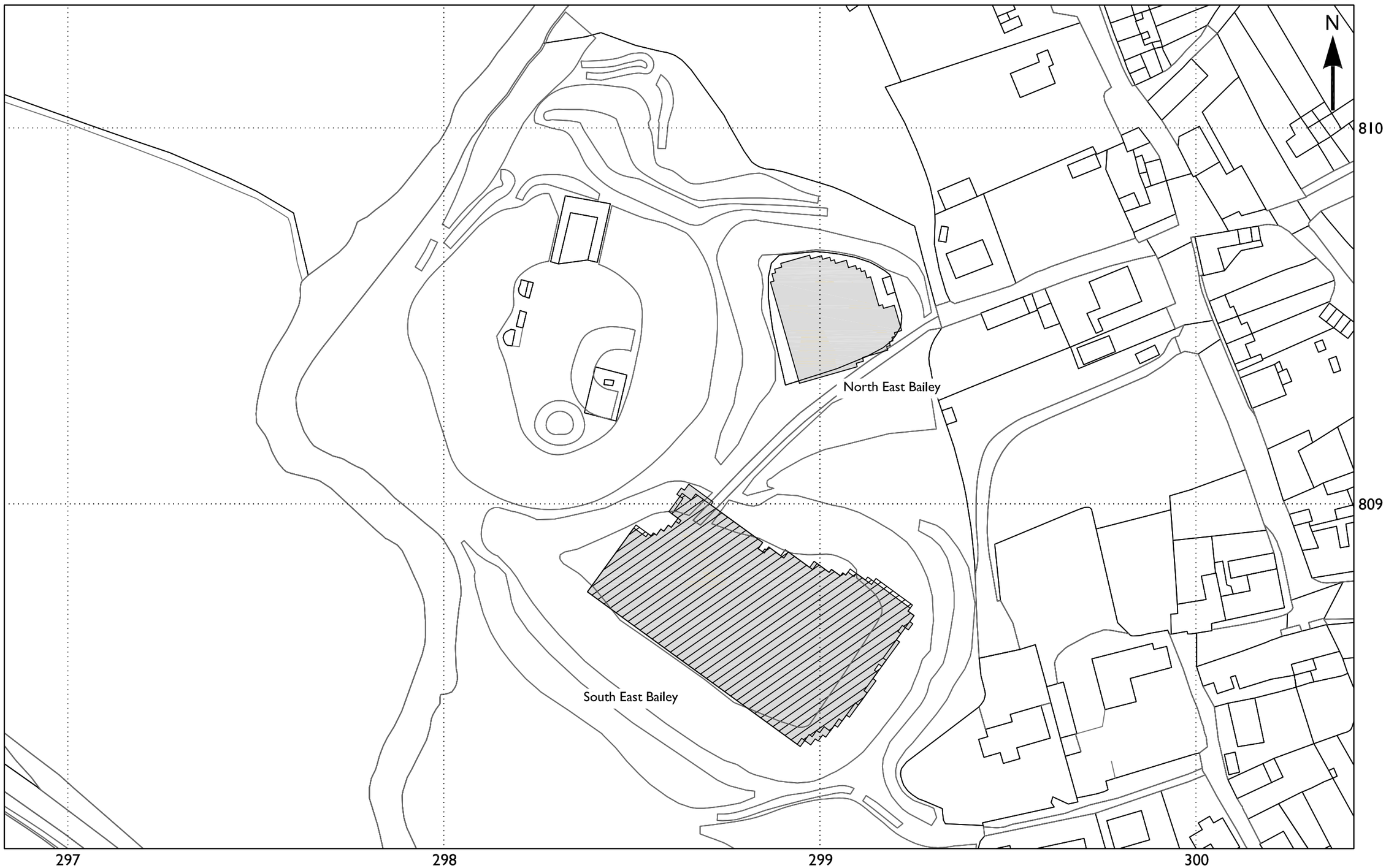
Figure 1

CLUN CASTLE, CLUN, SHROPSHIRE

Location of earth resistance and magnetometer surveys, March 1998



0 60m

1:1000

Earth resistance survey

Magnetometer survey

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Figure 2

CLUN CASTLE, CLUN, SHROPSHIRE

Location of 0.5m mobile probe spacing earth resistance survey, March 1998

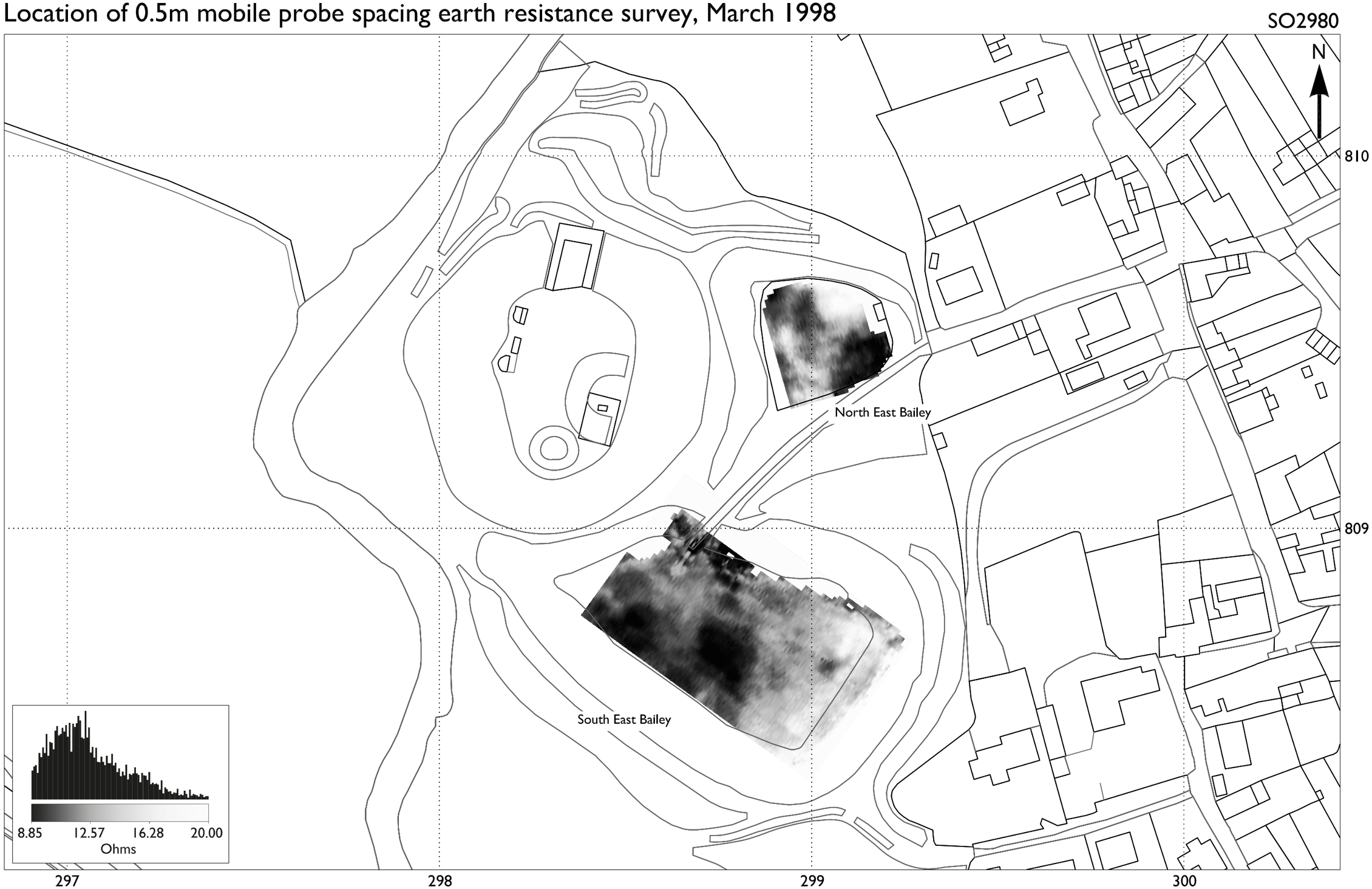

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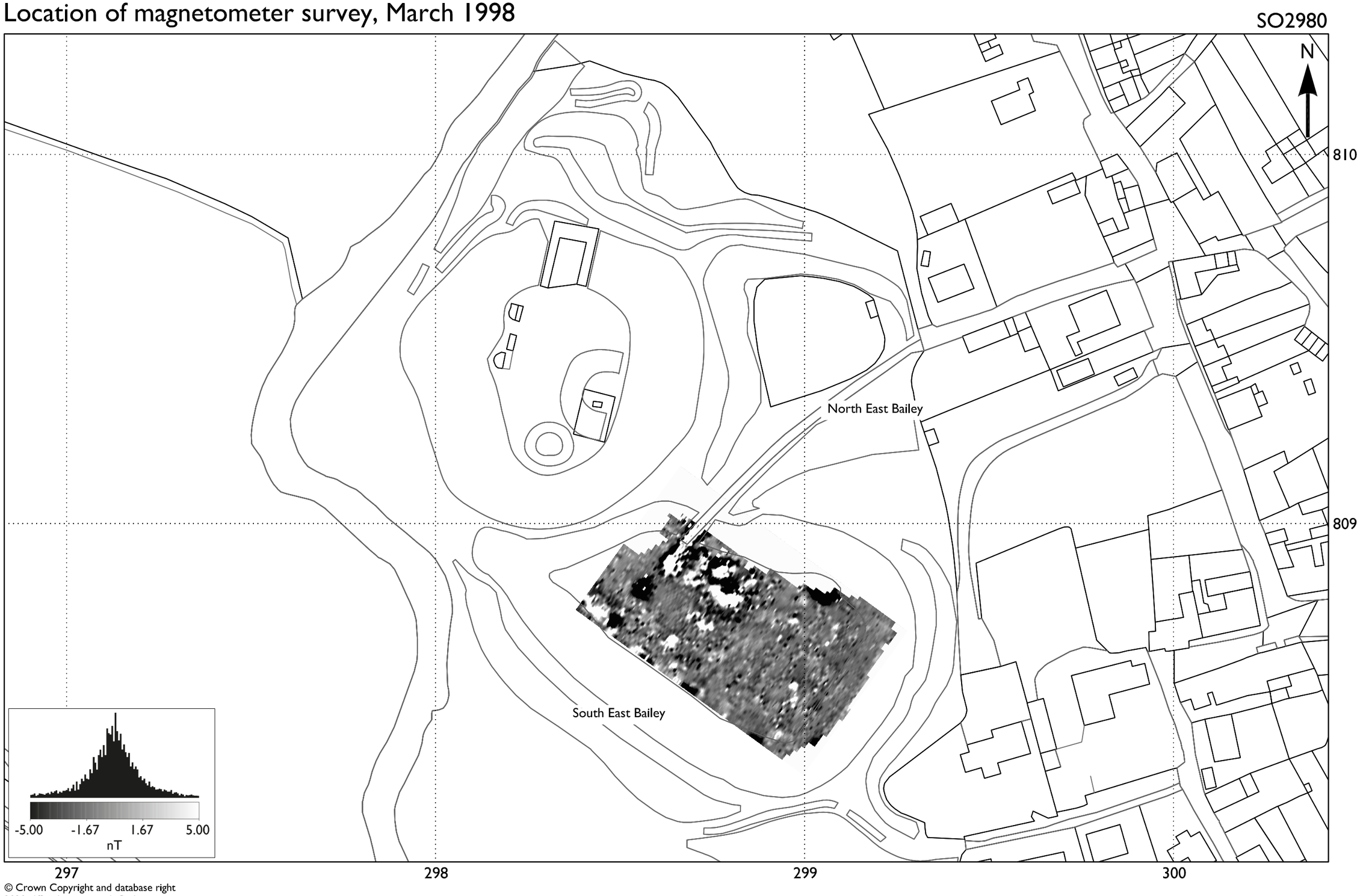
Figure 3

CLUN CASTLE, CLUN, SHROPSHIRE

Location of magnetometer survey, March 1998



0 60m

1:1000

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Figure 4

CLUN CASTLE, CLUN, SHROPSHIRE
Location of GPR profiles, March 1998

SO2980

N

BOWL10
BOWL07
BOWL06

North East Bailey 225MHz
amplitude time slice between
27.0 and 30.0ns (0.95 to 1.05m)

809

BAIL10
BAIL05
BAIL02

South East Bailey 900MHz
amplitude time slice between
19.0 and 20.0ns (0.67 to 0.7m)

298

299

0 30m

1:500

Location of GPR profiles

selected GPR profile shown on Figure 8

Low *High*
relative reflector strength

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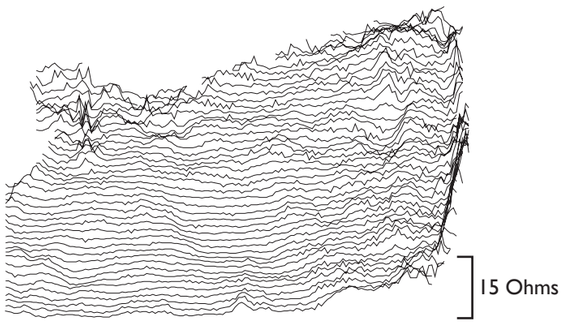
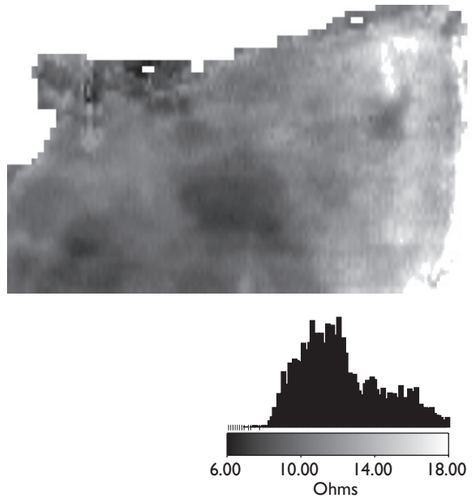
CLUN CASTLE, CLUN, SHROPSHIRE
Earth resistance survey of South East Bailey, March 1998

0.5m mobile probe separation data

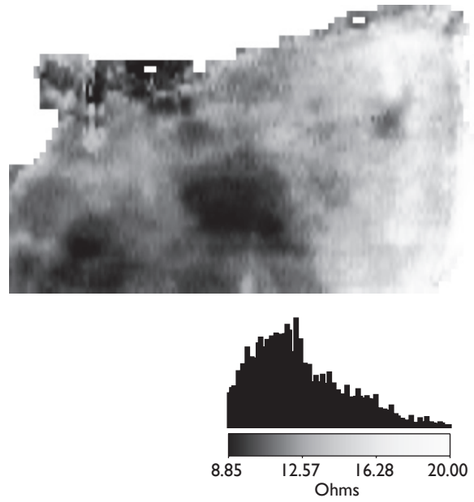
(A) Trace plot of minimally processed data



(B) Linear greyscale image of minimally processed data

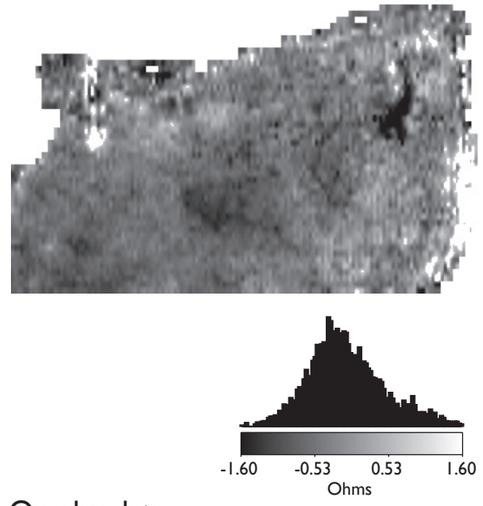


(C) Equal area greyscale image of data after noise removal



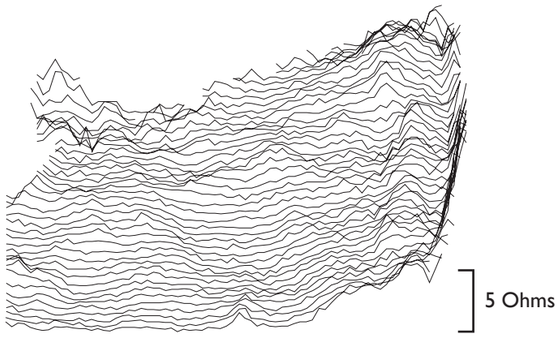
Overlay data

(D) Linear greyscale image with near-surface anomalies accentuated

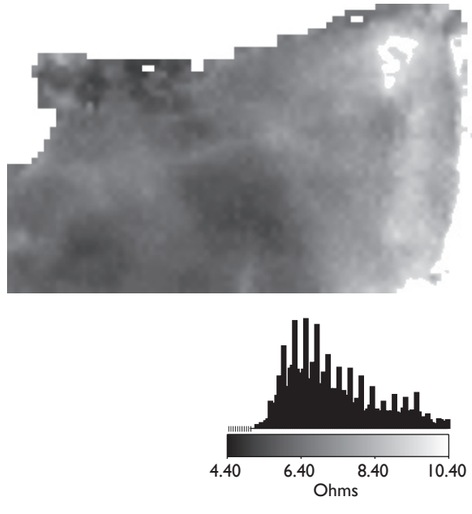


1.0m mobile probe separation data

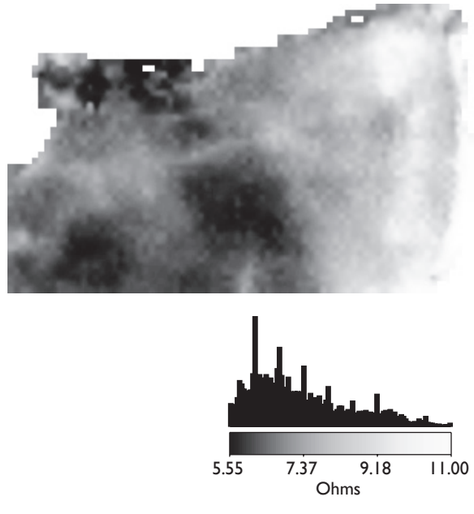
(E) Trace plot of minimally processed data



(F) Linear greyscale image of minimally processed data

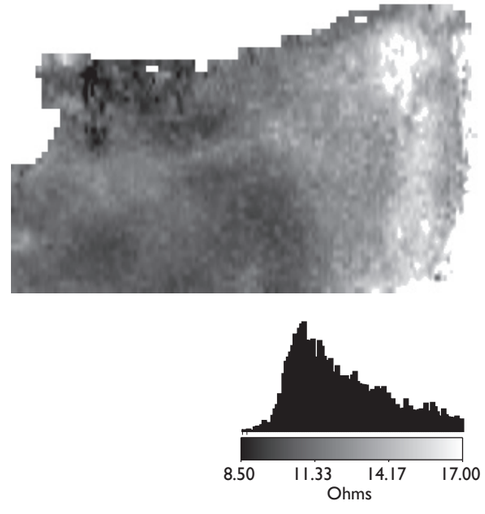


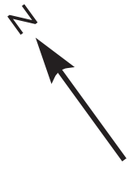
(G) Linear greyscale image of data after noise removal



Overlay data

(H) Linear greyscale image with deeper anomalies accentuated





0 90m

1:1000

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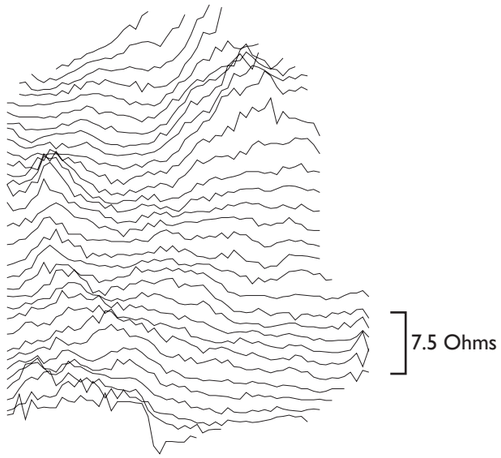
Figure 6

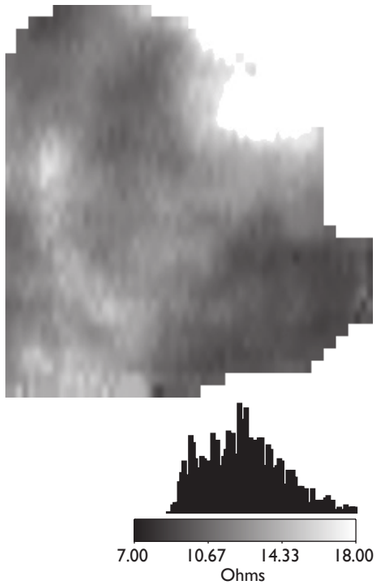
CLUN CASTLE, CLUN, SHROPSHIRE
Earth resistance survey of North East Bailey, March 1998

0.5m mobile probe separation data

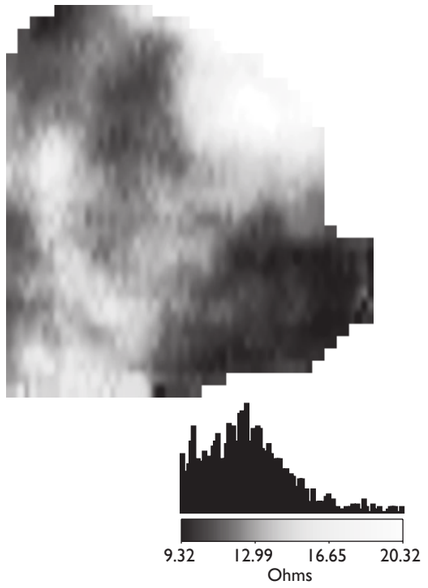
(A) Trace plot of minimally processed data



(B) Linear greyscale image of minimally processed data

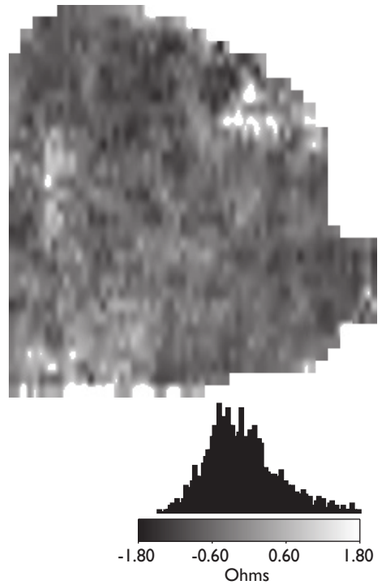


(C) Equal area greyscale image of data after noise removal



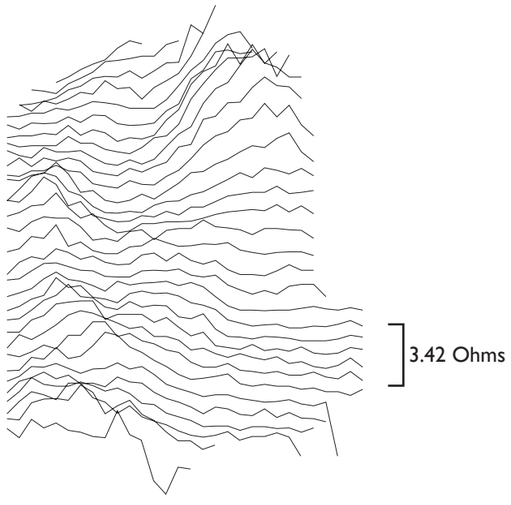
Overlay data

(D) Linear greyscale image with near-surface anomalies accentuated

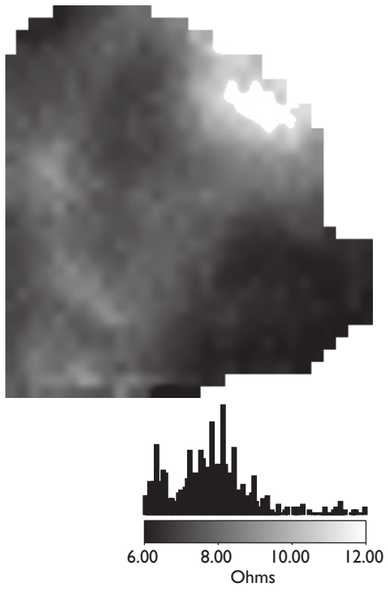


1.0m mobile probe separation data

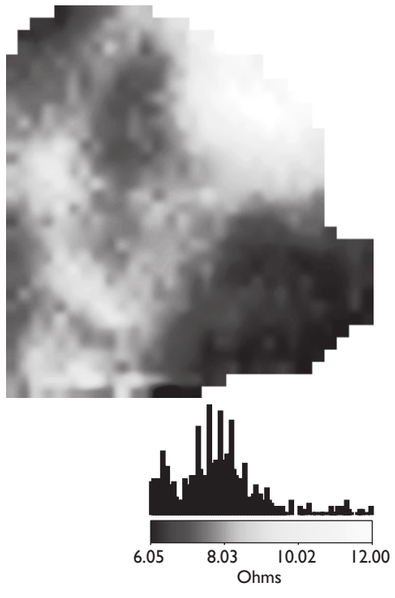
(E) Trace plot of minimally processed data



(F) Linear greyscale image of minimally processed data

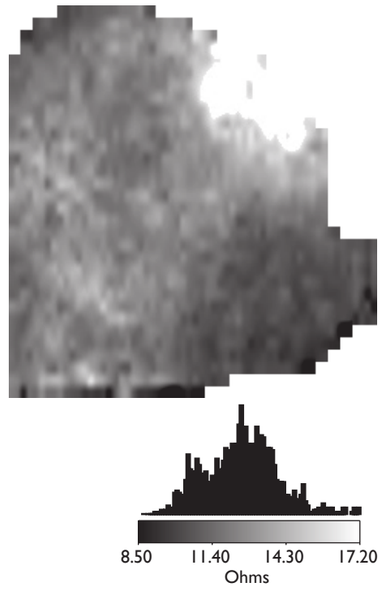


(G) Equal area greyscale image of data after noise removal



Overlay data

(H) Linear greyscale image with deeper anomalies accentuated



0 30m

1:500

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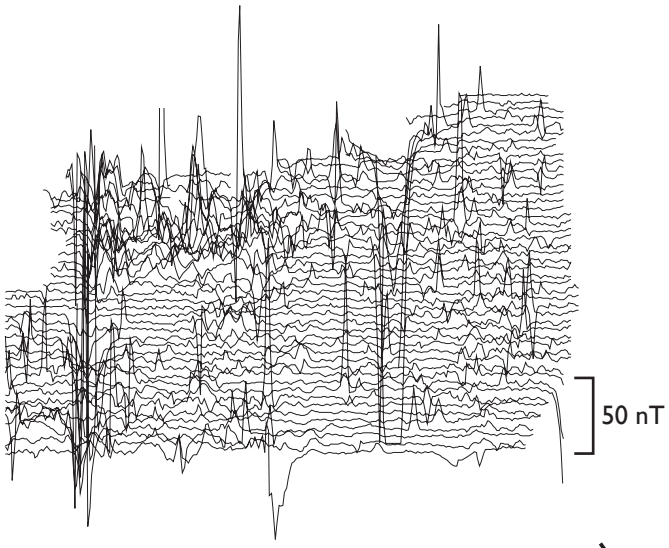
Figure 7

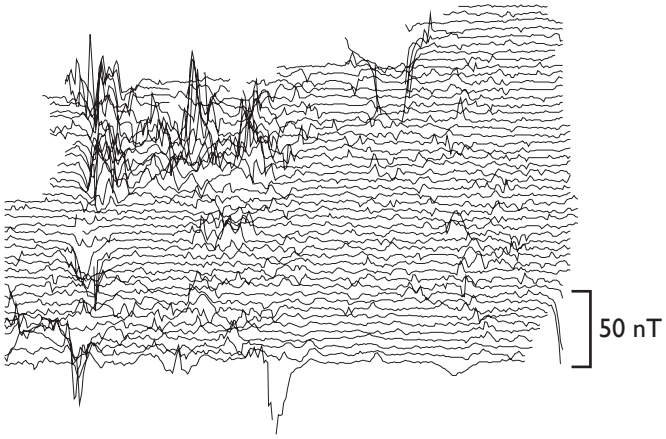
CLUN CASTLE, CLUN, SHROPSHIRE

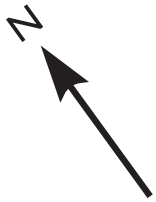
Fluxgate magnetometer survey of South East Bailey, March 1998

(A) Trace plot of raw data

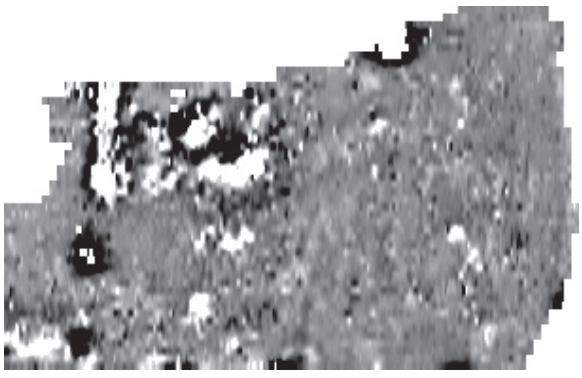


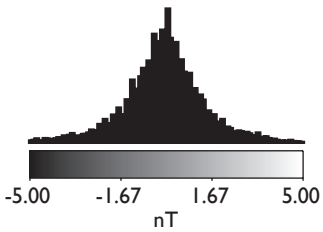
(B) Trace plot of minimally processed data



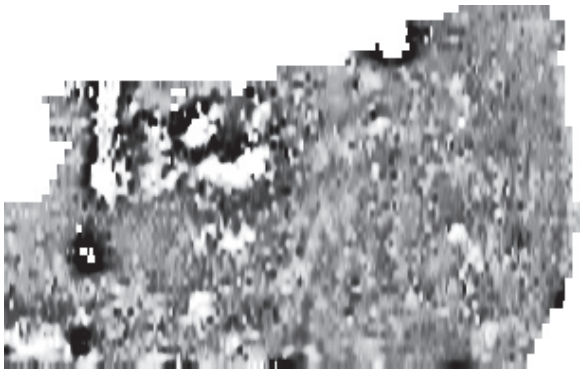


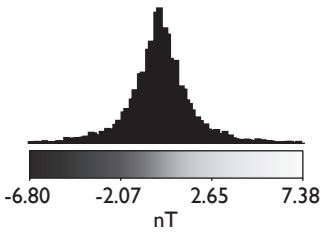
(C) Linear greyscale image of minimally processed data





(D) Histogram normalised greyscale image of minimally processed data





1:1000

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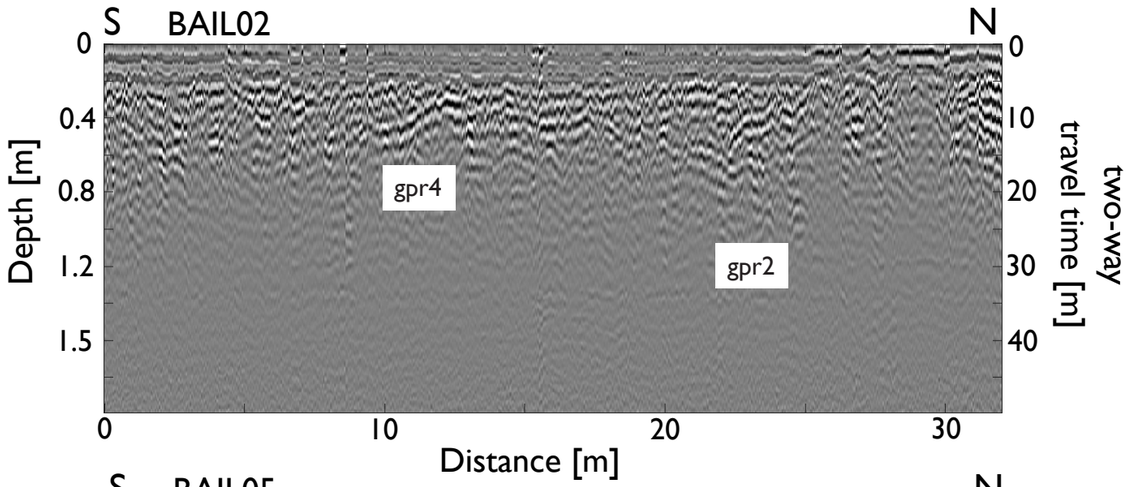
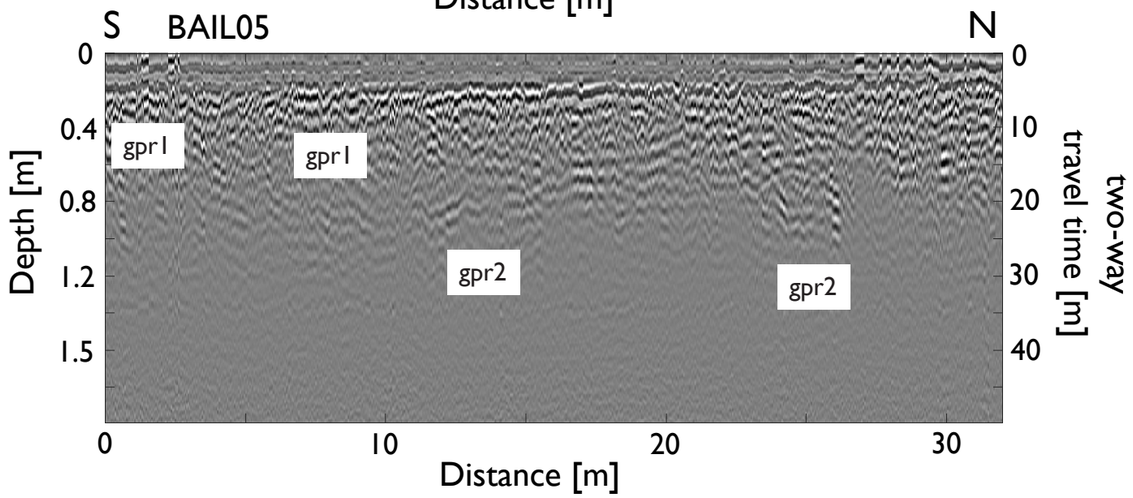
CLUN CASTLE, CLUN, SHROPSHIRE

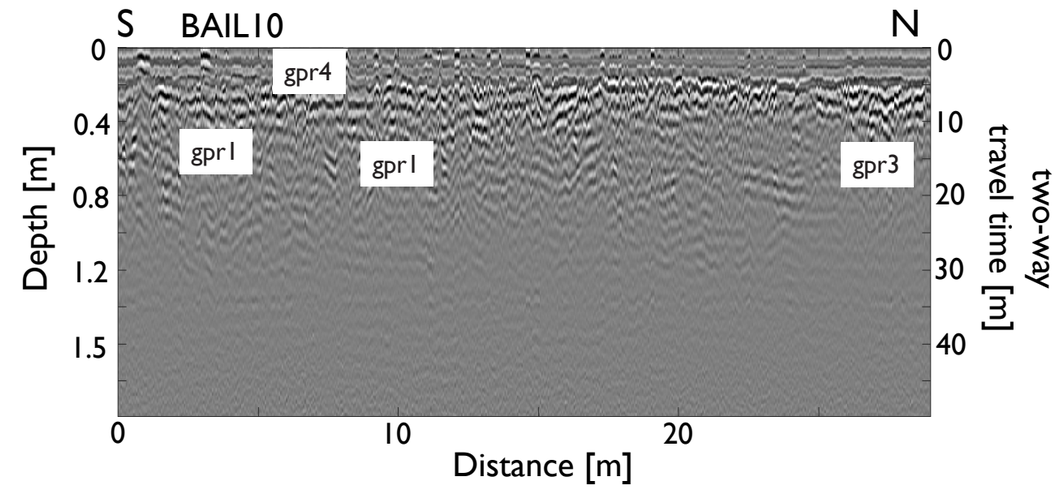
GPR profiles, March 1998

Figure 8

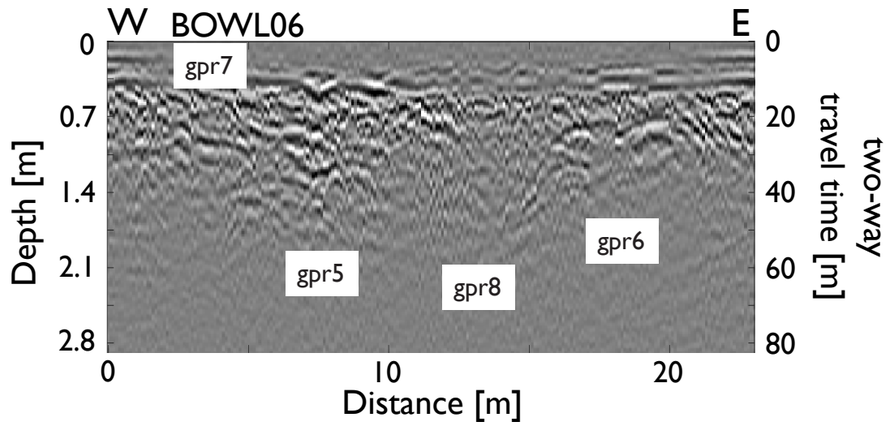
South East Bailey 900 MHz

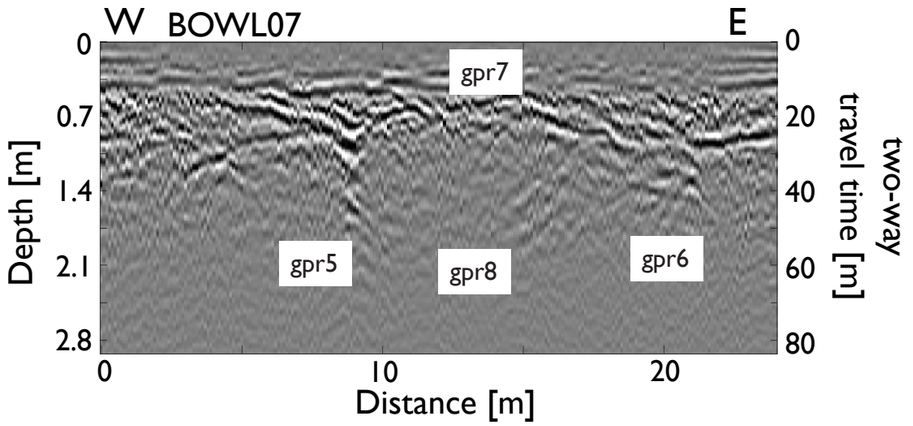






North East Bailey 225 MHz





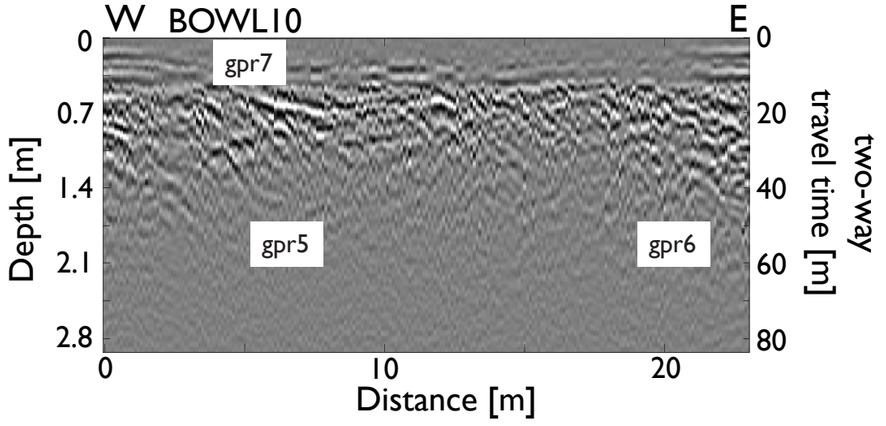


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Figure 9

CLUN CASTLE, CLUN, SHROPSHIRE

Graphical summary of significant earth resistance anomalies, March 1998

SO2980

N

810

809

r17
r16
r18
r17

r4
r11
r1
r2
r3
r5
r6
r7
r13
r8
r12
r14
r10
r9
r15
r10

297
298
299
300

0 60m

1:1000

very high resistance
high resistance
low resistance
modern response
weak high resistance linear trends

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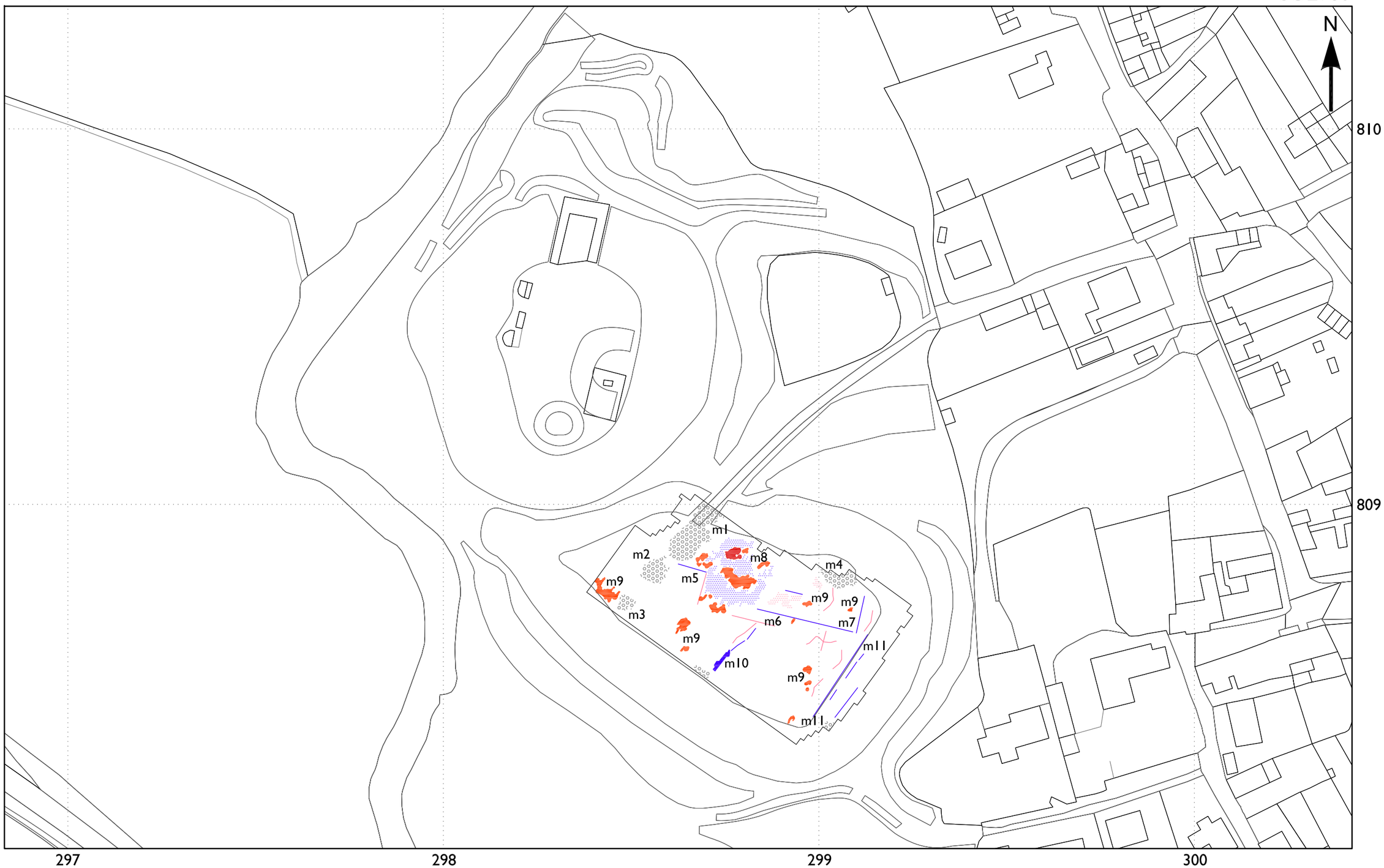
Figure 10

CLUN CASTLE, CLUN, SHROPSHIRE

Graphical summary of significant magnetic anomalies, March 1998



0 60m

1:1000

positive magnetic
negative magnetic
strong positive magnetic
raised magnetic
magnetic noise

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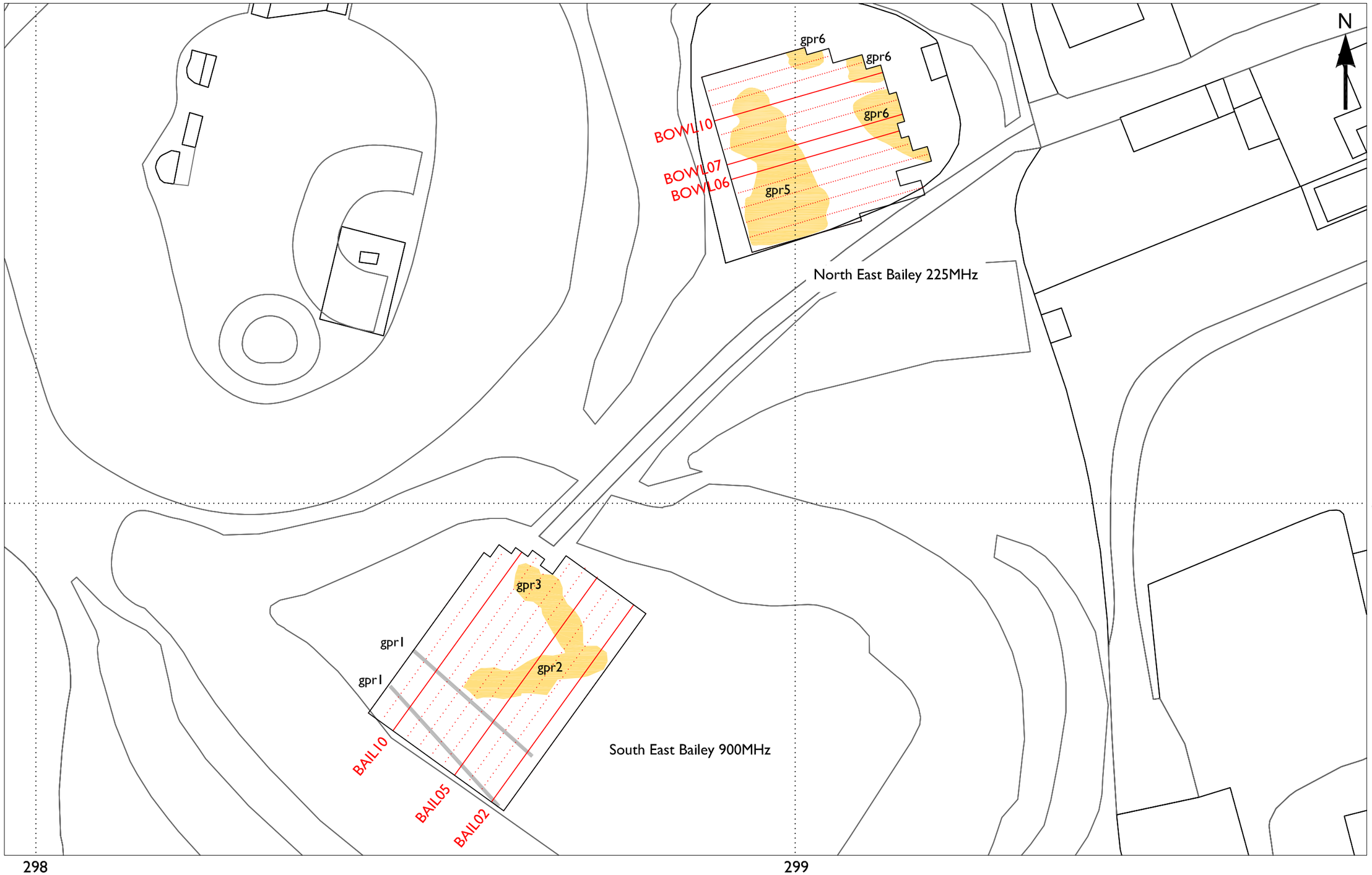
Figure 11

CLUN CASTLE, CLUN, SHROPSHIRE

Graphical summary of significant GPR anomalies, March 1998

SO2980



0 30m

1:500

Location of GPR profiles

selected GPR profile shown on Figure 8

low amplitude reflectors

high amplitude reflectors

anomalies of known or recent origin

Historic England

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ISSN 2398-3841 (Print)
ISSN 2059-4453 (Online)