ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
AOC Archaeology Group

Na Clachan Aoraidh Stone Circle
Blair Atholl
Perth & Kinross

geophysical survey

report 2800
December 2011

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted at Na Clachan Aoraidh stone circle near Blair Atholl, Perth & Kinross. The works comprised high resolution geomagnetic and earth electrical surveys of the stone circle and its immediate vicinity.

1.2 The works were commissioned by AOC Archaeology Group and conducted by Archaeological Services Durham University.

Results

1.3 Several features associated with the stone circle have been identified, including a stone kerb/revetment at the edge of the raised platform; possible ring-ditches outside the platform; possible cist burials.

1.4 Other features haven also been detected, including a possible stone wall or dyke.

1.5 Probable near-surface geology has also been identified.

2. Project background

Location (Figure 1)

2.1 The survey area was located on open moorland in the Allean Forest, to the north of Loch Tummell, approximately 4.5km south-west of Blair Atholl, Perth & Kinross (NGR centre: NN 8386 6200). The 40m x 40m survey area encompassed the Na Clachan Aoraidh four-poster stone circle, the platform on which it is set and some of its environs.

2.2 The works comprised high resolution geomagnetic and earth electrical resistance surveys. It was not possible to complete the northern corner of the resistance survey due to deteriorating weather and light conditions and safety issues, however, this part of the survey is known to contain a former forestry track.

Objective

2.3 The principal aim of the surveys was to detect and map any sub-surface features associated with the stone circle, in order to broaden the understanding of the Na Clachan Aoraidh monument and to inform any further heritage management and conservation issues at the site.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from the client and to current national standards and guidance (see para. 5.1 below).

2.5 Since the survey was within a Scheduled Monument the surveys were undertaken in accordance with a licence granted by Historic Scotland under Section 42 of the Ancient Monuments and Archaeological Areas Act 1979.

Dates

2.6 Fieldwork was undertaken on the 29th and 30th November 2011. This report was prepared for 12th December 2011.

Personnel

2.7 Fieldwork was conducted by Tony Liddell and Richie Villis (Supervisor). The geophysical data were processed by Richie Villis. This report was prepared by Richie Villis and Duncan Hale, the Project Manager, with illustrations by Tony Liddell.

Archive/OASIS

2.8 The site code is **NCA11**, for **N**a **C**lachan **A**oraidh 20**11**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University 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 **archaeol3-115344**.

Acknowledgements

2.9 Archaeological Services Durham University is grateful for the assistance of personnel of the Tay Forest District branch of the Forestry Commission Scotland in facilitating this scheme of works.

3. Historical and archaeological background

3.1 Na Clachan Aoraidh is typical of the 'four-poster' stone circles, usually dating to the Bronze Age, found uniquely in Britain and especially in Perthshire. These stone circles are typically classed as prehistoric ritual or funerary monuments.

3.2 The monument comprises four stones, three recumbent and one upstanding, set in the centre of a *c*.18m diameter raised platform, which is believed to be man-made. A shallow depression in the centre of the four stones is the result of earlier antiquarian investigation.

3.3 Na Clachan Aoraidh, meaning the 'Stones of Worship' is recorded as the preferred local name. Alternative names include Na Carriagean ('the rocks'), which is recorded on the 2nd edition Ordnance Survey map of Perthshire.

4. Landuse, topography and geology

4.1 At the time of survey the area comprised moorland with heather and former tree planting. The site was under snow at the time of survey.

4.2 The area was predominantly level with a mean elevation of approximately 420m OD.

4.3 The underlying solid geology of the area comprises Neoprotozoic metalimestone strata of the Blair Atholl Dark Limestone and Dark Schist Formation.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on 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, it was considered likely that cut features such as stone-holes, post-holes, ditches and pits might be present on the site, and that other types of feature such as stone or timber burial chambers (for example cists), trackways, wall foundations and fired structures (for example cremations, kilns and hearths) might also be present.

5.4 Given the anticipated depth and nature of targets and the geological environment of the study area, two complimentary techniques were considered appropriate in this instance: fluxgate gradiometry and earth electrical resistance survey.

5.5 Fluxgate gradiometry involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field, which are caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect, for example, ferrous, stone, brick and soil-filled features. Electrical resistance survey is suitable for detecting stone features such as walls, paths and culverts, but can also detect soil-filled features, depending on ground conditions at the time of survey. When a small electrical current is injected through the earth it encounters resistance which can be measured. Since resistance is linked to moisture content and porosity, stone and brick features will give relatively high resistance values while soil-filled features, which typically retain more moisture, will provide relatively low resistance values.

Field methods

5.6 A 20m grid was established across the survey area and tied-in to known, mapped Ordnance Survey points using a Leica GS15 global navigation satellite system (GNSS) with real time kinematic (RTK) correction typically providing accuracy of 10-15mm.

5.7 Measurements of vertical geomagnetic field gradient were determined using a Bartington Grad601-2 dual fluxgate gradiometer. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 0.5m, thus providing 3,200 sample measurements per 20m grid unit.

5.8 Measurements of earth electrical resistance were determined using a Geoscan RM15D resistance meter with a mobile twin probe separation of 0.5m. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was set to 0.1ohm, the sample interval was 0.5m and the traverse interval was 0.5m, thus providing 1,600 sample measurements per 20m grid unit.

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

Data processing

5.10 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 (minimally processed) data. The greyscale images and interpretations are presented in Figures 2-4; the trace plots are provided in Figure 5. In the greyscale images, positive magnetic/high resistance anomalies are displayed as dark grey and negative magnetic/low resistance anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla for the geomagnetic data and ohm for the electrical resistance data.

5.11 The following basic processing functions have been applied to the geomagnetic data:

clip	clips 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 geomagnetic anomalies caused by alternate zig-zag traverses
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

5.12 The following basic processing functions have been applied to the resistance data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
add	adds or subtracts a positive or negative constant value to defined blocks of data; used to reduce discontinuity at grid edges
despike	locates and suppresses spikes in data due to poor contact resistance
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.13 Colour-coded geophysical interpretation plans are provided. Three 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
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids
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

5.14 Two types of resistance anomaly have been distinguished in the data:

high resistance	regions of anomalously high resistance, which may reflect foundations, tracks, paths and other concentrations of stone or brick rubble
low resistance	regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches

Interpretation: features

5.15 A colour-coded archaeological interpretation plan is provided.

5.16 A sub-circular, weak, positive magnetic anomaly, with stronger discrete positive magnetic anomalies along its length, has been detected encircling the standing stones. This corresponds to a similar band of anomalously high resistance. Given the strength of the discrete positive magnetic anomalies and the uncertain and variable magnetic characteristics of the local rock, these anomalies together almost certainly reflect the location of a stone kerb or revetment around the edge of the platform on which the standing stones are set. It is understood that some kerbstones are visible under normal conditions, however, the site was under snow during the geophysical surveys.

5.17 Arcs of relatively low resistance have been detected just outside the presumed kerb. These may reflect the remains of a soil-filled ditch feature, possibly associated with the construction of the raised platform.

5.18 The four stones that make up the circle have been detected as high resistance anomalies, which may give an indication of the sub-surface extent of each stone.

5.19 Two small negative magnetic anomalies have been detected on the platform; these could reflect stone features or voids, such as cist burials. The high resistance data collected in this area also indicates the possibility of stone features or voids.

5.20 A positive magnetic and low resistance anomaly has been detected in the centre of the four stones. This may reflect a soil-filled feature, possibly the result of the back-filled antiquarian investigation.

5.21 A secondary, weak, sub-circular positive magnetic anomaly has been detected to the immediate west of the stone circle. This could reflect a soil-filled ditch feature.

5.22 A broadly north-west/south-east aligned magnetic and high resistance anomaly has been detected to the south of the stone circle. This could reflect the remains of a stone wall or dyke.

5.23 A rectilinear, negative magnetic anomaly has been detected to the east of the stone circle; this broadly corresponds to an area of high resistance data. These anomalies may reflect a concentration of stone.

5.24 An area of high resistance has been detected to the south of the stone circle, which could reflect an area with a high concentration of stone or free-draining soils. The broad, strong magnetic anomalies in this southern corner may also indicate near-surface bedrock.

5.25 Further areas of high resistance have been detected along the northern and western edges of the survey area. These anomalies may also reflect shallow bedrock; those along the northern side may reflect the former forestry track there or its shoulder.

6. Conclusions

6.1 High resolution geomagnetic and earth electrical resistance surveys were undertaken at Na Clachan Aoraidh four-poster stone circle near Blair Atholl in Perth & Kinross.

6.2 Several features associated with the stone circle have been identified, including a stone kerb/revetment at the edge of the raised platform; possible ring-ditches outside the platform; possible cist burials.

6.3 Other features haven also been detected, including a possible stone wall or dyke.

6.4 Probable near-surface geology has also been identified.

7. Sources

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute of Field Archaeologists

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

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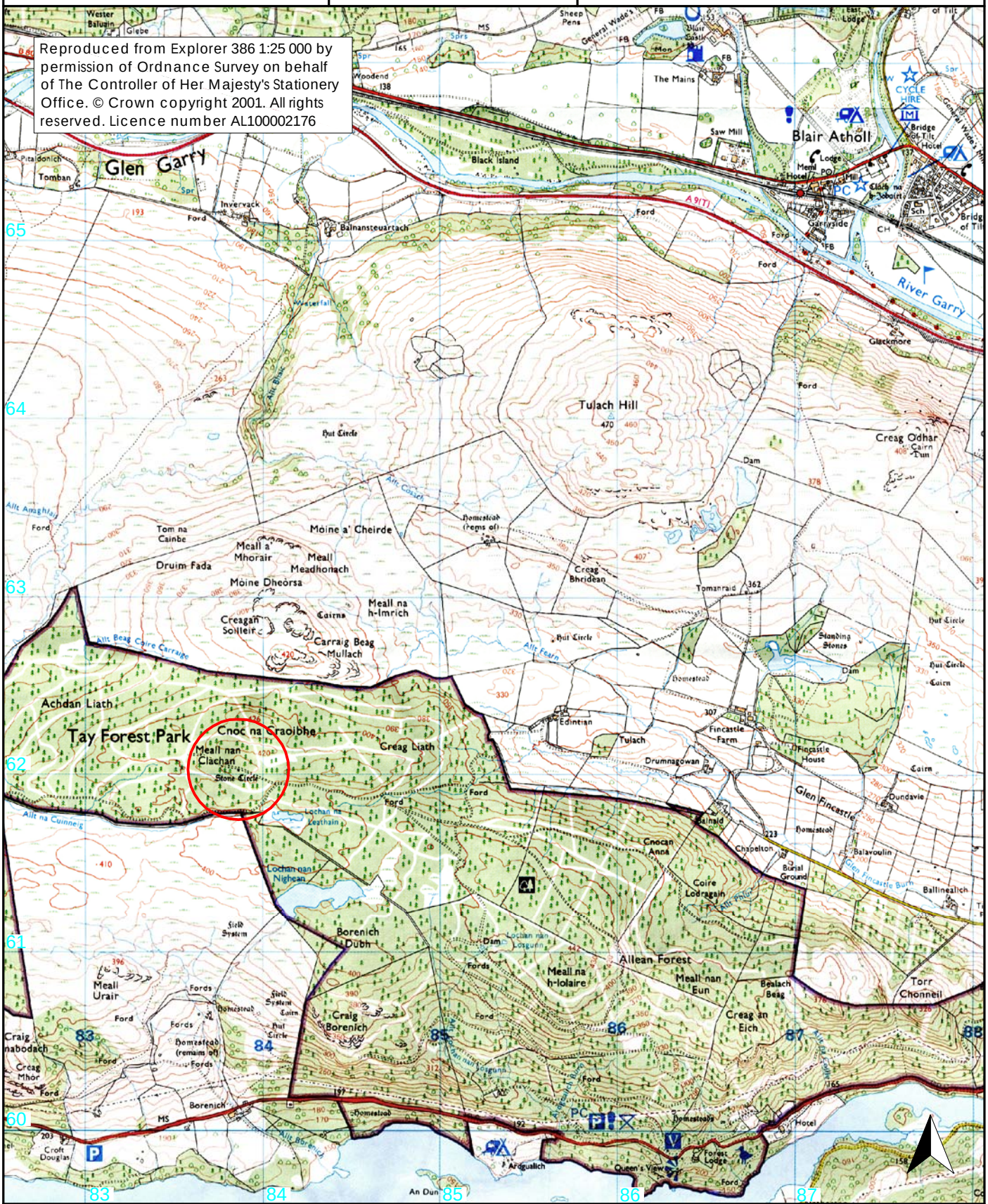
Figure 1: Site location



site location

0 1.5km

scale 1:30 000 for A4 plot

magnetic survey

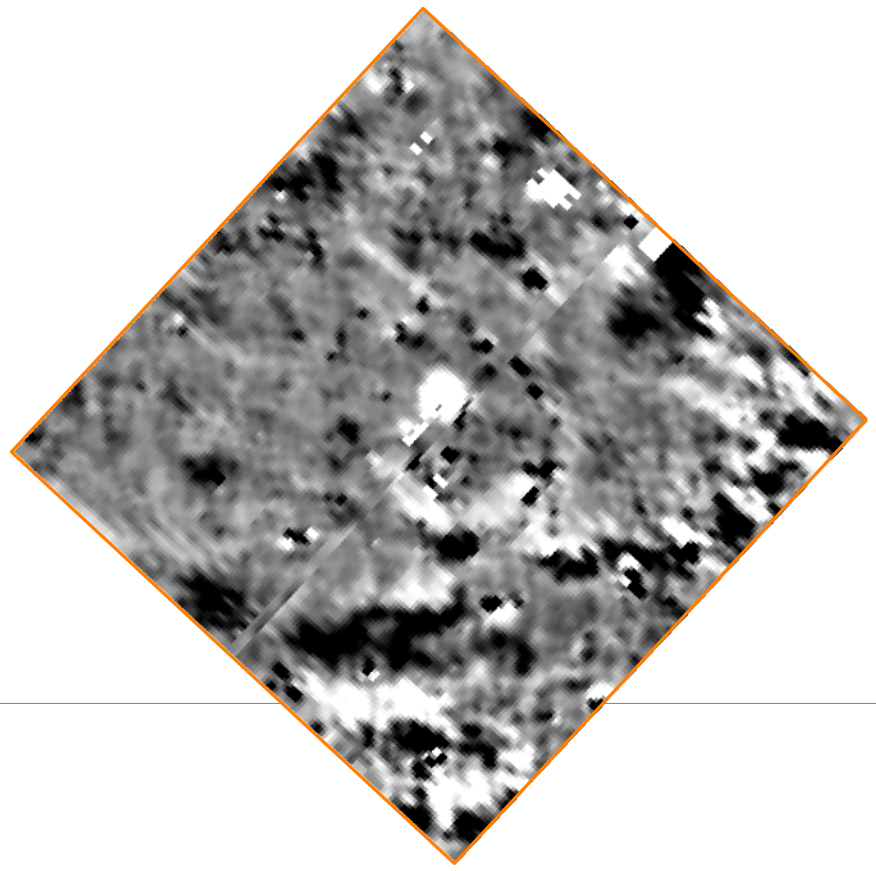
dipolar magnetic anomaly

negative magnetic anomaly

-5 nT 5

positive magnetic anomaly

A

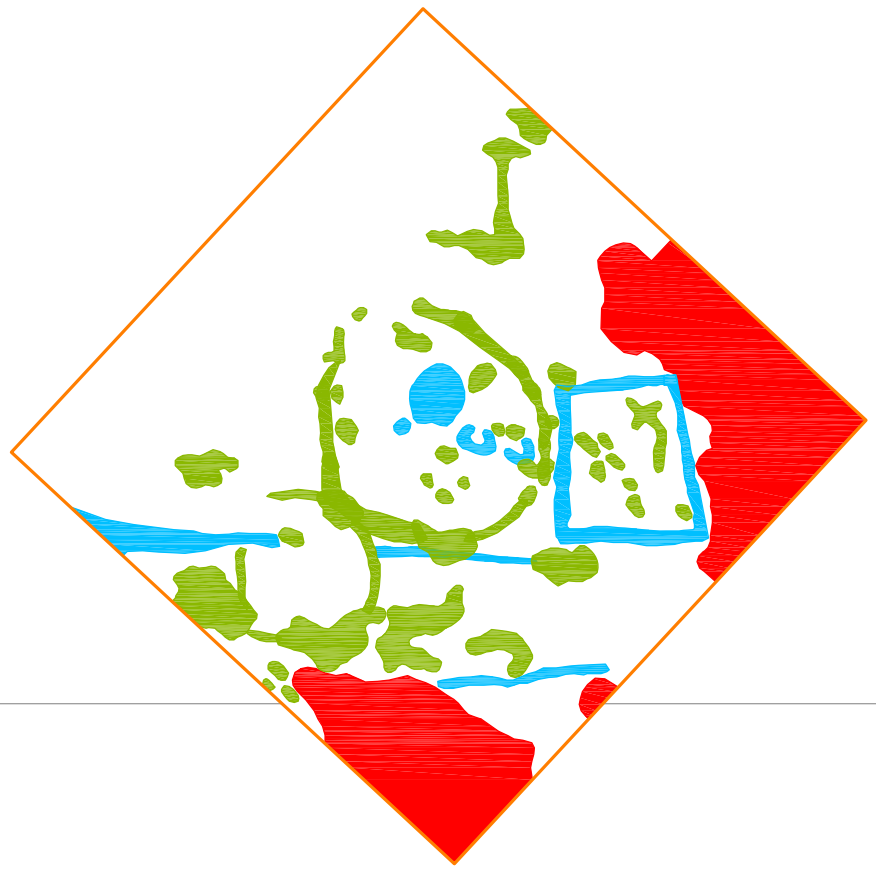


620

838

839

B



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838

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0 25m

scale 1:500 for A3 plot

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Figure 2: Geomagnetic survey and geophysical interpretation

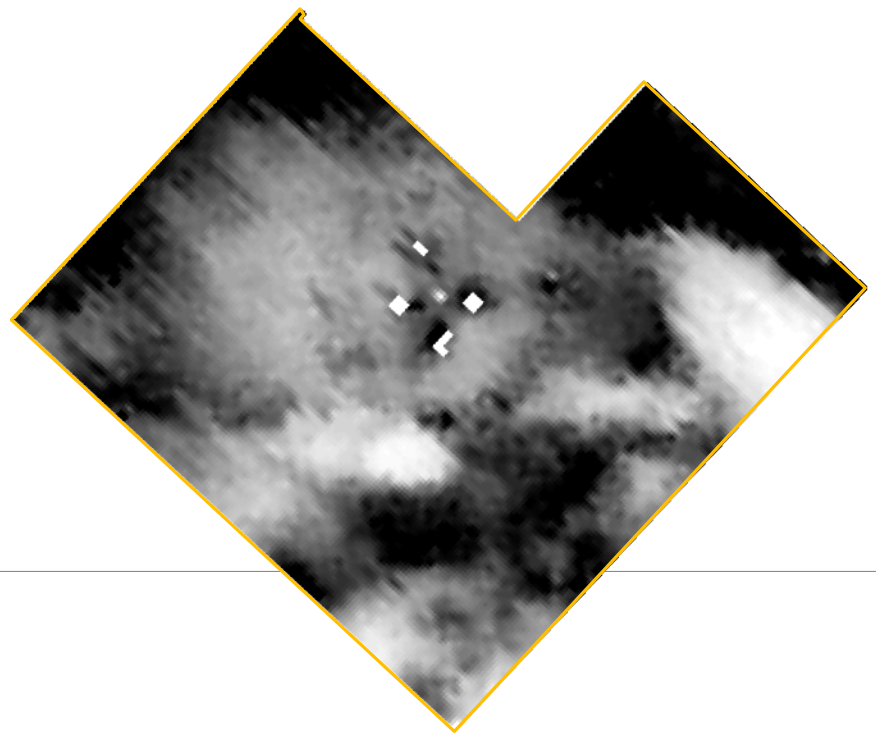
resistance survey

500 ohm 850

high resistance anomaly

low resistance anomaly

A



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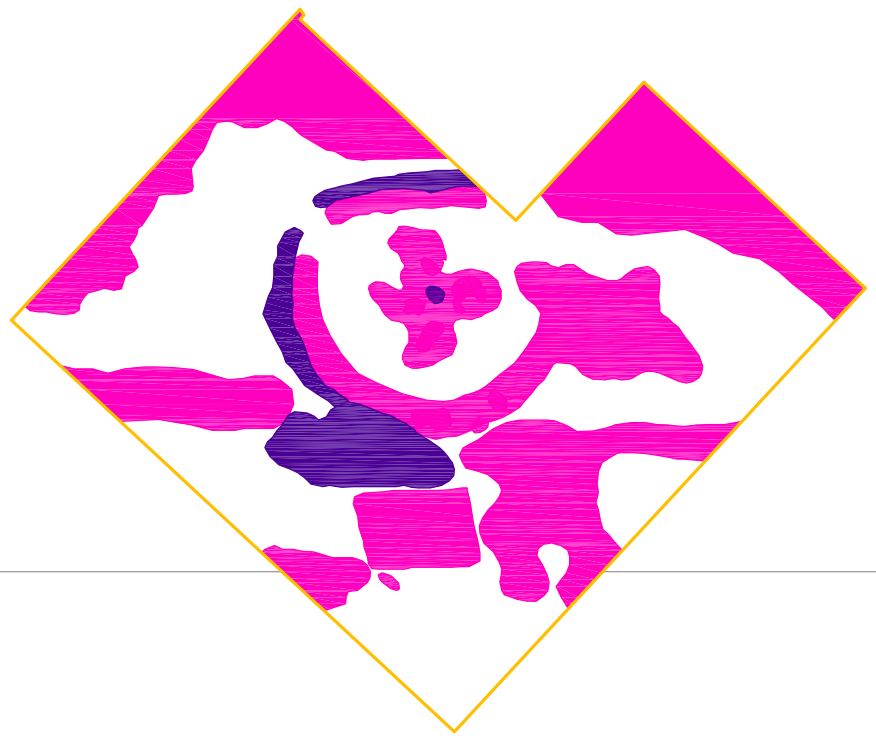

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0 25m

scale 1:500 for A3 plot

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Figure 3: Resistance survey and geophysical interpretation

620

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Figure 4: Archaeological interpretation

0 25m
scale 1:500 for A4 plot

- magnetic survey
- resistance survey
- soil-filled feature
- kerb
- concentration of stone/near-surface bedrock
- standing stone
- possible cist

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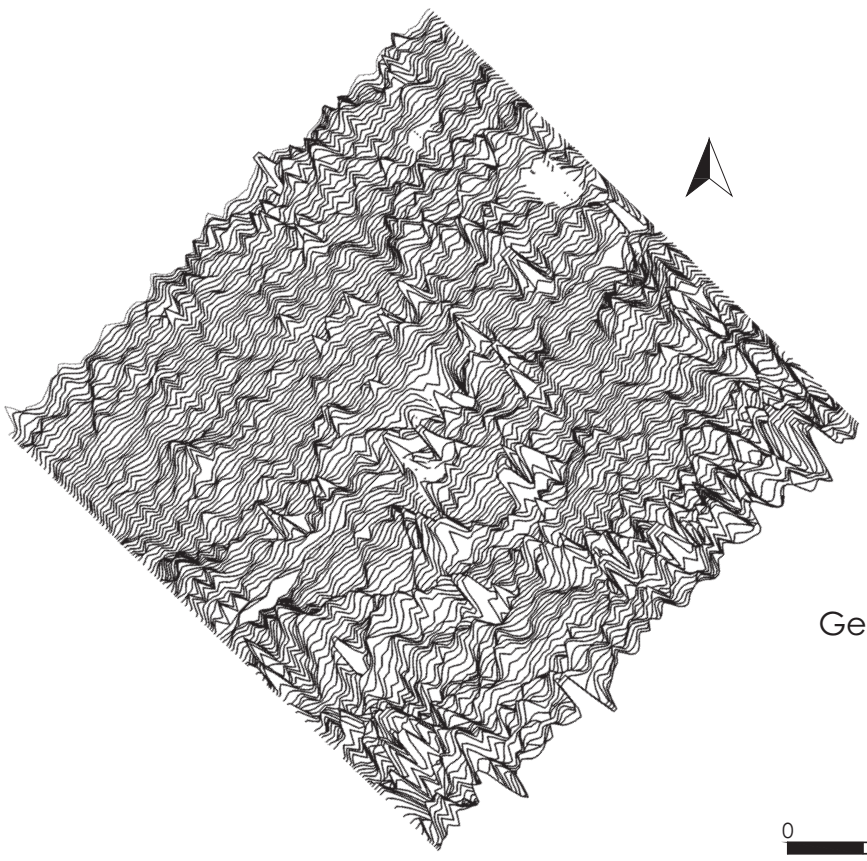
Figure 5:
Trace plots of geomagnetic data

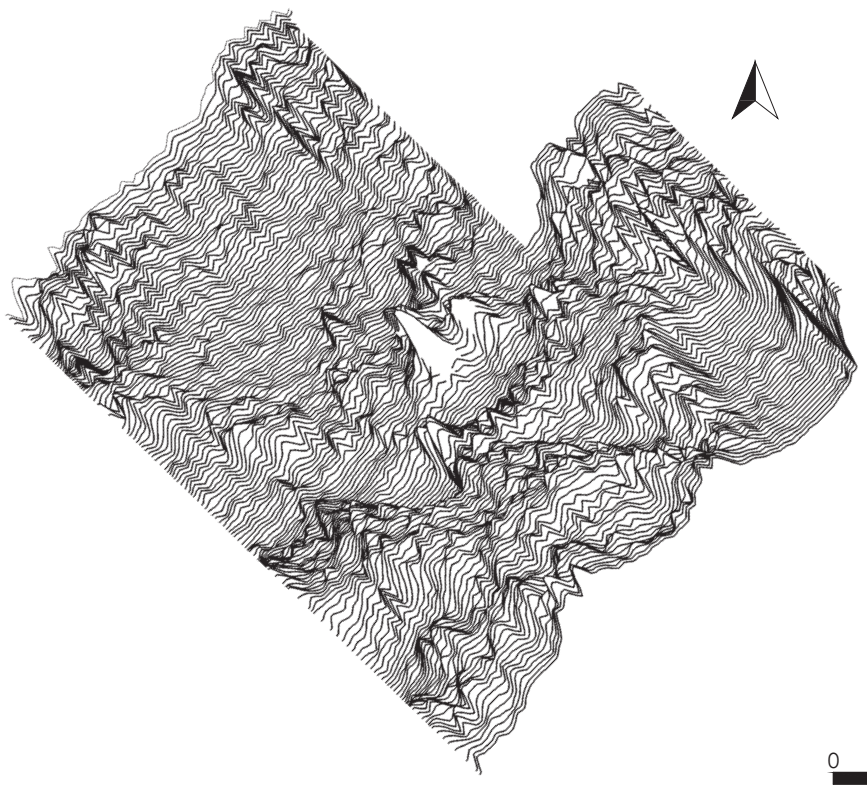


Geomagnetic Survey

0.20=26.60nT/cm

0 25m

scale 1:500



Resistivity survey

0.10=434.20ohm/cm

0 25m

scale 1:500