Ancient Monuments Laboratory
Report 5/98

OLD WARDOUR CASTLE, WILTSHIRE, REPORT ON GEOPHYSICAL SURVEY, 1997

N T Linford

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Summary

Earth resistance survey was conducted at both 0.5m and 1.0m mobile probe spacings at Old Wardour Castle, Wiltshire, to assist Historic Properties (SW) with development proposals at the site. Unfortunately, interpretation of the survey data was hampered by areas of disturbance possibly related to either the location of former out-buildings within the bailey or landscaping associated with the C18th century formal garden. The survey did, however, identify a number of anomalies apparently related to the original design of this garden. Further geophysical survey is not recommended until ambiguous anomalies within the current data set can be investigated through trial excavation.

Author's address :-

Mr N T Linford
ENGLISH HERITAGE
23 Savile Row
London
W1X 1AB

OLD WARDOUR CASTLE, Wiltshire,
Report on geophysical survey, 1997.

Introduction

Old Wardour Castle is a hexagonal courtyard castle originally built by John, 5th Lord Lovel who obtained a licence for its construction in 1393. The building was intended as a defended tower-house to offer lavish entertainment and domestic comfort for its residents above the provision of defensive protection. Following considerable damage to the SW side of the castle during the Civil War the building ceased to be occupied and was eventually incorporated as a romantic ruin within a landscaped park designed by James Paine between 1769 and 1776.

An initial request for geophysical survey was made by the Inspector of Ancient Monuments to assist with the location of original stone-lined drains emptying away from garderobe chutes on the N and SE walls of the castle recently excavated by the CAS (Reilly 1997a). It is hoped that these conduits can be reutilised to provide a minimally intrusive drainage channel for waste water collecting on the concrete floors of the building installed during the 1960s. Currently, this water is seeping through the sandstone walls of the castle causing considerable damage to its fabric.

In addition, it was hoped that a wider survey of the surrounding bailey may reveal evidence of the C18th formal garden design depicted by the contemporary Buck brothers engraving of 1735 and assist with development proposals to construct a new ticket office.

The castle (ST 938 263) apparently stands on a spur of Upper Greensand which overlies a band of Cretaceous Gault clay that forms the substrate of the site (Institute of Geological Sciences 1972). However, the excavation evidence (Reilly 1997b) suggests that at some point a considerable degree of foreign material has been introduced to level the ground at the site.

Method

Earth resistance survey was considered to be the most suitable technique both for the location of the stone lined drains and the detection of former garden features. A Geoscan RM15 resistivity meter, MPX-15 mutliplexor and adjustable PA5 electrode frame was used to simultaneously collect 0.5m and 1.0m mobile-probe separation data from a grid of 30m squares established over the site (Figure 1, Annex 2). Greater separation of the mobile-probe electrodes forces the applied electric current to penetrate further into the ground and can often detect anomalies arising from more deeply buried features (Scollar *et al* 1990, 321-4; Linford 1993). Readings for the shallow (0.5m mobile probe spacing) survey were collected at a 0.5m (EW) x 1.0m sample interval and at a reduced 1.0m x 1.0m interval for the deeper penetrating (1.0m mobile probe spacing) data set.

Raw data from both the shallow and deeper penetrating data sets are presented in both greytone (Plan A1/B1) and traceplot (Plan A2/B2) form together with various processed images to accentuate anomalies referred to in the following text. Individual plots detail the algorithms and parameters applied (see Scollar *et al* 1990 for further details).

Results

Modern interference and general response

Interpretation of the survey data has been hampered by distinct areas of erratic high resistance readings. Initial interpretation of the data suggested that this disturbance was caused by a combination of local de-watering caused by trees over the summer and the presence of substantial near-surface root systems. However, further examination of the data reveals a number of linear anomalies ([1], [2], [3] and [4]) associated with the disturbance possibly indicating the presence of former building remains in these areas. Disturbed areas in the S half of the survey are less intense (see traceplot A.2) and given the topography it is more likely that this represents a rubble deposit introduced in an attempt to level the highly sloping ground in this area.

The general response of the site is characterised by comparatively low readings[1] associated with the clay substrate (*cf* results from the Hamstead Marshall, Berks., reported by Linford 1997) although the castle itself appears to be surrounded by an annulus of high resistance. It is unclear whether this reflects building rubble associated with the monument itself or an outcrop of Greensand providing a more stable platform for the castle foundations than the Gault Clay.

Evidence of former garden features

The most obvious geophysical anomaly within the data is the circular high resistance response [5] found in square 3. This anomaly has a diameter of ~25m and seems most likely to represent an original garden feature in the form of a circular gravel path surrounding a central planting feature (*cf* Aspinall and Pocock 1995 and Cole *et al* 1997). The path appears to be encompassed by an additional circular high resistance anomaly suggesting either a cutboard or more substantial retaining wall. Anomaly [5] is mirrored in squares 10 and 13 by a less distinct circular response [6] (most clearly visible in A.4) whose dimensions and symmetry, with regard to [5] and the castle, offer compelling evidence for the interpretation of both anomalies as the remains of a former garden design.

This interpretation is further supported by linear wall-type responses [7], [8], [9], [10], [11] and [12] which can be related to the features depicted by the Buck engraving (Figure 3). Whilst the perspective chosen for the engraving fails to provide a detailed record of the

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1 During the survey the remote electrode pair were separated to a distance at which their contribution to the recorded reading became negligible. Under these conditions measurements recorded with the twin-electrode array multiplied by a factor of $2\pi r$ (where r = mobile probe separation) express the apparent resistivity of the volume of ground immediately below the mobile electrodes in units of Ωm.

original garden design it would appear that Paine created a geometric layout of secluded planting features centred around the castle ruins. It is unclear from the data whether the four high resistance anomalies [13] located directly in front of the N face of the castle also form part of this original design. Linear anomaly [14] to the N of the survey is indicative of either a former wall footing or, perhaps, a drain. The latter interpretation seems more likely as the anomaly appears continuous across its length and would not allow access to either an original entrance to the castle[2] postulated to the N (B. Davison *pers comm*) or to the much later grotto built in 1792 by Josiah Lane of Tisbury.

Evidence for structural features and drainage

Anomalies [15] and [16] are closely related to the standing remains of the castle. The former representing a low wall or path crossing the N face of the monument and the latter indicating the location of the original wall footings supporting the SW elevation prior to its destruction during the civil war. A number of other anomalies, [17], [18] and [19] appear to follow the hexagonal form of the castle from the E side to the SW elevation. The most intense of these, [17], is of interest as it approaches the location of the garderobe chute at a similar angle to the drainage conduit observed in this trench (Reilly 1997a). However, comparison with the Buck print reveals the presence of a low wall skirting the castle which the former anomalies possibly represent.

A number of more ephemeral high resistance anomalies [20], [21] and [22] can be resolved from an area of diffuse high resistance in the raw data adjacent to [17] together with a highly tentative low resistance anomaly [23]. It is plausible that the drainage conduit observed in the excavation trench follows the course of [17] and is obscured by this anomaly. Anomalies [20], [21] and [22] may then, perhaps, represent the continued outfall of this conduit.

Precise interpretation of anomaly [23] is difficult due to the low magnitude of its response and the expectation of high resistance anomalies associated with the stone lined drainage conduit. Indeed the anomaly is more reminiscent of a modern services trench such as the extension of an electricity supply from the castle to buildings beyond the curtain wall (*cf* Linford 1992). However, the author is not aware of any such supply and it is noted that the observed drainage conduit (constructed from porous Greensand stone) was filled with a water retentive silty loam which could possibly produce the extremely subtle low resistance anomaly visible in the plots A.3 and A.4 (Reilly 1997a).

The course of the underground passage, believed to run from a sealed entrance in the cellar to an exit beyond the curtain wall to the E of the castle, is not readily apparent within the resistivity data.

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[2] The location of the original gatehouse is uncertain as the extant curtain wall enclosing the bailey is a C16th alteration believed to be built upon the foundations of the original structure. It has been proposed (Pugh and Saunders 1968) that the original gatehouse stood on the site of the Gothic Pavilion requiring visitors to make a relatively steep climb around the rear of the castle to reach the front door. An entrance immediately N of the monument would allow visitors to make a more dignified ascent and approach the castle better composed. Current access to the bailey is through an C18th gateway.

Data in the vicinity of the garderobe chute investigated on the NW elevation of the castle contains no obvious anomalies beyond a subtle high resistance response [24]. This apparently bears no relation to either the standing remains or the former garden design revealed by the geophysical survey.

Ticket office area; Square 14

Data was collected from a partial square (Figure 1; *square 14*) beyond the curtain wall in the vicinity of the current ticket office and CAS trench 5 (Reilly 1997b). The area available for survey was encroached upon by the presence of a temporary builders compound which has severely limited interpretation of the resultant data (Plans C1-4). Two areas of high resistance [25] and [26] have been identified but their significance is impossible to ascertain from the limited data set available.

Conclusion

The survey has successfully located a number of anomalies that appear to be related to a former garden design established over the site and augments the information recorded by the Buck brother's print of 1735. Unfortunately, it would appear that during the establishment of the garden a considerable degree of material was introduced to level the variable topography of the site. This landscaping together with the apparent demolition of out-buildings within the bailey has produced areas of intense disturbance which have hampered detailed and confident interpretation of the data. In particular, the precise location of the garderobe drainage conduit exiting the E elevation of the castle has not proved possible. Further geophysical investigation can only be recommended following trial excavation to investigate the anomalies referred to above.

Surveyed by: N. Linford
P. Linford

Date of survey: 9-10/10/97
24/10/97

Reported by: N. Linford

Date of report: 19/11/97

Archaeometry Branch,
Ancient Monuments Laboratory,
English Heritage.

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Scollar, I., Tabbagh, A, Hesse, A, and Herzog, I, (eds), 1990 *Archaeological Prospecting and Remote Sensing*, Cambridge.

Enclosed Figures and plans

Annex 1: Notes on standard procedures

1) **Resistivity Survey:** Each 30 metre square is surveyed by making repeated parallel traverses across it, all aligned parallel to one pair of the square's edges, and each separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metres from the nearest parallel square edge. Readings are taken along each traverse at 1 metre intervals, the first and last readings being 0.5 metres from the nearest square edge.

   Unless otherwise stated the measurements are made with a Geoscan RM15 earth resistance meter incorporating a built-in data logger, using the twin electrode configuration with a 0.5 metre mobile electrode separation. As it is usually only relative changes in resistivity that are of interest in archaeological prospecting, no attempt is made to correct these measurements for the geometry of the twin electrode array to produce an estimate of the true apparent resistivity. Thus, the readings presented in plots will be the actual values of earth resistance recorded by the meter, measured in Ohms (Ω). Where correction to apparent resistivity has been made, for comparison with other electrical prospecting techniques, the results are quoted in the units of apparent resistivity, Ohm-m (Ωm).

   Measurements are recorded digitally by the RM15 meter and subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to the Ancient Monuments Laboratory using desktop workstations.

2) **Magnetometer Survey:** Each 30 metre square is surveyed by making repeated parallel traverses across it, all parallel to that pair of square edges most closely aligned with the direction of magnetic North. Each traverse is separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metre from the nearest parallel square edge. Readings are taken along each traverse at 0.25 metre intervals, the first and last readings being 0.125 metre from the nearest square edge.

   These traverses are walked in so called 'zig-zag' fashion, in which the direction of travel alternates between adjacent traverses to maximise survey speed. However, the magnetometer is always kept facing in the same direction, regardless of the direction of travel, to minimise heading error.

   Unless otherwise stated the measurements are made with a Geoscan FM36 fluxgate gradiometer which incorporates two vertically aligned fluxgates, one situated 0.5 metres above the other; the bottom fluxgate is carried at a height of approximately 0.2 metres above the ground surface. The FM36 incorporates a built-in data logger that records measurements digitally; these are subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to the Ancient Monuments Laboratory using desktop workstations.

It is the opinion of the manufacturer of the Geoscan instrument that two sensors placed 0.5 metres apart cannot produce a true estimate of vertical magnetic gradient unless the bottom sensor is far removed from the ground surface. Hence, when results are presented, the difference between the field intensity measured by the top and bottom sensors is quoted in units of nano-Tesla (nT) rather than in the units of magnetic gradient, nano-Tesla per metre (nT/m).

3) **Resistivity Profiling:** This technique measures the electrical resistivity of the subsurface in a similar manner to the standard resistivity mapping method outlined in note 1. However, instead of mapping changes in the near surface resistivity over an area, it produces a vertical section, illustrating how resistivity varies with increasing depth. This is possible because the resistivity meter becomes sensitive to more deeply buried anomalies as the separation between the measurement electrodes is increased. Hence, instead of using a single, fixed electrode separation as in resistivity mapping, readings are repeated over the same point with increasing separations to investigate the resistivity at greater depths. It should be noted that the relationship between electrode separation and depth sensitivity is complex so the vertical scale quoted for the section is only approximate. Furthermore, as depth of investigation increases the size of the smallest anomaly that can be resolved also increases.

Typically a line of 25 electrodes is laid out separated by 1 or 0.5 metre intervals. The resistivity of a vertical section is measured by selecting successive four electrode subsets at increasing separations and making a resistivity measurement with each. Several different schemes may be employed to determine which electrode subsets to use, of which the Wenner and Dipole-Dipole are typical examples. A Campus Geopulse earth resistance meter, with built in multiplexer, is used to make the measurements and the Campus Imager software is used to automate reading collection and construct a resistivity section from the results.

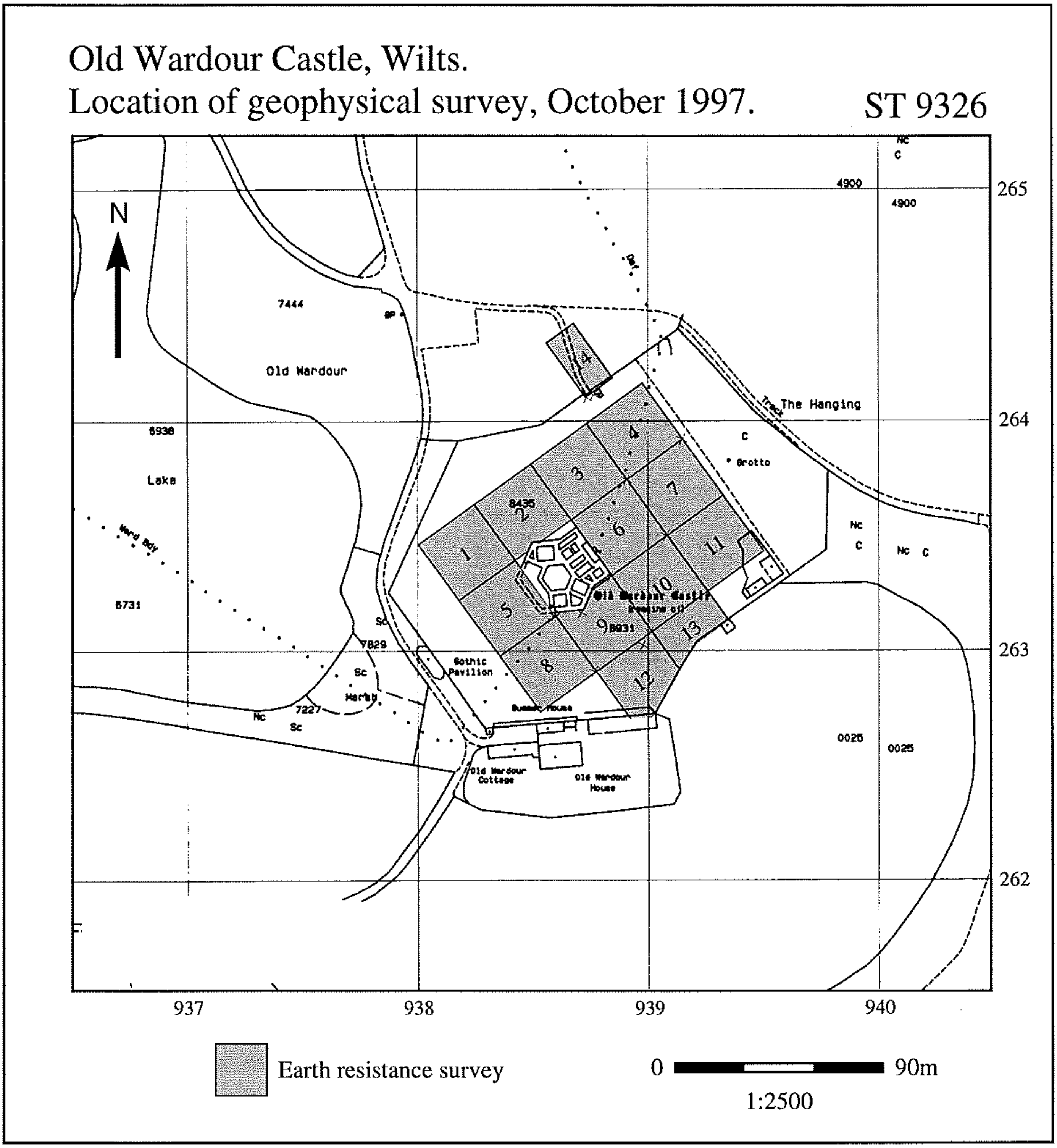
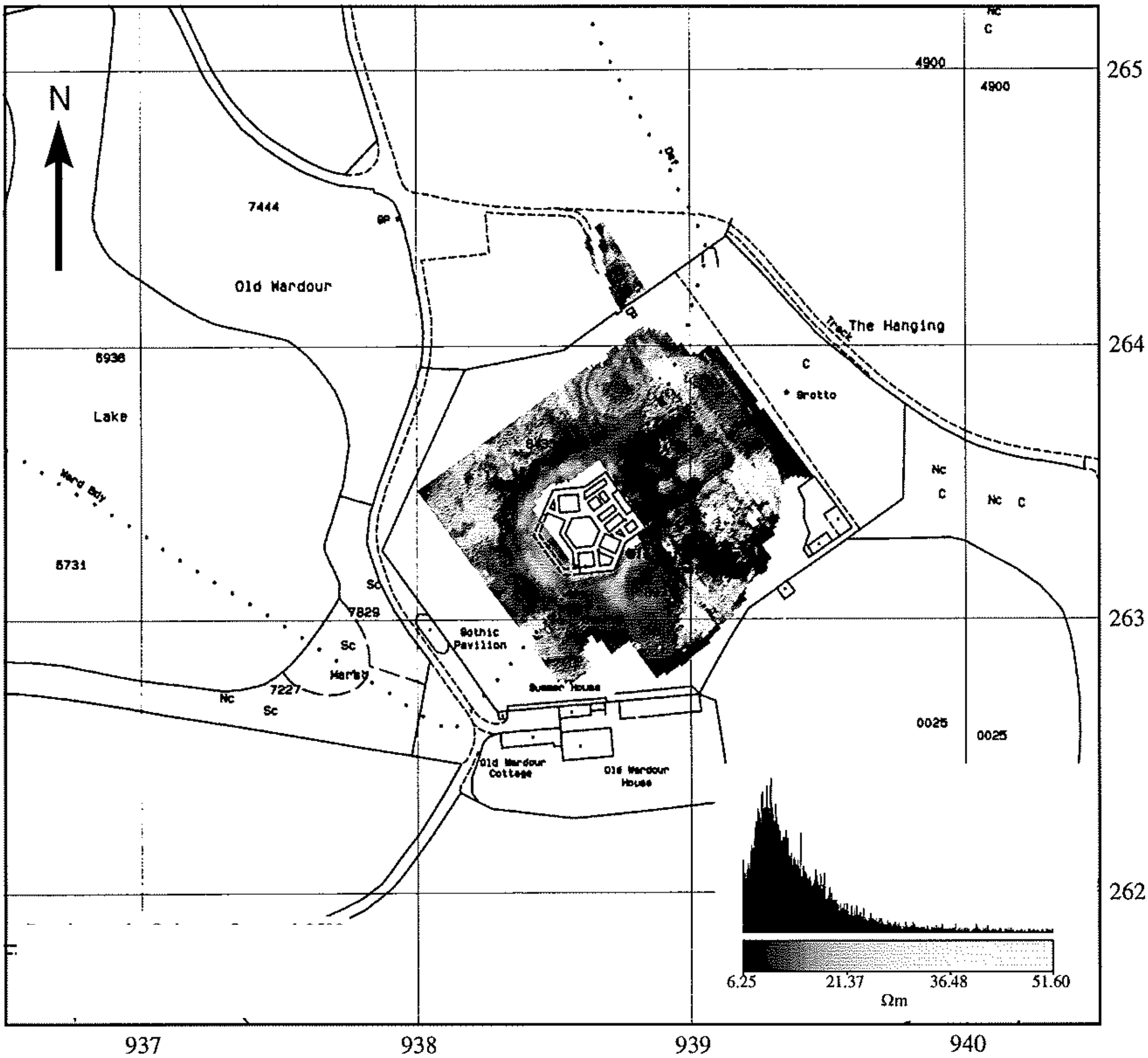


Figure 1; Old Wardour Castle, Wiltshire, *Location of geophysical survey October 1997.*

Old Wardour Castle, Wilts.
Location of geophysical survey, October 1997. ST 9326



0 90m

1:2500

Figure 2; Old Wardour Castle, Wiltshire, *0.5m resistivity data superimposed over base OS map.*

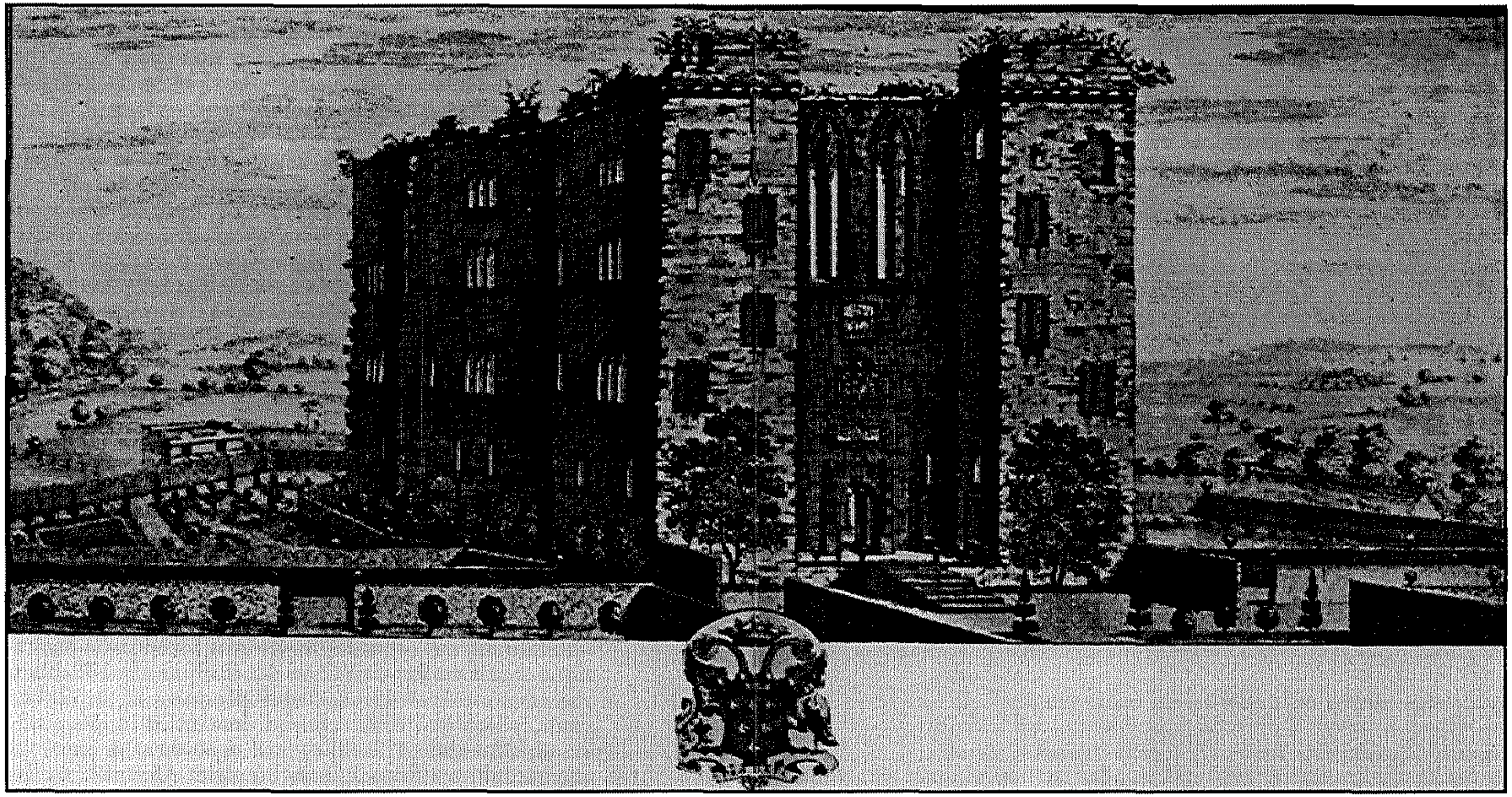
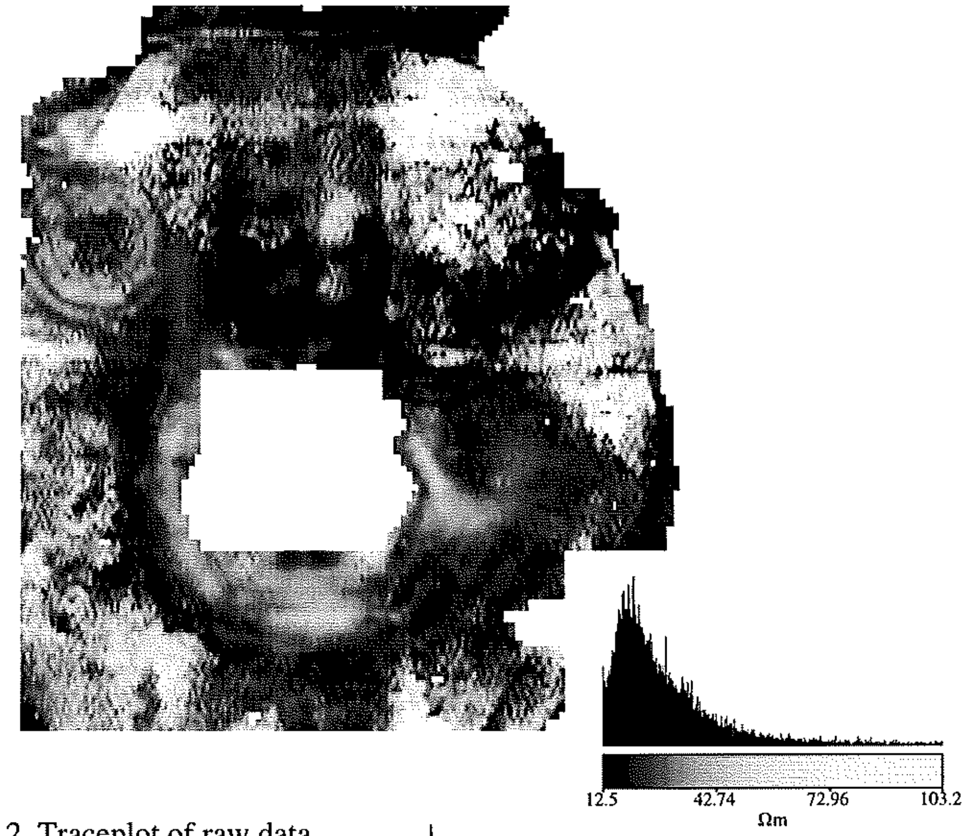


***Figure 3; Old Wardour Castle, Wilts**, Old Wardour Castle from an engraving by Samuel and Nathaniel Buck 1735.*

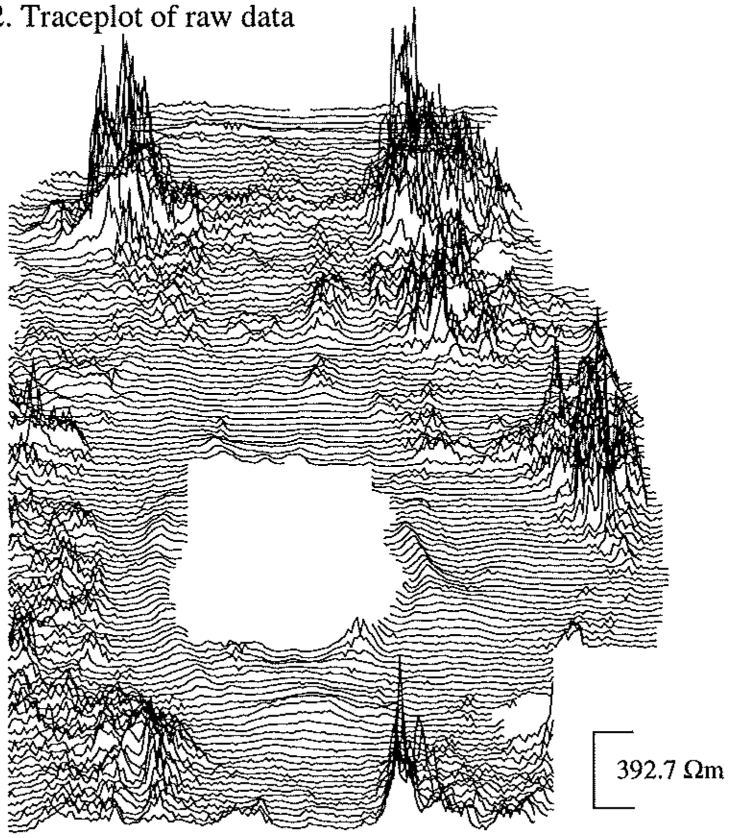
OLD WARDOUR CASTLE, WILTS.
Resistivity survey, October 1997.
Shallow 0.5m mobile probe spacing data

PLAN A

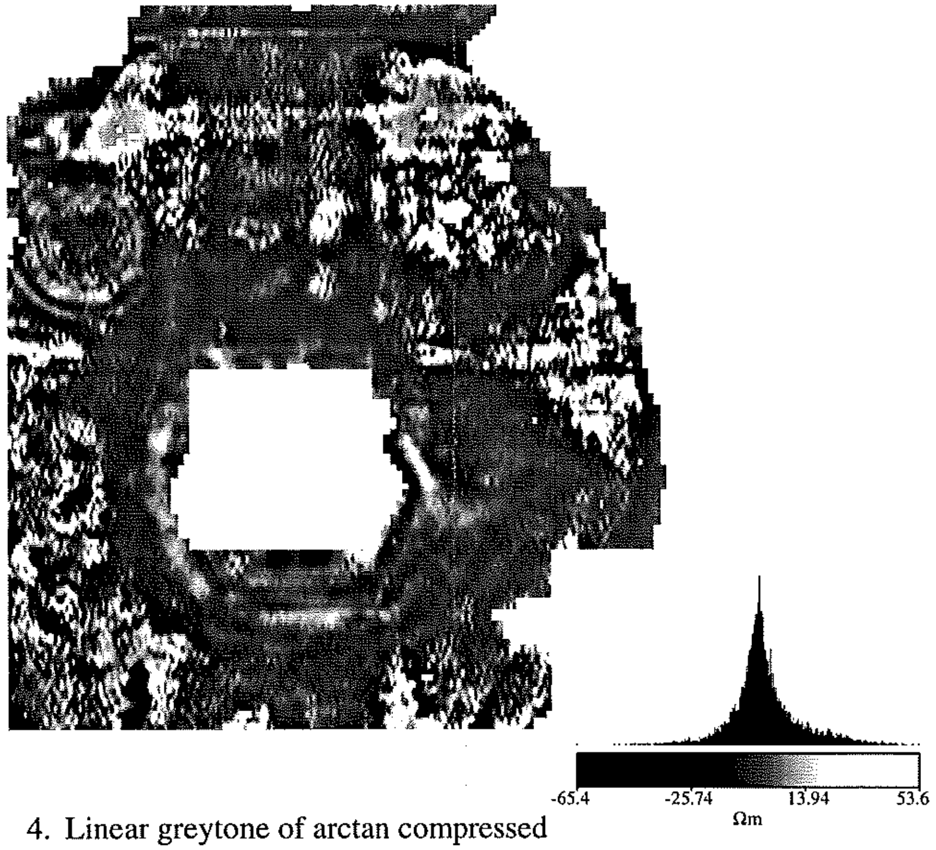
1. Greytone of raw data



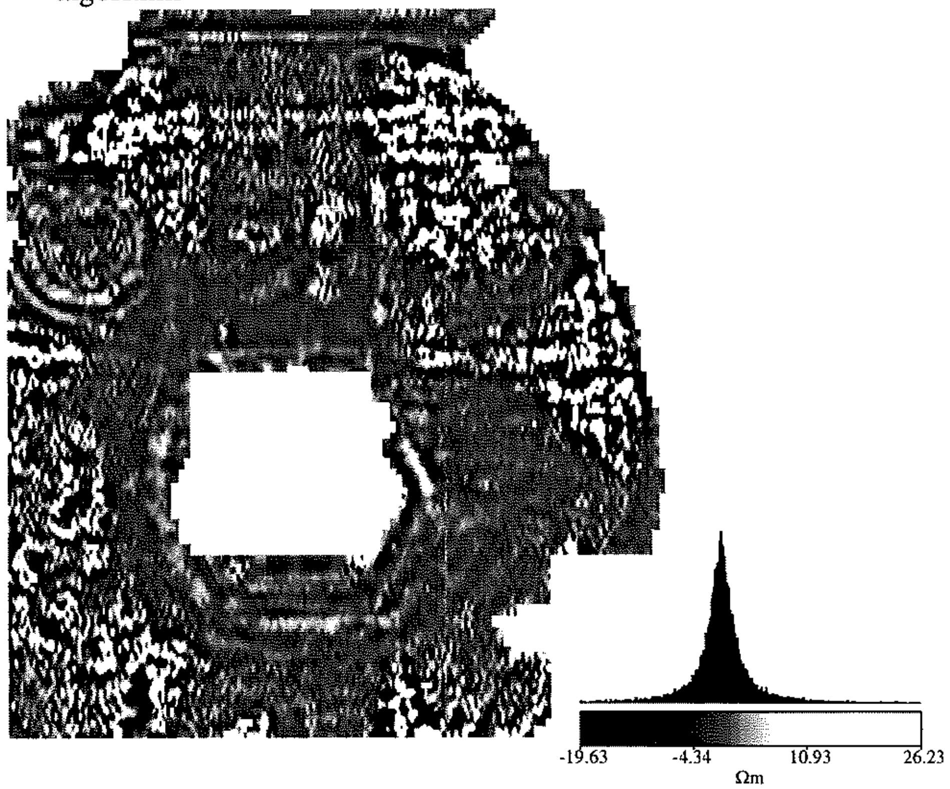
2. Traceplot of raw data



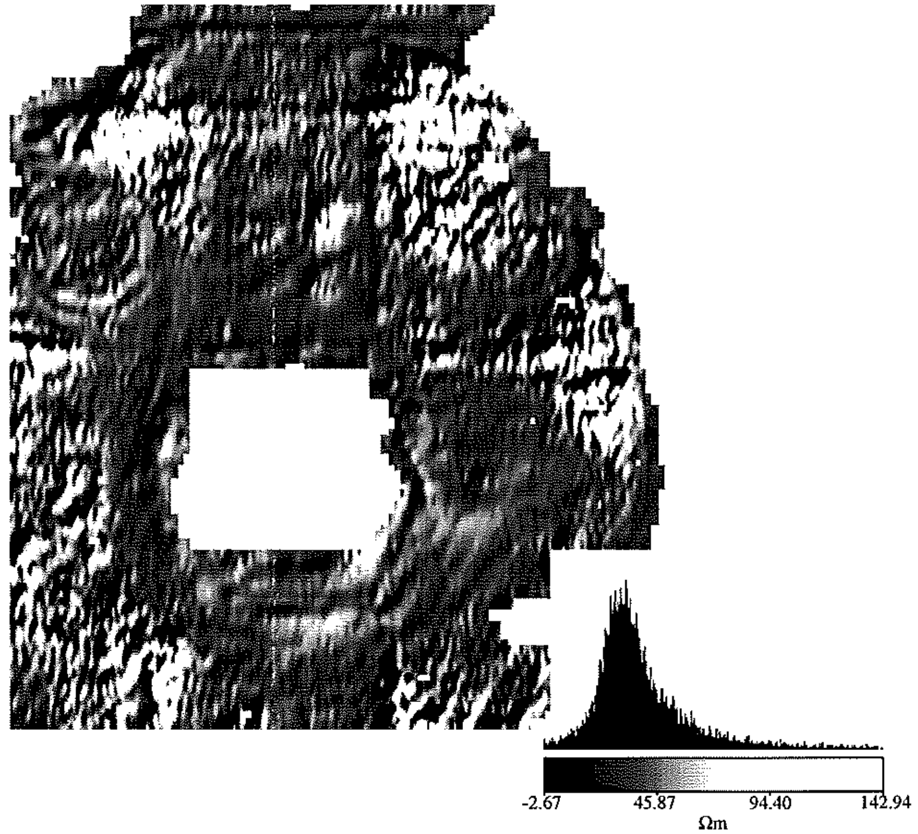
3. Linear greytone of High-pass filtered data

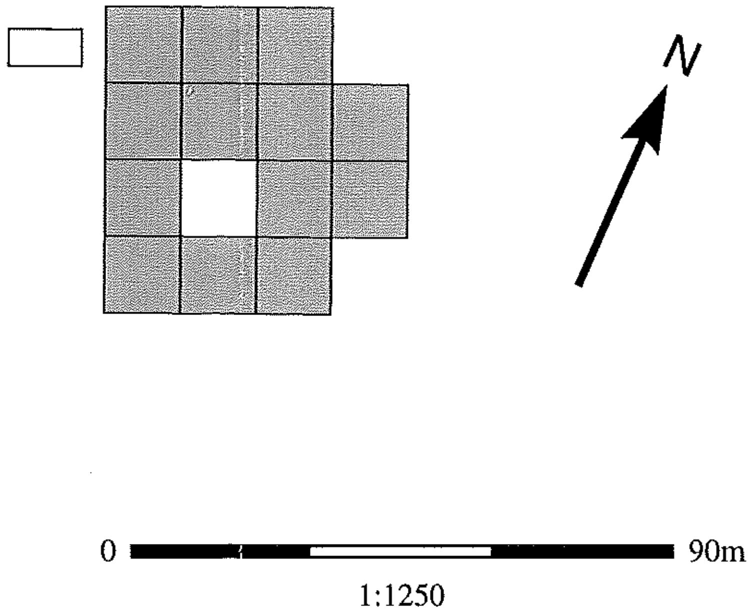


4. Linear greytone of arctan compressed data sharpened with Pratt's crispening algorithm



5. Linear greytone of directionally filtered data





Ancient Monuments Laboratory 1997.

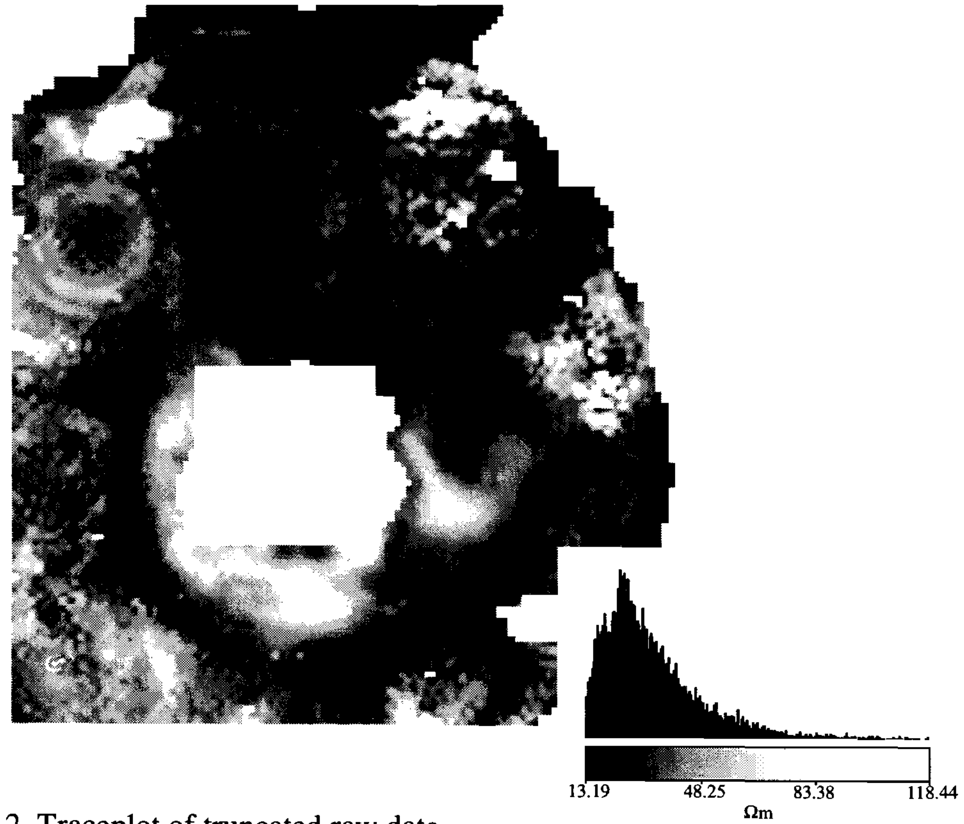
OLD WARDOUR CASTLE, WILTS.

Resistivity survey, October 1997.

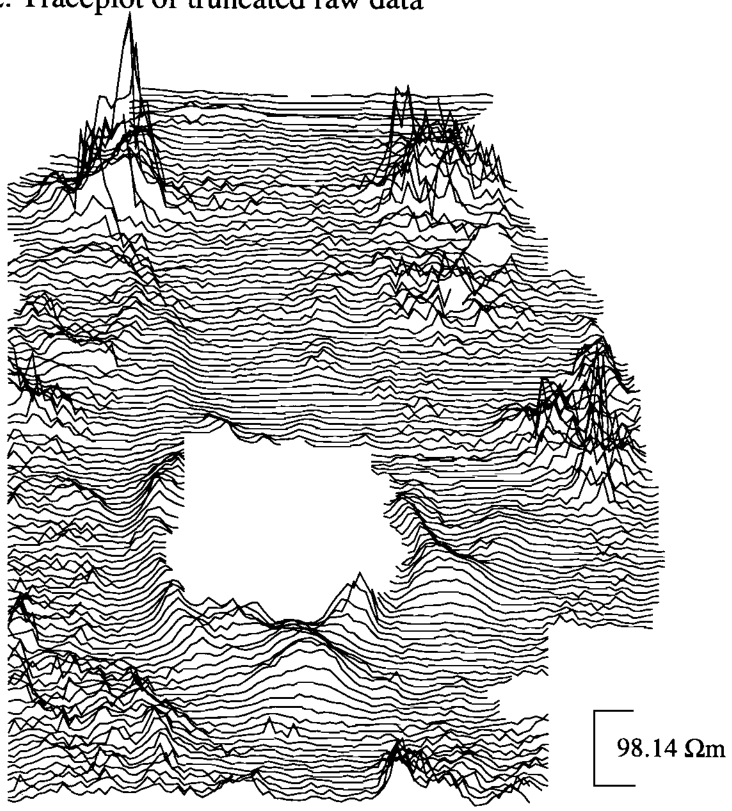
Deeper penetrating 1.0m mobile probe spacing data

PLAN B

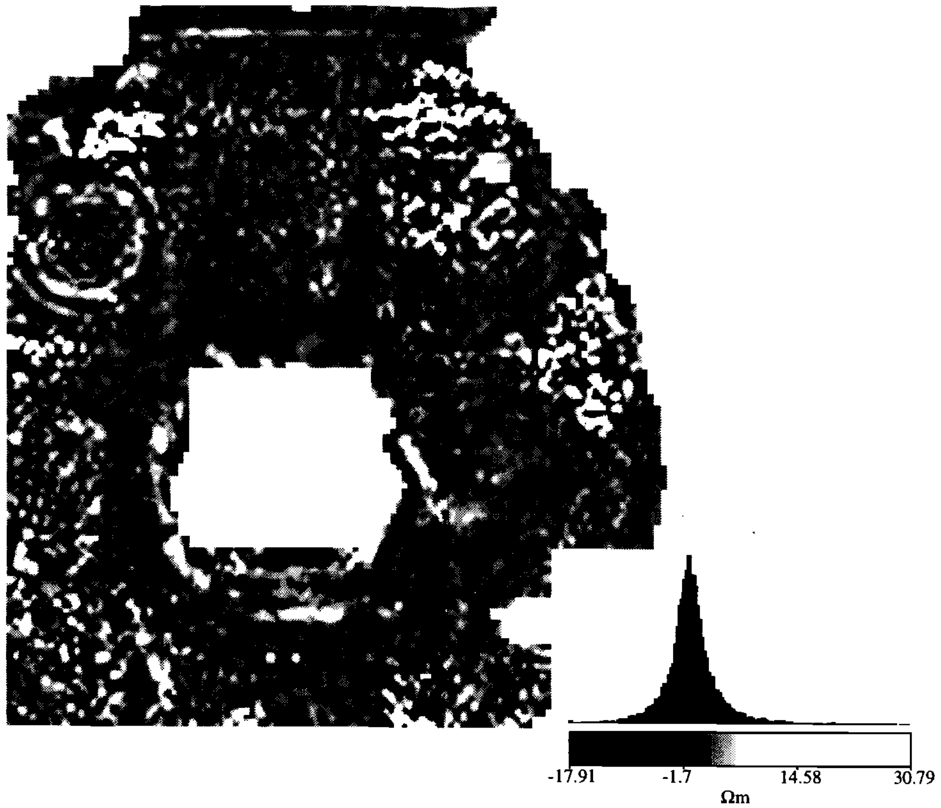
1. Greytone of truncated raw data



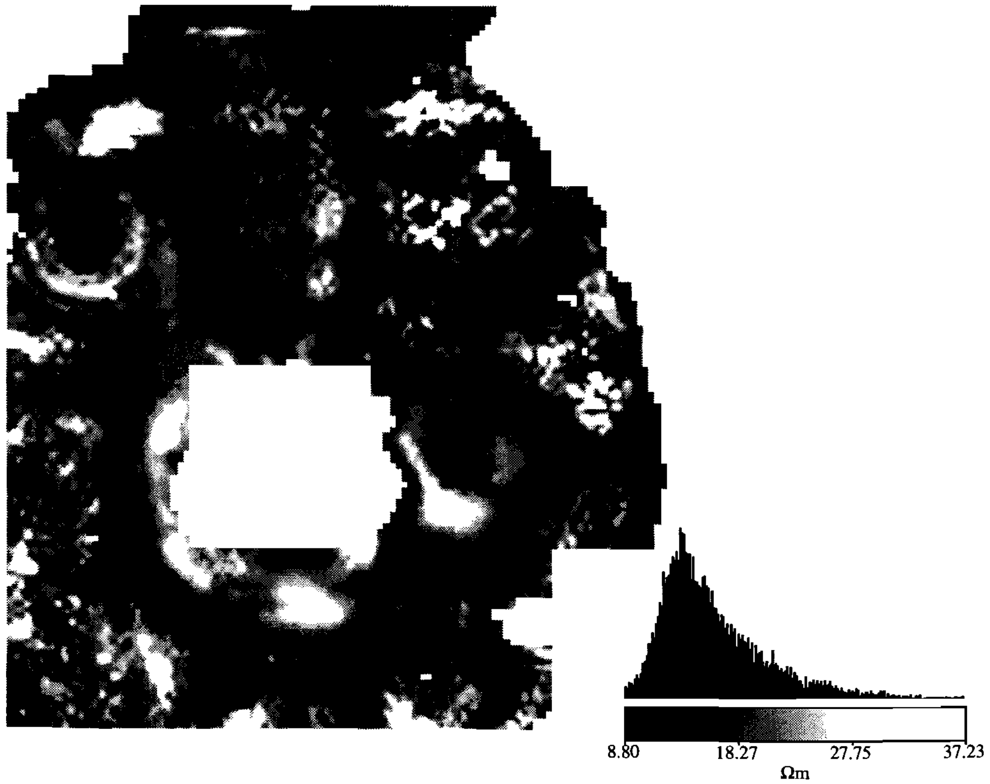
2. Traceplot of truncated raw data



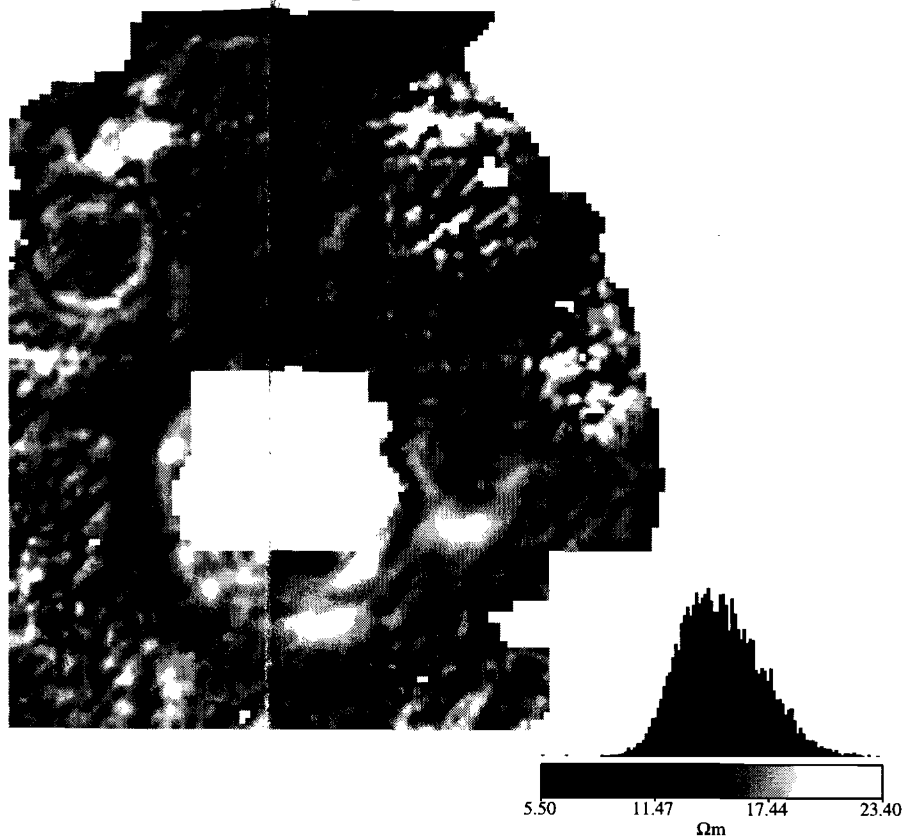
3. Linear greytone of High-pass filtered data *(Gaussian kernel, radius = 3.0m)*

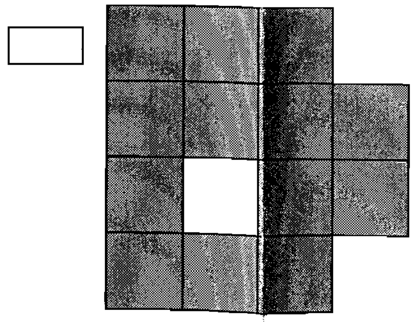


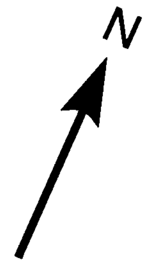
4. Linear greytone of data after contrast enhancement with the Wallis statistical differencing algorithm.

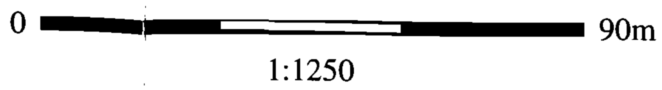


5. Linear greytone of directionally filtered data after arctan range compression.









Ancient Monuments Laboratory 1997.

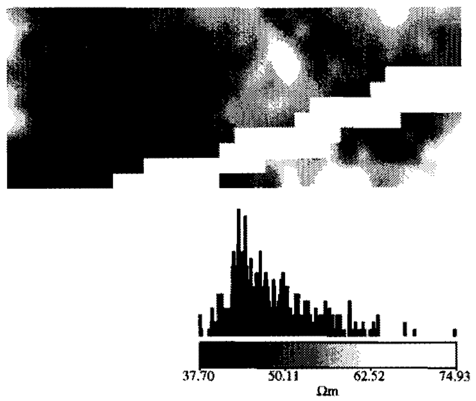
OLD WARDOUR CASTLE, WILTS.

Resistivity survey, October 1997.

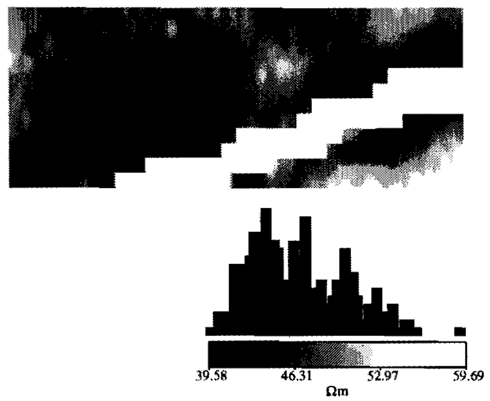
Square 14 data and summary of significant anomalies

PLAN C

1. Greytone of raw 0.5m data



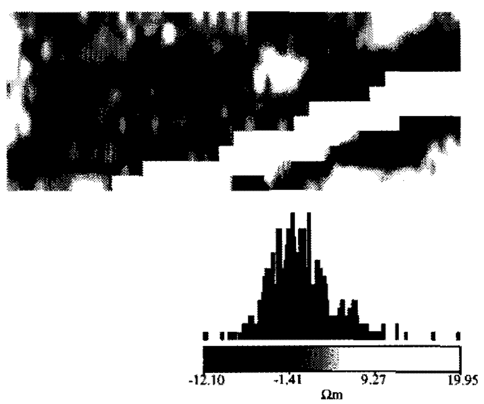
2. Greytone of Raw 1.0m data



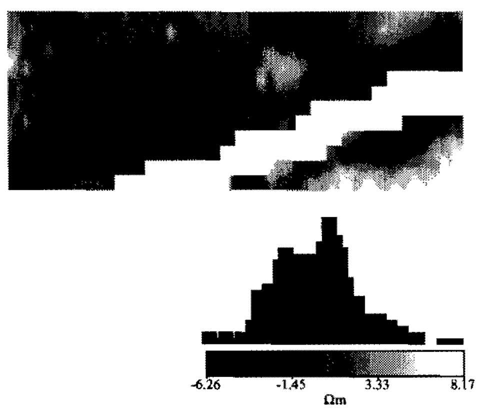
0 15m

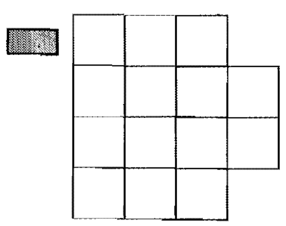
1:500

3. Linear greytone of High-pass filtered 0.5m data *(Gaussian kernel, radius = 3m)*

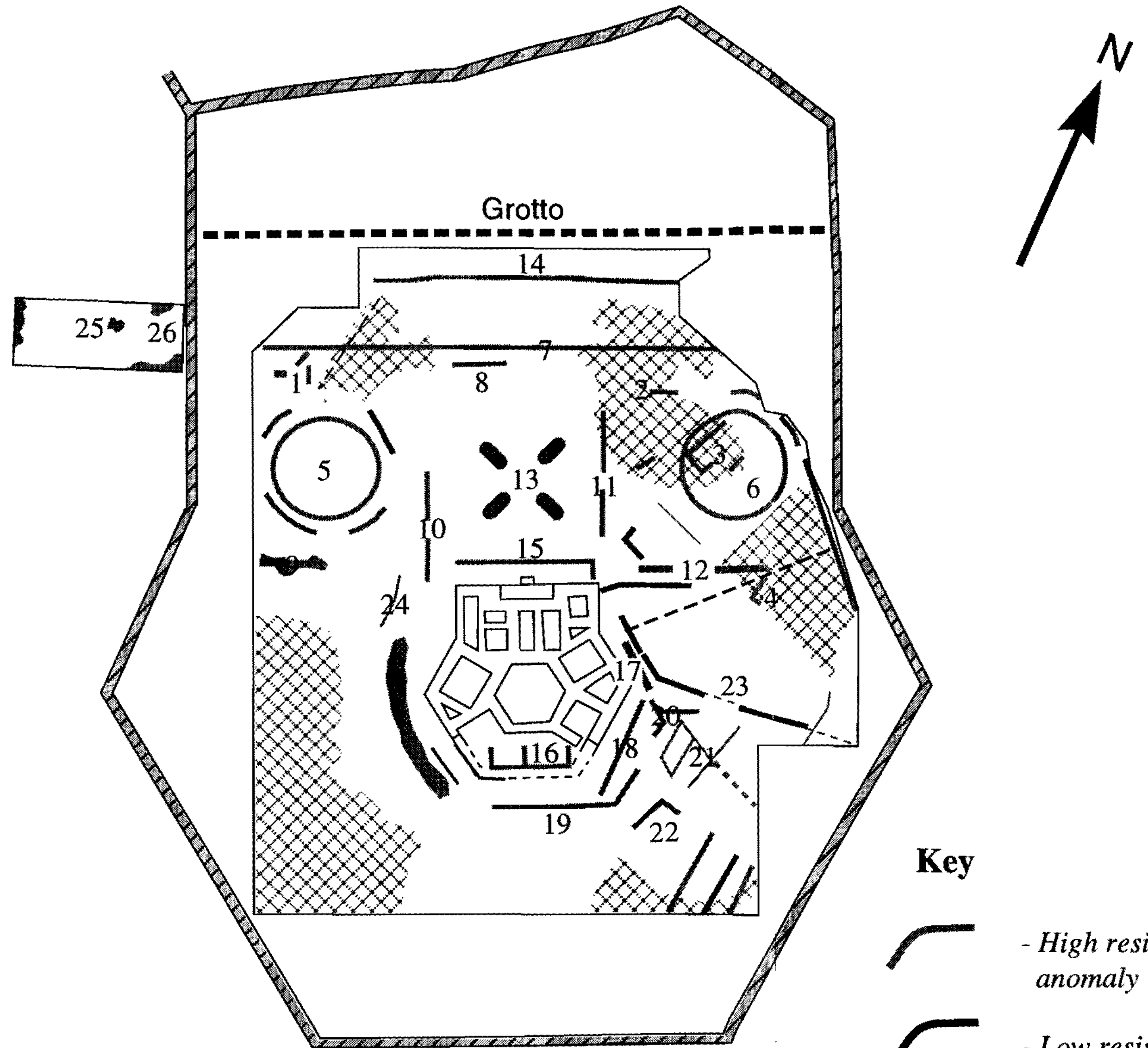


4. Linear greytone of High-pass filtered 1.0m data *(Gaussian kernel, radius 3m)*





5. Summary of significant anomalies



Key

- *High resistance anomaly*
- *Low resistance anomaly*
- *Disturbed area*

0 90m

1:1250