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Structural Layout of the Suburbs of Roman Butrint, Southern Albania: Results from a Gradiometer and Resistivity Survey

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ABSTRACT Butrint, a World Heritage Site in southern Albania, encompasses 3000 years of Mediterranean history from the Hellenistic Greeks to the Venetians. In Roman times a suburb of Butrint spread out across the marsh plain to the south of the city, where approximately 20 ha have been surveyed with a fluxgate gradiometer, and 4 ha with a ground resistivity meter. The magnetic anomalies show that the line of the aqueduct into the centre of Butrint is evident for part of this area, but the aqueduct signature becomes progressively less distinct on approaching the Vivari Channel, probably owing to deeper burial. A complex of confused, short-wavelength anomalies, but with some linear elements covers about 3 ha and is associated with exposed building remains. The abrupt termination of these anomalies to the west may be associated with the former Roman water front. Isolated smaller areas of magnetic anomalies up to 0.5 ha in the area surveyed, show buildings and associated ditches away from the main complex. The resistivity survey allows some detailed constraints on the position of buildings in the densely occupied area. Analysis of the orientation of linear anomalies indicates there are two co-genetic sets of magnetic and resistivity linear anomalies. A strong NW–SE and weaker NE–SW set, which parallel the aqueduct and the alignment of standing walls. This set appears to indicate a regular building alignment across the whole site, which is reflected in the orientation of the few current standing walls on the site. This set may post-date the building of the aqueduct, because these reflect the latest standing remains on the site. A second stronger set of E–W and (subsidiary) N–S linear anomalies may signify either an early system of streets, or perhaps an agricultural-based ditch system developed prior to the buildings on the site. This second set may pre-date the building of the aqueduct in the first century BC, when Butrint became a Roman colony. An alternative interpretation suggests part of the suburbs street plan may be based on a non-conventional triangular network of roadways, the design of which may have been emulated in the construction of the medieval Triangular Castle. Copyright © 2002 John Wiley & Sons, Ltd.

Key words: Roman Butrint; gradiometer; anomaly orientation; anomaly alignments; Roman roadways

Introduction

Butrint, ancient Buthrotum is a major archaeological site in southern Albania, and is the focus of an ongoing Anglo-Albanian archaeological project (Bowden *et al.*, 1998; Hodges *et al.*, in press). As well as a UNESCO World Heritage Site, the area around intramural Butrint is a national park, because it has a rich variety of archaeology extending back into the middle palaeolithic and preserves a largely unspoilt environment (Hodges and Martin, 2000; Figure 1). The most intense human occupation of Butrint started in

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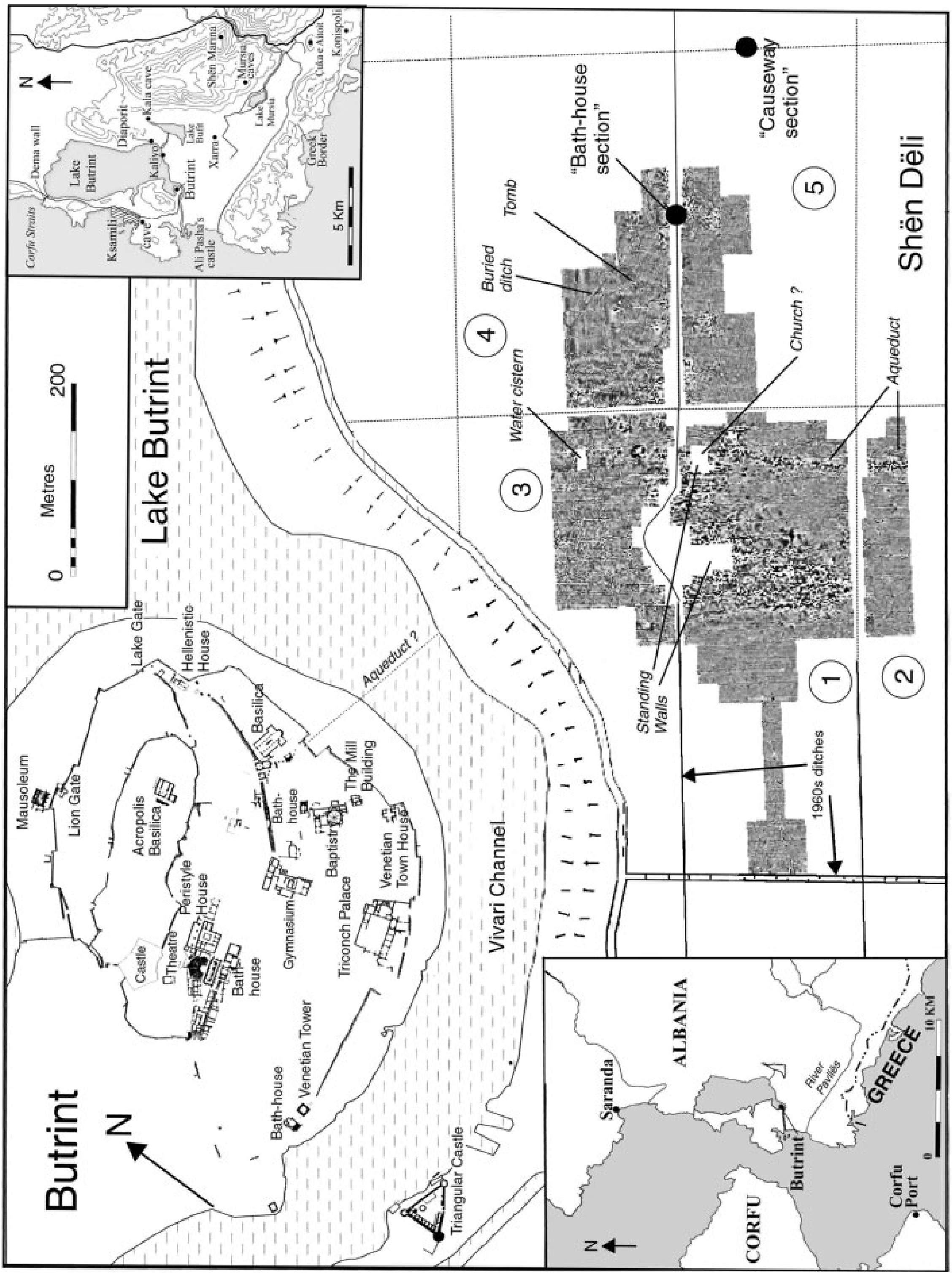

Figure 1. Location of the magnetic gradiometer survey in relation to the city of Butrint and its surrounding environment. The informal field survey numbers (1 to 5 in circles) are used in the text. The resistivity survey described here is within field 1, and its location is shown in detail on Figure 2A. The inset in top right shows the location of important archaeological sites and villages nearby Butrint.

the 8th century BC and ceased in the 16th century, and is centred on a limestone knoll that protrudes into the Vivari Channel (Hodges *et al*., 1997; Gilkes and Miraj, 2000; Figure 1). There are two main parts to the intramural area of Butrint, the acropolis area and the lower city that passes down towards the flanks of the Vivari Channel (Figure 1).

South across the Vivari Channel is the Vrina Plain, a marsh and alluvial floodplain, largely created by sediments derived from the Pavllës River sourced in the mountain ranges to the east (Figure 1). The Vrina Plain is predominantly composed of accreted marsh clay away from the main river channel, where vertical accretion occurs during winter flooding episodes. The area has a tidal range of a few centimetres, hence tidal channel development is virtually non-existant, unlike the macrotidal north European coast. Prior to the 1960s, fluvial systems to the north of Lake Butrint drained through the Vivari Channel, but this natural system was bypassed in the countries communist era by construction of a new channel draining into Saranda Bay, which subsequently made Lake Butrint more saline. The sediments of the Vrina Plain are thought to have accumulated since the mid-Holocene, although the progression and timing of this are currently uncertain (Hodges *et al*., 1997). The Vrina Plain sedimentation had evidently reached near its current limit by AD 1814, when the castle of Ali Pasha was built on the saltmarsh near the western end of the Vivari Channel (Figure 1). This accumulation has taken place in spite of regional sea-level rise of between 0.4 and 0.9 mm year^{-1} since ca. 4000 BC, so that current sea-level is 1 to 1.5 m higher than it was about 2000 years ago (Hodges *et al*., 1997; Mathers *et al*., 1999). This rise in relative sea-level is readily evident in the flooded lower parts of intramural Butrint (e.g. the theatre; Figure 1).

On the Shën Dëli district of the Vrina Plain, opposite intramural Butrint, a suburb appears to have developed, which belongs to the Republican, imperial Roman and late-Antique phases of Butrint. The detailed chronology of development and extent of the Shën Dëli suburb is uncertain, and what is known of this area is based on four areas of standing remains, finds from field walking and an on-going geophysics survey (Hodges *et al*., 1997; Chroston and Hounslow, in press; Pluciennik *et al*., in press). The area occupied by the suburb is much larger than the current standing remains, but is largely covered by a blanket of marsh clay that is a response to both the regional sea-level rise and the siltation of the Vrina Plain. Archaeomagnetic dating of the marsh clay above Roman building remains suggests that this siltation process was initiated about AD 650, continuing for several hundred years following this, and may have reached the present soil level by the fifteenth to sixteenth century in the Shën Dëli area (Hounslow and Chepstow Lusty, in press). This timing accords approximately with the building by the Venetians of the Triangular Fortress (Figure 1) between AD 1490 and AD 1540, which is adjacent to the current crossing point of the Vivari Channel and was the last actively occupied area of Butrint in the nineteenth century (Hodges *et al*., 1997).

An ongoing geophysics survey is being conducted over the area of the Shën Dëli site, to examine both the extent of the subsurface remains, and also to try and understand the possible layout of this suburb, and its organizational relationship to intramural Butrint.

The Shën Dëli site

The site has been informally subdivided into a number of 'field' parcels based on the constraints of the current drainage network (Figure 1). These drainage networks date from the 1960s and 1970s, when the plain was ploughed and the drainage channels dug. Also at this time, each field had a series of clay drainage pipes inserted into the subsoil. Currently, in the late summer, the dry surface vegetation is often burnt off to improve autumn and winter pasture.

The standing remains on the site include short segments of walls up to 2 m high (one of which is a possible church, R. Hodges, personal communication, 1999; Figure 1), the foundations of piers of an aqueduct, a water cistern, and a tomb (Figure 1). The aqueduct was built in the first century BC when Butrint became a Roman colony (Gilkes and Miraj, 2000). The standing remains of the aqueduct are at least 4 km long and brought water from Xarra, or from further southeast, into intramural Butrint, through the Shën Dëli site and across the Vivari Channel, presumably via the fallen water cistern present in field 3 (Figure 1). Butrint was located near (beyond Shën Marina) the main N–S road, which connected Aulon (modern Vlora) to Nikopolis (Preveza), but the location of the connecting roadway across the Shën Dëli site has remained problematic, although the archaeology in intramural Butrint indicates it probably entered Butrint near the same river crossing as the aqueduct, into the south of the city (Figure 1).

The drainage ditch separating fields 4 and 5 exposes part of a bath-house, which shows part of an *in situ* hypocaust exposed ca. 0.8 m below the present ground surface (Pluciennik *et al.*, in press; Figure 1). The associated pottery spans the early Roman to late Roman period. Also the ditch side exposes an upper midden-like deposit rich in charcoal, with magnetic properties consistent with it containing wood charcoal ash, discarded from the bath-house furnaces (Hounslow and Chepstow-Lusty, 2002). Within field 4, the location of the bath-house and the nearby tomb (often located adjacent to roadway entrances to Roman cities) both indicate that the main roadway probably passed nearby.

Two massive walls running in an approximately E–W orientation have been located at the 'causeway-section' to the east of the bath-house (Pluciennik *et al.*, in press; Figure 1). One of these is faced with dressed stone, with between them what appears to be a central drain. These have indicated that the main roadway may have passed to the east towards the foot of the hill Kalivo, where evidence of Roman activity also has been found (Figure 1; Hodges *et al.*, 1997).

Methods

Most effort has been concentrated on a gradiometer survey, using Geoscan FM36 fluxgate magnetometers (sensitivity setting used 0.1 nT). Measurements have been made using a 20 m × 20 m grid format (English Heritage, 1995; Clark, 1996), with survey lines 1 m apart, and measurements at 0.25 m spacing. The grids have been measured in by tape measure, with the survey lines being guided by plastic washing lines. The survey lines were predominantly oriented in a NE–SW direction. Initially the survey pattern used the zig-zag mode but tests showed the data quality to be improved when measurements were taken in the FM36 parallel format. The extent of the gradiometer survey at autumn 2000 is shown in Figure 1, and some details in Figure 2. Resistivity measurements were made using a Geoscan RM4 meter with a 1-m electrode spacing, and readings were taken at 1-m intervals along the 1-m spaced lines. The resistivity survey covers a smaller area than the gradiometer survey, being most of field 1 (Figures 2A and 3). Both the magnetometer and the resistivity data were downloaded to a PC with processing of the data using Insite software (Geoquest Associates). All the grid squares have been surveyed into local features at the time of the survey.

Access on the plain is easy, with no significant topography. Obstacles to a complete coverage were the modern drainage ditches, the few exposed building remains and scattered clumps of thorn bushes. Corrections following data processing mostly involved instrumental drift, using mostly the Insite software. However, for the gradiometer, some data showed non-linear instrumental drift related to changes in FM36 temperature and changes in operating regularity. This was corrected interactively for each grid square that showed the problem, using software written in-house. In some cases it is possible this may have suppressed small anomalies parallel to the survey lines.

From the gradiometer data and final processed images, anomalies were classified into linear and non-linear features using visual inspection of the images in CorelDRAW, aided by data inspection using the Insite software (Figures 2B, 3 and 4). The non-linear features were mostly isolated 'point source type' anomalies, representing a variety of possible sources, which might include isolated bricks, ferrous contamination or perhaps fired sites (e.g. 5e and 5f in field 5; 1f in field 1; Figures 2, 4 and 5). These point-source anomalies are not part of the analysis presented and are not discussed further.

The linear anomalies and strings of co-linear anomaly features were classified into several types.

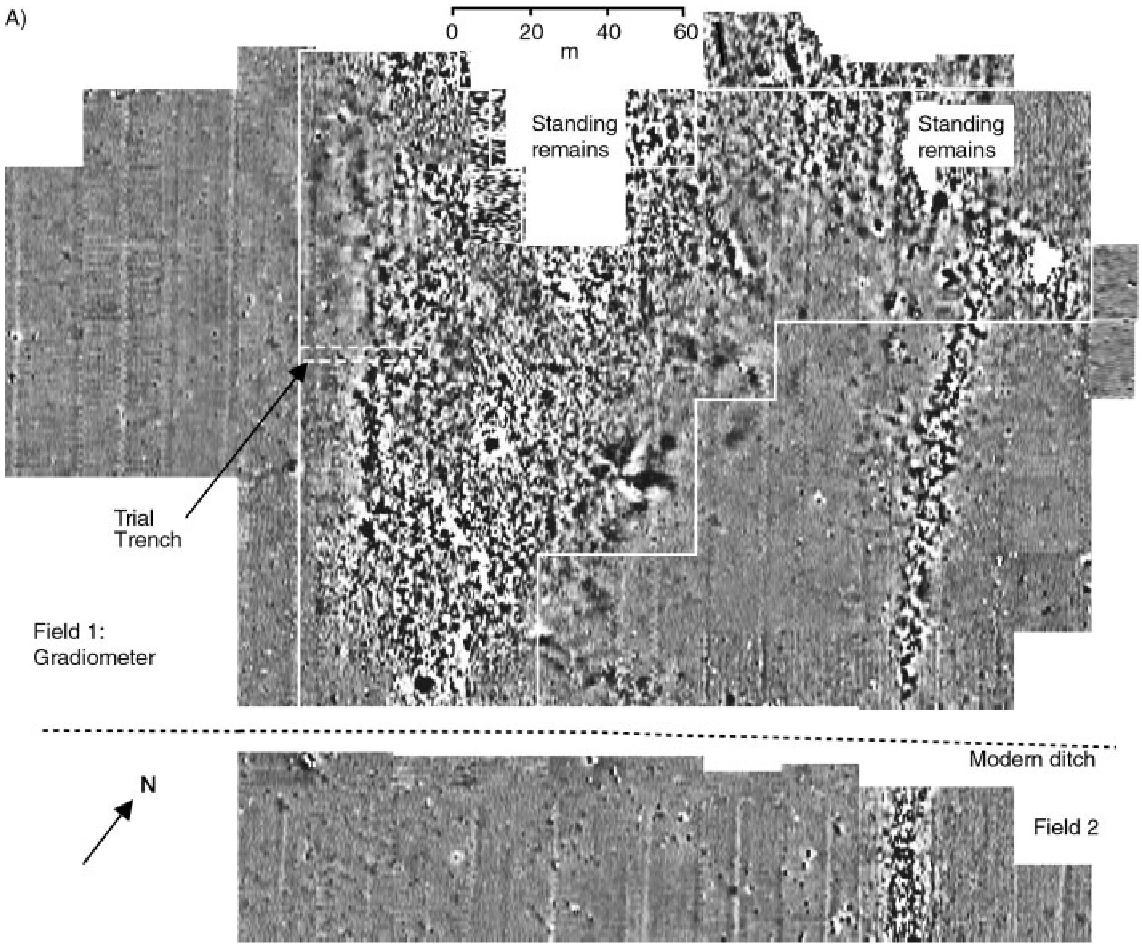

Figure 2. (A) Magnetic gradiometer image of fields 1 and 2. The eastern extent of the survey in field 1 is not shown here (Figure 1) as it shows no anomalies associated with apparent archaeology. The outline grid (in white) of the resistivity survey is shown on the gradiometer data. (B) Field 5, magnetic gradiometer data and interpretation of the anomaly features present. Sets of interpreted anomalies are labelled for textural reference. Horizontal scale is the same in all directions.

(i) Strong linear features, representing greater than about 5nT magnitude.
(ii) Weak linear features representing less than about 5nT magnitude.
(iii) Lines of possibly connected point-source anomalies, which may represent shallow discontinuous sources or perhaps variable depth magnetic features near the gradiometer detection limit.

The orientation and length of the interpreted linear features (i) and (ii) were measured in CorelDRAW, and their data analysed below.

Two-dimensional electrical resistivity imaging (depth slices) was also utilized on the site, but this for the most part failed to show any significant archaeological related features, probably owing to both the high clay content and saline ground water within about 2 m of the ground surface. The data analysed here were collected over three periods, May 1998, September 1998 and September 1999. Initial soil and building material magnetic susceptibility measurements were conducted with a hand-held Kappameter (Agico Instruments).

Results

One of the main problems for geophysical prospection at the Shën Dëli site is the variable depth (often deeply buried) of the building

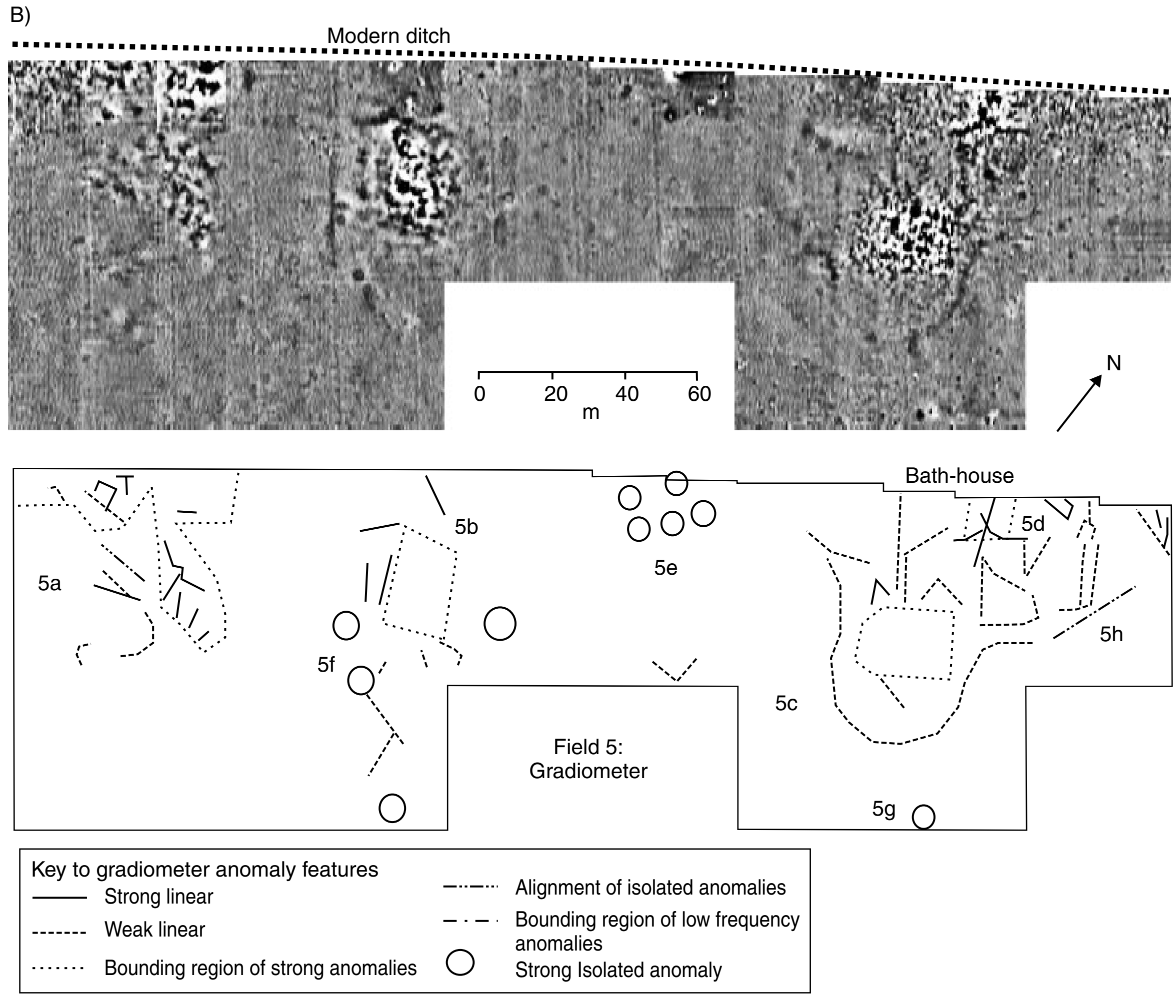

Figure 2. (*Continued*).

structures on the site, particularly as the magnetic gradiometer is most sensitive to archaeology within about the top 1 to 1.5 m (Clark, 1996). At the causeway section and at the western side of the site (middle of field 1, Figure 1), ditch sections and trial trenches (Figure 2a) indicate that 1.2–1.5 m of marsh clay are found above the archaeology (Hounslow and Chepstow-Lusty, in press). Similarly, further southeast from the Shën Dëli site, standing aqueduct piers indicate that about 1 m of marsh clay has accumulated since the aqueduct was built. However, in places such as at the bath-house section and the northern parts of field 1, the archaeology is close to the present soil surface.

In contrast to the magnetically enhanced red soils developed on the surrounding karst limestone hills, the marsh clay and soils of the Vrina Plain are weakly magnetic (Table 1). A survey of the building materials in the standing remains indicates largely limestone blocks with smaller amounts of fired clay (red bricks and tiles) with binding mortar. The fired clay shows significantly enhanced magnetic susceptibility in comparison to the limestone blocks and the muds and silts of the Vrina Plain (Table 1). Overall there is a weak negative magnetic contrast between the soil and limestone/mortar, in comparison to a stronger positive contrast between the soil and the fired materials.

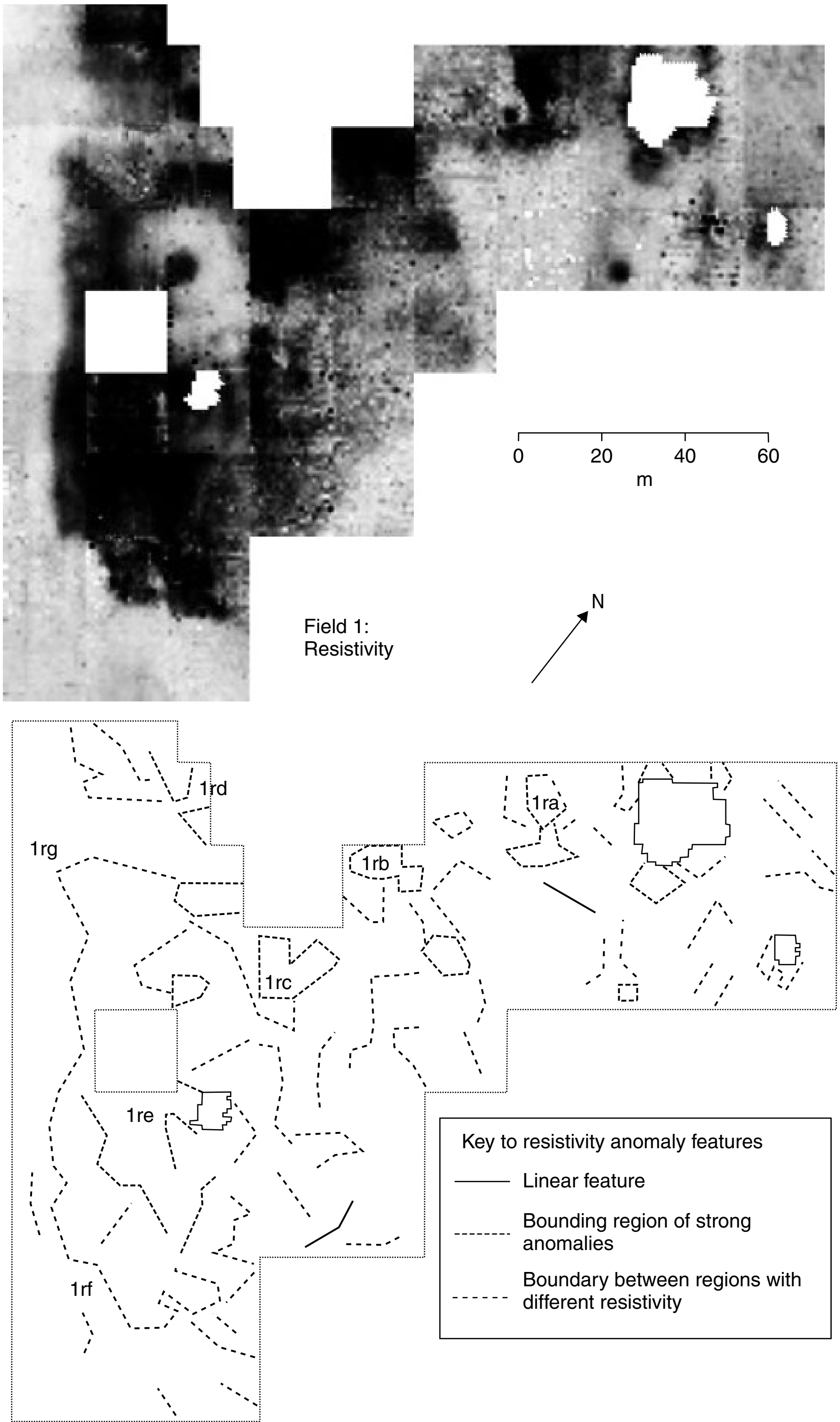

Figure 3. Resistivity data and its interpretation summary for field 1. See Figure 2A for location of resistivity survey in relationship to the gradiometer data for this field. Sets of anomalies are labelled for textural reference. Horizontal scale is the same in all directions. There is a poor match of some adjacent resistivity squares owing to very different soil moisture conditions, related to the different seasonal timing of these measurements.

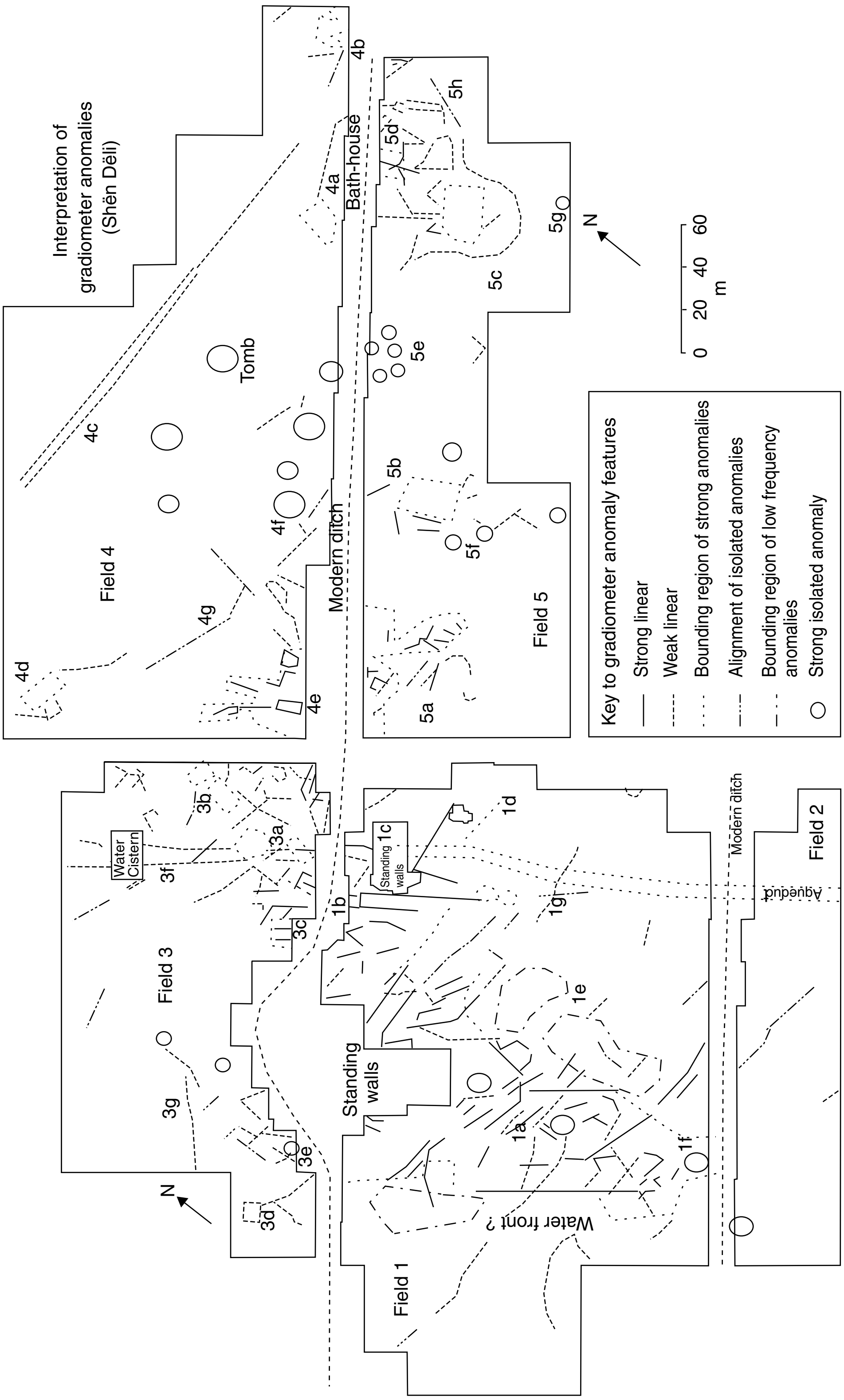

Figure 4. Interpretation summary of gradiometer data for all the fields surveyed. Sets of anomalies are labelled for textural reference. Horizontal scale is the same in all directions.

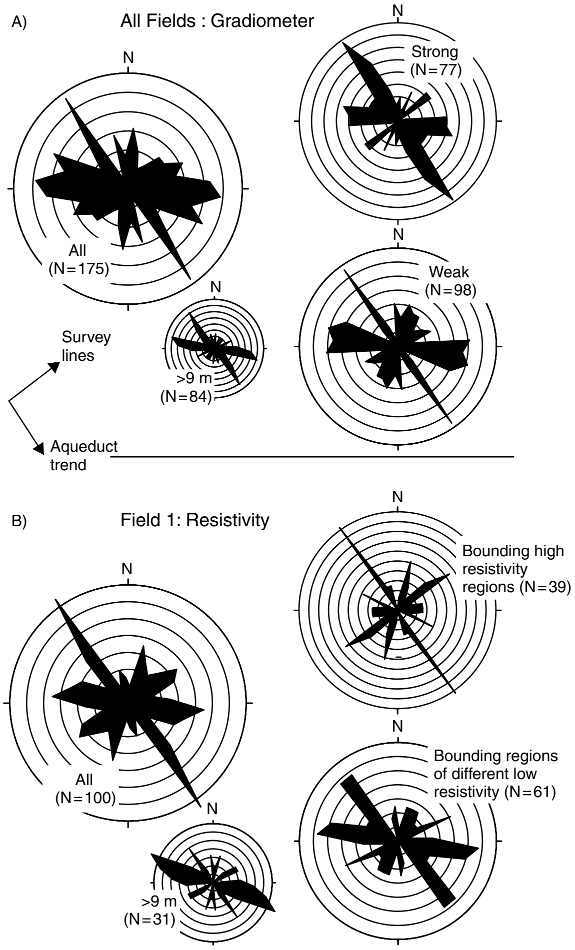

Figure 5. Summary linear anomaly orientations for (A) all the fields surveyed and (B) resistivity linear features from field 1. In each case the area of the rose diagrams is related to the frequency of occurrence (per cent) of a linear anomaly in that orientation. Each rose diagram is scaled according to the maximum percentage in each sector. Sector intervals are mostly 5°, except for data groupings with low numbers of total frequencies. The data groupings are those shown on the interpretation diagrams (Figures 2B, 3 and 4).

Table 1. Field measurements of typical magnetic susceptibilities at Shën Dëli

Material	Magnetic susceptibility ($\times 10^{-3}$ SI volume units)
Surface soil/silt/clay	0.5 to 0.9
Limestone wall blocks	0.00
Wall mortar	0.05 to 0.09
Red tiles and wall bricks	1 to 32 (mean 10)

Key geophysical anomalies

Figure 4 shows a summary diagram of the interpretation of the gradiometer survey and Figure 3 the resistivity survey, the key features of which are listed below.

(i) A large area of buildings remains covering about 200 m × 100 m on the main part of the Shën Dëli site in field 1 (Figure 4). The building remains appear to be clustered in an approximate triangular-shaped feature, which stretches from feature 3b in the north, to 1f in the south, to feature 3e in the northwest (Figure 4). Towards the north and northwest side of this, most of the current standing building remains are found (Figures 1 and 4). This triangular feature may be a former beach ridge, on which the Shën Dëli site was established in Roman times. Alternatively, it may be that buildings were concentrated on this feature, which subsequently acted as a nucleus above the rising sea-level in Roman times.

(ii) Most wall outlines are not clearly defined, although there are a number of exceptions (e.g. feature 4e in field 4; Figure 4). This may be because the building remains are for the most part deeply buried, with an extensive near-surface scatter of building debris. This scatter may be plough-induced, or perhaps wave-induced disintegration of the buildings during post-Roman sea-level rise. Even the apparently isolated building structures that are perhaps villas, evident in fields 4 and 5 (e.g. features 4d and 5c; Figures 4 and 2B), have no clearly defined rectangular wall outlines, but are often defined by the limits to high frequency anomalies.

(iii) There is clear evidence for the former position of the aqueduct across field 1, with some deviation (Figures 2A and 4). The deviation near feature 1g (Figure 4) was possibly to accommodate a prior building structure (perhaps the church (?) at feature 1c), hence the deviation probably signals buildings on the site, prior to aqueduct construction in the first century BC. The northerly extension of the aqueduct across field 3 to the water cistern is not shown in the same style of closely spaced high-frequency anomalies as in field 1 (Figure 1), but instead by weak linear features (Figure 4). It may be that the brick-rich aqueduct remains are buried deeply, or that there is a change to mostly limestone for the aqueduct construction material in field 3.

(iv) Where there is magnetometry evidence of near-surface rectangular building structures, this is often also reflected in the resistivity anomalies. Distinct high resistivity areas in field 1 (features 1ra, 1rb, 1rc and 1re; Figure 3), appear to represent the foundations of one or more buildings. A clear gradiometer rectangular wall feature, 4e (within field 4; Figure 4), shows relatively high ground resistivity (not shown) thus supporting the interpretation for the presence of building foundations.

(v) The southwest boundary of the Shën Dëli complex is a broad gradiometer anomaly (Figures 2A and 4) and an elongated low resistance over the same feature (boundary between features 1rg to 1rf, Figure 3). A trial trench over this feature in 1999 (Figure 1) showed an archaeological surface dipping at about 15° to the northwest, composed of disorganized limestone and brick building materials, covered by an ever westwards thickening cover of marine marsh clay (Hounslow and Chepstow-Lusty, in press). An extension of the survey to the southwest (Figure 1) failed to show archaeology. Hence, the geophysical features appear to mark the southwest boundary to the shallow remains of the buildings complex, and the linearity implies human influence in its definition. One can speculate that a channel here could have been an access point for boats, to the adjacent buildings, and possibly may be the site of the port of Butrint.

(vi) The anomalies adjacent to the bath-house structure in fields 4 and 5 (feature 5d; Figure 4) are aligned NW–SE approximately parallel with the wall seen in the bath-house section (Hounslow and Chepstow-Lusty, 2002). This complex of buildings extends 30 m to the south, where a very large rectangular building, possibly a villa, is bounded on the southern side by a weak arc-like anomaly (feature 5c, Figure 4), which may be an enclosing ditch.

(vii) An E–W aligned linear feature in field 4, which is at least 170 m long (feature 4c; Figure 4), was shown to be a ditch by a trial excavation in spring 2001.

(viii) There are distinctive thin NW–SE aligned linear features across the whole site (Figures 1 and 2), but which are particularly evident in the northern part of field 3 (Figure 1), which are the modern field drainage furrows and buried field drains. These slight topographic features evident in the fields are consistently orientated features, which are not included in the geophysical interpretation in Figure 4.

Urban morphology

The street layout of the suburb is not clearly evident from simple visual inspection of the anomalies, or their interpreted features. Hence, analysis of the orientation of the linear anomalies on the site was used to help in understanding the likely street and road layout of the Shën Dëli suburb. This is based on the assumption that the length of linear anomaly features might be a guide to the former functional use of the feature causing the anomalies. If the Shën Dëli suburb were a planned development following colony status, it would be expected to have typically regular *insulae* of 75–80 m square (Owens, 1996). Subdivision within the *insulae* might involve a variety of interconnecting streets, with building alignments following street alignments, with more or less some regularity (Brothers, 1996; Owens, 1996). The wall length of the buildings and their internal partition might vary widely from 2–3 m to perhaps 20–30 m, with the longer walls more likely to parallel the within-*insulae* street plan (Brothers, 1996). In an attempt to isolate the more structurally important anomaly features, an arbitrary subdivision of anomaly features longer and shorter than 9 m has been undertaken, based in part on the average subdivision of buildings into rooms (Brothers, 1996; Owens, 1996). This is also to try and isolate shorter linear anomaly features, which may have less bearing on the urban layout because they may derive from collapsed walls, later building subdivisions and errors in the interpretation and orientation of short linear anomalies.

Over the whole site there are two main sets of alignments, both of which appear to be composed of orthogonal linear anomalies.

Aqueduct-related alignment set

A set of (strong) NW–SE and (weaker) NE–SW linear anomalies. The NW–SE alignment is the strongest and has the least angular dispersion on the site (Figure 5A). It is clearly represented in both strong and weak gradiometer features, and also in the features over 9 m in length (Figure 5A). This set is the more abundant alignment in fields 1, 4 and 5 (Figures 5, 6 and 7). The NW–SE alignment parallels the aqueduct, the alignment of walls in the bath-house section, a collapsed wall in the causeway section and some standing walls in the northeastern area of field 1.

Its orthogonal NE–SW set is more weakly developed, except in field 3, where the NE–SW set is slightly more abundant (Figure 6B). The NE–SW linear anomaly set is parallel to the gradiometer survey lines; hence there may be some suppression owing to this bias (Clark, 1996). This is confirmed to some extent by the resistivity linear anomalies in field 1, with both sets being more equally evident, although the NW–SE set parallel to the aqueduct is the stronger (Figures 5B and 6A). The NE–SW alignment parallels the longer portions of standing walls in the northern area of field 1. Consequently these two orthogonal sets of linear anomalies may represent a regular wall alignment on the site, that is also associated with the aqueduct alignment. These alignment sets are indicated by the latest standing building structures on the site, and hence may be a relatively young feature of the site.

Causeway-related alignment set

A set of (strong) E–W and (weaker) N–S linear anomalies. The E–W set of alignments shows a relatively large degree of angular dispersion in comparison to the NW–SE linear anomalies (Figure 5A). Within fields 1 and 4 the set is centred about 5° south of east (Figures 6A and 7B), whereas in field 3 it is 5° north of east (Figure 6B).

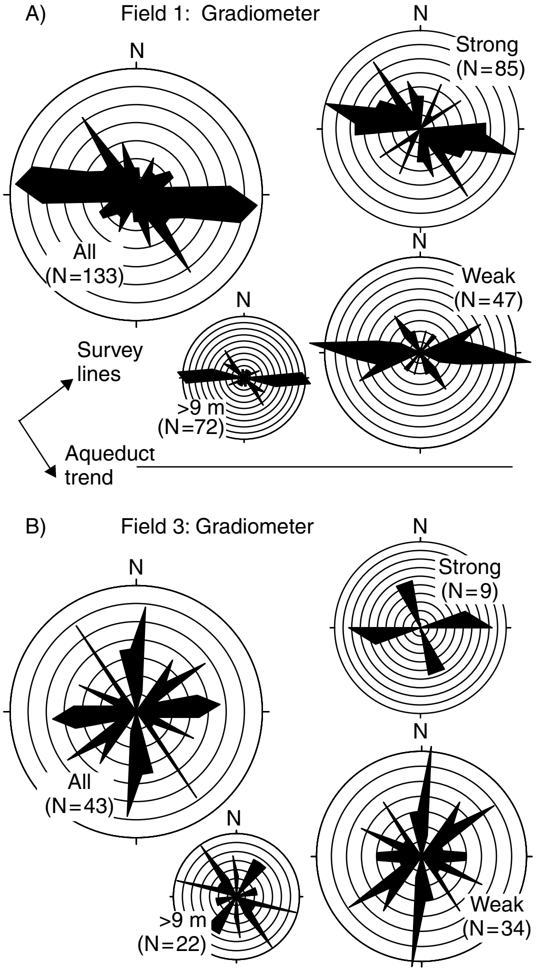

Figure 6. Summary linear anomaly orientations for (A) field 1 and (B) field 3. See Figure 5 for details.

This set is most strongly developed in field 1 and field 3 (Figures 4 and 6), but is represented by the exceptionally long E–W aligned ditch anomaly in field 4 (feature 4c; Figure 4).

The orthogonal set of N–S linear anomalies is not as strongly developed, except in field 3, but then mostly by the weaker magnetic linear anomalies (Figure 6B). The only known archaeology on the Shën Dëli site that shows this alignment is the footings of the feature at the eastern end of field 5 (causeway section, Figure 1), which has been interpreted as a causeway. This feature is also in line with the strong E–W ditch feature in field 4 (Figures 1 and 4).

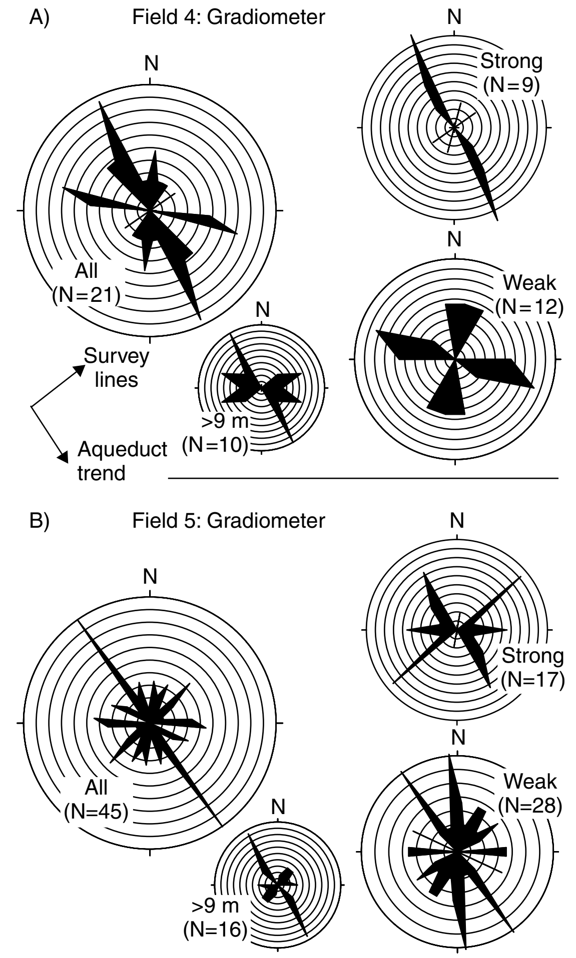

Figure 7. Summary linear anomaly orientations for (A) field 4 and (B) field 5. See Figure 5 for details.

Discussion

The parallelism of the current standing walls and the aqueduct-related alignment set suggest that the NW–SE set may post-date the building of the aqueduct, at about the first century BC. The aqueduct building coincides with Butrint being made a colony, and hence was likely of great administrative importance (Owens, 1996; Gilkes and Miraj, 2000). The expense and prestige in building the aqueduct may have outweighed the importance of most of the existing buildings, hence its building may have defined a new structural trend in the suburb. However, the way the aqueduct anomalies bend in field 1 suggests that the builders of the aqueduct modified its straight path from the southeast to accommodate some important pre-existing structure. This suggests that the E–W/N–S alignment set may have existed prior to the aqueduct building, perhaps following a regular system of agricultural drainage on the plain, which became populated with expanding development from central Butrint. The greater angular dispersal of the E–W linear anomaly orientations may represent the less centralized administrative control prior to Butrint becoming a Roman colony, supporting this idea. Also, the strong E–W ditch feature in field 4 would support the idea that the E–W/N–S set of alignments may be reflecting a prior land drainage system, later developed on by suburban growth. Hence, the two sets of alignments may represent a later (NW–SE set) and an earlier (E–W/N–S set) system of buildings and roadways.

However, it is not clear how the potentially later urban layout (i.e. NW–SE set) could accommodate the known roadway exits from intramural Butrint. The interpretation of Hodges *et al.* (1997) suggests that the presumed roadway exited from intramural Butrint across the aqueduct and through or nearby the structure at the causeway section, and through the Shën Dëli site to the east. Hence, the E–W linear anomalies could represent a dominant street system, parallel to this main road. This would certainly match with the greater than 9 m length of some of the E–W linear anomalies. Given the conventional rectangular plan of Roman cities, this might suggest that the weaker N–S linear anomaly represents a subsidiary connective roadway system. However, this interpretation is contradictory in terms of the known standing wall alignments and aqueduct alignments, as it would imply non-parallelism of walls with streets, and the aqueduct would be out of alignment with the roadways. This would be unusual in a strongly centralized Roman administration (Alcock, 1993). The E–W and NW–SE linear anomalies greater than 9 m in length are equally abundant on the site (Figure 5A). In each case it is the weaker orthogonal sets that are generally shorter than 9 m. Using the assumption that the longer linear anomalies correspond to street-related features, it could be inferred that the *insulae* of the suburb were triangular-like in shape, rather than the conventional form (de la Bédoyère, 1992; Alcock, 1993; Owens, 1996).

This would be compatible with the main roadway being E–W orientated suggested by Hodges *et al*. (1997). However, although triangular *insulae* of Roman towns may occur in limited areas to accommodate topographical or pre-defined major roadways (de la Bédoyère, 1992; Owens, 1996), the persistence of these triangular *insulae* over the whole site would be unusual. Perhaps they are restricted to the region of fields 1 and 3? The medieval builders of the Triangular Castle on the Vivari Channel have adopted a rather unusual wall plan (Figure 1), which has been invoked (Oliver Gilkes, personal communication, 2001) to be a response to building on an island in the Pavllës River. Perhaps instead, the castle builders were reflecting a still existing layout of triangular gridded roadways in the old Roman suburb to the east? Excavation in the future on the Shën Dëli site may help in deciphering these possibilities for the urban layout of the Shën Dëli suburb.

Conclusions

A magnetometry and resistivity survey of the extramural part of Butrint has indicated the former minimum extent of buildings. It is a minimum extent because it is clear that some of the archaeology is covered by a thickness of marsh clay, which means detection is at the limit or below fluxgate gradiometer sensitivity. The geophysical anomalies mostly do not reflect in a clear fashion the detailed geometry of street and building outlines. This is because of noise from the scatter of near-surface, brick and tile sources, either produced during post-Roman flooding and building disintegration or modern agricultural land improvement works. However, two sets of linear anomalies can be identified within the geophysical data. These can be interpreted satisfactorily as an E–W/N–S set related to pre-Roman colony status, prior to aqueduct building in the first century BC; with the second NW–SE/NE–SW set coinciding with post-*coloniae* status, following aqueduct building. An alternative interpretation of the geophysical data suggests the urban layout on part of the site may have been based on a triangular-like network of streets, rather than the conventional rectangular system. This may have been emulated in the later construction of the medieval Triangular Castle.

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