From Space to Place: the Aiali project  
(Tuscany-Italy)

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1 Introduction

The place name Aiali is sited on lowland between the medieval town of Grosseto and the Roman town of Roselle in central Italy. The site discussed in this paper was detected from the air during the Aerial Archaeology Research School organised by the University of Siena in 2001 (Campana et al. 2006). Aerial survey allowed us to recognise an area within which the growth of the wheat varied in such a way as to reveal an articulated group of traces that made up the plan of a complex of structures interpreted as a Roman villa, 4 hectares in extent. In the following years Aiali has become the most important test site for the Laboratory of Landscape Archaeology and Remote Sensing at Grosseto. Since 2001 we have collected, processed and interpreted many different kinds of data: Quickbird-2 satellite imagery, historical and recent vertical coverage (from 1954 to 2001), oblique air photographs in various years, seasons and lighting condition; field-walking survey, and geophysical survey (magnetometry, GPR, EM, ERT).

One intention of the Aiali project is to apply the highest available level and intensity of archaeological prospection methods on a large, complex and stratified site, producing material from the from Etruscan, Roman and Medieval periods. At the same time Aiali forms the starting point for a more wide-ranging approach to the study of the landscape between Grosseto and Roselle. This is an innovative project in Italy but it is clear that we are trying to emulate the strategy applied for more than thirty years by Dominic Powlesland in his Vale of Pickering project in northern England (Tipper 2004; Powlesland 2001; Powlesland 2006).

It is easy to understand, however, that it will never be possible to extend this approach to areas of the scale covered by the University’s archaeological mapping projects (Campana et al. 2006). As an example, the archaeological map of the province of Grosseto covers an extent of 4030 Kmsq and that of Tuscany as a whole about 22,990 Kmsq.

As Chris Musson has argued – during one of our long discussions on this topic – the archaeological objective and outcome of the Aiali project has to take account of the critical impact of the kinds of information that are available for recording: to use his own words “in assessing the potential or interpretation of a landscape it is at least as important to know what may not be visible as to appreciate what is visible”.

2 Remote sensing at work

Quickbird-2 Satellite imagery

At the end of spring 2002 we planned the acquisition of 70 Kmsq of Quickbird-2 imagery around Aiali. We ordered the multispectral and the panchromatic data. Unfortunately Digital Globe acquired the data rather later than we had hoped, on 13 June, right at the end on the intended time window.

Even though satellite imagery in this case failed to make a meaningful contribution at Aiali itself, we may consider that – without a multitemporal approach – the input of satellite imagery (and of airborne remote sensing data more generally) will not be effective for intra-site analysis but only for large scale landscape studies. In this case, for instance, on the same image set it is possible to see many other archaeological features, some of them very close to Aiali. One such site lies only 800 m to the south-east, where field-walking survey has revealed the existence of a large medieval mound (Fig.1).

Vertical air photography

As usual we started our work by examining the oldest available aerial photographs, in this case from the national coverage of 1954. Unfortunately no features were visible on this historical flight because the area was at that time used for olive cultivation (Fig.2). Even though the land-use changed to grain cultivation between the 1950s and 1970s we did not find any features on vertical photographs of 1976, 1996 and 2001.

Aerial survey and oblique photography

As noted in the introduction, the site was first detected in early summer 2001 during oblique aerial survey. In the following years we did not have the opportunity to survey the site from the air because of logistical problems until the spring of 2004 (Campana et al. 2006).
In that year, from the end of May to the middle of June, throughout the crop-ripening season, the site was repeatedly monitored from the air to record the aerial visibility of the cropmarks, using flights at intervals of between two and four days to document their development.

This procedure allowed the clear identification of new traces that had not been visible when the site was first discovered in 2001 (Fig.3). Photography was also continued into the later months of the summer. The new evidence included traces of an abandoned river-course and two new structures in the north-western part of the field, adjacent to the main complex of buildings (Fig.4).

The site was also monitored from the air in 2005 but the maize crop proved unhelpful. A similar situation applied in 2006, when the field was not under cultivation. Crop-rotation will return the field to grain in 2007 and this will perhaps present opportunities for the recovery of new information.

S. Campana

Figure 1 Above, Quickbird-2 imagery, red band. Below, near-infrared band

Figure 2 Above, 1954 vertical photograph with the field used for olive cultivation. Centre, 1996 vertical; despite the changed land-use no features are visible. Bottom, 2001 vertical; still nothing is visible but it is interesting to note that, as in the satellite imagery, it is possible to see features relating to the Brancaleta site, 800 m south-east of Aiali.
Field-walking survey and pottery analysis

During the course of 2004 we carried out field-walking survey and surface collection within a 10 m square grid (Fig.5). The ground survey and the study of the collected material has confirmed the archaeological character and interpretation of the site as seen in the air, demonstrating a high level of correspondence between the aerial evidence and concentrations of archaeological finds.

Analysis of the large amount of pottery recovered from the site has permitted us, at the present stage of working-in-progress, to define the chronological range of the villa. The cataloguing of about 1100 pieces of pottery has allowed us to identify a minimum of 1044 different vessels. The artefacts recovered from the grid collection have been catalogued and drawn to characterise useful comparisons so as to define the chronology of each single fragment. Each fabric was analysed under the optical microscope to define products traded over shorter or longer distances through the identification of characteristic mineral inclusions. This analysis confirmed, for instance, the presence at Aiali of medieval pottery from Pisa, containing sand rich in micro-fossils from the Arno. With regard to the imperial phase it was possible to define pottery derived from Africa, in particular amphora body-sherds, all characterised by the presence of the same minerals.

The settlement began as an imperial Roman villa in the first century AD. The best marker for the early imperial age is italic red slip ware. The substantial presence of African red slip ware, of types A, C and D, allowed us to estimate that the villa remained in occupation until the sixth century AD, though with reduced amounts of Africa imports from the last quarter of the third century (Fig. 6).

An interesting feature is the total absence of pottery from North Africa in the fourth and sixth centuries within two
adjacent rectangular structures (visible in the oblique air photograph, Fig.4) in the north-western part of the field. The study of the pottery assemblage as a whole allows us to identify a dominant presence of fine red-painted pottery, locally or regionally produced, at the same period in the fourth to sixth centuries (ARSW).

We have identified a minimum of 101 forms of fine red-painted pottery dating from the fourth and sixth centuries, with many different morphologies. Some products imitate forms of ARSW: the bowl Hayes 61, the flanged bowl Hayes 91 and cup Hayes 99; others are bowls, dishes and closed forms of local tradition.

The topographical distribution of this class at Aiali reveals, moreover, a precise coincidence with that of the ARSW. The pottery analysis reveals the abandonment of the villa between the end of the sixth and beginning of the seventh centuries AD, followed by a gap of about three centuries. During the late ninth and tenth century AD there are some vessels which reveal a re-occupation of the site. In particular there are jugs in acroma depurata with handles coplanar with the rim, along with cooking pots and red-painted ware from Pisa. This new phase in the site’s occupation does not last beyond the twelfth century AD and seems to be concentrated in the area of the villa structures (Fig. 5).

In summary, we can say that the systematic collection within georeferenced grids has been extremely useful in seeking to understand long-term the topographical transformations within the site.

M. Ghisleni

Ground-based remote sensing

The magnetic investigations

In the autumn of 2004 it proved possible to collect 2 hectares of gradiometer data at intervals of 0.50 m along profiles set 1 m apart. The results showed a series of magnetic anomalies which closely match the traces visible on the oblique air photographs (Fig.7). In addition to confirming, very precisely, the evidence seen from the air, the magnetic survey added a series of anomalies that fill in many of the gaps in the main building complex. The central part of the villa consists of a rectangular structure measuring about 70 x 25 m, oriented north-east/south-west, at each end of which are four square rooms 10 x 10 m across. A break in the magnetic data is caused by a disused iron pipe, which obscures the archaeology along its length without reducing the general readability of the structure (Fig.7, no.8). On the evidence of the aerial photographs, which show continuity across the line of the pipe, we can assume that the below-ground archaeological deposits are essentially undisturbed. This interpretation is confirmed by the GPR survey (Fig.8). It is fair to suggest that in the absence of the pipe the gradiometer data would have produced equally positive results. Further magnetic anomalies can be seen in various parts of the field which were previously blank (Fig.7, nos.5-7).

Figure 7  Magnetic map and interpretation

Some tens of metres to the north-east and south-east of the main complex a series of linear anomalies (Fig.7, no.6), more or less aligned with the main structure, seem likely to represent an enclosure, perhaps with an entrance-way. To the north there is a weaker anomaly (from -10 to +10 nT/m), approximately rectangular but not aligned on the villa and thus presenting problems of interpretation.

Both the magnetic and aerial surveys produced poorer results in the north-western part of the field, where the ground survey and gridded surface collection yielded considerable amounts of structural material and ceramics, covering a chronological range from the second century BC to the sixth century AD, with a final phase in the tenth to eleventh centuries AD.

C. Felici

The GPR investigation: data acquisition and processing

In 2006 high-resolution GPR surveys (conducted in collaboration with Dean Goodman, Archaeometry Laboratory, Los Angeles, CA, USA) were applied over four areas to test the potential of this technique. For the measurements a GSSI SIR3000, equipped with a 400 MHz bistatic antenna with constant offset, was employed. At each site radar profiles were collected alternatively in reversed and unreversed directions across the survey grids. The horizontal spacing between parallel profiles at the site was 0.5 m. Radar reflections along the transects were recorded continuously across the ground at 40 scans \(s^{-1}\), with a stack = 3; along each profile, markers were spaced every 1 m to provide spatial reference. The gain control was manually adjusted to be more effective. The data were later corrected for a variation in speed to constant 30 scans \(m^{-1}\) (or 1 scan approximately 0.03 m).

All radar reflections within 50 ns (two-way travel time) time window were recorded digitally in the field as 16 bit data and 512 samples per radar scan.
When GPR profiles are collected along closely spaced profiles the data can be processed to display horizontal maps of the recorded radar amplitudes. Referred to as time slice processing, these anomaly maps can be generated at various time/depth windows across the recorded radargram dataset. The time slice maps can provide information regarding the size, shape, location and depth of subsurface archaeological structures buried beneath a site.

Time slice data were created using the spatially averaged square wave amplitudes of the return reflection. These averaged square amplitudes were then gridded using a Kriging routine (Piro et al. 2003, Goodman et al. 2001). The spatially averaged time slice parameter minimizes the effects of line striation parallel to the profile direction.

The larger time window helped to create an understandable visualization of the subsurface. In particular, when structures are not level within the ground or when velocity variations across the site are significant, the larger time window can illuminate continuous features at variable depths (Conyers and Goodman 1997). Other line noises, parallel to the profile collection direction, were removed using a moving filter with customised threshold settings. Filter thresholds were set to signal levels just below the average reflections from buried Roman walls.

In Area AB a total number of 162 parallel profiles, stretching S-N, were collected with the instrument configuration indicated above. After the pre-processing, all collected GPR profiles were used to calculate the time-slices related to this area. Fig. 8 shows the time-slice in the depth range 1.05 – 1.38 m. In this slice linear radar reflections are clearly visible. These kinds of anomalies are due to the presence of portions of walls still present in the ground.

Conclusion

Bearing in mind the present stage of the research it would be premature to attempt a definitive interpretation. At this stage, however, we are confident enough to outline a few methodological points. Each technique has produced a remarkable increase in both the quantity and quality of the archaeological information available to us. In particular the use of geophysical survey represents an advance of great importance in our researches. In addition to confirming the evidence recovered from the air the geophysical data has without doubt added new and otherwise unseen evidence.

5 Conclusion

The case-study shows that the use of a variety of methods in the search for understanding of the site has made a considerable contribution to the overall result.

Each technique has produced a remarkable increase in both the quantity and quality of the archaeological information available to us. In particular the use of geophysical survey represents an advance of great importance in our researches. In addition to confirming the evidence recovered from the air the geophysical data has without doubt added new and otherwise unseen evidence.
In conclusion, already at the present stage of the research, we believe should be recognized that on large, complex and stratified archaeological site the contribution of an integrated approach is extraordinary.

The next challenge should be possibly to increase the extent of the research the landscape in the valley between the town of Grosseto and Roselle.

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