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AN INTEGRATED APPROACH TO THE APPLICATION OF GEOPHYSICAL METHODS TO THE CECINA VALLEY SURVEY PROJECT

1. Introduction

The Cecina Valley Survey, established in 1987, is a long-term field project aimed at investigating the distribution of settlements in an area defined by the river valley that begins in the Colline Metallifere of Tuscany, passes near Volterra and feeds into the Tyrrenian Sea at the town of Cecina. Whilst the survey records the presence of artefacts of all periods encountered on the landscape, decision making – in keeping with the primary research goals of the survey – is keyed to the recovery of sites that date between 600 BC and AD 600. Research has been undertaken through both field walking and excavation with a particular focus on rural settlement in the valley as initial investigations revealed a different pattern to settlement to that witnessed elsewhere in Etruria. To aid this investigation and clarify the results of the field survey, a program of geophysics was incorporated into the project that, over two seasons, completed twelve separate surveys. Presented here are some results of these campaigns, together with an explanation of the techniques employed and the methodology that was developed to incorporate these different survey techniques.

1.1 *Geographical characteristics*

The Cecina Valley Survey is on a regional scale, embracing a valley that stretches across Northern Etruria from Cecina on the Thyrrenian Sea to Volterra in the higher interior. The region can be divided into a number of distinct geographical zones. The first of these is the coastal plain around the mouth of the Cecina River, which is the most productive zone in agricultural terms, and is now subject to intensive exploitation. Behind this plain to the east lies a series of rolling hills, typical of Tuscany, with light soils, easily cultivated with ancient farming methods and thus a major focus of ancient rural settlement activity. This area is also characterised by terracing leading down towards the river and small alluvial plains created by the flooding of the river Cecina. The third geographical zone marks the beginning of a fairly inhospitable area of calcareous hills. This very steep rugged terrain, unsuitable for agriculture, is almost waterless and today is largely wooded and sparsely populated.

The other main geographical feature of the valley is the river itself. It undoubtedly played an important role in trade, and as Terrenato (1996, 92) has noted, it has always represented the main line of communication between the inland territory of Volterra and the coastal landing places. Indeed it is likely that the river was used to trade salt and alabaster, a stone that has been extensively mined within the region of Volterra.

It is clear that the geography of the valley, whilst by no means the single most important factor in conditioning settlement, would have significantly influenced the location of sites, their visibility and preservation.

1.2 *The geophysics program*

Geophysical survey is concerned with the identification of sub-surface features without excavation, utilising instruments, devolved from geology and physics, to measure the physical properties of materials. It is therefore fundamental for the successful application of the technique to select the prospecting method best suited for the locating of specific building types. The focus of the Cecina Valley Survey has been the identification of sites from between 600 BC and AD 600. The settlement pattern that has been identified for this period by the survey appears to vary greatly from the picture previously suggested. The progressive work of Ward-Perkins in the early 1960's identified over 2000 sites in the Tiber valley north of Rome, and commentators have subsequently spread this picture of southern Etruria to that of the north as well.

The work of Ward-Perkins was later continued and discussed by Potter who, in particular, noted a very high density of rural settlement in the Roman period (Potter 1979, 120). His survey work recorded density figures of several sites per square kilometre that were all apparently occupied at the same time. Potter concludes that this implies both a fast increasing population and a powerful incentive to invest in agriculture with the result that the scale of rural development reached an unprecedented level. M. Pasquinucci (Pasquinucci *et al.* 1999, 305) also suggests an increase in settlement in north-western Etruria due to the deduction of veterans in the late 1st century BC.

However, work in the Cecina valley and similarly further south in the Albegna valley (Attolini *et al.* 1991) has recorded only a moderate change in the rural settlement system. In these areas a more heterogeneous situation seems apparent whereby it kept much of its pre-Roman character, perhaps cushioned by distance and remoteness from the power of the centralising authority of Rome. The pre-Roman countryside is characterised by an overwhelming pre-dominance of rather small sites, most of which seem to be first occupied in the Hellenistic period (Terrenato 1992; 1998), and then it maintains the settlement during the period of the expansion of Rome, whereby in the Cecina valley there is a limited rural impact when Volaterrae was incorporated into the Roman state in 80 BC.

This diverse pattern recognised by the survey, perhaps only recently identified due to previous concentration on artefact rich Etruscan sites, is based upon an identification of long continuity on what have been identified as farmsteads. Indeed the other commonly identified rural site after the 1st century AD, those of villas (Potter notes a density for South Etruria of one villa for every two square kilometres) have been identified only on the coastal plain, a phenomenon itself that warrants further investigation.

Due to the uncertainty of the settlement pattern in this region of Etruria, a program of geophysics was established in 1997. The method of prospection chosen was guided by the previous experience of the project and results attained elsewhere in northern Etruria. Between 1991 and 1996 the project undertook the excavation of a farmstead at the site of San Mario (Camin *et al.* 1996; Regoli, Terrenato 2000) located in the second identified geographical zone of the valley. Geophysical survey was undertaken through the measurement of soil resistance after the site had been sampled and gridded. The results indicated only one significant anomaly that was later identified as a main structural wall. Similarly, at the site of Podere Tartuchino in the Albegna valley, resistivity survey was also conducted to further locate and identify a presumed farmstead site (Perkins, Attolini 1992, 73). The results were unable to provide precise locations for structures, perhaps, note the authors, due to the heterogeneous nature of the subsoil and recent plough disturbance. Soren and Somers (2000) report a recent application of megnetometry and resistivity at the Etruscan site of Chianciano Terme. However it is apparent, through lack of reference and illustration, that the magnetic survey produced fewer results.

A fuller discussion of the techniques of geophysics and characteristics of resistivity survey is provided in the following section, however it is important to note at this stage that resistance surveys require water content in the soil. The prospecting method chosen to undertake in the Cecina Valley was magnetic survey, the reasons for which will be more fully discussed below.

In order to assess the ability of this technique to record the presence of subsurface features on rural settlement sites, twelve sites were chosen across the different geographical zones (Fig. 1), although with greater emphasis given to the interior valley, as the sites previously identified on the coastal planes were predominantly villas.

The survey also took advantage of current technological advances and used mobile computing devices to gather and begin an initial analysis of the data whilst in the field. This methodology helped to ensure that the optimum amount of time was allocated to each site, as if results and conditions of a site were proving negative the survey team could advance on to the next survey area. Through implementing this system, a far greater number of sites were investigated than would otherwise be possible over the relatively short period allocated for the surveying.

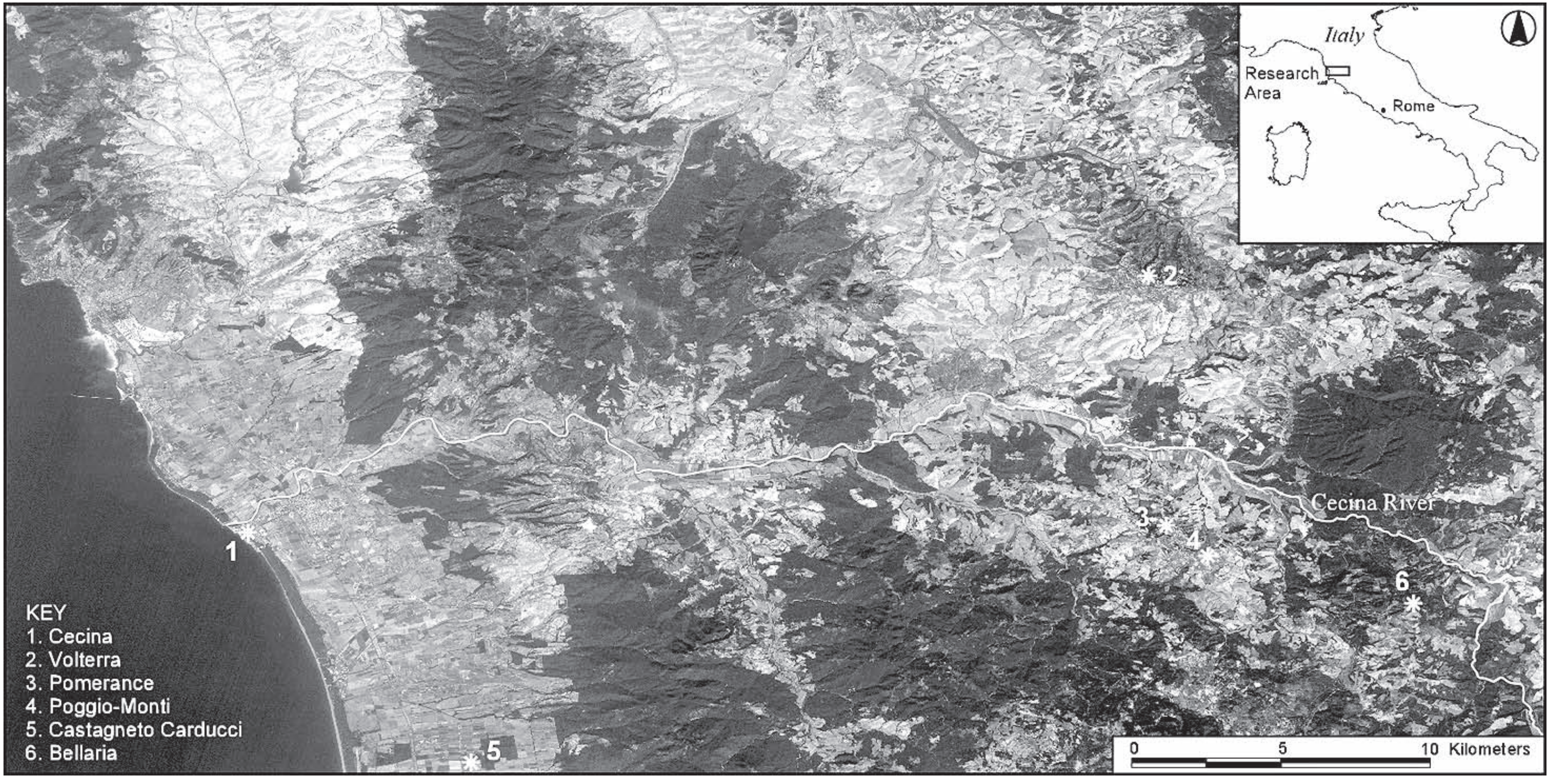

Fig. 1 – Location of towns and sites mentioned in the text.

2. Field survey methods

Since the project was initiated in 1987, the survey has covered over 120 kilometres and recorded the presence of over 500 sites, ranging through all periods. However, the site specific approach taken to the survey, whereby the site is the target of recovery, in contrast to a survey that takes the recording of individual artefacts and their distributions on the landscape as its objective (Terrenato 1992), has meant that a greater focus was made on identified sites.

Whilst Terrenato has shown that we can document in quantitative terms a strong relationship between surface visibility and the discovery of sites (Terrenato, Ammerman 1996), it is clear that problems still exist in the manner in which field walking is conducted due to the capacity of sites to be either visible or invisible depending on survey conditions. It is apparent that not all sites can be recognised by their surface remains, implying that some sites are being missed or excluded. Indeed, other variables that lead to a restriction in visibility, such as ground cover, climatic conditions and the individual ability and experience of field walkers may also lead to the non-identification of a site. It was therefore partly due to these concerns that an additional method was sought to compliment and develop the methodology of the field walking.

The concept of employing geophysics as an adjunct to standard field walking techniques was suggested by Clark as a means of providing the archaeologist with a "third eye" (Clark 1990, 89) whereby geophysics is not only useable in its own right but as a means of enabling the possibility of checking any site suspected from artefact scatters. Indeed not only can geophysical prospection methods establish whether actual features exist on the site, but the size of anomalies will give some indication of their state of preservation.

From a practical sense of conducting a field survey, the methodology involved in conducting a geophysical survey has much similarity with the field walking techniques employed by the Cecina Valley Survey. After the identification of a possible site through artefact scatters, a grid was established across the area to allow the accurate recording of artefacts. The geophysical survey could utilise the same grid and indeed extend it should anomalies appear to be beyond the original gridded area. As noted previously, this procedure is enhanced by the initial analysis of the geophysical data in the field, allowing the survey to move and target the sub-surface features remaining of the archaeological site.

The combination of field walking and geophysics has the possibility of providing the archaeologist with a rapid interpretation of a site. Through the utilisation of the same survey methods, features can be accurately located and recorded allowing precise investigation to take place through excavation. Prior to discussing some specific examples from the Cecina Valley Survey, a discussion is useful of the geophysical techniques best suited both for this form of combined field survey and for the locating and identification of structures commonly associated with Etruscan and Roman rural settlement.

2.1 *Geophysical survey methods*

The two most commonly used methods of geophysical prospecting, employed in order to determine the extent and nature of sub-surface structures and remains, are resistivity and magnetometry (Clarke 1990; Jordan 2000). These offer a high precision in gathering data, have a relatively low costing and flexibility of use in the field. A further technique, georadar prospecting, is increasingly being used in archaeological surveys, although it is the more limited in use of the techniques due to its higher cost, speed and need for greater expertise. Resistivity and magnetometry differ greatly in the information that they record, each being more susceptible to different physical properties in the earth. Therefore, before undertaking the survey in the Cecina Valley, an evaluation was made of which would better suit the requirements of the project, and in particular, the type of construction technique used for Etruscan and Roman rural settlements.

2.1.1 Resistivity survey

Resistivity survey is based on the ability of sub-surface materials to conduct an electrical current passed through them. Differences in the structural and chemical make-up of soils affect the degree of resistance to an electrical current (Clark 1990, 27). The technique involves the passing of an electrical current through a pair of probes into the earth in order to measure variations in resistance over the survey area. The resistance that is measured by the instrument will vary accordingly to the sub-surface features: a structure such as buried wall foundations contain less moisture than the surrounding soil and therefore give higher readings, or positive anomalies, whilst ditches, pits and comparable excavated features containing permeable soil silting, and cut into relatively impermeable or well drained natural, give negative anomalies because of their high moisture content (Clark 1990, 37).

2.1.2 Magnetic survey

Magnetic prospection of soils is based on the measurement of differences in magnitudes of the earth's magnetic field at points over a specific area. The iron content of soil, indicated through such elements as magnetite, maghaematite and haematite iron oxides, all affect the magnetic property of soils. Whilst several instruments are available to the surveyor, the most commonly used is the Fluxgate Gradiometer, which Clark has described as «the workhorse – and the racehorse – of British archaeological prospecting» (Clark

1990, 69). The fluxgate instruments are based around a highly permeable nickel iron alloy core, which is magnetised by the earth's magnetic field, together with an alternating field applied via a primary winding (Scollar *et al*. 1990, 456).

2.2 *The choice of method*

The construction techniques used to build Etruscan and then later Roman non-elite settlement buildings methodologically appear to be more likely to be recorded by a resistance survey. Typically, these surveys record the presence of buried walls, filled pits, paved or cobbled areas, ditches and foundation trenches. In comparison, magnetic survey has been shown to record archaeological features such as brick walls, hearths, kilns and disturbed building materials as well as foundation trenches, pits and ditches where the magnetic properties of the soil filling these features illustrate their presence.

The excavated farmstead of San Mario, the focus of activity of the Cecina Valley Project over a five-year period, revealed a structure whose foundations were built out of dry-stone walling with unworked pebbles local to the area, bound with clay at the base. The walls have been described by Motta (1993) as being of wattle and daub, whilst the roof was made of flat tiles and embraces. The floor surface of the rooms was of beaten earth, with gravel in some places. The materials used appeared not to vary or were reused throughout the occupation of the site, the first of which was in the Hellenistic period.

A similar technique of building has been noted at other sites throughout Etruria, dating also to the earlier archaic period. At Poggio Civitella (Donati 1999; 1999a), to the south-west of the Cecina Valley at the far end of the Sienese district, an excavated house was built using a mixture of rubble and mud, with the walls completed in timber. Similarly, the Etruscan site of Accesa (Camporeale 1997) used dry-stone walling for the construction of simple rectangular buildings. Other excavated sites, such as Murlo (MacIntosh Turfa, Steinmayer 2002), were built using mud-brick walls based around a timber structure with a tiled roof held by wooden tie-beam trusses.

The aim of the geophysical survey program was to locate sites similar to that excavated at San Mario, which methodologically should be more visible to resistivity survey with strong positive anomalies created by the foundation walls. However, these sites are also characterised by beaten, often sunken floors and hearths and other foundation trenches. Such features would also be recorded by magnetometry, with especially high readings expected at the location of the hearth or at other firing places.

In selecting the technique, other factors were taken into account including time limitations and climatic conditions. Magnetometry, a passive survey technique, is much quicker at covering survey areas than the active technique of resistivity, which requires the injection of a signal into the ground and a period of waiting whilst a satisfactory connection is established. Further, the climatic conditions under which resistivity survey is conducted is important, as the technique requires the soil to have moisture content. The period allocated for the survey work in the Cecina Valley, dictated by external factors, was the end of August, beginning of September, a particularly dry period of year in Tuscany. The decision was therefore taken to use a fluxgate gradiometer to undertake the surveys, as magnetometry can be reliably conducted in all survey conditions and can cover a substantial area in a limited amount of time.

3. Survey results

Since the geophysics program commenced in 1997, twelve different sites throughout the valley have been examined. In providing a discussion and interpretation of the results that were achieved, three example sites will be discussed here in some detail. However, it should also be noted that not all sites provided results, and indeed two sites which were surveyed in 1997 provided little evidence of any past activity, although it should not be excluded the possibility that the surveys were affected by interference, possibly from geological background noise or from modern intrusions. The sites that are discussed here fall within the categories defined by the survey as farmsteads or nucleated settlements, an evaluation based upon material evidence, known information about the site, local knowledge and surface scatter size.

3.1 *Site 1: Poggio-Monti*

Situated a few kilometres to the south of Pomerance (see Fig. 1), the site occupies a prominent position on the rise of a small promontory. The site holds commanding views in most directions, and indeed attention had been drawn to the site through the presence of several known Etruscan tombs. A preliminary survey by the project, hindered by modern settlement on the hill-top, noted a small dense scatter of material on the surface. The underlying geology of the site was of particular importance to the survey, as natural sandstone showed through in several areas, and the soil depth across the site appeared to be extremely shallow. The area defined for the survey was relatively small, limited by surrounding woodland, outbuildings of the modern habitation, garden ornaments and the edges of the hilltop.

The survey recorded the presence of one significant archaeological anomaly, seen in Fig. 2, which was however heavily masked by background noise. Therefore, it was necessary to conduct some post survey processing of the data, whereby an interpolation filter was applied to the dataset. This process increased the number of data points in the survey, creating a much

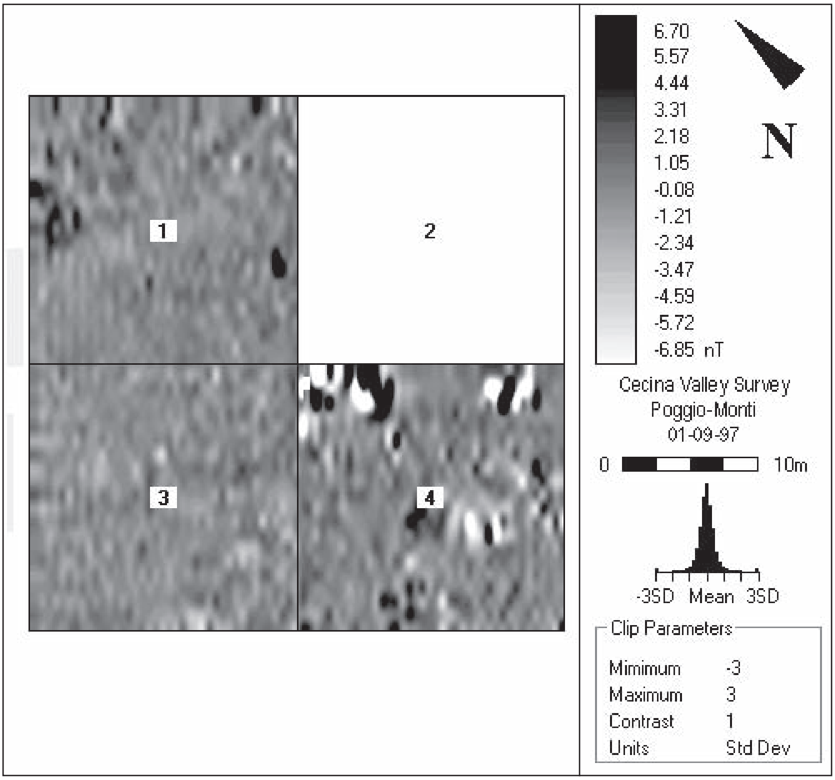

Fig. 2 – Results of fluxgate-gradiometer survey conducted at Poggio-Monti.

smoother appearance to the data, hence drawing out a weak feature to have much greater clarity.

The depth of the soil on this site indicates that this negative feature is unlikely to be a wall, and is more probably a foundation trench of a structure or a cutting. Comparison with other excavated structures of this period indicated by the pottery, such as those revealed at San Mario, suggests that the dimensions of this right-angled anomaly, measuring approximately 10 by 15 metres, are too great to be a single structure.

3.2 *Site 2: Castagneto Carducci, Podere La Pieve*

The site lies in the first geographical zone indicated previously, south east of the modern town of Cecina (Fig. 1). The locality had previously been examined by the project as traces of a Roman villa had been recorded in the area. The resulting field walking identified not only material associated with a high-status settlement, but in a further area a significant number of artefacts were recovered, associated more closely with a non-elite nucleated settlement, perhaps an outlying village associated with the villa. Further, the type and quality of this material suggested before geophysical examination that this was possibly the site of a larger more significant site than the farmsteads that had been observed elsewhere in the valley.

The geophysical survey was extended over an area of 100 by 100 metres, the largest survey undertaken by the project over the two seasons of survey. The surveying was partially affected by modern interference as several spoil heaps, seen in Fig. 3 and Tav. III as five white blocks (dummy readings), were located in the middle of the survey area, the result of the excavation of a new drainage ditch along the eastern edge of the site.

Similarly to the survey at Poggio-Monti, the readings recorded weak features, therefore making it necessary to conduct some processing to the raw data. The first filter applied to the dataset was focused on de-spiking the dataset. This process locates and removes random "iron-spikes" that are often present in gradiometer data, usually caused by such objects as discarded metallic agricultural machinery parts. Subsequently it was necessary to apply a low pass filter to the data, which removes high frequency, small scale spatial detail, resulting in a smoother dataset and enhanced larger weak features. Such processing was necessary, and indeed was on a majority of gradiometer surveys conducted in the Cecina Valley, as in general the readings were relatively weak.

The main identified anomaly of this survey is a square feature at the centre of the grids (Fig. 3 and Tav. III). Three of the edges are clearly visible, with sharp right-angles, whereas the fourth side has been partially obscured by the spoil heaps. These weak positive anomalies, with a stable measurement around 1nT, appear to be associated, and it can be hypothesised that they represent foundation trenches or ditches where the magnetic properties of the soil filling these features illustrate their presence. Radiating out from this central feature are several other linear anomalies, that would appear also to be ditches or ploughed out banks. These anomalies circle the square feature, suggesting that the features are associated. These features, if ditches or banks, would perhaps have served the purpose of dividing the land into parcels or irrigating the fields. Two parallel features also run in a northerly direction across the bottom of the plot seen in Tav. III. The alignment of these anomalies suggests some form of track or roadway, bound on either side by a ditch or bank.

The number and complexity of the anomalies located in the survey suggest that this was the site of a large settlement occupying a wide area, most probably a village of the Imperial period associated to the nearby villa. The survey successfully located the area of settlement and a number of anomalies, yet it is difficult to discern from the data individual structures. As such

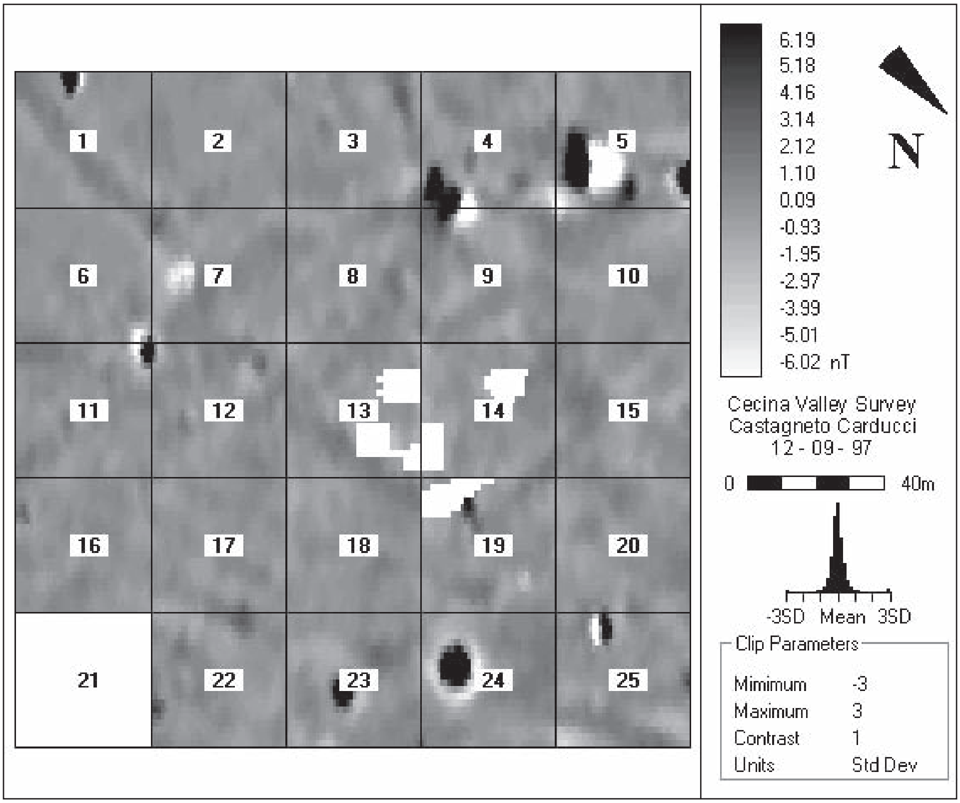

Fig. 3 – Results of fluxgate-gradiometer survey conducted at Castagneto Carducci.

raw materials as stone and clay, used elsewhere in the valley to construct non-elite buildings, was not freely available in this coastal area it is probable that material such as wood and wattle and daub, invisible to geophysical survey may have been used, as seen elsewhere at the site of Murlo (MacIntosh Turfa, Steinmayer 2002). Further, the definition of a magnetometry survey, whereby readings were taken at half metre intervals means that other features associated with timber structures, such as post-holes, would not be recorded by the survey due to their size.

3.3 *Site 3: Bellaria*

The site of Bellaria lies several kilometres to the east of the modern town of Pomerance (Fig. 1). The site commands a prominent position on a level hilltop, now in a clearing in dense woodland with clear views down the Cecina Valley. An initial evaluation of the site identified a considerable sur-

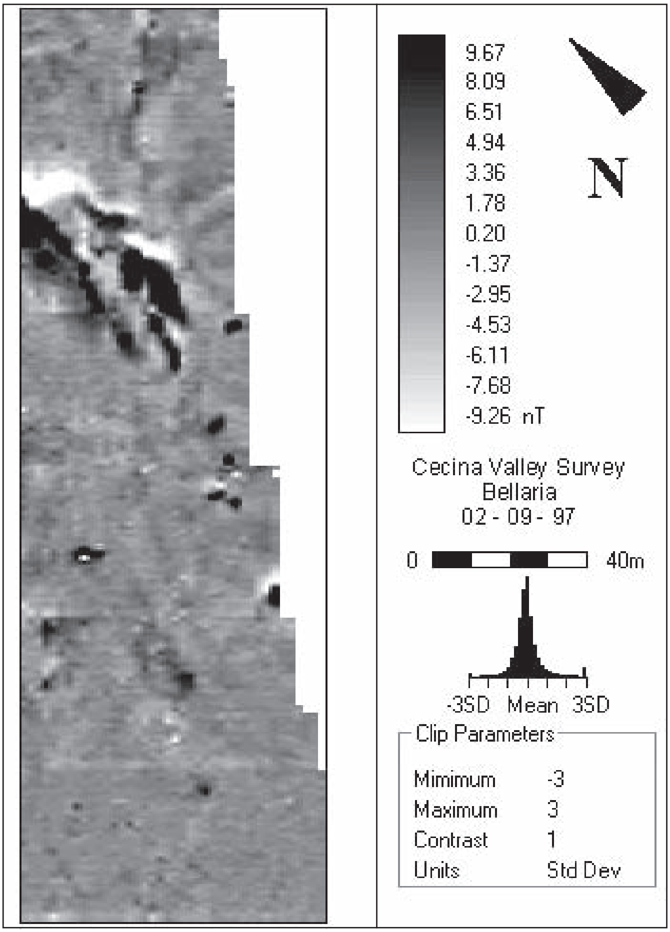

Fig. 4 – Results of fluxgate-gradiometer survey conducted at Bellaria.

face scatter, focused around a platform at the southern end of the site. However, in the intervening period between the first identification of this site and the geophysical survey, the site had been left to fallow, thus limiting the surface visibility. As a passive survey technique, magnetometry can be applied regardless of the surface coverage, although disproportionate interference has been noticed in surveys conducted over heavily ploughed land (Clarke 1990).

Some limited processing of the data was necessary to enhance the clarity of the features, as many probable archaeological anomalies were masked by magnetic interference. The initial filter used on the data was to remove spikes in the dataset, caused by modern interference. It was further necessary to run a filter on several blocks of data at the northern end of the dataset, with the application of a periodic defect filter, which was necessary to remove periodic features probably introduced as defects during gradiometer data collection.

The fluxgate survey covered a rectangular area of 4800m² and identified several anomalies similar to those seen at the site of Castagneto Carducci. A significant feature was recorded at the southern end of the site and would appear to be a square anomaly with several semi-circular annexes associated to it (Fig. 4). The anomaly covers an area of 10 by 15 metres, a size also seen at Poggio-Monti. The features are much narrower than those seen elsewhere, suggesting that foundations may still be in place. This particular feature also concurs well with the surface topography, which places this feature on a flat plateau in the south-west of the site. Other anomalies of apparent archaeological significance are two parallel features that run through the length of the site, appearing in the south-east of this site and exiting the survey area to the east. The anomalies would appear to be associated, although it is difficult to define their precise function. However, it is plausible that the two features represent ditches, and so in this case may represent the presence of an ancient track-way.

The size and number of anomalies recorded by this survey suggest a certain settlement, also indicated by the spread of rubble building material seen at the southern end of the site. Whilst few excavated examples of nucleated settlements of this period exist, it is probable that the site is larger than would be expected for the site of a farmstead. Furthermore, it is important to note that each of these sites surveyed were abandoned at the latest after the Imperial period and were never reoccupied. This detail, noted through the material scatter on the sites, is important for the accurate interpretation of the geophysics, as the results achieved are a palimpsest map of the subsurface features and different periods are difficult to distinguish.

4. An integrated survey approach

A fundamental aspect of the combination of magnetic survey with field walking has been the ability to analyse these results in their spatial contexts. Through the application of GIS, a system designed for the cataloguing, organising, mapping, analysing, querying and displaying of data was devised[1]. GIS is a powerful tool for determining trends, patterns, associations and other relationships among data layers, also allowing the integration of external databases for the joint analysis of data.

[1] The initial application of GIS and establishment of the system was undertaken by Sarah Poppy.

The foundation of the system is the cartography of the region, available to the project at a scale of 1:5000 (*Carta Tecnica Regionale*) as well as a series of cadastral maps at the same scale (*Mosaico Catastale*). In addition, a series of orthophoto maps (*Ortofotocarta*) at a scale of 1:10000 were entered into the system as raster base maps in combination with geomorphological maps drawn at a scale of 1:25000. The system developed for the field walking through the experience of this long-term project focused upon the characteristics of the cadastral maps. These show individual parcels of landownership as well as detailed definition of field boundaries thus allowing field-by-field mapping of archaeological concentrations. Information collected in the field was then entered into the spatial database, allowing further information to be attached to each concentration, such as field coverage and climate conditions, through the use of thematic layers with associated attribute data.

Whilst an important aspect of utilising a GIS system is for the management and documentation of a survey, perhaps its greatest strength is its ability to evolve and generate new information through the application of forms of spatial analysis. The most successful results drawn from this integration so far have been the visualisation of the field sampling results together with the magnetometry surveys. As previously noted, the survey strategy was, once a possible site was identified through surface scatters, to place a grid across the site to be used both by the geophysics, as 20 metre grids, and for field sampling whereby the same geophysics grids were divided into 5 metre parcels. All artefacts in each square were then collected and counted, although diagnostic material was recorded and kept for further spot-dating of the site.

A GIS system allows the combination and visualisation of both these results. The results from several surveys, although those in particular of the site of Sant'Emilia, were highly informative as the surface material, when visualised with the geophysical anomalies, showed a strong relationship. Combining the two techniques in such a manner allows the formulation of hypothesises not only of site type but also of individual features, therefore allowing examination of the site at both a macro and micro level.

5. Conclusion

The purpose of undertaking the geophysical program of the Cecina Valley Project was to provide greater clarity and information for the analysis of the field survey results. Previous applications of combining these techniques, such as at Falerii Novi as part of the Roman Town's Project (Keay *et al.* 2000), have used field sampling as a support for the geophysical survey, whilst the emphasis in the Cecina Valley Survey has been the reverse, with geophysics very much a support and aid to the traditional field survey techniques. Further, the successful completion of twelve surveys combining field sampling and magnetometry illustrates the ease in which these techniques can be combined. The choice of magnetometry as the method of survey was strongly influenced by time constraints and climatic conditions, however the technique has also been shown to satisfactorily record sub-surface anomalies associated with Etruscan and Roman rural settlement. Yet, it is also evident from the survey results that a more complete methodology would be the combination of both resistivity and magnetometry as each site is different and requires a singular approach. Whilst there is no definite technique and methodology that can unquestionably be applied to a site, the investigations undertaken in the Cecina Valley show that surveys benefit greatly from the addition of geophysical prospection to traditional field surveys. Whilst geophysical evaluations reveal much about a site, it is only when combined with all information collected by a survey, such as the study of diagnostic ceramics, that a clearer picture emerges. Through the application of GIS methodology and software, incorporating a range of data-sets, new patterns and directions are revealed for further, and more complete, investigation.

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ABSTRACT

Since its establishment in 1987, the Cecina Valley Survey Project, directed by Nicola Terrenato of the University of North Carolina at Chapel Hill, has undertaken the systematic investigation of the landscape surrounding the Etruscan, and then later Roman, city of Volaterrae in Northern Etruria, modern Tuscany. Whilst the main aim of the study is to investigate the distributions of settlements in the valley between 600 BC and AD 600, the survey has recorded the presence of artefacts of all periods. Together with a diverse approach to geophysical survey, the project has generated a wealth of data that has been fully documented within a spatial database, thus permitting interpretation to include both remotely sensed data and field surface collection.

Through the powerful application of this GIS technology combined with a detailed site documentation, a useful methodology was developed that could be reapplied in the field. The combination of field walking and a multiple site approach to geophysical survey, enhanced by the application of mobile computing technology, allowed an immediate initial interpretation of the site to be made. This approach to field survey, combining the techniques of GIS, geophysics and traditional field walking, allowed a rapid detailed appraisal of the site, particularly through a target specific form of remote sensing.

Presented here are some results from two seasons of geophysical surveying of rural settlements in the Cecina Valley and a discussion of the development of this integrated field survey approach. Appraisal is also made of the most suitable geophysical methods to be applied to individuate Hellenistic and early Roman rural settlements and the different forms of computer filter analysis that can be applied to extract clearer results.