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Geophysics applied to landscape archaeology: Understanding Samnite and Roman relationships in Molise (Italy) using geoarchaeological research methods

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Abstract: The Italian region of Molise features clear evidence of the people who have conquered it, inhabited it, tilled it, abandoned it, and reoccupied it. This research, focusing on the coastal area of Molise, attempts to show that the Samnite to Roman transition was not as violent as reported by the historian Livy (e.g., the Samnitic wars). Instead, the transition progressed as a gradual social, political, and cultural evolution. The geoarchaeological analysis of several sample sites helps to demonstrate this hypothesis by emphasizing how the landscape of coastal Molise changed during this particular historical period (i.e., between the sixth and fourth centuries BC). The use of geophysical methods (using both ground penetrating radar (GPR) and gradiometer techniques) in several coastal sites (Guglionesi, San Giacomo degli Schiavoni and San Martino in Pensilis) reveals settlement similarities between Samnite and Roman sites from a strategic and economic point of view. Moreover, this integrated study reveals that the traditional antagonistic relationship between these two populations in this period did not preclude a sort of mutual respect, which allowed this Italic population to be incorporated and assimilated into the Roman world without being completely destroyed and lost.

Keywords: Geoarchaeological Research Methods, GPR, Gradiometer, Landscape Archaeology, Molise

1. Introduction

Three powerful prerequisites are frequently defined as necessary for the development of “states”. First, there has to be a context of intensification of subsistence, which is generally achieved through agriculture. Agriculture (including certain types of pastoralism) provides the potential for producing a surplus that can be transferred away from the producers of subsistence. Second, there has to be what is frequently termed circumscription. This has been defined to describe the constraints of geography, society or resources. A society moving towards the state level of organization has to be subject to certain less-arduous solutions. State formation has many material and less tangible costs that would not be taken on unless the society’s position was circumscribed. Third, except in cases of extreme coercion, social formations that are receptive of state formation need to be present. Many early societies had checks and balances that prevented the assumption of excessive power by sub-groups of society. Taking into account this third factor also acknowledges the importance of the local history of a particular area, thereby reducing the importance of certain theories based on simple cross-cultural generalization.

The importance of intensification of subsistence is twofold. First, agriculture realizes the potential for a surplus of produce, thereby releasing certain sections of society for other specialized roles. Resources (measured in time and manpower) can be reallocated from subsistence production to political control. Second, intensification frequently has implications for investment, which reinforces sedentary behavior and can require protection. Intensification can involve the implementation of vulnerable, labor-intensive operations, such as terracing, irrigation networks and cultivation of slow-growing crops, including trees, which require nurturing for long periods of time but can be quickly destroyed if not protected by a regional authority.

Circumscription reinforces the conditions set by the intensification of production, the population and the warfare.

In some cases, this may take a geographical form; in other cases, it may take social form. In the latter, there is no physical circumscription, but the local society has developed in such a way as to provide a cultural circumscription. The competitive emulation described by peer-polity interaction may take place in a landscape of competing political centers, thus providing a powerful force of circumscription. Relocation in these circumscribed circumstances has severe costs and, therefore, the move towards state formation becomes more acceptable to all in society as the least costly of the alternatives.

The crucial phase of "state" formation may not be the implementation of the state itself but the development of important social changes prior to state formation. This is the more significant threshold: accumulation of wealth, associated with competitive feasting, ritual display and gift giving, can be seen in many regions of the world with emerging socio-economic differentiation.

"State" organization brings advantages and disadvantages. The primary area of disadvantage, for example, is exploitation. The organizers of many early states made successful attempts to extract labor from the majority. One prominent area is the well-being of the population, which can be calibrated by the simple measure of physical health. Increased population density has provided fertile ground for the development of diseases that differentially affected those at a material disadvantage.

The presence of the state is, therefore, a dynamic balance between the imposition of taxes (in the broadest sense) and the benefits of services and security. The limit of tolerance, if that formula went awry, varies between different societies. Many early states were under pressure to expand and extract more from the majority, producing tension between the rulers and the ruled. For the majority of the population, this would have disturbed the stable equation of advantage and disadvantage. Thus, in most early states, long-term trajectories were in the minority because there were always potential tensions contributing to decline and collapse.

In the final analysis, "state" formation is no more than the climax of a longer process in which social inequality is held more firmly in place. The formative phases are the development of the effective institutions of control and coercion in not just the urban center but the whole landscape. These institutions seek to provide more stable and resolute political power, which lies at the heart of the state. In reality, this control has never been absolute, and states exhibit varying control over space and through time. Considerable wealth differentiation may seem a very efficient implementation of power in the short term but may present a less stable political trajectory in the long term. This is perhaps the simple lesson that the knowledge of long-term trends determined by archaeology can provide for certain parts of the modern world.

The Molise region is a small territory with variable soil typology. The region of interest in this research is Low Molise, a territory that is decidedly rural both currently and in the past.

In this study, attention is concentrated on the demonstration of a hypothesis that differs from the traditional and current hypothesis that holds that the end of the Samnite population is clear and abrupt and corresponds to the heavy presence of the Roman people. The common current assumption is based on the general behavior of the Romans – attacks, conquests, destruction and 'Romanization' – towards the antecedent ancient people (Italic or foreign).

For historians, the reduction in the rural settlements in Molise, and in particular in Low Molise, where the situation is more evident, during the Roman period represents the main evidence of this 'violent' presence. In reality, this situation represents a better exploitation of the rural and human resources and, therefore, a stronger economy. In fact, if rural estates were combined together to form a single unit (or perhaps more plausibly a series of interconnected units), one might reasonably expect the changes in the way in which the land is exploited to be reflected in the archaeological record.

This work would like to show not only the gradual passage from the Samnite to the Roman period but also the importance of the settlement choices made by the Samnites and confirmed by the Romans. For this, it is necessary to use a multi-technique approach that combines techniques not frequently involved in historical and archaeological projects in Italy, despite their use in other countries, such as the UK, where I had the opportunity to spend part of my PhD in order to study such approaches.

This type of scientific approach begins with a survey of an area to evaluate the productivity of the resources customarily exploited by the inhabitants of a settlement. This survey represents a systematic study of an arbitrarily defined area around a series of known sites so that the main features of the areas can be compared to check for patterns or regularity. In this evaluation phase, geoarchaeology – a sub-field of archaeology that uses the techniques and subject matter of geology and other earth sciences – is very important to the examination of the natural physical processes that affect archaeological sites, including processes such as geomorphology, human behavior and the formation of sites through geological and anthropic processes and the post-depositional effects on buried sites and artifacts.

Then, the next step in the research is the detailed survey, which analyzes the archaeological potential of a specific site. Similar to field-walking, which can be fundamental to detecting fragments of tiles, pottery, and wall remains, geophysical surveys are necessary to determining the presence and geometry of buried structures, which is important to the global framework of the potential of the entire investigated site.

This type of multi-technique approach aims to support the conclusion about the settlement choices and the continuity throughout the Samnite and Roman periods.

If previous work was not the inspiration for the current research, the archaeologists will need to determine if any work has been done. Because many older surveys and excavations were published in papers that were not widely distributed, this may be a difficult task. A common way to handle this is through a visit to the area to check with local museums, historians and older people who might remember previous work.

Molise is the youngest of the Italian regions. Until the 1960s, it was administered with the neighboring region to the north, Abruzzo; the entire region was collectively known as the Abruzzi. Molise was formally recognized as an autonomous region in 1966, but its first elected administrative council took office in 1970. Until its own Archaeological Superintendency was established in 1970 in Campobasso, the capital city of the newly autonomous region, the archaeology of Molise was administered at a distance by the single Superintendency for Abruzzo and Molise in Abruzzo's town of Chieti. Because Molise lacked both a Superintendency and a university, its archaeology inevitably received far less attention than elsewhere in Italy, until the establishment of the autonomous region.

Given the wealth of knowledge to the north and south, it seemed highly likely that the almost total absence of published evidence for prehistoric finds in Molise reflected an absence of fieldwork rather than an absence of settlement. Indeed, the area was known to have been occupied in classical times. Molise, at least the inland mountainous portion, was known to have been the center of Samnium, the homeland of the Samnite tribes that the ancient historians describe as the most deadly and unforgiving enemies of the Romans during the Roman attempt to establish hegemony over the peninsula during the first three centuries BC. In 1967, E.T. Salmon published a masterly synthesis of Samnite history and culture [1]. While depending for the most part on ancient sources and epigraphic material, he also introduced into his narrative up-to-date archaeological research on the best-known Samnite and Roman monuments of Molise, notably the Pietrabbondante sanctuary in the northern mountains and the Roman town of Saepinum in the inland basin of the upper Tammaro River. Thirty years later, an Italian professor, G. Tagliamonte, refreshed the historical and archaeological views of the Samnite people in his book [2].

Most of the research in Molise was performed in the 1960s by a young Italian archaeologist, A. La Regina, working from the Chieti Superintendency. In 1970, he was appointed the first Archaeological Superintendent for the new autonomous region. In 1974, he invited G. Barker, who at the time was the Senior Lecturer in Prehistoric Archaeology at the University of Sheffield, to perform an archaeological survey of Molise [3]-[4].

The British field survey and excavation program began in September 1974 and the principal fieldwork continued every summer until 1978, though material studies and other fieldwork continued throughout the 1980s. The research on the historical landscape of the Biferno valley involved numerous specialist and students. In total, this survey covered approximately 400 km^2 of selected areas in the valley, which extends from the central plain around ancient *Bovianum*, the heartland of *Samnium*, down to the Adriatic. Fieldwork occurred primarily in the lower part of the valley between *Larinum* and the coast, but substantial areas were also covered in the uplands between *Bovianum* and *Saepinum* and in the middle reaches of the valley. In the upper part of the valley, 26 sites that certainly or most likely date to the early and/or middle imperial periods were identified (a population reduction of 40% relative to the previous "Samnite" period occurred during this time). Excavations of one such site, the farmstead at Matrice, showed that it originated in the late third/second century BC, was enlarged in the first century BC and again in the first century AD, but began to decline from the second century onwards, though it continued to be occupied into the Late Antiquity. Approximately two-thirds of all early imperial sites from the upper part of the valley failed to survive into the third century AD and many were abandoned earlier [5].

These findings have highlighted how the character of a Mediterranean valley landscape, the Biferno valley, changed profoundly over its prehistory and history. These changes were in response in part to changes in climate and environment and in part to human actions, and these changes presented new sets of constraints and opportunities for the inhabitants of the valley.

Following the British survey, the Biferno valley has become one of the most intensively investigated landscapes in Italy. Some of these studies [6]-[7] have continued in other parts of Molise. Moreover, this British research motivated the recent Archaeological Superintendent to perform fieldwork in this "new" region. Several studies, [8], [9], and [10], have revealed new information on this territory, with particular emphasis on the coastal and near-coastal areas.

The creation of the University of Molise with its Faculty of Preservation of Cultural Heritage creates a natural collaboration not only with the Molise Archaeological Superintendency but also with other Italian and foreign universities and institutions (e.g., the University of Perugia and the British School at Rome).

Special emphasis has to be placed on work in Molise [10], which in turn has encouraged more research on ancient Molise. Subsequently, the archaeological knowledge of Molise has improved, and it is now possible to estimate the chronology and the various findings from the relevant archaeological discoveries already known.

The first results of this new approach to the history of Molise was the creation of an archaeological map by the Regione Molise local government [11]. In this map, the Statistic and Cartographic Territorial Service (now Cartographic Research Centre) collected all the known, relevant, and scattered findings in the Molise territory, in order to create an updated database. However, this database was not updated after 1995, and recent findings and research are not included. New research has therefore been published in the form of single works without correlation to the other archaeological features.

This is relevant in particular for Low Molise, where many studies and fieldwork campaigns have been performed but are not collected together in a unique and coherent publication. This study, based principally on Barker's survey and Regione Molise's Archaeological Map, aims to analyze the Low Molise landscape and its previously discovered and new geoarchaeological features with a specific focus on rural settlement in the transition between the Samnite and Roman

period.

The aim of this paper is to develop a methodology for examining rural settlement choices in the transition between the Samnite and Roman period by combining several commonly available techniques used individually by geoarchaeologists: the interaction of geomorphology and archaeology and integrated prospecting strategies in the study of Low Molise sample sites.

Raw geophysical and field data can be obtained, processed and presented to enhance the education of the public in archaeology through the promotion of high standards of research, application and communication in the field of archaeological prospecting and related studies. These data can also provide, where appropriate, advice and recommendations on matters involving archaeological prospecting and related studies. However, the interpretation that follows generally requires a wider experience that encompasses an understanding of the site conditions and history, the principles of archaeological geophysics, and the limitations of instruments and survey methodologies.

A good knowledge of archaeology, geology and geomorphology is of course important. Ideally, an interpreter will already have such experience and will preferably have personally conducted and/or directed the relevant fieldwork (although this does not mean that the fieldworker is automatically qualified for the subsequent interpretation of the data). The factors that require consideration in arriving at an interpretation will vary from site to site but normally include at least the following: natural factors (e.g., bedrock geology, unconsolidated geology, soil type, soil magnetic susceptibility, geomorphology, surface conditions, topography, and seasonality) and artificial factors (e.g., landscape history, known/inferred archaeology, agricultural practices, modern interference, survey methodology, data treatment, and any other available data).

Any interpretation must normally take into account each of these factors, the emphasis of which varies according to the circumstances, and should include consultation with colleagues and other relevant specialists when necessary. For instance, experience shows that where there is even the most meager preservation of earthwork, a combination of field surveying and geophysical surveying is highly beneficial to the final interpretation. The degree of usefulness of the former will increase according to the conditions of the earthworks and the thoroughness of the field survey. Likewise, in situations where the earthworks have been completely ploughed out, a combination of aerial photographic analysis and evidence from historic maps will also yield useful interpretative data.

Arriving at an interpretation that takes into account so many factors can be a finely balanced process and the outcome will be colored by, and depend significantly upon, the experience of the interpreter. Above all, it is crucial that any interpretation draws a clear distinction between demonstrable facts that are securely supported by the data and less robust inferences. Additionally, the tendency to attribute significance to every detail – in other words, to over-interpret – should be avoided. Minutely annotated plots with laborious textual references to every apparently significant anomaly stretch the credibility and wear down the patience of readers. Generally speaking, it is preferable to exercise as much objectivity and restraint as possible and to err towards under-interpretation, resisting the embellishment of plots with wishful patterns and details.

Though much importance is given to the graphical presentation of results (which more often than the text holds the reader's attention), it is important that the graphics are supported and complemented by precise written discussions as well. Occasionally, contractors have risked applying percentage 'confidence ratings' to the interpretation of geophysical anomalies. These ratings are an acceptable additional option only with the clear understanding that such ratings are partially subjective and potentially fallible assessments, applicable only to the specific survey data.

The refinement of the interpretation of geophysical surveys is, to a significant degree, dependent upon the feedback of 'ground-truth' following the survey fieldwork. Whenever possible, every effort should be made to encourage such feedback and its subsequent dissemination into the general pool of accumulated experience. To aid this process, curators can stipulate that trial trenching and excavation reports are sent to the geophysical contractor, that mitigation and publication briefs make allowance for the results of geophysical surveys, and that reports include post-excavation comments for the geophysical contractor (if appropriate).

To summarize the general expected outcomes, it is possible to argue that the deliberately inter-disciplinary approach, the size of the research area and the accurate timescale of this study would provide at least some understanding of the forces that shaped this particular landscape rather than just describing the forces. Certain questions are necessary to target the outcomes: How did different forces of history shaped life in Low Molise? How did the outside world influence what happened there? How did the different people of Low Molise interact at different times in the past? What physical impact did the inhabitants of the valley have on their landscape?

This study focuses on a particular period of the past in Low Molise. The most important contribution of this work is to provide a set of detailed geoarchaeological and historical data detailing Low Molise's entire settlement history, which is likely unique for that period. Of course, there are major weaknesses in the data sets, but the repeated correlations between the Samnite and the Roman sequences on the one hand and periods of settlement expansions and/or land use intensification on the other provide powerful evidence for the critical role of Low Molise farmers in shaping their landscape.

2. Materials and Methods

The aim of this project is to develop a new methodology in Molise to examine the period between the Samnites and Romans based on a multi-technique approach. This research

attempts to demonstrate that the transition between these two societies was gradual and not violent and that the new culture tried to include and assimilate and not to cancel the culture, society and economy of the pre-existing inhabitants. This type of scientific approach, which is relatively innovative in Italy, examines several sample areas, analyzing their general context (natural and artificial, geological and archaeological) and their development through the centuries.

In certain contexts, geoarchaeo-physical methods can produce data sufficient for the description of and the intra- and inter-site analysis of features within geoarchaeological sites or larger landscapes. Geophysical surveys were applied at several sites located by field-walking for two purposes: to investigate the possibility of intact geoarchaeological deposits below the ploughed soil in order to identify representative sites for possible future excavations and to attempt to map outlying geoarchaeological features around known sites.

This study uses an integrated strategy and confirms the importance of complementary techniques for the assessment of not only a sample site but also an entire historical period.

By identifying certain interesting areas inside the Low Molise region based on bibliographical, Superintendency and previous survey sources, it was possible to plan the geoarchaeological survey.

This type of survey performs multiple functions. It is necessary to understand the geology and the geomorphology of Low Molise in order to evaluate the 'natural' impact on the ancient settlements. Moreover, a geoarchaeological survey can identify stratigraphic traces of these settlements with particular emphasis on the Samnite and Roman periods.

The geoarchaeological survey, therefore, involves the careful examination of the territory, including searching any exposed sections to analyze and report the geological stratigraphy. In this area, dipping clay layers are interbedded with limestone beds. Due to the region's seismic risk, this geomorphology makes this area subject to landslides, but the geology makes the soil particularly fertile [4].

The survey also located a large quantity of archaeological remains, from pottery fragments to building remains, scattered in certain specific zones. Geophysical techniques were used in these scattered areas, due to the specific chronology (Samnite and Roman), to detect buried structures, which would provide information on both the type of settlements and the choices made by former residents of the study area.

In the first part of the geoarchaeological survey, it is unnecessary to use particular tools (e.g., field-walking and the collection-evidence approach). The second part of the survey – the geophysical aspect – involves the use of specific purpose-built instruments. These instruments are a gradiometer, for the magnetic survey, and a ground penetrating radar (GPR) instrument, for the electromagnetic survey.

To be able to correlate between sites, the same settings are used for the gradiometer and GPR instruments for all investigated sites. The only difference is the grid dimensions due to the nature of the individual sites. The gradiometer is an Overhauser (GSM-19) instrument by GEM and uses a cycle rate of 0.5 sec, a frequency of approximately 10 cm, a resolution of 0.01 nT and an absolute accuracy of ±0.1 nT. The distance between sensors and between profiles is 1 m. The GPR device is a Noggin Plus Smart Cart by Sensors & Software, which uses 500 MHz antennas, a stacking of 4, a time window of 60 ns and a step size of 0.05 m. The distance between profiles is 0.5 m.

A portion of certain gain changes and all the raw gradiometer and GPR data are high quality and need no filters or other processing.

3. Results

The results of the visual, magnetic and electromagnetic surveys show remarkable evidence for the presence of people both in Samnite and Roman periods. The geophysical data sets are very similar to each other; namely, they reflect the same probable buried features, i.e., manmade structures such as buildings or roads, and chronologically correlate with the archaeological stratigraphy. The combined data are shown below in detail using maps that highlight the most relevant anomalies, and geoarchaeological and historical interpretations are provided.

Wherever possible, both GPR and magnetometer geophysical measurements were collected due to their differences in terms of geophysical and geological characteristics. Magnetometer surveys were optimal for the most conductive soils, whereas GPR surveys performed better in less conductive soils.

Using several geophysical approaches, [12] and [13], it is possible to eliminate the damage effects of ploughed soil in the geophysical data results, as well as to understand the stratigraphy of any buried structures, in particular whether these structures are related to different historical periods. The conventional techniques locate and delimit plough-threatened sites, confirm protected areas on the ground and indicate the condition and preservation of features. In contrast, the high-resolution techniques identify buried building materials based on geophysical anomalies (magnetometer, GPR or field walking), establish depth of burial, produce semi-quantitative models for assessment and monitoring and visualize the risk to buried remains. The practical approach to obtaining interesting results involves a noise-reducing principal component analysis (PCA) of adjacent time slices, the application of an appropriate threshold to extract high-amplitude responses and the calculation of the volume of high-amplitude responses per time slice. The aims of this type of approach are very clear and very useful. In fact, high-resolution geophysical surveys can identify plough-damaged building remains in the topsoil and their historical settlement sequence over the course of centuries [12]. Semi-quantitative models allow assessment without intervention, and complementary monitoring can be achieved through repeat surveys (involving glass chips or transponders). Finally, visualizing the impact of plough damage can assist mitigation [14].

3.1. Guglionesi

In the Guglionesi countryside, there are many areas in which it is possible to confirm the hypothesis of this work. In particular, three areas with certain peculiarities have been identified. In the locality Colle S. Adamo, the visual survey identified impressive remains of a Roman wall, partially rebuilt in the following centuries. This type of feature, along with the brick and ceramic fragments scattered around it and the considerable rural importance, motivated the geophysical investigations.

The magnetometer identified the presence of a dark anomaly close to the visible wall, and the GPR confirmed previously unidentified parts of this wall. The geophysical map also shows that the visible wall sits atop a substructure, which confirms the presence of two different periods of use for this possible farmstead. Moreover, the magnetic survey highlighted several orthogonal features that may be related to a Samnite farmstead that was later enlarged by Romans into a villa. In the magnetic map, the presence of a NW elongated anomaly is clear. This feature is likely a newly discovered ancient road, for which there is no previous archaeological evidence (Fig. 1).

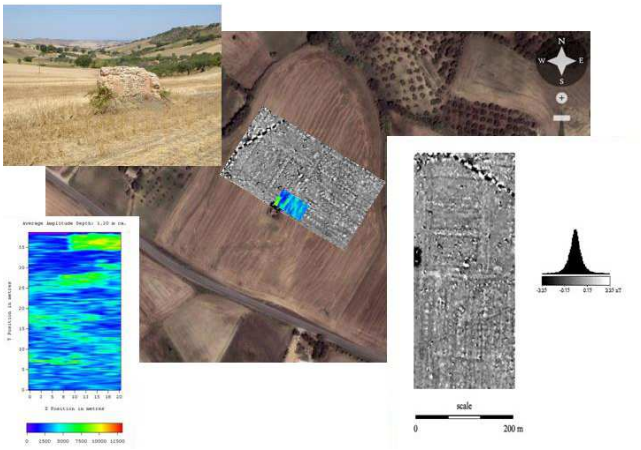

Figure 1. *The visible remains of an ancient wall (upper-left), and the geophysical results (overlapped and not) around this wall in Colle S. Adamo, Guglionesi.*

The archaeological potential of this area is relevant and the geophysical responses illuminate less investigated areas, confirming the presence of both Samnite and subsequently Roman settlement.

In the locality Colle del Fico in the area of Guglionesi, the visual survey revealed a large area of archaeological fragments dating to the Samnite and Roman periods. In particular, there were several partially burned brick fragments. The hypothesis of a burned site was confirmed by the GPR and magnetic investigations. In the geophysical data, an archaeological stratigraphy of two overlapped manmade structures with orthogonal external walls and an evidently burned inner portion. It is possible that the inner burned part was the most recent settlement, dating to the Roma Republic period, whereas the external walls were the old Samnite foundations used for the new Roman farmstead (Fig. 2). The superficial depths of the burned area, the very deep walls and the geoarchaeological evidence in the soil of burned traces support this reconstruction.

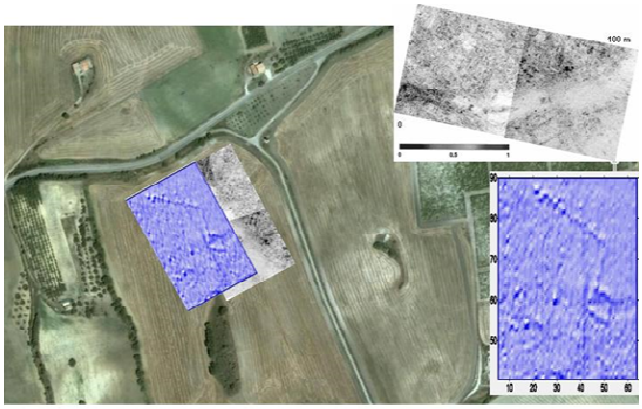

Figure 2. *The geophysical results (overlapped and not) for* Colle del Fico, *Guglionesi.*

3.2. San Giacomo Degli Schiavoni

The area close to the town of San Giacomo degli Schiavoni has commonly been the subject of archaeological investigations that attempt to identify the location of the ancient settlement of *Uscosium*, a Samnite town, and then the Roman *municipium*. These studies failed, but the survey collected in association with this thesis has changed the situation. In fact, before performing a visual survey in San Pietro, the analysis of satellite photographs identified the presence of relevant crop marks on the soil due to manmade structures, such as road crossings or similar (Fig. 3).

Figure 3. *The satellite photographs in which several crop marks are clear in San Giacomo degli Schiavoni.*

The visual survey located a very large area with a high density of scattered ceramic fragments, bricks, marble fragments, bones and other fictile elements at the scale of approximately one kilometer. The geophysical surveys displayed clear anomalies due to a road crossing and to a built-up rural area in the northern study area (Fig. 4). The southern study area featured the likely continuation of the road observed in the northern part (Fig. 5). Both GPR (for high resolution) and magnetometer (for large spatial coverage) data improve our understanding of the size of this type of buried

site, and this evidence, in association with the literature, indicates that this settlement was likely *Uscosium*.

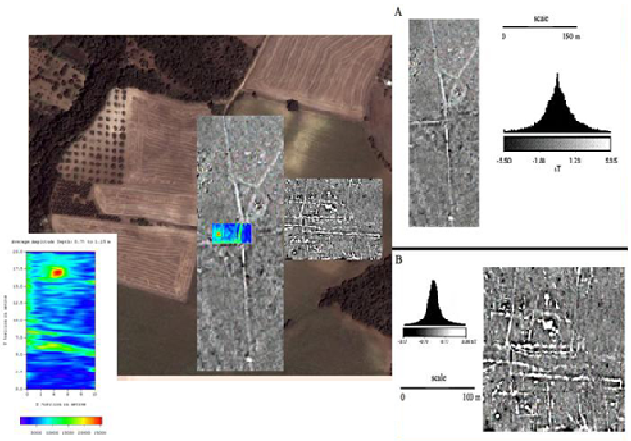

Figure 4. *The geophysical results (overlapped and not) for San Pietro, San Giacomo degli Schiavoni (the northern part).*

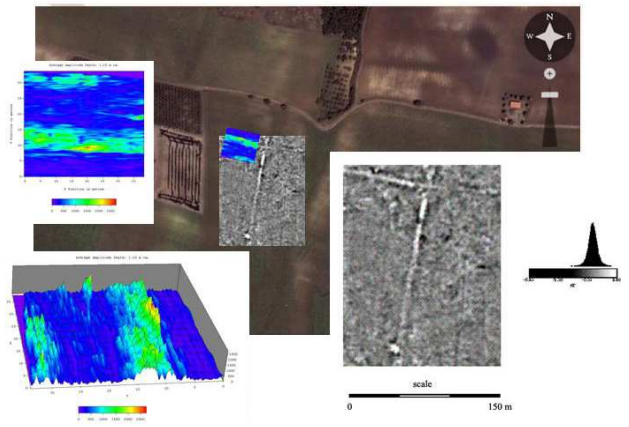

Figure 5. *The geophysical results (overlapped and not) for San Pietro, San Giacomo degli Schiavoni (the southern part).*

This revelation confirms the conscious choice of the Roman people to re-use the pre-existing Samnite settlement for its strategic position near the L'Aquila. Additionally, significant Foggia drove-roads and a buried road were identified by the geophysical surveys. The modern intensive rural exploitation of the area has hidden the exact localization of the site, which may explain the failures of previous investigations. Our findings confirm the marked rural occupation of this area in ancient periods. Finally, the presence of a Republican Roman villa in the proximity, discovered by the Superintendency [4], [5], [10], and [11], reveals that this ancient town was important enough that the Roman elite chose to build a luxury residence.

In another locality, Monte Antico, near San Giacomo degli Schiavoni, two areas were investigated. Both areas revealed, in the visual survey, the existence of a broad zone with fictile fragments dated to generally Samnite and Roman periods. The geoarchaeological survey found two different soils, one conductive and the other non-conductive. Therefore, the geophysical data were collected using the GPR technique for the non-conductive soil and the magnetic technique for the conductive one.

The results of both techniques are not very interpretable. The magnetic data show certain anomalies with partially rectangular features (a farmstead?) that are stratified and from two different ages. The GPR survey in the other zone shows several better-defined anomalies. These anomalies are similarly interpreted as a farmstead with different occupations during the centuries (Fig. 6).

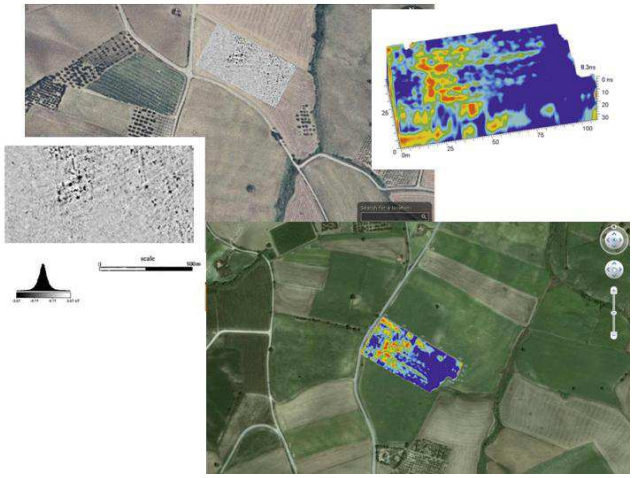

Figure 6. *The geophysical results for the two localities of Monte Antico, San Giacomo degli Schiavoni, using magnetometry (upper-left) and GPR (bottom-right).*

3.3. San Martino in Pensilis

San Martino in Pensilis is an interesting case study. The Superintendency discovered a Roman villa in the locality Mattonelle [10] and [11]. At this site, the visual survey found did not find many fictile fragments around the remains of the villa. Surprisingly, at a distance of approximately 50 meters from the villa, a mass of scattered Samnite remains, partially hidden by a tomato field, was discovered. These remains were part of walls, ceramics and other fictile fragments definitely linked to a Samnite farmstead.

The geophysical survey supported this evidence. A rectangular anomaly, related to a rural building, is clear in both the magnetic (even though the magnetometer experienced some interference during the data collection) and in the GPR data (Fig. 7).

This is the only case in which the Romans preferred to choose a settlement a slightly removed from the Samnite one. This difference is small (a few dozen meters), but it is relevant compared to the other cases studied so far. A possible reason could be related to the geological characterization of this area. Even today, the area is sometimes subject to flash floods and landslides, which disrupt the soil and everything are on it. In all likelihood, a similar catastrophe occurred in the past, exactly in the transitional period between Samnite and Roman occupations, and for this reason the Romans preferred to build their villa rustica in a safer area.

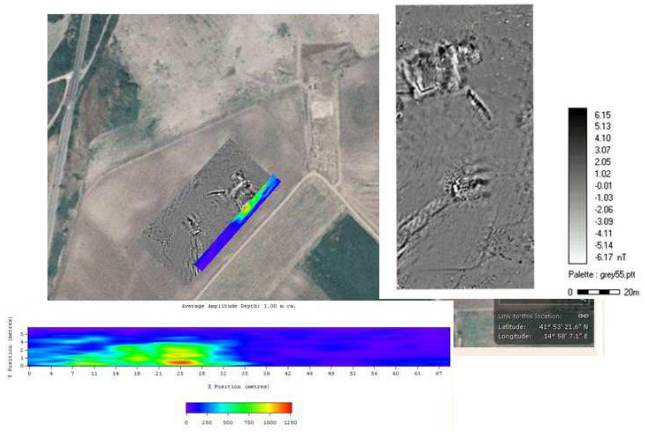

Figure 7. *The geophysical results (overlapped and not) for the locality Mattonelle, San Martino in Pensilis.*

3.4. Petacciato

The coastal town of Petacciato features archaeological potential in two different but proximal localities very close to the Roman traces of centuriation [10], and [11]: Marozza and Fonecale. The visual survey of these two sites revealed debris concentrations of Samnite and Roman pottery, fragments of a single adult human's bones and many tiles and bricks, especially in Fonecale.

As shown in the case of locality Monte Antico (San Giacomo degli Schiavoni), different soil characteristics led to the use of GPR in the case of less conductive soil (Marozza) and the magnetometer in the case of highly conductive soil (Fonecale).

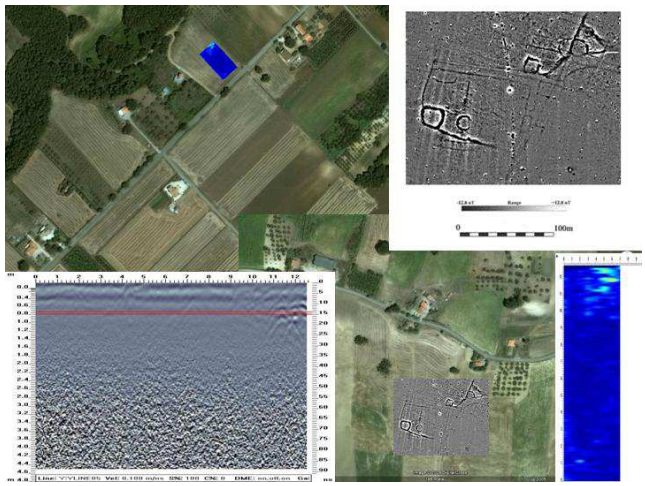

Figure 8. *The geophysical results for the two localities of Marozza and Fonecale, Petacciato, using magnetometry (Fonecale, bottom-right) and GPR (Marozza, upper-left).*

The GPR investigations reveal anomalies that are difficult to interpret. These anomalies may represent a rural settlement but are certainly related to anthropic stratified occupation dating to the Samnite and Roman periods. The stratigraphy of this site is also documented in the GPR section, in which the hyperbolas are stacked. The magnetic data set, instead, features many anomalies that appear to be agglomerated to each other, creating a complex rural stratified settlement with two different times of visitation (Fig. 8). These data, correlated with the presence of human bones, pottery, tiles and bricks, are important to understanding the evolution of the landscape of this area and, in particular, the Roman selections of their settlements according to the pre-existing Samnite choices.

4. Final Remarks

Recent discoveries about ancient Italic peoples have revolutionized our knowledge of the past and have revealed an extraordinary mosaic of peoples and cultures [14].

There was a gap in the history of Italy. This historical gap was damaging because it conditioned the knowledge of the first events that pulled the peninsula out of the prehistoric age and lead to the creation of an organic country via a troubled process that stretches from roughly the 8th to the 2nd centuries BC. In that process, we knew the main actors, namely the Romans, but we knew little of their antagonists, who fought against the conquest of Rome. Worse yet, we knew only what the Romans recorded.

In recent years, a great succession of archaeological discoveries has profoundly changed this situation. Throughout Italy, the non-Roman people, who lived on the peninsula in the oldest historical period, have been brought to life with variable pieces of culture and art. If it is true that the conquest homogenized these peoples, it is also true that memory survived in the Roman world, which has provided evidence in its own way. Is there a reason why so many discoveries have occurred in recent years? We have a more prodigious research techniques due to geophysical surveys and satellite/aerial photography, which can identify subterranean features without even a pickaxe.

More advanced historical perceptions also now exist. These perceptions focus on the historical gaps, as well as on better understood periods, and on the losers, as well as the winners. Above all, surveys and excavations should not only to objects but should solve problems.

Therefore, the greatest discoveries regarding the ancient Italic peoples and their environment contribute to create a part of the reference frame. However, above all, it is necessary to change attitudes and to recognize the extraordinary mosaic of peoples and cultures (both those that arose on the peninsula and those from abroad) in ancient Italy. The Roman unification, then, appears almost a parenthesis in the dominant reality of a dispersed and fragmented world.

The development of this research aims to illuminate the unclear period straddling the Samnite and Roman periods in the Molise region, where this dichotomy between the Italic people and Romans was delicate and painful.

The results obtained here suggest that the handover between the Samnites and Romans was not only gradual but also featured the development of Roman settlements on the sites of Samnite ones. The Romans clearly identified areas most strategically useful for communications (close to drove roads and capillary infrastructure throughout Low Molise) and

agricultural production (one of the cornerstones of Molise across all centuries).

The analysis of the historical Low Molise landscape, therefore, clearly shows settlement continuity between the 4th century BC and 1st century AD (between Samnites and Romans). The analysis also shows how this transition was sequential from the three Samnite Wars to the Roman awareness about the Italic value in the social economy of the Republic with regard to the rising Empire.

The general conclusion must be that the earliest rural dwellings in Roman Italy were made of wood, with a thatched roof and wattle or stone walls. Where it existed, rock was utilized for foundations. The style of building varied spatially and temporally according to the locality and the materials available. By the end of the Republic, most farmhouses were made of stone, with outbuildings of similar construction. Temporary buildings, shepherds' huts and the homes of the montani continued to be constructed in the primitive manner. Greek influence in South Italy resulted in more elaborate stone buildings and was probably responsible for the tower-like structures, in which, as in medieval and modern times, the lower story was used for stabling and storage. Small farms, which have been mapped and in some cases excavated, have until recently usually been found on or near Roman roads. This pattern arose naturally because the roads themselves were being traced and studied. There were, however, many others cottages and farm plots, some widely scattered and, currently, not served by any paved road.

Though many questions concerning subsistence farming in the Roman period remain unanswered, certain conclusions can be drawn within the limits of present knowledge. First, the subject of ancient farming must be discussed with reference to Italy as a whole and not merely to the *ager publicus* or the *coloniae*. A considerable proportion of the Samnite small farms in Molise throughout the Roman period must have been in hill-country and on marginal land. [1]. Variations in climate and terrain produced large differences in the methods of farming, the crops grown and the life-styles of the agricultural communities. Moreover, it would be undesirable to confine the study of ancient agriculture to large farms, the commercial production of oil and wine and the *latifundia*. If we are to fully understand the political and social history of Rome, we must be aware of the modes of life pursued in the countryside by thousands of Roman citizens and "allies" and of the changes, however slight, that can be discerned within rural communities during the period of Rome's conquest and supremacy. Such changes, however, were often organizational and structural, leaving the basis of traditional procedures little altered. Second, we cannot and should not make a sharp division between Roman farm life and those agricultural practices existing in Molise before the Roman period. It is possible to detect a clear continuation between the Samnite and Roman periods, especially for rural settlements. The Roman people took advantage of the geographical position of these lands, as had the Samnite people a few centuries before [14].

This decision is double justified: First, in a delicate period of alliances, the Romans preferred to not disrupt the equilibrium with this particularly aggressive Italic people, and they became slowly involved in the Samnite social and economic system (in which agriculture was the fulcrum), thereby preserving structures and their uses. Second, Romans understood that the Samnite geomorphological choices regarding rural land exploitation were the decisions that produced the most food and commodities.

4.1. Research Improvement and Future Opportunities

Where does this leave the study of the landscape? This type of study has social, cultural and political imperatives, as well as an academic one. One might see the origins of geoarchaeology as a whole in terms of two conflicting impulses. The first impulse is to make generalizing statements about humankind: From this impulse springs evolutionary geoarchaeology in all its forms and a heavy emphasis on theory. The second impulse involves the curiosity about what is in one's own backyard. This impulse does not strive to explain the general sweep of history but to answer questions about the fields around one's home and one's local community.

Due to this assumption, I would like to propose three very simple steps for research future in general and landscape geoarchaeology in particular. First, anthropological otherness in the past should be acknowledged: The celebration of the landscape and the human history it contains ceases to be an inherently conservative enterprise and can instead be an exploration of human possibility. Second, mobility, conflict and change should be accounted for in reconstructions of the past: People moved around, had conflicts with each other, and often saw very sudden changes in their lifetime, such as parliamentary enclosure. Third, and perhaps most vitally, the assumption that there is one single way of understanding the landscape should be questioned: Almost anyone can be coached to internalize and produce an "appropriate" response, but that will be at the expense of the person they thought they were.

The stabilization of decay is a continuous activity that requires varying inputs of labor and funds depending on the nature of the remains and the circumstances of their setting. The concept of a management cycle has been proposed to outline the different stages of monument management and to highlight the need for continuous attention. For example, sites cannot simply be fenced and left: Grass cover will regenerate to woodland, and stonework and other upright remains will decay and collapse.

The management cycle can be characterized as follows:

- Identification: Geoarchaeological remains in the landscape must be located, ideally by systematic survey as shown in this study, though many important sites are discovered by chance, often in the course of their destruction.
- Assessment: Geoarchaeological sites and landscapes must be assessed in terms of their importance or significance and their prospects for continued survival. Priorities for preservation have to be established and

decisions made regarding which sites can be saved and which must be excavated and recorded before destruction. These choices should be made in terms of local and wider research objectives, as well as the physical circumstances of survival. Survey and recording are particularly necessary at this stage.

- Stabilization: A management plan should be drawn up to indicate the immediate and long-term steps that need to be taken to preserve the remains. The short-term stabilization may involve repairing masonry, burial of exposed deposits or protection from artificial or natural forces.
- Long-term management: All geoarchaeological remains require long-term attention, whether by incorporation into an agricultural regime (i.e., regular grazing of buried sites) or by intensive monitoring and constant work involvement.
- Research: Without a research framework to promote interpretation and understanding, all geoarchaeological conservation is pointless. Research, both into suitable methods of conservation and into the sites themselves, is required at all stages of the management cycle.

Different conservation strategies are required for different geoarchaeological environments. In many ways, a 'cook book' approach is not possible because each particular site, monument or landscape has its own unique combination of environmental, landholding, financial and legal problems. The management plan drawn up for a particular site will have to be tailored to its specific circumstances.

The philosophy of preserving the past is justified by a number of ideas about the notion of social continuity, lessons from history, national and cultural identity, world cooperation and a desire to save a finite resource for the less-damaging investigative methods of future generations. It is a political tool that can be used to justify claims to land or to treasures, as well as claims of racial chauvinism or equality. What may seem to some to be a 'dead' past is to others a very real component of the present. Geoarchaeologists are continuously engaged in sifting through the rubbish heap of history and representing selected aspects of previous worlds, thereby bringing those lost and forgotten pasts into the present.

It may be said that the job of researching the past is too important to be left to specialists such as geoarchaeologists and historians. Everyone should be empowered to research the rubbish heap and select for themselves the knowledge that they seek. Equally, the judgment of what to preserve and what to present is open to abuse and falsification, either in pursuit of profit rather than knowledge or in the promotion of political ideologies. However, there is no escape from the dilemma. Time and money are invested into geoarchaeology partly because it provides returns on that investment, if only in an indirect way. It is not possible to conceive of a past free of political ideology or without contemporary political overtones. Whether these are the ideologies of living traditions and their sacred sites or the writing of the past in terms of the political present, there is no escape. However, people in the present have to learn to exercise critical judgment about the claims that are made, including the present contexts in which the claims are made.

Geoarchaeology can be used for numerous ends: It teaches to transcend the territorial boundaries of the modern 'nation-state-regions' and to challenge the accepted wisdom, oral traditions and official myths. It is necessary to use it to debunk long-held notions, as well as to recover the memory of humankind. In so doing, researchers must constantly question and examine the myths that are created by geoarchaeology's practitioners.

5. Conclusion

It has become imperative for the scientific community to achieve a 'global' knowledge of the landscape, both to obtain comprehensive answers to specific historiographical and geoarchaeological questions and to cope with the problems of territorial protection and planning, including urban areas.

An issue of such proportions will require the development of strategies that rationalize the workforces involved. It is clear that the research may be influenced by several factors that determine the operational manner because it is programmed, has restricted time limits or funding, or has the goal of a particular valorization. In any case, the preliminary assessment of the potential intervention will determine the adopted procedures.

The multiplicity of the possible approaches makes it essential to adopt an open multi-technique approach in an objectively complex field and to employ investigation tools of various types. These approaches are more productive when supplemented with additional data.

Who 'knows' that the layered landscape is the result of complex dynamics, produced by what is generally understood as cultural process? This question gives an opportunity to reflect on the meaning of planning. No geoarchaeologist knows whether the subject of his or her investigation was produced by gradual and long-term changes or sudden and traumatic shifts.

In the light of new studies and methodologies, the purpose of this work is to transition this type of investigation (with respect to overviews of the cultural potential and the possible valorization of the landscape) from pure rescue operations – which tend to be episodic, weak and sometimes paralyzing – to guidelines for planning and management. The goal is the non-destructive discovery of new sites into the already existing framework.

The idea that people lived in landscape and that the distribution of their material remains over broad areas produces a larger understanding of past behaviors. The results of a large regional study have been constrained along three dimensions. First, not all past societies produced large constructions, such as mounds, earthworks, terracing or irrigation systems, that might remain visible on the surface today and that might form the basis for a landscape geoarchaeological study. Second, focus has been placed principally on portable artifacts even though they represent only a small fraction of past human activities and material

manifestations.

Third, most work has been necessarily confined to arid landscapes or, in some cases, to ploughed fields in more vegetated climates, where surface artifact distributions can be observed and mapped. In general, buried architectural features, such as houses and farmsteads, are rarely revealed by surface evidence, an unfortunate circumstance given that dwellings represent the focus of cultural activity and are nearly ubiquitous throughout much of the past. Other buried features, such as roads, trails, ditches, plazas, storage facilities, gardens and graves, are likewise rarely discovered through a simple surface survey.

In this thesis, the direct and visual study of settlement context and forms through the analysis of the current and ancient rural environment allows us to suggest an alternative perspective based on regional or landscape geoarchaeology. Space can be viewed in terms of human choices with regard to cultural resource management.

The results demonstrated that a multi-technique approach can be useful not only to support a historical hypothesis in place of a traditional thesis but also to develop strategies for future improvements and landscape valorization opportunities. The period between the Samnites and Romans was gradual and not violent. The Romans tried to include and assimilate and not to cancel the culture, society and economy of the pre-existing inhabitants. This type of scientific approach, innovative for Italy, was used to examine several sampling areas and to analyze their general context – natural and artificial, geological and archaeological – and their development through the centuries, emphasizing the importance of the Low Molise rural countryside.

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