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Wieke de Neef, Kayt Armstrong and Martijn van Leusen

Groningen Institute of Archaeology, Groningen, the Netherlands

ABSTRACT
This paper presents the results of an in-depth multidisciplinary restudy of small Metal Age surface scatters recorded in earlier fieldwalking surveys in northern Calabria (Italy). Guided by a stratified sampling approach based on site types and topographic positions, high-resolution surface collections at the selected sites were combined with geophysical surveys, test pits, and soil studies to investigate both archaeological deposits and the site formation processes that have an effect on their detectability. This approach is shown to result in a better definition of archaeological 'sites', and to help fill in details of regional exploitation and settlement dynamics at the landscape scale. At this broader scale we are also able to model post-depositional processes and slope dynamics affecting the preservation of the archaeological record. With regard to methodology, our study has enabled the evaluation of diverse archaeological detection methods and the fine-tuning of field strategies for the study of Metal Age remains.

KEYWORDS
Landscape archaeology; Italian Metal Ages; site classification; prospection methodology; interdisciplinary site studies

Introduction

Our understanding of pre-Classical rural landscapes in the Mediterranean is hampered by the often poorly preserved archaeological remains, the limitations of fieldwalking, and a persistent research bias towards 'central places' and easily accessible landscape zones (Bintliff 2011; Van Leusen 2001; Feiken 2014: 3). For these reasons small pre-Classical surface scatters, which are found in almost all Mediterranean fieldwalking surveys, are often not investigated beyond the initial mapping stage. In this paper we argue that it is possible to come to a better interpretation of such sites by systematically integrating high-resolution surface and subsurface datasets. Furthermore, by extrapolating site-specific results to a set of similar find locations, a reconstruction of ephemeral land use on a regional scale becomes feasible.

Our argument is based on the results of the Rural Life in Protohistoric Italy (RLPI) project, a research program (2010–2015) directed by P. M. van Leusen, focusing on the Raganello Basin in northern Calabria, Italy (FIGURE 1). This project takes as its point of departure 155, mostly small, surface scatters documented during ten years of systematic intensive fieldwalking surveys by the Groningen Institute of Archaeology (GIA), which broadly date to the Metal Ages (ca. 3000–720 B.C.). These scatters occur everywhere in our research area, from the gently undulating agricultural areas in the foothills and upland valleys to steep slopes and mountaintops, and testify to human activity in various landscape zones. Demonstrating the presence of such activities in what many consider to be marginal parts of the landscape has already added significantly to our knowledge of Metal Age society in southern Italy, which is still mostly based on the study of large 'central' settlements. However, if we want to understand what activities these scatters represent, we need to know more—not only about the remains themselves but also about how they enter the archaeological record.

An interpretation of what small-scale Metal Age scatters actually represent in terms of settlement patterns, land use, and exploitation dynamics, is hampered by a set of problems which require special attention. Firstly, the most common Metal Age surface remains consist of poorly preserved, handmade ceramic fragments. In Italy, many survey projects are faced with non-diagnostic body fragments of such *impasto* pottery, which cannot be dated more precisely than 'Metal Age'; this makes it almost impossible to assess what they mean in terms of function, chronology, and possibly related structural remains. Secondly, most Italian and Mediterranean landscapes are characterized by pronounced relief and until recently were under intensive agricultural exploitation; thus, geomorphological and anthropogenic post-depositional processes deeply influence the preservation and detection of such sites. A third issue, related to the previous two, consists of the multiple research biases involved in the recording of ephemeral surface remains, caused by survey strategies, accessibility of research areas, and artifact visibility.

The limitations of interpreting past land use only on the basis of surface remains have been recognized by most Mediterranean fieldwalking projects, and additional prospection techniques such as geochemistry, aerial photography, and geophysical techniques are applied by many of them (Bintliff et al. 2007; Vermeulen et al. 2006; Guldager Bilde et al. 2012). However, further detailed investigations are usually not directed at small sites or remote places, resulting in a systematic bias in favor of large sites and/or historical periods, and an underrepresentation of marginal landscape zones such as the inland areas of Italy (van Leusen 2001). So far, only the Biferno Valley Survey and the Laconia Rural Sites Project have systematically investigated small surface scatters from different periods with

CONTACT Wieke de Neef w.de.neef@rug.nl Groningen Institute of Archaeology, Poststraat 6, 9712 ER, Groningen, the Netherlands

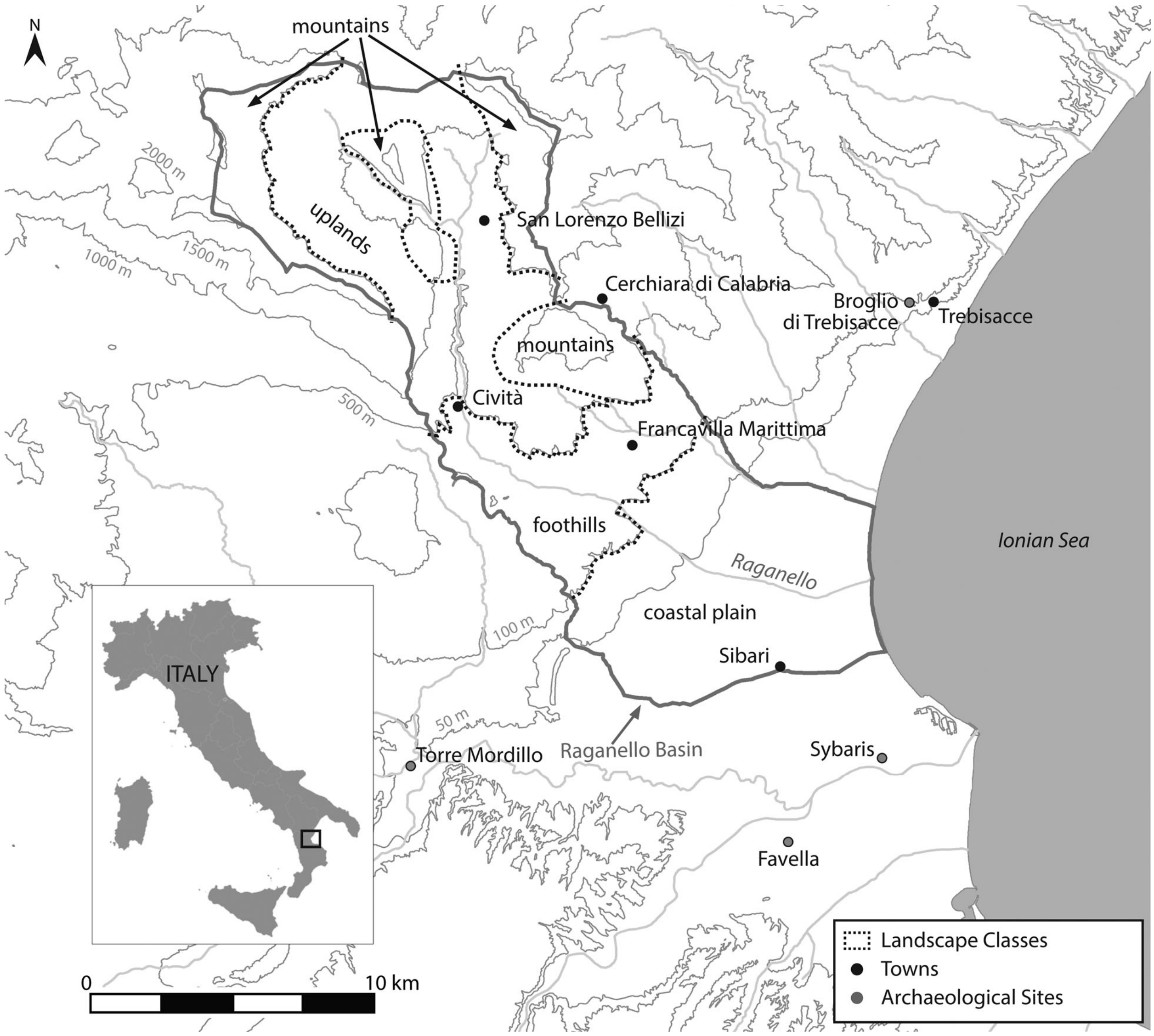

Figure 1. The Sibaritide in Northern Calabria (Italy). The Raganello Basin is indicated with a grey outline. The four landscape classes used in site classification are marked with dotted lines. Towns (black dots), archaeological sites (grey dots), and case study areas (bold italic font) mentioned in the text are indicated.

non-invasive prospection methods, and published their results in detail (including, laudably, their failures; Barker 1995; Cavanagh et al. 2005). The integration of high-resolution datasets incorporating rural sites within the framework of a landscape approach, as applied by the RLPI project, is unprecedented in Mediterranean Metal Age studies.

To counter the distortions in our knowledge of Metal Age landscapes, we decided on an inter-disciplinary approach focusing on three key questions. Firstly, we aimed to establish the presence of buried deposits to explain the presence of artifacts on the surface, to extract datable material, and to obtain better-preserved artifacts for a stronger functional interpretation. Secondly, we mapped the natural and anthropogenic processes that affect the preservation and detection of these subsurface deposits. This is important if we want to evaluate our distribution map in terms of geographical circumstances: whether archaeological surface sites are recorded, and recordable, in specific landscape parts, where they may be eroded or otherwise destroyed, and where they may be hidden beyond the range of our methods. Finally, we tested and evaluated the use of complementary prospection methods in order to mitigate detection biases. In this paper we will use three case studies to argue that a combination of these three approaches is crucial for the reconstruction of Metal Age rural landscapes.

Background

Our fieldwalking dataset was compiled between 2000 and 2010 in the basin of the seasonal Raganello River, which connects the mountainous hinterland of the Pollino range, at the southern end of the Apennine chain, to the coastal plain of Sibari. Originally a student exercise aiming to explore the surroundings of the excavations at the Iron Age/Archaic sanctuary of Timpone della Motta, these surveys grew into a large independent research project (the Raganello Archaeological Project or RAP) (Attema et al. 2012: 6–7). Over the course of 10 years, approximately 13 km^2 were covered in three transects crossing different landscape zones, resulting in 255 archaeological sites, ranging from Metal Age ceramic scatters to sub-recent threshing floors. A valuable addition to the range of detected sites, as well as a significant bias correction, came from members of the local speleological club, Sparviere, who reported archaeological materials from caves, rockshelters and other remote locations out of range of the regular fieldwalking survey. However, at the same time, the coastal plain remains largely uninvestigated: coring campaigns have shown that Classical period surfaces are buried under several meters of alluvial sediments (Cherubini et al. 2005: 16). Known sites outside the Raganello Basin research area, such as the Archaic colony of Sybaris (Rainey et al. 1967) and the Neolithic village of Favella (Tiné 2009), indicate that the plain must have been inhabited too. The RAP for the most part employed a non-site oriented, all-period survey strategy, in which units of 50 × 50 m were covered at a 10 m walking interval (20% surface coverage); relative increases in artifact density were investigated by subsequent targeted 'total samples' at 100% coverage. Site definition was not based on absolute density thresholds but rather on local increases with respect to general background levels; even very diffuse scatters of only a few artifacts could therefore be defined as a 'site'. This approach allows us to assign meaning even to very ephemeral remains, which is useful in an artifact-poor landscape such as the Raganello Basin. All archaeological material was collected, documented, and stored, and the find assemblages remain available for restudy. In the current RLPI project this has proven to be a valuable asset, since our knowledge of the material categories has increased to such an extent that we can extract more information from our inventory than during the RAP years.

The majority of sites recorded by the RAP, 155 out of 255, consist of Metal Age handmade pottery (impasto) scatters. This constitutes a substantial increase in the general dataset of Metal Age sites in the Sibaritide, which before the RAP consisted of 36 locations published by renowned Italian protohistorian Renato Peroni, only four of which are located in our study area (Peroni and Trucco 1994). Based on these 36 landmark locations overlooking the coastal plain, Peroni proposed a model of population growth, emerging elites, and dynamics between major and minor settlements from the Middle Bronze Age (MBA) to the Early Iron Age (EIA) (ca. 1700–900 B.C.). The first result of the RAP surveys therefore is that Metal Age settlement is not restricted to prominent, defensible, and presently artifact-rich places overlooking the Ionian coast, but that it also occurs as small-scale remains in open locations, as well as in the remote mountainous interior. As such, we believe that we have recorded the rural 'base' of the settlement pyramid. However, understanding what activities took place there, when and how long they took place, and why we were able to detect them, required us to proceed with systematic investigations beyond the initial surface recording.

<table>
<tr><td></td><td></td><td colspan="4">ASSEMBLAGE TYPE</td><td></td></tr>
<tr><td></td><td></td><td>simple</td><td>rich</td><td>storage</td><td>funerary</td><td></td></tr>
<tr><td rowspan="5">LANDSCAPE ZONE</td><td>coastal plain</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">foothills</td><td rowspan="2">simple scatter in foothills (46)</td><td>rich site in foothills (4)</td><td>storage vessel site (22)</td><td rowspan="2">funerary site in foothills (4)</td><td rowspan="2">-</td></tr>
<tr><td colspan="2">rich site with storage vessel in foothills (4)</td></tr>
<tr><td>uplands</td><td>simple scatter in uplands (22)</td><td>rich site in uplands (2)</td><td>-</td><td>-</td><td rowspan="2">a-typical site (9)</td></tr>
<tr><td>mountains</td><td>simple scatter in mountains (8)</td><td>cave site (9)</td><td>-</td><td>-</td></tr>
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Figure 2. Classification scheme for 130 Metal Age surface scatters recorded by the RAP fieldwalking survey in the Raganello Basin, 2000–2010. In parentheses: the number of sites in each class. Shaded categories were not investigated by the authors.

Approach and Methods

Our field investigations followed an informal stratified sampling approach, based on a classification of the 130 RAP surface scatters for which sufficient documentation was available (FIGURE 2). To avoid a priori interpretation, we used only unambiguous properties of their material assemblages and locations. For locations, we have used four broad landscape zones based on elevation and relief. Finds assemblages were divided into four classes: 'simple' ceramic groups without recognizable vessel type variations; 'rich' ceramics groups with a variety of fine and coarse wares; 'simple' artifact assemblages including Late Bronze Age (LBA) storage vessels of purified clay (*dolio a cordoni o fasce*; Schiappelli 2003; Capriglione et al. 2012); and 'rich' assemblages including such dolio wares. A further three classes contain known plowed-up Iron Age funerary assemblages, cave sites, and sites in atypical upland and mountain locations. We studied selected examples of seven of these 10 classes (FIGURE 2), with a view to extrapolating from the site-specific details to the respective site class and landscape zone.

Although the RAP surveys are already among the most intensive conducted in the Mediterranean, we suspected that many small Metal Age surface scatters could still have escaped detection. To test this, we conducted repeat surveys in 14 areas, using walker intervals ranging from 1 m to 5 m. The collection units were recorded by Total Station for optimal integration with other datasets; at four previously known and 10 newly recorded sites we even used the Total Station to record individual artifacts.

Geophysical techniques were tested and applied at both the site and landscape scales. At the site scale, we applied them only to detect subsurface features on and around known ceramic sites, whilst at the landscape scale we used them to prospect for unknown features without surface manifestations, to investigate areas with low surface visibility, to study confounding anomalies caused by soil properties and geological features, and to map the background variation in soil magnetic properties. Our ultimate aim was to develop a non-invasive research strategy for ephemeral Metal Age remains.

We tested several conventional geophysical prospection methods over the course of the project, obtaining very poor results with Ground Penetrating Radar (GPR), Electrical Resistance Tomography (ERT) and conventional twin probe electrical surveys. We therefore focus here on the results of our geomagnetic surveys (mostly fluxgate gradiometry), with some reference to our Electromagnetic (EM) and Magnetic Susceptibility (MS) results where relevant. The latter two methods were used for both very large scale (transects of 100 m to 12 km) and very small scale (excavation trenches and sections) surveys. We emphasize that magnetic methods were not preselected, but emerged as the approach producing the most archaeologically useful results. We recognize that these techniques are not 'universal ditch detectors' (Gaffney and Gater 2003: 180), especially when employed in isolation, and we highlight some failures of detection below.

Wherever possible, we studied a whole landscape unit such as an enclosed field to investigate the ceramic scatters and their immediate surroundings. In some instances, however, it was only possible to survey very small areas directly associated with a ceramic scatter. In two key areas in the foothills

(Contrada Damale and Portieri) and one in the upland zone (Fonte di Maddalena), we obtained good multi-method geophysical data by making many revisits whenever conditions allowed survey to proceed. We surveyed selected sites from the targeted site classes (FIGURE 2), and then within each of the spatial clusters of Metal Age sites identified in fieldwalking, conducted 'transect' magnetometer surveys to cover blank areas of the landscape where either Metal Age scatters had not been found or no fieldwalking had been conducted. This was in an attempt to understand how many possibly archaeological subsurface features occurred without producing a detectable surface scatters, and how many of the known surface scatters lacked detectable sub-surface remains. We also undertook opportunistic surveys when new scatters came to light during revisits. We aimed to utilize at least two methods on each site or area, hence we often have MS or EM data (as part of a transect or as gridded survey) to complement the gradiometer surveys; this allows stronger interpretations to be reached than would have been possible by a single-method approach (see below). The geophysical surveys showed that on a significant number of sites in the Contrada Damale and Portieri areas, strongly magnetic rectangular anomalies interpreted as structures ranging in size from 4 × 4 m to 8 × 4 m were present (see below). These structures were hitherto unknown.

The spatial and temporal association between surface materials and geophysical anomalies was tested by minimally invasive methods. We applied manual coring with a screw auger and a hammer gouge to confirm the presence and investigate the character of buried archaeological stratigraphy. Manual coring was also the main method for soil mapping and descriptions of slope processes. Full-scale excavations were beyond our research goals and permits, but small test pits were used to obtain soil samples and datable material, and establish the cause of geophysical anomalies. Since the interpretative possibilities of such 'keyhole' investigations are limited, we also decided to use the minimally invasive approach of topsoil stripping, during which only the already disturbed plow layer is removed. In several cases this proved to be sufficient to establish the presence, on the exposed undisturbed level, of features and deposits related to both the surface scatters and geophysical anomalies. The test pits and corings also allowed the retrieval of soil samples from known depths and anomalies/features for laboratory investigation of their structural and geophysical properties (texture analysis, loss on ignition tests to establish the amount of moisture and impurities lost after strong heating, dual frequency magnetic susceptibility, and fractional conversion tests), which again improved our interpretation of the geophysical results and provided insights into the nature and biography of the natural and anthropogenic layers encountered.

Case Studies

The RAP and RLPI fieldwalking data have added considerably to our understanding of the nature and scale of Metal Age settlement in the Sibaritide. The succession of research projects allowed us to fill in the gaps, and the growing dataset has made us rethink our earlier models of the past. Yet the current state of research also lays bare issues that cannot simply be resolved by producing more data. These issues will be elaborated upon below.

Case study 1: Late Bronze Age settlement in the foothills

The first case study concerns adjacent undulating sloping agricultural areas in the foothills called Contrada Damale and Portieri (FIGURE 3). In this zone, delimited by a limestone bluff to the north and seasonal rivers to the south and east, two seasons of RAP surveys recorded 40 Metal Age pottery scatters, some of which are aggregates of several poorly defined areas of elevated find densities. These scatters were classified into three types: 14 'simple' scatters containing only Metal Age handmade pottery, 22 scatters containing both simple pottery and *dolio a cordoni o fasce*, and four 'rich' scatters containing a variety of vessel forms including such storage vessels. The dolio material category is known from excavated contexts at large LBA sites elsewhere in southern Italy that were in contact with the Aegean world (Peroni and Trucco 1994; Vanzetti 2013; Schiappelli 2003; Levi 1999). In the Raganello Basin, these storage vessels are known from the prominent settlements of Timpone della Motta and Timpone della Fave (Ippolito 2016), but also from the rural context of Contrada Damale (FIGURE 4: top).

In three years of intensive, detailed studies by the RLPI project, the number of known Metal Age scatters in the Contrada Damale increased to 64 (TABLE 1). A re-study of the RAP survey finds and documentation revealed that two storage vessel sites had not been recognized and that six 'aggregate' sites should be split up into discrete scatters, in most cases also with dolio pottery. Intensive re-surveys yielded one new 'simple' site and 13 storage vessel sites in areas already systematically fieldwalked by the RAP; additional surveys of previously inaccessible fields added another 10 dolio sites. Considering that the type of dolio pottery found all over the Contrada Damale can be dated to the brief final phase of the Bronze Age (FBA), ca. 1100–950 B.C., these re-surveys thus reveal an explosion of small, dispersed habitations in this area of approximately 2 km^2. At the same time, the re-surveys also show that none of these sites continues into the Iron Age, and we therefore appear to be dealing with a short-lived, intensive occupation phase followed by a sudden abandonment around 950 B.C. Iron Age surface sites are also absent from other coastal and foothill areas in Calabria, so this appears to be part of a wider radical settlement change (Foxhall et al. 2007: 24).

Magnetic prospection conducted in several of the re-surveyed areas shows that many of the dolio scatters occur in close proximity to magnetic anomalies, more or less rectangular ones in nine cases (FIGURE 5). Except in one case, the surface scatters all occur slightly to one side and mostly downslope from these rectangular features. Furthermore, there are seven rectangular anomalies without an associated Metal Age surface scatter, eight dolio scatters with differently shaped features, and 10 dolio sites without any associated anthropogenic geophysical anomalies.

The associations between magnetic anomalies and archaeological features were tested by topsoil stripping and small test pits on two 'ordinary' storage vessel sites with a rectangular anomaly (sites RB219a and RB231). Though the anomalies have different dimensions and shapes, both are caused by compact burnt clay encountered directly below the plow layer. The very high gradients (+/- more than 100nT in most cases) associated with these structures strongly suggest thermoremanent magnetization, and hysteresis loop tests

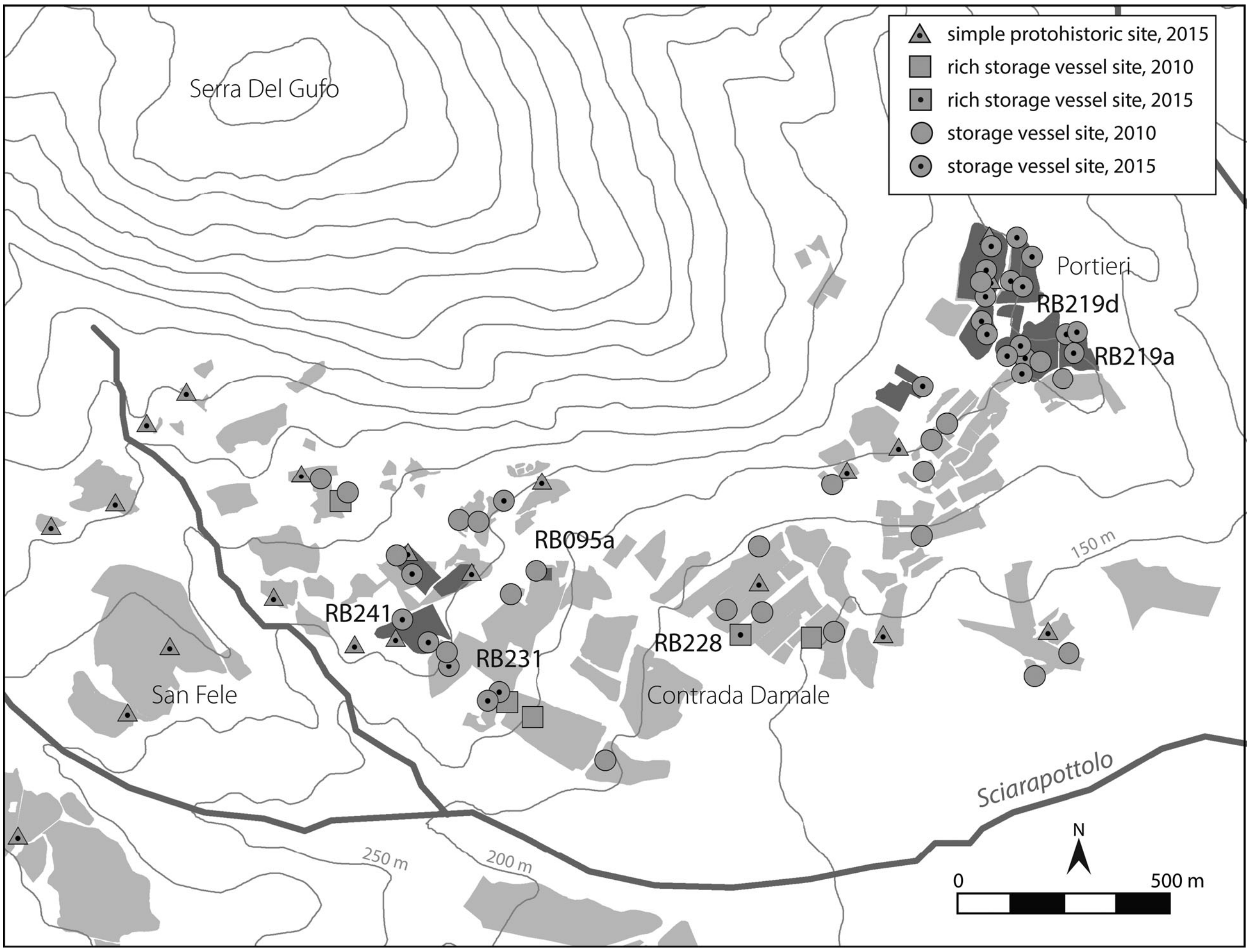

Figure 3. Metal Age site classes in the Contrada Damale and Portieri areas. RAP survey areas are indicated in light grey, RLPI resurvey areas in dark grey. Sites mentioned in the text are labeled.

performed on a sample from site RB219a confirm that they indeed produce a thermoremanent magnetic signal. Although the limited dimensions of the test pits do not permit a proper interpretation of the remains, we think that the clay deposits are the remains of wattle-and-daub or cob buildings, burnt at high temperatures. Such buildings are known from excavated LBA contexts elsewhere in southern Italy (Moffa 2004; Vanzetti 2013; Peroni and Trucco 1994: 100–106; Vagnetti and Trucco 2001: 27–37), and are here attested in a rural setting for the first time.

The combined efforts of re-surveys, magnetic prospection, and test pitting at these two dolio sites on Contrada Damale confirm the spatial and temporal association between buried remains, geophysical anomaly, and surface finds. These results make us confident that similar situations reflect the presence of LBA building remains. However, the minimally invasive approach cannot answer site-specific questions such as how and why the rectangular buildings burned down, how long they were in use, and what their function was. Magnetic gradiometry allows us to detect such burnt structures but may well fail at detecting daub structures that simply collapsed and washed out. Therefore, we cannot be sure whether surface scatters without an associated magnetic anomaly reflect similar structures but with a different depositional history.

The integration of distribution maps of surface archaeological materials and geophysical data reveals that surface scatters may occur near geophysical anomalies but almost never right on top of them; with one exception (site RB241) there is always an offset of several meters. This offset can be interpreted as the result of post-depositional processes such as plowing or soil erosion, in which sherds move laterally away from their original deposition location (Dunnell and Simek 1995; Odell and Cowan 1987; Roper 1976), but that does not explain why scatters appear only to one side of an anomaly instead of distributed across it. Therefore, it seems more plausible that the offset reflects a specific spatial arrangement, with the sherds on the surface coming from refuse heaps or workspaces outside the buildings themselves (FIGURE 6). No similar Metal Age rural contexts have so far been published to provide parallels for this, but ethnography provides many examples in which artifacts end up in rubbish or 'provisional discard' heaps away from the house rather than in the actual habitation area (Deal 2005; Forbes 2013: 566–567; Beck 2006).

Exceptions to the dolio scatter and rectangular anomaly association were also studied. Since we have established that the offset between surface scatter and magnetic anomaly may be up to several meters, simply laying out a test pit based on surface material to find buried remains would be a shot in the dark. We selected three situations (rich storage vessel sites RB050 and RB228, and simple storage vessel site RB219d) where Metal Age material occurs at the base of an agricultural terrace or lynchet, on the assumption that if the surface scatter is the result of a plowed-out deposit, archaeological features and/or stratigraphy may still be present beneath the bank. The test pits did indeed confirm that this is the case at sites RB228 and RB219d, but we encountered no structural remains to indicate that these locations had

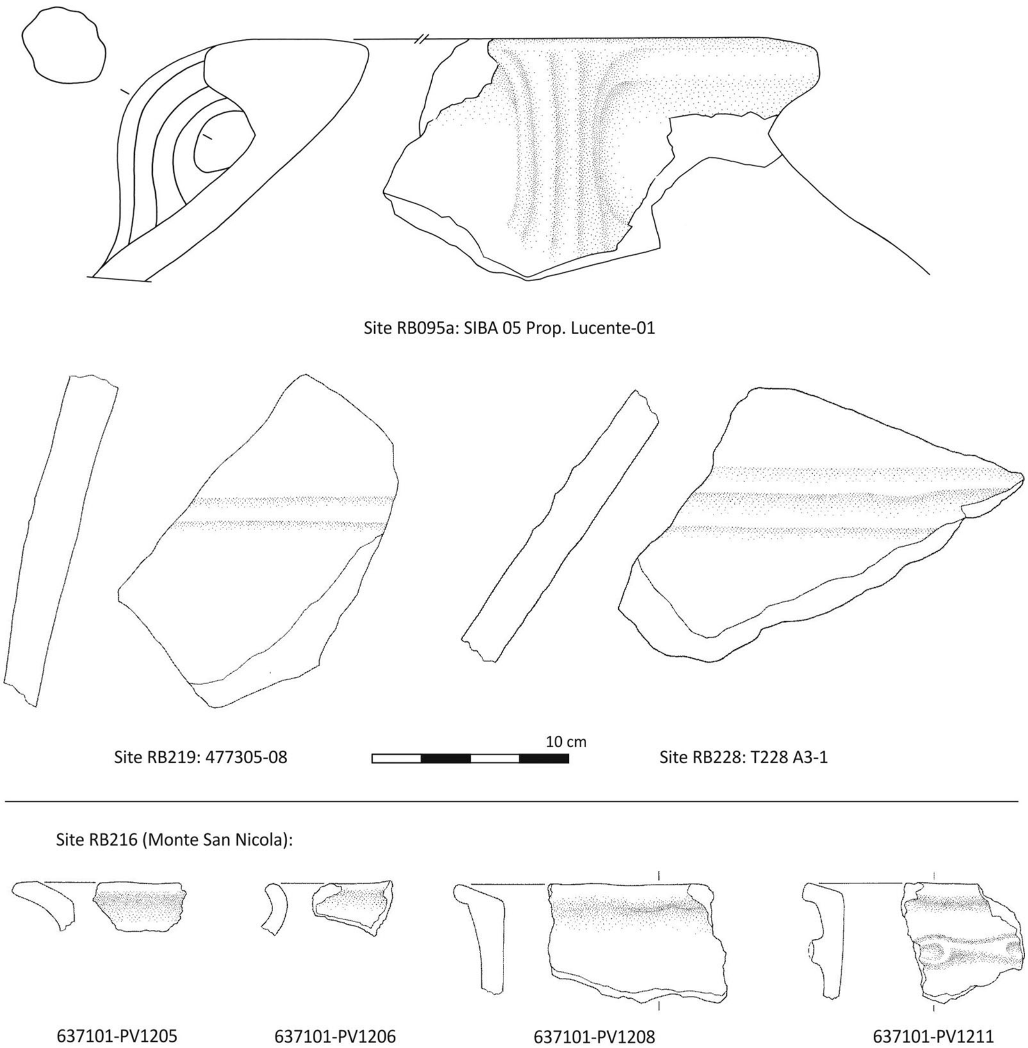

Figure 4. Examples of datable Metal Age pottery from the Raganello Basin. Top: *Dolio a cordoni o fasce* fragments from sites RB095a, RB219, and RB228; Bottom: *impasto* fragments from site RB216.

rectangular daub buildings. At sites RB050 and RB219d, the finds assemblages of plain cooking wares and storage vessels suggest that they must belong to habitations. By contrast, the rather unusual finds from site RB228 suggest a different context than habitation: they include finely decorated purified and handmade pottery, storage vessels, but also a horse-shaped figurine, fragments of a bronze ingot, and a perforated murex shell. Similar horse figurines are known from funerary contexts in the Aegean but also from nearby Broglio di Trebisacce, where several fragmentary figurines were found in what appears to be a non-habitation context away from the settlement structures (De Neef 2013).

Case study 2: an urnfield on the marine terraces

Monte San Nicola (536 masl) is the highest point in the landscape zone of the marine terraces south of the Raganello, and consists of conglomerate banks alternating with silty deposits (Santoro et al. 2009). Scatters of Metal Age pottery have been recorded on its flanks since 1983 (Peroni and Trucco 1994: 669–670) but these early surveys were not accompanied by good topographical information. The RAP surveys yielded diffuse artifact scatters on all slopes but did not establish a major settlement focus as hypothesized by Peroni (FIGURE 7). In the RLPI site typology presented above, the Monte San Nicola complex is classified as 'atypical' because of its location on a summit too high for the foothill zone (i.e., above 400 masl) but not remote enough to qualify as a mountaintop site.

Large-scale magnetic gradiometry prospection conducted with a cart array on all reasonably flat parts of the summit area revealed a number of magnetic anomalies. Some of these were identified as topographical effects or geological phenomena such as outcropping conglomerate banks. No archaeological features interpretable as building remains were recognized, but a few pit-like anomalies were noted.

Table 1. Effects of repeated intensive resurvey of the Contrada Damale foothill area showing increasing site densities and assemblage richness.

	2010		Newly discovered 2011–2014		
Site class	count	density	in previously surveyed areas	in previously unsurveyed areas	2015 density
Simple foothill site	14	27 / km^2	3; -2 (storage vessel sites)	-	26 / km^2
Simple storage vessel site in the foothills	22	42 / km^2	12	10	77 / km^2
Rich storage vessel site in the foothills	4	7 / km^2	1	-	8 / km^2
Total	40	70 / km^2	14	10	112 / km^2

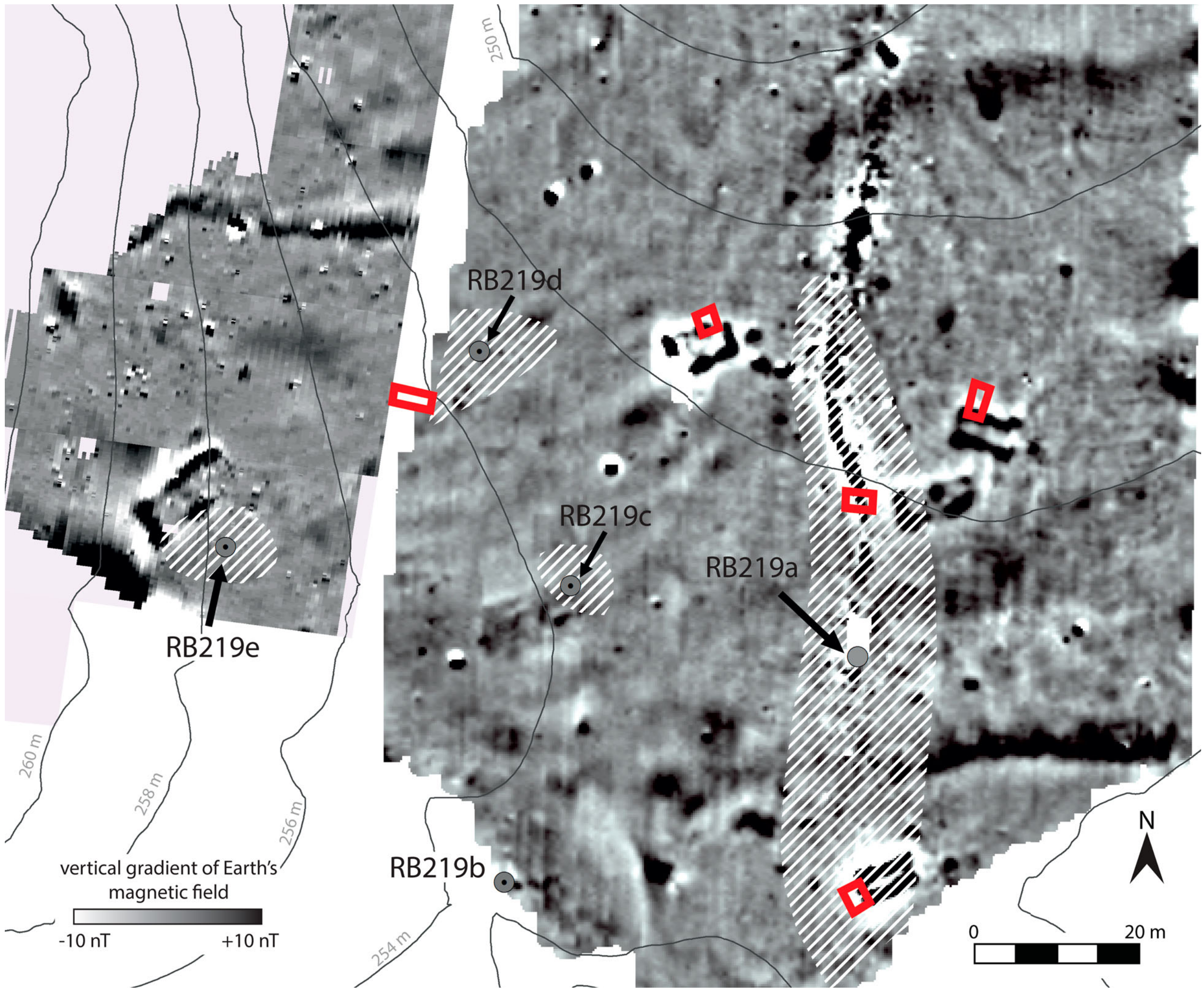

Figure 5. Site RB219 at Portieri: the conjunction of Metal Age surface scatters (labeled) and magnetic gradiometry data. All possible combinations of rectangular anomalies and surface scatters are present. Test pit locations are marked in red.

The northern and southwestern lobes of Monte San Nicola were re-surveyed using a 2 m walker interval in 2012. This produced one dense and one diffuse protohistoric scatter on the northern lobe, and another diffuse scatter on the southwestern lobe (FIGURE 7). The diffuse scatters had not been documented in previous RAP surveys conducted using a 10 m interval, but the dense ceramic concentration (RB216) on the northern lobe had, and comparison between the two records shows that this ceramic scatter is being plowed out. We classified all individual artifacts in a 60 × 60 m area around both scatters on the northern lobe in the field and recorded their locations by Total Station (FIGURE 8). The assemblage consists of high-quality protohistoric handmade pottery, including some typical FBA/EIA vessel forms such as fine bowls with in-curved rims and vertical handles (*scodella ad orlo rientrante*) but also more generic protohistoric coarse wares (FIGURE 4).

The integration of the magnetometry and fieldwalking data for site RB216 reveals that a dense leaf-shaped scatter of protohistoric pottery, approximately 15 × 5 m in size, has formed to the northwest of a very weak positive circular anomaly. This leads us to hypothesize that this anomaly represents an almost plowed-out subsurface deposit, the most recent contents of which were probably plowed up shortly before the July 2010 RAP survey recorded them, and which later plowing has further fragmented and spread out. The second, more diffuse scatter of protohistoric material (site RB233) also coincides with a group of discrete, positive, round and elongated anomalies of about 1.5 m in diameter, likely reflecting further pit-like features where pottery may still be preserved in situ. The interpretation of these features, however, remains uncertain in the absence of identifiable structural remains or special-purpose find categories. In the southern Italian Bronze Age, round pits usually containing settlement debris occur in or near habitations, but they may also be graves. LBA cremation urnfields using round pits are known from Apulia and Basilicata (Mancinelli 2003; Gorgoglione 2002).

Confirmation of the association between the pit-like anomalies and the surface pottery was obtained in the autumn of 2013 by stripping off the plow layer over one of the anomalies (RB245a) and investigating its contents. Over an area of 1 × 1 m we sieved the 15 cm of plowed silty soil over a 5.6 mm mesh. This yielded six high-quality impasto sherds and three wheel-turned ceramic fragments, whereas only one impasto sherd had been found on the surface in this same area during the intensive survey. Moreover, the exposed surface revealed a reddish brown circular feature, clearly cut into the light yellow natural silt. In the top of this feature fragments of high quality, burnished black FBA/EIA pottery belonging to at least three different vessel

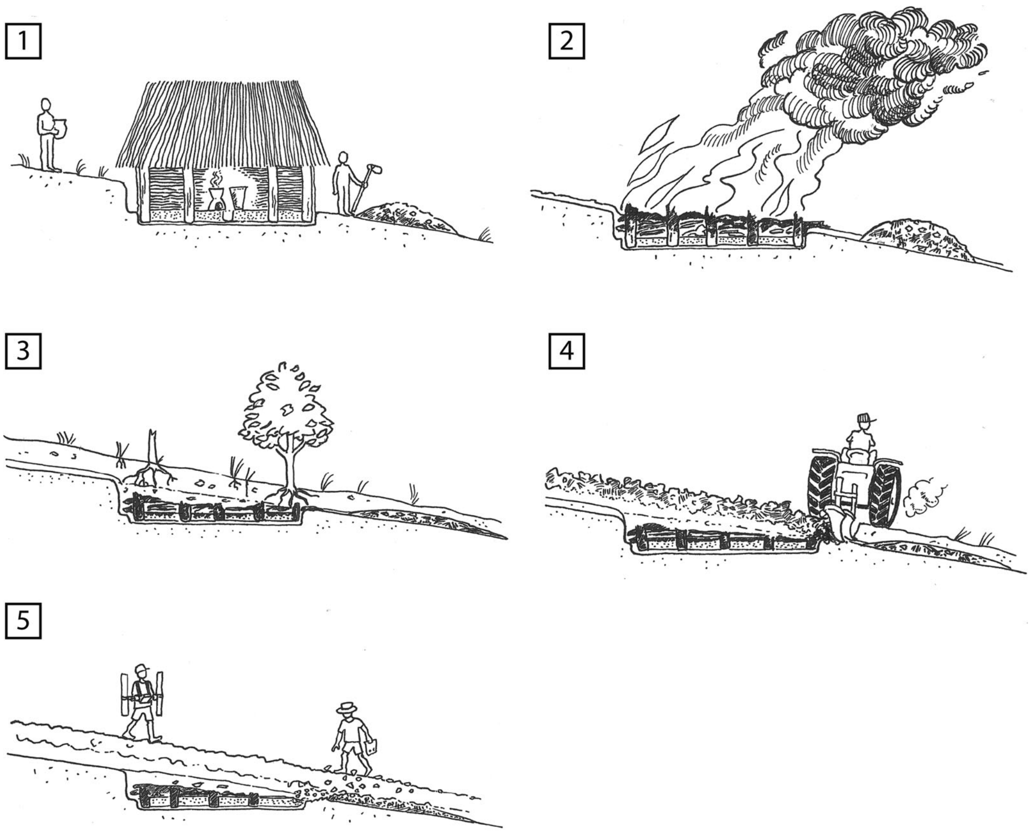

Figure 6. Schematic representation of site formation, exposure and detection at site RB231. 1) LBA building on gentle slope; 2) the building is destroyed by fire; 3) the remains of the burnt structure are covered by colluvium; 4) modern plowing exposes the downslope part of the structure and the refuse heap; 5) geophysical and archaeological detection of the remains. (Drawings W. de Neef).

types were recorded, including a bowl and a medium-sized globular vessel. The top of the feature also contained a few pebbles and a small fragment of burnt bone.

Topsoil stripping in this case proved sufficient to confirm the spatial and temporal association between the surface material, the magnetic anomaly, and the buried remains.

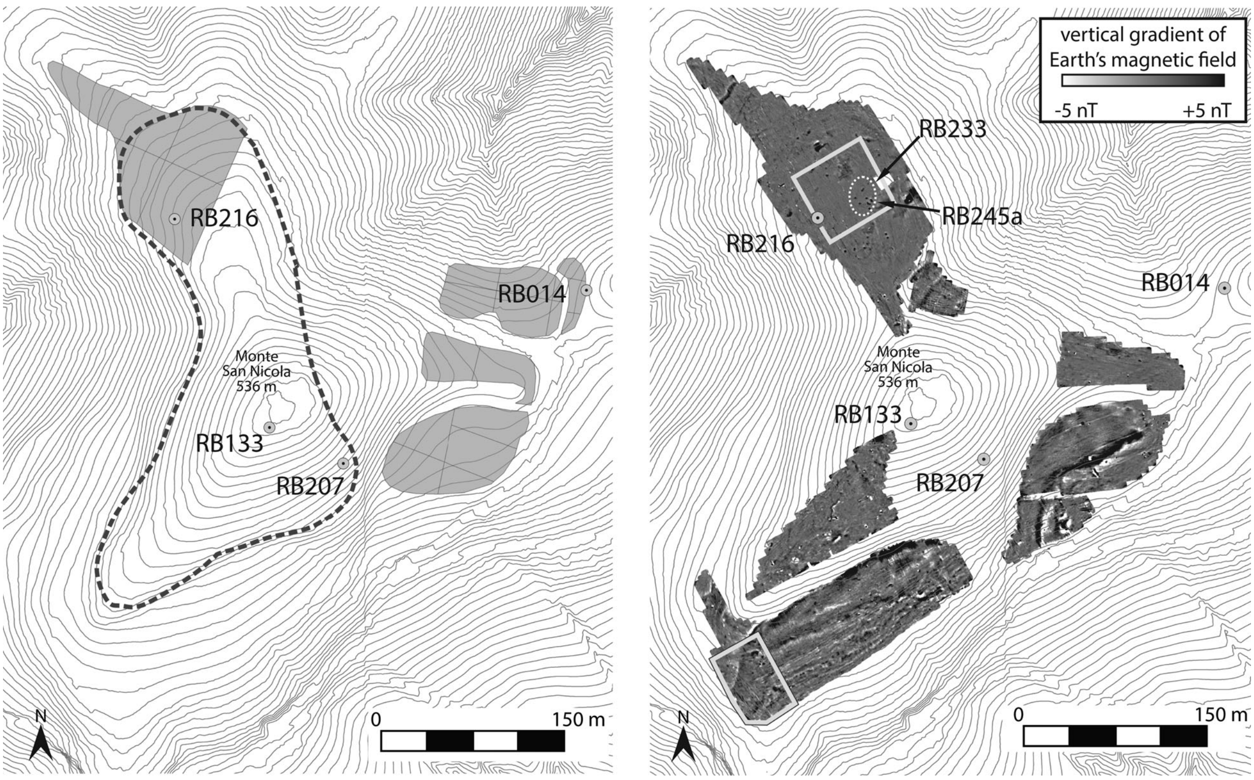

Figure 7. Monte San Nicola: contour lines at 2 m. Left: locations of RAP sites (numbered dots) and survey units (grey). The approximate area of the site as mentioned in Peroni and Trucco (1994) is indicated with a dashed line; Right: Magnetic gradiometry results. The two areas of increased surface material density are outlined in white.

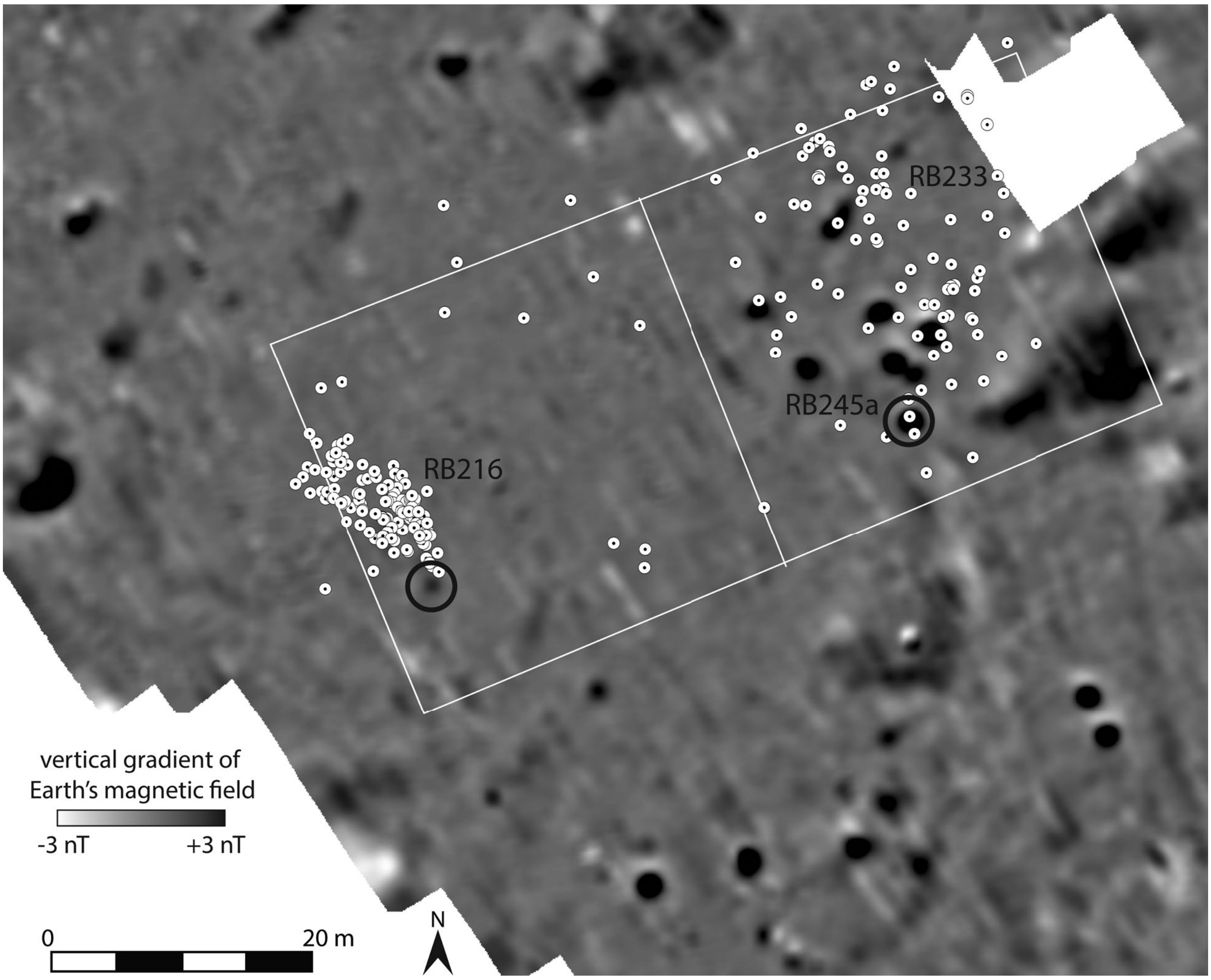

Figure 8. Monte San Nicola. Surface distribution of impasto fragments in two 30 × 30 m areas, with part of the magnetic gradiometry data produced by Eastern Atlas. Dense pottery scatter RB216, diffuse scatter RB233, and magnetic anomaly RB245a are labeled. Black circles indicate magnetic anomalies mentioned in the text.

Similarities in shape and amplitude suggest that the circular anomalies on the Monte San Nicola northern and southwestern lobes represent a cluster of roughly contemporaneous pits, probably forming a funerary context, with high-quality burnished vessels containing the cremation remains and covered with overturned bowls. The difference between the RB216 and RB233 surface scatters can be explained by assuming that the cremation grave at RB216 had recently been severely damaged, whereas those at RB233 had last been damaged perhaps as much as 10 years ago, allowing more dispersal, fragmentation and weathering of the material to take place.

Case study 3: ephemeral occupation in the upland valley

Understanding settlement in the uplands proved to be even more complicated than it was in the foothills. The RAP surveys, in many cases following up observations by amateur archaeologists, had demonstrated a considerable Metal Age presence in the uplands and highlands. This consists of small sites on slopes and ledges, cave sites, a cluster of small ceramic scatters in the catchment of the seasonal Maddalena River, and three larger, multi-period sites on debris cones below limestone rock faces. The RLPI investigations of upland sites targeted the simple Metal Age scatters in the Maddalena catchment, the three rich upland sites on debris cones, and one atypical, very remote site on a high limestone ridge.

Our studies of the simple scatters in the Maddalena catchment show that site detection in this upland valley is strongly influenced by colluviation and erosion processes (FIGURE 9). In a precursor study of biases concerning archaeological remains in marginal areas (the Hidden Landscapes Project) (van Leusen 2005), a computational erosion model for the Maddalena Basin was designed and implemented to investigate the correlation between depth of erosion and deposition, and the presence of surface archaeology (Feiken 2014: 125–163). While too coarse for the study of very local phenomena, this model does help understand general patterns of erosion and deposition, including the fact that, under very specific circumstances, archaeological features and deposits may become buried under several meters of sediment—beyond the reach of mechanical plowing and near-surface geophysics.

A test pit at the small upland site RB073 revealed that its surface manifestation of weathered undiagnostic fragments of Metal Age ceramics represents a local exposure of an extensive set of occupation layers. From the place where these mix into the plowzone, they dip down towards the west, out of reach of modern plows. Older phases were documented in a section down to 1.8 m below the surface, the oldest so far being radiocarbon-dated to the Early Bronze Age (EBA) (1955–1890 CAL B.C.; GrA-62341). Such an early occupation phase was previously unknown in the upland valley, as

Figure 9. Soil erosion (mud flow) after heavy rainfall in the Maddalena catchment in November 2013. Site RB073 is located downslope of the rectangular transformer building in the middle distance. (Photo W. de Neef).

the RAP surveys yielded only weathered, non-datable Metal Age ceramics. A second pit some 40 m to the northwest, initially planned to document the off-site soil profile, revealed not only an EBA layer at a depth of 2 m (1885–1770 CAL B.C.; GrA-60835), but also an overlying sequence of strongly tilted layers dating to the Hellenistic and Roman periods (FIGURE 10). Although dispersed Roman sherds had been recorded on the surface, the deep archaeological stratigraphy exposed in this second pit did not produce a concentration of materials in the plowzone that was recognized as an archaeological 'site' during the RAP surveys. This strongly suggests that our pottery distribution maps for the upland valley do not represent a habitation pattern, but rather signal areas of less deeply buried archaeological remains, and underlines our conclusion that reconstructions of post-depositional processes are essential for our understanding of the archaeological surface record.

In the absence of archaeological features and well-preserved material remains, these test pits did not do much to clarify the character of the Metal Age layers recorded at and near site RB073. Magnetic gradiometry survey resulted in a set of sinuous anomalies, but no obvious anthropogenic features were detected (FIGURE 11: left). Only after further systematic coring in March 2015 were we able to reconstruct a paleo-depression, filled with alternating dark and light layers dating from the EBA to the Roman period, which coincides with the sinuous magnetic anomalies recorded in the center of the field. The present topography, however, suggests anything but the presence of a palaeo-channel and illustrates the fact that 'natural' sinuous anomalies may in fact be archaeologically relevant because they are filled with secondary deposits from nearby settlements.

Biases and the Archaeological Record

The case of site RB073 raises an issue not easily resolved by adding more data: our understanding of the various findspot circumstances in the research area is still limited. We are able to detect LBA remains on gravel fans with shallow soils in the foothills, and pits with archaeological deposits on even shallower soils in the marine terraces. Yet for the dynamic and erosive upland environment, our current dataset does not allow us to assess to what extent archaeological remains remain hidden. Here, understanding the archaeological record demands an intensification of (minimally) invasive methods rather than an increase in the detail of surface and near-surface detection methods. Only if we understand the variegated post-depositional history of the uplands can we begin to grasp why we do not detect rectangular structures there and whether or not this is caused by different past exploitation strategies, different materials, or different environmental factors. Only a deeper understanding of local deposition circumstances can help us assess the results of our non-invasive prospection techniques, and help deal with biases tainting our interpretations.

While site re-visits and high-intensity surface detection help us tackle some of the biases normally caused by Mediterranean fieldwalking strategy and recording protocols, the

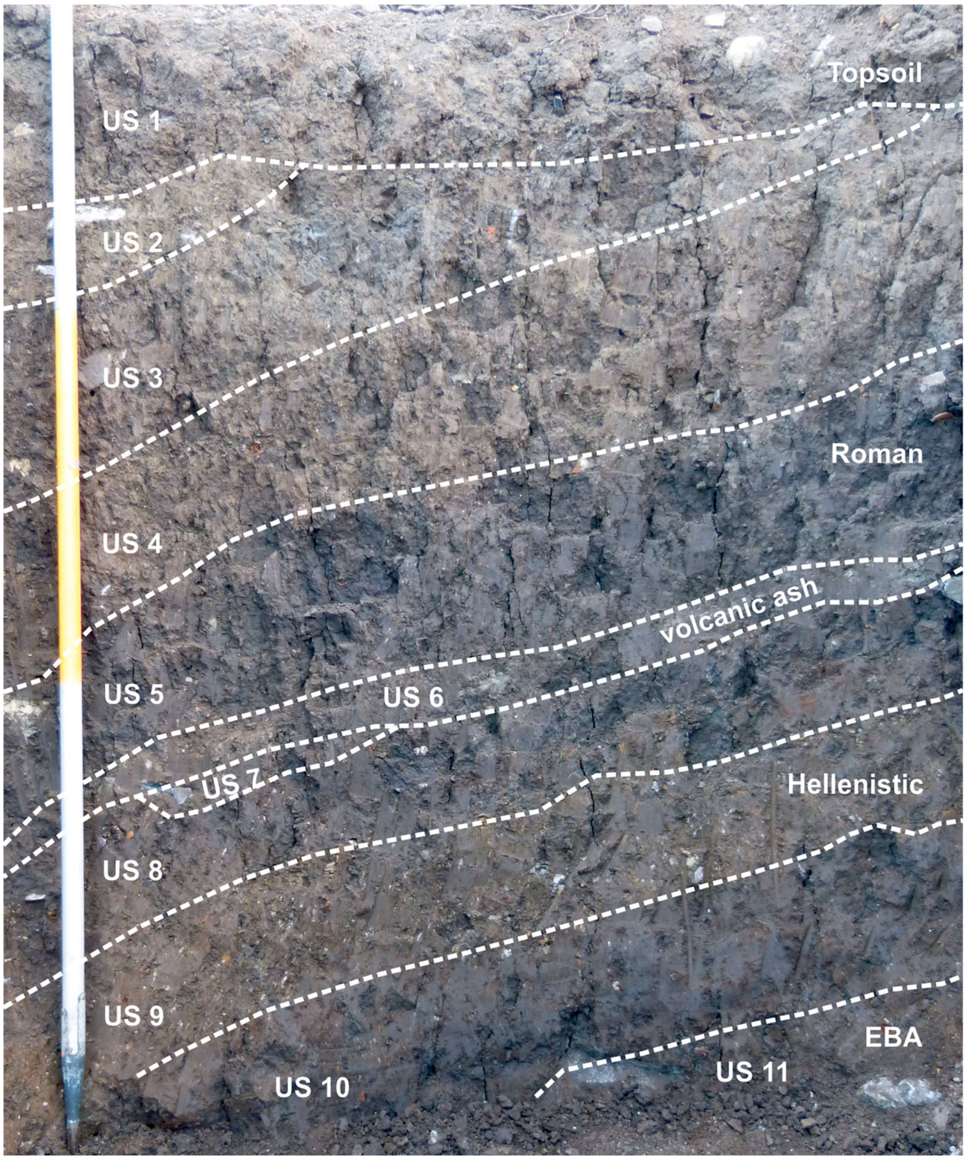

Figure 10. North section of a test pit placed 40 m north of site RB073. The deep, tilted archaeological stratigraphy outcropping a few meters to the right of this pit did not result in a RAP surface scatter.

reduction of biases caused by environmental dynamics requires an interdisciplinary approach involving systematic investigation of the geomorphology, soils, and slope processes of the Raganello Basin. Like the archaeological and geophysical investigations conducted in the study area, the soil studies were also conducted at different scales. Transects of manual augerings to map and describe the variations in soil properties on a landscape scale were combined with field and laboratory studies of soil texture and magnetic susceptibility. At the site scale, coring and soil pits were employed to understand local aggradation and degradation processes, whereas at the micro-scale, textural properties, moisture, organic content, and fractional conversion rates (Crowther 2003) of soil samples were studied in the laboratories of the Johannes Gutenberg University in Mainz (Germany) to provide local backgrounds for geophysical measurements and to explore the magnetic enhanceability of the soils.

At the start of the RLPI project we envisaged developing a rapid magnetic susceptibility (MS) surface survey method to complement fieldwalking when detecting sites in areas of poor visibility, exploiting the MS enhancement that should generally accompany habitation sites (Marmet et al. 1999). However, although pilot studies had suggested that some sites in the survey area produce detectable on-site enhancements (van Leusen et al. 2014), this result could not reliably be repeated. MS surface surveys at different resolutions in the same landscape produced wildly different results. For example, a 1 m resolution MS survey over site RB219 showed enhancement over some, but not all, of its gradiometer anomalies, whereas the landscape transect surveys crossing that same site showed very similar small enhancements both over the strongest anomaly in the 1 m data set, and in other locations where no archaeological indicators have been found. We provisionally attribute the latter false-positive to pedological effects due to the proximity of a limestone cliff; and since some, but not all, limestone cliffs have associated sites this presents a problem. Similar signal-to-noise problems occur in other landscape zones as well. On the marine terraces, the MS results seem more strongly associated with the well-developed red soils (high values) and their unweathered substrata (low values) than with any archaeological remains. Fractional conversion tests suggest this is to do with a lack of magnetizable iron in the latter. In the upland Maddalena catchment we even encountered negative surface

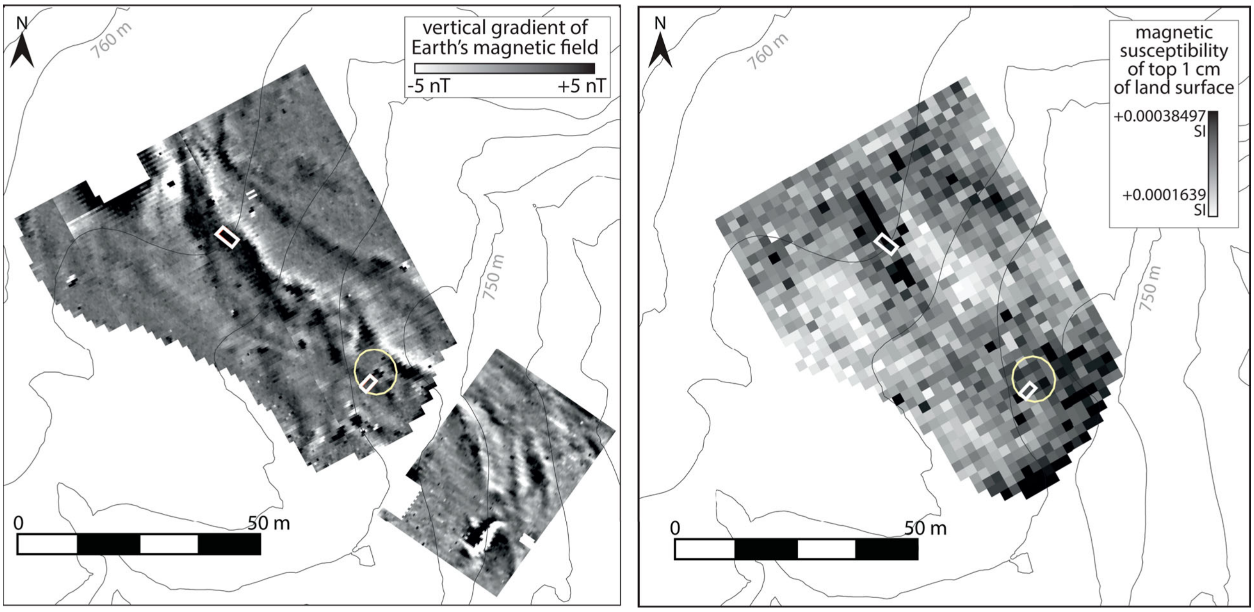

Figure 11. Geophysical data for site RB073 and surroundings, produced by K. Armstrong (2012). Left: Magnetic gradiometry results; Right: surface MS readings. The extent of the surface scatter is indicated by a circle; the two test pits are outlined in white.

MS readings, due to the specific nature of the induced magnetism on soils derived from shale and the response of our particular instrumentation.

The laboratory work, and in particular the fractional conversion tests (Crowther 2003), has started to help us unpack the landscape variation both in the apparent MS and in the capacity for enhancement of the different soils, but further fundamental research is needed before we can effectively use MS survey alongside fieldwalking to help detect sites. One particularly useful aspect of the work on soils has been the dual-frequency MS measurements made with the Bartington MSB sensor, which have allowed the discrimination of anthropogenically from naturally enhanced soils (Dalan and Bevan 2002; Dalan 2006; Thompson and Oldfield 1986; Dearing 1994). This has been especially helpful in understanding the keyhole stratigraphy revealed in the small test pits, where higher frequency dependencies can be shown to correlate with layers containing cultural material.

The integrated results of archaeological, geophysical, geomorphological and pedological studies allow us to model archaeological deposits affected by slope processes and anthropogenic activities such as terrace building and plowing. These models in turn feed our overall archaeological distribution maps and lead to the recognition of areas of uncertainty, where the absence of archaeological data requires an explanation. The geophysical datasets play a central role in these models: while initially magnetometry is employed as a prospection method to locate buried archaeological features, the specific forms and dimensions of magnetic anomalies are also used to recognize geological phenomena and to reconstruct specific events such as the plowing-out of the probable cremation grave RB216 on Monte San Nicola, discussed above. Another example concerns the rectangular structures detected in the Contrada Damale, which all appear to have an open end facing downslope. Topsoil stripping at storage vessel site RB231 revealed that the two long walls were touched by the plow, causing building material to be mixed into the topsoil. The 'closed' upslope end of the building was buried more deeply and perhaps cut into the natural slope, and thus preserved better, whereas the 'open' end of the U-shaped anomaly may not have been open at all (except for maybe a door), but rather may have been lost to plow erosion (FIGURE 6).

Settlement and Exploitation Dynamics

The detailed RLPI approach provided new data on Metal Age land use, which must now be incorporated into the existing models for settlement patterns and exploitation strategies. We have demonstrated a dense LBA settlement pattern in part of the foothill zone, a cremation cemetery on the highest marine terrace, and traces of EBA occupation in the upland valley, none of which were previously recognized. How will reconstructions of the Metal Age presence in northern Calabria benefit from these results?

The detailed surveys, geophysical measurements, and test pits in the Contrada Damale have brought to light a dispersed distribution of relatively small ceramic scatters, most of which include the dolio storage vessels, and some of which are associated with a rectangular structure. Since these LBA sites lie mostly within the 150 m hailing distance often used to distinguish isolated farmsteads from hamlets (Roberts 1996: 24), the Contrada Damale can be interpreted as a single dispersed settlement. Some sites may have had special functions, such as site RB228, but the majority consist of simple handmade household wares in combination with storage vessels. Although we have not had the chance to excavate a complete example yet, we think the rectangular structures are simple one-room habitations or farm buildings.

This local explosion of LBA settlement in the foothills fills a hiatus already recognized by Peroni, albeit in an unexpected way because small settlements do not figure in his reconstruction of protohistoric settlement dynamics in northern Calabria. In the years 1978–1985, Peroni and his collaborators at La Sapienza University in Rome made an inventory of protohistoric settlement within the first ring of foothills surrounding the Plain of Sibari, excluding highland zones such as the upper Raganello valley. These investigations were site-oriented and, guided by the assumption that these would be the favored places for protohistoric settlement, focused on plateaus and other defensible, isolated locations (Vanzetti

2013: note 7). Peroni's site definition is different from our own signal-to-noise one: it is interpretative and flexible, based on ideas about exploitation and hierarchy, as well as key components of human activity, such as habitation, necropolis, and sanctuary (Vanzetti 2013: 13). Although his topographic survey resulted in a limited dataset of 36 sites and left many areas uninvestigated, Peroni nevertheless used it to develop an elegant and densely argued model of BA–EIA social and spatial developments in the Sibaritide. Even as more Metal Age remains are inevitably discovered in northern Calabria, this remains the point of reference for studies of Metal Age settlement dynamics in this area (Peroni and Trucco 1994; Attema et al. 2012).

Peroni's model highlights increasing social complexity and territorial behavior towards the last phase of the Bronze Age. While the few dispersed remains recorded for the EBA (ca. 2200–1700 B.C.) are interpreted as an unstable settlement system of autonomous mobile groups, the MBA (ca. 1700–1350 B.C.) sees the emergence of a system of relatively stable and regularly distributed settlements in the ring of foothills around the coastal plain. According to Peroni, this MBA system of autonomous territories separated by major rivers is the base from which the settlement system of the later Bronze Age expands. In these later phases, major and minor settlements evolve that function as strategic elements of territorial control and increasing competition between the different groups inhabiting the Sibaritide. The places that he defines as major or central sites are located in landscape units of at least 10 ha in size, and show a stable, uninterrupted occupation from the MBA to the EIA. Single period sites, or those in landscape units of 1–3 ha, are classified as minor. Further evidence for increasing social stratification is found in the occurrence, at only a few central sites, of rare material categories such as ivory, imported Mycenaean pottery, and specialized wares such as the *dolio a cordoni o fasce*. In the Recent Bronze Age (the first phase of the LBA, ca. 1350–1100 B.C.), these material symbols of sociopolitical diversification are obtained in contacts with Aegean traders. When the palace economies of the Aegean collapse in the transition to the Final Bronze Age (the late phase of the LBA, 1100–950 B.C.), the socio-political system in the Sibaritide remains intact, with local elites in the central sites now using locally produced imitations of Aegean products. At the same time, population growth results in more inhabited areas, especially inland. This local resilience to crisis indicates that the pathway to social complexity in the Sibaritide is essentially an indigenous development. For the EIA, when contacts with the eastern Mediterranean are renewed, Peroni notes a further inland expansion of the settlement system, while some sites in the sub-coastal zone are abandoned. Finally, this indigenous process towards monocentric territories controlled by dominant kin-based groups is cut short by the arrival of Greek colonists in the coastal plain around 720 B.C.

However valid this model may be as a broad outline, our investigations suggest that the major/minor division of Metal Age settlement is too simplistic. Peroni's model has no room for large dispersed settlements such as the Contrada Damale, nor does it allow inhabitants of minor sites to access the rare, specialized material category of dolio a cordoni o fasce. Instead, we find that these large storage vessels were available to a broad segment of LBA society, including single households in a non-centralized settlement. Peroni's idea that the emerging LBA elites used these Aegean-inspired vessels to centrally store agricultural surplus from the territories under their control therefore needs to be rethought. Since the foothill zone of the Raganello Basin is currently the only intensively studied foothill area of the Sibaritide, we have no reason to believe that the Contrada Damale is unique in this. And since storage vessel fragments are highly detectable we see good prospects for an investigation of other sections of the Sibaritide foothills.

Peroni's model of protohistoric settlement is also silent about the upland and mountain zones, which are seen as areas of non-intensive exploitation. The cluster of small sites detected by the RAP surveys in the upland valley shows, however, that the mountainous inland was systematically exploited during protohistory, and radiocarbon dates confirm that this was already happening in an early phase of the Bronze Age. Although this suggests that EBA settlement was less ephemeral than previously thought, the evidence so far does not support the presence of a permanent open village type settlement here. As was discussed above, the distribution of detectable Metal Age remains in the upland valley is strongly biased by post-depositional processes, and the geophysical results are ambiguous. In addition, the re-surveys and new material studies have not yielded finds to support a better dating or functional interpretation. Therefore, we cannot assume that these sites are contemporary as a group or even that the same types of activities were performed at them. The dipping layers observed at and near site RB073 indicate that the detectable ceramic scatters reflect surfacing occupation layers, but so far, we have not been able to confirm that these belong to permanent habitation contexts. Other site classes present in the uplands and highlands, such as the cave sites and small ceramic scatters on steep slopes, indicate that both the valley floor and the more inaccessible parts of the mountainous hinterland are components of regular exploitation during the Bronze Age. How this exploitation was organized cannot be answered on the basis of the present study, and it merits additional attention.

Conclusions and Implications

In this article we have shown that studying small Metal Age surface scatters, despite the poor prospects suggested by these poor remains, helps fill in the blanks in the current rather coarse models of pre- and protohistoric land use. By applying multiple complementary prospection methods, we have begun to unlock the archaeological potential of such remains in northern Calabria. As similar ephemeral remains occur in almost all Mediterranean fieldwalking studies but are usually neglected, we believe that there is still a wealth of information to uncover in similar landscapes.

In our study of the Raganello Basin, the integration of complementary archaeological, geophysical, geomorphological and pedological datasets has resulted in several new insights. Firstly, by combining different methods we were able to detect many new, previously overlooked sites, as well as to better delineate existing ones. We were able to establish that many Bronze Age surface scatters are associated with buried features or even structural remains, and that they are therefore not as ephemeral as they look in fieldwalking records. This allows us to fine-tune our survey methodology for this type of site, which often gets obscured by more visible remains from later periods. Secondly, the high spatial resolution of our surface recordings and geophysical measurements allow us to come to a better interpretation of the association between surface manifestations and subsurface features. The horizontal offset between ceramic scatters and buried features, which we recorded in a number of cases, informs us about local post-depositional processes and site preservation. This is shown most clearly in the probable urnfield on Monte San Nicola, where the density of the ceramic scatters could be correlated with the strength of the magnetic signals of nearby pits. In combination with detailed MS measurements on the surface, in corings, and in test pit sections, we have obtained a better understanding of the types and depths of the deposits that cause magnetic anomalies. Thirdly, by conducting off-site coring and gradiometry and MS surveys, we were able to map the natural contexts of our on-site data. In the generally erosive upland valley, this resulted in the discovery of surprisingly deep stratigraphies and anthropogenic deposits buried out of the range of our archaeological and geophysical detection methods. We see this as evidence that our (near-) surface recordings are only the tip of the iceberg of a hidden Metal Age landscape. We also know now that the sinuous anomaly at site RB073 is archaeologically relevant, even though at first it seemed unrelated and looked natural: similar magnetic features can therefore now be added to our catalogue of anomalies of potential archaeological interest.

Our approach not only integrates different techniques, but also different scales. We conducted site-specific studies, surveys aimed at broader land units, and soil and slope-process mapping on a regional scale. We have shown that a site classification system based on broad landscape units allows us to study local expressions of Metal Age activities in a broader framework of settlement and land use strategies. By placing our site-specific studies in the context of broader geomorphological processes we have significantly increased our understanding of why archaeological remains are detected in certain places and not in others. Studying the landscape at different spatial scales and resolutions has allowed us to make and test predictions, and to extrapolate explicitly from site-specific details to regional patterns.

Geophysical investigation played a central role, as a prospection toolkit but also as the object of methodological study. Since small Bronze Age scatters are usually not the focus of targeted geophysical surveys or excavations, we had to start from scratch, not knowing what to expect: we wanted to test the available geophysical techniques in the full range of geological, pedological, and land use circumstances. Fully aware that such testing can yield only more questions, our program of corings and test pits was essentially organized as a test of the surface readings. Site RB073 in the Maddalena Valley is an example of how gradiometry yielded only more questions, which had to be resolved by invasive work.

This brings us to the challenges to be faced by our approach. First of all, whilst spatial and chronological associations between surface manifestations and buried features can only be established by invasive research, and firm data on slope processes and depth of burial can only be established through coring or test pits, invasive research is not always feasible. Since larger-scale excavation was not permitted during our study, our site interpretations must often remain speculative. Secondly, the integration of high resolution datasets such as ours requires input from specialists from different disciplines, as well as considerable effort to translate their different viewpoints and research questions into a feasible field strategy and to maintain this throughout the analytical and synthetic phases of a research program. Finally, the backbone of successful data integration is precise positioning. We found that maintaining accurate measurement systems in the centimeter range over several years in mountainous and tectonically active areas such as Calabria is not at all trivial, and requires the help of a geodetic specialist.

Notwithstanding these challenges, the level of detail accomplished by the integration of archaeological, geophysical, geomorphological, and pedological datasets in our research area makes us confident that Metal Age rural landscapes can be discovered even in adverse circumstances. Instead of the current trend towards large-scale prospection, we argue that it is crucial to investigate very local phenomena in order to reconstruct the bigger picture of Metal Age landscapes. We are convinced that with a detailed approach employed at different scales, more hidden landscapes of the pre- and protohistoric Mediterranean can be unveiled.

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Notes on Contributors

Wieke de Neef (Ph.D. 2016, University of Groningen) is a post-doctoral researcher at the University of Groningen. Her research interests include Mediterranean pre- and protohistory, landscape archaeology, mountain environments, and archaeological prospection methods.

Kayt Armstrong (Ph.D. 2010, Bournemouth University) is a post-doctoral researcher at the University of Durham. Her research interests include geophysics, social archaeology, GIS, and prehistory.

Martijn van Leusen (Ph.D. 2002, University of Groningen) is associate professor of Classical and Mediterranean Archaeology at the University of Groningen. His research interests focus on the methodology of landscape archaeology, and he has directed several large competitively funded research projects in Italy around this theme.

ORCID

Wieke de Neef http://orcid.org/0000-0003-2243-4814
Kayt Armstrong http://orcid.org/0000-0002-9685-5649
Martijn van Leusen http://orcid.org/0000-0002-4778-9534

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