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Caring about Sediments: The Role of Cultural Geoarchaeology in Mediterranean Landscapes

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Abstract

Geoarchaeology and, in particular, the way in which it is exploited in the Mediterranean, emphasises the study of human and climate impact on the geomorphic system. This paper assesses some of the problems with this approach, as well as some of the more recent uses of Mediterranean geoarchaeology, where authors tend to underplay the importance of geoarchaeological processes in the past. Case studies from two different environment types in Provence (south of France) are presented. These are used to demonstrate how we might employ geoarchaeological information in discourses that emphasise human appreciation and perception of natural processes and geomorphological features in the past.

Introduction

The Mediterranean marginal landscape debate revolves around notions of environments or micro-regions that are meta-stable, often characterised by a potential for degradation. In turn, such areas may well be characterised by archaeologists as possessing a reduced potential for settlement and economic activity. Much traditional geoarchaeological work makes an important contribution to this characterization through the provision of 'environmental backdrops' for human activity. This type of geoarchaeology emphasises the study of human and climate impact on the geomorphic system. Whilst this approach is crucial to archaeological fieldwork, this writer contends that the full potential of a cultural geoarchaeology has yet to be achieved. An overview of the major themes in geoarchaeological research in the Mediterranean is presented. The case studies will contextualise geoarchaeological research from Iron Age and Roman sites in Provence that emphasise the relevance of geoarchaeology to cultural archaeology (Figure 1). The central premise is that a contextual analysis of human attitudes towards landscape processes permits a deeper reading of geoarchaeological information. Geoarchaeological data and other physical geographical information should be treated in the same way as monumental, architectural and artefactual information, in an attempt to understand how people understood and engaged with all of the elements that comprised their landscapes (see Ashmore and Knapp 1999; Richards 1999).

Mediterranean Geoarchaeology

More often than not, environmental reconstruction in Mediterranean landscape archaeology employs geoarchaeological evidence. Taphonomic processes that are often unsuitable for the preservation of palynological evidence, and the importance of sedimentary processes within Mediterranean environments, explain this emphasis on the study of the geomorphic system (Walsh 1999). Much of this work has

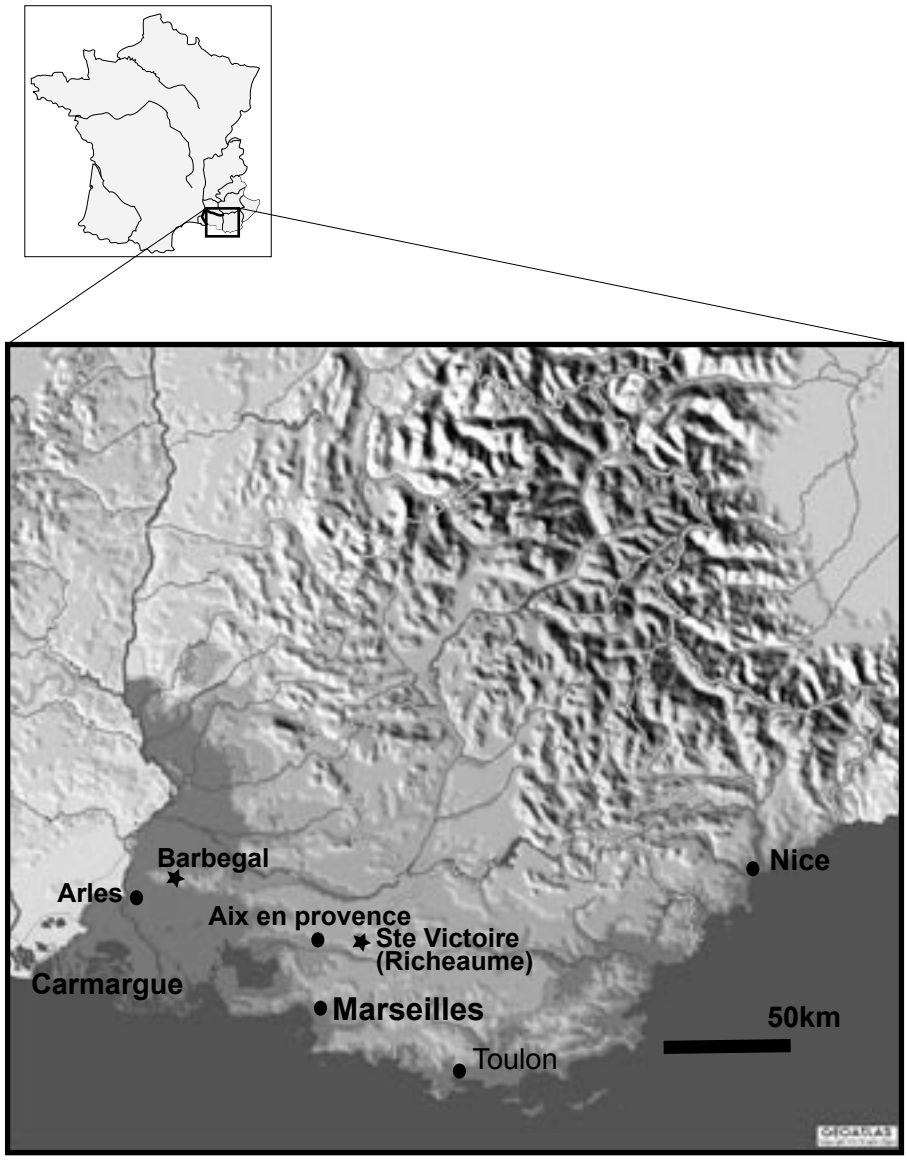


Figure 1. Location of the case studies referred to in the article.

traditionally been concerned with describing the history of geomorphological processes; ascribing natural and/or anthropogenic causes within a framework characterised by discourses that place importance on chronological phases of 'stability' and 'instability' within an overall trend of landscape degradation. More nuanced arguments do operate within this foundational paradigm. The fundamental question is: when did degradation start, and *who* or *what* was responsible (e.g. Delano-Smith 1996)? Unsurprisingly, different researchers have varied approaches to the analysis of these phenomena (e.g. Bintliff 2002; Thornes 1987; van Andel and Zangger 1990; van Andel *et al.* 1986). In recent years, some scholars have criticised this paradigm (notably Horden and Purcell 2000; Grove and Rackham 2001) and, to

some degree, they have questioned the extent, and impact of, erosional processes within the Mediterranean. Despite these welcome contributions to the debate, the full potential of cultural geoarchaeological approaches in Mediterranean archaeology has yet to be fulfilled. Such an approach comprises a more extensive interpretation of landscape processes and moves beyond the orthodox analyses of geomorphic cause and effect. The aim is to consider how these processes may have been understood in the past and to what extent they were important and also to move away from a discourse that separates people from nature, a process that has characterized humanity's ever-increasing intervention in nature (Hirsch 1995: 6).

Review of Environmental Themes in Mediterranean Geoarchaeology

Geoarchaeology is usually defined as the study of sedimentary processes, which affect the archaeological record, the study of past landforms and their associated geomorphic processes (for an extensive definition of the discipline, see Rapp and Hill 1998). In particular, the aim is the construction of 'integrated models of human-environmental systems and the interrogation of the nature, sequence and causes of human versus natural impacts on the landscape' (French 2003: 3). Many definitions emphasize the importance of investigating environmental processes, where people are an element within a dynamic system. Brown (1997) goes a step further, and emphasizes the importance of the cultural interface between people and the range of possibilities that exists within a given milieu at a particular time.

There is little doubt that within Mediterranean geoarchaeology, Vita-Finzi's (1969) research is the referential paradigm that all subsequent hypotheses have tested (or attempted to verify). There is no need to present a detailed description of the Vita-Finzi school of thought, although some contextualisation is useful. In a recent assessment of approaches to Mediterranean geoarchaeology, Bintliff (2002) demonstrates how much of the debate concerning landscape stability and instability in the Mediterranean has concentrated on issues of cause: essentially, climatic or anthropic. Van Andel and his co-researchers are more often than not portrayed as the challengers to Vita-Finzi's hypotheses, having developed models based on their research in the Argolid that argue for a more complex mosaic of erosional events, where people were often the primary cause (van Andel *et al.* 1986; Jameson *et al.* 1994: 325-414). The climate *vs.* human impact debate is partly founded on the notion that contemporaneous events over large areas were probably caused by climatic events, whilst non-contemporaneous processes, especially as we move into the protohistoric and classical periods, would have been caused by human impact (e.g. Brückner 1990). The Archaeomedes Research Programme aimed to understand the dynamics of land degradation, and focused 'on the relationship between the natural processes involved and the socioeconomic dynamics underlying human interaction with the environment' (van der Leeuw 1998). Part of this research included the study of *contemporary* perceptions of the natural and cultural environment, and the ways in which decisions are made *vis-à-vis* the manipulation of these milieux (Green and Lemon 1996). As with the vast majority of research into *ancient* Mediterranean landscape dynamics, there was little attempt to move beyond the systemic analysis of causes of landscape change; emphasis was placed on the investigation and modelling of degradation and desertification (e.g. Castro *et al.* 2000).

Recently, Grove and Rackham (2001: 8-9) have demonstrated how the contemporary view of a degraded Mediterranean (or the lost Eden) is in essence a romantic eighteenth-century myth. Despite their argument, we should however accept that soil erosion, and related

environmental stresses, have always limited the economic potential of certain landscapes during the past. Forbes demonstrates how some northern and western observers have tended to decry the supposedly ill-considered landscape management strategies developed by unthinking, exploitative Mediterranean peasants (Forbes 2000: 98-99). There have been successful management strategies during the recent historical period and 'over-exploitation and degradation of grazing resources have simply not been an option' (Forbes 2000: 107). However, as Forbes admits, we cannot demonstrate that all pastoralists in the past have successfully managed their landscapes and avoided degradation. We have to accept that much of this debate is related to notions and perceptions of hazard and risk. Hazards (the actual threat itself) and risk (the possibility, or in rationalised Western parlance, the probability) that the hazard will materialise, are culturally specific, and people's perceptions and understandings of them are heterogeneous across time and space. Green and Lemon's research in Greece demonstrates how modern attitudes towards the environment 'are generated by the seamless interrelation between the socioeconomic and physical characteristics of the landscape. In this sense, any local distinction between the "natural" and the "social" is a matter for investigation rather than something that can be assumed as self-evident' (Green and Lemon 1996: 181-82). There is no reason why geoarchaeology should not be employed in the development of discourses that assess possible relationships between people and the geomorphic processes that they experienced in the past.

Horden and Purcell (2000) argue that Mediterranean marginality (characterised to a great extent by erosional processes) is negotiated through the integration and connection of the different elements in a mosaic of niches through the optimum exploitation of each environment type. Consequently, risk is spread through flexibility and mobility within the productive system. Therefore, we might expect to see the development of links (through time) between different environmental zones as different societies ingeniously integrate and connect across the Mediterranean. They assert that geomorphological determinism is problematic, and replace this with a form of macro-economic determinism (their productive strategies). This allows them to connect and integrate their micro-regions. Horden and Purcell fail to engage with issues of spatial scale, and rarely attempt deep analysis of specific case studies that address diachronic changes.

As with the vast majority of discourses on Mediterranean erosion, they also emphasize research into the nature of the causes of erosion (human *vs*. nature), rather than an assessment of the daily relevance of these processes for different peoples in the past. They suggest that erosion is not important unless it can be demonstrated that it had an effect on large spatial and temporal scales. They also state that, 'Although the irreversible destruction of soil-cover, and the formation of the gullies and barren slopes that are often called "badlands topography", can be locally devastating, it is important to emphasise just how local the effect may be' (Horden and Purcell 2000: 310). They go on to argue (2000: 320) that the history of erosion can take on importance if we assess the aggregate effect of colluviation over time: 'The sediments are there, and it is vital to enquire what effect their arrival had on the economy and society of the locality. Even if the fills cannot be synchronized, we should still attempt to assess the impact, in aggregate, of their deposition.' They also state (Horden and Purcell 2000: 339) that they 'see the relationship between human communities and the environment as a *relatively* stable symbiosis'. This perspective emphasises the *longue durée*, that of an economic system and its managers/owners, rather than the day-to-day lives of the people who had to negotiate these environmental processes. It is these people, and their dynamic relationships with the

landscape, that become anonymous in Horden and Purcell's Mediterranean. Even if erosion is rarely an immediate and catastrophic process, this does not mean that the daily and mundane processes are not interesting, and did not have repercussions for the ways in which people lived in and experienced their landscapes. If we are not convinced by this assertion, we need only look at the direct, and indirect, impact of the 2003 forest fires across the Mediterranean, not forgetting the increased mortality rates also due to higher-than-average summer temperatures.

Recent Geoarchaeological Research in the Mediterranean and Human Responses to Erosion

Krahtopoulou's (2000) study of alluvial sequences in Macedonia is an informative illustration of the paradigm within which contemporary geoarchaeology operates. This clear assessment of the reasons for periods of erosion and phases of stability within a typical Mediterranean landscape demonstrates how the alluvial record can contribute to the debate over human landscape dynamics. This discussion highlights the issue of chronological resolution in geoarchaeological research and, for those of us who wish to assess how erosion may have been perceived in the past, this is the fundamental problem. Some sedimentary records may seem impressive when examined in section, and the few accurate dates that we possess may imply a long history for some periods of stability and instability (see also Whitelaw 2000: 145-46). However, we can rarely assess the level of immediate perceptible impact of erosional events in the past. This is one of the reasons why we are obliged to develop discourses that accentuate the long and medium *durée*, and articulate models that present humans as an anonymous, amorphous group operating within long time-scales. People merely appear as one element within a systemic analysis of landscape processes.

In some ways, the environment is treated as 'grey'-box, whose state is affected by two types of process; one is climate, and the other is people. These two sets of process can produce feedbacks. Whilst dating techniques improve, and fine-resolution studies of erosion histories do take place in some parts of the Mediterranean (Brown 1999; Brown and Ellis 1995), we cannot escape the fact that many stratigraphic sections must have been truncated, and portions of the erosional record have been lost. For example, Moody's constructive assessment of the Cretan record contends that certain sediments deposited by intense storms in the past may have been removed by subsequent events (2000: 58). Clearly, this problem is common to many sequences, and is an issue that is not always broached by geoarchaeologists, despite its inherent importance. This theme is also taken up by Delano-Smith (1996: 161-62), who highlights the problem of sediment record truncation, and quite rightly argues that the fact that many of the sedimentary records that do exist point to high levels of Roman and post-Roman erosion does not mean that there was no, or little, pre-Roman erosion.

We know that classical writers (and, we might therefore assume, their contemporaries who worked the land) were aware of certain geomorphological processes, and in some instances they possessed a reasonably clear notion of their causes. Pausanias made observations of numerous natural features and, more importantly, associated processes. For example, he made the link between abundant water sources and flourishing forests (Pausanias 7.26.4). Pliny clearly understood how deforestation contributed to erosion (*Historia Naturalis* 31.3). The (geo)archaeological study of cultural responses to erosional events (whether we believe these events to be short-term and catastrophic, or long-term and mundane) is one way of assessing the perceived importance of these processes in the past.

Geoarchaeological projects do sometimes consider the nature of human response to erosion. One response (probably from the Bronze Age onwards) was terracing (Frederick and Krahtopoulou 2000), or trenching (Foxhall 1996). Research has been carried out in various regions around the Mediterranean characterising and dating terrace systems, the majority of which are post-medieval (Blanchemanche 1990). It is possible that terracing was initially developed during the Bronze Age, or perhaps earlier. In some areas of the Mediterranean, these systems are, and have been, extremely extensive (Whitelaw 1991: 405); Foxhall (1996) rightly contests that the absence of unambiguous archaeological evidence is problematical, and that trenching (which would not be as visible in the archaeological record as terraces) was possibly used on Greek estates. Whatever method was employed, it should be apparent that the construction of terraces, or the digging of trenches, is more than an automatic response to hill-slope erosion.

It is important to contextualise the development of terraces within the cultural analysis of human responses to landscape change, whether these changes are the results of climatic or anthropic factors, or indeed both. The terraces that were constructed around the Aegean during the Bronze Age represent the organisation and control of the landscape by an elite: terraces were as much about the articulation of political power in the landscape as they were about managing erosion and food production. There is little doubt that the construction of terraces around Roman villas had similar socio-economic and political roles. Rome's domination of the conquered regions was very much concerned with the imposition of a new mode of production within a complex economic system; this had many repercussions for how land was worked, owned and experienced by those within it (Quilici Gigli 1995). Terracing is but one response to erosion. Forbes (2000) demonstrates how place-specific control mechanisms, such as the regulation of the number of grazing animals present in a given area, contribute to the successful management of areas which might otherwise evolve as degraded landscapes. This type of evidence reveals how erosion and potential instability might have been understood and responded to. People do not develop such mechanisms if there is not a potential problem.

Zangger's (2001: ch. 6) study of technological solutions to alluvial sedimentation problems on the Argive plain is another useful example of how geoarchaeology can contribute to the discussion of people/landscape dynamics in the Mediterranean. Although such research addresses human responses to environmental change within a framework of means-ends rationale, where the success of an economic system is the paramount aim, it does allow us to move away from the traditional geoarchaeological analysis of cause and effect within the sedimentary system.

Cultural Geoarchaeology in Provence

Much of the contextual data and fieldwork results associated with the case studies presented below have been described elsewhere (Leveau 1995; Leveau *et al.* 2000; Walsh and Mocci 2003). The aim here is to present the geoarchaeological results of this work in a manner that allows us to move beyond basic analyses of sedimentary processes, and then assess how these studies contribute to the study of human perception and understanding of past environments. One study considers results from a landscape project on the Sainte Victoire massif near Aix-en-Provence, and the second study is from the Barbegal Roman watermill near Arles, in western Provence (Figure 1). The Sainte Victoire study presents evidence for human activity from the Iron Age through to the end of the Roman period and particular emphasis is placed on the presentation of results from a series of excava-

tions on the Domaine Richeaume. In order to appreciate cultural attitudes towards landscape processes, we must contextualise them within their specific chrono-cultural framework. The Barbegal mill study is quite different in that this is concerned with a major industrial site, where specific research questions were concerned with identifying the chronology of the mill's function and the environmental context within which it operated.

The interpretation of the geoarchaeological characteristics of these sites relies on a premise that geoarchaeological events on archaeological sites can elucidate the nature of human responses to geomorphological processes through an assessment of changes in the characteristics of these sites. On some excavations, it may be possible to follow a sequence of geoarchaeological and archaeological events that demonstrate a plausible set of causes of, and/or responses to, an erosional event, or a particular attitude towards a geomorphic feature. Another problem (mentioned earlier) is the fact that we cannot quantify rates of sedimentation in the past with any degree of confidence. The truncation of units by both natural and anthropogenic processes (a reoccurring characteristic of the geoarchaeology discussed in the case studies below) means that we can only characterise phases of probable geomorphic stability and instability. For that reason, no attempt is made in the subsequent case studies to give specific quantitative measurements of the sediments described. However, the geoarchaeological data are presented with scaled figures, plans and contextual information that should permit the reader to assess the validity of the discussions that emanate from these results.

A fundamental thread in the discussion below is the assertion that the environmental processes and topographical characteristics described were important to the site's inhabitants or builders, no matter how mundane these processes were. In these vignettes, the aim is not to tackle issues of climatic or anthropogenic culpability in the production of erosional events, but rather to understand the nature of human relationships with particular landscape processes and features.

The Sainte Victoire

Introduction. The Sainte Victoire massif (SE France) comprises a 1000-m-high mountain that dominates a relatively flat plain to the south and an undulating topography to the north. The piedmonts on which many of the sites (including those at Richeaume) are located, comprise marls, breccias and clays. The clays have been severely eroded in places and provide the context for some complex geomorphic processes. The results of prospection and excavation carried out from 1990 to 2003 allow us to assess the waxing and waning of settlement from the Neolithic through to the end of the Roman period. Part of this research addresses associated geomorphological processes, as well as the evolution of landscape management and control, in an area that is adjacent to two important urban centres (Marseilles, established in the seventh century BC; and Aix-en-Provence established by the Romans during the first century BC, but with protohistoric antecedents in the form of the oppidum at Entremont). The field-walking and excavation results from this project have been published elsewhere (Walsh and Mocci 2003). The aim here is to present the geoarchaeological elements within a framework that critically assesses what this type of evidence can contribute to our understanding of human/landscape dynamics. However, it is important to present some detail of the landscape survey results, as the changes in settlement pattern during the Iron Age and Roman period must inform our interpretation of the site-specific geoarchaeological data.

For the Early Iron Age there are only eight sites identified in the study area that covers a zone of some 8,500 ha. Two of this group are

tumuli dating to the end of the seventh and the beginning of sixth centuries BC. There are four oppida and only two low-lying sites. The oppidum at Bramefan has been excavated (Bofinger *et al.*1996), as has one of the low-lying sites, Richeaume III (Walsh and Mocci 2003). The Middle and Later Iron Ages (which correspond to La Tène I, II and III) witness an important increase in settlement activity on the Sainte Victoire. During the late third and second centuries BC, there are about 50 sites on the Sainte Victoire, with a concomitant evolution in settlement hierarchy: 10 oppida, at least 35 minor sites, as well as a possible 30 sites in addition to this. Other than the substantial domestic, defensive and storage structures discovered on the oppida, there is no direct evidence for structures on the low-lying minor sites. Our evidence is entirely based on ceramic assemblages collected during prospection.

During the Early Roman period, sites were often established on, or close to, their Late Iron Age precursors. The first villas were located adjacent to low alluvial terraces with direct access to the best agricultural land. During the first and second centuries AD, there was a gradual intensification of settlement on the massif, with a total 35 sites dated to this period. During the third century AD there was a decline in activity in this landscape, followed by a re-emergence of many settlements during the fourth century. A final decline then took hold during the sixth century, and this situation continued into the early medieval period.

The excavation on the Domaine Richeaume, at the foot of the Cengle (a limestone bar that delimits the southern edge of the Sainte Victoire mountain) allows us to add some archaeological depth and rigour to the landscape survey (many surveys being overly reliant on their analyses of surface scatters). The excavation of one Early Iron Age site (Richeaume III) and a Roman villa (Richeaume I) has allowed us to consider two very different sites, with dramatically different geoarchaeological problems and processes (Figure 2).

Richeaume III. One of the fundamental questions in landscape archaeology is: When is a site a site? The vast majority of the dots presented on landscape survey maps are representations of surface scatters whose subsurface extent is unknown. Another issue is that many sites are obviously masked by subsequent sedimentation, and the gaps that exist on our maps may have once been filled by archaeological sites. In Provence, this is a particularly important issue for the study of the protohistoric periods. There is a number of areas where there seems to be an absence of archaeological evidence for the Bronze and Early Iron Ages. Another issue is the fact that where we do have dots representing lower status sites, very few have been excavated. The majority of research concentrates on the higher status oppida, or substantial lowland sites. The excavation at Richeaume III provided the opportunity to assess the characteristics of one of these dots.

Richeaume III comprised a scatter of hand-thrown Early Iron Age pottery, situated on a talus of eroding Pleistocene clays at the foot of the Sainte Victoire (Figure 3). A series of sondages delimited the extent of the spread of pottery, and larger trenches were excavated on the area where the ceramic material was concentrated (Figure 2). Over 500 sherds of hand-thrown pottery, along with an example of an imported kylix from Marseille, dated this site to the beginning of the sixth century BC. There was no convincing evidence for any kind of structure on the site. It is possible to interpret one element on the site as the vestigial remains of a small wall.

This lack of orthodox archaeological features, however, was compensated by the presence of some interesting geoarchaeological elements. In sondage five, a curved infilled

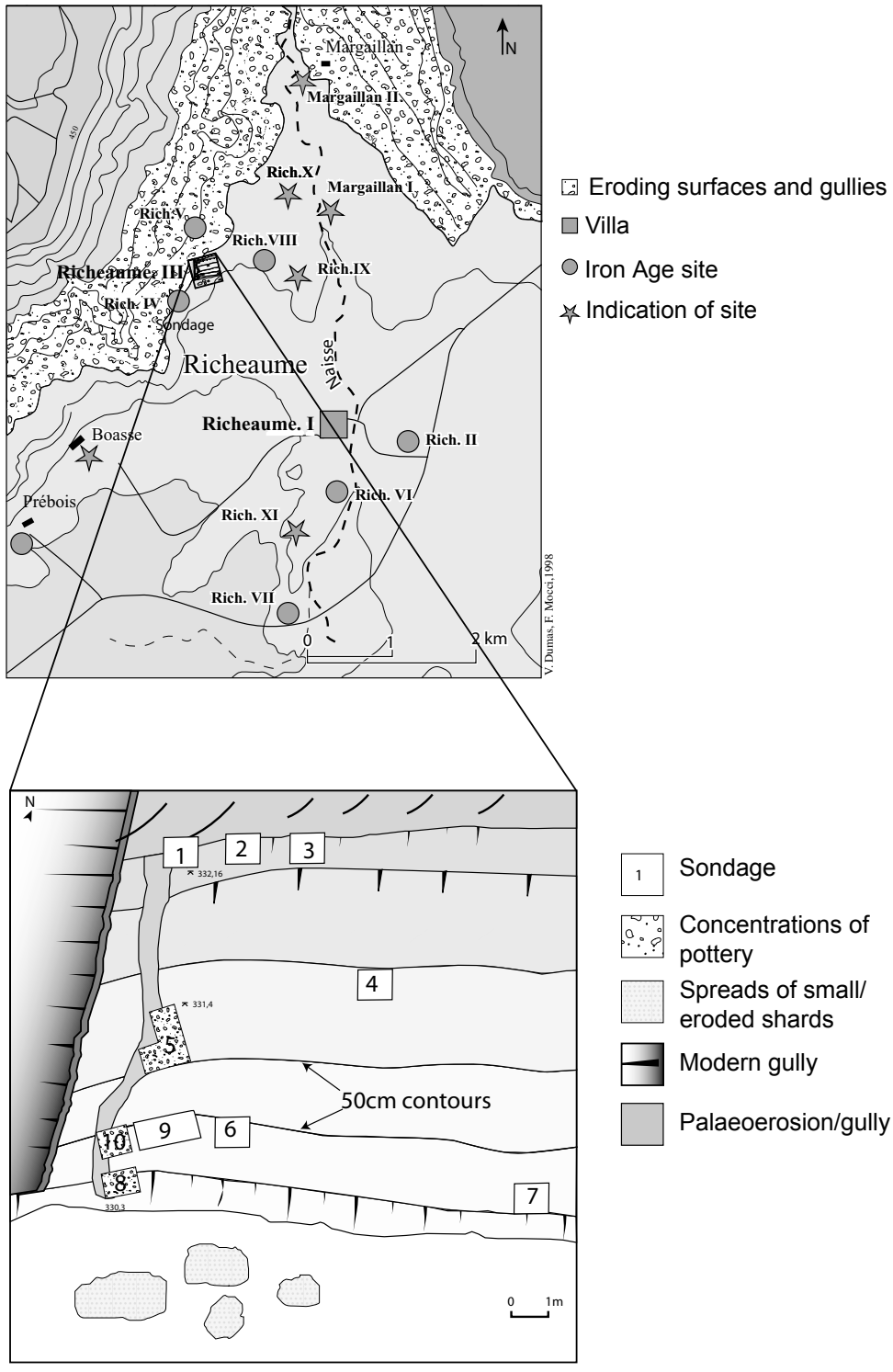


Figure 2. Map of the Richeaume Domaine with all archaeological sites and detail of Richeaume III (below).

Photo: K. Walsh

Figure 3. View of Richeaume III from the south, with the central part of the Sainte Victoire Mountain in the background.

gully containing some well-preserved sherds of pottery was discovered (Figure 2). Initially it was thought that this could have been the foundation trench of a hut. The extent of this feature was followed to the northern limit of the site, where a section (S1) was cut into the face of the upper talus (Figure 4). An infilled palaeo-ravine was discovered with sherds of Early Iron Age pottery at the base of the fill. The basal layer of this ravine is the local red clay substrate and the edge of this (unit 7 in Figure 4) defines the surface of the ravine bottom. The actual ravine was probably never more than 1 m deep (taking into account the probable truncation of the superficial layers towards the top of the section). The ravine was then infilled with a coarse colluvial sediment that comprised small rocks and stones (5-15 cm diameter) within a clay-silt matrix. The Iron Age pottery was found towards the bottom of this fill. The final layers that cap this infilling comprise relatively soft clays and silts that could quite easily have replaced pre-existing truncated units. Whilst one must accept the problems associated with dating units via their association with artefacts, the cutting and the filling of the ravine must have occurred at the end of the Early Iron Age. This process would probably have taken place once the site was abandoned, although one could plausibly argue that the erosion was the reason for abandonment. On the Bramefan oppidum, 2 km from Richeaume, on the south-facing slope of the mountain, two distinct periods of occupation have been identified (Bofinger *et al.* 1996). The first is dated to the Early Iron Age (sixth century BC) and the second to the La Tène III period. The evidence for the early

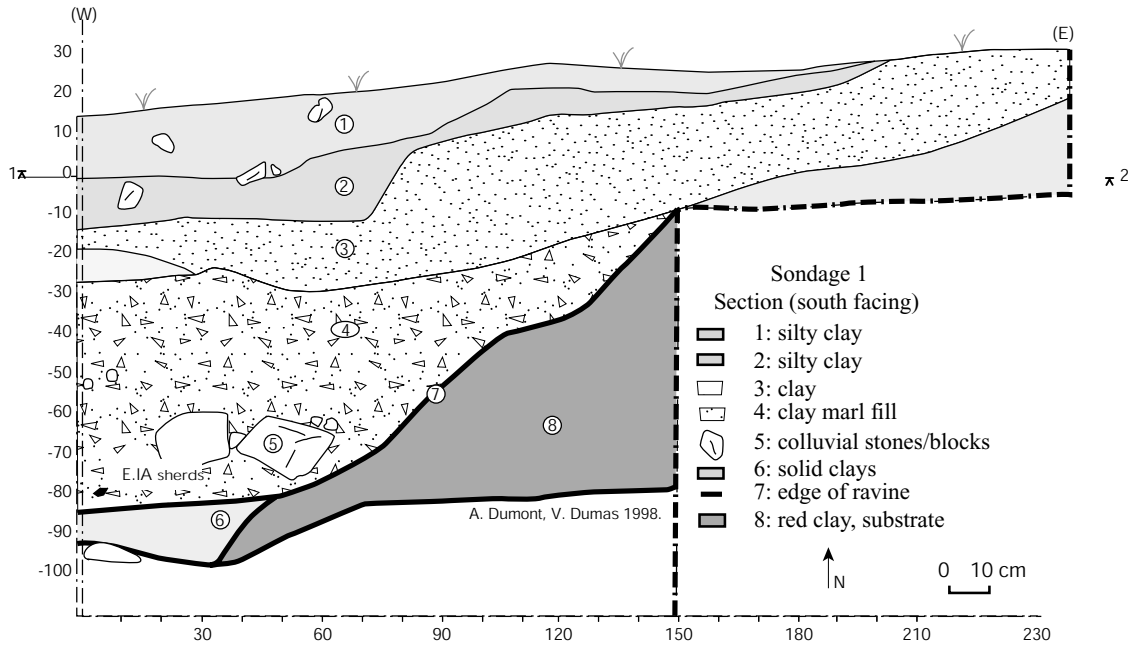


Figure 4. Section of sondage 1 on Richeaume III with Early Iron Age pottery at the base of the colluvial fill (unit 5).

phase of activity comprises large quantities of storage vases, lentil and barley seeds, but no evidence for structures. The end of the first occupation phase is characterised by a substantial colluvial deposit (Jorda and Mocci 1997). At the broader regional level, there are a number of other sites across Provence that also demonstrate phases of erosion during this period (Provansal 1995). The evidence from several sites in Provence for an Early/Mid-Iron Age phase of erosion is convincing, although one cannot argue for exact synchronicity.

The principal cause of hill-slope erosion and ravine incision is water run-off, with surfaces becoming more susceptible to erosion where there is reduced vegetation cover. It is quite probable that the inhabitants of low-lying sites cleared much of the vegetation cover, in order to expand agricultural land, or to gather timber for a whole range of uses. When we observe and interpret such phenomena, we tend to fall into a discourse that revolves around notions of environmental stress, instability and even crisis (for a useful critique of this, see Grove and Rackham 2001). Because there are very few Early Iron Age sites on the Sainte Victoire, we can be quite sure that there was little pressure on land due to a low population density. In such circumstances, even dramatic erosional events may not be perceived as a problem. This would be especially true for semi-sedentary populations, who had yet to establish permanent substantial settlements, which may well have been the case in parts of Early Iron Age Provence (Garcia 2002: 90-92). It appears that during the Early Iron Age, the Sainte Victoire was quite marginal when compared with the neighbouring areas. Other zones in eastern Provence appear to have had reasonably high levels of population, whilst the Sainte Victoire was neglected (Trément 1993; Bérato 1995; Walsh and Mocci 2003). The perception of peoples from beyond the Sainte Victoire may well have been one that saw this micro-region as too risky and difficult to manage. This negative appreciation of the

Sainte Victoire may then explain the relatively low levels of settlement during the Early Iron Age. Erosion, however, may not have been considered a problem by those who lived and worked on the massif. Even today, where much of the world is regulated by risk managers, erosion is not always perceived as important if it does not directly damage or threaten a people's livelihood. As Green and Lemon (1996: 188) observe in modern Epirus:

> Erosional episodes were not regarded as an annoyance: they did not inconvenience grazing animals, and cultivation was a relatively insignificant activity carried out on a small scale. In consequence, the occasional loss of a portion of one's vineyard or garlic plot due to erosion was not regarded as life-threatening, and was seen as one of those things that happens.

Attitudes such as this are largely contingent on each belief system; we could argue that a seemingly indifferent attitude to erosion may be due to a feeling that such events are 'the will of the gods'. These issues will be discussed further after the following case study that presents a very different type of site and may therefore represent a relationship with landscape processes quite different to those that existed at Richeaume III.

The Roman Period: The Richeaume I Villa. The Roman villa (Richeaume I), just 500 m to the south of Richeaume III (Figure 2), was excavated between 1997 and 2004 (Walsh and Mocci 2002; Mocci and Walsh in press). Substantial hydrological features have been excavated on this site. The most important of these comprise two pools and a substantial aqueduct (Figure 5). The research at Richeaume I has included the analysis of these hydrological structures and their relationship with the floodplain just to the east (Zone III in Figure 5). Resistivity surveys have made an important contribution to the geoarchaeological work, identifying buildings, and a palaeochannel that was directly related to the hydrological structures. The first aqueduct would have transported water away from the site: this element runs from north to south (AQ 1 in Figure 5), and was built during the first half of the second century AD. This structure turns east, and would have emptied into the stream channel (now an in-filled palaeochannel). This element is discussed in detail below. The second branch of the aqueduct (AQ 2) was constructed during the third century, runs from west to east, and joins with the first branch just to the west of the stream/channel to form a single aqueduct. The geoarchaeological work has demonstrated that the agricultural buildings located just to the west of the aqueduct junction were subjected to flooding, as alluvial sediments abut all of the buildings in this area.

The palaeochannel is the most important geoarchaeological element on the site (Figure 6). Four distinct phases of activity, which cover the second through to sixth centuries AD, have been identified. These phases reflect the principal periods of floodplain development and management. The first phase of alluviation is dated by ceramic material and has yielded a *terminus ante quem* of the fifth century AD for this event. However, the date proposed for the construction of the aqueduct demonstrates that the channel was active from the second century AD. On or after this date, overbank deposits were laid down either side of the channel and threatened the structures in Zone III. A dyke was then constructed, undoubtedly as response to the flooding. The dyke is dated by a second-century, upturned, votive sealed jar containing burnt grain. The next phase comprised the cutting of the floodplain silts by a new channel with almost vertical sides: vertical channels can develop naturally in cohesive sediments, although this channel may have been dug deliberately, or a natural channel could have been modified. Coarse alluvial

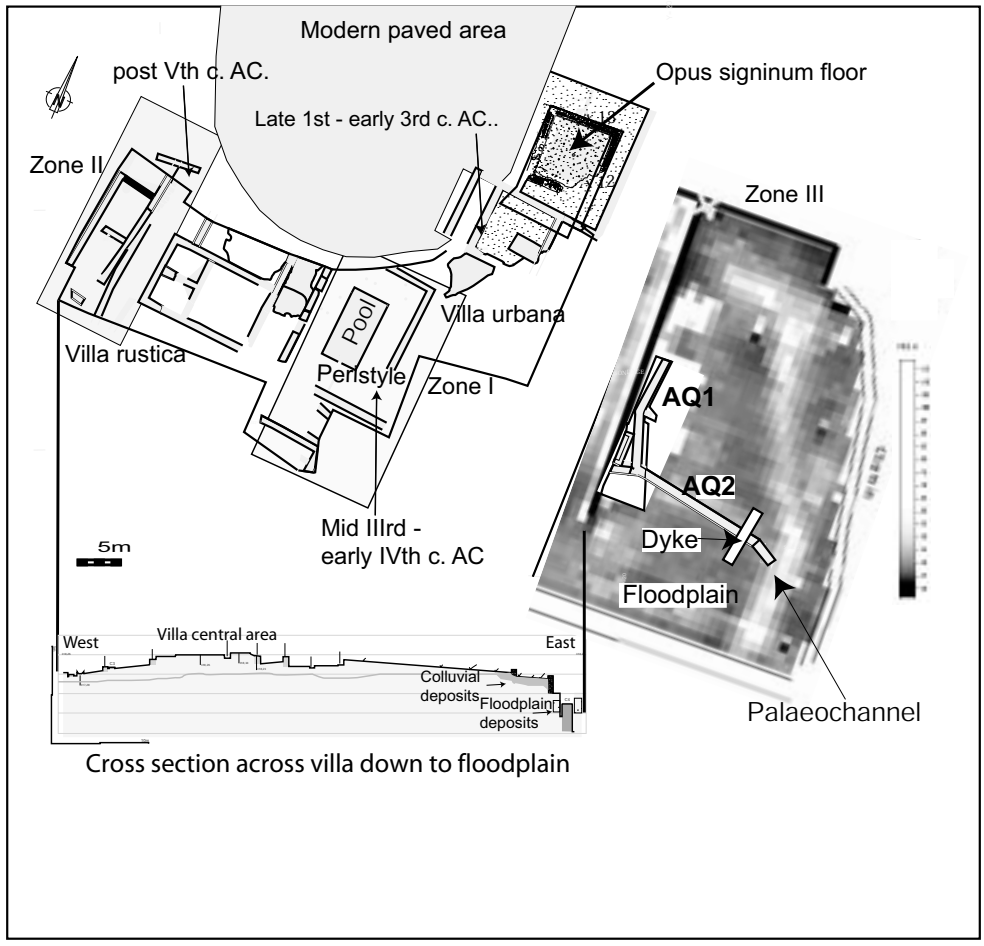
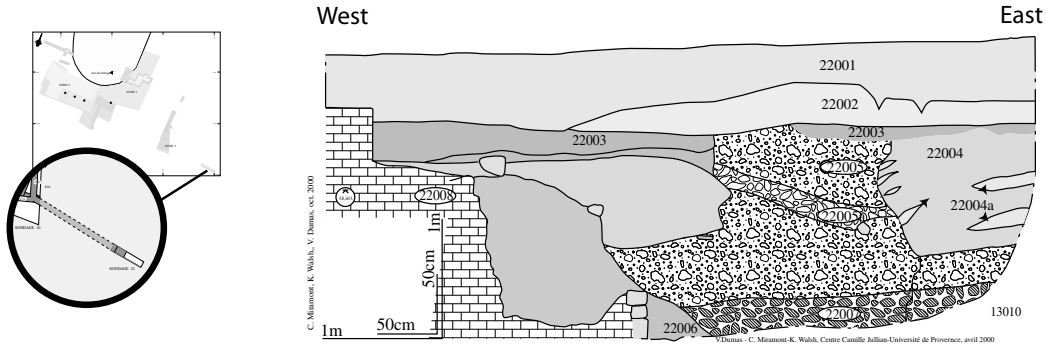


Figure 5. Plan of the Richeaume I villa with cross-section, and resistivity plot of floodplain and palaeochannel.

material then infilled this channel, probably during the sixth or seventh centuries. The traditional geoarchaeological questions here are: What caused the infilling of this channel and when did this take place? It suffices to note that the stream system is bounded by hill-slopes that were undoubtedly managed (terraced?) fields during the Roman period. The collapse of the management system may have contributed large amounts of sediment to the stream system. Whilst it is impossible to support this hypothesis directly, there is other evidence for a late/post Roman phase of erosion in the area. At Roque Vaoutade, 2 km upstream from Richeaume, geoarchaeological work also implies a late or post-Roman phase of alluvial deposition; one radiocarbon-dated sequence has produced an estimation of 1,470 ± 60 BP (Ly 5500) (Ballais and Crambes 1993: 472). Despite the fact that we have identified sedimentary facies and explained the probable geomorphic reasons for their deposition, the fundamental question is: what does this tell us about the people who lived with these processes?

Richeaume I and its geoarchaeological elements can only be understood within the broader context of settlement and activity across the Sainte Victoire as a whole. During the height of Roman activity on the massif,



22001 : Modern surface
20002 : "B" Horizon: silty sand
22003 : Silty sand - homogeneous - flood deposit (covered aqueduct)
22004 : In-filling homogeneous sand (no evidence of pedogenesis = rapid in-filling.)
22004a : Gravel lenses
22005 : Pebbles and small rocks
22005a : Lens of well-rounded pebbles - fragments of non-rounded tegulae and ceramics
22005b : Well-rounded small stones and pebbles High levels of manganese
22006 : Stones in a gravel matrix and silty sand. Numerous ceramic fragments = Stream edge
22007 : Pebbles and stone blocks: summit of older palaeochannel anterior to the occupation of the site and aqueduct construction ?
22008 : Aqueduct
13010 : palaeochannel
Tile in flat position

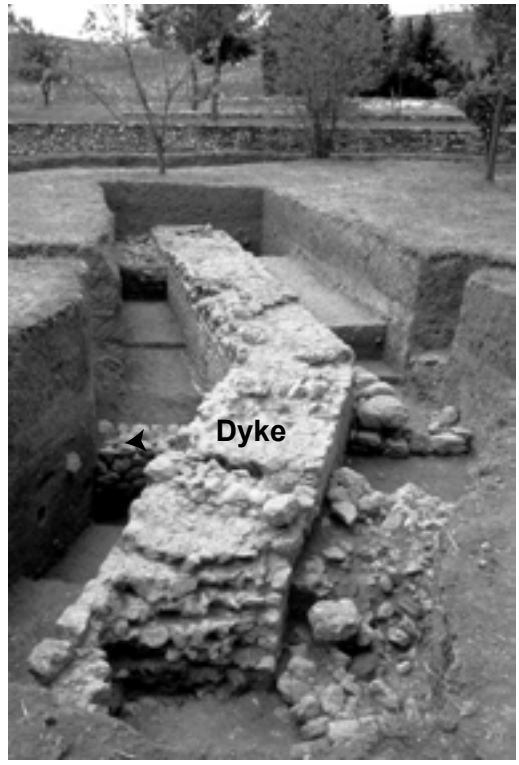


Figure 6. Above, Richeaume I palaeochannel section. Below, a view from the south-west of the aqueduct and dyke.

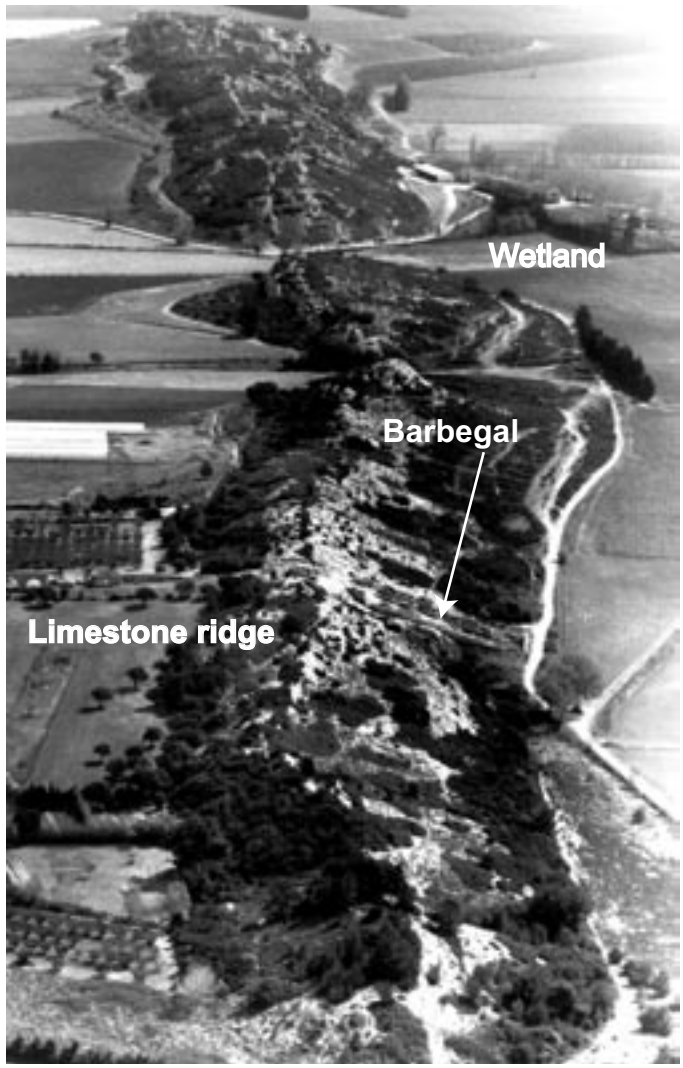
there may well have been 10 villas, a pottery-production site, an oil-production site, plus a network of c. 20 smaller agricultural sites. This settlement pattern implies an organised and economically productive landscape where the control of hazards and the reduction of risk would have been essential to the success of economic production. The suite of complex (and expensive) hydraulic structures on the Richeaume villa, which includes a dyke to protect buildings on a low terrace susceptible to flooding, demonstrates a desire to control and defeat environmental threats. A villa would have been a long-term and expensive investment that was in many ways static, in that buildings and engineered structures could not be moved; therefore, they had to be protected. The absence of substantial colluvial layers dated to the Roman period may be taken as a demonstration of the success of Roman landscape management, or that the Roman landscape managers may have actually removed any such evidence of erosion as a part of their management process—a theme that is developed in the final case study below.

The Barbegal Mill: The Control and Management of Dynamic Landscape Processes

The Roman watermill at Barbegal (in the Vallée des Baux, 7 km east of Arles in western Provence: see Figure 1) is one of the most impressive pieces of hydrological engineering in the Roman world. The mill was supplied with water by an extensive aqueduct system that also supplied the city of Arles to the west. Located on the south-facing slope of a limestone bar (part of the Alpilles) (Figure 7), the site was partially excavated by Fernand Benoit in the late 1930s (Benoit 1940), and was the object of further research directed by Philippe Leveau during the late 1980s and early 1990s (Leveau 1995; Leveau *et al.* 2000). The modern excavations at Barbegal included extensive geoarchaeological work on, and adjacent to, the mill. Much of this research aimed to reconstruct the characteristics of the immediate landscape (an area that is now a drained wetland). The contribution of this author was the excavation of a series of Late Roman burials at the foot of the mill, along with an associated geoarchaeological study of the hill slope on which the mill was constructed (Leveau *et al.* 2000).

The fundamental aim of the geoarchaeological research carried out on the presently drained wetland in front of the mill (*les Marais des Baux*) was to assess past variations in water level. The reconstruction of the hydrologic regime in this area has always been crucial to the interpretation of how wheat and flour were transported to and from the mill. Benoit had originally argued that rafts were brought up to the foot of the mill, and transportation to and from Arles took place over the water. The results of the geoarchaeological work undertaken during the 1990s (Bruneton 1999 and 2000) clearly demonstrated that the wetland in front of the mill was relatively dry during the Roman period, and therefore wheeled transport must have been employed. The study of sedimentary facies and ostracods allowed Bruneton to establish an underlying trend of a rising water level, punctuated by periods of regression—most notably during the Roman period, when this wetland was undoubtedly drained and managed for arable agriculture. The geoarchaeological work was of fundamental importance to the interpretation of the day-to-day functioning of the mill. A hypothetico-deductive analysis informed a processual model, whereby the environmental reconstruction informed a reassessment of the daily function of an economic tool: the watermill. Leveau quite rightly takes us a stage further in his analysis of Rome's capacity to control and manage new territories through complex technologies which also have an important ideological function (1999; see also Purcell 1996 for a broader discussion of hydrological technology and ideology).

The analysis of the hill-slope deposits abutting



(Photo: Centre Camille Jullian, Aix-en-Provence)

Figure 7. Aerial view of the limestone ridge with the Barbegal mill and the wetland area to the south (situated on the right of the photograph).

the mill does not contribute in the same way as Bruneton's research to the reconstruction of the environmental milieu in which the mill operated. Nevertheless, it does allow us to reiterate the importance of the Roman landscape management associated with this important feat of engineering. The aim was to assess the relationship between the colluvial deposits on the slope, and those that had been investigated on the site and on the wetland. A series of 11 units was identified; the earliest units were the hydromorphic clays and the limestone slope on which the Roman activities took place. The earliest colluvial units were coarse and stony and contained Roman archaeological material (Figure 8). This allowed us to date the onset of hill slope erosion to the post-Roman period. It is clear, however, that this hill-slope must have witnessed earlier phases of colluvial activity throughout the Holocene. Therefore, the

construction of the mill undoubtedly included the removal of pre-existing sediments in order to facilitate construction. This removal of sediments extended down as far as the red hydromorphic clays that define the northern edge of the wetland, and the limestone slope that dips down under these clays. The mill's engineers must thus have removed any existing colluvial deposits when clearing the area in preparation for construction. The mill itself is situated directly on the limestone slope. At the foot of the mill was a pit (4.85 m × 2.5 m × 1.8 m) containing 790 sherds of Roman pottery, with diagnostic pieces dated to the very end of the second century AD. This pit was dug into the red hydromorphic clays. Immediately to the east of this feature, four burials were discovered. The pottery directly associated with one of these burials is dated between the end of the third and the start of the fourth century AD. The trenches for these burials were also dug into the red hydromorphic clays. The different events represented by the construction of the mill, the pit and the burials, demonstrate that the area around the mill was managed and any colluvial deposits present around the site were removed, or the slope was managed to such an extent that the potential for colluviation was obviated.

After the abandonment of the mill, which must date to the period immediately prior to the burials (it seems unlikely that burial would occur whilst the mill was active), the first layers that appear in the geoarchaeological section were deposited. The colluvial layers that contained the Roman archaeological material showed no signs of pedogenesis. This implies that the deposition of these layers was relatively quick, with little time for the development of soil (measurements of organic matter, pH, $CaCO_3$ and particle-size analysis were carried out on samples from every unit). These lower layers possessed exactly the same sedimentary characteristics as the sediments surrounding the four early fourth-century AD burials excavated at the foot of the mill.

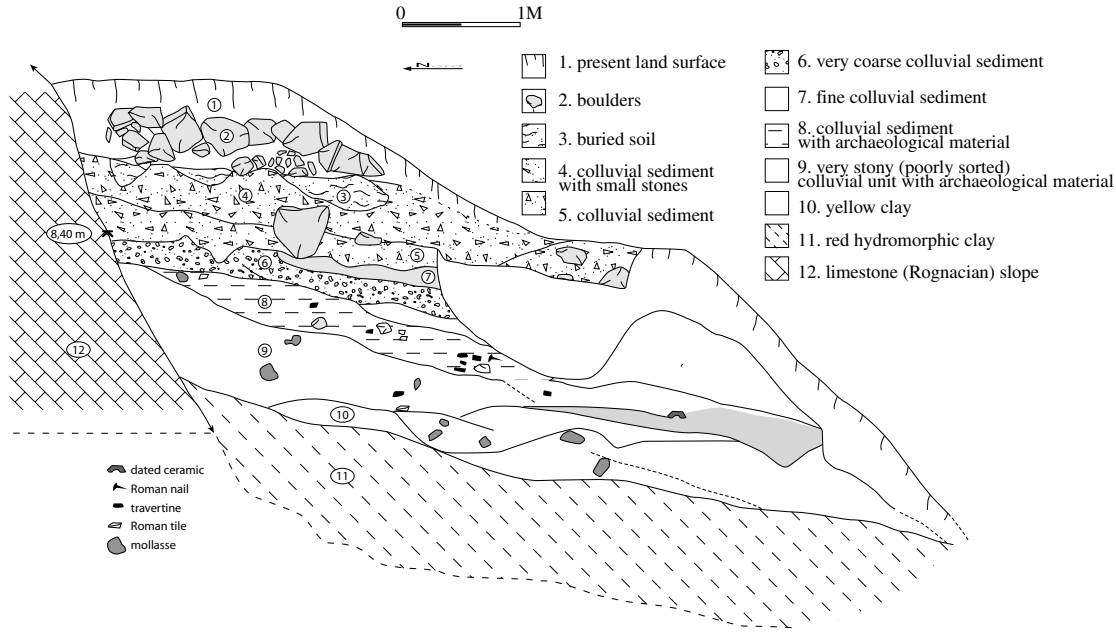


Figure 8. Geoarchaeological section from the foot of the Barbegal mill. All of the colluvial layers are Roman and post-Roman in date.

Consequently, this initial, post-abandonment phase of erosion is dated to the fourth century AD. The subsequent post-antique layers have not been dated. The penultimate unit is characterised by a relatively high organic content, and is identified as a buried soil and represents a period of relative stability, or transport of topsoil from upslope. This layer is superseded by a unit that is still active, containing large stones and small boulders within a silty/sandy matrix. A similar sequence was also recorded at the Pont Simian Roman Bridge, less than 2 km from Barbegal (Bellamy and Ballais 2000). This bridge was part of the aqueduct which supplied Barbegal. A series of sediments against the bridge reveal mid-Iron Age erosion, followed by a phase of slope maintenance (removal of sediments) designed to facilitate the construction of the bridge.

In summary, this geoarchaeological work demonstrated how any pre-existing sediments around the mill were removed as part of the site's construction. The absence of archaeological material spanning the period of mill activity also implies that this area was managed, with erosion either prevented, or colluvial material removed at regular intervals.

Discussion

At both Barbegal and Richeaume I, anthropogenic manipulation of geomorphic features is an important issue. Anthropogenic truncation of sedimentary records should not be seen as a problem, but rather a phenomenon with a cultural aspect that archaeologists should attempt to understand and interpret. The colluvial facies at Barbegal (and the nearby Pont Simian) reveal periods of direct intervention in the landscape. Such endeavours were designed to facilitate engineering projects that would contribute to agricultural production as well as the supply of water to the city of Arles. This intervention in the geomorphic system may seem banal, but it should be studied in the same way as the architecture and statuary that represent economic and political power within urban and rural imperial landscapes. The manipulation of the environment is very much associated with a certain attitude towards nature, and an appreciation of what can and cannot be controlled within the natural world. We know that in Pliny's *Natural History* 'man was at the centre of the story: nature had made all things for him, and Pliny's book was partly a survey of what was available' (French 1994: 207).

Economically important landscapes were controlled and managed. Barbegal and Richeaume I represent two very different types of site, but the geoarchaeological work in both places reveals evidence for direct management of the landscape. When considered in conjunction with other types of evidence for landscape management (in particular, centuriation), this type of geoarchaeological sequence is unsurprising. Such sequences, which often represent phases of human truncation of the geoarchaeological record, may mean that strata representing earlier erosional events were in fact removed by Roman intervention and land management practices. We need to ask if these landscapes were characterised by geomorphological stability, or whether the Roman management of the geosystem disguised or masked some phases of erosional activity: stability is often assigned to periods where facies are either absent, or comprised of fine sedimentary material. The relative dearth of evidence for Roman erosion in this region does not necessarily imply that erosion was not a problem. As Beagon demonstrates, Pliny observed the destructive effect of certain types of activity on the landscape (1996: 293). Whilst one would have to disagree with the general tone of Hughes' (1996) pessimistic account of the impact of Greek and Roman civilisations on the natural environment, his assessment of attitudes to the environment is nevertheless useful. It is apparent that Classical philosophers questioned the notion that the gods were active in every facet of environmental, and in particular, agricultural processes.

Consequently, we see the development of an ethical system which allowed more pragmatic approaches to the management of the environment and that involved direct, and sometimes significant, intervention.

Conclusions: Sediments and Society

The case studies presented above can by no means represent the rich variety of relationships that must have existed between different groups of people and their landscapes during the Iron Age and Roman period in Provence. The research was initially undertaken with traditional geoarchaeological research questions in mind. The publication of Horden and Purcell's *The Corrupting Sea* (2000) and Grove and Rackham's *The Nature of Mediterranean Europe* (2001) led to a fundamental reassessment of why I felt geoarchaeology was important. These recent publications explicitly question the significance or magnitude of geomorphological processes in the past. What is the relevance of geoarchaeology in the Mediterranean if we argue that the integration of *connected*, marginal environments produces a successful economic system where risk and fragility are of little importance? Even if we do not agree with these revisionist perspectives, we must accept that geoarchaeology should move beyond discourses that prioritise descriptive histories of 'erosion', 'stability', 'crisis' and 'environmental deterioration'. This type of fundamental, 'scientific' research into the history of geomorphic systems is, and will always be, important. However, we need to reorient some of our research questions.

Whilst the positions taken by ancient philosophers (and some contemporary ancient historians) reflect the perspectives of the owners and managers of ancient landscapes, these views may not reflect the relationships that many ordinary people had with their Mediterranean landscapes. Some might view the Barbegal watermill as an example of successful Roman engineering, where the geomorphic system was managed, and any obstacles blocking economic productivity were literally removed. Nevertheless, someone had to clear the hill slopes, and deal with colluvial deposits which may have been a reoccurring problem, a problem that we can never identify as these deposits may well have been truncated.

One way to assess how perceptions of the geomorphic system have evolved over time is to consider how notions of risk and hazard change with specific spatial and chronological contexts, ideally through the diachronic study of particular micro-regions. The Domaine Richeaume study reveals how perception of erosion is linked to the potential success of any risk-buffering mechanisms that are in place within any given society. As Halstead (2000: 113) demonstrates, the rich variety of agricultural systems that range between extensive/specialized and intensive/diversified husbandry would have resulted in a range of responses to landscape degradation, as well as influencing the very nature and scale of sedimentary processes within a given landscape. The relative flexibility of the early Iron Age system on the Sainte Victoire demonstrates how mobility may well have been the answer to erosional events.

As we move into the Roman period, we see how a society attempts to control the same landscape through engineering and complex landscape management. The apparent success of the Roman system in controlling erosion belies the probability that small independent peasant farmers, and slaves working on the villas, or on processing-sites such as Barbegal, would have been obliged to deal directly with any hazards on behalf of the villa or mill owners. Storm erosion and flood damage would have been repaired by these workers, and even the mundane, annual, small-scale hazards would have had a direct impact on their lives. Essentially, we should be asking for whom were these processes relevant in

the past? We must attempt to steer a course between an archaeology and ancient history which prioritise macro-economic structures, and a (geo)archaeological discourse which often does little more than depict an environmental backdrop where anonymous people are portrayed as dehumanised input within the geomorphic system.

These case studies, I hope, have demonstrated how one aim for geoarchaeology, in a region where geomorphic processes are so important, is to emphasise the relationships that ordinary people must have had with even the most mundane geomorphic process and topographical features.

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