JOURNAL OF EASTERN MEDITERRANEAN ARCHAEOLOGY AND HERITAGE STUDIES

THE PENNSYLVANIA STATE UNIVERSITY PRESS

VOL. 7 NO. 4 2019

JEMAHS

Front cover photo: Overview of the Dereköy Highlands in southwest Turkey. The hills of this area are chiefly exploited by shepherds. (Photo by R. Vandam; courtesy of the Sagalassos Archaeological Research Project.)

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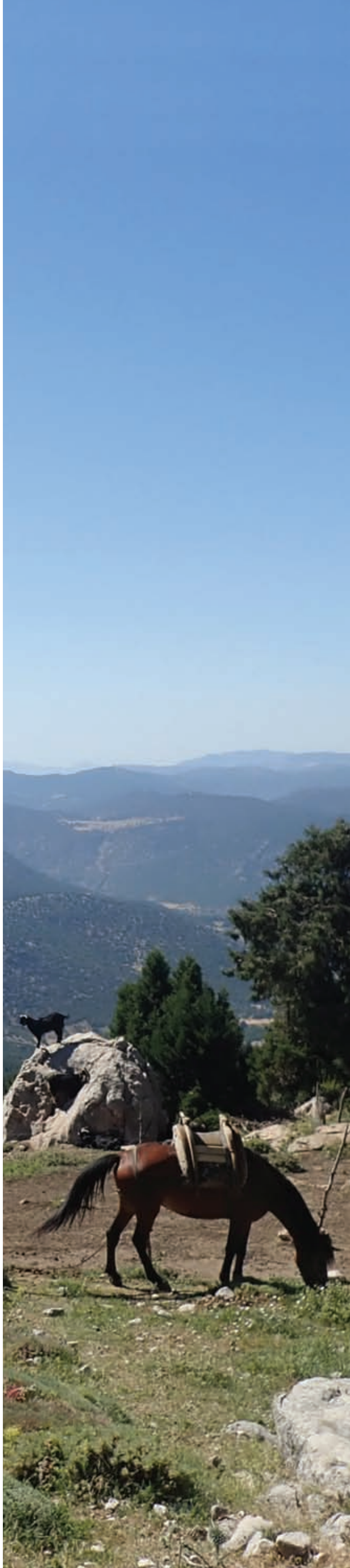

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RIGHTS AND PERMISSION

“MARGINAL” LANDSCAPES

Human Activity, Vulnerability, and Resilience in the Western Taurus Mountains (Southwest Turkey)

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ABSTRACT

The western Taurus mountains, southwest Turkey, comprise a diverse set of landscape zones that are characterized by great altitude variations. This article focuses on the agricultural so-called marginal highlands within this mountainous region. Large parts of the uplands are labeled “marginal” nowadays as they are not regarded as highly productive in terms of agricultural output or permanent occupation. Three decades of interdisciplinary research within the Sagalassos Archaeological Research Project (KU Leuven) have provided an enormous amount of archaeological, bioarchaeological, and geoarchaeological datasets that will be brought together in this article to explore diachronic patterns in human-environmental interactions within these areas. The study demonstrates not only the archaeological value of a highland area, but its vulnerability for human impact as well. The changing environments both naturally and sociopolitically favored a more resilient behavior of the human groups within the highlands.

KEYWORDS: Sagalassos, marginality, highlands, landscape archaeology, geoarchaeology, diachronic study

JOURNAL OF EASTERN MEDITERRANEAN ARCHAEOLOGY AND HERITAGE STUDIES, VOL. 7, NO. 4, 2019

DOI: 10.5325/jeasmedarcherstu.7.4.0432

This article will focus on the western extent of the Taurus mountains in the Burdur Province of southwest Turkey (Fig. 1). The highland region is not a uniform landscape, but rather fragmented and diverse as it includes small river valleys, flood plains, large open fertile plains, badlands, moderate hills, plateaus, and steep mountains. Within this rough mountainous region ancient towns like Sagalassos thrived and intensively used the topography and natural resources. The Sagalassos Archaeological Research Project (KU Leuven) has been conducting fieldwork in this area for more than 30 years. From the start, the project has been studying the long-term development of socio-ecological systems within its research area, which roughly corresponds to the territory of the Roman imperial city of Sagalassos (see Fig. 1). To achieve this goal, the project did not just limit its activities to excavating the site but also conducted various archaeological surveys and environmental research in the countryside. This has created a rich corpus of regional paleoenvironmental and archaeological data which we will use here to investigate the so-called marginal landscapes within our study region.

Marginality can be approached from many different perspectives (see the introduction to this special issue of *JEMAHS*). Most essential is that marginality can only be defined in a specific referential context; something is marginal only in reference to something else. For example, a region is only peripheral in relation to

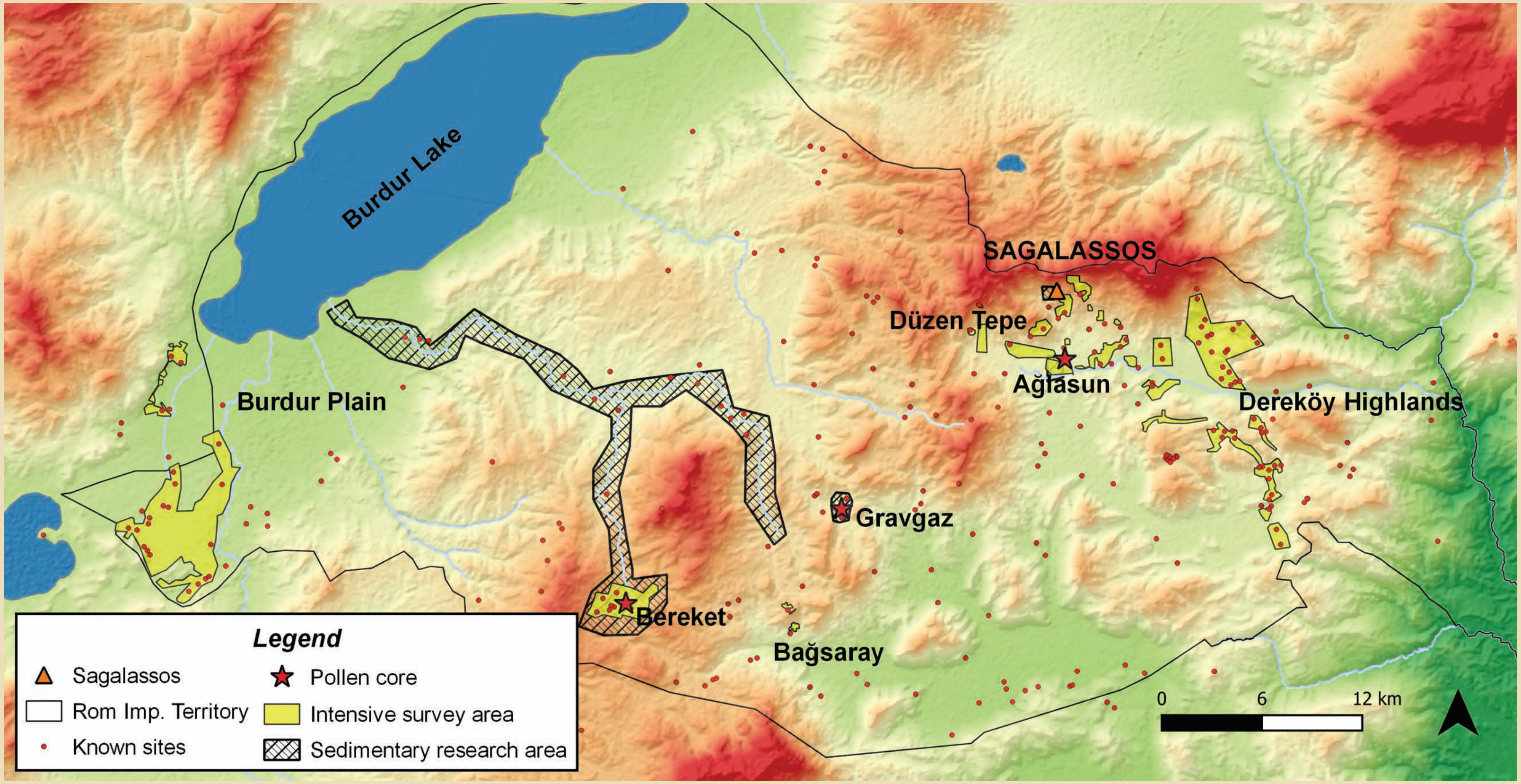

FIG. 1

Overview of the Sagalassos study area with the mentioned sites. (Courtesy of the Sagalassos Archaeological Research Project.)

a center. In this article, marginality is discussed with respect to the ecological characteristics of the landscape. Ecological marginality is more difficult to define because ecosystems are made up of several interdependent components that are each influenced by biophysical factors (Callo-Concha et al. 2014). To limit the potential scope of ecological marginality, we refer in this article to the potential for intensive agriculture of ecological zones. Large parts of the upland areas of the study region are characterized by high erosion, thin soil depth, and limited permanent fresh water sources (see research area). Today, these areas are perceived by the local inhabitants as marginal as they are not ideal for crop cultivation or permanent occupation.

In general, archaeological research in Turkey has focused on ecological zones that are well suited for crop cultivation, like valleys and plains. In several periods these areas were intensively used, and complex, multi-period sites have been discovered here. However, other landscape units have remained underexplored, partly because they are less accessible and remains of human activity are often less obtrusive. These areas were, however, not devoid of human activity as will be illustrated in this article. The dichotomy between lowland and highland archaeological patterns within the study region has been discussed elsewhere (Vandam et al. forthcoming). Here we will mainly focus on the areas that, from the perspective of crop cultivation, are marginal. By integrating the archaeological, bioarchaeological, and geoarchaeological datasets of the Sagalassos Project, we aim to explore diachronic patterns in human-environmental interactions within the marginal lands of the western Taurus mountains. The article will mainly focus on the 800 BCE–1100 CE time range as for this period sufficient data is available. Within this period, the *polis* of Sagalassos waxed and waned. Three key questions will be addressed. First, how did humans use marginal landscapes and how did this change over time? Important in this discussion is the notion of time. Through time human groups have used these landscapes for different purposes and with changing technology. If these landscapes attracted people, they will have been impacted by their activities, which leads to the second key question. How vulnerable were these marginal landscapes to human activities? Do we have evidence of land degradation in the highlands, and if so, what are the causes? Lastly, we will assess how people in the highlands responded to these changing landscapes and sociocultural processes in order to investigate the level of resilience. Do we have evidence of a "fall from Eden" scenario or did people adjust to the new situation? By asking this set of questions, the article aims to present a much-needed integrated approach (Walsh 2008: 548–49) to assess marginal lands, using information from several scientific disciplines, and to provide a more nuanced view on the archaeology of marginal agricultural zones.

Research Area

As mentioned, the landscape of the western Taurus mountains in the Burdur Province is particularly diverse. Elevation within the region varies drastically with a range of ca. 2,000 m between its highest and lowest points. The mountains, with peak at 2,300 m, are not extremely high compared to other parts of the Taurus range. In general, the mountains are well-watered with permanent and seasonal water sources, which in combination with relatively poor natural drainage due to thick clayey subsoils resulted in the formation of marshlands in several of the valley bottoms, for example in the Gravgaz and Bereket valleys. At the same time, relatively thin soil cover on the hillslopes and good drainage in some valleys and plains have created zones of semi-aridity. The combination of variations in local hydrological, climatic, and geomorphological conditions created a patchwork of different vegetation covers—from semiarid steppe and badlands, to marshes, riparian and deciduous woodlands in the highland valleys, and oromediterranean zones at higher elevations (Paulissen et al. 1993: 231–32). The differences in average annual temperature between lowland areas (e.g., 13.2°C in Burdur) and the highlands (e.g., 8.2°C at Sagalassos) are a significant driving factor in the ecological variation of the Burdur Province.

Sagalassos originated on a south-facing slope of the Taurus mountain range, at an altitude of approximately 1,400–1,600 m (Fig. 2). The earliest evidence of occupation at Sagalassos dates to the Late Achaemenid period (late fifth century BCE), after which it remained continuously inhabited into the Middle Byzantine period (thirteenth century CE; see Daems and Poblome 2017; Poblome,

FIG. 2
The ancient town of Sagalassos is located within the Taurus mountains. It was laid out on the plateaus in the center of the image. (Courtesy of the Sagalassos Archaeological Research Project.)

Talloen, and Kaptijn 2017). Mainly during the Hellenistic (323–25 BCE) and Roman imperial periods (25 BCE–300 CE), various waves of building programs were developed at Sagalassos. It grew into a regional center and was named the first city of Pisidia (Talloen and Waelkens 2004: 180). These periods are characterized by important urban developments including population increases and growing impacts on Sagalassos's surroundings. In the Roman imperial period, the territory of Sagalassos reached its maximum size, ranging from the Burdur Lake in the west to the Aksu River in the east, covering about 1,200 km^2 (see Fig. 1) and forming the study area of the Sagalassos Project (for a detailed description of the territory border see Waelkens et al. 1997: 97–102; Waelkens et al. 2000: 112–14).

Methods

Archaeological Methods

The insights regarding the archaeology of the marginal landscapes discussed here were gained through many years of interdisciplinary research on the ancient city of Sagalassos and its countryside, during which we implemented different archaeological field methods, with excavation and archaeological surface survey forming the backbone. The site of Sagalassos was surveyed in the 1980s by the Pisidian Survey Project of Prof. S. Mitchell (then Swansea College), and the first excavations started in 1990 under the direction of Prof. M. Waelkens (KU

Leuven) (Waelkens 1993: 37–41). These excavations are ongoing and have been under the supervision of Prof. J. Poblome (KU Leuven) since 2014. The focus of these excavations has been on the monumental center of the ancient city, and with increasing focus on the ways the townsfolk dwelled, worked, ate, and died. In addition to Sagalassos, the project has also excavated at the site of Düzen Tepe from 2006 to 2011, a hilltop settlement dated to Late Achaemenid and Early Hellenistic times (late fifth to second centuries BCE), approximately 1.8 km from Sagalassos (Vanhaverbeke et al. 2010). The site was once considered to be the predecessor of Sagalassos, but it seems now that they were largely contemporaneous (Waelkens, Poblome, and Vyncke 2011).

In 1993 the Sagalassos Archaeological Research Project initiated a survey program in the territory. Over the years, the project has been implementing both extensive and intensive survey methodologies. During the first four seasons, the survey worked on a large and extensive scale (Vanhaverbeke and Waelkens 2003: 11) to gain insights in the general patterns of habitation within the countryside. This provided a context to the detailed intensive surveys that followed. The extensive surveys encompassed the recording of archaeological remains in the modern villages, visiting the most promising locations in the landscape, and interviewing the local inhabitants to gain information about possible archaeological sites in the area. In addition, previously published sites were revisited and further documented. From 1999 onwards, intensive field-walking surveys were conducted. Initially, these methods were applied to the suburbia and the immediate vicinity of Sagalassos (Martens 2005; Vanhaverbeke, Martens, and Waelkens 2007), representing the catchment area of two hours walking distance from Sagalassos. This was followed by intensive surveys in more remote valleys of the territory, that is, around Bereket (Vanhaverbeke et al. 2011b; Kaptijn et al. 2013), Bağsaray (Vanhaverbeke et al. 2011b), the Burdur Plain (Kaptijn et al. 2012; Vandam et al. 2013) and recently in the catchment area of the Ağlasun Valley. In the latter, the intensive survey started to focus on ecologically more "marginal" landscapes such as the highlands around Dereköy, 8 km eastwards of Sagalassos (Vandam, Willett, and Poblome 2017, forthcoming). By doing so the project wanted to investigate when and how communities operated in these landscapes in terms of subsistence, mobility, and resource exploitation. We also were interested in assessing how these areas were integrated within the larger socioeconomic system and how this changed through time. In order to find a good balance between precision and sufficient coverage of the intensive survey areas, the project has experimented over the years with the size and organization of the grids and transects (Vandam, Kaptijn, and Poblome 2019: 117–21). The data generated from these intensive surveys complemented the extensive-survey results to a great extent and allowed us to create more detailed reconstructions of the settlement patterns. Recently, the Sagalassos Project has implemented modeling techniques and spatial analyses to assess settlement choices (e.g., Vandam, Kaptijn, and Vanschoenwinkel 2013; Willett et al., forthcoming).

Geoarchaeology

The impact of past human activities on the landscape can be reconstructed using geomorphic records. Sedimentation data for the study region, Gravgaz (altitude 1,220 m [valley bottom]) and Bereket (altitude 1,420 m [valley bottom]) valleys specifically, come from a radiocarbon-dated coring dataset (178 AMS radiocarbon ages in total), collected over the past 15 years (e.g., Bakker et al. 2012, 2013; Dusar et al. 2012; Six et al. 2008). Given their mountainous and isolated location, the Gravgaz and Bereket valleys can be considered peripheral, marginal areas with regard to the city of Sagalassos. They are approximately 15 to 25 km southwest of Sagalassos, with Bereket being the most remote location vis-à-vis Sagalassos. The sedimentation data for Gravgaz were in turn used by Dusar et al. (2012) and Van Loo et al. (2017) to adapt the WaTEM/SEDEM model, a spatially distributed soil erosion and sediment delivery model (Van Oost et al. 2000; Van Rompaey et al. 2001; Verstraeten et al. 2002). The WaTEM/SEDEM model was used to simulate the impact of past human activities on hillslope soil erosion and valley bottom sediment deposition over the past 4,000 years in the Gravgaz catchment. Since the Gravgaz valley is an endorheic catchment and serves as a perfect sediment trap for eroded material from the hillslopes, the evolution of soil thickness through time could be reconstructed in the catchment (Van Loo et al. 2017). In turn, the effect of soil erosion on crop yields was modeled by Van Loo et al. (2017) through the application of AquaCrop (Raes et al. 2009), a water-driven crop-yield model.

Bioarchaeology and Palynology

Faunal and botanical assemblages from excavation contexts provide valuable information on past human activities and are often used to reconstruct human subsistence in the past (for a recent overview see VanDerwarker and Peres 2009). The faunal assemblages document—among other things—the importance of hunting *versus* herding, the composition of livestock, and the exploitation of animals by humans in the past (Davis 1987; Reitz and Wing 1999). The plant remains uncovered from the archaeological layers further provide information on the crops cultivated in an area and their relative importance for the economy, modes of cultivation, storage and exchange, but also on used plant habitats in the sites' surrounding and the available woodland resources (Pearsall 2015: 27–28).

Animal remains have been studied since the beginning of the excavations at Sagalassos (De Cupere 2001; Van Neer and De Cupere 2013). These remains were both collected by hand in the excavation trench and retrieved through sieving. The archaeozoological study of this material has allowed for inferences about various aspects of the animal economy. Indeed, the contribution or importance of each animal species or group, as reflected by the number of their respective remains, led to a reconstruction of the livestock's composition in the past. In addition, information on pig-husbandry practices was obtained through an integrated dental analysis including kill-off pattern, traditional and geometric morphometry, linear enamel hypoplasia, and stable isotope analysis (Frémondeau et al. 2017). Bone collagen stable isotope analysis (d13C, d15N) carried out on animal remains from Düzen Tepe and Sagalassos assemblages documented changes in livestock feeding strategies from the Late Achaemenid-Early Hellenistic to the Middle Byzantine periods (Fuller et al. 2012).

The archaeobotanical evidence on the site has been and is collected systematically and nearly continuously. Over nearly two decades, more than 85,000 plant remains from various excavation areas were recovered by machine flotation and analyzed, allowing detailed insights into the plant economy. Integrated with the archaeozoological and further environmental evidence, the data of the region covers a time span of more than 1,000 years: from Late Achaemenid times until the Middle Byzantine period, that is, the lifespan of the *polis* of Sagalassos.

Pollen data are available from three basins, Ağlasun (Vermoere 2004), Gravgaz (Bakker et al. 2013; Vermoere et al. 2002) and Bereket (Bakker et al. 2013; Kaniewski et al. 2007), illustrating the vegetation changes in the Sagalassos region. A detailed overview of these vegetation changes is provided by Bakker et al. (2012). The most prominent disturbance period in the Sagalassos region is the Beyşehir Occupation Phase (BO-Phase). The BO-Phase is a period of anthropogenic activity characterized by forest clearance, crop cultivation, arboriculture, and disturbances. It is observed in large parts of the eastern Mediterranean (Eastwood, Roberts, and Lamb 1998). The beginning and end of the BO-Phase in the Sagalassos region differs between locations and is estimated by Bakker et al. (2012) to have taken place between ca. 1000 BCE and 300/650 CE.

Discussion

How Did Humans Use Marginal Landscapes through Time?

The recent archaeological surveys in the highlands of Dereköy shed a unique light on the archaeology within an agriculturally marginal landscape. First and foremost, this survey made clear that marginal landscapes can be very rich in archaeological remains, even more so than the lowlands (Vandam et al., forthcoming). Clear episodes of increased human activity within the Dereköy highlands were identified (Vandam, Willett, and Poblome 2017, 2019). For instance, the Palaeolithic (120,000–10,000 BCE), the late antique (300–700 CE) and the Late Ottoman (1700–1920 CE) periods were particularly well represented within the archaeological record (Fig. 3). During these periods, however, the Dereköy highlands were not exploited in a uniform way, but the various resources of these landscapes attracted groups for different reasons. In the autochthonous limestone hills of the Cretaceous to Eocene

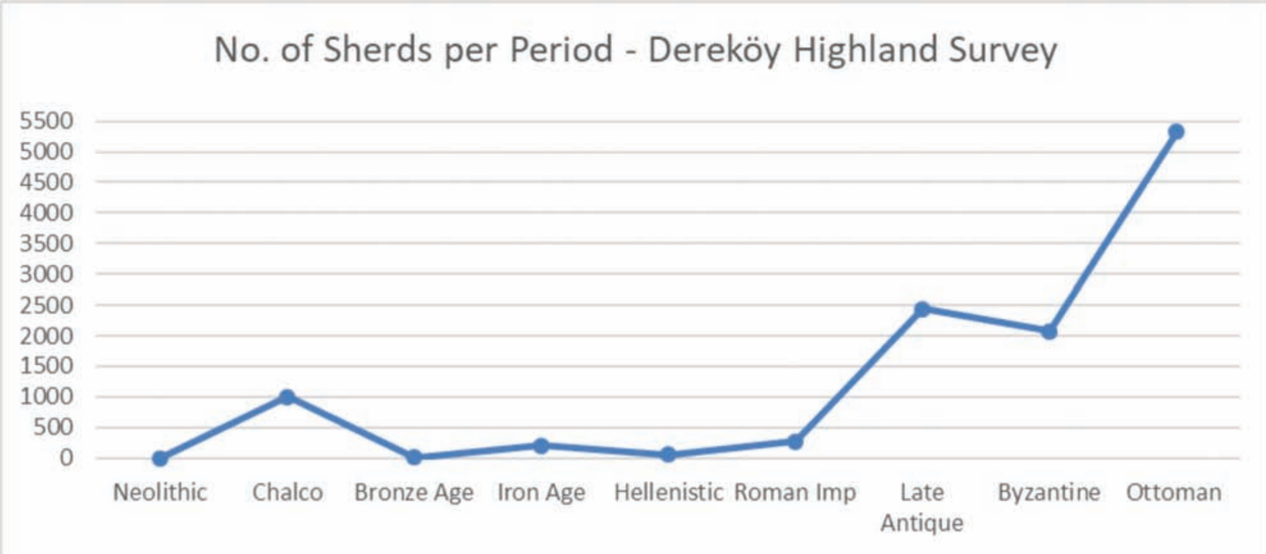

FIG. 3
Chronological distribution of the dated sherds of the Dereköy highlands survey. (Courtesy of the Sagalassos Archaeological Research Project.)

age around Dereköy, heterogeneous chert and radiolarite outcrops are occurring, ranging from light to beige to dark gray colors (Vermeersch et al. 2000: 458). Small nodules of these resources up to 10–20 cm in diameter occur on the surface, and the majority of the identified lithic artifacts in the survey are made of these local resources. The combination of the abundant flint resources and the expansive terrain of rich hunting grounds largely explain why we could locate so many Paleolithic hunter-gatherer activity areas (Fig. 4).

Later, in the late antique (300–700 CE) and Byzantine invasion (700–900 CE) periods, the arable lands in the highlands were cultivated, and the archaeological evidence suggests the appearance of a productive landscape. In contrast to the Roman imperial period, for which only a few occupation spots are known, the survey picked up a sharp rise in rural populations residing in small isolated farms or farming villages (Vandam, Willett, and Poblome 2017: 330–34; see also Vandam, Willett, and Poblome 2019: 266–67). The many locally produced amphorae fragments and (counterweight-and-screw) presses identified at the sites indicate that these communities were engaged in some sort of (small-scale) wine/oil production (Fig. 5). However, considering the altitude, it is not certain that the plant products processed in the presses were grapes or olives. Also other oil crops, for example flax and *Eruca*, should be considered as they can be grown on a relatively large scale, as shown by ethnographic evidence (Ertuğ 2000). Due to their oil content, the seeds of most oil crops are less well preserved than cereal crops, for example, and are therefore underrepresented in the archaeobotanical record (Märkle and Rösch 2008). An increase in oil crops is clearly observed in late-antique Sagalassos (De Cupere et al. 2017: fig. 3). This was related mainly to an increase in flax seeds, which probably entered the site either as food (roasted before consumption) or as secondary, used oil-pressing residues (for example as fodder), or perhaps for textile production. The many abandoned and active terrace walls that occur on the slopes serve as a testimony to agricultural practices in the highlands. Terracing reduces the inclination on steep slopes and increases soil depth, thereby making these high-altitude areas suitable for agriculture and especially arboriculture (Isager and Skydsgaard 1995; Baryła and Pierzgalski 2008: 1a). At Sagalassos there is an increase of importance of arboriculture in Roman times through the Early Byzantine period (450–700 CE; De Cupere et al. 2017: fig. 5). Research by De Laet has shown that in the higher hillslope areas especially,

FIG. 4
Middle Palaeolithic Levallois artifacts. The oldest human-made artifacts in the Sagalassos study region have been found in the Dereköy highlands. (Courtesy of the Sagalassos Archaeological Research Project.)

FIG. 5
A sample of the many Late Roman amphora handles found at the various farms that were identified during the Dereköy archaeological survey research. (Courtesy of the Sagalassos Archaeological Research Project.)

on Lycian limestone, which typically has shallow soil depths, and on ophiolitic melanges with its poor water retentive quality, terraces were abandoned (De Laet 2007: 142). However, at one time in history, these areas, now considered too marginal, were cultivated. Without a doubt some of the terraces can be dated back to ancient times. Indeed, in several cores in the sediments behind the terraces evidence was found of late antique intensive agricultural activities (De Laet 2007:149–50). The sediments contained charcoal, ceramics, and bone fragments as well as large concentrations of phosphorus, copper, lead, manganese, potassium, and calcium, which were probably the result of manuring activities.

Additionally, the hills must have provided excellent grazing terrain. For the Late Ottoman period especially, it seems that the highlands were exploited by shepherds. For the Dereköy highlands almost one third of the collected sherds could be associated with this period (see Fig. 3) (Vandam et al., forthcoming). Also, many Late Ottoman fieldstone structures and animal pens and enclosures were identified during this survey. For the earlier periods there was no evidence of a similarly intensive pastoral subsistence strategy in our research area. This fits the idea that the modern vertical intensive transhumance strategy does not go far back in time, but rather, as has been illustrated elsewhere, pastoralism in Anatolia has taken many forms through time (Hammer and Arbuckle 2017: 250–52). The archaeobotanical evidence from Sagalassos, for instance, shows an increase in plants, which can be considered indicators of grazing during the late antique period. This is expressed by higher proportions of plant macrofossils indicating grassland and anthropogenic steppe, but also shrubland and maquis (De Cupere et al. 2017: fig. 3)—all these are habitats that in part are a consequence of sustained grazing activities. Also, sheep and goat abundance would have increased from the first half of the fourth century CE onwards (De Cupere 2001: 139). Collagen stable isotope analysis shows a specialization in herd-management strategies at Sagalassos; different species had (mostly) different food resources, thus they were most likely grazing in different areas (Fuller et al. 2012). In addition, shifts in the herding areas of goats and cattle from Sagalassos were indicated by the heavy-metal analysis of their bones. During the Early to Middle Roman Imperial and Early Byzantine periods, these domesticates were kept or herded close to the polluted urban area; during the Late Roman period they were likely grazing at a distance beyond the polluted area around the settlement (Vanhaverbeke et al. 2011a).

The archaeological records of the highlands in the Sagalassos study area indicate that they were also appealing for other reasons than those discussed above. During the Iron Age people congregated in elevated locations. Throughout the study area several Iron Age hilltop settlements, of which many continued into the Achaemenid period and beyond, are known (Fig. 6) (Vanhaverbeke and Waelkens 2003: 195–96, 217–22). All of these are situated on the top, on ridges of a mountain, or on high altitude plateaus with a sufficient amount of arable land in their vicinity. Due to their location these sites had excellent views over their surrounding area and were easy to defend. The flanks that were naturally unprotected were further fortified by stonewalls. It is a common assessment or hypothesis among archaeologists working in the region that during this period some sort of land claim developed in which each of these sites started to control its surrounding lands and valleys, the local catchment area. Although it is difficult to pinpoint specific selection criteria that determined this social organization and settlement location, it is likely that both environmental and societal factors were at play (Daems et al., forthcoming). The lack of contemporary farms within most of the valleys during the Iron Age is notable, the Burdur plain being an exception. Possibly, most hilltop settlements had a local self-sustaining economy with agricultural activities on the surrounding slopes. The bioarchaeological remains form Düzen Tepe, a Late Achaemenid-Early Hellenistic site that can serve as a proxy, support this hypothesis. Düzen Tepe is an elevated, fortified site with a small-scale rural and self-sustaining economy that seems to form part of the Iron Age tradition of settlement organization in the area. Isotope data (d13C and d15N) of the domestic animals (cattle, sheep, goat, and pig) at this site indicate that they were herded in the same general area or kept in enclosures and fed on similar foods (Fuller et al. 2012).

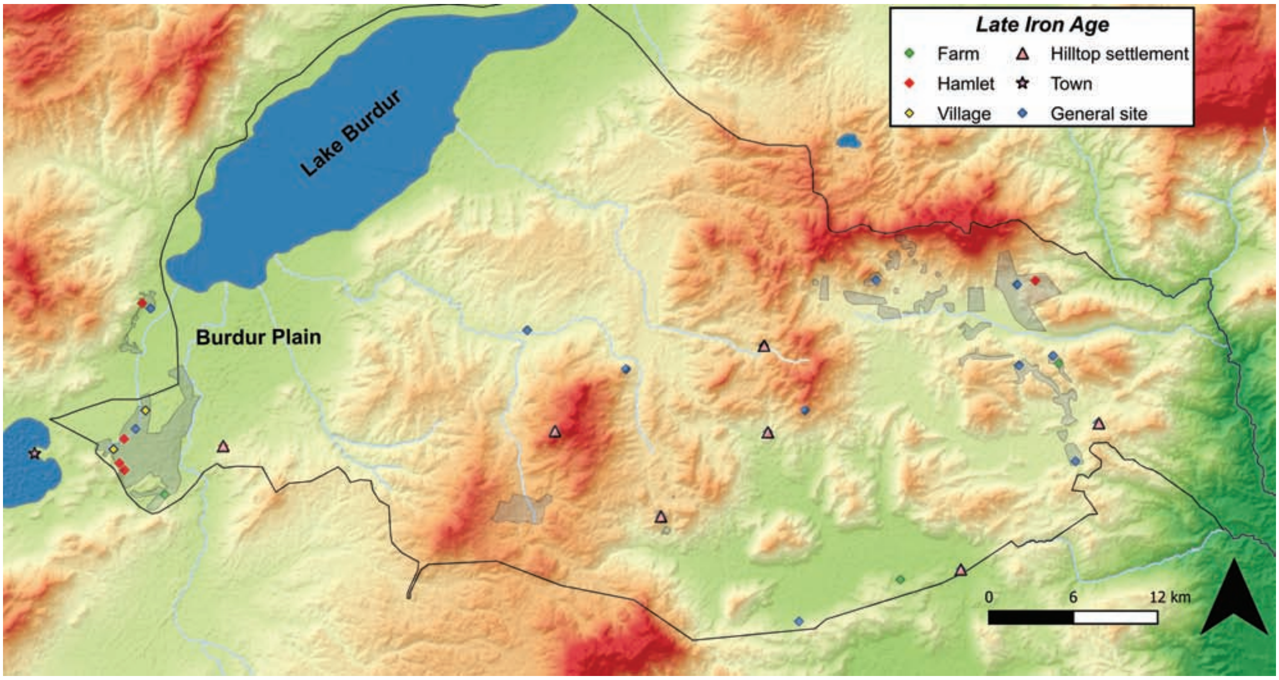

FIG. 6

Late Iron Age settlement distribution within the Sagalassos study area, characterized by substantial fortified settlements on elevated locations. (Courtesy of the Sagalassos Archaeological Research Project.)

This is likely to happen in a self-sustaining community, producing its own domestic animals (Fuller et al. 2012). The plant economy relied on free-threshing wheat and, to a lesser extent, on barley accompanied by a relatively high variety of pulses, including lentil, bitter vetch, and chickpea (Vanhaverbeke et al. 2010: 124; Cleymans et al. 2017: 67–69). Pulses comprised ca. 20% of the archaeobotanical finds, indicating that they played a significant role in the human diet as an important protein source. Furthermore, they are also important suppliers of nitrogen in the crop rotation cycle and their straws can be used as cattle fodder. Further evidence of the increased use of hillslopes for agricultural purposes can be found in the erosion and sediment rates that peaked during the Iron Age (see below).

It is increasingly clear that the highlands attracted many different groups for various reasons. By exploiting these landscapes in the right way, they become very appealing to dwell in. In contrast, there are certain periods such as the Late Neolithic and Bronze Ages for which we have little to no evidence of human activities in the more mountainous landscapes of the Sagalassos study region. Our surveys documented that these communities focused on more optimal parts of the landscape such as the fertile areas in the Burdur Plain, which largely suited their horticultural lifestyle (Vandam 2014). Also, Roman imperial remains were poorly represented in the Dereköy highlands survey as farming communities seem to have mainly concentrated around Sagalassos and other secondary settlements that served as their main markets (Poblome 2015).

How Vulnerable Are Marginal Landscapes?

From the previous sections it is clear that people were active in agriculturally more “marginal” areas. Human presence in these areas will also have impacted the landscapes, a fact that can be assessed in various ways, including with the help of geomorphological data. Relevant data is present for the Dereköy highlands but is too incomplete to run geomorphological models.

From other remote inter-mountainous valley systems within the Sagalassos study area, like Gravgaz and Bereket, there is sufficient data to investigate human impact. The geomorphological data make it clear that before 900 BCE erosion on the hillslopes and sedimentation in the Gravgaz and Bereket valleys was limited. In general, the geomorphic system in the Sagalassos study area became most active during the Iron Age (1150–546 BCE) when habitation emerged on high elevations, as discussed, accompanied by large-scale land clearance (Bakker et al. 2012: 258–59). This resulted in high erosion values on the hillslopes and high sedimentation rates at colluvial and alluvial locations (see, e.g., Verstraeten et al. 2017). A first land-clearance peak around 900 BCE in the Gravgaz catchment led to erosion on the hillslopes and sedimentation in the valley (Fig. 7A). The subsequent clearance phase, also within the Iron Age, caused an even higher erosion and sedimentation phase (Van Loo et al. 2017). The peak in sedimentation occurred later in the Bereket valley (Fig. 7B), possibly due to its higher altitude, more remote location, and later start of occupation. After the Iron Age peak in soil erosion, soil reservoirs on the slopes were depleted and soil erosion values decreased from the Roman to Byzantine periods (see Fig. 7). At Bereket however, renewed geomorphic activity can be observed around 700 CE related to local reactivation of human impact in an already degraded landscape, as demonstrated by geochemical fingerprinting of the sediment (D'Haen et al. 2012, 2013).

The WaTEM/SEDEM model was used to simulate hillslope soil erosion and valley-bottom sediment deposition over the last 4,000 years in the Gravgaz catchment (Van Loo et al. 2017). The model results (Fig. 8) clearly illustrate the intensive soil erosion on the hillslopes and the sediment deposition in the colluvial dry valleys. Model results showed that soil erosion at the Gravgaz catchment was mainly driven by deforestation and therefore anthropogenic activity. As a result of this intensive soil erosion on the hillslopes, soil thickness in the catchment of Gravgaz changed. Soil thickness decreased significantly on the hillslopes. At present, after 3,000 years of human impact and soil erosion, 70% of the catchment is covered with soils, with a soil thickness of less than 30 cm mostly located on hillslopes. Deeper soils moved towards the valley (see Fig. 8) (Van Loo et al. 2017). To account for the effect of this changing soil thickness on crop yields in the Gravgaz catchment, Van Loo et al. (2017) used the AquaCrop model. The results (Fig. 9) show that in the valleys crop yields remained at acceptable levels, whereas on the hillslopes crop yields decreased to very low values.

The high levels of activity in the geomorphic system during the Iron Age seem to match well with the archaeological record. As mentioned, back then the majority of settlements occurred at higher altitudes. This constellation seems to have had its impact on the landscape. Through land-clearance activities the land immediately surrounding the settlements was made suitable for agricultural purposes, which led to large erosion rates, the highest recorded among the cores. The impact of these activities was far greater than had they taken place in or near the valley bases. This short but intense episode of human activity impacted the highlands enormously and for all centuries to come, as there was little soil left on the hillslopes that could be further eroded. This illustrates the vulnerability of hills and highlands well. For later periods, such as the Roman imperial period, the human impact must have also been significant, but its impact on the erosion-sedimentation rates has been masked by the fact that hill soil reservoirs were at least already partially depleted by this time (Dusar et al. 2011). For instance, on the basis of pollen-data it is clear that primary and secondary anthropogenic indicators gradually increased over Hellenistic and Roman times (Bakker et al. 2013), which implies further land clearance and intensified agriculture.

How Resilient Is Human Activity in Marginal Lands?

From a diachronic point of view, human activity was not continuous in the investigated marginal landscapes. As mentioned, certain periods were much better represented than others and people were doing different things during different times in the highlands. In this context, one can study evidence related to resilience in human behavior in the marginal lands in view of environmental and socio-political processes of change.

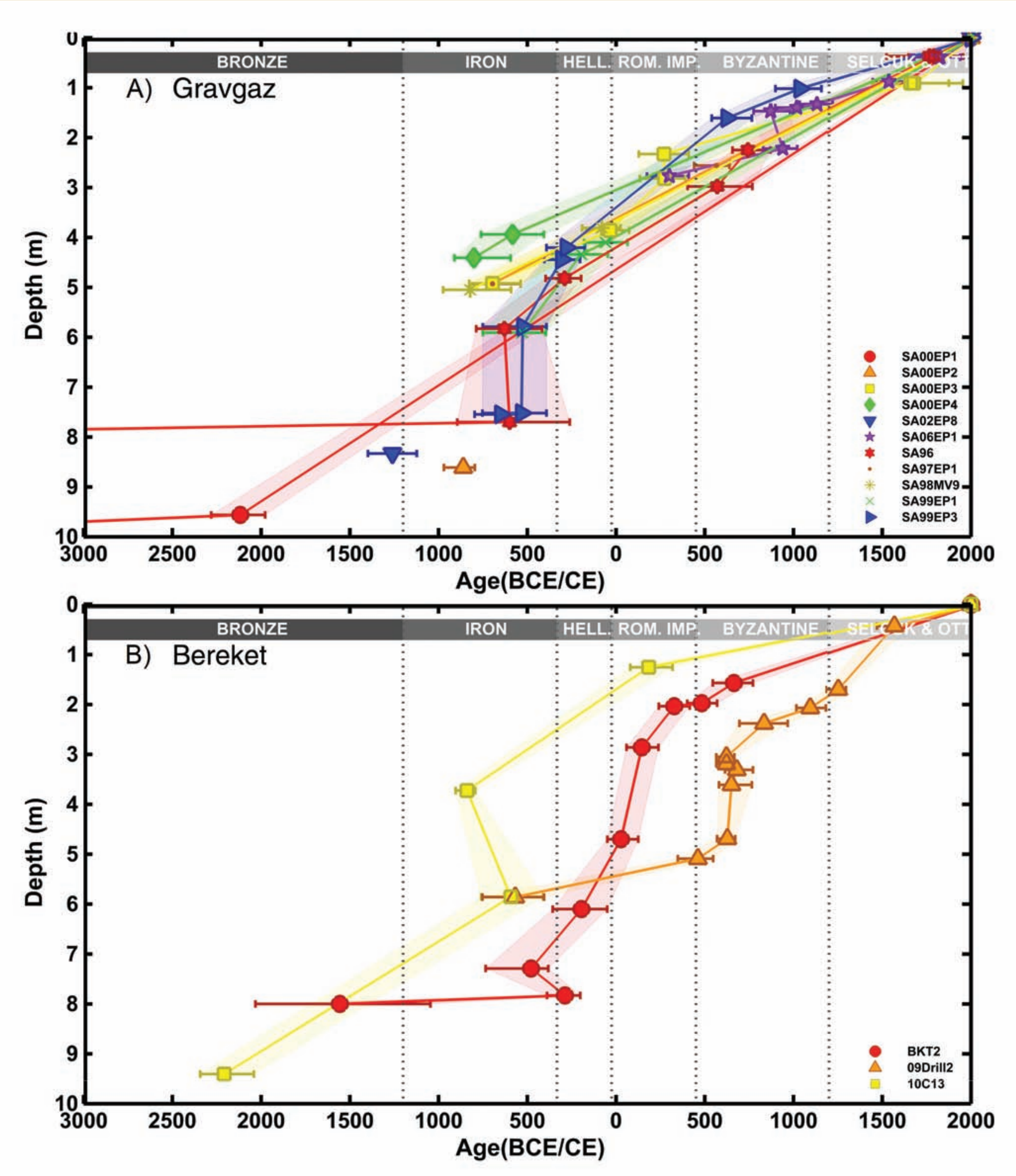

FIG. 7

Sedimentation chronologies for (A) Gravgaz valley, and (B) Bereket valley. Based on Verstraeten et al. 2017; radiocarbon ages taken from Dusar et al. 2012 and D'Haen et al. 2013. (Courtesy of the Sagalassos Archaeological Research Project.)

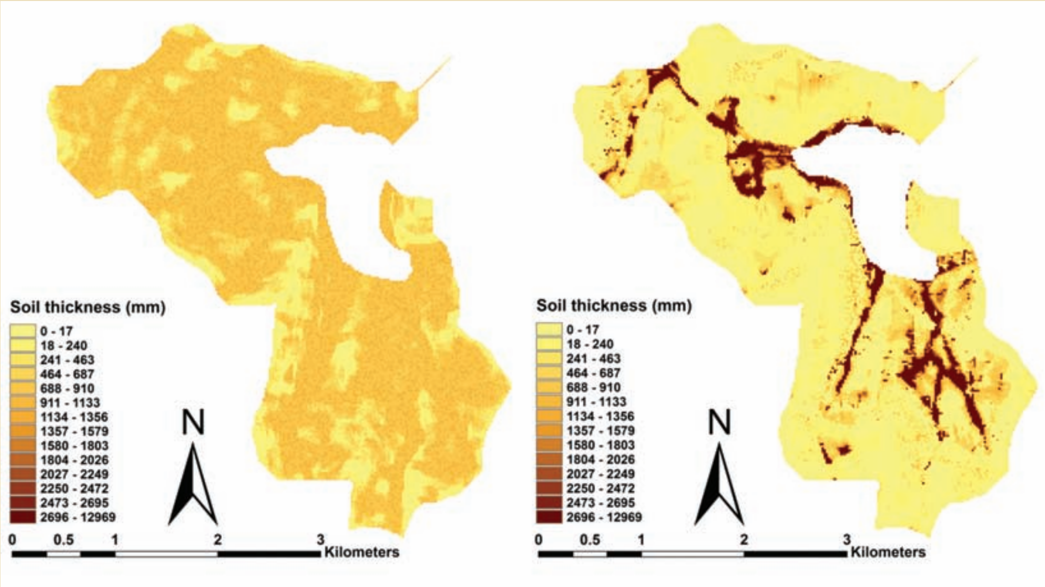

FIG. 8

Modeled soil thickness (mm) in Gravgaz valley, (left) 4,000 years ago and (right) present. (Reprinted from Van Loo et al. 2017; courtesy of Elsevier.)

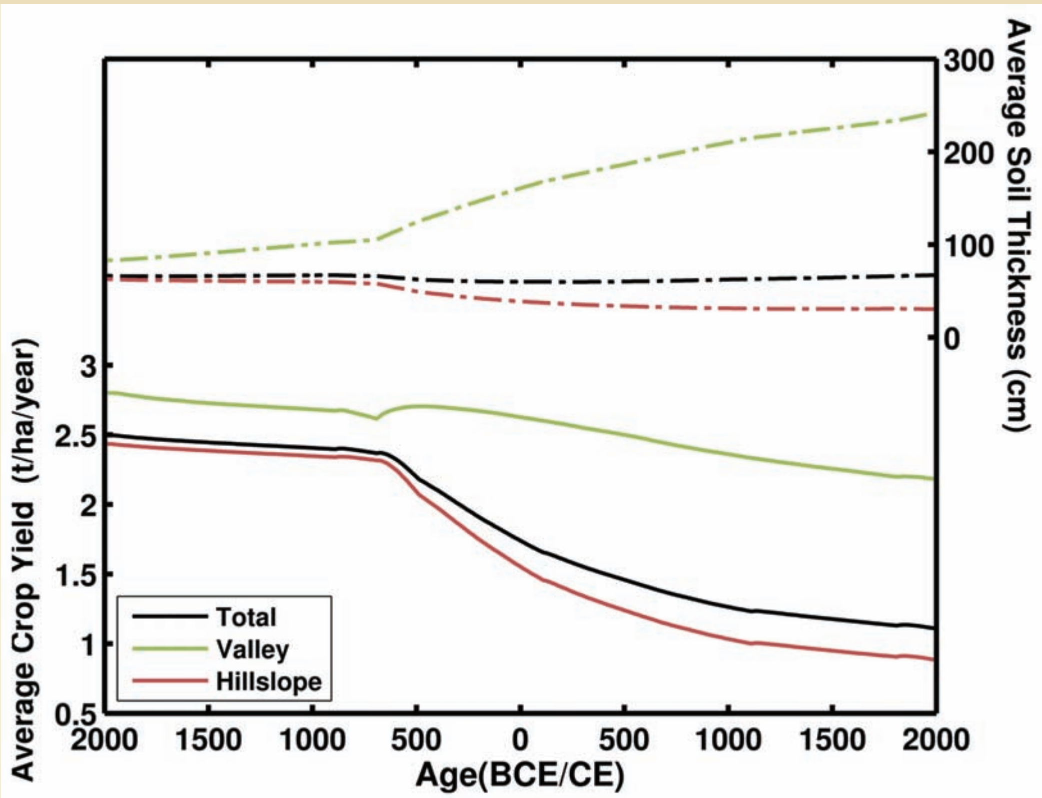

FIG. 9

Crop yield (ton/ha/year) and average soil thickness (cm) for the total Gravgaz catchment, valley and hillslopes. (Reprinted from Van Loo et al. 2017; courtesy of Elsevier.)

During the Iron Age, hilltop settlements dominated the settlement pattern. The associated land-clearance activities on the hillslopes created massive erosion processes resulting in depletion of soil thickness (see Fig. 8) and decreasing crop yields (see Figs. 8–9). On the other hand, sediments were deposited in the valleys where high crop yields could be gained (see, again, Figs. 8–9). In this way, the receding crop yields on hillslopes would not necessarily have been dramatic for these communities as these were compensated by high crop yields in the valleys (Van Loo et al. 2017). In this light, the changing settlement pattern during the following Hellenistic period is noteworthy. During those centuries there is an increase in settlements located near the valleys at the expense of hillslope locations (Kaptijn et al. 2013: 90). Beginning in the Hellenistic period, settlements gradually tend to be located on ever lower elevations, culminating in the Roman imperial period when new settlements mainly originate on valley floors. During this period there was a bigger demand to produce more (see below), for which the valley bottoms themselves became more suitable. The changes in crop cultivation potential and crop yields might have been one of the reasons that caused people to focus their activities and settlements on the valleys instead of the hillslopes. The agriculturally marginal areas were most likely still in use then, predominantly for pasture and arboriculture.

It is only from the late antique period onward that the highlands really became of interest again. In the Dereköy highlands survey we noted a sharp rise in rural population inhabiting small isolated farms and farming villages (see above). At this time, the available arable lands in the highlands must have been under cultivation. The fact that this changing settlement pattern and an increased specialization took place during late antiquity in the Dereköy highlands fits well with the current understanding of this period. One might argue that this was a response to major socioeconomic changes (e.g., reorganization of the provinces and central responsibilities in the area) in which Sagalassos's role as the regional point of attraction started to change. During Roman imperial times, Sagalassos was considered a regional gateway to the Roman Commonwealth that generated potential and connectivity for its entire territory (Poblome 2015: 131–38). The growth of Sagalassos in combination with a countryside that focused on cash crops for local and external markets put the system under heavy pressure and made it vulnerable (Poblome 2015: 131–38). The decreasing external market dependencies in the succeeding period fueled a more regionally based niche economy (more in balance with the supporting ecosystem) and a more specialized agriculturally and artisanally productive landscape (Poblome 2015: 138–40). The survey results from the Dereköy highlands suggest that less productive areas were incorporated in this new strategy. In general, in late antiquity the countryside witnesses an increase in rural population with a new focus on different activities. In the Bereket Valley there is a shift away from mixed farming towards a specialized focus on pastoral activities (Kaptijn et al. 2013: 89–91). This coincides with a period when grazing animals, supposed to be brought to Sagalassos for consumption, came from larger distances in contrast to the previous Roman imperial period (Vanhaverbeke et al. 2011a). The diachronic pattern shown in the sheep and goat bones sustained regional potential, connectivity through local exchange, and resilience in shifting grazing locations, as Poblome (2015: 125) argued. In the Bereket valley, the transition to more specialized pastoralism led to looser ties with Sagalassos. This is demonstrated by the ceramic repertoire (Kaptijn et al. 2013: 79–88). The phase of greater regional specialization seems, at least in the Bereket highlands, to have been accompanied by greater autonomy of the marginal areas.

Based on the evidence presented above, we concluded that the Iron Age habitation of the upper reaches of the highlands was not sustainable in the long run as deforestation caused severe soil erosion. At the same time, this slope erosion caused an increase in soil depth and crop yields in the valleys where a very productive system of intensive crop cultivation and arboriculture emerged during Hellenistic and Roman imperial times, as is evident in the pollen record and the settlement pattern. Increased human activity in the marginal highland areas becomes archaeologically very visible from late antiquity onwards. However, the character of this activity was markedly different from earlier Iron Age activity. Activity was at a smaller scale and more specialized. It probably involved a relatively larger pastoral component as well, as has been illustrated at Bereket for instance. In later time periods, life in the highlands was undoubtedly much better integrated with lowland habitation than during the Iron Age period when activity in or near the valleys is poorly visible archaeologically. From late antiquity onwards the activities carried out in the marginal upland areas were much more in line with the capacities of this ecological zone and hence the mode of subsistence was more resilient.

Conclusions

The case study presented here builds on 30 years of research in the Sagalassos study area and it illustrates the complexity of conceptualizing highlands as marginal landscapes. Our study demonstrates that these landscapes are as valuable to explore archaeologically as other, more fertile ones. Humans used highlands to their advantage, availing themselves of the extant resources. The diachronic perspective of this article further supports the idea that the concept of marginality is relative, and that both meaning and perspective change over the course of time. Occupation of the highlands was not continuous in the Sagalassos study area. For certain periods, such as the Bronze Age, it can be argued that the highlands were considered marginal as no evidence of human activity has been found so far. This, however, stands in stark contrast to the Iron Age during which the highlands became the focus of settlement, as witnessed by, among other things, the severe erosion that we illustrated for the period. Changing landscapes as well as changing sociopolitical environments, such as the rise and fall of Sagalassos, influenced human behavior in the highlands. All the many different forms of human activity, as well as episodes of abandonment and occupation of these landscapes, illustrate how humans adapted to the "marginal" regions over time. Because of the vulnerability of these environments and of human groups within them, much more resilience was necessary to succeed.

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