# IN THE SORRAIA RIVER VALLEY (CORUCHE, PORTUGAL): SETTLEMENT DYNAMICS OF ANCIENT PEASANT SOCIETIES ON THE LEFT BANK OF THE LOWER TAGUS RIVER (5500 TO 1800 B.C.E.)

En el valle de Sorraia (Coruche, Portugal):
Dinámica del asentamiento de sociedades campesinas antiguas en la margen izquierda del Bajo Tajo (5500 a 1800 a.n.e.)

VICTOR S. GONÇALVES *, ANA CATARINA SOUSA *,
ANDRÉ TEXUGO ** and ANA RAMOS-PEREIRA ***

*To Suzanne Daveau,*
*with a friendly hug.*

**ABSTRACT** This article is the result of archaeological and paleoenvironmental investigations carried out within the scope of the ANSOR project in the Sorraia valley (Coruche), on the left bank of the Lower Tagus. In the analysis of settlement dynamics between 5500 and 1800 a.n.e. we considered four moments: 1) The first peasant societies of the ancient Neolithic; 2) The Middle and Late Neolithic; 3) Chalcolithic; 4) The Early Bronze Age. The Sorraia valley was also framed in the framework of the Center and South of Portugal during the period under analysis. Interpretative models are presented for changes in the implantation patterns in the four stages under study, oscillating between paleoenvironmental factors and the socio-economic changes registered in the old peasant societies.

**Keywords:** Settlement, Ancient Peasant Societies, Paleoenvironment, Coruche.

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* UNIARQ, Centro de Arqueologia da Universidade de Lisboa, WAPS / Workgroup on Ancient Peasant Societies Faculdade de Letras de Lisboa, Alameda da Universidade, 1600-214 Lisboa. *vsg@campus.ul.pt, sousa@campus.ul.pt*

** UNIARQ, Centro de Arqueologia da Universidade de Lisboa, WAPS / Workgroup on Ancient Peasant Societies Faculdade de Letras de Lisboa. Alameda da Universidade, 1600-214 Lisboa, CEG, Centre of Geographical Studies. FCT SFRH/BD/136086/2018 *andrelopes@campus.ul.pt*

*** CEG, Centre of Geographical Studies, IGOT - Institute of Geography and Spatial Planning, Rua Branca Edmée Marques, 1600-276 Lisboa, Portugal. *anarp@campus.ul.pt*

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**RESUMEN** Este artículo es el resultado de las investigaciones arqueológicas y paleoambientales realizadas en el ámbito del proyecto ANSOR en el valle de Sorraia (Coruche), en la margen izquierda del Bajo Tajo. En el análisis de la dinámica de asentamiento entre el 5500 y el 1800 a.n.e. consideramos cuatro momentos: 1) Las primeras sociedades campesinas del Neolítico Antiguo; 2) El Neolítico Medio y Reciente; 3) El Calcolítico; 4) La primera Edad del Bronce. El valle de Sorraia se sitúa también en el marco del Centro y Sur de Portugal durante el periodo analizado. Se presentan modelos interpretativos de los cambios en los patrones de implantación en las cuatro etapas estudiadas, dependiendo de los factores paleoambientales y de los cambios socioeconómicos registrados en las antiguas sociedades campesinas.

**Palabras clave:** Asentamiento, Sociedades campesinas antiguas, Paleoambiente, Coruche.

## ANSOR. AN ONGOING PROJECT

In the early 1980s, one of the authors (VSG) devised a research programme for the Sorraia Valley, in the framework of the "Programa para o estudo da antropização do Baixo Tagus e afluentes" [Programme for the Study of Anthropization of the Lower Tagus and its tributaries].

The project "Antropização do Vale do Sorraia" (ANSOR) [Anthropisation of the Sorraia valley] targets the upper stretch of the Sorraia River, the largest affluent on the left bank of Lower Tagus, corresponding to the present-day Coruche municipality. Its main objective is to obtain territorial readings of the Sorraia River valley between the 6$^{th}$ and the 2$^{nd}$ millennia B.C.E., i.e., installation strategies, settlement networks, resource collection areas, technological change, cultural exchanges, and influences.

Developed in 1982-1983, Project ANSOR 1 chiefly consisted of an intervention in the Chalcolithic site of Cabeço do Pé da Erra (Gonçalves, 1982, 1983-84, 1988, 1989), and the "geoarchaeological" studies were conducted in collaboration with Suzanne Daveau (Gonçalves and Daveau, 1983-84). The project was abruptly interrupted due to lack of funding, but it remained a reference for the study of the Chalcolithic in the region.

In 2010, research returned to Coruche and resumed Project ANSOR (ANSOR 2: 2010-2015 and ANSOR 3: 2016-2021), accompanied by an interdisciplinary team that includes the other authors of this paper. Over the past ten years, research included several prospecting campaigns, geophysical surveys (3), excavations (4), radiometric analysis (31), in addition to several publications (Gonçalves, 2009, 2011; Gonçalves and Sousa, 2014, 2017, 2018; Gonçalves *et al.,* 2017).

The published studies focused mainly on specific sites, corresponding to three important chronological-cultural phases, i.e., Early Neolithic (Casas Novas), Chalcolithic (Cabeço do Pé da Erra), and Chalcolithic with Beaker and Early Bronze Age (Barranco do Farinheiro).

This paper studies the evolution of settlement patterns correlated with the dynamics of the Sorraia River.

## THE SORRAIA PALEOLANDSCAPE – AN APPROACH

### Major geomorphological ensembles

This study covers the geographical area of Portuguese Estremadura and Ribatejo. Located in Westernmost Iberia, this region includes varied landscapes developed in different terrains, made of limestone, marl, clay or sandstone, in the sedimentary units of the Lusitanian Basin and the Tagus Basin. This landscape relief results from this lithological diversity and the tectonic strain it endured over more than 200 million years (My). Accordingly, we can distinguish (fig. 1):

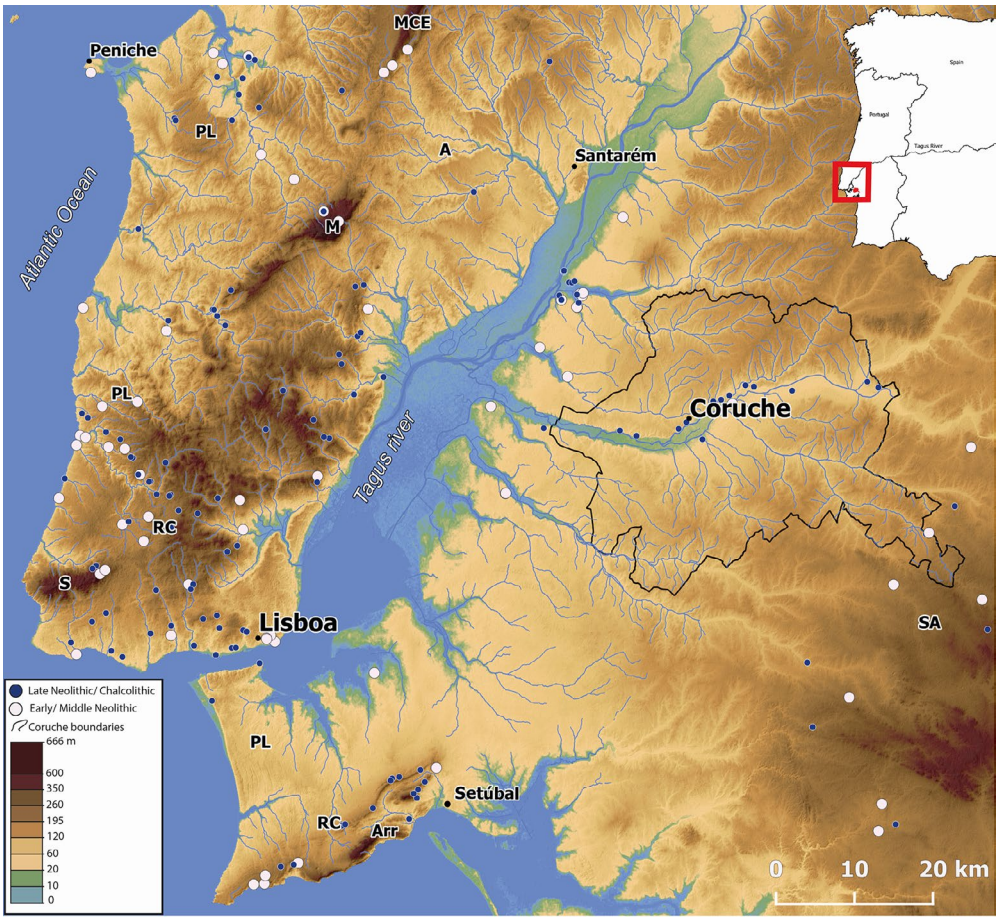



Fig. 1.—Geoarchaeological framework of the Sorraia valley (Coruche), including the early/middle Neolithic settlements and the late Neolithic/Chalcolithic. The relief units of Estremadura and Ribatejo: A, Arrifes; Arr, Arrábida; M, Montejunto; MCE, Estremadura Limestone Massif; PL, coastal platform; RC, cuesta landforms; S, Sintra; SA, general Alentejo's surface. Figure in colour in the electronic version.

1. *Limestone Massifs* are a set of reliefs cropping out of the landscape – e.g., the Candeeiros Mountain Chain, the Santo António plateau and the Aire Mountain (in the Northern end) generically called the Estremadura Limestone Massif, and the Montejunto Mountain (fig. 1). They are limestone compartments elevated by tectonic. Their carbonated nature favoured the creation of a specific karst pattern, responsible for the existence of caves, pits and several depressions, in addition to subterranean water circulation that infiltrates the karst cavities.
2. *Sintra Mountain and Arrábida Mountain Ridge.* Despite their different composition, they began to rise approximately 60 (My) ago. The first, composed of magmatic rocks (sienite, granite, dolerite, and gabbro), reaches 529 meters and dominates the entire surrounding area. In this subvolcanic massif, there is also a particular meso and micro landforms with granite boulders, *tors* (piles of granite blocks forming tubular pinnacles) and *taffonis* (natural cavities, centimetres- to meters-long, resulting from weathering). The Arrábida Mountain Ridge was formed by the tectonic wrinkling of predominantly carbonated rocks, which sank on its southern side. In addition to the anticline of Formosinho Hill, reaching 501 m, the landforms have the same pattern as the Northern Lisbon area.
3. *Cuesta Reliefs.* Found in areas North of Lisbon and in Arrábida, these asymmetric reliefs were caused by the continuous impact of external geodynamical agents on rocks with different resistance to mechanical erosion (preferably limestones and marls) and different plasticity versus rainwater. The landscape is marked by positive reliefs, punctuated by cornices and slopes with different inclinations – some of which affected by mass movements, and negative reliefs corresponding to depressions dug in softer rocks (sandstones and clayish rocks). This type of relief is also found, albeit with sharper contrasts due to tectonic deformation, in the contact area with the Tagus Basin, on its South side, in the so-called *arrifes* (hog backs) (fig. 1).
4. The littoral is marked by a plateau, i.e., a set of flat areas forming the interfluves that separate the valleys from the scarcely dense hydrographic network. These higher flat areas, softly tilted towards the sea, compose what we call the *Coastal/Littoral Platform*. This type of relief is now dissected by the hydrographic network and has a complex fluvial-marine origin, where marine sediments (sands and pebbles) intersect with alluvial materials (sands and clays). Below its higher level, there is a sequence of flat levels successively lowering towards the sea – the so-called raised beaches, where sands and marine pebbles are found, clearly bearing witness to the ongoing elevation of this entire area of Portuguese Estremadura.
5. The *Alentejo Surface* is a flat area with a smoothly rising relief consisting of a multi-level altimetry. The highest level is called the Fundamental

Alentejo Surface, corresponding to the Cenozoic Tagus Basin's sedimentary filling (in the Southeast area shown in fig. 1), approximately 200 m high. After the filling phase of the Tagus Basin, probably in the transition from the Pliocene to the Quaternary, this region began to rise, with its draining basin fitting to it, and a stairway of embedded levels was formed.

6. The *Tagus Valley* is the key element of the entire area, a real artery of this territory, with various tributaries from both banks flowing into it. This sector of the valley, usually called the Lower Tagus Valley, is deeply asymmetric, with a very well defined and higher Northern slope, generally scarp faults, and a softer, less inclined, Southern slope marked by a terraced stairway.

**Tagus River, Muge Stream and Sorraia River: a system of communicating vessels**

Knowledge of the paleolandscapes of these river valleys is uneven. The Tagus valley has been broadly studied, from the geomorphological, sedimentological, and tectonic points of view, and so has the Muge Stream valley. The same did not happen to the Sorraia River valley. Since both Muge Stream and the Sorraia River are left-bank tributaries of the Tagus River, changes occurred in the main river, mainly caused by variations of the sea level, tectonic impulses, and climate changes, also impacted on these two.

This hydrographic network established itself in what we usually call the Lower Tagus Tectonic Basin [Bacia Tectónica do Baixo Tejo (BBT)]. Detrital and less frequent clayey sediments gradually have been deposited in this depression over the Cenozoic period, reaching a 2,000 m thick between the Paleogenic and the Pliocene (Cabral, 2006). As a result of the tectonic regime's reversal, which occurred in the late Cenozoic, the BBT began to rise – and is still rising. Today's hydrographic network also began to settle in this period. This river network carried approximately 70 m of Quaternary (Pleistocene and Holocene) sediments to the depressed areas, according to Cabral *et al*. (2011). We know that the Lower Tagus Valley, along the NE-SW river course, was set up on top of a complex tectonic system and its valley floor endured great changes (Martins, 1999; Ramos-Pereira *et al.,* 2002; Mendonça and Cabral, 2003; Azevêdo *et al.,* 2007; Ramos *et al.,* 2007; Schriek *et al.,* 2007; Vis, 2008; Cabral *et al.,* 2011; Sanz de Galdeano *et al*., 2020). Installed inside a complex tectonic system (*graben*), it endured many impulses of tectonic rise that promoted the appearance of terraces, especially on the left bank of the Lower Tagus Valley. After the definition of four terrace levels (Zbyszewski, 1953 and 1957), fieldwork took a more in-depth approach to larger scales, thanks to the new dating methods (namely $^{14}C$, OSL, series of Uranium/Thorium, electron paramagnetic resonance and cosmogenic nuclides (see Cunha *et al.,* 2016). As a result, a total of six Pleistocene terraces were defined (Martins, 1999; Barbosa and Barra, 2000; Cunha *et al.,* 2016), with the bottom one buried by the Holocene filling of the alluvial plain.

Thus, the Tagus was carved in consecutive notching phases, interspersed by an enlargement of the valley; the first phases matched the low sea levels. Special reference should be made to the evolution of the Tagus valley after the Last Glacial Maximum, approximately 20000-18000 years ago, when a deep valley was dug, accompanying the lowering of the sea level to a depth of approximately 120-130 m. In this phase, the Tagus bottom in the area near the present-day mouth of the Sorraia River was located at approximately –40 m (Vis *et al*., 2008). With the heating of the planet and the rising of the sea level, the Tagus valley was flooded, and its entryway transformed into an estuary (a single channel) – a ria, influenced by tides, and preserving its bottom of anastomosed channels near the Sorraia's mouth (Vis *et al*., 2008), approximately 12000 cal BP (10000 B.C.E.). According to these authors, approximately 7,000 cal BP (5000 B.C.E.) the continuous rise of the sea level enabled the appearance of a delta formed by maritime progression, until near the confluence with the Muge Stream, at a time the floor of the Tagus valley near the Sorraia's mouth was at a depth of 10 m below the sea level. Tributary rivers lowered their beds when the sea levels were lower, trying to bring their mouths closer to the base level, which was then the Tagus valley floor. When the sea levels rose, sea waters invaded the entryway of the valleys of the Muge Stream and the Sorraia River and continued to penetrate up to the mouth of the Muge Stream until approximately 7000 cal BP (c. 5000 B.C.E.). The same must have occurred in the Sorraia River, whose mouth was located at a depth of 10 m (Vis *et al*., 2008). According to Schriek *et al*. (2007), between 7800 cal BP and 7500 cal BP (5850 to 5550 B.C.E.) the Muge Stream had an estuarine environment, in which the maximum tidal influence may have penetrated 4 km upstream, as confirmed by the presence of marsh animal shells (brackish water). As the Sorraia River lay downstream of the Muge Stream, sea water probably penetrated more deeply into it. According to the abovementioned authors, a transition regime characterised the Muge Stream until approximately 5750 cal BP (3800 B.C.E.), as it evolved from an estuarine to a fluvial environment – a freshwater environment, accompanied by the formation of swamps (and peat), interlocking with estuarine sediments, with marshes and shells. In the Muge Stream valley, the river system began to dominate after that, just like it happened in the Tagus, where the abundant deposition of sediments blocked the mouth of its tributaries (Schriek *et al*., 2007; Vis *et al*., 2008). In the Muge Stream valley, around 5710 cal BP (3760 B.C.E.), salt is absent from the sediments and swamps existed, due to the poor drainage caused by sediments brought by the Tagus to the stream's mouth. River sediments gave way to soil formation, enriched and renewed by floods, as still happens today. The alluvial plain environment (Ramos-Pereira *et al.*, 2002), tightly connected to drainage, gradually prevailed.

No climate fluctuations have been recorded, either in the Tagus nor in the Muge Stream, according to Schriek *et al*. (2007) and Vis *et al*. (2008). However, the analysis of a 19 meters deep survey (the SEV core), conducted upstream, near Santarém, provided other data. Approximately 20 km upstream the Sorraia's mouth, the estuarine regime was preserved between c. 9500 cal BP and 4900 cal BP (7550

to 2950 B.C.E., between 15 m and 8 m below the level of the present-day alluvial plain). The existing Mediterranean weather conditions were confirmed by pollen tests and non-pollen palynomorphs, evidencing the presence of pollens of *Quercus ilex*, *Juniperus* and *Arbutus*, some of *Vitis vinifera* and *Olea europea,* Isoëtas, which suggest the existence of freshwater (foraminifera evidence forays of salt water), as well as coals (Azevêdo *et al*., 2006, 2018). In 4900 cal BP (2950 B.C.E.) an exclusively fluvial environment finally prevailed, confirmed by the absence of brackish water and foraminifera, which lasted until 2800-2600 cal BP (850-650 B.C.E.). In this time window, sediments, namely those 3.5 m below the surface (c. 5000 cal BP, c. 3000 B.C.E.), contain soil relics (eroded and re-deposited) as well as coal. These testimonies possibly evidence the soil erosion caused by deforestation (and heath expansion, as shown by the pollinic analysis) and farming, and coals may be the product of fires, either wild or induced by human action. In the Tagus River, for the period between 3546 and 3079 cal BP (1596 and 1129 B.C.E.), the SEV survey showed an extremely high sedimentation rate, 4,2 mm/year, reaching 6,2 mm/year between 3079 and 2806 cal BP, i.e., 1129 and 910 B.C.E. (Ramos-Pereira *et al*., 2008; Azevêdo *et al.,* 2018). The significant accretion in the plain appears to have been caused by combined climate and anthropic factors, which were responsible by the intense erosion of the drainage basin. From a climate point of view, it corresponds to a relatively hot and dry period, which occur simultaneously with the anthropogenic impact on the drainage basin. The SEV survey showed a strong deforestation, evidencing a sharp decrease of *Quercus* and the near disappearance of *Pinus* pollens, accompanied by a significant increase of *Ericacea*. Due to heath expansion at that time, we find mainly species of *Erica* and *Calluna*, to the detriment of the forest (Azevêdo *et al.,* 2018). In the Muge Stream, the strong impact of human action was also felt around 3150 cal BP, 1200 B.C.E., (Schriek *et al*., 2007). The same must have happened in the Sorraia River – a mere speculation since no data is available.

In the Tagus, the last evolution phase of the plain reveals a situation similar to the previous human-made alterations of the Tagus channel, i.e., with a pattern typical of alluvial plains of anastomosed channels, channel migration and avulsion, natural levee, or crevasse splay, which is called *rebentão* in the Lezíria Ribatejana [Ribatejo's marshlands], and flood basins (Ramos-Pereira *et al.,* 2002), but with strong variations of the fluvial energy. These characteristics can still be recognised in today's morphology of the Tagus alluvial plain (Ramos-Pereira *et al*., 2002), although human-made alterations transformed it into a single- channel river.

Like the Tagus valley, the Sorraia River valley, located in the municipality of Coruche, is also asymmetric on the NE-SW section, with a steeper Northern slope that corresponds to a set of fault scarps (Martins, 1999). The Southern slope of the river is also characterised by a terrace stairway (fig. 2).

Detailed analysis shows a valley floor where, despite human-made intervention, namely a set of ditches and farming, we can recognise anastomosed channels and several natural levees. We can still identify the contours of some anastomosed channels, testified by small and narrow hills that accompanied such channels – natural

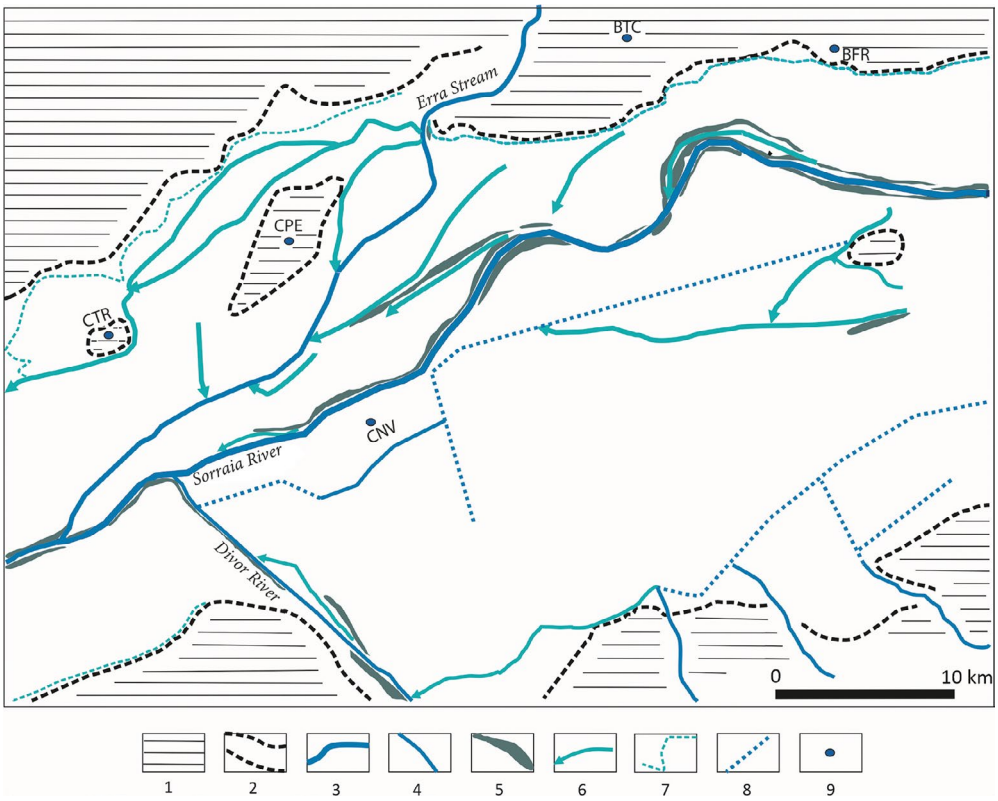



Fig. 2.—The bottom of the Sorraia valley, upstream from Coruche, with the reconstruction of paleo-channels extant before the alluvial plain artificialization. 1, the frame; 2, slope top and bottom; 3, Sorraia River channel; 4, tributaries; 5, natural levee; 6, paleo-channels of a braided river; 7, yazoo river; 8, drainage ditches; 9, archaeological sites. Figure in colour in the electronic version.

levees. In the Southern half of the area mapped in figure 2, these ancient channels are not identified due to the abovementioned reasons. However, to the North, these anastomosed channels of the Sorraia River and those of the Erra Stream can be seen (symbology 6 on figure 2). Special reference should also be made to the yazoo rivers, tributary waterways that accompany the foot slopes, draining the floodbasin that composes the lowest area of the alluvial plain (symbology 8 on figure 2).

The Sorraia River valley is the less known of all three. Unlike the Tagus or the Muge Stream, it has not yet been the object of a multidisciplinary study that enables us to detail the paleoenvironmental variations it endured and acknowledge settlement strategies. Project ANSOR has envisaged such approach, which must be enriched with those contributions. We know that, since approximately 5000-4000 cal BP (3000-2000 B.C.E.), the valley floor was subject to floods. Before human-made intervention and drainage, it had anastomosed channels that shifted, according to the floods, little climate fluctuations and anthropogenic interventions

on the hydrographic basin. The plain's fluvial environment did not favour human settlement; people rather settled on its borders. Another hypothesis can be offered to explain why no settlements are found in the alluvial plain: they once existed but were destroyed by the river's fluvial dynamics. The first hypothesis seems more appropriate.

## PACE OF SETTLEMENT ALONG THE BANKS OF THE SORRAIA RIVER (CORUCHE)

### Available sample

The study of any settlement is obviously restricted by the available sample: soil use, the nature of the archaeological remains and the type of fieldwork developed.

On the Sorraia River banks, we find two extremely different historical uses of the soil, which hamper the archaeological visibility of the terrain.

On hilltops, located on the right bank of the Sorraia River, we find large *montado* [dehesa] areas, forested zones in which cork-oak (an important economic resource enabling cork harvesting) prevails. Having a medium-to-high forest density (80 to 120 trees per hectare), only a small part of the *montado* is also used for grain farming. The largest concentration of *montado* in the entire Mediterranean is found in the Coruche area, which is the world's largest cork producer; this natural heritage is legally protected. As a complement, in Coruche and Ribatejo at large, the *montado* is associated with wild bull husbandry, and there is a centuries-old tradition of cattle-raising ranches. Soil inversions are rarely found in the *montado*, which explains why the archaeological visibility of the soil is virtually non-existent. In Coruche there are also areas of intensive forest exploration (namely pine trees and eucalyptus), that hamper the identification of archaeological remains since the subsoil was more affected. In the Sorraia valley, the largest areas of pine and eucalyptus forest exist downstream, between the river mouth and present-day Coruche.

In the alluvial plain, on the left bank of the Sorraia River, farming activity is also intensive in the *lezíria*, marshland that is periodically flooded by the river. In the Sorraia, a complex network of irrigation channels has been developed since 1933 (*Aproveitamento Hidroagrícola do Vale do Sorraia*), which deeply changed the hydrographic network. Highly dynamic farming strongly impacted on the area's archaeological remains; a few points of settlement were likely affected by more than 7000 years of farming on the left bank of the Sorraia. This farming dynamic partially affected the Tagus' famous shell deposits, located around the streams of Muge and Magos, tributaries of the Tagus, just 25 km away from the Sorraia.

The sheer geomorphological features of the Sorraia valley limit the type of archaeological site; the tertiary lands of the Tagus did not have any rock formations that could provide materials for building tombs and settlements.

Orthostatic megalithic monuments are the most clearly visible and recognisable pre-historic constructions, and they were identified and excavated early on. The dolmens of Coruche were built on a very different landscape, outside the Sorraia valley, already in the granite area of the peneplain, the essential surface of the Alentejo. These were excavated by Manuel Heleno in the 1930s (Leisner and Leisner, 1951; Martinho and Calais, 2009; Gonçalves, 2011). The only tomb identified in the Sorraia valley (Monte da Barca / Quinta Grande) was detected by chance, in 1971, during construction works conducted by the Cooperativa Transformadora dos Produtos Agrícolas do Vale do Sorraia, and probably corresponds to a "negative" funerary site (Andrade *et al.,* 1974; Gonçalves, 2011). It is a ditch or a hypogeum, as those broadly detected in Lower Alentejo in the context of preventive archaeology, outside the megalithic area of the Upper Alentejo (Neves and Silva, 2019).

Like dolmens, Chalcolithic fortified settlements are also relatively easy to locate. That is why 17 of the 21 fortified settlements known in the Lisbon Peninsula were identified early on, before the 1970s, and many of them even in the 19$^{th}$ century (Sousa, 2010). In fact, in Portuguese Estremadura walled pre-historic sites are probably overvalued versus "open" settlements, which are harder to identify in a markedly anthropised territory. But the absence of raw material to build walled structures in the Sorraia certainly determined the Chalcolithic settlement's occupation morphology. It also hampers the identification of surface remains.

In 1980, the site of Cabeço do Pé da Erra was identified (Gonçalves, 1982). At that time, the Neolithic and Chalcolithic settlements in the Sorraia (and Ribatejo) were virtually unknown. Cabeço do Pé da Erra was a one-off serendipitous find. Three excavations conducted after its discovery (1982, 1983, 1984) enabled a first chronological and cultural characterisation of the site (Gonçalves, 1983-1984). For 30 years, Cabeço do Pé da Erra remained alone in the pre-historic charts of Sorraia and Ribatejo, reflecting to some extent the low intensity of archaeological research in the area. In the late 1990s, the first prospections enabled a collection of hard to identify items in chronological and cultural terms.

This void virtually lasted until 2010, when project ANSOR 2 was launched.

Knowledge of the region's geomorphology and soil use showed that the archaeological characterisation of the settlement required several actions, namely (1) re-localization of the places where some separate items had been collected, (2) systematic prospection on both banks of the Sorraia, (3) surveys and excavations in sites of different time frames, enabling the acquisition of chronological and stratigraphic readings, (4) geophysical surveys, and (5) compounding data obtained from preventive archaeology actions (fig. 3).

This methodology made it possible to increase the number of archaeological sites in the area. Today, 17 occurrences have been recorded in the Sorraia valley, dated between the Early Neolithic and the Bronze Age. In addition to these confirmed occurrences, there are also other atypical collections at Cavaleiros, Vinha do Chapéu, Alto da Boavista, and Azervada (Calais, 2003) (table 1).

Stratigraphic, chronological, and spatial characterisation enabled by the excavations at Casas Novas and Cabeço do Pé da Erra could be extrapolated to other

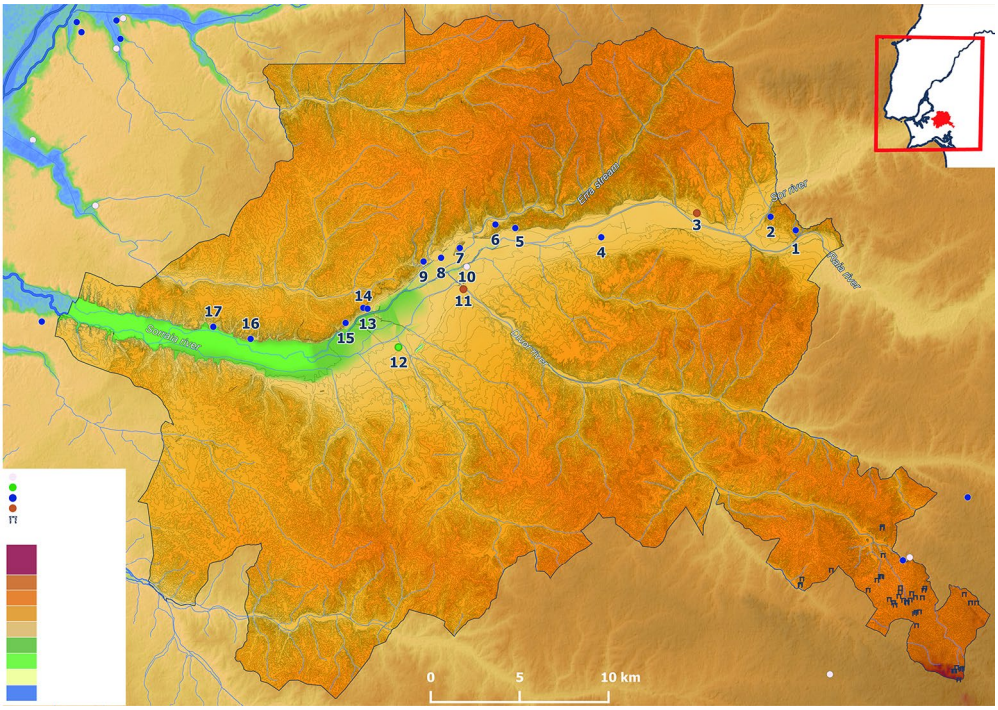



Fig. 3.—Archaeological sites of ancient peasant societies in the Sorraia valley, Coruche (5,500 – 2,200 cal BCE). 1, Raia 1; 2, Entre-Águas; 3, Monte da Açorda; 4, Galegos; 5, Barranco do Farinheiro; 6, Barrocas do Tira Cão; 7, Cabeço do Pé da Erra; 8, Barrocas do Tira Cão; 9, Catarroeira; 10, Monte Velho 2; 11, Casas Novas; 12, Quinta das Amoreiras; 13, Monte Barca; 14, Coruche; 15, Senhora do Castelo; 16, Monte dos Lacraus; 17, Gamas; 18, Monte do Vinagre. Figure in colour in the electronic version.

sites of the Sorraia valley. Geophysical surveys and excavations were conducted in both cases, associated with radiocarbon dating programmes (Gonçalves and Sousa, 2017; Gonçalves *et al.,* 2017).

Results obtained at Cabeço do Pé da Erra were particularly important for characterising the region's Chalcolithic settlements, as they made it possible to identify the first ditched sites of Ribatejo. In 2011, following a geophysical survey, an anomaly interpreted as a ditch was detected, which was later excavated and characterized between 2012 and 2015 (Gonçalves and Sousa, 2017). The existence of ditches in the area was confirmed at the site of Barranco do Farinheiro, only 3 km away (Gonçalves *et al.,* 2017). Perhaps ditches also exist in other sites (Entre Águas, Lacraus...), but surveys may potentially be hampered by many limitations, especially in *montados* with a greater arboreal density.

Sites better characterised through excavations may help to determine the settlement models. Although this tool has not been systematically applied in the prospections of the Sorraia valley, it was a useful empirical indicator of the settlement strategies.

TABLE 1
ARCHAEOLOGICAL SITES IN THE SORRAIA VALLEY (CORUCHE), 5,500-1,800 B.C.E.

| *Site* | *Work* | *Chronology* | | | |
|---|---|---|---|---|---|
| | | *Early Neolithic* | *Middle / Late Neolithic* | *Chalcolithic* | *Bronze Age* |
| 1. Entre Águas | Geophysical, Prospection | | | ● | |
| 2. Raia 1 | Prospection | | ● | ● | |
| 3. Monte da Açorda | Prospection | | | | ● (LBA) |
| 4. Galegos | Prospection, Collection | ● | ● | | |
| **5. Barranco do Farinheiro** | Excavation | | | ● $^{14}$C | ● $^{14}$C |
| 6. Barrocas do Tira Cão | Prospection | | | ● | ● ? |
| **7. Cabeço do Pé da Erra** | **Geophysical, Excavation** | | | ● $^{14}$C | |
| 8. Barrocas do Tira Cão | Prospection | | ● | ● | |
| 9. Catarroeira | Prospection, Collection | | ● | ● | |
| 10. Monte Velho 2 | Prospection | | | ● | |
| **11. Casas Novas** | **Geophysical, Excavation** | ● $^{14}$C | ● $^{14}$C | ● | ● $^{14}$C |
| 12. Amoreiras | Collection | | | | ● (LBA) |
| 13. Monte da Barca | Survey, Collection | | ● | ● | |
| 14. Coruche | Monitoring | | ● | | |
| 15. Senhora do Castelo | Collection, Surveys | | ● | ● | |
| 16. Monte dos Lacraus | Prospection | | | ● | |
| 17. Monte do Vinagre | Prospection, Collection | | ● | ● | |
| 18. Gamas | Prospection | | ● | ● | |

Also, excavations made in the scope of project ANSOR enabled a better geoarchaeological characterisation of the area. Both in Cabeço do Pé da Erra and Barranco do Farinheiro, surface levels were completely sterile, reflecting soil use for *montado* with rare subsoil inversions, and, on the other hand, the total abandonment of these settlements in the late 3$^{rd}$ millennium. In both cases, sites could only be identified due to recent invasive actions, with few items collected at the surface. Contrary to Portuguese Estremadura's fortified settlements, where we frequently find proto-historic reuses (Sousa and Sousa, 2018), most ditched sites appear to

have suddenly disappeared. Site abandonment and the absence of soil inversions contributed to an excellent preservation of archaeological sites in *montado* areas.

Identification has progressed gradually, demonstrating the need to develop long-term projects that enable the assessment of methodologies and direct contact with present-day communities. Regular dissemination actions have made it possible to obtain information and materials that led to the identification of new sites, such as Catarroeira and Gamas.

Today, the Sorraia Valley is the region with the greatest neo-Chalcolithic settlement density on the Lower Tagus's left bank and one of the best characterized in Central and Southern Portugal. Many information gaps, however, continue to exist.

We established four timeframes for analysing the settlement models, (1) first peasant societies of the Early Neolithic, (2) Middle and Late Neolithic, (3) Chalcolithic, and (4) Early Bronze Age.

## Early Neolithic (6th / 5 th millennium)

Abundant remains of the last hunter-gatherer communities have been found on the Tagus River's left bank, namely in the estuaries of the Muge and Magos streams (Bicho *et al.,* 2012, 2013).

No Mesolithic remains have been found so far in the Sorraia valley, perhaps due to different reasons. On the one hand, we should consider the dynamics related to the environmental changes of the early Holocene, with the formation of estuarine areas offering excellent hunting possibilities as from 8200 cal BP, 6250 B.C.E. (Bicho *et al.,* 2012). Shell deposits were found only in sites closer to the Tagus but none in the Sorraia area. Hypotheses can be proposed for explaining the absence of shell deposits in the Sorraia, namely the effects exerted by farming or paleoecological factors.

According to the current state-of-the-art, the first significant anthropic occupation in the Sorraia valley apparently began with the first productive societies of the Early Neolithic. We know only one site of this early phase – Casas Novas (fig. 4).

Identified in 2009 (Gonçalves, 2009), the site of Casas Novas was studied by two archaeological excavation campaigns (2010, 2011) and one geophysical survey (2011). The results of the archaeological work done by project ANSOR, under the supervision of two of the authors (VSG, ACS), have been exhaustively disseminated (Gonçalves and Sousa, 2015, 2018; Inácio *et al.,* 2019).

Casas Novas is located a few dozen meters from the Sorraia River, on its left bank (fig. 4). With altimetry of just 21-22 m, the occupation area is seasonally submerged by uncontrolled rises of the Sorraia, and successive flood traces were evident in the surveys. It is a narrow sedimentation, and the occupation level lies under the superficial layer. The site was deeply anthropised, with irrigation pipes and constant sand dredging.

Materials are widely scattered on a flat area (fig. 5A) of more than 3 hectares. Nine surveys were made and a total of 404 $m^2$ were excavated.

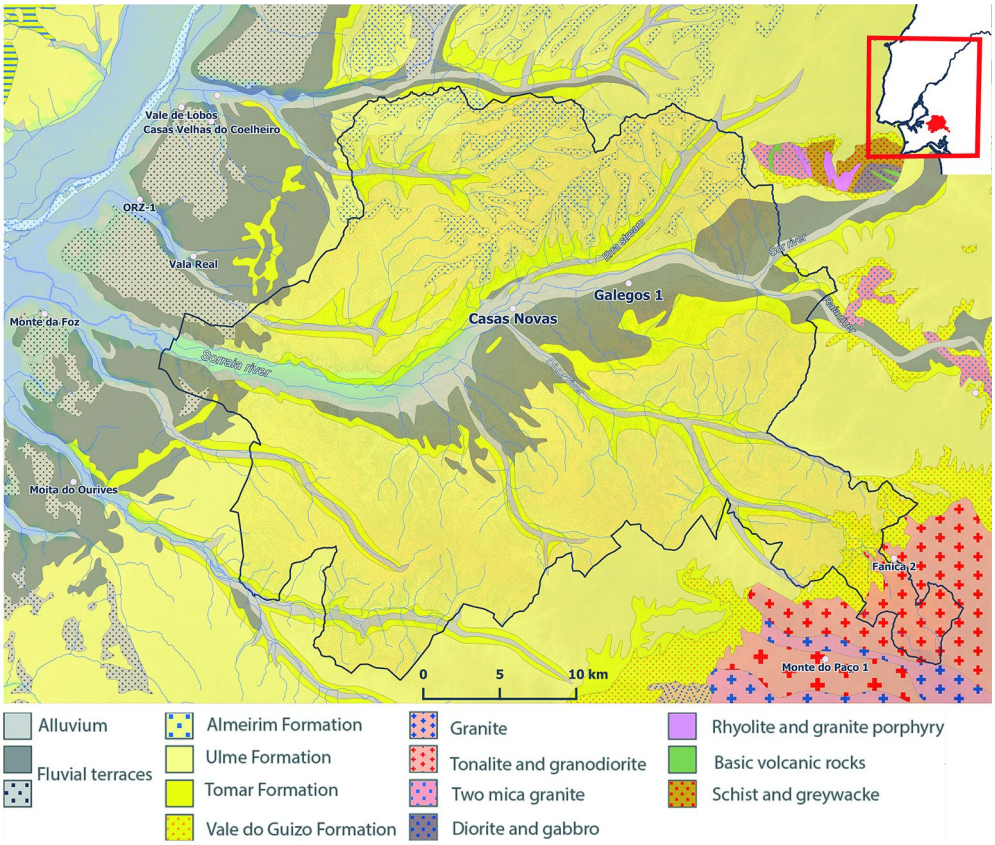



Fig. 4.—Casas Novas in the Sorraia valley (geological map). Figure in colour in the electronic version.

Geophysical works resorted to the geomagnetism method (fig. 6), which enabled the identification of a large group of anomalies, broadly interpreted as prehistoric combustion structures. Most of the 32 identified structures (combustion, ditches, stone structures) are found in the bottom layer, which presents a pebble level (fig. 5B).

Six radiocarbon dates were obtained (Gonçalves and Sousa, 2018). In Sorraia Valley (as well as in the left bank of Lower Tagus) there is poor organic preservation: very small bones and often the charcoal does not allow botanic preservation. Despite this limitation, the radiocarbon sequence of Casas Novas clearly shows the long occupation of the site: 6$^{th}$ millennium, 4$^{th}$ millennium and 2$^{nd}$ millennium BCE. However, the stratigraphy and material culture evidence that Casas Novas occupation is essentially from the Early Neolithic with very residual episodes of Chalcolithic (Bell) and Late Bronze Age. Material culture included an important set of cardial ware and many pieces of printed ceramics. The material culture (ceramics and lithics) and a very ancient radiocarbon date from the 6$^{th}$ millennium


Fig. 5.—A) A view of Casas Novas (W-E). B) CNV Survey 1. Figure in colour in the electronic version.

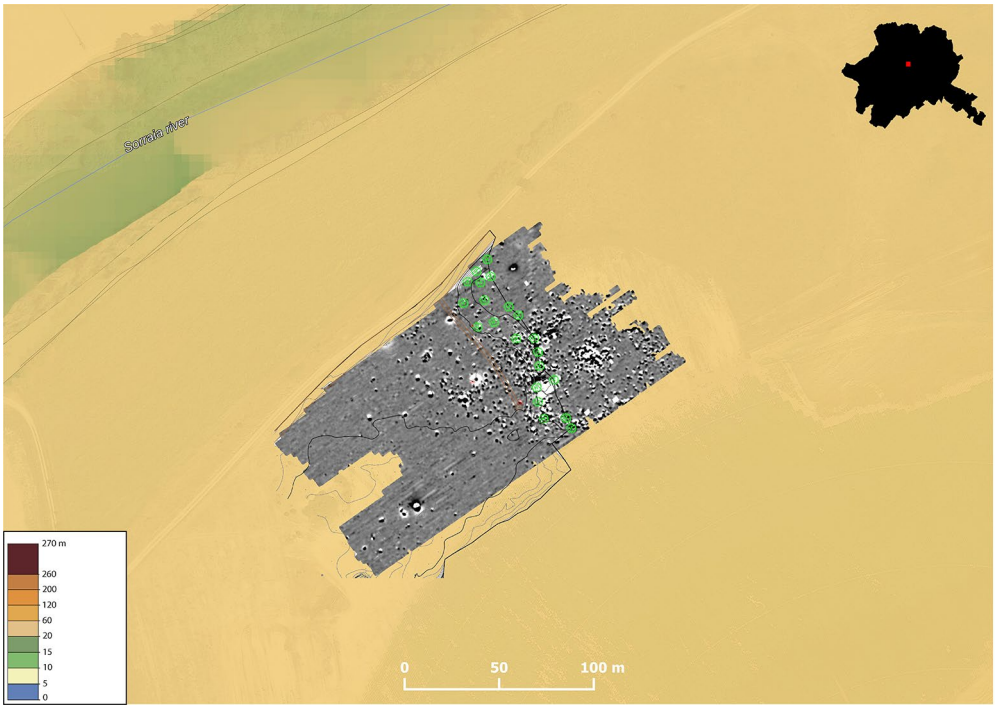



Fig. 6.—Geophysical survey of Casas Novas. Figure in colour in the electronic version.

(Beta-310057: 6680±40 BP; 5660-5540 cal BCE 2 sigma) lead to the hypothesis that it could have been an ancient pre-cardial occupation in the western façade, with parallel with other sites located in the Southwest coast (Guilaine, 2018), a proposal to be tested in future research.

Today, more than ten years after its identification, Casas Novas remains an ancient stand-alone Neolithic site, lacking contemporary contexts in the Sorraia valley.

At Galegos, also located on the left bank of the Sorraia, was collected a small set of materials, including a schist bracelet, a pendant, and a bead (Calais, 2003), which may point to an Early Neolithic chronology. It is possibly funerary, although these items do not have such exclusive provenance; stone bracelets have been found in dwelling contexts, such as Valada do Mato, Évora (Diniz, 2007) or Xarez 4, Reguengos de Monsaraz (Gonçalves *et al.,* 2013). In relocation works conducted in 2011, we collected a few atypical pre-historic ceramics at this place.

We should consider geo-archaeological factors to explain the isolated position of Casas Novas. In the alluvial plain, the landscape in which the early phases of Neolithic settlements were probably located, sedimentation likely hid other settlements of this phase. Intense irrigation farming also obliterated habitat sites situated on the left bank of the Sorraia.

Another explanation can also be pondered, i.e., the type of occupation at Casas Novas. The site has been considered a semi-permanent settlement, with high mobility indications, on a plain strongly affected by floods. Material culture gives evidence of medium-to-long distance contacts, namely the ceramic decoration (Mediterranean world and Meseta). As regards raw material supplies, the lithic industry also suggests contacts: abounding flintstone from Portuguese Estremadura, contrasting with the use of local materials in the Chalcolithic settlements, such as Cabeço do Pé da Erra (Gonçalves and Sousa, 2017). Petrographic analysis of ceramics also highlights this mobility, with clays from granitic environments located over 25 km away (Inácio *et al.,* 2019). In this area we find some sites that may belong to the early Neolithic, such as Fanica 2, in Mora, or Monte do Paço 1, in Montemor-o-Novo (Calado, 2004). In the Mora region, two settlements from an early phase of the Neolithic were intervened, near the Raia Stream, Barroca 1 and Chaminé 3, but these have a poor conservation status and are hard to identify in chronological and cultural terms (Rocha, 2017).

## Middle / Late Neolithic (5th and 4th millennia)

An information gap of nearly two thousand years characterises the period of the Middle and Late Neolithic, the second half of the 5th and the entire 4th millennium, in what now is Portugal's territory (Neves, 2018). In contrast, we generally find a strong settlement density in the Late Neolithic (3200-2900 cal B.C.E.), both in Portuguese Estremadura (Sousa, 2010) and the Alentejo (Rodrigues, 2015).

In the Sorraia valley, few occupations date from the Middle and Late Neolithic, except Monte da Barca/ Quinta Grande's mysterious site, located on the left bank of the Sorraia River.

The site of Monte da Barca was identified in 1971, during the construction works of a silo by Cooperativa da Quinta Grande (Andrade *et al.,* 1974; Gonçalves, 2011). Context information is scarce, almost exclusively restricted to the nature of the collected artefact set and vague stratigraphic information. Concentration of votive pieces (i.e., engraved schist plaques, croziers, halberd and dagger, flint blades, polished stone axes, pendant and hemispheric carinated vases of the type "Crato-Nisa") apparently suggests a funerary context attributable to the transition between the 4th and the 3rd millennium B.C.E. (Late Neolithic / Early Chalcolithic). The absence of human remains can be explained by the nature of the substratum, which is acidic, just like in every pre-historic context of the Sorraia valley and of the left bank of the Lower Tagus. The number of votive plaques picked (32) suggests a collective funerary context. The tomb's nature is hard to define due to insufficient context information (Gonçalves, 2011:150). However, it seems plausible that such structure may have been dug into the subsoil without the orthostatic component (*idem, ibidem*).

Scattered remains of domestic nature were found in the area surrounding Monte da Barca's tomb, in present-day Zona Industrial do Monte da Barca. Preventive

archaeology works conducted here between 2017-2020 did not shed any light on the occupation that once existed. Despite the intervened areas' extension, scarce information is available, which does not enable a global picture; it is thus important to get a global reading of the field data (figs. 7 and 8). A geophysical survey of the area would be essential to interpret the site.

The four teams that participated in preventive archaeology works at the site have not yet published their findings, but the technical-scientifical reports seem to suggest a low density of archaeological materials, poorly preserved (possibly in secondary position), and a small number of structures. In general, materials date from the Neolithic and the Chalcolithic, but no type fossils are found from the main chronological and cultural phases, i.e., cardial and printed ceramics, plates with almond-shaped rim and decorated ceramics from the Chalcolithic. Therefore, this sparse occupation possibly corresponds to an intermediate phase of the Neolithic; this interpretation, however, requires a more in-depth analysis. Scattered findings appear to reflect the impact of the modern agro-industrial activity on the site and are possibly associated with a small settlement that was deeply affected by soil use.

Given the site's preservation issues, we should emphasise its settlement pattern and its relevance to the settlement network of the Sorraia valley. Located on the left bank of the Sorraia, with altimetry ranging from 20 to 25 m, the site of Monte da Barca was vulnerable to the fluctuations of the Sorraia River, and this circumstance may have exerted a greater impact on its archaeological contexts.

The left bank of the Sorraia River was indeed visited for a long time. Casas Novas is a fine example. The site's main occupation clearly dates from the Early Neolithic. There is also chronometric and material evidence of successive revisits from the Early Neolithic to the Iron Age. One date points at the Late Neolithic (Beta-303433, 4370±30, 3088-2907 cal BCE 2 sigma), but no archaeological materials belonging to this evolved phase of the Neolithic were collected. Some late Beaker ceramics were collected at Casas Novas, but there are no absolute dates from the 3rd millennium. Finally, some materials and dates can be attributed to the Late Bronze Age. Thus, occupying a site for installing a permanent or semi-permanent settlement is clearly different from making quick visits to an area, as may have happened at Casas Novas.

Also, the site of Monte da Barca likely corresponded to a succession of sparse occupations. Without dates and without contexts and published material, we cannot go much further in this direction.

It is the funerary context that gives a unique meaning to Monte da Barca and points to influences from the Alentejo: not just the schist plaques, but also the small carinated vases typical from megalithic contexts. The association between a "negative" funerary context, with a megalithic artefact set, and an adjacent settlement area can also be found at the site of Sobral de Martim Afonso (Salvaterra de Magos), also located on the left bank of the Tagus River, on the hydrographic basin of the Muge Stream (Simões, 1878; Cardoso, 2016; Andrade, 2017). We can foresee a tomb type hard which is hard to detect in the Tagus tertiary basin. The isolated picking of an engraved schist plaque in historic center of Coruche (Praça

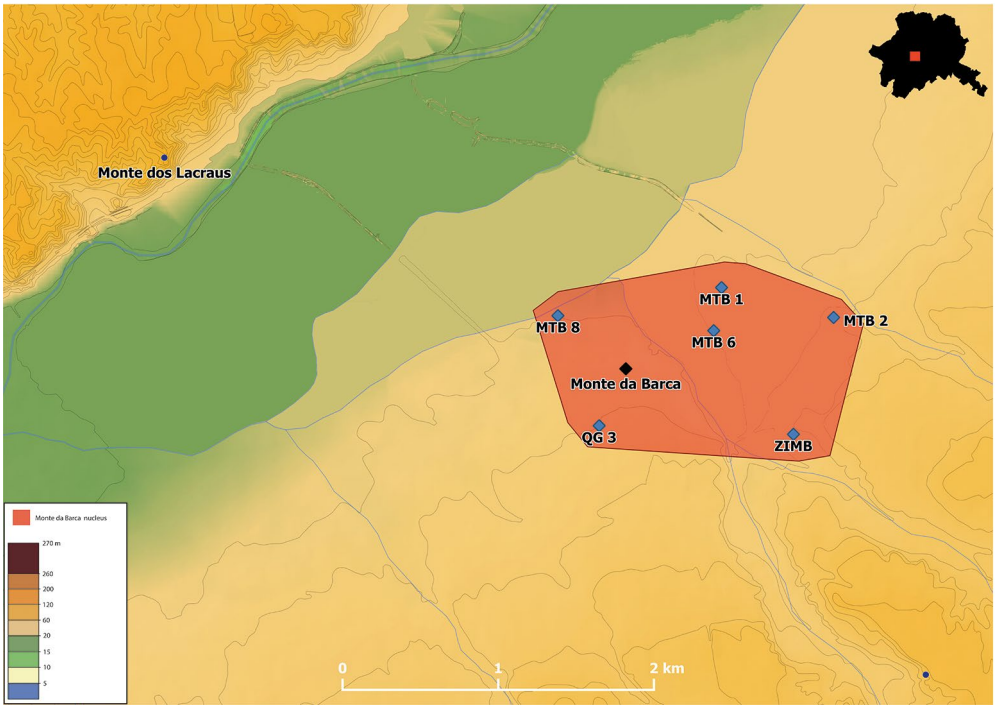



Fig. 7.—Scattered area of Monte da Barca, with indications of the surveys conducted: MTB1, MTB2, ZIMB, MTB8, QTG3, and the votive context of Monte da Barca. Fig. in colour in the electronic version.

Fig. 8.—View of Quinta Grande/Monte da Barca from Senhora do Castelo. Figure in colour in the electronic version.

da Liberdade, information provided by the company *Empatia*, to which we thank), could be associated with a ditch funerary context, also in the alluvial plain.

We must highlight that, despite the information gap regarding the 4th millennium in the Sorraia Valley, in the "alentejana" area of Coruche, in the granite territories of Brotas and Couço, approximately 20 km South of the Sorraia valley, there is an important megalithic nucleus (fig. 9). This group is composed by 46 orthostatic tombs, including small monuments from ancient phases (Mouchão das Azinheiras 1 and 2, Tanque do Monte, Bertiandos 3, Vale de Covas, or Vale de Gatos) and more evolved monuments (Bertiandos 1, Vale Beiró, Tanque Velho), entirely excavated by order of Manuel Heleno in the 1930s, with scarce published information (Martinho

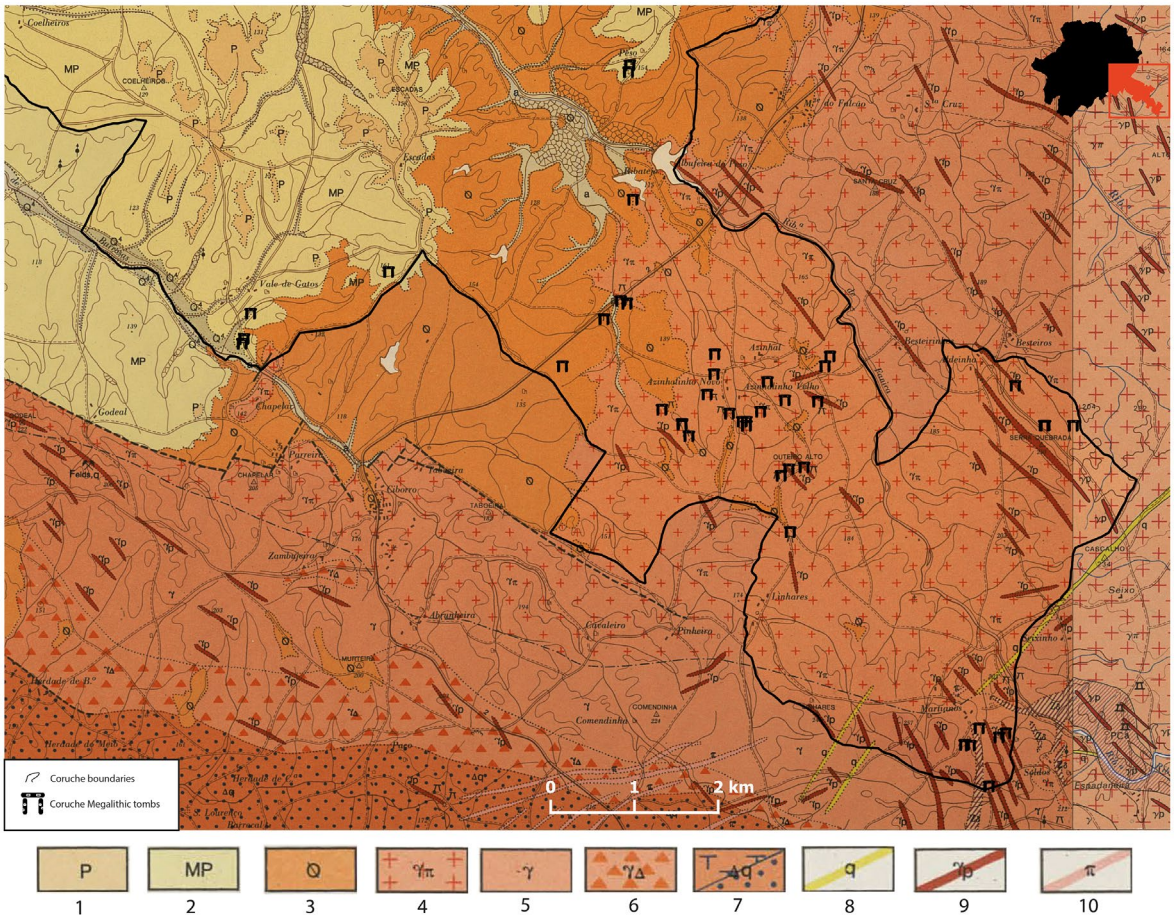



Fig. 9.—Megalithic monuments of Coruche, in the granodioritic bedrock, in SA (Superfície Alentejana). Geological map: 1, Detritical complex of Santana do Mato (sand-clay conglomeratic); 2, Detritical complex of Coruche (Sand-clay); 3, Arkosic and clay of Brotas complex, with some limestone areas; 4, Porphyroid granite, biotitic; 5, Granitic medium size grain, biotitic; 6, Granodiorite; 7, Quartz-diorite; 8, Quartz; 9, Pegmatite; 10, Granitic Porphyry. Figure in colour in the electronic version.

and Calais, 2003; Gonçalves and Sousa, 2014), and no dates. No settlements are known in this megalithic territory, but there is a *deficit* of recent archaeological work: *Muitas antas, pouca gente ?* (Gonçalves, 2003).

The duality between the megalithic territory South of the Sorraia and the Neolithic settlement in the Sorraia valley still has not been clarified. In the present state of our knowledge, we may ponder if there was a displacement from the settlement of the Sorraia valley to the granitic area during the Middle and the Late Neolithic. An abandonment of the megalithic nucleus seems to have occurred in the 3rd millennium (judging by the artefact set), and a settlement concentration in the Sorraia valley.

## Chalcolithic (3 rd millennium. 2900-2200 B.C.E.)

As from the 3rd millennium, there is an explosion of occurrences. This is the first effective settlement network detected in the Sorraia valley.

The common denominator of all identified sites is their implementation on the right bank of the Sorraia River, in the hills dominating the alluvial plain, basically corresponding to forest areas (cork-oaks and pines) with scarce visibility of the soil.

We have significant information regarding four of the 10 sites integrated in the 3rd millennium: Entre Águas, Barranco do Farinheiro, Cabeço do Pé da Erra, Monte dos Lacraus. As regards the others, information is scarce and does not allow an accurate chrono-cultural integration.

As concerns the Chalcolithic settlement of the Sorraia valley, we must make an individual reading of the four sites under analysis.

### *Entre Águas (ENA)*

Entre Águas (ENA) is located in the interfluve that dominates the confluence of the Sor and Raia streams, where the Sorraia River begins (fig. 10). It has a maximum height of approximately 75 m, and it offers good visibility to the South and the West, controlling the Sorraia valley.

The geological substratum corresponds to Miocene and Pliocene strata and now has dense arboreal coverage (pine) that hampers the sites' characterisation. Surface material is scarce but does generically point to a chronology of the 3rd millennium B.C.E.

Project Ansor's team identified this archaeological site in 2011 (CNS 35728) and it was studied by a geophysical survey in 2016. Its excavation is planned for a near future.

Materials were identified at the top of the hill (Entre Águas 1) but also in the plain, and there was an adjacent occurrence (Raia 1). It is likely that these three occurrences are interconnected. We estimate that the settlement may be 6 hectares wide, but the soil visibility is extremely low. The artefact set is scarce and includes

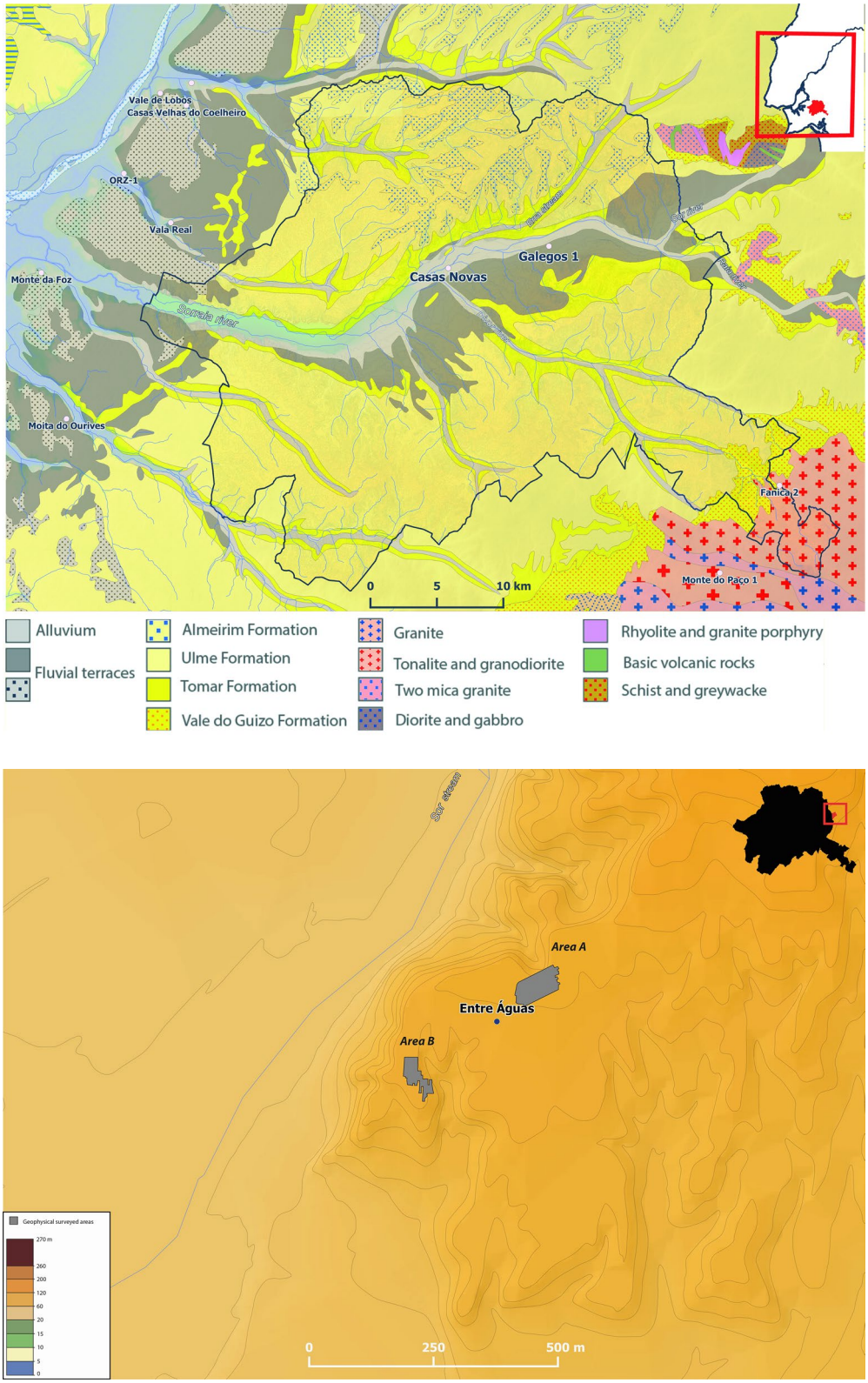



Fig. 10.—Entre Águas. Location of the two areas studied by the geophysical survey. Figure in colour in the electronic version.

ground stone (anvil and a millstone element), smooth manual ceramic, the fragment of a loom component and a nodule of clay coating. No decorated ceramics were collected (Acácia Leaf or Beaker...), which could have allowed a finer relative chronology of the site (figs. 11 and 12).

The geophysical survey was conducted over two top areas where materials were collected. They were concentrated in the slope facing the Sor Stream, which is precisely the steeper slope and therefore exposed to more natural erosion (fig. 10). Geophysical prospection conducted by geomagnetism (*Easternatlas*) covered 0,7 hectares and demonstrated possible archaeological structures, such as circular anomalies interpreted as ovens, hearths, or metallurgical features. A semi-circular anomaly was found in one area, which may correspond to a hut.

Considering the strategic location of Entre Águas in the confluence of the Sor and Raia streams (fig. 11) and the great scattering of materials, this site may have played a central role in the region's settlement. Now it is placed in an eccentric situation as regards the greater settlement concentration near Erra.

*Barranco do Farinheiro (BFR)*

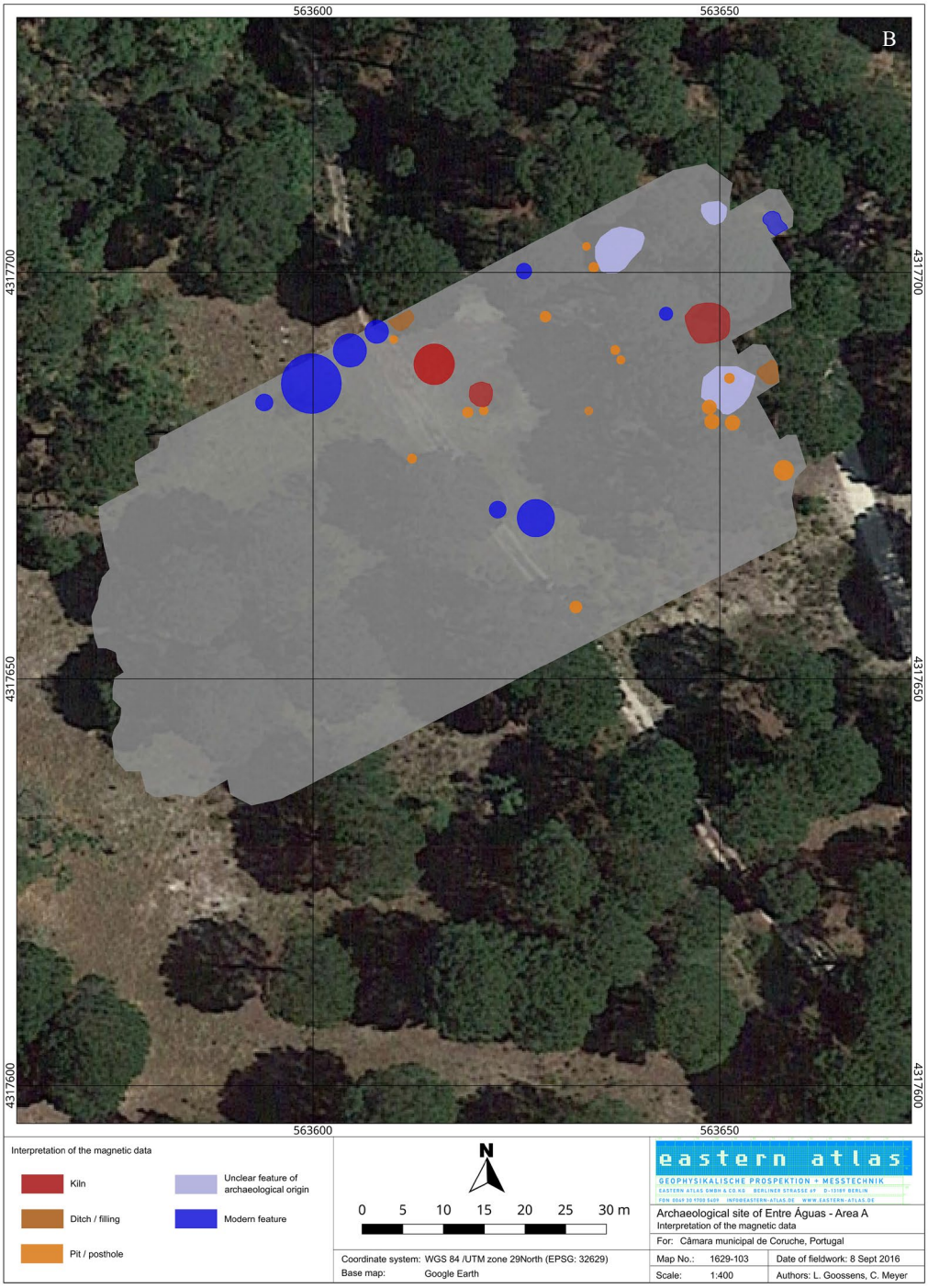
The site of Barranco do Farinheiro is located at the top of a hill, near a fault scarp in the tertiary deposits of the Tagus, between the right bank of the Sorraia and the Erra Stream. This hill, and its associated slope, has gullies caused by erosion that may have affected the site. The use of a sand quarry approximately 30 years ago has cut part of the vegetation (fig. 13).

The site was identified in 2012 by Project ANSOR's team through the observation of a cut in a sand quarry. Three possible occupation nuclei were identified at different heights in Herdade do Farinheiro, but only the one detected in the sand quarry area was excavated. The other nuclei were merely characterised by scarce surface materials. Soil visibility is quite poor due to the high tree density of the *montado* and the site's relative chronology and occupation morphology cannot be determined. The construction of a municipal road may have partially affected the site. The excavated nucleus is just 700 m away from the present-day Sorraia River, at an altitude of 50-52 m (fig. 14).

Six excavation campaigns were carried out at Barranco do Farinheiro (2012-2015, 2017, 2019) (Gonçalves *et al.,* 2017). Between 2012 e 2015, the intervention focused on an area adjacent to the sand quarry, where a ditch section was detected (Gonçalves *et al.,* 2017). Between 2017 and 2019, a new section of the same ditch was identified and a possible hut (fig. 15). Overall, 170 $m^2$ were excavated but contexts were only detected inside negative structures, which showed abundant clay coating. Tree density of the *montado* prevents the excavation of the area and hampers a geophysical survey, thus making it difficult to identify the site's total occupied area and the ditched enclosure plans.

Occupation has been chronometrically established, dating from the Chalcolithic through to the Bronze Age. Chalcolithic occupation dates mainly from the


Fig. 11.—Geophysical surveys of Entre-Águas, areas A and B. Figure in colour in the electronic version.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eastern atlas
GEOPHYSIKALISCHE PROSPEKTION + MESSTECHNIK
Archaeological site of Entre Águas - Area A
Interpretation of the magnetic data
For: Câmara municipal de Coruche, Portugal
Map No.: 1629-103
Date of fieldwork: 8 Sept 2016
Scale: 1:400
Authors: L. Goossens, C. Meyer

Fig. 12.—S-N view to Entre Águas. Figure in colour in the electronic version.

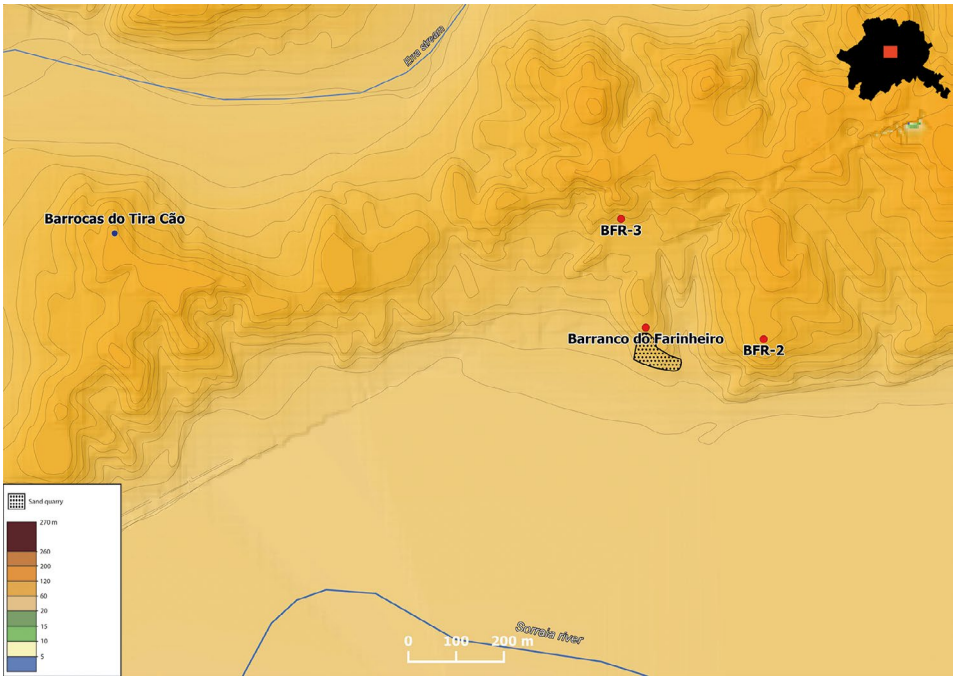



Fig. 13.—Detailed plan of the Barranco do Farinheiro nucleus, showing the area of the sand quarry. Figure in colour in the electronic version.


Fig. 14.—Barranco do Farinheiro: A) S-N view; B) View from CPE. Figure in colour in the electronic version.

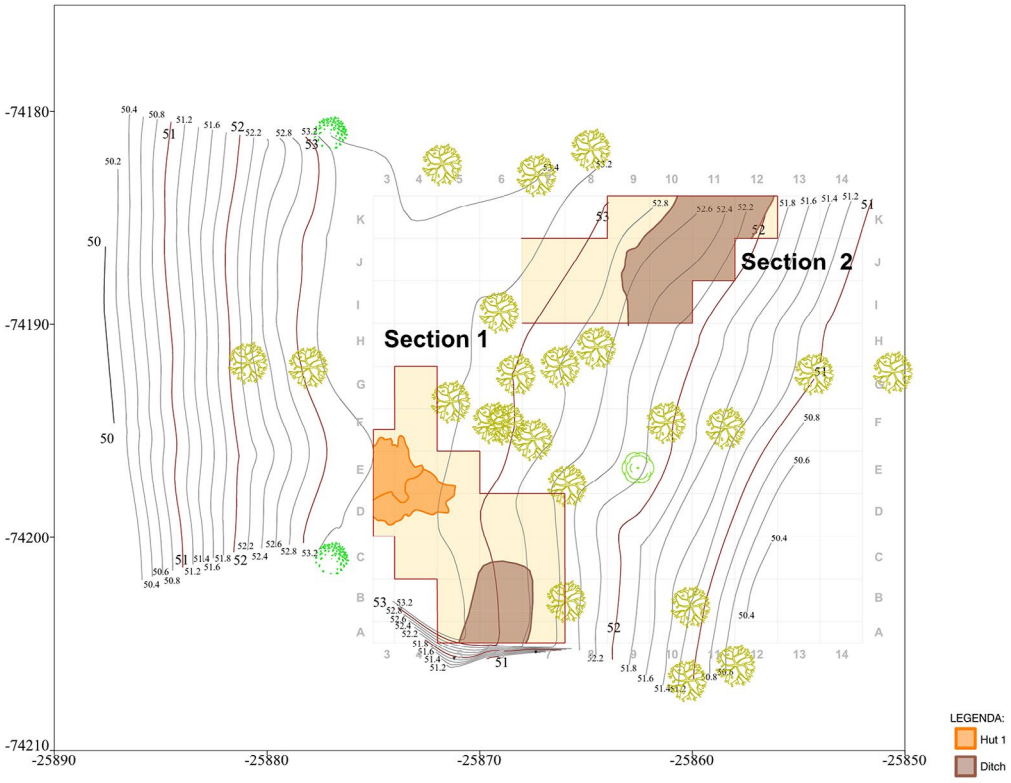



Fig. 15.—Schematic plan of Barranco do Farinheiro with ditch (sections 1 and 2) and hut 1. Figure in colour in the electronic version.

second half of the 3rd millennium, with an important ceramic set belonging to the Portuguese Estremadura tradition (Acacia Leaf group) and ceramic from the Beaker group (Gonçalves *et al.,* 2017), with dates grouped in the second half of the 3rd millennium (Beta-331680: 2550-2300 cal BC Beta-386974: 2616-2469 cal BC Beta-425876: 2469-2298 cal B – Gonçalves *et al.,* 2017). The first occupation from the Bronze Age (Early Bronze) was detected in 2019 and is currently under study.

Barranco do Farinheiro lies only 3.27 km away from Cabeço do Pé da Erra, the best-characterised settlement of the Sorraia valley. According to absolute chronology, the two sites partially existed at the same time. However, at Cabeço do Pé da Erra, occupation seemingly began at an early phase of the 3rd millennium, slightly before Barranco do Farinheiro. Both sites existed simultaneously during most of the 3rd millennium, evidencing good intervisibility. They share strong common features, i.e., the presence of ditches and abundant clay structures. Material culture is similar, with two significant differences: Beaker ceramics are present in BFR and stone structures are absent (figs.15 and 16).

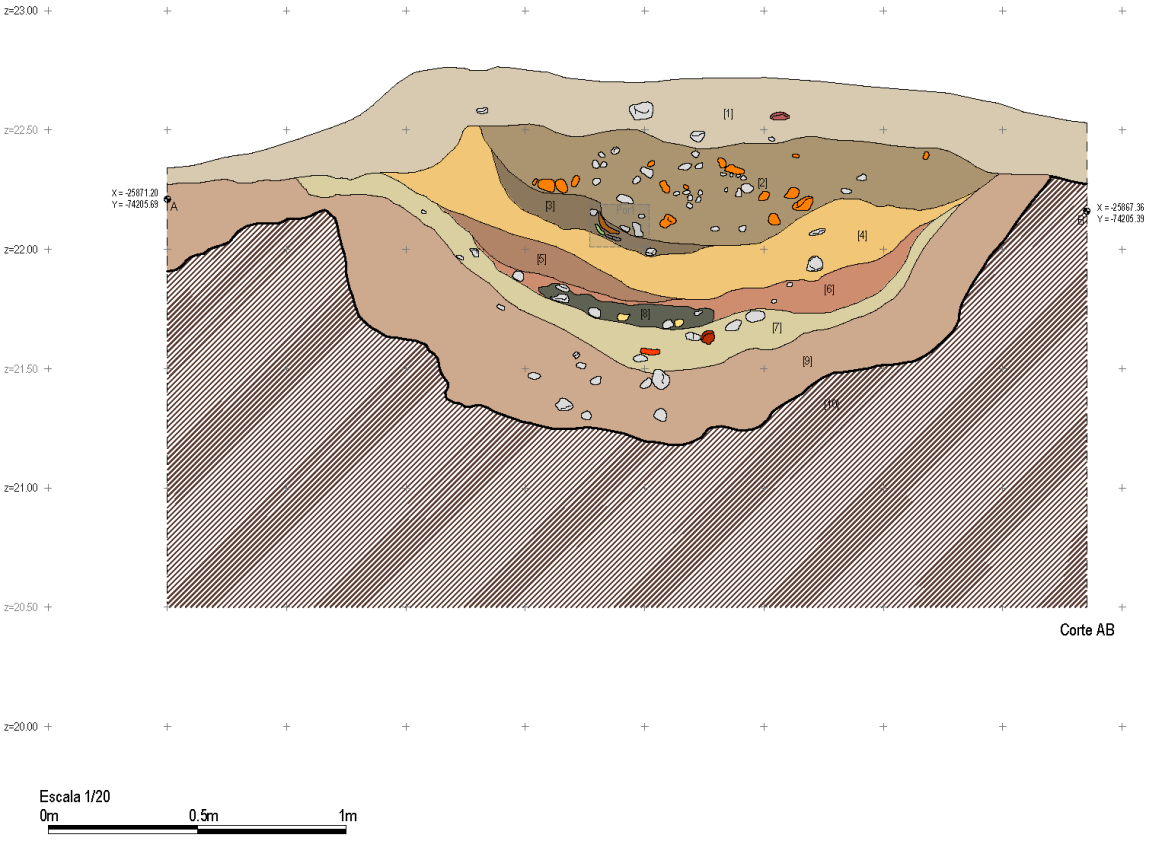



Fig. 16.—Ditch profile, section 1. Figure in colour in the electronic version.

*Cabeço do Pé da Erra (CPE)*

The Chalcolithic farm of Cabeço do Pé da Erra is located roughly at the centre of a long hill, demarcated from the North by the contact with Vale Judeu, and from the South by the Erra Stream and the Sorraia River, appearing as an island in the interfluve between these two bodies of water (fig. 17). The base of this island was periodically flooded by the fluctuations of the Sorraia River and the Erra Stream, which would cause some discomfort in these communities' daily lives.

Today it is a *montado* area, with a cork-oak density slightly lower than what is found at Barranco do Farinheiro. Its soils are also used for wild bull husbandry.

On an elongated hill, approximately 1 km long, the pre-historic remains are concentrated roughly at the centre, at the height of 54 m (fig. 18). Although the full extension of the occupation has not yet been determined, it was probably concentrated exclusively in the hill's central area, with a total area of approximately 1 ha.

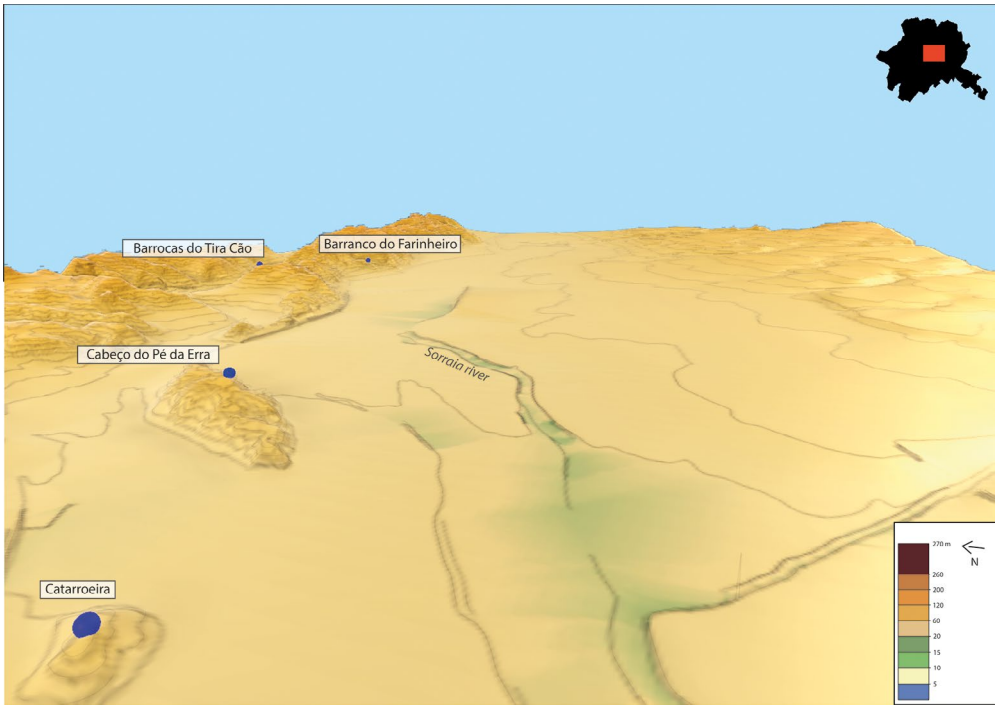



Fig. 17.—Cabeço do Pé da Erra and Erra's settlement nucleus. Figure in colour in the electronic version.

The site was found in 1980 by a group of scouts who collected materials in grounds where the soil was occasionally trampled by bulls (Gonçalves, 1980). One of the authors (VSG) directed the first archaeological campaigns at the site in 1982, 1983 and 1984 (Gonçalves, 1983-84, 1989), identifying hut structures and a workshop where schist plaques were made at the beginning of the 3rd millennium (ICEN-587, 4220±45 BP, 2911–2640 CAL B.C.E.). This promising fieldwork was interrupted and resumed only in 2011, in the scope of Project ANSOR 2, directed by that author. The new work phase began in 2011, with a geomagnetic geophysical survey (*Easternatlas*) that enabled the identification of a U-shaped ditch. Four extensive excavation campaigns, conducted between 2012 and 2015, covered a total area of 536 $m^2$.

The settlement stands on the slope facing the Sorraia River (Southeast), corresponding to the main occupation area (Area 1). A secondary (or support) area, facing North was found (Area 2) (fig. 19).

Totalling 800 $m^2$, Area 1 is partially demarcated by a ditch that surrounds a subcircular space, with 10 habitational structures (huts), functional occupation areas and dejection areas in the periphery (figs. 20 and 21).

Considering the extension of the excavated area and the existence of a geophysical survey enabling an approximate reconstruction of the site's plan, we know that Cabeço do Pé da Erra was a small farm protected by a ditch.

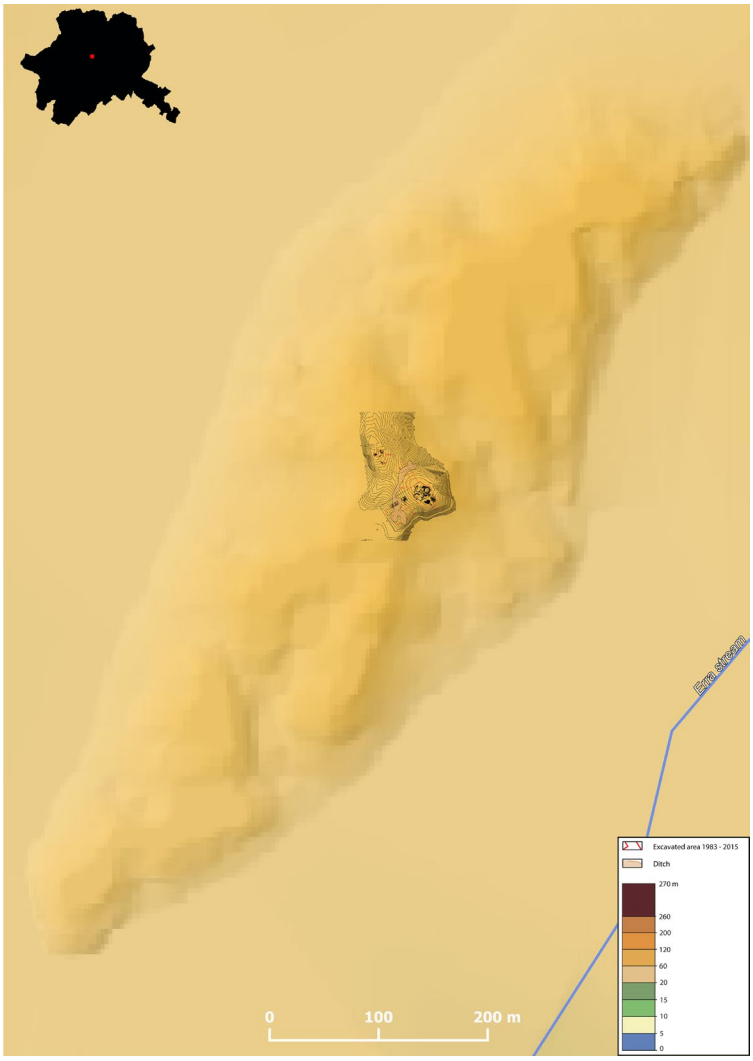



Fig. 18.—Cabeço do Pé da Erra. Location of the settlement.
Figure in colour in the electronic version.

In general, we can identify three occupation phases, characterised by stratigraphy and 12 radiocarbon dates (Gonçalves and Sousa, 2017). Lasting between 2817-2665 B.C.E., phase one consisted of a sparse occupation with perishable structures associated with a workshop where engraved schist plaques were produced. In phase two, the defensive ditch —and probably the huts— were built (2633-2474 B.C.E.). In the last occupation phase (2382-2139 B.C.E.), the site was abandoned, which may have happened extremely fast. Every context is well preserved: a concentration of intact vessels (kitchen), two pits, and a circular, peripherical hut. In more recent phases, there was a short reuse in the Iron Age, only in area 2 (fig. 22).

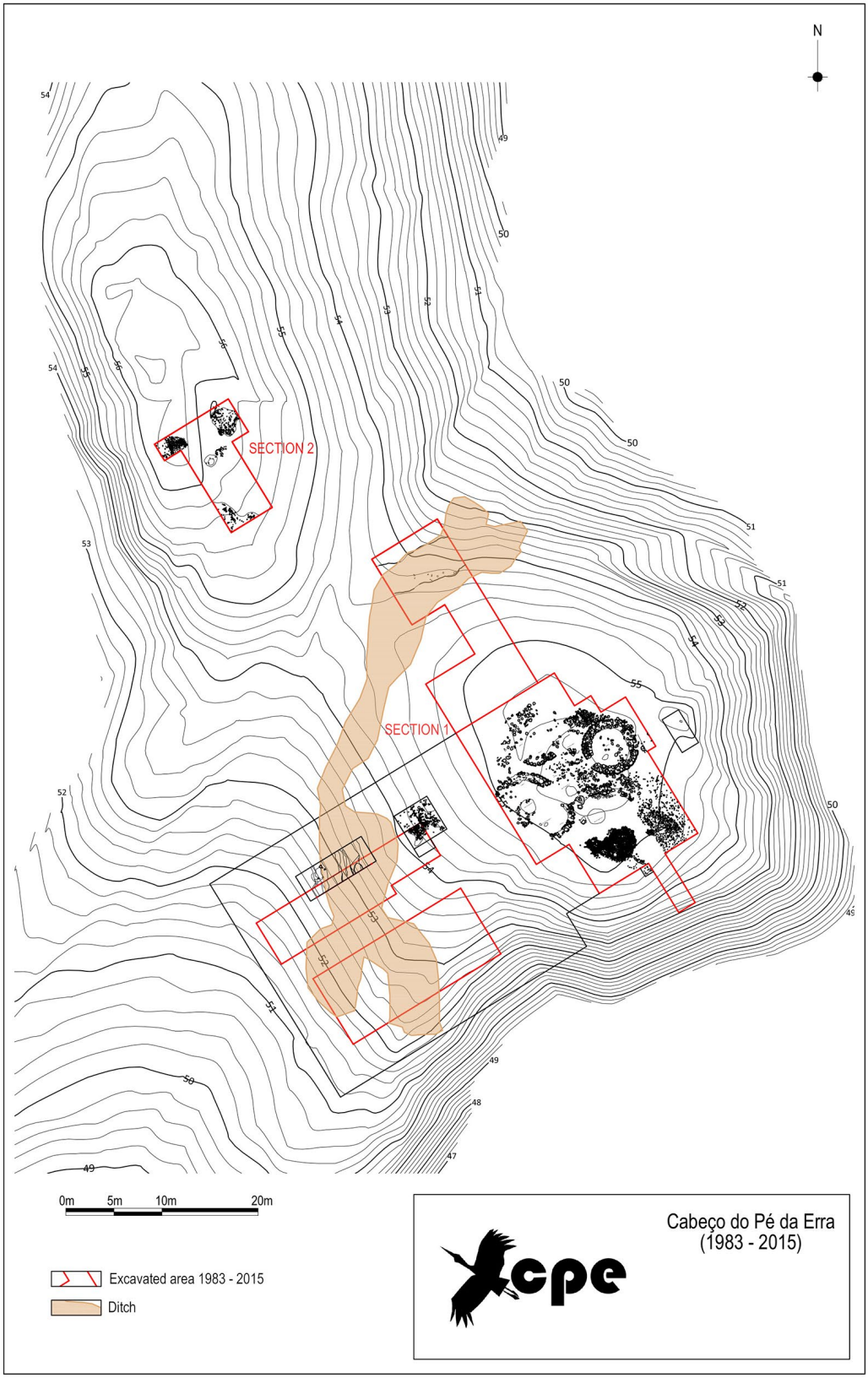



Fig. 19.—Plan with indication of the excavated areas and the outline of the ditch, determined by geomagnetic prospecting. Figure in colour in the electronic version.


Fig. 20.—Cabeço do Pé da Erra. A) W-E view to Cabeço de Pé da Erra; B) SW-NE view. Figure in colour in the electronic version.


Fig. 21.—A) Central area of the settelement, with semi-circular huts and hut 7, in the initial excavation phase (CPE 2013). B) Ditch section (W area). Figure in colour in the electronic version.

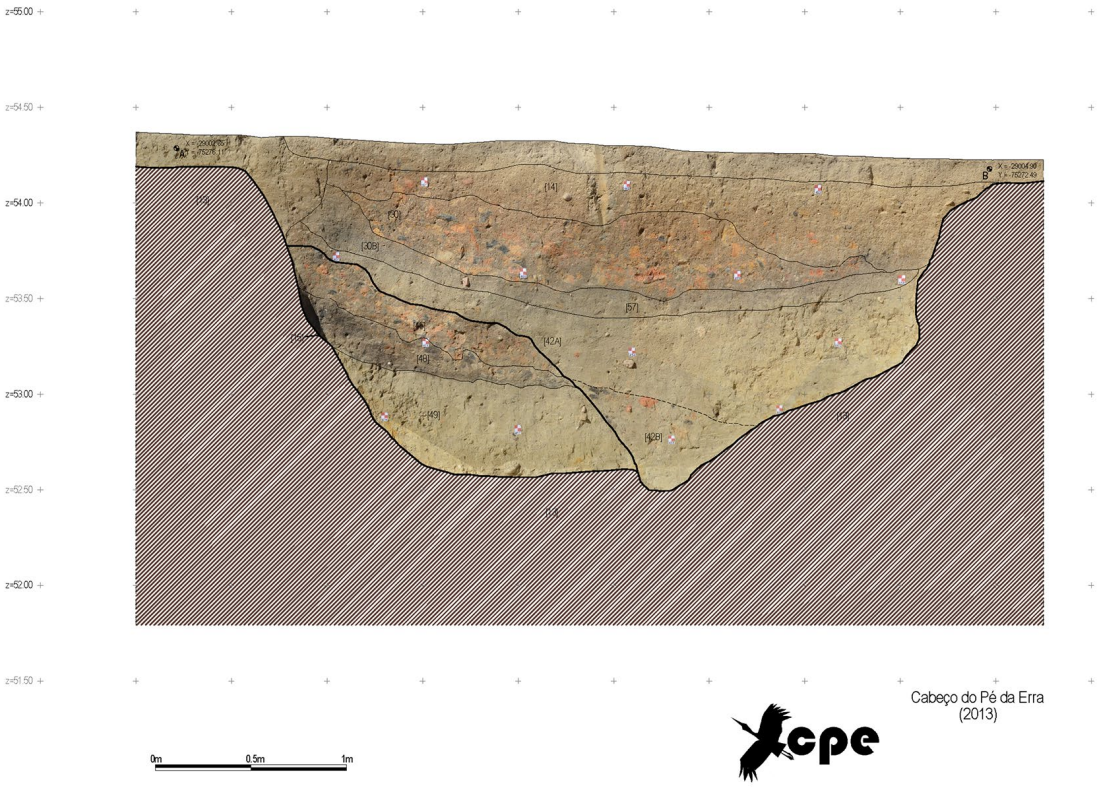



Fig. 22.—CPE ditch profile, with two phases of recutting. Figure in colour in the electronic version.

*Monte dos Lacraus (MLC)*

The Monte dos Lacraus site was identified at the time of the prospection works conducted under the Coruche Master Plan (PDM), with only a general mention (Calais, 2003).

The hill is approximately 70 m high, located West of the present-day town of Coruche (fig 23).

It has excellent visibility to the South and the East, and it is almost visually aligned with the necropolis of Monte da Barca. The site of Castelo, where a few Chalcolithic archaeological remains have been collected, is located just 1,400 meters away.

No surveys (geographical or other) have been conducted, but surface materials are particularly important, including ceramics of the Acacia Leaf group, fragments of loom components, chipped flints, and clay coating. Due to these materials, Monte dos Lacraus (fig. 24) can be dated from the same time frame of Cabeço do Pé da Erra and Barranco do Farinheiro – i.e., the mid-3rd millennium B.C.E. Clay coating seems to suggest clay constructions, as happens in the abovementioned Chalcolithic settlements that have already been excavated.

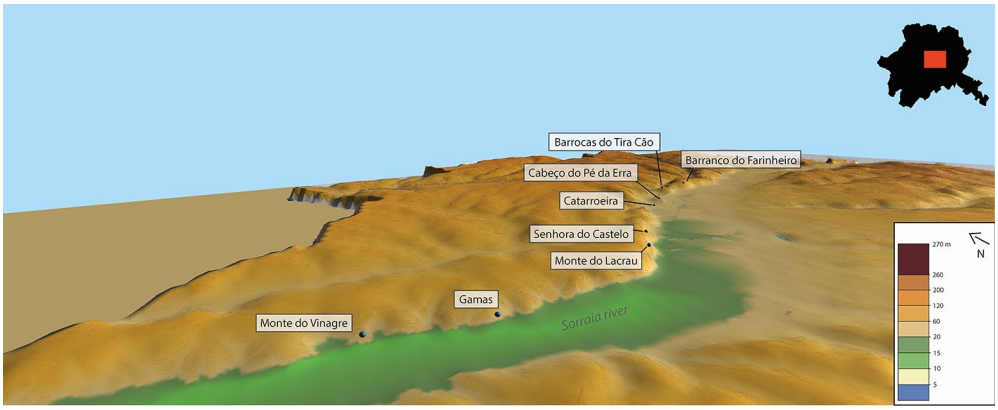



Fig. 23.—Sorraia River Fault with Monte dos Lacraus and settlements located on the right bank. Figure in colour in the electronic version.

*Undetermined (Late Neolithic / Chalcolithic)*

In addition to the four abovementioned sites, other occurrences with poor chronological and cultural data also exist.

Many occurrences are mapped in the Sorraia River section between Coruche and Barranco do Farinheiro, which possibly reveals the presence of a scattered settlement or satellite areas.

We find different situations. On the one hand, a few sites (Catarroeira, Monte do Vinagre and Gamas) were primarily identified due to polished stone artefacts collected by their owners. Monte do Vintager was the first habitat site identified in the Sorraia valley, and Afonso do Paço (Paço and Leal, 1962) emphasised that the estate's caretakers collected polished stones. In 2015, the Project ANSOR team contacted the owners of Herdade da Catarroeira and Herdade dos Gamas (figs. 24 and 25), and they had also collected polished stone artefacts during previous soil inversions. Although prospection conducted at Catarroeira and Gamas yielded no surface materials, we should remember that soil visibility is poor in this area. We should stress that the abovementioned polished stone artefacts show a more evolved typology (rectangular section), and the number of polished stone artefacts is very small at Cabeço do Pé da Erra: only 22 items (Gonçalves and Sousa, 2017).

Scarce materials were collected in other cases; for example, a few plain prehistoric ceramics and a fragment of a flint blade at Barrocas de Tira Cão, located East of Vila Nova da Erra, near the cemetery (Oosterbeek *et al*., 1996). Monte Velho also yielded some materials, including a cheese strainer fragment, collected by Project ANSOR during relocation prospections.

Evidence of long-term occupation, from the Neolithic until today, was found at the site of Senhora do Castelo, the medieval nucleus of Coruche. Artefacts began to be collected at this site in the early 20th century and were successively deposited at the National Archaeological Museum (Ribeiro, 1959), including a polished stone

Fig. 24.—Monte dos Lacraus. Figure in colour in the electronic version.

Fig. 25.—Catarroeira, view from East-West. Figure in colour in the electronic version.

axe and a flint blade. Surveys conducted by the authors (VSG, ACS) in 2016 did not provide pre-historic materials, but the intervened area was rather small.

Little information was found at the six abovementioned sites, and so the respective type of settlement is particularly relevant. All of them are located on the right bank of River Sorraia, at heights between 35 m e 75 m, and show the same settlement model as Cabeço do Pé da Erra, or Barranco do Farinheiro.

The site of Catarroeira shares many similar features with Cabeço do Pé da Erra (fig. 25), both being small islands in the alluvial plains of the Sorraia River and the Erra Stream. Located just 1 km away, Catarroeira would have perfect intervisibility with Cabeço do Pé da Erra, although it was located at a lower altitude (35 m).

Gamas (fig. 26), Senhora do Castelo, and Monte Velho share similar features with the type of settlement of Barranco do Farinheiro, Monte dos Lacraus or Entre Águas, all located on top of hill spurs on the right bank of the Sorraia.

*A settlement network in the 3rd millennium B.C.E.?*

All ten sites, with a domestic occupation generally datable from the 3rd millennium B.C.E., provide uneven archaeological information. Therefore, their chronology, size and architectural structure can hardly be evaluated with accuracy (fig. 27).

Fig. 26.—Gamas, with sand quarry. Figure in colour in the electronic version.

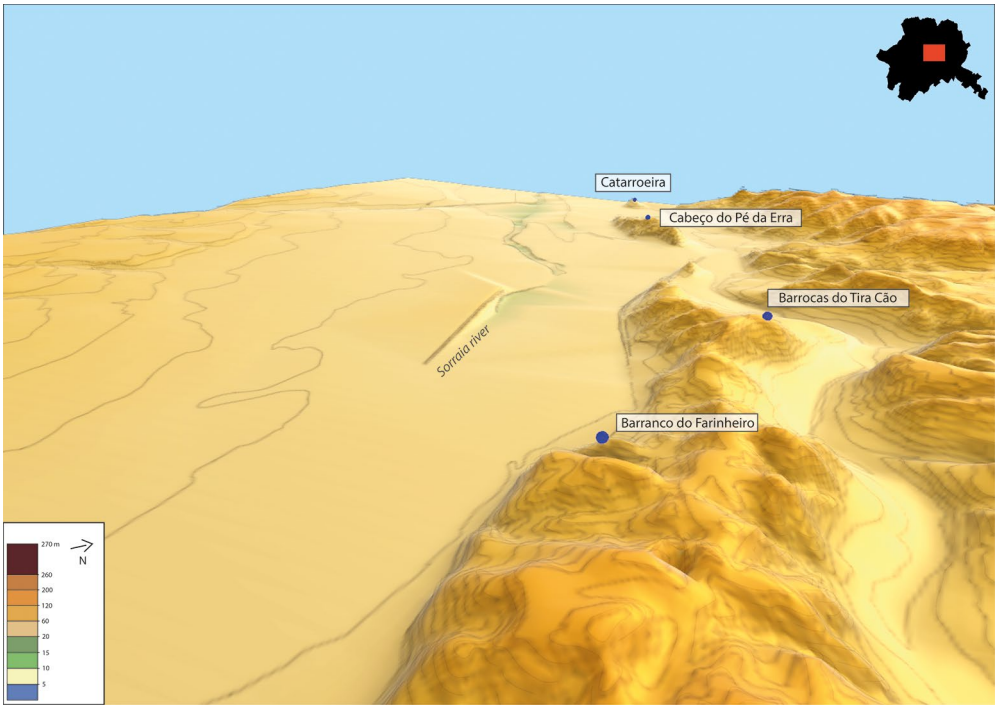



Fig. 27.—Concentration of Chalcolithic settlements in the Erra area (E-W view). Figure in colour in the electronic version.

Possibly, not every occurrence effectively corresponds to permanent settlement nuclei. These could be complementary areas or areas of temporary use. This may explain the compounding of close places, like the nuclei around Barranco do Farinheiro (BFR 1, BFR 2, BFR 3 and Barrocas do Tira Cão) or around Entre Águas (Raia 1, Entre Águas 2). Geomorphological restrictions could also affect this type of settlement, as occupation was concentrated on raised areas, which small floods could not reach.

Perhaps we can also consider that a chronological gap separated these places' occupation, given its exceptionally long timeframe (c. 2900-2100 cal B.C.E.). There may also exist dynamics we cannot verify without excavations and radiocarbon dating.

The relationship between Cabeço do Pé da Erra and Barranco do Farinheiro, separated by only 3.27 km is extremely important. Since both were the object of archaeological work, we know they were occupied simultaneously, and both had ditches.

Both sites share similar features, in general. It is impossible to conduct a geophysical survey at Barranco do Farinheiro, which limits the site's functional interpretation. This is aggravated by the fact that it was partially destroyed.

Did two different nuclei share the same agropastoral area? Did each correspond to different functions, integrating a single settlement network?

As to question number one, we should remember that large estates prevail in the Ribatejo region, which still exists in today's parcel plan. Two estates still coexist, Pé da Erra and Farinheiro, generally matching the two Chalcolithic settlements. Therefore, two small nuclei possibly coexisted, i.e., farms, to recover the designation offered by Cerro do Castelo de Santa Justa (Gonçalves, 1989). The designation "farm" here refers to small settlements of ancient peasant societies that were possibly single-family. Larger settlements (or villages) could include a set of households.

We could determine the total area of the Cabeço do Pé da Erra settlement, which did not exceed 1 hectare, with only ten huts surrounded by ditches. It was a small farm, occupied by a relatively small human group. Analysing the remains of the hill of Barranco do Farinheiro, it also seems plausible that the useful area was not too large. The morphology of the land where the remaining Chalcolithic sites of the Sorraia are located seems to suggest the presence of small habitats, concentrated on top of spurs on the right bank of the Sorraia.

There is only one exception to this settlement model, i.e., the site of Entre Águas (fig. 28). Although very few materials were collected (arboreal density severely

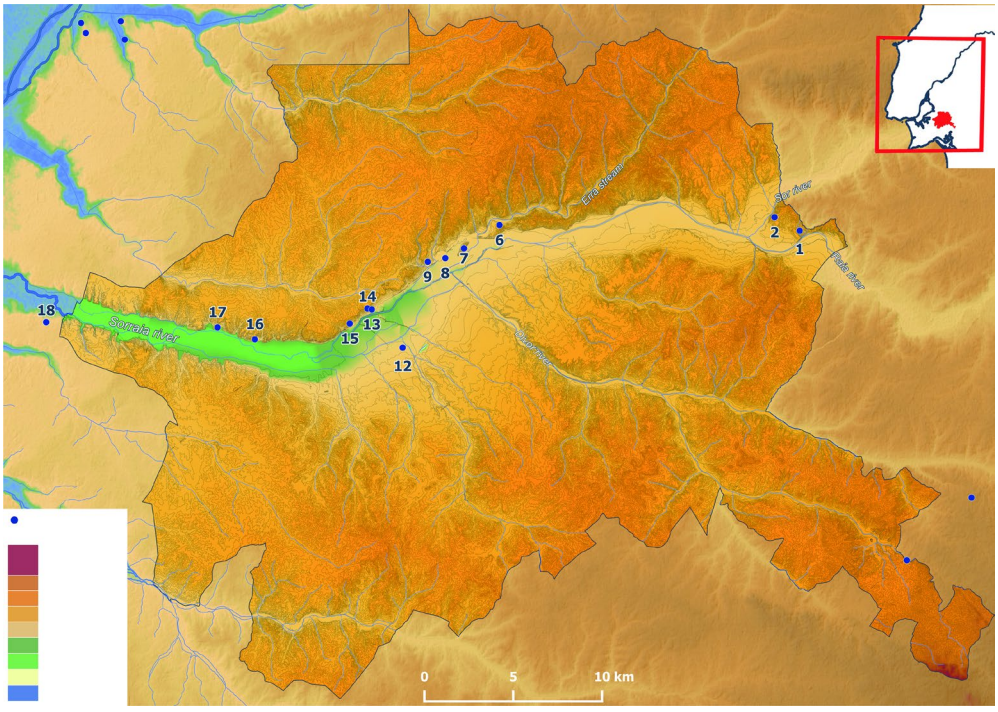



Fig. 28.—Late Neolithic and Chalcolithic settlement of the Sorraia valley. 1, Entre Águas; 2, Raia 1; 3, Barranco do Farinheiro; 4, Cabeço do Pé da Erra; 5, Barrocas do Tira Cão; 6, Catarroeira; 7, Monte Velho 2; 8, Monte Barca; 9, Coruche; 10, Senhora do Castelo; 11, Monte Lacraus; 12, Gamas; 13, Monte do Vinagre; 14, Monte da Quinta 1. Figure in colour in the electronic version.

hampers the reading), the site's platform could accommodate a larger settlement. If we combine this with its strategic position, at the confluence of the Sor and Raia streams, we may suggest that this was a relevant place in the regional settlement network. In fact, the site stands at the margin of the largest density area in the Sorraia. Although we conducted several prospection campaigns, from Barranco do Farinheiro to Entre Águas (approximately 14 km), we have not identified any other settlement so far.

It is always complicated to establish a hierarchic relationship between large and small sites on the same territory. Examination of two of the largest sites in Portuguese Estremadura and Alentejo shows rather different situations. In some cases, such as Liceia (Licêa after Ribeiro, 1878; Liceia after Ferreira and Cardoso, 1975 later published as Leceia since Cardoso, 1979), Vila Nova de S. Pedro (Gonçalves, 1994), Perdigões (Lago *et al.,* 1997) or Alcalar (Morán, 2018), no contemporary settlements are found in their immediate vicinity. In others, like Zambujal (Kunst, 2010) or Porto Torrão (Cunha *et al*., 2016), we can infer a hierarchy of settlements. Nevertheless, there is no systematic study, chronologically accurate, to gauge the existence of central places in the hierarchy of settlement networks.

Sites' functional characterisation is also made possible by comparatively interpreting Barranco do Farinheiro and Cabeço do Pé da Erra. Ditches, the first ever found in Ribatejo, are present in both cases.

According to today's state-of-the-art, we can say that the presence of ditches in the Sorraia clearly results from the region's geomorphological environment. In the tertiary terraces of the Tagus, there was no stone to build lithic structures, and most constructions were made of earth, a technique preserved by traditional architecture. Stones appear exclusively at the basis of huts at Cabeço do Pé da Erra and are entirely absent from the excavated area at Barranco do Farinheiro.

The option, however, to build ditches or walls might be related with some cultural and socio-political identity.

In Portuguese Estremadura, a region with a strong identity as regards material culture (Sousa and Gonçalves, 2011), 21 fortified settlements were discovered, forming a relatively regular settlement network —including small-sized settlements such as Penedo do Lexim (3 hectares), or large-sized sites such as Zambujal (5 hectares of walled area, that may reach 26 hectares of occupied area— Kunst, 2017). Although the geological substratum enabled the excavation of ditches these are virtually absent, with some atypical exceptions, like Travessa das Dores (Neto *et al.,* 2015), Gonçalvinhos (Sousa, 2008) or Santa Sofia (Pimenta, 2013).

In the Alentejo, ditches and walls (or palisades) coexisted in the same territory, as is the case of Perdigões (Valera, 2015), and Monte Novo dos Albardeiros (Gonçalves, 1991), in Reguengos de Monsaraz, or São Pedro (Costeira, 2017) and (Valera *et al*., 2014) in Redondo.

Ditches also have different meanings. Ditch research gave rise to different explanations. Some propose that they performed hydraulic functions (Camara Serrano *et al.,* 2011; Rodrigues, 2015). Others consider them geopolitical centres (Nocete, 2001) or focal points for communities inhabiting large territories (Garcia-

Sanjuan, 2018; Valera, 2020). Today, 74 enclosures have been recorded in Central and Southern Portugal (Valera, 2020), and we begin to realise that not every ditched site played the same role, even if we only speak about the 3rd millennium B.C.E.

In the Sorraia valley, ditches would perform a demarcating function that strengthened the defensibility provided by the settlement model adopted in those places, located on high ground, always overlooking the landscape, in contrast with large enclosures such as Perdigões or Porto Torrão, set up in open areas with soft slopes.

Not only is the settlement model of the Sorraia different from the ones found South of the Tagus, but its configuration and morphology are also different. In the case of Cabeço do Pé da Erra, the ditch encircled the most vulnerable area, protecting the residential space. The presence of ditch(es) demarcating a hut area has no parallel in the Alentejo. Nevertheless, even though we find many ditched enclosures south of the Tagus, few sites have yet been extensively excavated.

Dense clay mounds were found, collapsed into the ditches both at Cabeço do Pé da Erra, and Barranco do Farinheiro. This somehow suggests the presence of a clay structure associated with the ditches, another specificity of the Sorraia: were ditches with clay structures the local alternative to the walled enclosures found elsewhere?

Nevertheless, we find important differences between Barranco do Farinheiro and Cabeço do Pé da Erra, in terms of structure type, the nature of contexts and archaeological materials, and even installation (figs. 29 and 30).

Cabeço do Pé da Erra is finely conserved, as its quick abandonment enabled the preservation of testimonies of a broad range of daily activities, i.e., housing, stone carving, cereal processing, cheese production or weaving areas. Huts with stone bases, cobbled pavements, hearths, and ditches were preserved.

The excavated area of Barranco do Farinheiro is smaller than the one at Pé da Erra (32%), and no geophysical surveys have yet been conducted. We should cautiously point out its differences: archaeological contexts appear exclusively inside negative structures (ditches and a small pit), and no hut-type stone structures were found. The number of lithic materials, namely ground and polished, is extremely small. However, the main difference is the abundance of Beaker ceramics – virtually every style is present, especially Ciempozuelos type, a few maritime bell beakers and Palmela-type. There is, however, a contextual and spatial separation of the decorated ceramics: the few bell beaker (maritime) were found separated in a pit and the remaining beaker ceramics appeared concentrated in separate areas of the site. This significant difference between Barranco do Farinheiro and Cabeço do Pé da Erra should be interpreted with caution, considering Outeiro Redondo, a fortified settlement located at the Setúbal Peninsula (Cardoso, 2019), where Beaker ceramics were identified only in an extremely small sector of the settlement, in a peripheral area.

Context interpretation is harder due to the absence of organic materials. Still, there could have been real differences regarding the activities developed at Cabeço do Pé da Erra and Barranco do Farinheiro. Comparative analysis versus the remaining sites is exceedingly difficult, given the absence of data on stratigraphy,

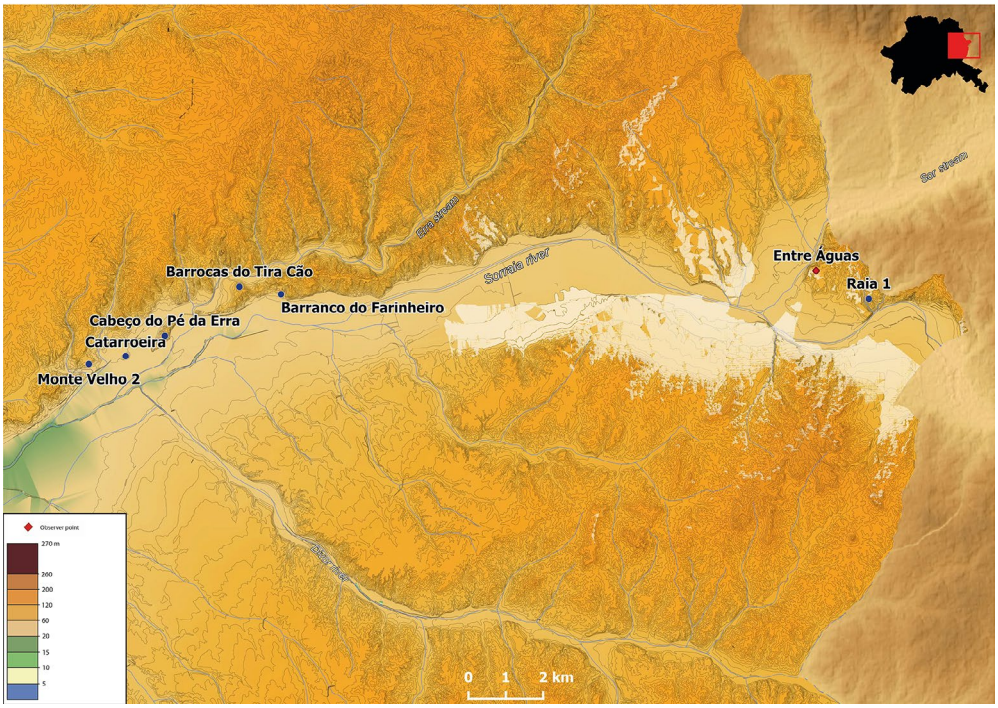



Fig. 29.—Visibility map from Entre-Águas. Figure in colour in the electronic version.

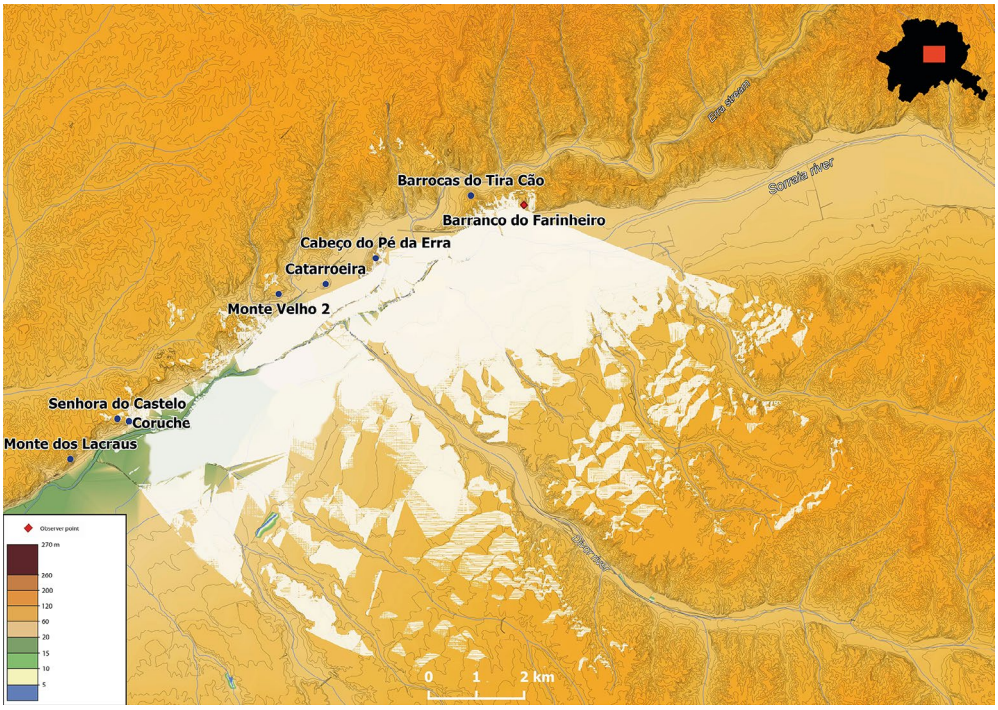



Fig. 30.—Visibility map from Barranco do Farinheiro. Figure in colour in the electronic version.

chronometry, or material culture. However, the existence of a settlement network does seem obvious (fig. 31).

The settlement network of the Sorraia valley apparently lacked burial spaces in the 3rd millennium. Judging from Monte da Barca's site, we can presume that pit necropolises or hypogea-type existed on the alluvial plain of the left bank. The older dolmens, located more than 20 km away, do not seem to evidence a 3rd millennium occupation.

Comparing the Sorraia valley case with other Central and Southern Portugal regions, we also do not find any burial spaces directly associated with domestic spaces. The necropolises of the fortified settlements of Vila Nova de S. Pedro, Zambujal, Liceia or Penedo do Lexim, in Estremadura, or São Pedro, Porto das Carretas or Santa Justa, in Southern Portugal, have not been found. Annexed necropolises were found only in ditched enclosures, such as Perdigões, Porto Torrão or Alcalar (fig. 32).

## Bronze Age

This text focuses on the period between 5500 and 2200 B.C.E., covering Neolithic and Chalcolithic in Western Iberia. We should, however, understand the

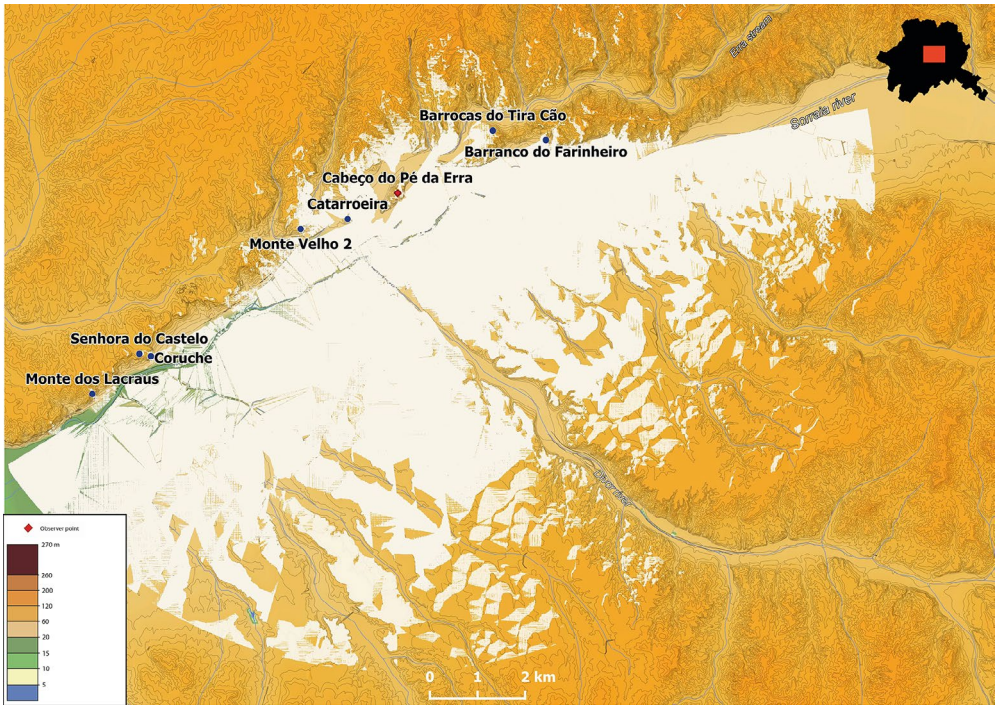



Fig. 31.—Visibility map from Cabeço do Pé da Erra. Figure in colour in the electronic version.

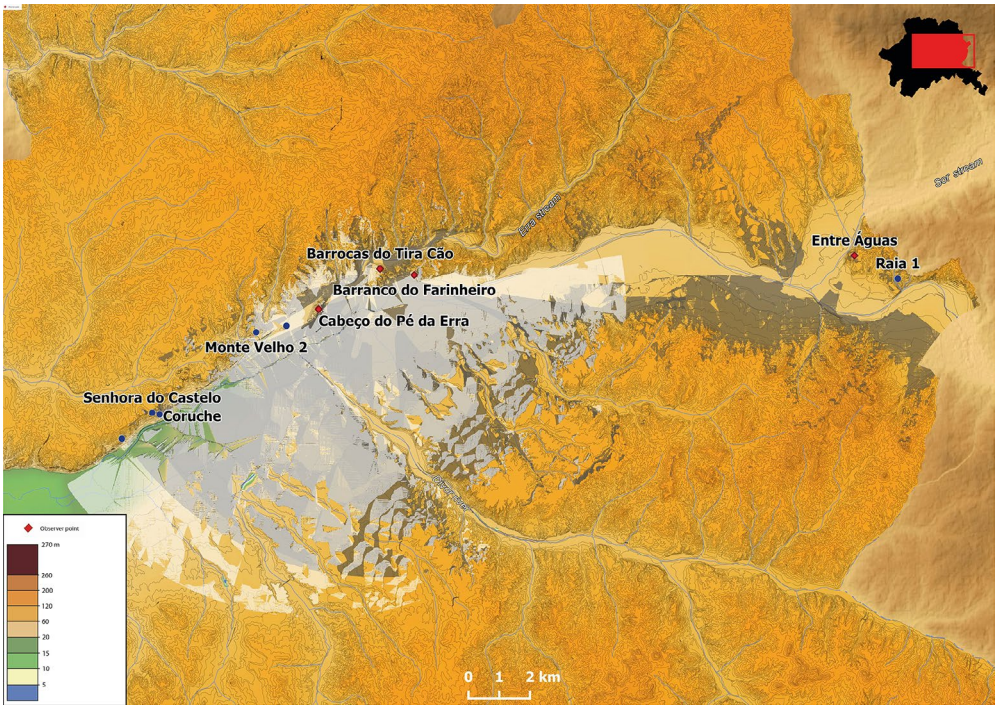



Fig. 32.—Cumulative visibility areas of Entre-Águas, Barranco do Farinheiro and Cabeço do Pé da Erra. The increased visibility of CPE is evident. Figure in colour in the electronic version.

settlement of the Sorraia valley in previous (Mesolithic) and subsequent (Bronze Age) phases.

Bronze Age is traditionally divided into three different moments, i.e., Early Bronze Age and Middle Bronze Age, both pre-historical and Late Bronze Age, the period of the first contacts with the Mediterranean and Atlantic world (Vilaça and Arruda, 2004; Arruda and Sousa, 2015).

We only know five sites with Bronze Age occupation in the Sorraia, i.e., Barranco do Farinheiro, of the Early Bronze Age, and Casas Novas, Barrocas do Tira Cão, Monte da Açorda, Amoreiras, and Cavaleiros, of the Late Bronze Age (fig. 33).

Transition from the 3rd to the 2nd millennium is one of the least known periods of the Portuguese territory. Discontinuity between Chalcolithic and Early Bronze Age settlements is huge, roughly overlapping the 4200 cal BP, c. 2200 B.C.E. climate event (Meller *et al.,* 2015; Blanco-Gonzalez *et al.,* 2018), the disruption of the Chalcolithic settlement (Hinz *et al.,* 2019), and evidence of migration from the steppe (Olalde *et al.,* 2019). We only find significant domestic and funerary records in the Spanish Southeast, the so-called Argaric Culture (Lull *et al.,* 2014). Regarding present-day Portuguese territory, many traces of the first half of the 2nd millennium have appeared over the last decade, following preventive archaeological

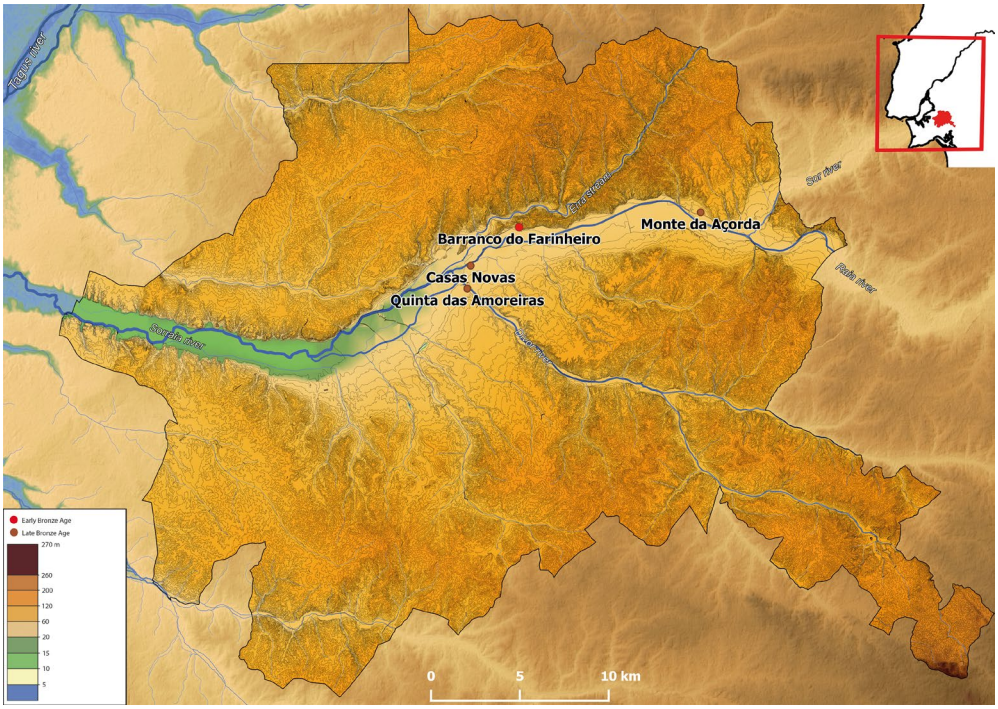



Fig. 33.—Bronze Age settlements: EBA: Barranco do Farinheiro; LBA: Monte da Açorda, Casas Novas, Quinta das Amoreiras; Undetermined: Barrocas do Tira Cão. Figure in colour in the electronic version.

works conducted in the Alentejo (Mataloto *et al.,* 2013; Soares *et al.,* 2019) that has filled some gaps. Even so, there is still little evidence on the 3rd / 2nd millennium B.C.E. transition in the region. There is also little evidence on Early and Middle Bronze Age in Portuguese Estremadura (Cardoso, 2005).

In most Chalcolithic settlements of the region, namely Cabeço do Pé da Erra, habitats seem to have been abandoned. Therefore, the identification of Bronze Age occupation at Barranco do Farinheiro is very important. This occupation is currently under study. It is restricted to a specific sector of the site inside a ditch, with a ceramic set with carinated vessels, plastic applications and archaeometallurgy activity.

In Late Bronze, circa 1200 to 800 B.C.E., there seems to be a real settlement network associated with participation in long-distance trading with the Mediterranean and the Atlantic, already announcing the proto-historic interaction dynamics (Vilaça and Arruda, 2004). In Portuguese Estremadura and the Tagus valley, we find sites built-in high places, open settlements, and votive sets (Sousa and Sousa, 2018; Arruda *et al.,* 2017). In the Tagus valley, particularly in Lower Tagus, there are some habitat sites, namely at the Alcáçova de Santarém (Arruda and Sousa, 2015) and Alpiarça (Arruda *et al.,* 2017) or Porto do Sabugueiro, evidencing concentrated settlement on riverbanks.

Occurrences from the Late Bronze Age in Coruche correspond to scattered and insufficient known findings, a scenario also present in other regions (Vilaça and Cardoso, 2017).

On the one hand, we have one-off metallic items, such as the bronze axe with socket and side rings collected at Monte da Açorda 1, and the small axe from Quinta das Amoreiras (Vilaça, 2003). These metallic materials were, respectively, found near sites where ceramics was collected: Casas Novas (Gonçalves and Sousa, 2018) is relatively close to Amoreiras and the axe from Monte da Açorda 1 was found near an area with surface materials, called Monte da Açorda 2 (Sistema de Informação Endovélico). Only Casas Novas was excavated, and no effective signs of occupation were found — only a few carinated ceramics. So, the occupation was likely sporadic.

The remaining occurrences correspond to items collected on the surface (Barrocas do Tira Cão and Cavaleiras). Therefore, it is difficult to establish a safe date for them.

## SETTLEMENT MODELS IN THE SORRAIA VALLEY

Sorraia flows along a NE-SW axis, from the mains to the town of Coruche (20 km), inflecting its direction in the final section until it reaches the Tagus estuary. Pre-historical occupation is precisely concentrated in the upper-to-central stretch of the river course, with few sites near the river mouth, i.e., Monte da Foz 1 (Neves, 2010), a settlement from the Early Evolved Neolithic / Middle Neolithic, and Monte da Quinta 2, a salt exploration site from the Late Neolithic / Chalcolithic (Valera *et al.,* 2006).

Different types of explanations can be considered for this concentration of settlements in the upper section of the Sorraia.

Perhaps this distribution reflects terrain visibility, as the *montado* becomes less dense in the river section between Coruche and the Tagus, and there are more forested areas with pines and eucalyptus that reduce the visibility of the soil.

Also, archaeology has not covered the entire region equally, as few systematic archaeological research projects have been developed in the Sorraia's lower section, in contrast with the intense research work done by the ANSOR Project, at Coruche.

Maybe the stronger farming potential of the river's initial section is also a driver to consider.

In the absence of more accurate paleoenvironmental data, namely on the longitudinal fitting profile of the Sorraia River into the substratum, or surveys like the ones conducted in the Muge Stream or the Tagus River, as mentioned above, any interpretation is merely illustrative. We know that, in the Muge Stream, estuarine penetration ascended approximately 4 km upstream of the mouth. Since the Sorraia lies closer to the mouth of the Tagus, penetration was probably longer. The existence of the neo-Chalcolithic site of Monte da Quinta 1, specialised in salt production, could be an indicator; located 9 km away from the mouth, it demonstrates a stron-

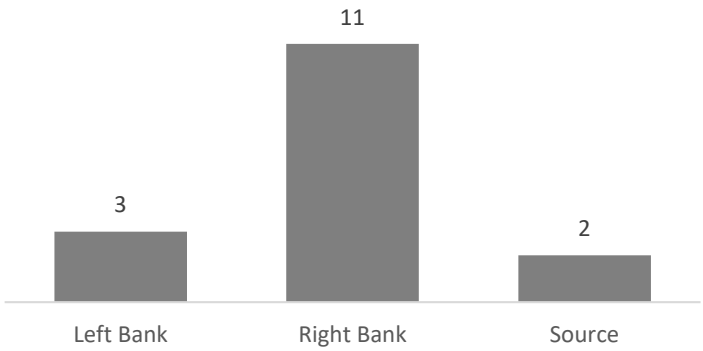
ger estuarine penetration indeed. The authors (VSG, ACS) studied thousands of ceramics fragments found in excavations conducted in Coruche and only found two conical-trunk fragments at Cabeço do Pé da Erra. No traces of salt production by means of briquetting exist at Coruche.

We must have paleoenvironmental information for each specific region to study these dynamics, as there could have been wetter episodes that sporadically affected those readings. This is evidenced by several paleoenvironmental studies, like the one conducted at Alcabrichel, in Portuguese Estremadura, where several episodes with higher humidity were identified in an area closer to the Atlantic Ocean (Ramos-Pereira *et al.,* 2018).

As settlement in the Sorraia is concentrated 15 to 30 km away from the river's mouth, we can presume that it happened in areas with a weaker estuarine penetration and stronger agricultural potential.

The explanation for the settlement distribution that exists today will surely be found in the combination of these three factors.

GRAPH 1. LOCATION OF NEOLITHIC AND CHALCOLITHIC SITES IN THE SORRAIA VALLEY (CORUCHE). NUMBER OF SITES




The settlement pattern of the Sorraia valley also shows another trend, i.e., people settled predominantly on the right bank, on top of the scarps and in the islands close to the Sorraia.

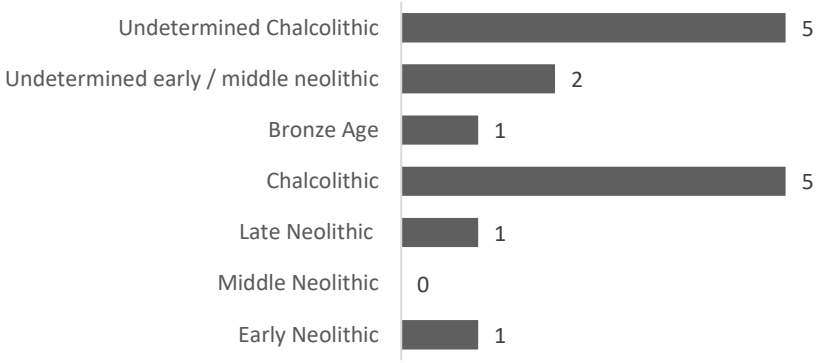
The anastomosed course of the Sorraia certainly imposed restrictions on settlement, as it created regularly flooded areas with better farming potential but hardly habitable. Setting up a settlement with permanent structures on the left bank of the Sorraia would be extremely difficult, which may explain the absence of occupation, especially in the 3rd millennium —closer to the Climate Optimum. Casas Novas, an older site, was certainly affected by the Sorraia basin's floods, as documented by stratigraphy (Gonçalves and Sousa, 2018). The left bank was probably visited by peasant communities of the Sorraia valley, judging from Beaker ceramics found at Barranco do Farinheiro, or possibly at Monte da Barca. However, they did not

inhabit this marshland and continued not to do so in historical times; the type of settlement found in the medieval nuclei of Coruche (Castelo), or Vila Nova da Erra, is identical in the Chalcolithic settlement of the Sorraia valley.

We may also ask whether settling on hilltops reflected different social dynamics. Although the most usual settling pattern of the Early Neolithic is open sites, in flat areas, such as Casas Novas, there is also another kind of settlement on hilltops —as observed at São Pedro de Canaferrim, in the Sintra Mountains (Simões, 1999). Today's absence of evidence of older occupation on the hills on the right bank seems to suggest that, in addition to environmental factors, social factors were also at stake, probably reflecting the non-permanent character of Casas Novas, which was possibly part of a network that could include the granitic areas of Brotas/ Mora, extending to Portuguese Estremadura.

In Portuguese Estremadura, in general, 3rd millennium settlements are concentrated on high grounds, and walls reinforce their defensibility. We find a different situation in the Alentejo, i.e., walled settlements, but also ditched sites in flat or slope areas. In the Sorraia valley, more defensible sites, reinforced by ditches, seem to have been deliberately chosen.

GRAPH 2. NUMBER OF SITES, BY CHRONOLOGY, IN THE SORRAIA VALLEY




Between the 6th and the 3rd millennium, we find a growth trend in the number of sites, abruptly reduced in the Bronze Age.

We feel tempted to associate the increasing number of sites with demographic growth; this is one of the macro readings indicators (Hinz *et al.,* 2019). Such indicators, however, stem from a quite heterogeneous information base and may often yield inaccurate readings.

In the broad picture of Central and Southern Portugal's pre-historical settlement, we find only a few cases of systematic territorial study, incorporating research and preventive archaeology, that enable a comparative reading.

The Cheleiros Stream area (Mafra/ Sintra), in the Lisbon Peninsula, is one of the few examples of such a systematic territorial approach. The results are some-

how different from those recorded for Coruche (Sousa, 2010). The number of Early Neolithic sites is much smaller in this region, but population growth was strong in Late Neolithic. In the first half of the 3rd millennium, population concentrated in walled settlements. In the second half of the 3rd millennium, we find it scattered in small habitats, already with Beakers ceramics. These trends were interpreted according to the society model, i.e., stronger aggregation in the Early and Fully Developed Chalcolithic, and disaggregation in the second half of the 3rd millennium.

Notwithstanding, in the Sorraia, the population was not grouped into large settlements during the first half of the 3rd millennium, judging from the size of Cabeço do Pé da Erra or Barranco do Farinheiro —even if Entre Águas was possibly larger. In Coruche, we find stronger settlement dispersion in the 3rd millennium, contrary to the Cheleiros Stream and the Lisbon Peninsula trend.

Therefore, quantifying the number of sites as a population growth indicator is a too simplistic approach for this scale of analysis, as the issue must be addressed by taking into account many more variables, e.g., site size, population density of each settlement, resource exploitation area (Schmitt *et al.,* 2020:7), and obviously the social fabric of each chronological period.

The importance of using several reading scales is demonstrated in other demographic approaches, like the probabilistic studies of absolute dating (SPD) that have been recently made (Blanco-González *et al.,* 2018; Pardo-Gordó and Carvalho, 2020). According to these studies, the global population grew in the 4th / 3rd millennium transition, though they point at regional specificities determined by the environment, the economy, social complexity, and historical background (Pardo-Gordó and Carvalho, 2020:9).

Our analysis of this settlement network, especially as it concerns the 3rd millennium, should also consider abandonment dynamics at the regional level. Abandonment dynamics are often examined in general terms, as is the case of most of the fortified settlements (Lillios, 1993) or ditched enclosures (Valera, 2015), but site abandonment requires higher chronological accuracy when approached at a regional scale. Be that as it may, we should mention the occurrence of one quick abandonment, marked by a fire level at Cabeço do Pé da Erra. Apparently, occupation at Barranco do Farinheiro lasted a few extra decades at the end of the 3rd millennium. Still, this last phase was also likely marked by a fire, judging from the clay mounds found at the ditch and in hut 1, possibly consolidated by fire.

The Sorraia valley, part of Ribatejo, a region characterised by the alluvial plains of the Tagus River "(...) quite strong when compared to the limestone mountains of Portuguese Estremadura and still sensitive at the edge of the ancient massif of Beira, or Alentejo" (Ribeiro, 1945:231), is a natural connection of different landscapes, i.e., between Portuguese Estremadura and the Alentejo, and to the Meseta through the Tagus valley. The Sorraia valley is a crossroads that preserved influences from different points of the Peninsula, a real turning plate in Western Iberia.

In the Early Neolithic, Casas Novas illustrates the intersection of influences from the Meseta, reflected by *punto y raia* and Mediterranean ceramics, with car-

dial ceramics and other printed motifs. The abundance of flintstone demonstrates contacts with Portuguese Estremadura, namely the areas of Tomar and Rio Maior.

Material culture had more obvious regionalisms in the Chalcolithic, namely in Portuguese Estremadura, where it evidenced a stronger identity, in stylistic and technological terms than in the Alentejo (Sousa and Gonçalves, 2011).

In the Sorraia valley, we found a significant cultural and stylistic presence of the Estremadura, namely through the abundance of Acacia Leaf Group decorations that shared many similarities with its Estremadura version, possibly with a slightly smaller percentage. However, the ceramic repertoire shows a Southern influence, namely as regards the importance of large plates and open shapes, much scarcer in the Estremadura.

Other daily life materialities also reflect the fusion of influences from the Estremadura and regions to the South of the Tagus. In the Sorraia valley, we find sub-quadrangular loom components that are typical of Portuguese Estremadura, along with several crescents characteristic from the Alentejo (Costeira, 2017).

This trend is also found in raw materials: the relatively high number of variscite beads from Cabeço do Pé da Erra (Gonçalves and Sousa, 2017) has parallels in the Estremadura, contrary to what happens in the Alentejo, where this exotic raw material is limited to large accumulations in few and exceptional sites, such as Perdigões and Anta Grande do Zambujeiro (Odriozola, 2017).

We find external influences in places more distant from the Sorraia River, i.e., clay statuettes of the Andaluz-type at Cabeço do Pé da Erra, or Beakers ceramics of the Ciempozuelos-style, similar to Madrid counterparts, at Barranco do Farinheiro.

## Settlement of the Sorraia Valley in the Chalcolithic, the Lower Tagus and Central and Southern Portugal

There are areas that were more intensely occupied and endured changes in the long course of history, depending on the resources deemed critical at each stage, but also on sociocultural factors.

Looking at the Lower Tagus and Central and Southern Portugal area, we can consider several trends.

In the Late Mesolithic, the settlers clearly preferred estuarine areas, like Muge and Paul de Magos. Occupation density was possibly lower in Atlantic areas like Portuguese Estremadura (Araújo, 2012). In Coruche, we currently have no knowledge of traces of shell deposits or other specialised hunter-gatherer camps.

In the Early Neolithic, especially in earlier phases, occupation must have targeted areas where hunter-gatherer occupation was weaker, according to the maritime pioneer model of João Zilhão (2001), e.g., the Limestone Massif of Portuguese Estremadura (Carvalho, 2008), Low Estremadura (Sousa, 2016/2017) or the tip of Sagres (Carvalho, 2008). In line with this thought, the upper section of the Sorraia valley's choice possibly reflects a shift from the more populated areas of Muge, located only 25 km away from Coruche.

Only a small number of Early Neolithic sites located on the left bank of the Tagus have been excavated, lacking radiocarbon dating, i.e., Quinta da Praia, Alcochete (Carvalho *et al*., 2020); Gaio, Moita (Soares *et al.,* 2004); Moita do Ourives and Monte da Foz, at Benavente (Neves *et al*., 2008; Neves 2010, 2018), Cortiçóis, in Almeirim (Cardoso *et al*., 2013; Carvalho *et al.,* 2013) and Bernardo and Alminho, in Ponte de Sor (Angelucci and Deus, 2006). Material culture seems to date from a later chronology, either the "evolved" Early Neolithic (Quinta da Praia, Gaio, Cortiçóis, Monte da Foz) or the Early Middle-Neolithic (Monte da Foz).

According to the most recent work done at the Muge shell deposits, these *habitats* were continuously used (Bicho *et al.,* 2017).

The Middle Neolithic is poorly known in Central and Southern Portugal, especially as regards its domestic aspect. Tombs that share the same megalithic rituals (caves and small orthostatic monuments) are virtually the only known testimonies of this period, and domestic signs are extremely rare. According to some authors, population decreased during approximately 250 years after productive practices were introduced (Bocquet-Appel and Dubouloz, 2003). That would correspond to the beginning of the Middle Neolithic. These societies would possibly have more mobility, which could explain the settlements' invisibility and their poor territorial expression. Megalithic monuments would thus appear as appropriation landmarks in this landscape (Pardo-Gordó and Carvalho, 2019). Confirming this point of view, isotopic studies on the funerary contexts of Algar do Bom Santo (Montejunto, Estremadura) demonstrated the presence of groups from exogenous areas (Carvalho *et al.,* 2019), matching to some extent the data from the dolmen of Cabeceira 4, located at Mora, in the Alentejo, near the Sorraia valley (Carvalho *et al.,* 2019). The Sorraia valley would thus be the connection axis between the Alentejo and the Estremadura. Special reference should be made to the fact that, despite the absence of signs attributable to the Middle Neolithic on the banks of the Sorraia, there is a concentration of ancient megalithic monuments approximately 20 km away, located in the present-day municipalities of Coruche, Mora and Montemor-o-Novo, i.e., the possible ancient Megalithic nucleus of the Alentejo (Gonçalves and Andrade, 2020). Sites like Monte da Foz (Neves, 2018), located in the Upper Sorraia valley, seem to suggest a temporary occupation. The megalithic area of Coruche is still insufficiently known; there could have been a settlement displacement between the Sorraia valley and the Ancient Massif during the Middle Neolithic.

Only in the 3rd millennium do we find a proper settlement network, with permanent sites and the first huts. This trend is observed in most Central and Southern Portugal, though there is not much information on the Late Neolithic domestic structures —except for a few ditched sites in the Alentejo. Despite the scarcity of paleobotanic data, the relative abundance of grinding elements at Cabeço do Pé da Erra seems to translate the importance of agricultural activities on the banks of the Sorraia, which date back from the 6th millennium, as shown by the vegetable prints found in clay coatings at the site of Casas Novas.

In the Chalcolithic, settlement was differently expressed on the two banks of River Tagus. On the right bank, fortified sites are frequently found, apparently

with the population concentrated and regularly distributed over the territory (two fortified sites in each present-day municipality, on average). On the left bank, no walled sites are found, and settlement is more scattered but here there is a lower archaeological activity, and the archaeological visibility is very bad. This difference clearly indicates that people lacked stone for building walls on the left bank of the Tagus, but it also demonstrates an influence from the Alentejo. Apparently, the ditches of Cabeço do Pé da Erra are defensive, but we still do not understand the nature of the occupation at Barranco do Farinheiro, since we do not know the geometry of the ditch and part of the site was destroyed by a quarry.

Like the ditched sites of the Sorraia, fortified settlements are placed on high grounds, overlooking the landscape, though defensibility was not their only determinant factor (Gonçalves *et al.,* 2017). Instead, there seems to be a combination of factors, namely the relation between nearby farming areas and water resources.

Comparing the visual fields of Chalcolithic settlements on both sides of the Tagus may be an interesting tool to assess settlement strategies. In addition to the visual field, we must consider how communities saw the landscape (Gonçalves and Sousa, 2000; Friedman and Gilling, 2007), punctuated by landforms, dwelling sites, areas of temporary use, farming fields, and areas in which resources were collected.

A comparative reading of visibilities should weight many variables. The relief is different in the two regions, and vegetation must have been so as well. Architecture was also different in these landscapes; the stone constructions of Portuguese Estremadura (orthostatic tombs, walls, *tholoi*) have no parallel in the Ribatejo and were certainly a beacon in the landscape. In the rugged terrain of Estremadura, we also find landscape features that must have impacted the communities, e.g., the Mountains of Sintra or Montejunto, the Ocean, or the Tagus River, contrasting with the alluvial plain of the Ribatejo, with its more diffuse profile.

While examining visibilities (figs. 28 to 37), we assumed the human point of view (adding 1,6 m to the soil surface), selecting a visibility span of 10 km. In the case of fortified settlements, we interpreted the higher points as vantage points, corresponding to the heights of what remains of the archaeological structures or to natural rocky areas. One must consider that this exercise is based on a fixed observation point and that these sites could have different visibilities, depending on the desired objectives.

Human visual fields have visibility scales. At a short distance (up to 500 m), structures, men and animals could be identified. At a medium distance (500-1000 m), only structures were perceptible. At a long distance (more than 1000 m), only landforms, large structures and cultivated vs forested areas (concepts developed in Gonçalves and Sousa, 2000, based on the infantry combat manual of the Portuguese Army) would be visible.

We can also consider different types of visibility (Criado and Vaquero, 1993; Gonçalves and Sousa, 2000), e.g., circular, sectorial, linear, and punctual.

Comparing the visibility maps of Chalcolithic sites of Sorraia and Estremadura, we find that they have vantage in both cases, though slightly lower in large sites such as Zambujal or Vila Nova de São Pedro, located in the central area of large spurs.

Even if we apply the walls' height to the visual field, there are large unseen areas in the immediate surroundings, less than 1 km, which is considered a critical distance (Gonçalves and Sousa, 2000).

If we use large fortified settlements of Estremadura, such as Vila Nova de São Pedro, Zambujal or Liceia, as an example, we notice that their visibility is oriented to large landforms, over a long distance.

TABLE 2
EXAMPLES OF INTERVISIBILITY WITH OTHER FORTIFIED SETTLEMENTS IN PORTUGUESE ESTREMADURA

| | *Direct visibility* | *Settlements* | *Landscape* |
|---|---|---|---|
| **Vila Nova de São Pedro** | → | Montejunto | Montejunto |
| **Zambujal** | → | | Sizandro |
| **Penedo do Lexim** | → | Anços (Beaker, open settlement)<br>Marreiros (open settlement)<br>Lameiras (Late Neolithic phase, Beaker, open settlement)<br>Negrais (open settlement)<br>Olelas (fortified settlement) | Sintra |
| **Liceia** | → | Carrascal (Late Neolithic) | Tagus |

In Vila Nova de São Pedro's case, visibility was calculated from the top of the highest tower to the North of the central enclosure, adding 1,6 m. We see that the visibility is sectorial, encompassing every quadrant, but seems to be restricted by the Montejunto Mountains or the Almoster Stream (fig. 34).

Regarding Zambujal, visibility was calculated from the central area, at the top of Barbacã, adding 1,6 m. Visibility at this settlement, of the linear type, was limited and targeted at River Sizandro (fig. 35).

In Liceia, the visibility field was calculated from the central area, next to Hut L (Cardoso, 2010). Adding 1,6 m, we found that, as in Zambujal, visibility was limited, clearly oriented to the Barcarena Stream and the Tagus River, with an extremely short visual field.

On the contrary, in small sites, such as Penedo do Lexim, visibility was calculated from the central nuclei, the volcanic chimney's natural acropolis. In this site, visibility is circular, except for some unseen areas (figs. 36 and 37).

Back to the Sorraia, the situation is apparently the same found in Portuguese Estremadura's fortified settlements, with different visibility strategies. For these, we considered as vantage points the highest points within the areas with archaeological potential.

The island of Cabeço do Pé da Erra (CPE), located between the Sorraia River and the Erra Stream, has nearly total visibility of the circular type. Visibility was calculated from the area outlined by the ditch, and there is intervisibility with all the settlements between Monte dos Lacraus, and Barranco do Farinheiro. Visibility was high, not only from but also to the CPE site.

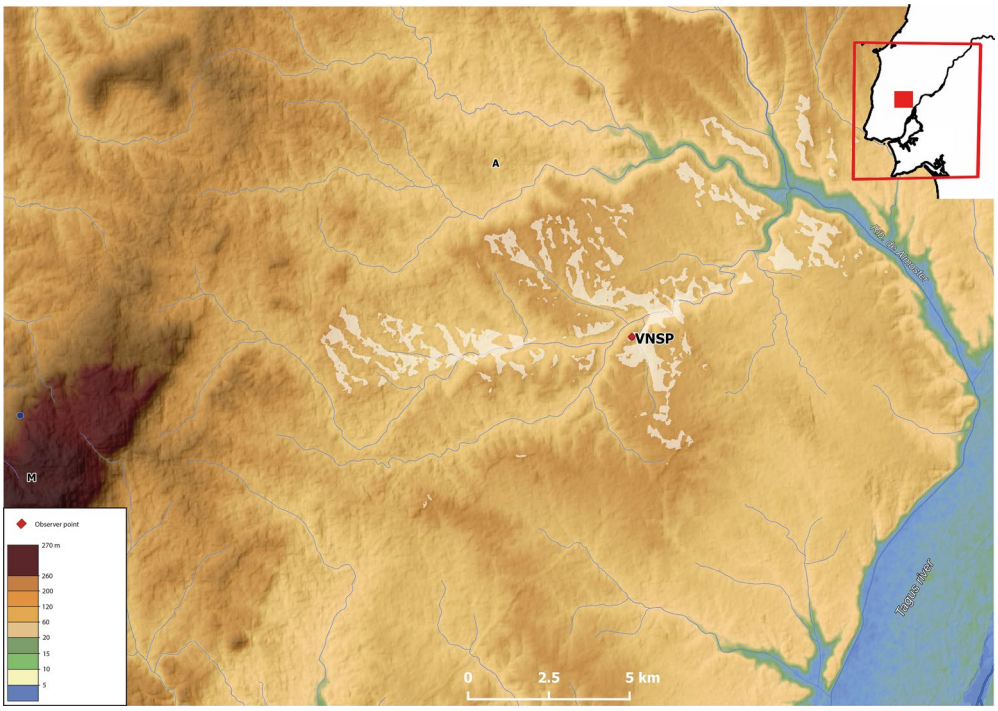



Fig. 34.—Visibility map from Vila Nova de S. Pedro. Figure in colour in the electronic version.

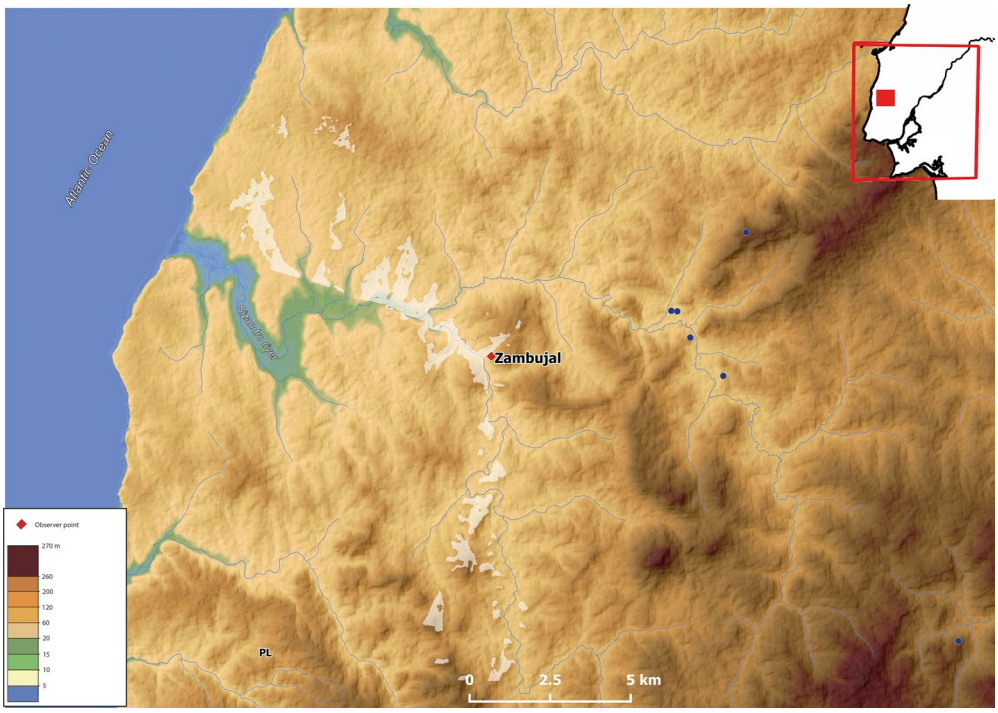



Fig. 35.—Visibility map from Zambujal. Figure in colour in the electronic version..

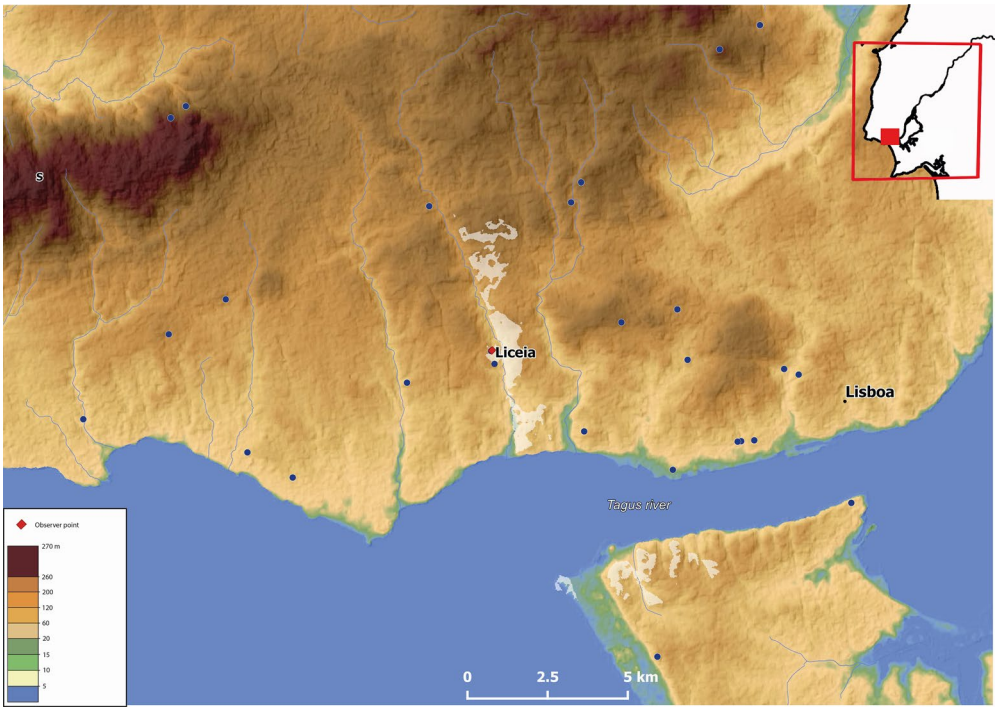



Fig. 36.—Visibility map from Penedo do Lexim. Figure in colour in the electronic version.

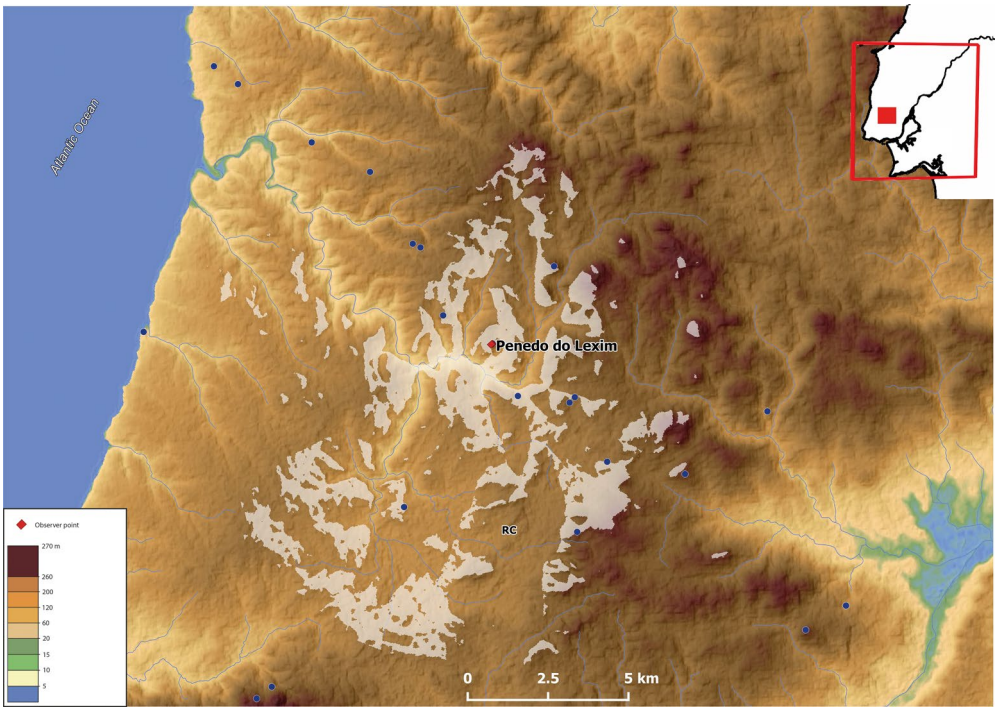



Fig. 37.—Visibility map from Liceia. Figure in colour in the electronic version.

In fact, CPE controlled the entire Sorraia section between Lacraus and Farinheiro. This visual control should be increased by human occupation, and the fires of several settlements around Erra would further increase the visual fields. In contrast, Entre Águas has a shorter immediate vantage but benefits from visual reading over several territories: the Sor valley, Raia valley and Sorraia.

TABLE 3
INTERVISIBILITY OF THE MAIN SETTLEMENTS FROM SORRAIA VALLEY IN 3rd MILLENIUM

| | *Direct visibility* | |
|---|---|---|
| **Entre Águas** | → | Raia 1<br>Monte da Açorda (LBA) |
| **Cabeço do Pé da Erra** | → | Barranco do Farinheiro<br>Catarroeira<br>Barrocas do Tira Cão<br>Monte Velho 1<br>Casas Novas<br>Monte dos Lacraus |
| **Barranco do Farinheiro** | → | Cabeço do Pé da Erra<br>Casas Novas<br>Senhora do Castelo |

Visibility reading seems to suggest the existence of different strategies, according to the size of each site and, possibly, its hierarchical rank (fig. 38).

## A FEW CONCLUSIONS AND MANY QUESTIONS

Paleoenvironment and social dynamics were the two structural vectors chosen for interpreting the settlement dynamics of the Sorraia valley.

Between 5500 and 1800 B.C.E., the Sorraia valley's paleoenvironment changed significantly, namely in terms of sea level and human impact on the landscape. This changing paleoenvironment possibly favoured certain settlement models, both in the micro-regional scale of the Sorraia valley and the macro scale of Central and Southern Portugal. As the sea level rose — and consequently that of the Tagus River and its tributaries, the left bank of the Sorraia was subject to constant flooding and fluctuations of its water basin, possibly explaining why the alluvial plain was tendentially abandoned as a settlement area. In the 2nd millennium, with drier weather conditions, the left bank possibly offered better habitation conditions.

During the Late Mesolithic, these environmental fluctuations appear to have either favoured the creation of communities in some ecosystems, namely in the estuaries of Muge and Magos, or influenced their permanence regime, as their high mobility during the early Middle Neolithic seems to suggest.

Also, social dynamics are apparently associated with different settlement models. Although Ribatejo and Portuguese Estremadura's landscapes are quite different, in the 3rd millennium, we find a settlement model in both regions that favoured

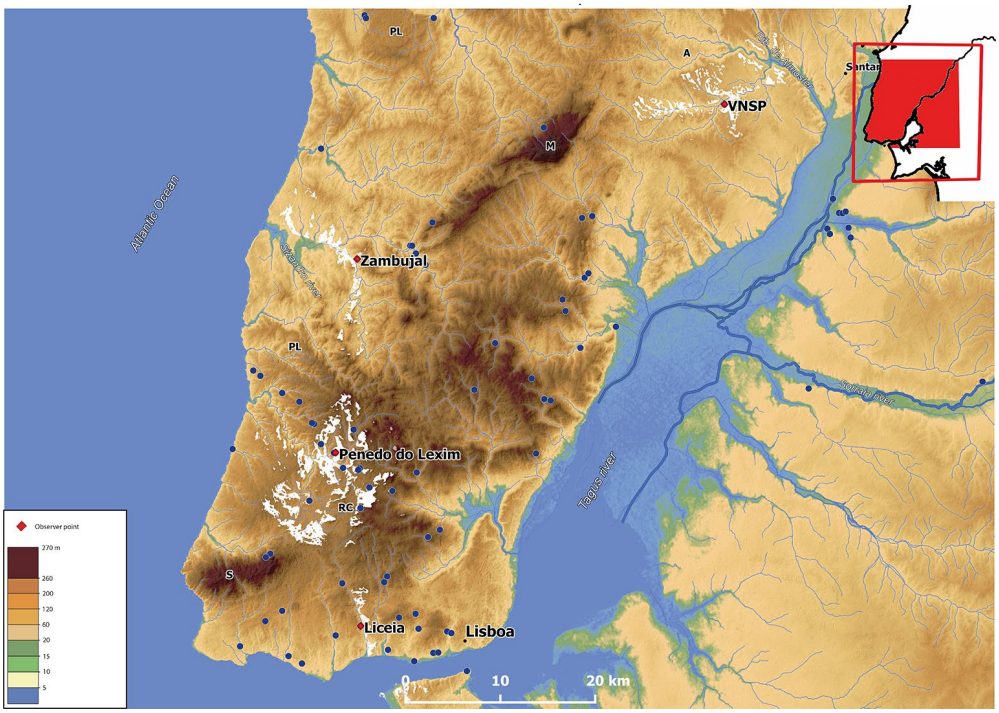



Fig. 38.—Cumulative visibility areas of Vila Nova de S. Pedro, Zambujal, Penedo do Lexim, Liceia. Figure in colour in the electronic version.

medium height grounds, with good visibility from and to the site. This seems to suggest stronger territoriality and a higher complexity of settlement networks.

Located on a flat area, the Sorraia valley settlement apparently split into various close nuclei, with sites with ditches located at a short distance from each other, as is the case of Barranco do Farinheiro and Cabeço do Pé da Erra. Entre Águas requires further clarification, but it may have played a central role or been a cone vertex. In contrast, a network of relatively separate settlements appears to have existed in Portuguese Estremadura in the Chalcolithic, exception for the Sizandro valley in Torres Vedras. We find a different scenario in the Alentejo, where large ditched enclosures coexisted with a few fortified settlements. More than different landscapes, these three units (Portuguese Estremadura, Ribatejo, and Alentejo) have different models of social organisation.

The Sorraia valley was apparently pervious to the cultural influence of two different regions: Portuguese Estremadura and the Alentejo, which clearly share Southern Iberia's dynamics. Ribatejo is a transit area for materials, ideas, and people. While the mobile material culture demonstrates the crossed influence of Portuguese Estremadura and Southern Iberia, settlements models also record that cultural intersection; the CPE and BFR ditches evoke their counterparts of Southern Portugal, and the type of settlement resembles the one found in fortified settlements.

Project ANSOR identified and characterised a considerable number of sites covering a broad chronology, enabling an interpretation of the settlement dyna-

mics over several thousands of years. Nevertheless, research in the region has not been exhausted, and there is an obvious need to increase the number of excavated sites due to extremely poor soil visibility and develop a systematic programme of paleoenvironmental studies on River Sorraia, its tributaries and the vegetable cover. We shall deal with this subject matter in the fourth edition of Project ANSOR.

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