

NEOLITHIC ARCHAEOLOGY AT THE PENEDO DOS MOUROS ROCK-SHELTER (GOUVEIA, PORTUGAL) AND THE ISSUE OF PRIMITIVE TRANSHUMANCE PRACTICES IN THE ESTRELA MOUNTAIN RANGE

La arqueología neolítica en el Abrigo de Penedo dos Mouros (Gouveia, Portugal): la evidencia de prácticas de trashumancia primitiva en la Sierra de la Estrella

António Faustino CARVALHO*, Vera PEREIRA**, Carlos DUARTE*** and Catarina TENTE****

* *Dpt. of Arts and Humanities. Faculty of Human and Social Sciences. Univ. of Algarve. Campus de Gambelas. 8000-117 Faro (Portugal). E-mail: afcarva@ualg.pt*

** *Dpt. of Archaeology. Faculty of Arts and Humanities. Univ. of Coimbra. Largo da Porta Férrea. 3004-530 Coimbra (Portugal). E-mail: vera_lcpereira@yahoo.co.uk*

*** *Instituto Internacional de Investigaciones Prehistóricas de Cantabria (IIIPC). Univ. of Cantabria. Avda. de los Castros, 52. 39005 Santander. E-mail: carlosduarte.simoes@unican.es*

**** *Dpt. of History. Institut of Medieval Studies. Nova Univ. of Lisboa. Avenida de Berna, 26C. 1069-061 Lisbon (Portugal). E-mail: catarina.tente@fcs.unl.pt*

Recepción: 9/10/2016; Revisión: 3/02/2017; Aceptación: 23/03/2017

ABSTRACT: Located in the foothills of the north-western sector of the Estrela Mountain (Beira Alta province in central-north Portugal), Penedo dos Mouros Rock-shelter revealed a succession of three distinct archaeological horizons datable to the evolved Early Neolithic and initial Middle Neolithic, thus partially coinciding with the onset of the regional Megalithism. The find of a few caprine remains at least one possible sheep, among a large spectrum of species –swine, rabbit, hare, Iberian lynx and toad–, makes this site the oldest in the region to provide direct evidence for herding practices. Small-sized pots, expedient use of local lithic raw materials together with curated use of exogenous flint, and low density of artefacts indicate a strategy of residential mobility in line with similar evidence observed elsewhere in Beira Alta. Given previous claims of Neolithic vertical transhumance between montane plateaux –in the summer– and lowland plains –in the winter–, this hypothesis is here discussed –and refuted– based on spatial analysis of Neolithic sites, economic characterization of the period and local orographic and bioclimatic constraints.

Key words: Neolithic; Beira Alta; Megalithism; settlement systems; livestock; pastoralism.

RESUMEN: Ubicado en las estribaciones del sector NO de la Sierra de la Estrella (provincia de Beira Alta, en el centro-norte de Portugal), el Abrigo de Penedos dos Mouros ha revelado una sucesión de tres horizontes arqueológicos distintos, asignables al Neolítico Antiguo evolucionado y Neolítico Medio, coincidiendo así, parcialmente, con el inicio del Megalitismo regional. El hallazgo de un número limitado de restos de caprino –al menos una posible oveja– entre un largo espectro de especies –cerdo, conejo, liebre, lince ibérico y sapo– convierte este

yacimiento en el más antiguo de la región con evidencia directa de mantenimiento de ganado. Vasos de pequeño tamaño, uso oportunista de materias primas líticas locales, acompañado de uso extensivo de sílex exógeno y baja densidad de artefactos, indican una estrategia de movilidad residencial en la misma línea de evidencias similares observadas en otros yacimientos en Beira Alta. Dadas reivindicaciones anteriores de trashumancia vertical entre la meseta serrana –en verano– y las planicies bajas –en invierno–, esta hipótesis es discutida –y refutada– con base en el análisis espacial de yacimientos neolíticos, caracterización económica del periodo, orografía local y restricciones bioclimáticas.

Palabras clave: Neolítico; Beira Alta; Megalitismo; sistemas de asentamiento; ganadería; pastoreo.

1. Introduction¹

The Estrela Mountain –*Serra da Estrela*, in Portuguese– forms the westernmost tip of the Iberian central ridge (Fig. 1A-B), and is the highest mountain range in continental Portugal, reaching 1993 metres above sea level –hereafter, a.s.l.–. In geological terms, it is characterized mostly by granites, along with schists in its more southerly sectors, often under a very thin, acid soil cover. Due to anthropogenic deforestation and subsequent soil erosion –a fact attested since Prehistoric times– fertile lands are found mostly in lower areas, at the foot of the mountains and in the surrounding river valleys, where thicker sedimentary deposits can be found. In higher altitudes, outcrops dominate the landscape. The so-called ‘castles of rocks’ are the resulting features of erosion over granite outcrops and constitute true landmarks on the mountain’s summits and plateaux. Some of these granite boulders attracted human occupation in several periods, in rock-shelters in some cases or as enclosed settlements in others, when their specific location in the landscape was favoured. Penedo dos Mouros –or ‘Boulder of the Moors’– is one of these cases.

Due to the relative proximity of the Atlantic, to the west, and the Spanish Meseta, to the east,

highly diversified climate conditions characterise the region. Determined not only by these oceanic and continental factors but also by altitude, the vegetation in the mountain is today divided into three distinct sections: the basal –up to 800-900 m.a.s.l.–, under strong Mediterranean influence and profoundly altered by human intervention; the middle –from 800-900 to 1300-1600 metres a.s.l.–, corresponding to the declining oak forests due to fire and long-lasting economic strategies of sheep and goat grazing –see below–; and the upper section –above 1,300-1,600 metres a.s.l.–, where juniper dominates after the human destruction of the post-Würmian cover of pine and birch.

Palynological research in highland lakes –such as at Charco da Candeeira and Lagoa Comprida, located at 1400 and 1600 metres a.s.l., respectively (e.g. Van Den Brink and Janssen, 1985; Van Der Knaap and Van Leeuwen, 1995, 1997)– allowed the reconstruction of an anthropogenic and bioclimatic model from the end of the Pleistocene to the present-day. According to this model, after a rapid expansion of Post-Glacial vegetation in the Pre-boreal climatic period –with oak forest optimum reaching 1,777 m.a.s.l.–, three other main phases of vegetation succession were recognized: moist and cold climate with human impact on the forest –grazing and small-scale local deforestation– from c. 3300 cal BC (Late Neolithic) onwards; large-scale human-induced deforestation in the 1500-1100 cal BC period (Bronze Age), but with forest regeneration; and forest disappearance and soil erosion due to intensive grazing, burning and agriculture, from 1,100 cal BC onwards. The consequence was the irreversible replacement of the spontaneous vegetal cover of oak, birch and willow by heath.

¹ The excavations at the Penedo dos Mouros Rock-shelter took place in the framework of the research project *The Upper Mondego Valley: land of frontier between Christians and Muslims*, directed by Catarina Tente, which was funded by the Portuguese Foundation for Science and Technology for the 2007-2010 triennium. Acknowledgements are due to two anonymous reviewers for their helpful insights and suggestions that helped improving a first version of this paper. Any errors or omissions remain however our responsibility.

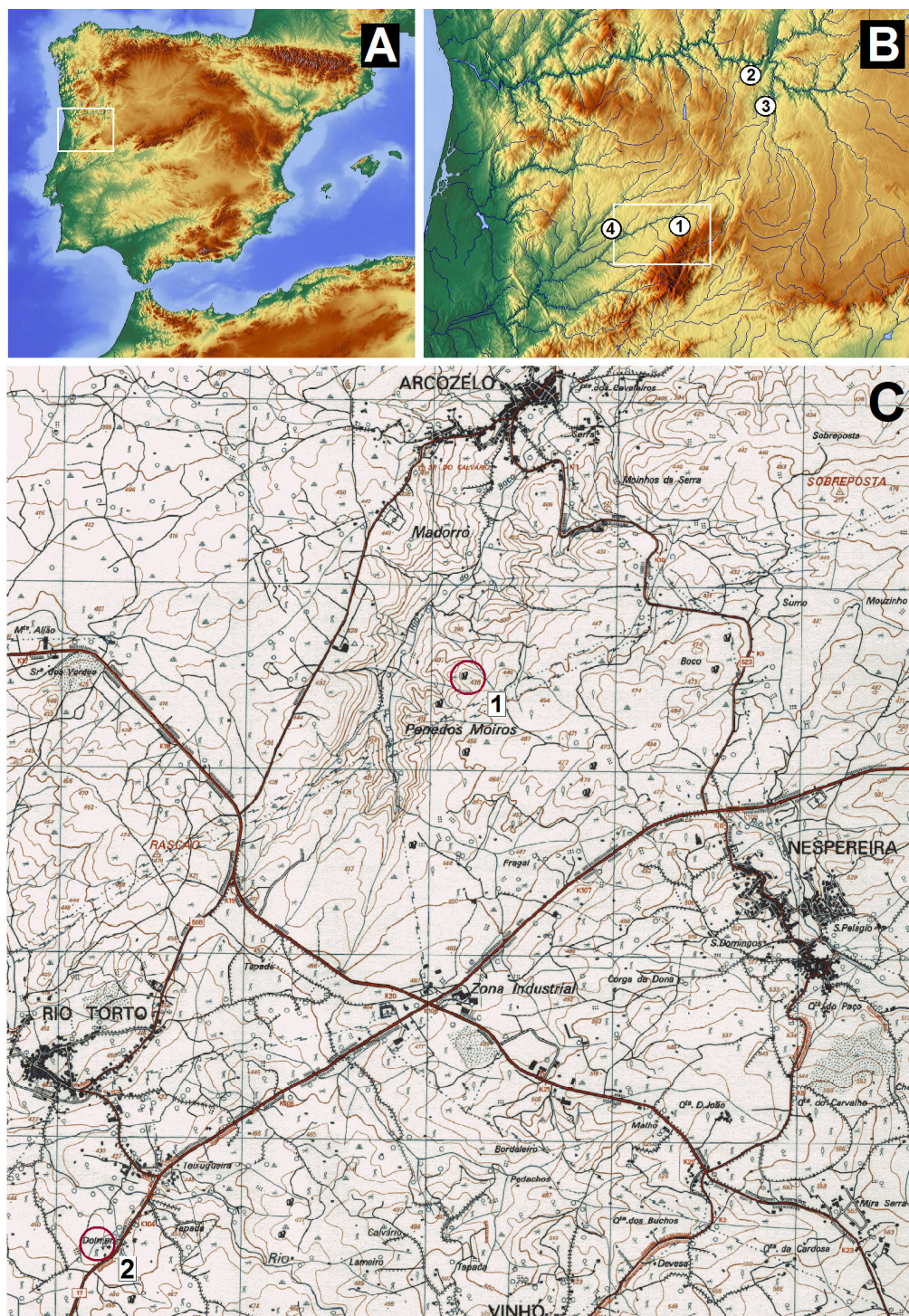


FIG. 1. A) Location of the Mondego Platform in the Iberian Peninsula (box); B) The Mondego Platform and location of the study area, the north-western sector of the Estrela mountain range (box). Early/Middle Neolithic sites mentioned in text: 1. Penedo dos Mouros; 2. Prazo; 3. Quebradas; 4. Folhadal. C) Location of Penedo dos Mouros (n.º 1) and dolmen of Rio Torto (n.º 2) in the Carta Militar de Portugal, n.º 201 (squares = 1 km).

Around the mountain's northern and western flanks, Estrela's principal drainage system is the upper section of the Mondego River, which drains to the south-west and meets the Atlantic north of the Estremadura region. Together with the Vouga river basin that drains to the west, it forms a vast highland plateau –the Mondego Platform, according to the designation proposed by Ferreira (1978)– separated from the coastal plain by the Gralheira and Caramulo mountain chains.

The economy of the Estrela Mountain has long been famous for the herding of sheep and goats according to a vertical transhumant regime, with highland pastures exploited in the summer and lowland plains and valleys during the winter months. Grazing animals in the lowlands often implied travelling across vast territories, to the Douro River and to the Montemuro Mountain –c. 80 km to the north and north-west–, and to the lower Mondego basin and the Beira Baixa province, in the fields around Idanha –c. 100 km and 80 km to the south-west and south-east, respectively–. There are also post-Medieval written records on transhumant itineraries reaching as far south as the Ourique region of the Lower Alentejo province, about 300 km away. These traditional practices were thoroughly studied in the 1930-40s by Ribeiro (e.g., 1941), who was able to observe them before their collapse in the last quarter of the twentieth century. This economic and cultural phenomenon has been proposed for the prehistoric past in Estrela as a key feature of subsistence strategies from the end of the fourth millennium BC onwards (Cardoso *et al.*, 1995/96; Senna-Martinez, 1995/96), or even starting at the very beginning of the Neolithic (Senna-Martinez and Ventura, 2008). Such claims are exclusively based on deforestation events recorded in pollen diagrams from the above-mentioned highland lakes.

However, the dating of anthropogenic impact in the montane landscape may be dubious. For example, vegetal cover changes and the presence of *Cerealia* in so-called pollen zones B3b-B5a at the Charco da Candeeira were dated to c. 6450-5500 cal BC and interpreted as “[...] either a period of

agriculture in the lowlands or a period of human-induced expansion of steppe grasses”. It is only after pollen zone c1, dated to c. 4500 cal BC, that those phenomena are fully present in montane environments, a moment during which “[...] the forest dynamics are predominantly anthropogenic, including some grazing and small-scale deforestation, although the area covered by forest was hardly affected” (Van der Knaap and Van Leeuwen, 1995: 186, 191, respectively). The problem with the older date is its anteriority to any documented farming economy in the whole Iberian Peninsula! The only possible conclusion from these data is that the dating of pollen sequences suffers from anomalies –an ‘old wood effect’ inherent to the dated samples?– that need to be scrutinized and evaluated. Thus, the chronological structure of these pollen diagrams and the derived conclusions must be understood with serious reservations when correlations to historical events are attempted. Similar problems of a scarcity of data also affect later periods. Ribeiro (1941) himself acknowledges the scarcity of written documents preventing a clear depiction of Medieval practices from being obtained. Interpretative models are still sketchy and based on indirect observations and ethnographic parallels from elsewhere rather than supported by local zooarchaeological data².

Indeed, little was known about the medieval settlement and economy in the Estrela Mountain until a systematic research project was designed to evaluate human occupation between the sixth and twelfth centuries –for syntheses, see Tente, 2007, 2010, 2012/13–. It enabled the excavation of several archaeological sites, including the resumption of the work at the enclosed settlement of Penedo dos Mouros. Unexpectedly, these allowed Neolithic occupations in a small rock-shelter, with faunal preservation, to be identified and studied.

The aim of this paper is thus twofold: to present a detailed description of the Neolithic at Penedo dos Mouros, from stratigraphic contexts to material

² Fernández-Mier, M. and Tente, C.: “Transhumant herding systems in Iberia”. In Costello, E. and Svensson, E. (eds.): *Historical archaeologies of transhumance across Europe*. London: Routledge; in press.

culture and faunal remains, and to discuss its integration in the early stages of the Neolithic in the Estrela Mountain, paying particular attention to the beginning of caprine herding in the region. Despite the limited excavated area, the scanty artefactual assemblages and the poor preservation conditions of the faunal remains, these are exceptional finds if the overall adverse geological features of the area are considered, and constitute therefore unique pieces of evidence on the subject.

2. The Penedo dos Mouros Rock-shelter

Penedo dos Mouros is located on a platform surrounded by granitic *tors* around 435 metres a.s.l., in the municipality of Gouveia (Fig. 1C). Previous citations of the site in the literature were provided by Alarcão (1993), who includes it in the archaeological survey of the Estrela Mountain Natural Park, and by Tente and Martins (1994) when describing a rock-cut tomb found on top of the higher boulder at the site. However, the first known reference to its archaeological interest dates back to the nineteenth century, when it was mistakenly referred to as a dolmen located “[...] between [the villages of] Rio Torto and Arcozello, called ‘Pedra de Orca’ or ‘Penedo dos Mouros’” (Sarmento, 1883: 21), after oral information obtained by the scientific expedition to the Estrela Mountain carried out by the Lisbon Geographic Society in 1881.

Three excavation seasons in 1999-2001 allowed the recognition of an enclosed settlement built on top of the steep slope that delimits the site on its western rim (Fig. 2A-C). A medieval stone wall and palisade, enclosing an estimated area of around 0,6 ha, were built between boulders to protect open sections of the settlement. Inside, different types of archaeological testimonies—carved steps and notches to support beams, remains of burnt tree trunks, etc.—indicate the existence of wooden structures in its central part—Sector I—, very likely a two-storey building with a roof made with perishable materials—roof tiles were not found—. The finds of artefactual assemblages—mainly pottery and metal artefacts—

along with abundant botanic remains of broad bean (*Vicia faba* var. *minuta*), wheat (*Triticum aestivum*), sweet cherry and/or dwarf cherry (*Prunus avium* and/or *Prunus cerasus*) and coriander (*Coriandrum sativum*)³ suggested the presence of storage facilities associated with a domestic use of the site. Two radiocarbon determinations indicated the tenth century AD (Tente and Carvalho, 2011)⁴. The choice for this location was determined not only by its invisibility in the surrounding landscape, but also by its proximity to the Boco Valley (Angelucci *et al.*, 2004), which would have been exploited by the farming group established at Penedo dos Mouros (Fig. 2C); the hundreds of broad beans referred to above may have been cultivated in small, irrigated plots on both banks of the stream.

A rock-shelter formed under granite boulders—Sector II—near the settlement’s original entrance, facing east (Fig. 2B), was excavated in 2008, 2009 and 2011. It revealed a thick, heterogeneous deposit interpreted as an embankment for the regularization of the local surface with very high concentrations of phytoliths—originated from the accumulation of ash, straw, cereal ears, and wild grasses—that were interpreted as testimony of a sheepfold used during the Medieval occupation of the site⁵, as it is still today used as shelter by local shepherds. Underlying this more recent deposit, at a depth of around 1,5 metres, Neolithic layers with potsherds, knapped and polished stone tools, and faunal and botanic remains were identified.

The main objective of the 2008 excavation season was to test the shelter’s deposit to evaluate the possibility of older occupations being preserved there, a possibility suggested by its clear thickness

³ Also cf. Queiroz, P. F. and Ruas, J. P. (2001): *Estudos de arqueobotânica do Penedo dos Mouros*. Trabalhos do CIPA, 13. Lisbon: Instituto Português de Arqueologia; unpublished report; Queiroz, P. F. (2009): *Novos dados arqueobotânicos sobre o Penedo dos Mouros (Gouveia)*. Lisbon: Terra Scenica, Territórios Antigos, unpublished report.

⁴ Also cf. Tente, C.: *Arqueologia medieval cristã no Alto Mondego. Ocupação e exploração do território nos séculos V a XI*. Unpublished Ph.D. dissertation defended in 2010 at the Universidade Nova de Lisboa.

⁵ Cf. *op. cit.* n. 1.

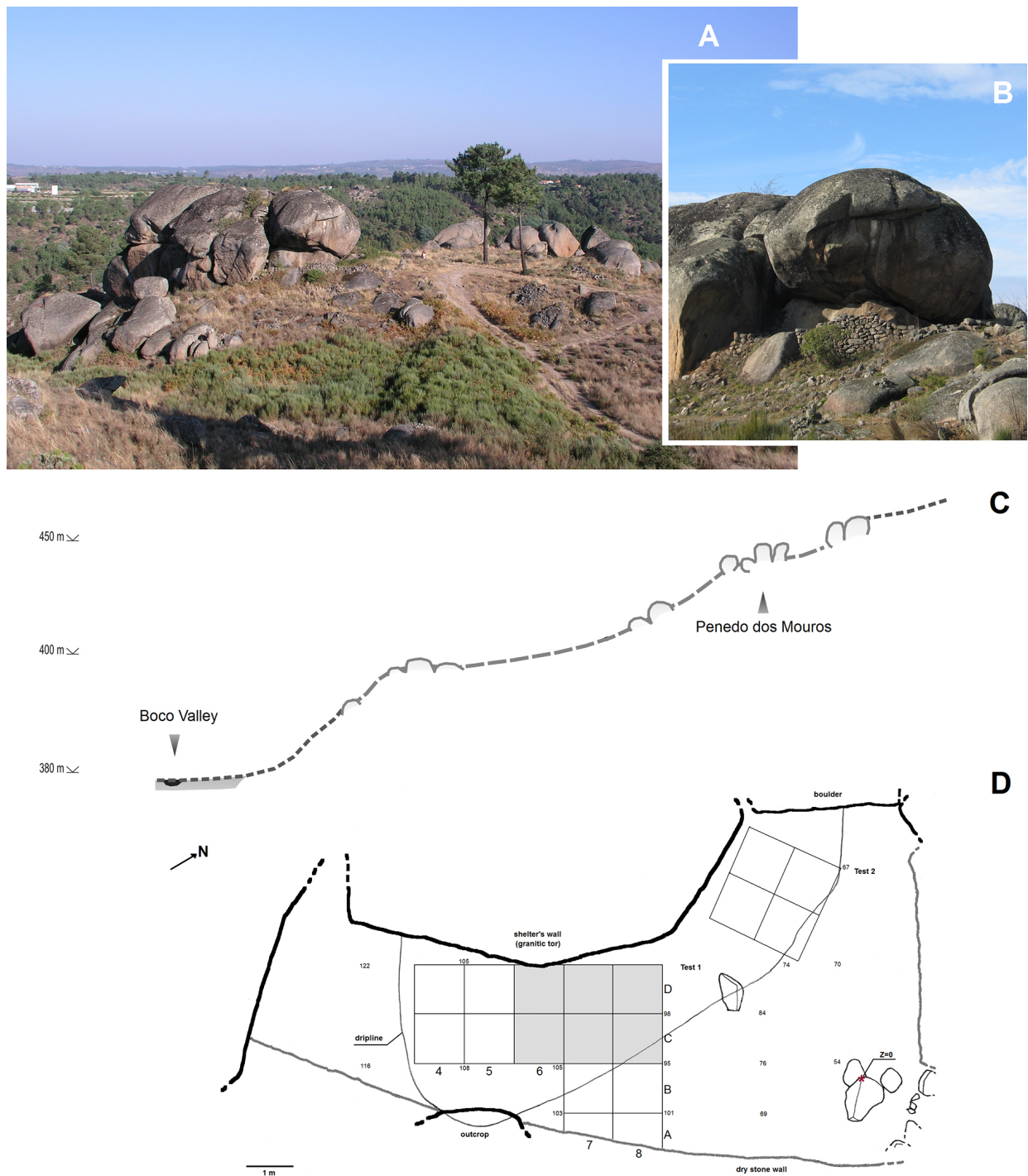


FIG. 2. A) General view of Penedo dos Mouros, from the south-east; B) Close-up view of the rock-shelter. Note the medieval/modern dry stone wall contouring the shelter's deposit; C) Topographic profile through Penedo dos Mouros and the Boco stream valley (Angelucci et al., 2004: fig. 6, adapted); D) Excavation plan at the Penedo dos Mouros Rock-shelter, with indication of the square units where Neolithic occupations could be individualized (grey squares).

as observable from the exterior (Fig. 2A-B). With that purpose in mind, two test pits were opened (Fig. 2D): Test 1, between the shelter's natural wall and a dry-stone wall (probably built in the first half of the twentieth century over the medieval structure), and Test 2, in its north-east section. Whereas Test 2 was 2 × 2 m in area and soon revealed what seemed to be a boulder collapsed from the shelter's roof –allowing the excavation of only a portion, around 0,5 m², of the Neolithic level–, Test 1 was better preserved in both stratigraphic and archaeological terms. Initially, it was excavated in a 2 × 4 m area –square units A-D/7-8–. However, as the digging progressed it was observed that in squares A-B/7-8 and partially in c8 there was a stone feature (related to the building of the medieval stone wall?) preventing further excavations. During the 2009 and 2011 seasons the area under work reached the local bedrock in squares C-D/6 only due the presence of collapsed boulders. Thus, the Neolithic deposit comprised a total area of little more than 6 m² at the end of the fieldwork (Fig. 2D).

The excavation was carried out according to stratigraphic units divided into 10 cm –thick arbitrary spits–. Sediments were systematically dry-screened

in 2 mm mesh screens, with 3D coordination of main artefacts and osteological elements. Samples of sediments were collected for phytolith and micromorphological analyses, and charcoal was retrieved for anthracological analyses and radiocarbon dating.

2.1. Stratigraphy and formation phases

A complete, more representative stratigraphic sequence was recorded in Test 1, where it comprises a total of 17 different units that are testimony to rather complex formation processes, both anthropic and natural. In particular, micromorphological analysis provided evidence that the sediment source is the local granite and incipient surrounding soils exposed to erosion. Sedimentary microstructure also suggests that cryogenic and biogenic activities were responsible for sediment transport and contributed to the general reworking and homogenization of the deposit. Human occupations, that were seasonal –see discussion–, did not affect the rate of sedimentation. These conditions ceased at some point between the Neolithic and the building of the medieval structures, as testified by the development

	Sample	¹⁴ C Lab. number	δ ¹³ C (‰)	Years BP	Cal range BC/AD (95,4% prob.) ⁽¹⁾	Comments
Test 1, unit 07	fragment of mandible (<i>Canis familiaris</i>)	wk-27462	–	–	–	abandoned; no collagen
Test 1, unit 09	charcoal (<i>Erica arborea</i>)	wk-25818	-25,0	1,147 ± 30	776-974 cal AD (95,4%)	Medieval occupation
Test 1, unit 09	bone fragments (unknown species)	wk-25159	–	–	–	abandoned; no collagen
Test 1, unit 11	epiphysis of metacarpal (<i>Ovis aries</i>)	wk-35998	⁽²⁾	3,559 ± 27	2,013-1,999 cal BC (2,0%); 1,979-1,871 cal BC (79,7%); 1,846-1,812 cal BC (8,2%); 1,803-1,777 cal BC (5,5%).	rejected
Test 2, unit 12	fragment of mandible (<i>Sus</i> sp.)	wk-25160	–	–	–	abandoned; no collagen
Test 2, unit 13	charcoal (<i>Erica</i> sp.)	wk-25158	-24,9	2,375 ± 30	702-696 cal BC (0,6%); 541-390 cal BC (94,8%).	intrusive; percolation?

⁽¹⁾ Calibrations according to IntCal13 atmospheric curve (Reimer *et al.*, 2013) with OxCal program, version 4.2.4 (Bronk-Ramsey, 2013).

⁽²⁾ Comments from the laboratory: Because of the small size of this sample, the Carbon 13 stable isotope value (δ¹³C) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured δ¹³C value can differ from the δ¹³C of the original material and it is therefore not shown.

FIG. 3. Penedo dos Mouros Rock-shelter: radiocarbon determinations.

of a spodic B-horizon in the Neolithic deposit, with a hard pan in its lower part –layer 09–. Bone preservation is due to cementation of layer 11 by calcium carbonate coming from dispersed ashes, only visible at microscopic scale, that precipitated as result of both water percolation, possibly from melting snow or frost, and stagnant water. These balanced the originally acidic pH of the sediment and prevented the dissolution of at least some of the bones in layer 11.

Overall, the micromorphological characteristics of the deposit provide explanation for the differential conservation of organic matter and the respective radiocarbon results (Fig. 3), that failed in dating the Neolithic at the site. The hard pan that constitutes layer 09 preserved the only charcoal in the entire sequence; however, as the radiocarbon date indicates, this charcoal might have migrated from above together with the colloidal gels that form the pan. Also, bones observed in thin section display severe mineralization by calcium carbonate and oxidation, which might have affected the result obtained with the sheep metacarpal from layer 11.

In sum, the stratigraphic and archaeological evidence obtained in the excavation suggests the following phasing:

- *Phase 1*: Successive Early and Middle Neolithic –fifth-fourth millennia BC– occupations of the rock-shelter taking place in the context of short stays by Neolithic human groups inhabiting lower sectors of the Estrela mountain range –as will be discussed below–.
- *Phase 2*: Abandonment phase between the third millennium BC and the first millennium AD during which there is no archaeological evidence for human occupation at the rock-shelter.
- *Phase 3*: Occupation of the rock-shelter in the tenth century, when this sector was used as a sheepfold belonging to the medieval settlement built on the adjacent platform.
- *Phase 4*: Post-Medieval abandonment phase.
- *Phase 5*: Recent occupation horizon represented by a pit-hearth identified in Test 2 and by the use of the site as temporary shelter by modern-day shepherds.

	Rimsherds plain	decorated	Sherds plain	decorated	Other knobs	cords	Total Number	Weight (g)
Test 1, layer 08	6	1	73	1	2	2	85	723
Test 1, layer 11	7	-	65	3	-	-	75	390
Test 2, layer 07	-	-	1	-	-	-	1	24
Test 2, layer 11	6	-	-	-	1	-	7	321
Total	19	1	139	4	3	2	168	1458

FIG. 4. *Penedo dos Mouros Rock-shelter: inventory of pottery; one and three decorated sherds from layers 02 and 05 of Test 1, respectively, not included.*

2.2. Pottery

As can be seen in Fig. 4, the pottery assemblage totals 168 pieces, with a total weight of 1,458 kg, if all Neolithic layers are summed together. The majority of the potsherds were found in Test 1, which is not surprising given its better state of preservation, its thickness and the larger excavation area. In this regard, it is also interesting to note that the larger assemblage is from the thinner layer

08 –c. 20 cm– rather than from the thicker layer 11 –c. 50 cm–, respectively with 85 –55%– and 70 –45%– potsherds.

A minimum number of 14 vessels from the two test pits have been recognized after systematic refitting. Based on technological and typological analyses, it was possible to draw a general overview of their main characteristics. Most vessels show recipes with abundant inclusions –n = 7; 50%–, mostly locally available quartz sands, with

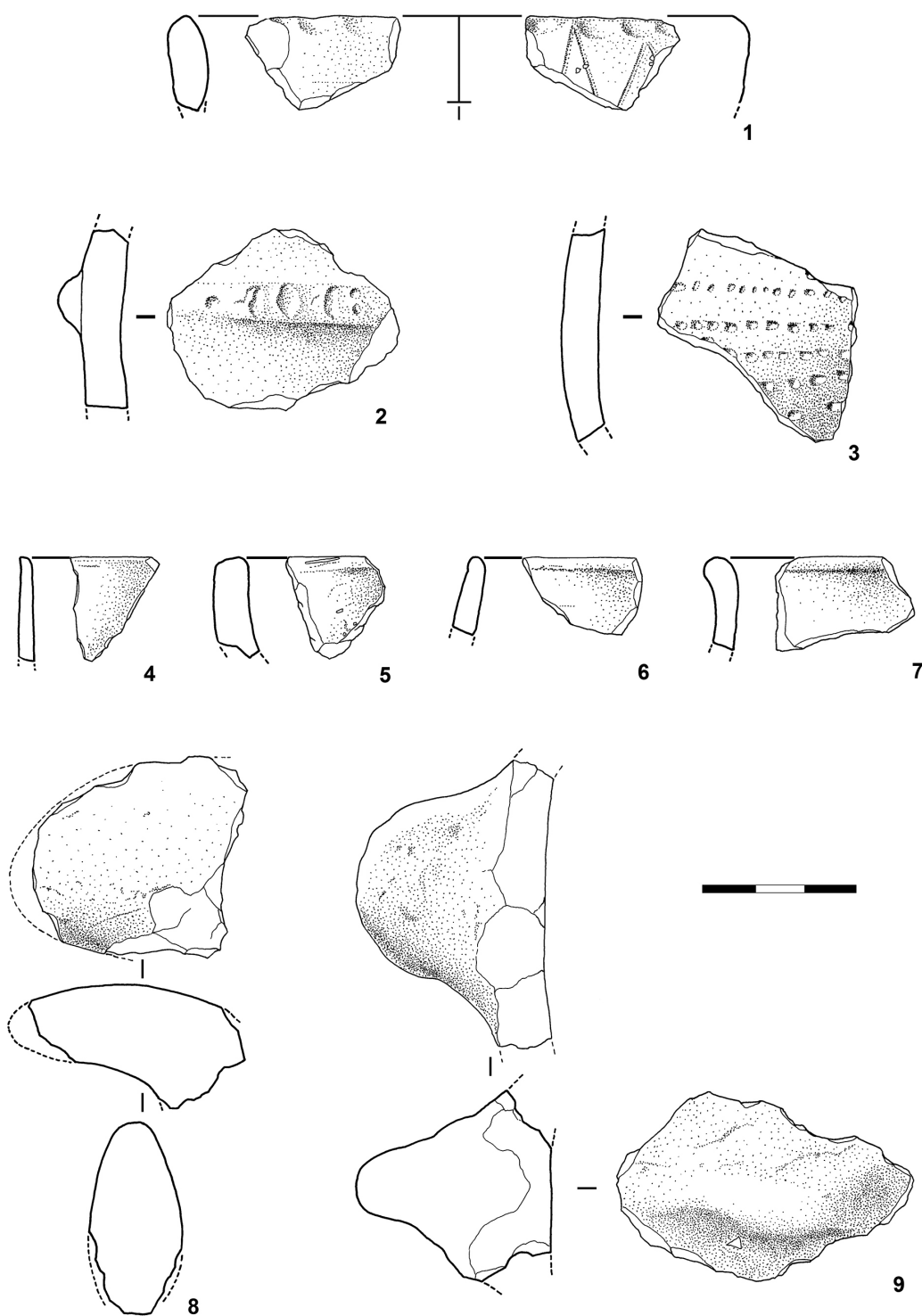


FIG. 5. Neolithic pottery from stratigraphic unit 08: 1) Vessel 6, decorated with incised lines and fingerprints on both sides of the rim; 2) cord segmented with (nail?) imprints; 3) sherd with dotted impressed lines; 4) Vessel 4; 5) Vessel 5; 6) Vessel 7; 7) Vessel 8; 8-9) knobs (drawings by M. F. Sousa).

medium paste consistencies –n = 9; 64%– and schistose-like textures –n = 9; 64%–. Surfaces are mostly smoothed –n = 6; 43%– or rough –n = 5; 36%–, whereas the typical *almagre* red slip was not recorded despite its acknowledged presence in other Neolithic sites of the region. Reduction firing atmospheres dominate, with 11 vessels –79%–. In terms of morphological analysis, it can only be inferred that straight and open mouths predominate whenever this attribute could be observed, with three –22%– and two –14%– cases, respectively. Indeed, high fragmentation patterns prevented refitting providing sound indications on the formal variability of the assemblage. If the wall thicknesses of the identified vessels are considered, it can be concluded that the assemblage is made of small-sized pots; larger vessels, such as storage containers, are absent. It is only possible to deduce that vessels had round bases, simple spherical morphologies –in which carinated or necked forms are absent–, in some cases with incised or impressed decoration and with knobs or handles.

This is a predominately undecorated assemblage, with five decorated potsherds out of 168 –3%–, a percentage that increases very little –4%– if the two cordoned fragments listed in Table 3 are included. A trend within the shelter's sequence is the fact that most decorated potsherds were exhumed from layer 08, and this is an important differentiating feature between the two layers. The exception is a refitted incised sherd from layer 11 (Fig. 6, n.º 4) which finds no parallel in the Estrela Mountain region but which can be compared in broad stylistic terms with incised motifs described as “decorative organization xvii”, comprising “[...] a band in which the basic motif is the triangle, defined by incised lines, and filled also by incisions oblique to the rim” (Monteiro-Rodrigues, 2011: 234; Portuguese original), from layer 3 in Sector VII at the open-air site of Prazo, in the north-east sector of the Beira Alta province (Fig. 1B, n.º 2), where this is dated to around 4,500–4,350 cal BC. Thus, this is the likely archaeologically-based

chronology for the oldest Neolithic at Penedo dos Mouros. An attempt at radiocarbon dating the sheep metacarpal found near the bottom of layer 11 (Fig. 3) has to be rejected given its aberrant result, probably due to the acidity of the sandy sediments where it was buried.

As a consequence of the above, the upper layer 08 at Penedo dos Mouros is attributable to the second half of the fifth millennium or to the beginning of the following. Decoration and handle types recorded here are scarcely represented or unknown in the Beira Alta region but share similarities with sites dated to this time period in Portuguese Estremadura –evolved Early Neolithic and initial Middle Neolithic–. This is the case of Vessel 6 –the only decorated rim fragment– which shows incised lines forming triangular motifs on the exterior surface associated with finger imprints around both sides of the rim (Fig. 5, n.º 1). The cordoned sherd and handles (Fig. 5, n.º 2 and 8-9, respectively) are similar, among other examples, to the pottery productions known at Cortiços (Cardoso *et al.*, 2013: figs. 15, 17-18, 21-23) and Costa do Pereiro –unpublished; see Carvalho, 2008: 51-52 for a short description–, open-air sites attributable to the Early-Middle Neolithic transition. These parallels indicate the late fifth and early fourth millennia BC as the likely chronology for layer 08. The more striking parallel, however, comes from the nearby dolmen of Rio Torto, located only 2 km to the south-west (Fig. 1C, n.º 2), where a rim fragment similar to the impressed sherds from layers 05 and 08 (Fig. 5, n.º 3 and Fig. 6, n.º 5-8) was found during the 1895 excavations (Vasconcelos, 1895), although only published one century later (Leisner, 1998: taf. 70, n.º 32). Clearly, this find suggests some contemporaneity between the later Neolithic occupation at Penedo dos Mouros, recorded in layer 8, and the earliest phases of the local megalithism, thus reinforcing the above chronology as the strongest possibility.

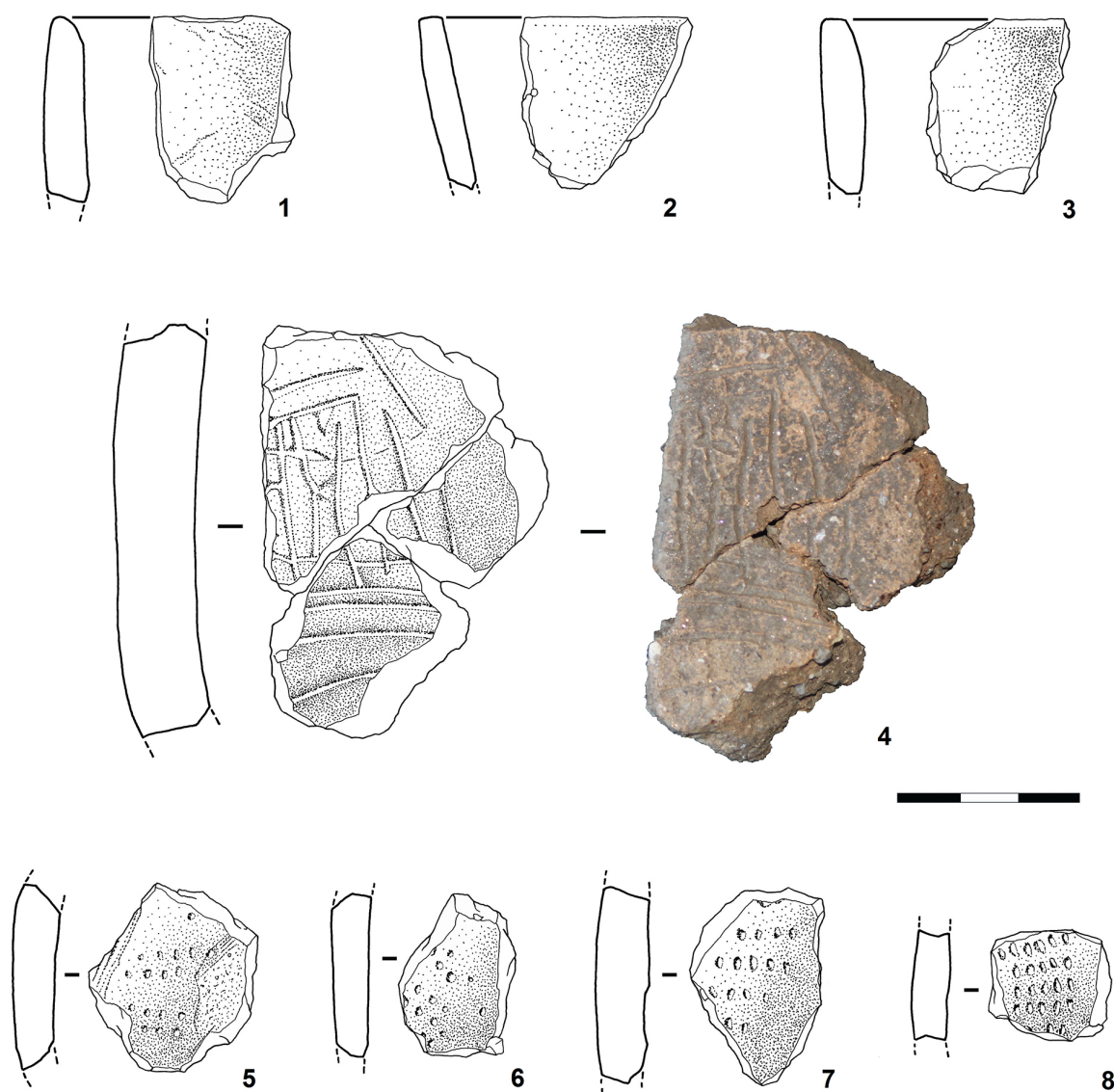


FIG. 6. Neolithic pottery from stratigraphic units 05 (n.º 5, 6 and 8) and 11 (n.º 1 to 4): 1) Vessel 11; 2) Vessel 12; 3) Vessel 14; 4) Drawing and photo of refitted sherd, with incised lines; 5-8) Four sherds decorated with dotted impressed lines, probably from the same vessel; piece 7 was found misplaced in stratigraphic unit 02 (drawings by M. F. Sousa).

2.3. Knapped stone

Figures 7 and 8 inventory the knapped stone assemblages from layers 08 and 11, respectively, along with other raw materials employed in the making of polished tools (axes/adzes and grinding stones). A feature common to both layers is the dominance of locally-available raw materials. Quartz has in this

regard a particular role, representing the majority of the knapped material, with very similar percentages: 87% –44 out of 52 pieces– and 88% –187 out of 212– in layers 08 and 11, respectively. Other presumably local or regional raw materials present in these layers are rock crystal, schist, granite and quartzite. Among the quartz there is a particular type of micro-quartz with reddish colour displaying

very good knapping qualities, of unknown origin –but also found in the unpublished excavations of the fourth millennium BC dolmen of Lapa da Meruje, in the north-western sector of the Caramulo Mountain–. Only for flint can an exogenous, supraregional origin be securely attributed since this rock's sources are inexistent in the whole Beira Alta province, so the sources known in Estremadura are an acceptable possibility given the pottery stylistic parallels referred to above. This is surely why flint is represented by very low percentages, with 10% –5 out of 52– and 3% –7 out of 212– in layers 08 and 11, respectively. It is however interesting to note that, despite the low number of pieces, some still show cortical surfaces, thus indicating that this raw material circulated in the form of nodules or cores, not blanks. This behaviour is documented elsewhere at coeval Neolithic contexts in Beira Alta –such as Quebradas (Carvalho, 1999) and Folhaldal (Senna-Martinez and Ventura, 2008) (Fig. 1B, n.º 3 and 4, respectively)– where flint cores and maintenance products were also found.

With the exception of one rock crystal core, all the remaining cores are in quartz. Both raw materials show expedient knapping strategies, thus in good accord with its local abundance: core blanks were obtained from dismantled quartz layers and were subsequently used to produce flakes or chips –which are the most abundant products– following random, not predetermined, knapping sequences. This option resulted in the abandonment of cores with very irregular shapes, a high number of non-cortical flakes with flat butts, and low percentages of formal, retouched tools. Among

	FLINT	QUARTZ	QUARTZITE	SCHIST	TOTAL
DEBITAGE:					
Cortical flakes	-	1	1	-	2
Partially cortical flakes	1	-	-	-	1
Non-cortical flakes	1	24	-	1	26
Bladelets	1	-	-	-	1
Cores	-	2	-	-	2
DEBRIS:					
Fragments	-	2	1	-	3
Chips	1	13	-	-	14
RETOUCHED TOOLS:					
Side-retouched flakes	-	1	-	-	1
Wedges	-	1	-	-	1
Side-retouched blade	1	-	-	-	1
TOTAL	5	44	2	1	52

FIG. 7. *Penedo dos Mouros Rock-shelter (Test 1, layer 08): general inventory of the lithic assemblage; two amphibolite flakes from the resharpening of polished tools not included.*

the latter, side-retouched flakes and wedges –mainly in layer 11– predominate, whereas only one micro-lithic tool was found: a backed bladelet from layer 11. Quartz flakes must have been used expediently,

	FLINT	QUARTZ	RED QUARTZ	ROCK CRYSTAL	QUARTZITE	TOTAL
DEBITAGE:						
Cortical flakes	1	3	2	1	-	7
Partially cortical flakes	1	-	-	-	1	2
Non-cortical flakes	2	110	-	2	-	114
Bladelets	-	2	-	-	-	2
Cores	-	1	-	1	-	2
DEBRIS:						
Fragments	-	5	1	4	-	10
Chips	3	60	-	6	-	69
RETOUCHED TOOLS:						
Side-retouched flakes	-	2	-	-	-	2
Splintered pieces	-	1	-	-	-	1
Wedges	-	2	-	-	-	2
Backed bladelets	-	1	-	-	-	1
TOTAL	7	187	3	14	1	212

FIG. 8. *Penedo dos Mouros Rock-shelter (Test 1, layer 11): general inventory of the lithic assemblage. One pebble (schist), six fire-cracked pebbles, one fragmented grinding stone and one pebble used as hammer (all in granite) not included.*

without retouch. Flint is represented almost exclusively by debris and unretouched flakes, therefore suggesting that knapping activities did take place at the site but were probably aimed at the production and recycling of lithic implements that were used elsewhere in the landscape and/or subsequently taken to other sites. Clearly, this pattern indicates a curated strategy contrasting with, but complementing the one employed in the exploitation of quartz and rock crystal. Both coexisting strategies constitute a generalized, patterned behaviour identified at all Neolithic sites in the Beira Alta province.

2.4. Zooarchaeology

A few bone remains, largely from layer 11 of Test 1, were exhumed during the 2008 and 2009 excavations at Penedo dos Mouros. Although very scarce and poorly preserved, this faunal assemblage is however extremely useful and interesting since bone preservation in granitic contexts is quite rare. Furthermore, this is one of the few faunal assemblages known in the whole Beira Alta region attributable to Neolithic times—see discussion—, and the first to be discovered in the region. The presence of possible domestic animals, as will be described below, may attest the presence of production economies in the mountain range and neighbouring areas from this early period onwards.

All animal remains recovered were analysed and a number of key features were taken into account. Criteria used to examine and record bones included all the excavation references as well as the data obtained from the bone itself: taxonomic identification to a species level—whenever possible—; element; portion; side; fusion; human, animal and natural modifications. Measurements were taken with a digital calliper according to the parameters described in Von Den Driessh (1976), and bone classification was concluded with the aid of the zooarchaeological reference collections of the General-Directorate of Cultural Heritage (Lisbon) and University of Algarve (Faro) laboratories. This assemblage consists of a total number of 38 bone

fragments, with a number of identified specimens—hereafter, NISP— of 14. Most— $n = 32$; 84.2%—come from layer 11 in Test 1, with the exception of one element (indeterminate) from layer 8 in Test 1, three—two indeterminate, one *Ovis/Capra* tooth—from layer 09 in Test 1, and two elements—one *Sus* sp. mandible and one indeterminate—from layer 12 in Test 2.

Both amphibians and mammals were recognized but with a clear predominance of the latter, with 16 specimens out of 17—94%—. Thus, a wider range of bone elements ($n = 21$)—mostly belonging to the appendicular skeleton—could not be classed at species level due to high fragmentation—. All bones display traces of burning—from light brown to charred—, are more or less mineralized, and show iron concretions on the surface. These alterations are undoubtedly the causes underlying their preservation; otherwise the acidity of the sediments would have resulted in the completely decay of the organic matter. However, as a consequence of their exposure to fire and mineralization, these bones were not suitable for radiocarbon dating, as demonstrated by one aberrant and two unsuccessful determinations (Fig. 3).

The taxonomy of identified species is described below according to Order.

ANURA

Bufo sp. (Toad)

This amphibian species is represented by a single bone, a complete tibio-fibula. Its presence in the Neolithic layers suggests a moist environment under the rock-shelter during their formation.

LAGOMORPHA

Oryctolagus cuniculus (Rabbit)

Rabbit is represented by seven documented elements: two incisor teeth, a scapula fragment, a proximal half of a left femur, a fragmented calcaneus, a proximal half of a left metatarsal III and an unidentified diaphysis. This is the most relevant species in terms of NISP, with 41,2%, but representing a minimum number of individuals—hereafter MNI— of one.

Lepus sp. (Hare)

As expected given its usual low representation in archaeological contexts, the total number of hare remains is lower than rabbit. Only three remains were recovered –NISP = 17.6%–: a complete right tibia, a diaphysis fragment of a left tibia and the proximal half of a left metatarsal III, thus with a MNI of one.

CARNIVORA

Lynx pardinus (Iberian lynx)

Although nowadays it subsists as a rare species in Portugal, in danger of extinction, it was quite common in prehistoric times; thus, it is not surprising to find a distal half of a metapodial among the assemblage.

ARTIODACTYLA

Sus sp. (Wild Boar or Pig)

Evidence for swine was attested through a fragmented mandible and one incisor, representing 11.8% of NISP. Unfortunately, there is not enough evidence to determine whether these remains belong to wild boar (*Sus scrofa*) or domestic pig (*Sus domesticus*).

Caprines (Sheep and/or Goat)

In the majority of the Caprine bones the distinction between goat-either ibex (*Capra pyrenaica*) or domestic goat (*Capra hircus*) –and sheep (*Ovis aries*) was not possible; therefore, they were analysed together. A fragment of a tooth (M3), a fragment of a calcaneus and a proximal epiphysis of a metacarpal were identified –NISP = 17.7%–. Although difficult to distinguish, the latter fragment was relatively well preserved, allowing a morphological approach and subsequent distinction.

Many authors have studied different methodologies on the distinction of sheep and goat and, through measurements alone, were not able to identify any distinctive patterns for the proximal metacarpals, focusing afterwards on the distal ends, as Rowley-Conwy (1998), for example. In this case, the measurements of the greatest breadth of the proximal end (Bp) is 23.47 mm, which could be

either sheep or goat, confirming the lack of biometric divisions. But when the approach is centred at the morphology of the skeletal elements, some variances are consistently identified as a reliable source to distinguish sheep from goat, as Boessneck *et al.* (1964) point out and later agreed by Fernández (2001). Accordingly, the palmar edge of the lateral facette of the articular surface is curved down on the palmar side, which often happens in sheep and nearly never in goats (Boessneck *et al.*, 1964: 107, 116 and fig. 66B)⁶. Furthermore, there is a clear angle between the medial and lateral facette of the articular surface on the palmar edge, representative of sheep –with 53% of incidence–⁷ while in goat the palmar edges are somewhat straight. Also, the medial facies articularis for the c2 + 3 protrudes dorsally (Boessneck *et al.*, 1964: 107, fig. 66B, feature a) which happens very often in the case of sheep. Due to all these individualities combined, it strongly suggests sheep (*Ovis aries*) and, consequently, the earliest direct evidence for Neolithic pastoralism in the Estrela mountain range –see discussion–.

3. Discussion

According to the comparisons presented above, the Neolithic at Penedo dos Mouros is dated to the second half of the fifth millennium BC –layer 11– and the transition to the following millennium –layer 08–. This broad chronology coincides, respectively, with the end of the Early Neolithic and the emergence of the earliest megalithism in the region, i.e., the Middle Neolithic. The record retrieved from this site is therefore critical as it provides a picture of the domestic contexts coeval with such important cultural changes within Neolithic societies. In this regard, Penedo dos Mouros is extraneous to issues surrounding the introduction of

⁶ Fernández, H.: *Ostéologie comparée des petits ruminants eurasiatiques sauvages et domestiques (genres Rupicapra, Ovis, Capra et Capreolus): diagnose différentielle du squelette appendiculaire*: p. 250, MTC a8. Unpublished Ph.D. dissertation defended in 2001 at the University of Genève.

⁷ Fernández, H.: *op. cit.* n. 3, p. 249, MTC a5.

farming economies in the Estrela Mountain region, of which the neighbouring site of Buraco da Moura de São Romão (Valera, 1998) is an important point of reference. An assessment and discussion of this process under different perspectives can be found in Carvalho (1999), Valera (2005) and Monteiro-Rodrigues (2011), among others. Nor is it our intention to discuss here the emergence of local megalithism in its all complexities, but rather to stress the contribution of Penedo dos Mouros to the study of the lifeways of the builders and to open up some possibilities for future research.

3.1. *Archaeological horizons at Penedo dos Mouros Rock-shelter*

One crucial aspect is the observation –which was rapidly acquired during fieldwork–that at least two, but most probably three, independent occupation events, or archaeological horizons, are recorded in the vertical scattering patterns of artefacts and human made structures within the rock-shelter's stratigraphic sequence detected in Test 1. As discussed in the previous section, and synthesized in Figure 9, the following archaeological horizons can be established from top to bottom:

Layer 08. Individualized in sedimentological terms, the Neolithic horizon recorded in layer 08 is characterized by cordoned and decorated pottery with thick knobs (Fig. 5), which are absent from the underlying unit. More relatively abundant flint artefacts (Fig. 7), presence of all the polished stone tools found in the rock-shelter –two amphibolite flakes from arbitrary spit 1, square D6, resulting from the reshaping of axes or adzes–, and an ochre nodule found in spit 2 in square C6, related to indeterminate uses –personal ornamentation? painted rock-art?– also characterise this horizon.

Top of layer 11. The only decorated potsherd from layer 11 was found in arbitrary spit 2 in square C7 (Fig. 6, n.º 4). It should also be noted that spits 1 and 2 yielded the highest

amounts of potsherds and knapped stone artefacts in layer 11 –both in terms of number and weight–, which decrease downwards (Fig. 9). Among the knapped material there is a reddish micro-quartz (Fig. 8), which is not found in layer 08 or in the bottom of layer 11, and the single backed armature. Lying immediately below these spits –i.e., in arbitrary spit 3– there were a few human-made structures, consisting of granite blocks and slabs accumulated to form what seems to be a hearth and associated wind-shield.

Bottom of layer 11. After diminishing amounts of materials in spits 3 to 5, another increase in the frequency of artefacts takes place in the lower spit 6 (Fig. 9). It should be noted that this is not a topographically regular level –its thickness varies due to the irregular topography of the bedrock– and therefore it is not straightforwardly comparable with the overlying spits. Thus, the possibility that it is an artefact of the excavation rather than a discrete archaeological horizon cannot be completely excluded. Pottery is exclusively plain and knapped stone is not characteristic –mostly quartz and rock-crystal by-products–.

In general terms, the faunal remains seem to be evenly scattered throughout the strata but showing one peak in arbitrary spit 4 in layer 11 (Fig. 9), which does not coincide with any of the above archaeological horizons. This peak is formed by six taxonomically indeterminate remains (most of them belonging to small-sized mammals), six rabbit and two hare remains. Interestingly, these rabbit and hare specimens constitute the overwhelming majority of these species' remains in all Neolithic units, representing 86% (six out of seven) and 67% (two out of three) of the respective total inventory. In sum, the scarcity of medium-sized mammals in this level –either presumably hunted (swine) or domesticated (sheep/goat)– is very suggestive of a twofold aspect: a hiatus in the human occupation during which only naturally deposited animal remains occurred, and the logical inference that the Leporids found at

	POTTERY		KNAPPED STONE		FAUNAL REMAINS
	Number	Weight (g)	Number	Weight (g)	Number
layer 08, artificial level 1	68	523	40	104	0
layer 08, artificial level 2	17	200	13	26	1
layer 11, artificial level 1	16	74	47	70	2
layer 11, artificial level 2	20	130	64	57	3
layer 11, artificial level 3	11	66	34	22	7
layer 11, artificial level 4	12	51	31	35	14
layer 11, artificial level 5	2	13	6	7	1
layer 11, artificial level 6	8	40	27	24	5
TOTAL	154	1097	262	345	33

FIG. 9. Penedo dos Mouros Rock-shelter: vertical scattering of material culture items and faunal remains according to number and weight of pieces (Test 1 only); granite and amphibolite artefacts not included; faunal remains from layer 09 ($n = 3$) not included.

Penedo dos Mouros were not hunted. The species inventory in the overlying spit 3 (rabbit, hare, lynx and toad) should be understood as accumulating in the very same context.

3.2. Settlement and subsistence strategies: the issue of Neolithic transhumance

Regardless of their distinctive features, the three archaeological horizons described above show common trends that strongly suggest short stays at the rock-shelter in Neolithic times. This is particularly evident in the preferential exploitation of local raw materials –quartz, rock-crystal– along with the curated use of exogenous flint, in the small sizes of ceramic pots –suggesting either a local, expedient production or their transport from campsites–, and the exclusiveness of caprines among the domestic mammals –the domestic or wild status of the swine remains cannot be assessed–, as previously also observed at the open-air sites of Prazo (Monteiro-Rodrigues *et al.*, 2008) and Quebradas (Carvalho, 1999) (Fig. 1b, n.º 2 and 3, respectively). Therefore, the open question is to determine the purpose of these occupations at Penedo dos Mouros and the broader settlement systems within which these were carried out, from the mid-fifth millennium BC to the beginning of the following.

Unfortunately, the only botanic remains preserved in Test 1–charcoal of cork oak (*Quercus*

suber) and heath (*Erica arborea*) collected in layer 09– are intrusive and cannot be correlated to the Neolithic. Phytolith analysis of sediment samples from layer 11 failed to identify clear traces of human use of vegetal species. As pointed out in the results' comments⁸ “[e]n lo referente a la muestra neolítica, su interpretación se ve dificultada por el alto número de [fitolitos] alterados. Aún así, la alta presencia de carbonatos, así como de fitolitos de leñosas, nos hace pensar en la posibilidad de la existencia de un hogar o quizás cenizas dispersas. Esta hipótesis se basa en la composición mineral y el tipo de fitolitos, ya que el número de fitolitos es relativamente bajo para tener un origen antrópico”. In other words, direct evidence for agriculture is lacking; the only indirect testimony of such practices at the site would be, with all due reservations, the granite grinding stone found in arbitrary spit 4 in layer 11 in square c6 which in fact can also be correlated with the processing of inorganic –e.g., ochre, as testified by the nodule found in layer 08 of Test 1– or wild botanic species –e.g., acorns–.

Although a residential hypothesis cannot be ruled out with the available evidence and the small area that was excavated, the archaeological and zooarchaeological records observed at Penedo dos Mouros are suggestive of a type of settlement system and mobility first hypothesised for the Beira Alta after the

⁸ ICPHES [Institut Català de Paleoeologia Humana i Evolució Social] (2009): *Análisis de fitolitos*. Tarragona: URV, p. 13, unpublished report.

study of the Neolithic open-air sites in the Côa Valley Archaeological Park. One of the two settlement models then put forward –residential *versus* logistical mobility– seems now to be better substantiated empirically, thus deserving to be quoted at length (Carvalho, 1999: 68; Portuguese original):

In sum, the few contexts presently known for the Early Neolithic in the Beira Alta and Trás-os-Montes seem to reflect a settlement carried out by small human groups with a still high degree of mobility, within a strategy of ‘residential mobility’. The dominant strategy would rely on frequent changes of camps accompanied by successive forest clearances for crops or pastures. Indeed, these sites always have in common: small areas, even in the case of open-air sites; presence of archaeological palimpsests only in locations favourable to reoccupation events within a given space, such as rock-shelters; and the recurrent identification of a domestic component. As tentatively demonstrated, these sites may occasionally exhibit a greater functional bias in favour of agricultural activities –as at Quinta da Torrinha–, herding and/or hunting –as at Quebradas–, or others, which is reflected in the respective artefactual contents. The reasons determining these variations would rely mostly on the seasonal character of some economic activities and on some geographical factors –regime of water courses, topography, etc.–.

This residential mobility model seems to have been corroborated, not only now by Penedo dos Mouros, but also by discoveries that took place in the meantime at Prazo (Monteiro-Rodrigues, 2011) or along the sector of the Mondego valley between Nelas and Carregal do Sal, where a number of open-air sites have been under study and interpreted in a similar fashion (Valera, 2005; Senna-Martinez and Ventura, 2008).

As mentioned in the introduction section, claims for seasonal transhumant practices have also been explicitly proposed for the Estrela mountain range –starting as early as the beginning of the Neolithic– deriving mostly from pollen evidence obtained in mountain lakes. However, it is our opinion that site distribution patterns, pastoralism economics and, to some extent, ethno-historic evidence may provide

in the current state of our knowledge a sounder approach to test the likelihood of Neolithic transhumance in the region.

Indeed, the megaliths known between the mountain range and the left banks of the Mondego River do not surpass the 500 m.a.s.l. contour line –see Senna-Martinez and Ventura, 2000a, 2000b and respective maps–. Moreover, with very few exceptions on (or near) hilltops, most sites are located on the sandy plateaux of this vast, elongated platform, preferentially in the vicinities of the Mondego’s main tributaries. In sum, repeating the same strategy identified at Penedo dos Mouros and compatible with a mixed farming regime encompassing herding practices and agriculture. Only the Early Neolithic rock-shelter site of Buraco da Moura de São Romão shows a rather distinct location, in the foothills of the mountain at 680 m.a.s.l. (Valera, 1998) but clearly still away from the mountain’s higher sectors.

If the absence of settlements or megaliths in higher altitudes can be attributable to lacunae in the current state of the research –obviously, more evidenced in the former rather than in the latter cases due to relative archaeological visibility–, the altitudinal scheme of the mountain range’s agricultural potential proposed by Ribeiro and Santos (1949) provide interesting research possibilities. Despite being based on orographic and modern-day bioclimatic features, these authors established a sequence of stratified compartments within which traditional cultures find favourable ecological conditions. As can be seen in Fig. 10, wheat could have only been cultivated below 800 m.a.s.l. The outcome of this observation is twofold. First, the upper limit of wheat agriculture in the Estrela Mountain is in itself a very relevant constraint, preventing a full farming economy to be permanently established in the range’s higher sectors. Therefore, if wheat was part of these groups’ “farming package” –see Carvalho (2017) for a discussion on Early Neolithic agriculture in Portugal– such restriction must have favoured the occupation of the lowlands only, a possibility apparently confirmed by current site distribution maps. Second, if transhumant herding is

hypothesised above the upper limit of wheat, the question of what its triggering cause/s might have been requires explanation.

Demographic pressure, bioclimatic forcing or economic intensification are the most commonly argued causes to explain emergent transhumant pastoralism in small-scale societies. If the first can be ruled out given the relatively low demographic density of early farmers in Iberia, especially after the sixth-fifth millennia BC transition (Bernabeu *et al.*, 2014), the second cause must be also excluded from reasoning in the southern regions of temperate Europe. As stated by Greenfield (1999: 16), “[...] in strong contrast to arid and alpine conditions, temperature extremes in the lowlands are not sufficiently extreme during the summer to drive livestock into the mountains in search of pastures. Sufficient water and grazing are available year-round in most low and mid-altitude pastures in temperate climatic zones. Ecologically, there are fewer incentives for pastoralists from low and mid-altitude settlements in temperate regions to practice transhumance. Stock may be safely herded throughout the year in the lowlands, especially where a host of micro-environments are juxtaposed (e.g. marshes, streams, plains, hills, etc.) [...]”. This applies well to the Estrela Mountain region even if its specific bioclimatic conditions in the Middle Holocene are considered. On the other hand, most authors agree that there is no evidence in Beira Alta pointing to relevant economic intensification processes taking place throughout the earliest stages of the local Neolithic (e.g., Valera, 2005; Senna-Martinez and Ventura, 2000a, 2008; Monteiro-Rodrigues, 2011; Monteiro-Rodrigues *et al.*, 2008). Such processes, however, would have to be necessarily present to envisage the beginning of transhumance in the higher

sectors of the mountain. This scenario has been recently put forward by Rojo *et al.* (2013) to explain the zooarchaeological evidence from the cave site of Els Trocs, in the axial Pyrenees. But if the Pyrenees are to be used as framework for the Beira Alta case, it should also be borne in mind that the identification of a logistical type of mobility in the region –i.e., permanent settlements located in the more fertile soils around which specialized activities take place, as also hypothesised by Carvalho (1999) and recently identified in the lower sector of Portuguese Estremadura (Carvalho, 2017)– would be another previous requisite that does not find support in the empirical evidence from the Estrela counterpart at this point of the research.

4. Conclusions

It is our opinion that the available evidence and theoretical prerequisites favour a settlement model according to which the Estrela mountain range might have been devoid of any form of permanent economic exploitation –even if on a seasonal basis only– at least before the end of the fourth millennium BC. The finds of polished stone axes and grinding stones on the right bank of the Vale do Rossim Dam (Fig. 10), at 1430 m.a.s.l., is compatible with this view if their typological attribution to the Late Neolithic or Chalcolithic, as proposed by Cardoso and González (2002), is confirmed in the future.

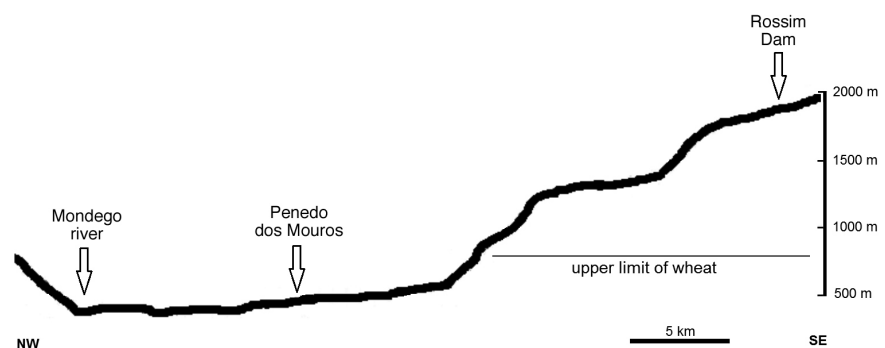


FIG. 10. Topographic profile of the study area between the Mondego river valley and the Rossim Dam near the summit of the Estrela mountain range, with location of Penedo dos Mouros and the modern upper limit of wheat cultivation.

Notwithstanding, the question of what type of occupation in the highlands those artefacts represent remain unanswered. Regarding the Neolithic occupation of the mountain range, not only is the absence of any megalithic monuments noteworthy but also a further two phenomena: schematic, Late Prehistoric rock-art is also unknown – a fact that contrasts with evidence from other mountains in the region (Alves, 2008)– and most of the dolmens in the Mondego basin are oriented to the south-east (i.e., to the mid-winter sunrise), thus pointing towards the mountain range (Senna-Martinez *et al.*, 1997). These aspects are very suggestive of the role played by this orographic feature as a landscape reference within the local “megalithic world”, whose specific influence in the lifeways of the surrounding Neolithic communities have been approached only tentatively.

Bibliography

- ALARCÃO, J. (1993): *Arqueologia da Serra da Estrela*. Manteigas: Parque Natural da Serra da Estrela.
- ALVES, L. B. (2008): “O sentido dos signos. Reflexões e perspectivas para o estudo da arte rupestre do pós-glaciar no norte de Portugal”. In BALBÍN, R. (ed.): *Arte prehistórica al aire libre en el Sur de Europa*. Documentos Pahis. Valladolid: JCYL, pp. 381-414.
- ANGELUCCI, D. E.; TENTE, C. and MARTINS, A. R. (2004): “O Penedo dos Mouros e a sua integração paisagística”, *Revista Portuguesa de Arqueologia*, 7 (1), pp. 467-481.
- BERNABEU, J.; GARCÍA-PUCHOL, O.; PARDO, S.; BARTON, M. and MCCLURE, S. (2014): “Socioecological dynamics at the time of Neolithic transition in Iberia”, *Environmental Archaeology*, 19 (3), pp. 214-225.
- BOESSNECK, J.; MULLER, H.-H. and TEICHERT, M. (1964): “Osteologische unterscheidungsmerkmale zwischen Schaf (*Ovis aries* LINNÉ) und Zeige (*Capra hircus* LINNÉ)”, *Kuhn Archiv.*, 78, pp. 1-129.
- CARDOSO, J. L.; CARVALHO, A. F. and GIBAJA, J. F. (2013): “O sítio do Neolítico antigo de Cortiços (Almeirim, Santarém)”, *Revista Portuguesa de Arqueologia*, 16, pp. 27-61.
- CARDOSO, J. L. and GONZÁLEZ, A. (2002): “Testemunhos da ocupação pré-histórica da Serra da Estrela”, *Al-Madan*, 11, p. 242.
- CARDOSO, J. L.; SENNA-MARTINEZ, J. C. and VALERA, A. C. (1995/96): “Aspectos da economia alimentar do Bronze pleno da Beira Alta: a fauna de grandes mamíferos das ‘Salas 2 e 20’ do Buraco da Moura de S. Romão (Seia)”, *Trabalhos de Arqueologia da EAM*, 3-4, pp. 253-261.
- CARVALHO, A. F. (1999): “Os sítios de Quebradas e de Quinta da Torrinha (Vila Nova de Foz Côa) e o Neolítico antigo do Baixo Côa”, *Revista Portuguesa de Arqueologia*, 2 (1), pp. 39-70.
- CARVALHO, A. F. (2008): *A neolitização do Portugal meridional. Os exemplos do Maciço Calcário Estremenho e do Algarve ocidental*. Promontoria Monográfica, 12. Faro: Univ. Algarve.
- CARVALHO, A. F. (2017): “When the Mediterranean met the Atlantic. A socio-economic view on the Early Neolithic communities of central-southern Portugal”, *Quaternary International*. <https://doi.org/10.1016/j.quaint.2016.12.045>.
- COSTA, F. A. P. (1868): *Noções sobre o estado prehistórico da Terra e do Homem seguidas da descrição de alguns dolmens ou antas de Portugal*. Lisbon: Academia Real das Sciencias.
- FERREIRA, A. B. (1978): *Planaltos e montanhas do norte da Beira. Estudo de Geomorfologia*. Memórias, 4. Lisbon: Centro de Estudos Geográficos.
- GREENFIELD, H. J. (1999): “The advent of transhumant pastoralism in the temperate southeast Europe: a zooarchaeological perspective from the Central Balkans”. In BARTOSIEWICZ, L. and GREENFIELD, H. J. (eds.): *Transhumant pastoralism in Southern Europe*. Budapest, pp. 17-36.
- LEISNER, V. (1998): *Die megalithgräber der Iberischen Halbinsel. Die Westen*. Berlin: Walter de Gruyter.
- MOITA, I. N. (1966): “Características predominantes do grupo dolménico da Beira Alta”, *Ethnos*, v, pp. 189-297.
- MONTEIRO-RODRIGUES, S. (2011): *Pensar o Neolítico antigo. Contributo para o estudo do Norte de Portugal entre o VII e o V milénio a.C.* Estudos Pré-Históricos, 16. Viçeu: Centro de Estudos Pré-Históricos da Beira Alta.
- MONTEIRO-RODRIGUES, S.; FIGUEIRAL, I. and LÓPEZ-SÁEZ, J. A. (2008): “Indicadores paleoambientais e estratégias de subsistência no sítio pré-histórico do Prazo (Freixo de Numão, Vila Nova de Foz Côa, Norte de Portugal)”. In *III Congresso de Arqueologia de Trás-os-Montes, Alto Douro e Beira Interior. Pré-História: gestos intemporais*. Vila Nova de Foz Côa: Associação Cultural, Desportiva e Recreativa de Freixo de Numão, vol. 1, pp. 96-119.

- RIBEIRO, O. (1941): "Contribuição para o estudo do pastoreio na Serra da Estrêla", *Revista da Faculdade de Letras de Lisboa*, IV (1-2), pp. 213-303.
- RIBEIRO, O. and SANTOS, M. A. P. (1949): "Montanhas pastoris de Portugal". In *Compte Rendu du XVI^e Congrès International de Géographie. Travaux de la Section IV*. Lisbon: Union Géographique Internationale, vol. III, pp. 59-69.
- ROJO, M. Á.; PEÑA-CHOCARRO, L.; ROYO, I.; TEJEDOR, C.; GARCÍA, Í.; ARCUSA, H.; GARRIDO, R.; MORENO, M.; MAZZUCO, N.; GIBAJA, J. F.; ORTEGA, D.; KROMER, B. and ALT, K. W. (2013): "Pastores trashumantes del Neolítico antiguo en un entorno de alta montaña: secuencia crono-cultural de la Cova de Els Trocs (San Feliú de Veri, Huesca)", *Boletín del Seminario de Estudios de Arte y Arqueología*, LXXI, pp. 9-54.
- ROWLEY-CONWY, P. (1998): "Improved separation of Neolithic metapodials of Sheep (*Ovis*) and Goats (*Capra*) from Arene Candide Cave, Liguria, Italy", *Journal of Archaeological Science*, 25, pp. 251-258.
- SARMENTO, M. (1883): *Expedição científica à Serra da Estrela em 1881. Secção de Archeologia*. Lisbon: Soc. Geographia de Lisboa.
- SENNA-MARTINEZ, J. C. (1995/96): "Pastores, recolectores e construtores de megálitos na Plataforma do Mondego no IV e III milénios AC: (1) O sítio de habitat do Ameal VI", *Trabalhos de Arqueologia da EAM*, 3-4, pp. 83-122.
- SENNA-MARTINEZ, J. C.; LÓPEZ-PLAZA, M. S. and HOSKIN, M. A. (1997): "Territorio, ideología y cultura material en el Megalitismo de la Plataforma del Mondego (Centro de Portugal)". In RODRÍGUEZ-CASAL, A. (ed.): *O Neolítico atlântico e as orixes do Megalitismo*. Santiago de Compostela: Univ. Santiago de Compostela, pp. 657-676.
- SENNA-MARTINEZ, J. C. and VENTURA, J. M. Q. (2000a): "Os primeiros construtores de megálitos". In SENNA-MARTINEZ, J. C. and PEDRO, I. (eds.): *Por terras de Viriato. Arqueologia da região de Viseu*. Viseu: Gov. Civil Distrito de Viseu/Museu Nacional de Arqueologia, pp. 35-38.
- SENNA-MARTINEZ, J. C. and VENTURA, J. M. Q. (2000b): "Pastores, recolectores e construtores de megálitos: o Neolítico final". In SENNA-MARTINEZ, J. C. and PEDRO, I. (eds.): *Por terras de Viriato. Arqueologia da região de Viseu*. Viseu: Gov. Civil Distrito de Viseu/Museu Nacional de Arqueologia, pp. 53-62.
- SENNA-MARTINEZ, J. C. and VENTURA, J. M. Q. (2008): "Neolitização e Megalitismo na plataforma do Mondego: algumas reflexões sobre a transição Neolítico antigo/Neolítico médio". In *IV Congreso del Neolítico Peninsular*. Alicante: MARQ, vol. II, pp. 77-84.
- TENTE, C. (2007): "Comunidades medievais cristãs do Alto Mondego: projecto de estudo das estratégias de ocupação do território", *Promontoria*, 5, pp. 245-269.
- TENTE, C. (2012/13): "A origem da formação da paisagem rural medieval no Alto Mondego (Guarda, Portugal). O contributo da arqueologia", *Norba*, 25-26, pp. 61-75.
- TENTE, C. and CARVALHO, A. (2011): "The establishment of radiocarbon chronologies for Early Medieval sites: a case-study from the Upper Mondego Valley (Guarda, Portugal)", *Munibe*, 62, pp. 461-468.
- TENTE, C. and MARTINS, A. R. (1994): "Levantamento arqueológico do concelho de Gouveia, 1.^a fase: a necrópole medieval do Risado, o conjunto de Carreira Cova e a sepultura do Penedo do Mouros. Notícia preliminar", *Trabalhos de Arqueologia da EAM*, 2, pp. 283-291.
- VALERA, A. C. (1998): "A neolitização da bacia interior do Mondego". In *A Pré-História na Beira Interior*. Estudos Pré-Históricos, 6. Viseu: Centro de Estudos Pré-Históricos da Beira Alta, pp. 131-148.
- VALERA, A. C. (2005): "Problemas da neolitização na bacia interior do Mondego". In *III Congreso del Neolítico en la Península Ibérica*. Santander: Univ. de Cantabria, pp. 945-956.
- VAN DEN BRINK, L. M. and JANSSEN, C. R. (1985): "The effect of human activities during cultural phases on the development of montane vegetation in the Serra da Estrela, Portugal", *Review of Palaeobotany and Palynology*, 44, pp. 193-215.
- VAN DER KNAAP, W. O. and VAN LEEUWEN, J. F. N. (1995): "Holocene vegetation succession and degradation as responses to climatic change and human activity in the Serra de Estrela, Portugal", *Review of Palaeobotany and Palynology*, 89, pp. 153-211.
- VAN DER KNAAP, W. O. and VAN LEEUWEN, J. F. N. (1997): "Late Glacial and early Holocene vegetation succession, altitudinal vegetation zonation, and climatic change in the Serra da Estrela, Portugal", *Review of Palaeobotany and Palynology*, 97, pp. 239-285.
- VASCONCELOS, J. L. (1895): "Acquisições do Museu Ethnographico Português", *O Archeólogo Português*, 1, p. 325.
- VON DEN DRIESCH, A. (1976): *A guide to the measurement of animal bones from archaeological sites*. Cambridge: Peabody Museum Press.