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Sperm-whale V-perforated buttons from Galeria da Cisterna (Almonda Karst System, Torres Novas, Portugal)*

Botones de cachalote con perforación en V de Galeria da Cisterna (Sistema Kárstico de Almonda, Torres Novas, Portugal)

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ABSTRACT

During excavation of the prehistoric necropolis of Galeria da Cisterna in 1988-1989, the remains of several individuals were recorded. The direct dating of four attests to use of the cave for funerary purposes during Beaker times. Whilst no Beaker pottery was found, a small fragment of a golden spiral and a set of V-perforated ivory buttons are diagnostic of the period. These items can be securely associated with the human remains dated to the corresponding time range. Visual inspection identified sperm whale ivory as the raw-material the buttons were made of, which density measurements confirmed. This indicator was chosen because it is non-destructive and discriminates well between the different types of ivory found in the Chalcolithic of Iberia. The average obtained for the 13 specimens from Galeria da Cisterna is 2.32 ± 0.12, well outside the range for elephant and hippopotamus ivories and consistent with the average value (2.2) for sperm-whale ivory published by Schuhmacher *et al.* (2013). The gold object was most likely made from regional sources. These data reflect on the wide intra-regional networks in operation during the Chalcolithic of the Lisbon peninsula. They also suggest that extra-regional exchange was rather more limited, as the golds of the Alentejo sites usually are of a distinct composition and sperm-whale has never been identified among their ivories (which are of North-African elephant, a rare occurrence in the Lisbon peninsula).

RESUMEN

La excavación de la necrópolis prehistórica de Galeria da Cisterna (1988-1989) recuperó los restos de varios individuos. La datación de cuatro de ellos demuestra que la cavidad fue usada con fines funerarios en época campaniforme. No se ha encontrado ningún fragmento de la característica cerámica del periodo, pero un pequeño fragmento de espiral en oro y un conjunto de botones con perforación en V justifican la asignación cultural del contexto. Su asociación con los restos humanos fechados puede considerarse segura. La observación macroscópica de los botones concluyó que la materia prima usada había sido el marfil de cachalote, lo que confirmó el análisis de densidad. Este indicador se eligió debido a que el análisis es no destructivo y discrimina bien los diferentes tipos de marfil conocidos en el Calcolítico de la península ibérica. La densidad media obtenida para los 13 botones de Galeria da Cisterna es de 2,32 ± 0,12, claramente por encima del rango de variación de los marfiles de elefante y de hipopótamo y acorde con el valor medio (2,2) publicado por Schuhmacher et al. *(2013) para marfil de cachalote. El oro usado para la espiral es probablemente de origen local. Estos datos revelan la amplitud de las redes intrarregionales del Calcolítico de la península de Lisboa y sugieren que los intercambios extrarregionales serían bastante más limitados, puesto que los oros de los yacimientos coevos del Alentejo suelen tener una composición distinta y el cachalote no se ha podido identificar nunca entre sus marfiles (los cuales son de elefante norteafricano, raro en la península de Lisboa).*

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Palabras clave: *Campaniforme; Portugal; botones con perforación en V; marfil de cachalote; Calcolítico*.

1. INTRODUCTION

The Galeria da Cisterna is an ancient karst outlet of the Almonda river; its entrance is located some 5 m above the extant spring. A year-round availability of water, plus the ecotonal location, help explain why the area was a focal point for human settlement throughout Prehistory (Fig. 1).

Archaeological work at the Galeria da Cisterna was first carried out between 1937 and 1942 (Paço *et al*. 1947; Guilaine and Veiga Ferreira 1970). In a second, 1988-1989 phase, the area affected by the older excavations was delimited and additional archaeological deposits were identified and excavated in three *loci*: AMD1, AMD2 and AMD3 (Maurício 1988; Zilhão *et al.* 1991; 1993; Zilhão and Carvalho 2011; Zilhão 1997, 2001, 2009, 2021; Carvalho 2007; Trinkaus *et al*. 2011; Martins *et al*. 2015). AMD1 featured a remnant Upper Paleolithic deposit under a Holocene cave earth, which formed the upper 20-40 cm of the AMD2 sequence (layer A). The latter was separated from beaver teeth-yielding, river-accumulated Pleistocene sands (layer C) by a dense lens of microfaunal remains, mostly of bats (layer B). AMD3 is a lens of organic sediments that represents a continuation of layer A of AMD2; a short stretch of outcropping bedrock separates these two *loci* (Fig. 2).

Layer A contained a large, chronologically heterogeneous set of finds: pottery; highly fragmented faunal and human osteological remains; stone and metal tools; personal ornaments made of shell, bone, ivory, stone, glass, and metal. The lack of internal stratigraphic differentiation is primarily due to the thinness of the deposit, compounded by animal burrowing and the impact of repeated human activity. The interior location, well beyond the twilight zone, the restricted space, unsuitable for residential purposes, and the numerous human skeletal remains suggest that AMD2 was used for funerary purposes only. Both the artefacts and the faunal remains are very probably grave goods, and the personal ornaments could relate to the finery and clothing worn by the deceased. Even though the literature tends to emphasise individual interment and collective burial in rock-cut and megalithic tombs as typical of Beaker funerary customs (Gonçalves *et al*. 2018), the use of natural caves as burial sites was a widespread feature of littoral-central Portugal through Prehistoric and Protohistoric times (Neolithic to Iron Age).

Most diagnostic finds from AMD2 are of unambiguous attribution to the Early Neolithic. However, later periods are also represented. For instance, diagnostic pottery and metal objects, such as wheel-made, stamp-decorated vessels, an iron earring, and a hafted iron spear show that the Galeria da Cisterna continued to be used for burial possibly until as late as the 1st and certainly until at least the 4th century BC (Tente and Lourenço 2016). Given the unstratified nature of the Holocene deposit, absolute ages for the accumulation were obtained via radiocarbon dating of faunal and human remains as well as of diagnostic artefacts made of organic materials. The results corroborate that AMD2 was used during the Early Neolithic, the Bell Beaker period, the Bronze Age, the Iron Age, and the Roman Era, as inferred from typological considerations.

2. THE BELL BEAKER CONTEXT

2.1. Radiocarbon chronology

Here, our focus is on the Late Chalcolithic (Bell Beaker) context, represented by a set of V-perforated ivory buttons and a gold fragment, possibly of a spiral (Zilhão 2016). Six radiocarbon dates on human bone samples provide an age for this context (Tab. 1). As the skeletal remains were disarticulated, the minimum number of dated individuals is given by the four adult first phalanges of the right foot. Of these four, a DNA analysis was able to determine that two, F23-90 and G18-187, were of women (Olalde *et al.* 2018).

According to the sample significance test included in Calib 7.0.4 (Stuiver and Reimer 1993), the six dates are statistically indistinguishable: Test statistic T = 10.72; $\chi^2(0.5) = 11.1$ with five degrees of freedom. Together, these results constrain the burial activity to the 2nd half of the 3rd millennium BC. In the Lisbon peninsula, available radiocarbon dates place the start of the Bell Beaker culture in the middle of the 3rd millennium BC (Soares *et al.* 2007; Cardoso *et al.* 2013; Mataloto *et al.* 2013). Therefore, even though no Beaker ceramics (e.g., "maritime" vessels, Palmela bowls, or Ciempozuelos-type cooking pots) were present among the site's large pottery assemblage, we can be certain that the funerary use of Galeria da Cisterna spans a period during which these different styles of Beaker pottery decoration would seem to have co-existed (Cardoso 2014).

2.2. V-perforated buttons

Fourteen V-perforated buttons made of ivory were recovered during the excavation of AMD2, and another

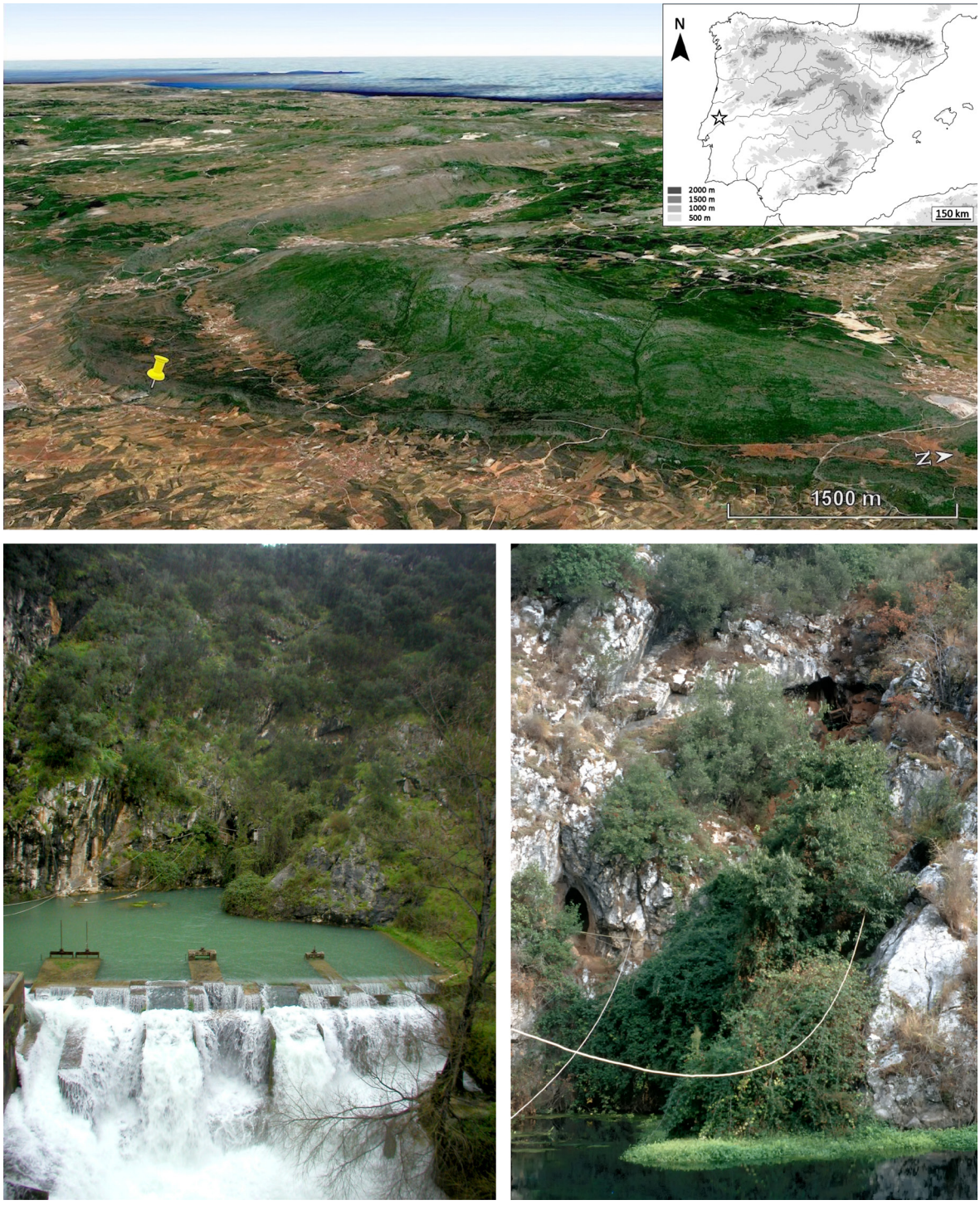
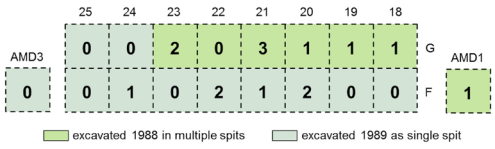
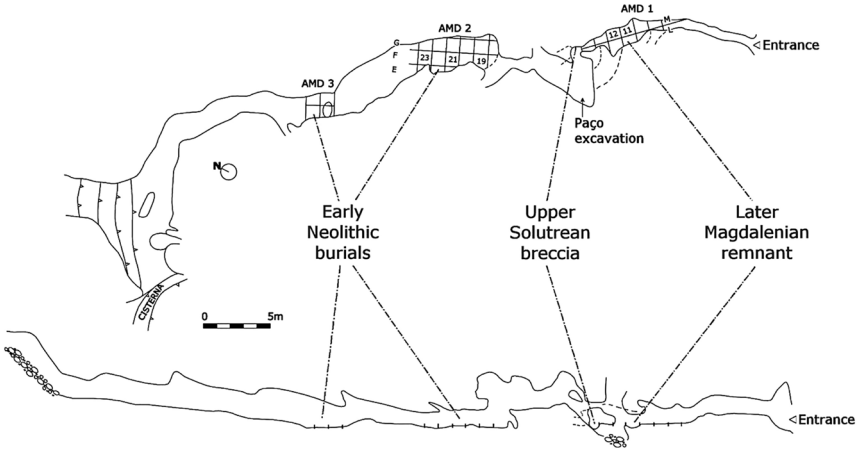


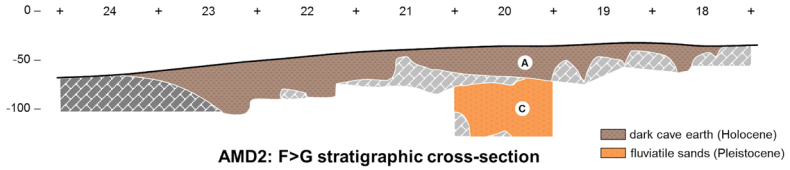
Fig. 1. Location and setting. Top: Overview of the Central Limestone Massif (GoogleEarth view; imagery dated December 31, 2009, with elevations set at 1.5x); the Almonda spring (indicated by the pin) opens at the base of the fault escarpment separating the Tertiary basin of the Tagus from Portuguese Estremadura's Central Limestone Massif; the insert indicates the location in the Iberian Peninsula of the Almonda spring and associated karst network (marked by the star). Bottom left: The Almonda spring in winter; the entrance to the Galeria da Cisterna is visible in the centre of the image. Bottom right**:** The Almonda spring in early summer; the entrance to the Galeria da Cisterna is visible in the lower left corner of the image (after Zilhão 2021: fig. 1c). In colour in the electronic version.



Chalcolithic V-perforated buttons: distribution



Galeria da Cisterna: plan, profile and 1988-89 excavation grid



AMD2: F>G stratigraphic cross-section

Fig. 2. Site plan. Top: Distribution (number of items per grid unit) of the V-perforated buttons recovered in the 1988–89 excavations (those from G20, G21 and G23 come from the basal spits of layer A), and position of the different *loci* and excavation grid along the passage (after Zilhão 2016: fig. 2). Middle: Stratigraphic cross-section along the longitudinal axis of the grid (elevations in cm below datum); except in G20, tested to a depth of ~140 cm below surface, excavation stopped at the surface of layer C, marked by an accumulation of slabs and a dense lens of bat bones (layer B). Bottom left: The AMD2 *locus* seen from downstream after setting-up of the grid; the excavator is squatting in grid unit G20 (after Zilhão 2009: fig 2). Bottom middle: The AMD2 *locus* seen from upstream after setting-up of the grid; the excavator is squatting in grid unit G19. Bottom right: View of the stratigraphy exposed in grid unit G20 — a dark Holocene cave earth (layer A) separated from reddish fluviatile sands (layer C) by collapsed slabs associated with a lens of bat remains (layer B) (after Zilhão 2009: fig 2). In colour in the electronic version.

Field #	Spit	Description	Lab #	Age BP	$\delta^{13}C$ (‰)	cal BC (2σ)*
G21-1079	A3	Human fifth metatarsal	S-EVA-27410	3872±19	-19.5	2480-2239
G21-1762	A4	Human rib	S-EVA-25635	3865±17	-19.5	2457-2238
F23-90	**	Human first phalanx, right foot	OxA-28859	3847±29	-19.2	2458-2203
G18-187	A1	Human first phalanx, right foot	OxA-28857	3836±29	-19.1	2454-2153
G21-1765	A4	Human first phalanx, right foot	OxA-28858	3819±29	-19.5	2438-2143
G19-785	A2	Human first phalanx, right foot	OxA-28856	3774±28	-19.5	2291-2054

Tab. 1. Radiocarbon chronology of the Bell Beaker context. * Calibrated with OxCal v4.4.2 using IntCal20 (Bronk Ramsey 2009; Reimer *et al.* 2020). ** Excavated as a single spit in 1989, after realization that no consistent internal stratigraphy existed in the thin Holocene deposit overlying the basal alluvium.

was found in AMD1 (Fig. 3). Six are complete, three are halves, and the remaining fragments are too small and cannot be classified to type. The complete buttons correspond to the pyramidal type with square base (Fig. 3: 1-3) and to the anthropomorphic type (Fig. 3: 4-6). The three half-buttons (Fig. 4: 1-3) are anthropomorphic. A bottle-shaped bead, previously considered to be a variant of the V-perforated button concept (F18-20; Zilhão 2016: fig. 5, no. 6), was not analysed; it is identical to an object retrieved in the Bronze Age settlement of Cabezo Redondo (Villena, Alicante), radiocarbon dated to the 1765-1276 cal BC interval (Hernández-Pérez *et al.* 2016: 100), and is therefore likely part of the Bronze Age phase of the Galeria da Cisterna's funerary use, otherwise documented by diagnostic ceramics and three radiocarbon dates on astragali of sheep and goat (Martins *et al.* 2015: table 4).

The initial identification of the buttons' raw-material was based on visual observation. Some (cf. Fig. 3: 2-3, 5-6) displayed a white-over-orange/brown colouring pattern reflecting a marked separation between cementum and dentine, a feature that can be observed in the teeth of the sperm-whale. Such an identification was consistent with Schuhmacher *et al*.'s (2013) finding that all Portuguese V-perforated buttons up till then analysed were of sperm-whale ivory.

Several analytical techniques can be used to identify ivory. We have used the determination of the artefacts' density because this non-invasive and non-destructive approach is also among those that best discriminate between ivory types. Indeed, according to Schuhmacher *et al*. (2013), the average specific gravity of the ivory is 1.7 for elephant, 1.6 for mammoth, 1.8 for hippopotamus, and significantly higher, 2.2, for sperm-whale. We were able to measure the specific weight of 13 of the Galeria da Cisterna's 15 buttons. The results are given in table 2 and plotted in figure 5. Using water at its densest as a reference substance, these values, ranging between 1.91 and 2.60 g/cm³ and averaging of 2.32 ± 0.12 g/cm³, are consistent with those for the spe-

Fig. 3. The complete V-perforated ivory buttons from Galeria da Cisterna: 1-3. Pyramidal; 4-6. Anthropomorphic. Inventory numbers: 1. F24-7; 2. G18-455; 3. F22-80; 4. G21-2272; 5. F20-26; 6. G20-1090/G21-2273. Scale bar = 1 cm. In colour in the electronic version. Photos José Paulo Ruas.

Fig. 4. The fragments of V-perforated ivory buttons from Galeria da Cisterna: 1-3. Anthropomorphic; 4-8. Fragments. Inventory numbers: 1. F22-81; 2. SUP-41; 3. G23-6; 4. G21-122; 5. F20-27; 6. G23-15; 7. F21-87; 8. G19-523. Scale bar = 1 cm. In colour in the electronic version.

cific gravity of sperm-whale ivory reported by Schuhmacher *et al*. (2013). These results corroborate that teeth of this marine mammal were indeed the raw-material used.

2.3. Gold

The small gold object illustrated in figure 6, probably a spiral ring fragment, comes from AMD3. Micro-EDXRF analysis of this ornament shows that it was made with a gold-silver alloy (Au 89.5 ± 0.3 wt %, Ag 10.4 ± 0.3 wt %, Cu < 0.04 wt %). This elemental composition is comparable to that of a set of gold ornaments (one double-conical bead, 11 tubular beads, two spiral beads, and one spiral ring) associated with Beaker pottery found in a collective tomb located nearby, at Convento do Carmo, in the city of Torres Novas, some 7.5 km to Southeast (Valério *et al*. 2017).

3. DISCUSSION AND CONCLUSIONS

In the Chalcolithic of Portugal, ivory finds are not infrequent. Possibly due to differential preservation issues (in the acid soils making up most of the inland and of the central and northern parts of the country, archeological contexts seldom yield organics of any kind), their distribution is largely restricted to the littoral bands of limestone substrate in the Algarve and between Coimbra and Lisbon. However, isolated occurrences exist in the interior of Alentejo. Cardoso and Schuhmacher's (2012) review names 40 sites, which yielded 163 objects, most retrieved from the differ-

Locus	Field #	Type	Condition	Specific weight
AMD1	SUP88-41	Anthropomorphic	Half	2.33
AMD2	F20-26	Anthropomorphic	Complete	2.27
AMD2	F20-27	Anthropomorphic	Fragment	2.40
AMD2	F21-87	Undetermined	Fragment	2.12
AMD2	F22-80	Pyramidal	Complete	2.14
AMD2	F22-81	Anthropomorphic	Half	2.60
AMD2	G18-455	Pyramidal	Complete	1.91
AMD2	G19-523	Undetermined	Unfinished?	2.18
AMD2	G20-1090/G21-2273	Anthropomorphic	Refitted broken halves	2.40
AMD2	G21-122	Undetermined	Fragment	2.33
AMD2	G21-2272	Anthropomorphic	Complete	2.28
AMD2	G23-6	Anthropomorphic	Half	2.42
AMD2	G23-15	Undetermined	Fragment	2.32

Tab. 2. Specific weight (g/cm³) of the V-perforated ivory buttons from Galeria da Cisterna, determined using the Archimedes principle.

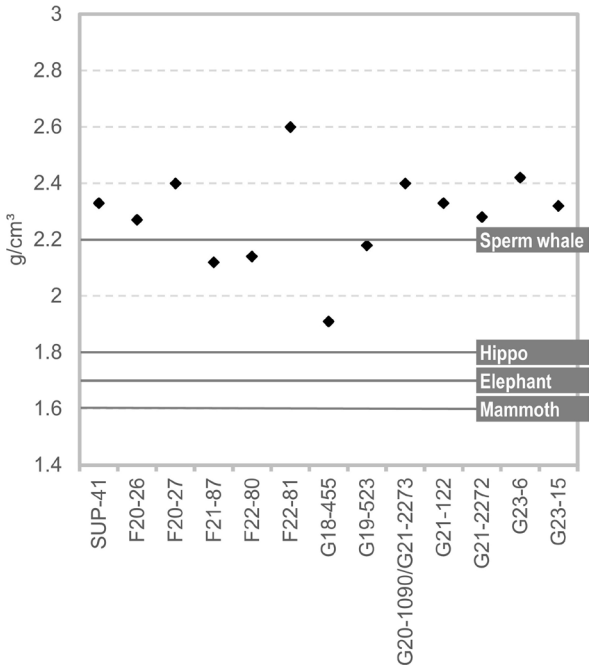


Fig. 5. Specific weights of the Galeria da Cisterna buttons. See table 2 for typological details.

Fig. 6. The Galeria da Cisterna gold. The object is probably a spiral ring fragment. Scale bar = 5 mm. In colour in the electronic version.

ent pre-Beaker phases of the Portuguese Chalcolithic; those authors conclude that the use of ivory decreases in the Beaker period, to which no more than 40 (with a total weight of 68.3 g) of those 163 items could be securely assigned. As subsequent research has shown, these numbers incompletely reflect the importance of ivory during the 3rd millennium BC.

For the Alentejo, the incomplete nature of the picture of Copper Age ivory use available until a decade ago has been eloquently illustrated by Valera *et al.*'s (2015) report of an assemblage totalling 1348 fragments recovered primarily from funerary contexts within the Perdigões ditched enclosure. The majority, 837 of these fragments (1897.3 g) were found in two tholos-type collective tombs associated with the enclosure. The tombs' chronology, based on directly dated human bone remains, spans the second and third quarters of the 3rd millennium BC. The types identified among the ivory ensemble include decorated thin plaques, cylindrical boxes, pins, bracelets, lunulae, beads, different types of idols, dagger hilts, combs, pendants, zoomorphic figurines, a staff, and buttons. The latter are represented by three specimens from Tomb 2, one assigned to its first phase of use and two assigned to the second. Among those second-phase buttons, a "little button with appendages" (Valera *et al.* 2015: 406) is one of the 16 ivory items from Perdigões whose provenience was determined. In all cases, the raw-material was found to come from African savannah elephants (*Loxodonta africana africana*).

The radiocarbon dates in table 1 are indistinguishable from those obtained at Perdigões for the second phase of Tomb 2, and for some in Assemblage 1 (Valera *et al.* 2015: 393-394; Valera *et al.* 2019: table 1.1). Despite the contemporaneity, Galeria da Cisterna's Beaker context yielded no elephant ivory; sperm-whale was the only raw-material identified among V-perforated buttons. Except for a recently reported hippo button from Convento do Carmo (Schuhmacher and Banerjee 2019), the same applies to all of the Lisbon peninsula's Beaker ivory (Schuhmacher 2017). In addition, note that the sperm-whale buttons from the tomb of Verdelha dos Ruivos (located some 20 km northeast of Lisbon) are virtually identical to those from Galeria da Cisterna, as are those from Dolmen das Conchadas (Belas, Lisbon) and the Quinta do Anjo rock-cut tombs (Palmela) illustrated by Schuhmacher *et al.* (2013: fig. 2: 1-6, 12). Typology and raw-material therefore concur to draw a pattern strongly suggestive of the Lisbon peninsula and the Alentejo belonging, during the Beaker period, to largely separate spheres of interaction.

This conclusion is supported by the similar contrast found when comparing the elemental composition of gold objects. In the Chalcolithic of the Lisbon peninsula, they are characterized by a very low Cu content and a consistent Ag content, between 6 and 16 wt %. In the Alentejo and adjacent regions of Spain, they are characterized by a high prevalence of pure gold and a wide range of variation in Ag content (0.7 to 21 wt %) (Valério *et al.* 2017). These authors suggest that the contrast is due to the natural composition of the alluvial sources used in each region, and that it is indicative of "very limited trade of nuggets and jewellery with neighbouring regions."

	Estremadura			Alentejo		
	African elephant	Sperm-whale	Other	African elephant	Sperm-whale	Other
Pre-Beaker	2 (0)	–	1 (0) (a)	15 (0) (c)	–	–
Beaker	–	32 (32)	1 (1) (b)	1 (1) (d)	–	–
TOTAL	2 (0)	32 (32)	2 (1)	16 (1)	–	–

Tab. 3. Regional distribution of the ivory artefacts from the Copper Age of southern Portugal whose raw material has been determined (in parenthesis, the number that are V-perforated buttons). (a) Fossil elephant (*Elephas antiquus*) plaque. (b) Hippo (*Hippopotamus amphibius*?). (c) Artefacts from Perdigões Tombs 1 and 2, which lacked Beaker pottery and yielded six human bone dates in the 2870-2460 cal BC range (Valera *et al.* 2019). (d) From Perdigões Tomb 2, where two human bone dates in the 2470-2200 cal BC range indicate usage that overlaps with the Cisterna context (Valera *et al.* 2019).

The spring of the Almonda being located >40 km inland, its Beaker finds nonetheless imply that the Lisbon peninsula was crisscrossed by extensive trade networks. Likely, not just the gold and the sperm-whale ivory found at Galeria da Cisterna, but also other rare, valuable, and prized raw-materials and finished objects would have been distributed across, but not beyond them. Whether similarly bounded coeval networks existed in the adjacent regions of central and southern Portugal and whether the boundaries (if any) between such networks reflect the geography of the period's polities or simple source-to-destiny distance effects must remain, for the time being, an open issue.

In Chalcolithic contexts of the Lisbon peninsula for which a pre-Beaker age has been postulated, ivory provenance analyses are available for three objects only (Schuhmacher *et al.* 2009; Cardoso and Schuhmacher 2012): a small plaque from the hill-top settlement of Leceia (Oeiras) was made on the ivory of a fossil elephant, *Elephas antiquus*, while a needle from the same site and a barrel-shaped bead from one of the Quinta do Anjo tombs were made of African savannah elephant ivory. Thus, if representative, these data would seem to imply a chronological trend from a pre-Beaker/exotic (North African elephants) to a Beaker/regional (beach-stranded sperm whales) procurement.

Alternatively, we need to bear in mind that the 17 Beaker ivory objects analysed by Schuhmacher *et al.* (2013) plus the 15 we here report on are all ornaments whose size range is consistent with that of a sperm whale's tooth. In secure Beaker contexts of the Lisbon peninsula, larger items such as some of those making-up the Perdigões collection, ones that would have required a bulkier raw-material source, namely elephant tusk (e.g., bracelets), have yet to be analysed. In this respect, note that the study of lead isotopes suggests that the copper artefacts manufactured in the Chalcolithic of the Lisbon peninsula used Ossa-Morena Zone ores (although sources in the so-called Iberian Pyrite Belt cannot be excluded); and the sourcing of the amphibolite used through the 3rd millennium BC to make the polished stone tools found in the region's settlement sites accords well with a similar Alentejan provenance (Cardoso and Barros e Carvalhosa 1995; Lillios 1997; Müller and Cardoso 2008; Müller and Soares 2008; Gauß 2016). Therefore, it remains possible that African elephant ivory continued to be imported and used in the region during the Beaker period, its current invisibility being simply an artefact of functional factors and research biases.

Be it as it may, enough evidence seems to exist that some of the patterns revealed by our data and review are likely real. The evidence, which we summarize in table 3, supports the following conclusions:

During the Beaker period, based on the sample analysed so far, sperm-whale ivory does not seem to be making its way to such Alentejo sites as Perdigões, despite the distance involved – 120 km inland from the mouth of River Sado, where the adjacent sea was used for sperm-whale hunting in the 1920s (Brito 2008) – being much less than that separating such sites from the primary sources (North Africa) of the coevally used elephant ivory. This suggests that the latter arrived in the Alentejo via commercial routes linking the area to the East and South. Put another way, the direct trade connection between North Africa and the Lisbon peninsula hypothesised by Schuhmacher (2017) cannot be supported with present evidence; based on parsimony, it is most likely that the Lisbon peninsula represented instead the tail end of the routes linking the Alentejo with southern Spain (Fig. 7).

Sperm-whale would seem to be an alternative source of ivory that the Lisbon peninsula societies developed in Beaker times to supplement the North Africa-South Spain supply chain. The emergence of this alternative might reflect a growing popularity of the raw-material, implying the need to find additional (or cheaper, i.e., closer) sources to satisfy increased demand (Schumacher *et al.* 2013). Whether the substance's new appeal reflected a change of taste among the elites or responded to a now socially more widespread fashion must remain, however, yet another open issue.

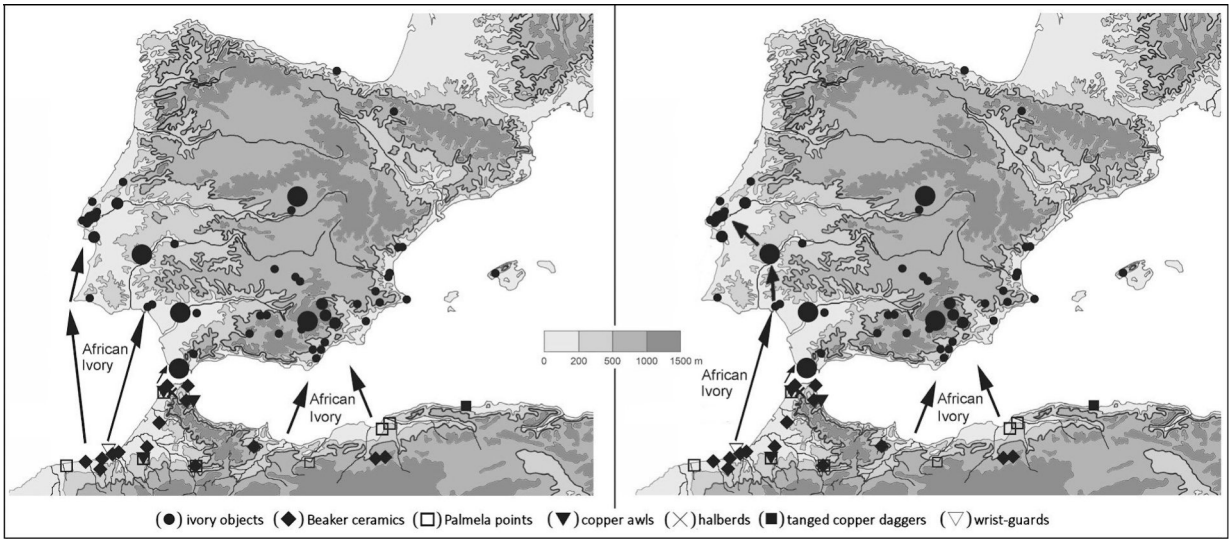


Fig. 7. Iberia-North Africa Beaker trade routes. Distribution of ivory objects in Iberia compared with that of Iberian imports found in the Maghreb (modified after Schuhmacher 2017: fig. 5). Left: Schuhmacher's model. Right: The elephant ivory trade route suggested by the Portuguese evidence.

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