

# Beaker people without beaker pots: the Chalcolithic funerary context from the Galeria da Cisterna (Almonda karst system, Torres Novas, Portugal)

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## ABSTRACT

Even though no characteristic ceramics were found, a small set of V-perforated buttons indicates that the Galeria da Cisterna cave was used for funerary purposes by people of the Beaker culture. Direct dating of human bone corroborates that the bodies of at least four adult individuals were laid down here during the second half of the third millennium cal BC. The buttons belong to well-known types and their textural properties suggest that, as with all the other Portuguese specimens analyzed so far, sperm whale ivory is the raw-material used. A small fragment of a gold spiral completes the site's Beaker context.

KEYWORDS: Bell Beaker, V-perforated buttons, sperm whale ivory, radiocarbon, Portugal.

## RESUMEN

*Campaniformes sin campaniforme: el contexto funerario calcolítico de Galeria da Cisterna (complejo cárstico de Almonda, Torres Novas, Portugal).* A pesar de que no se han recuperado cerámicas del Campaniforme en Galeria da Cisterna, un pequeño conjunto de botones con perforación en "V" indica que la cueva fue utilizada como lugar de inhumación por gentes de esa cultura. La datación directa de restos humanos confirma que al menos cuatro individuos fueron enterrados allí durante la segunda mitad del tercer milenio cal BC. Los botones pertenecen a tipos bien conocidos y las características de la materia prima utilizada indican que, como ocurre con todos los ejemplares de yacimientos portugueses hasta ahora analizados, están fabricados en marfil de cachalote. Un pequeño fragmento de espiral en oro completa este contexto.

PALABRAS CLAVE: Vaso Campaniforme, botones de perforación en "V", marfil de cachalote, radiocarbono, Portugal.

## 1. INTRODUCTION

The Galeria da Cisterna (Gallery of the Cistern; 39°30'17.32"N, 8°36'55.06"W; WGS84 datum; Fig. 1) is an ancient karst outlet of the Almonda river, whose spring is now found ~5 m below, at the base of a ~75 m high rock face. This narrow, meandering passage is approximately 100 m long, and its cross-section is in general less than 2×2 m (Fig. 2). The entrance was exposed in the 1920s by a landslide, which allowed access and a first phase of limited archaeological work, carried out between 1937 and 1942 (Paço et al., 1947; Guilaine and Veiga Ferreira, 1970). In 1988-89, a second phase of work delimited the area affected by these earlier explorations, identified additional deposits filling discontinuous depressions in the karren-like bedrock, and excavated them in three loci: AMD1, AMD2 and AMD3 (Maurício, 1988; Zilhão, Maurício and Souto, 1991, 1993; Zilhão and Carvalho, 2011; Zilhão, 1997, 2001, 2009; Carvalho, 2007; Trinkaus et al., 2011; Martins et al., 2015).

Under Holocene cave earth, a remnant Upper Paleolithic deposit containing two archeologically fertile units (levels 3 and 4) existed in the AMD1 locus. A few tens of stone tools

and animal bone fragments were recovered in each; level 3, radiocarbon-dated to 13-14 ka cal BP (thousands of calendar years before present), also yielded perforated shell beads and a small set of human remains. AMD3 corresponded to a low-density lens of organic sediments directly atop bedrock. AMD2 (of which AMD3 is but a continuation, the two loci being separated by outcropping bedrock) is the more spacious area of the Galeria da Cisterna. The upper reaches of the stratigraphy uncovered here consisted of a homogeneous, 20-40 cm thick cave earth of Holocene age (level A); this deposit lied on beaver teeth-yielding, river-accumulated Pleistocene sands (level C), from which it was separated by a dense lens of microfaunal remains, mostly of bats (level B).

Level A contained a chronologically heterogeneous, high-density accumulation of pottery and stone and metal tools, as well as personal ornaments made of shell, bone, stone, glass, bronze and iron, commingled with highly fragmented faunal and human osteological remains. The lack of internal stratigraphic differentiation is primarily due to the thinness of the deposit, compounded by the impact of repeated prehistoric and early

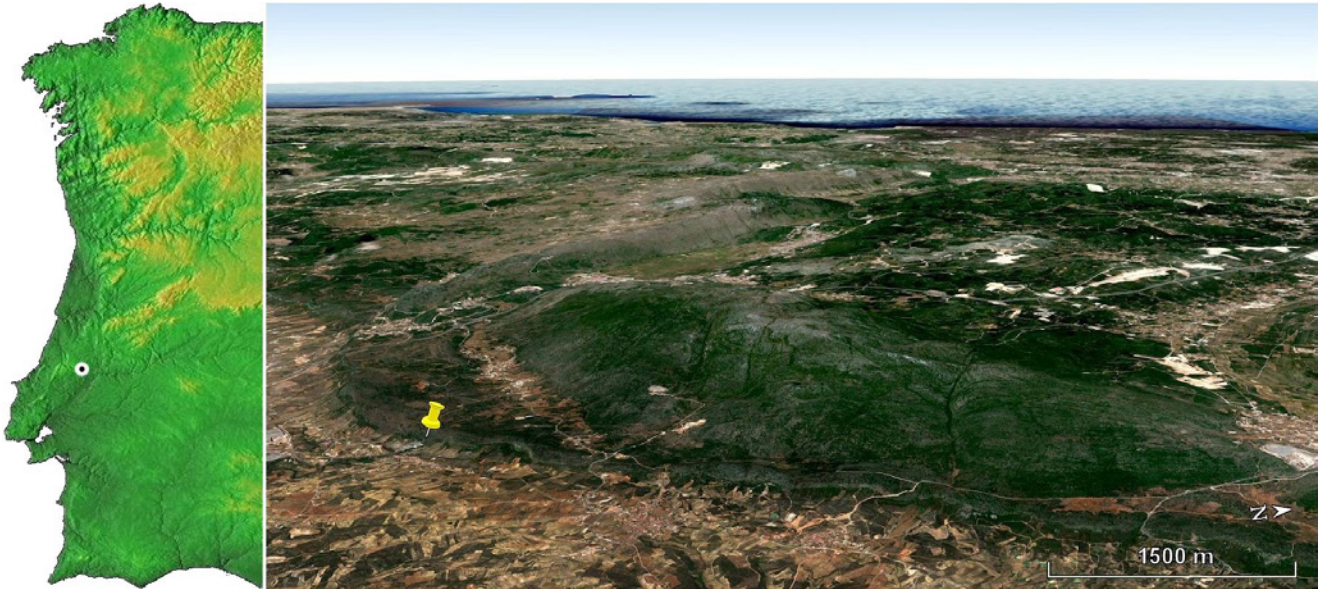


Fig. 1. The Almonda karst system: location and geographical setting. The GoogleEarth view uses imagery dated December 31, 2009 and has elevations set at 1.5x. The spring of the Almonda opens at the base of the fault escarpment separating the Tertiary basin of the Tagus from the Central Limestone Massif of Estremadura.

historic human frequentation and the activity of burrowing animals. The occasional reactivation of the passage whenever the water level in the karst is exceptionally high has always represented an additional source of turbation. The restricted space, unsuitable for residential purposes, and the numerous human skeletal remains, suggest an exclusively funerary use of the place; the associated fauna and artefacts are therefore likely to reflect burial offerings and/or to be part of the clothing borne by the deceased at the time of body deposition in the cave.

## 2. THE BEAKER CONTEXT

The overwhelming majority of the diagnostic ceramics from AMD2 is of unambiguous attribution to the Early Neolithic, and the same applies to the small number of stone tools found alongside. The range of ornaments in these deposits is also dominated by items that are characteristic of the Early Neolithic as documented in both eastern Spain (Pascual, 1998) and Portugal (Zilhão, 1992, 1993, 2009). However, although primarily an Early Neolithic cemetery, the presence of later prehistoric, proto-historic and Roman artefacts shows that the AMD2 locus of Galeria da Cisterna continued to be used in similar manner in post-Neolithic times.

Given the unstratified nature of the Holocene deposit, the age of the different AMD2 occupations was established via direct radiocarbon dating of samples consisting of diagnostic artefact categories and/or faunal and human remains representing different individuals (Zilhão, 2001; Martins et al., 2015). This strategy corroborated use of the locus in periods for which occupation was inferred on the basis of typological considerations, namely:

- Early Neolithic, as anticipated from the Cardial and Epicaldial affinities of most decorated ceramics and confirmed by results of 6445±45 BP (OxA-9287) for a pierced deer canine,

- 6445±45 BP (OxA-9288) for a bone bead imitating the shape of a deer canine, and 6280±34 BP (OxA-28855) for a first phalanx of the right foot of an adult human;

- Bronze Age, as anticipated on the basis of undecorated sherds with characteristic carinated morphology and confirmed by the results obtained on three right astragali of caprines — 3378±32 BP (OxA-X-2515-17; sheep), 3354±28 BP (OxA-27984; goat), and 3310±28 BP (OxA-27983; probably goat);

- Late Iron Age, as anticipated on the basis of a few fragments of wheeled pottery with characteristic stamped impressions and confirmed by another result on a right astragalus of a caprine (probably sheep) — 2129±27 BP (OxA-27982).

Four other adult human first phalanges of the right foot representing as many different individuals (Table 1; Fig. 3) were dated to between 3774±28 BP (OxA-28856) and 3847±29 BP (OxA-28859) (Table 2; Fig. 4). According to the Calib 7.0.4 significance test (Ward and Wilson, 1978; Stuiver and Reimer, 1993), these samples are statistically indistinguishable at the 95% confidence level. They indicate funerary use of the AMD2 locus during the second half of the third millennium cal BC, more specifically between 2061 and 2433 cal BC. If we assume that a single burial episode is represented by the four results and calculate their pooled mean, we can restrict this interval to just under a century (2201-2298 cal BC); whether the assumption is warranted is, however, uncertain.

In Portugal, this chronological range corresponds to the Bell Beaker culture of the Copper Age. Based on the contexts recently published by Cardoso (2014a) — namely, the open-air settlement of Freiria, AMS-dated on animal bone to 3630±40 BP (Beta-296577) and 3770±40 BP (Beta-260301), and the cave burial site of Ponte da Lage, AMS-dated on human bone to 3833±26 BP (Wk-34424) and 3846±30 BP (Wk-25164) — the four AMD2 individuals from the third millennium would belong to a later phase of the culture, when the characteristic

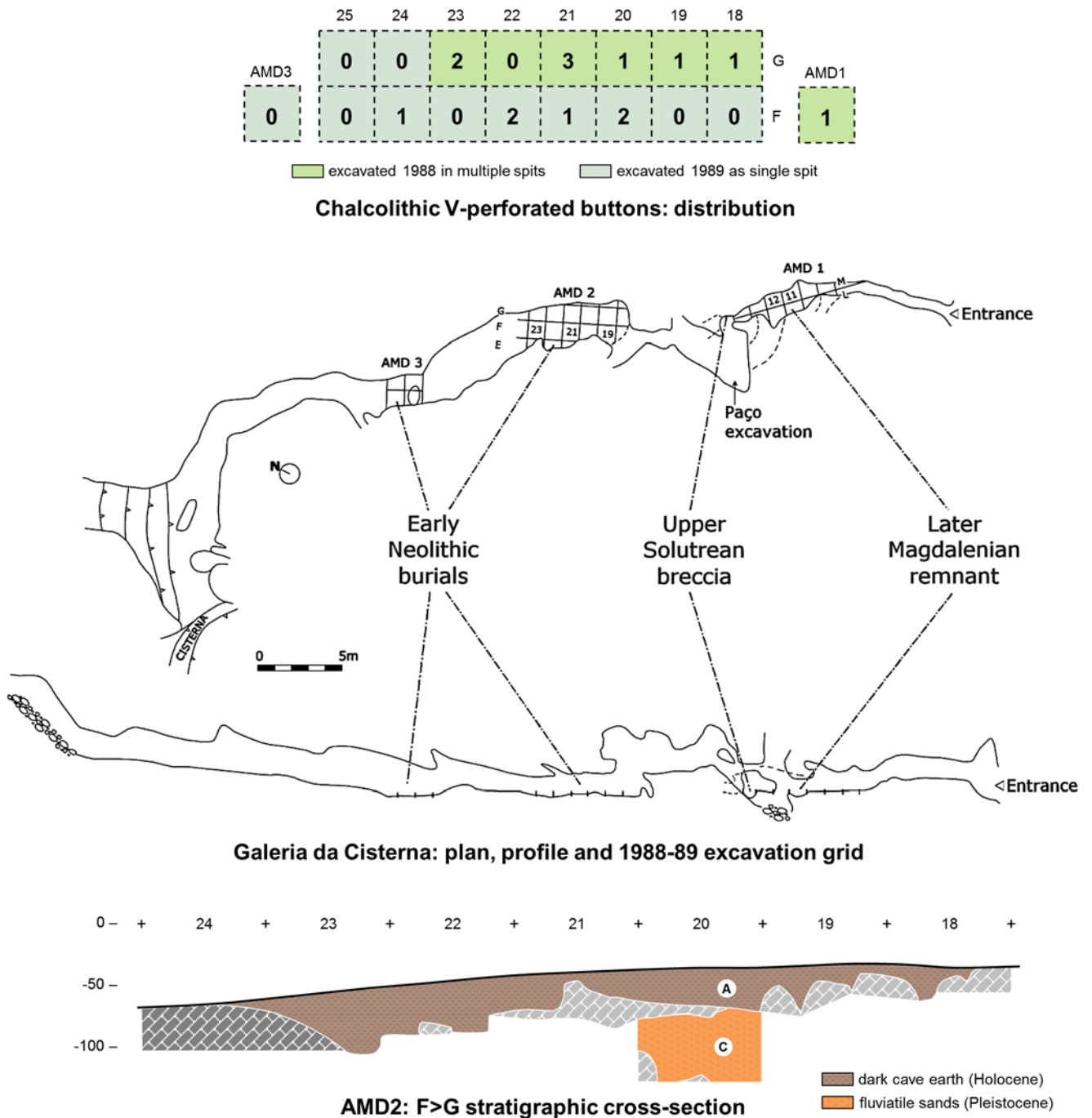


Fig. 2. The Galeria da Cisterna (Almonda karst system). TOP: distribution (number of items per grid unit) of the V-perforated buttons recovered in the 1988–89 excavations; those from G20, G21 and G23 come from the basal spits of layer A. MIDDLE: topographic plan and profile, with indication of the excavation grid. BOTTOM: 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 boulders and slabs and a dense lens of bat bones (layer B).

decoration of its ceramics was effected with incision rather than impression techniques. However, because no Beaker pots were recovered in the Galeria da Cisterna, this inference cannot be taken any further.

The artefact assemblage recovered in the Galeria da Cisterna also features a set of V-perforated buttons (Table 3, Figs. 2 and 5), a type of object that is commonly found in Beaker

contexts (Roche and Veiga Ferreira, 1961; Uscatescu, 1992). One was recovered on the surface of locus AMD1, the others come from the excavation of locus AMD2. Six are complete, three are half-broken, and two are small fragments preserving enough of the original morphology for their classification to be secure; there is also a possibly unfinished blank, and two small flat ivory fragments probably represent as many addi-

Table 1. Human right foot first phalanges from Galeria da Cisterna (AMD2) directly dated to the Beaker period. Measurements are in mm; the value in italics is an estimate of the distal breadth prior to loss of the missing articulation.

Catalogue #	GL	Bp	SD	Bd
F23-90	26.9	17.3	10.6	13.6
G18-187	31.5	18.5	11.9	16.5
G19-785	29.7	17.1	12.9	14.8
G21-1765	39.2	20.5	13	17

GL = greatest length  
 Bp = greatest breadth of the proximal end  
 SD = smallest breadth of the dyaphysis  
 Bd = greatest breadth of the distal end



Fig. 3. Human first phalanges from the right foot, representing four different individuals, directly dated by radiocarbon to the time range of the Bell Beaker period. A. F23-90; B. G19-785. C. G21-1765; D. G18-187. Scale bars = 1 cm.

tional buttons. The complete specimens correspond to the following types: pyramidal with square base (Fig. 5, nos. 1-3), and anthropomorphic (Fig. 5, nos. 4-5 and 7). One of the anthropomorphic buttons (Fig. 5, no. 5) bears two simple perforations on the reverse side instead of the normal V-perforation seen on the other two. Another (Fig. 5, no. 7) was found in two separate, conjoining halves, and three of the fragments of anthropomorphic buttons correspond to similar halves of identical morphology whose pair could not be found.

A perforated ivory piece in the shape of a baseball bat (Fig. 5, no. 6) probably belongs in this context as well; it could represent an elongated variant of Uscatescu’s (1992) “tortuga with one appendix” type, perhaps repaired or reworked from a larger piece after breaking (Pascual Benito, personal communication, July 17, 2015). Indeed, similar, V-perforated specimens are known from a few sites elsewhere in Iberia, namely the Copper Age fortified settlement of Vila Nova de São Pedro, situated some 40 km to the Southwest (Roche and Veiga Ferreira, 1961).

In the rock-cut tombs of Rocallaura, in Catalonia (Vilaseca, 1953), and São Pedro do Estoril, in Portugal (Leisner, Paço and Ribeiro, 1964; Cardoso, 2014b), aligned rows (of thirteen and eleven, respectively) of buttons were found in situ, indicating the presence of clothing and corroborating the items’ inferred functionality. Vilaseca (1953) suggests that, of the two individuals in the Rocallaura tomb, the row of buttons associated with one indicates the presence of a front-buttoned skirt and, hence, of a female (the other, based on its association with a copper dagger, would have been male). Harrison and Heyd’s (2007) argument that, in the Beaker culture, such buttons are female-related, supports Vilaseca’s suggestions and, following these authors, we would therefore conclude that at least one of the adult humans from AMD2 dated to the Beaker period would have been a woman. The fragmentary nature of the bone remains prevents addressing the issue from a physical anthropological perspective, but ongoing ancient DNA work has already established that two of them are indeed female (Lalueza-Fox, personal communication, July 20, 2015).

Schuhmacher et al. (2013) analyzed 15 Portuguese V-perforated buttons, including eight of the anthropomorphic type and four of the related tortuga type. They have shown that, in all cases, these buttons were carved out of sperm whale ivory. Visual inspection of the Galeria da Cisterna specimens indicates that, whenever the distinction can be ascertained, they too are made out of tooth, not bone; in particular, nos. 2-3 and 5-6 of Fig. 5 display a white-over-orange/brown coloring pattern reflecting the marked separation between cementum and dentine featured by the teeth of the sperm whale. Given

Table 2. Oxford AMS radiocarbon dating results for Galeria da Cisterna (AMD2) Beaker humans. Calibration used OxCal v.4.2.4 with the INTCAL13 calibration curve (Bronk Ramsey, 2013; Reimer et al., 2013).

Catalogue #	Spit	OxA-	Age BP	Used (mg)	Yield (mg)	%Yld	%C	δ <sup>13</sup> C (‰)	δ <sup>15</sup> N (‰)	C:N ratio	cal BC (2σ)
F23-90	–	28859	3847±29	600	34.4	5.7	43.8	-19.24	9.20	3.3	2206-2457
G18-187	A1	28857	3836±29	600	66.99	11.2	45.4	-19.15	9.30	3.3	2201-2456
G19-785	A2	28856	3774±28	620	51.62	8.3	46.6	-19.53	8.60	3.3	2061-2290
G21-1765	A4	28858	3819±29	820	46.5	5.7	45	-19.50	8.90	3.4	2144-2433

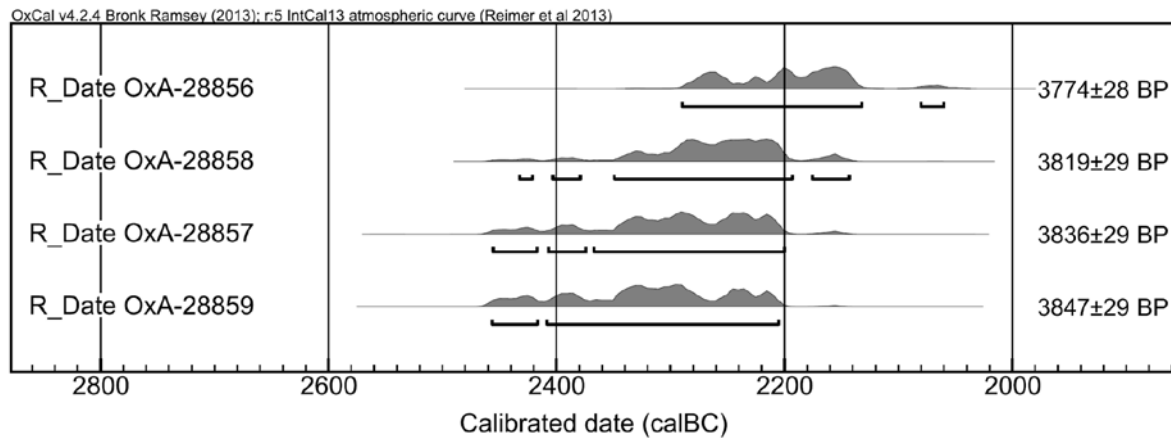


Fig. 4. Age ranges of the four individuals from the Galeria da Cisterna directly dated by radiocarbon to the Bell Beaker period. Calibration used OxCal v.4.2.4 with the INTCAL13 calibration curve (Bronk Ramsey, 2013; Reimer et al., 2013).

this texture and the 9.2 mm thickness of one of the pyramidal specimens in which the pattern can be observed, we can infer that large, non-hollowed teeth were used in the manufacture of these buttons. This fact excludes other marine mammals, and the overall size of these buttons further implies that such teeth could have not come from even the largest of the terrestrial mammals, wild or domestic, then living in the country.

Even though analytical corroboration remains necessary, it is therefore concluded that the raw-material the Galeria da Cisterna buttons are made of is sperm whale ivory. The occurrence of the

species in coastal waters is well documented; historical records extend its exploitation back to the 12th century AD but whether this involved hunting or just the manipulation of the bodies of stranded animals remains to be clarified (Brito, 2008). As pointed out by Schuhmacher et al. (2013), a significant implication of the Portuguese Beaker buttons is that, along the country's coast, land-based whaling has deep roots in late prehistoric times.

A small fragment of gold spiral recovered in zone AMD3 (Fig. 6) completes this Beaker context. In the rock-cut tomb of São Pedro do Estoril, a complete gold spiral of similar

Table 3. Buttons from the Galeria da Cisterna. Measurements are in mm. Length is the dimension defined by the horizontal alignment of the perforations and width is the dimension measured perpendicular to length; for the flat forms, height is the maximum thickness of the object and sagitta is the height of the arc defined along the length of the concave face, when one exists.

Catalogue number	Layer	Spit	Condition	Length	Width	Height	Sagitta
<i>Anthropomorphic</i>							
AMD1-SUP88-41	Surface	–	half-broken	30.0	–	5.8	1.3
AMD2-F20-26	A	–	complete	24.8	20.1	7.2	0.0
AMD2-F20-27	A	–	fragment	–	–	2.9	–
AMD2-F22-81	A	–	half-broken	24.8	–	5.5	–
AMD2-G20-1090/G21-2273	A	B2/A4	two broken halves refitted	28.4	24.2	7.0	4.2
AMD2-G21-2272	A	A4	complete	21.5	16.7	3.2	0.0
AMD2-G23-6	A	A4	half-broken	30.4	–	6.0	–
<i>Pyramidal</i>							
AMD2-F22-80	A	–	complete	13.1	14.4	5.6	n/a
AMD2-F24-7	A	–	complete	15.4	14.8	9.2	n/a
AMD2-G18-455	A	A1	complete	23.3	20.5	9.2	n/a
<i>Undetermined</i>							
AMD2-F21-87	A	–	fragment	–	–	–	–
AMD2-G19-523	A	A1	unfinished?	22.8	13.5	2.2	0.6
AMD2-G21-122	A	A1	fragment?	–	–	1.8	–
AMD2-G23-15	A	A4	fragment?	–	–	3.7	–



Fig. 5. The complete V-perforated and associated ivory buttons from Galeria da Cisterna: 1-3. Pyramidal; 4-5, 7. Anthropomorphic; 6. Reworked tortuga type (?). Inventory numbers: 1. F24-7; 2. G18-455; 3. F22-80; 4. G21-2272; 5. F20-26; 6. F18-20; 7. G20-1090/G21-2273. Scale bar = 1 cm. Photos: José Paulo Ruas.

make was found around a human phalange, proving use as a ring. Direct dating of that phalange to  $3790 \pm 40$  BP (Beta-178468; Gonçalves, 2009) placed the associated spiral in the time range (2045-2401 cal BC) of the Beaker-aged humans from Galeria da Cisterna. This result supports attribution to the same period of the Cisterna gold piece as well as its interpretation as funerary gear — in this case, given size, we are probably dealing with an earring fragment.

### 3. DISCUSSION

In Spain as a whole, according to Uscatescu (1992), the square base type of pyramidal buttons is commonly ascribed to the “Eneolithic”, a designation that subsumes the Beaker culture with the Bronze Age. On the face of this ascription, one might be led to



Fig. 6. The fragment of gold spire from Galeria da Cisterna (AMD3-6). Scale bar = 5 mm.

posit that it is equally plausible that the specimens of this specific type found in AMD2 belong in the Bronze Age context defined by this locus’ carinated ceramics and caprine bones, dated by the latter to the second quarter of the second millennium cal BC.

However, in Valencia, Bernabeu (1984: 101) states that most pyramidal buttons come from Incised Beaker contexts, namely those retrieved from the sites of Cova Bolta, Cova Bolumini, Cova de la Recambra and Cova Santa de Mallada. Interestingly, this author also cites two instances where such buttons are the only Beaker diagnostic present — Cova de Giner and Cova del Partidor. Rather than stand for the persistence of the type into non-Beaker, later periods (and the absence of Bronze Age ceramics does preclude such an assignment), these two sites therefore seem to represent Valencian counterparts of the Beaker-people-without-Beaker-pots situation identified in the Galeria da Cisterna.

Assigning pyramidal buttons to the Beaker period is also consistent with the Catalonian evidence. In the Rocallaura tomb, the presumably male-associated dagger found with the presumably female-associated pyramidal buttons is of a type (elongated, tongued) commonly found in Beaker contexts. Another sepulchral cave yielding a closed context of rather homogeneous material culture is Calvari d’Amposta (Esteve, 1966); here, Beaker pots and a copper tongue dagger were found in Burials 1 and 2, while Burial 4 yielded five pyramidal buttons made out of shell in association with a small, undecorated, hemispheric vessel (10 cm in diameter, 5.6 cm in height).

In addition, in the few cases where pyramidal buttons come from stratified contexts, Beaker ceramics were found alongside. This is the case in Portugal, where the square-based subtype was hitherto unrecorded but the one rectangular-based specimen known comes from the Beaker level of Vila Nova de São Pedro (Roche and Veiga Ferreira, 1961: Fig. 1, no. 8). It is also the case in Catalonia, namely at Cova del Frare, where a square-based pyramidal button comes from level 3, dated on a bulk charcoal sample to  $3990 \pm 100$  BP (MC-2296) and for which a date on a similar sample collected at the interface with overlying Bronze Age level 2 provides the terminus ante quem of  $3790 \pm 100$  BP (Martín, Guilaine and Thommeret, 1981). These chronological constraints place the Cova del Frare specimen in the time range of the Cisterna Beaker humans; in addition, this 15 mm object is about the same size as the AMD2 specimens, even if a bit thinner (5 mm) — which may well relate to the fact that it is made out of shell instead of ivory.

Another Catalonian example concerns the Neo-Chalcolithic funerary horizon of Can Sadurní cave, where both forms of the pyramidal button, rectangular and square, were found together (Edo, Blasco and Villalba, 2011). This horizon is a cultural palimpsest spanning the entire interval comprised between the Middle Neolithic and the Bronze Age; establishing the associations of the buttons is therefore not an easy task but, alongside the characteristic ceramics, this horizon yielded a number of other Beaker diagnostics, namely barbed and tanged, bifacially flaked flint arrowheads. In addition, most of the 53 buttons retrieved therein were found at the interface between excavation units 8 (defined as “Neo-Chalcolithic”) and 9c (defined as “Early Bronze Age”). This stratigraphic evidence suggests that the Can Sadurní buttons belong in the later part of the Copper Age and are more likely to be related to the Beaker ceramics found in the upper part of unit 8 than to the components defining an earlier, Late Neolithic or Verazien mortuary context, most of which were recovered towards the base of that unit.

This pattern is replicated in the Balearic archipelago. In Mallorca, a set of pyramidal buttons is known from the rock-shelter of Cueva de los Muertos (Waldren and Kopper, 1967; Stuiver, 1969). Retrieved in an apparently well-stratified sequence, they were associated with Incised Beaker ceramics, and a bulk charcoal date of 3790±80 BP (Y-1789) obtained for this context falls, again, in the time range of the Cisterna Beaker humans.

Although pyramidal is believed to be the correct classification, describing one of the AMD2 specimens (no. 3 of Fig. 5) as prismatic would not be inappropriate because of its low height and flattened, smoothed apex. According to Uscatescu (1992: Fig. 34), however, prismatic buttons are only found in the eastern half of the Iberian Peninsula and in the Balearics while, chronologically, they would belong in the Early Bronze rather than the Copper Age. In the case of the Galeria da Cisterna specimen, assignment to the prismatic type would therefore imply, on one hand, a significant geographic distribution anomaly, and, on the other, the possibility that this button (and perhaps the pyramidal ones as well) related to an Early Bronze Age context whose other components would remain unidentified (namely, among the ceramics). Considering the set of available radiocarbon results, however, it is clear that no use of the Galeria da Cisterna is documented during a period of at least four centuries (2061-1658 cal BC) — and perhaps as much as eight (2290-1511 cal BC) — following the interval defined by the Beaker dates. As this hiatus entirely encompasses the time range of the Early Bronze Age in Portugal (Mataloto, Martins and Soares, 2014), it is therefore rather unlikely that any of the Cisterna buttons relates to this period instead of the Beaker.

Bearing in mind the problems of typological ambiguity illustrated by the Cisterna specimen, it must also be noted that Uscatescu (1992) records a number of Catalonian instances where the prismatic-square type is associated with Beaker or so-called epi-Beaker ceramics, namely: the Garrofer cave, where the association included a pyramidal specimen; and Cova del Frare, where, as seen above, a pyramidal specimen comes from level 3 and the prismatic specimen is from overlying level 2 — assigned to the Bronze Age but also containing ceramics decorated in Beaker fashion (Martín, Guilaine and Thommeret, 1981: 105). Considering the fuzziness of the boundaries and the instances of stratigraphic reversals apparent in the site’s dating (Martins et al., 2015), this Cova del Frare evidence is not inconsistent with the

notion that the two buttons belong in its Beaker occupation. That buttons classified as prismatic can also occur in Beaker contexts is further supported by Pascual’s (1998: 168) account, based on Arribas and Molina (1979), of the distribution of the type in the stratified settlement of Castillejos de Montefrío (Granada): “pyramidal ivory buttons appear in phase IV, in association with maritime and stippled Beakers, and become larger, adopting a range of shapes (pyramidal and prismatic), in phase V (Incised Beaker)”.

The buttons that Roche and Veiga Ferreira (1961) define as “stylized anthropomorphic” and form Uscatescu’s (1992) type XIV are exclusive to the Lisbon peninsula. These authors list finds made at habitation sites, namely the hilltop settlements of Castro de Olelas and Castro do Zambujal, as much as in funerary sites of four kinds: rock-cut tombs (Quinta do Anjo, Palmela; São Pedro do Estoril, Cascais); dolmens (Cabeço dos Moinhos, Figueira da Foz); tholoi (São Martinho, Sintra, and Conchadas, Adebeja); and natural caves (Casa da Moura, Cesareda; Verdelha dos Ruivos, Vila Franca de Xira). In all these instances, pottery and other items regionally diagnostic of the Beaker culture were also present.

#### 4. CONCLUSION

Despite the shortcomings of their immediate context, the small set of V-perforated buttons from the Galeria da Cisterna can therefore be confidently considered as documenting funerary use of the site by people of the Bell Beaker culture. The dating evidence and the broader context suggest that such use more specifically occurred during the later, so-called “Incised” phase of the culture. The raw-material used for the manufacture of these buttons is likely to have been sperm whale ivory, as previously documented in a number of localities in littoral Portugal (Schuhmacher et al., 2013): the Palmela rock-cut necropolis, on the estuary of the Sado; the megalithic tomb of Conchadas, the cave of Verdelha dos Ruivos, and the hill-top settlement of Pedra do Ouro, on the estuary of the Tagus. The spring of the Almonda, however, is located >40 km inland, and the innermost reaches of the Tagus estuary are at a similar distance. The ivory, therefore, is unlikely to have been directly obtained by the resident populations that used the site for funerary purposes. Rather, its acquisition, or that of the finished objects themselves, must reflect the existence of trade networks through which the material and/or the items circulated widely across the region. By the same token, we can infer from such a circulation that, like the gold ornaments with which, as is the case at Cisterna, they are often associated, ivory buttons would have been rare, valuable and prized — perhaps more so than the distinctive decorated vessels that define the Beaker culture and are conspicuously absent from the Galeria da Cisterna ceramic assemblage.

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## REFERENCES

- ARRIBAS, A. and MOLINA, F. (1979): "Nuevas aportaciones al inicio de la metalurgia en la Península Ibérica. El poblado de Los Castillejos de Montefrío (Granada)". In M. Ryan (ed.): *The origins of metallurgy in Atlantic Europe. Proceedings of the fifth Atlantic colloquium (Dublin 30th March to 4th April 1978)*. The Stationery Office, Dublin, p. 7-34.
- BERNABEU, J. (1984): *El vaso campaniforme en el País Valenciano*. Servicio de Investigación Prehistórica, Diputación Provincial de Valencia (Trabajos Varios del SIP, 80), 140 p.
- BRITO, C. (2008): "Assessment of catch statistics during the land-based whaling in Portugal". *Marine Biodiversity Records*, 1, e92 (<http://dx.doi.org/10.1017/S175526720700930X>).
- BRONK RAMSEY, C. (2009): "Bayesian analysis of radiocarbon dates". *Radiocarbon*, 51 (1), p. 337-360.
- CARDOSO, J.L. (2014a): "Absolute chronology of the Beaker phenomenon North of the Tagus estuary: demographic and social implications". *Trabajos de Prehistoria*, 71 (1), p. 56-75.
- CARDOSO, J.L. (2014b): "A presença campaniforme no território português". *Estudos Arqueológicos de Oeiras*, 21, p. 29-82.
- CARVALHO, A. F. (2007): *A neolitização do Portugal meridional. Os exemplos do Maciço Calcário Estremenho e do Algarve ocidental*. PhD dissertation, University of the Algarve.
- BLASCO, A.; EDO, M. and VILLALBA, M.J. (2011): "La cova de Can Sadurní, guió sintètic de la prehistòria recent de Garraf". In A. Blasco, M. Edo, and M. J. Villalba (eds.): *La cova de Can Sadurní i la prehistòria de Garraf. Actes de les Jornades Internacionals de Prehistòria 'El Garraf, 30 anys d'investigació arqueològica'*. Begues, 5 al 7 de desembre de 2008. EDAR-Hugony, Milan, p. 13-95.
- ESTEVE, F. (1966): "La cueva sepulcral del 'Calvari d'Amposta'". *Pyrenae*, 2, p. 35-50.
- GONÇALVES, V.S. (2009): "Construir para os mortos. Grutas artificiais e antas na Península de Lisboa. Algumas leituras prévias". *Estudos Arqueológicos de Oeiras*, 17, p. 237-260.
- GUILAINE, J. and VEIGA FERREIRA, O. (1970): "Le Néolithique ancien au Portugal". *Bulletin de la Société Préhistorique Française*, 67, p. 304-322.
- HARRISON, R. and HEYD, V. (2007): "The Transformation of Europe in the Third Millennium BC: the example of 'Le Petit-Chasseur I + III' (Sion, Valais, Switzerland)". *Praehistorische Zeitschrift*, 82 (2), p. 129-214.
- LEISNER, V.; PAÇO, A. and RIBEIRO, L. (1964): *Grutas artificiais de São Pedro do Estoril*. Fundação Calouste Gulbenkian, Lisboa, 78 p.
- MARTÍN, A.; GUILAINE, J. and THOMMERET, Y. (1981): "Estratigrafía y dataciones C<sup>14</sup> del yacimiento de la 'Cova del Frare' de St. Llorenç del Munt (Matadepera, Barcelona)". *Zephyrus*, XXXII-XXXIII, p. 101-111.
- MARTINS, H.; OMS, F.X.; PEREIRA, L.; PIKE, A.W.G.; ROWSELL, K. and ZILHÃO, J. (2015): "Radiocarbon dating the beginning of the Neolithic in Iberia: new results, new problems". *Journal of Mediterranean Archaeology*, 28 (1), p. 105-131.
- MATALOTO, R.; MARTINS, J.M.M. and SOARES, A.M.M. (2013): "Cronologia absoluta para o Bronze do Sudoeste. Periodização, base de dados, tratamento estatístico". *Estudos Arqueológicos de Oeiras*, 20, p. 303-338.
- MAURÍCIO, J. (1988): "Contribuição para o conhecimento da Pré-História de Torres Novas". *Almondinha*, 2, p. 6-9.
- PAÇO, A.; VAULTIER, M. and ZBYSZEWSKI, G. (1947): "Gruta da Nascente do Rio Almonda". *Trabalhos de Antropologia e Etnologia*, XI (1-2), p. 171-187.
- PASCUAL, J.L. (1998): *Utilidade Óseo, Adornos e Ídolos Neolíticos Valencianos*. Servicio de Investigación Prehistórica (Trabajos Varios del SIP, 95), Valencia, 358 p.
- REIMER, P.J.; BARD, E.; BAYLISS, A.; BECK, J.W.; BLACKWELL, P.G.; BRONK RAMSEY, C.; BUCK, C.E.; CHENG, H.; EDWARDS, R.L.; FRIEDRICH, M.; GROOTES, P.M.; GUILDERSON, T.P.; HAFLIDASON, H.; HAJDAS, I.; HATTÉ, C.; HEATON, T.J.; HOFFMANN, D.L.; HOGG, A.G.; HUGHEN, K.A.; KAISER, K.F.; KROMER, B.; MANNING, S.W.; NIU, M.; REIMER, R.W.; RICHARDS, D.A.; SCOTT, E.M.; SOUTHON, J.R.; STAFF, R.A.; TURNEY, C.S.M. and VAN DER PLICHT, J. (2013): "IntCal13 and MARINE13 radiocarbon age calibration curves 0-50000 years calBP". *Radiocarbon*, 55 (4), p. 1869-1887.
- ROCHE, J. and VEIGA FERREIRA, O. (1961): "Révision des boutons perforés en V de l'Énéolithique portugais". *L'anthropologie*, 65 (1-2), p. 67-73.
- SCHUHMACHER, Th.X.; BANERJEE, A.; DINDORF, W.; SASTRI, C. and SAUVAGE, Th. (2013): "The use of sperm whale ivory in Chalcolithic Portugal". *Trabajos de Prehistoria*, 70 (1), p. 185-203.
- STUIVER, M. (1969): "Yale natural radiocarbon measurements IX". *Radiocarbon*, 11 (2), p. 545-658.
- STUIVER, M. and REIMER, P.J. (1993): "Extended <sup>14</sup>C Data Base and Revised CALIB 3.0 <sup>14</sup>C Age Calibration Program". *Radiocarbon*, 35 (1), p. 215-230.
- TRINKAUS, E.; BAILEY, S.; DAVIS, S.J.M. and ZILHÃO, J. (2011): "Magdalenian Human Remains from the Galeria da Cisterna (Almonda karstic system, Torres Novas, Portugal)". *O Arqueólogo Português*, Série V, 1, p. 395-413.
- USCATESCU, A. (1992): *Los botones de perforación en "V" en la Península Ibérica y las Baleares durante la Edad de los Metales*. Foro, Madrid, 270 p.
- VILASECA, S. (1953): "Un sepulcro prehistórico en Rocallaura y otros hallazgos". *Zephyrus*, IV, p. 466-472.
- WALDREN, W.H. and KOPPER, J.S. (1967): "Mallorca chronology for Prehistory based on Radiocarbon method". *Pyrenae*, 3, p. 45-65.
- WARD, G.K. and WILSON, S.R. (1978): "Procedures for comparing and combining radiocarbon age determinations: a critique". *Archaeometry*, 20 (1), p. 19-31.
- ZILHÃO, J. (1992): *Gruta do Caldeirão. O Neolítico Antigo*. Instituto Português do Património Arquitectónico e Arqueológico (Trabalhos de Arqueologia, 6), Lisboa, 326 p.
- ZILHÃO, J. (1993): "The spread of agro-pastoral economies across Mediterranean Europe: A view from the Farwest". *Journal of Mediterranean Archaeology*, 6 (1), p. 5-63.
- ZILHÃO, J. (1997): *O Paleolítico Superior da Estremadura portuguesa*. Colibri, Lisboa, 2 vols., 1159 p.
- ZILHÃO, J. (2001): "Radiocarbon evidence for maritime pioneer colonization at the origins of farming in west Mediterranean Europe". *Proceedings of the National Academy of Sciences USA*, 98, p. 14180-14185.
- ZILHÃO, J. (2009): "The Early Neolithic artifact assemblage from the Galeria da Cisterna (Almonda karstic system, Torres Novas, Portugal)". In *De Méditerranée et d'ailleurs. Mélanges offerts à Jean Guilaine*. Archives d'Écologie Préhistorique, Toulouse, p. 821-835.
- ZILHÃO, J. and CARVALHO, A.F. (2011): "Galeria da Cisterna (rede cárstica da nascente do Almonda)". In J. Bernabeu, M. Rojo and L. Molina (eds.): *Las primeras producciones cerámicas: el VI milenio cal AC en la Península Ibérica*. Universitat de València (Sagvntvm-Extra 12), Valencia, p. 251-254.
- ZILHÃO, J.; MAURÍCIO, J. and SOUTO, P. (1991): "A Arqueologia da Gruta do Almonda. Resultados das escavações de 1988-89". In *Actas das IV Jornadas Arqueológicas (Lisboa, 1990)*. Associação dos Arqueólogos Portugueses, Lisboa, p. 161-171.
- ZILHÃO, J.; MAURÍCIO, J. and SOUTO, P. (1993): "Jazidas arqueológicas do sistema cárstico da nascente do Almonda". *Nova Augusta*, 7, p. 35-54.