

THE PROBOSCIDEAN IVORY ADORNMENTS FROM THE HYPOGEUM OF PADRU JOSSU (SANLURI, SARDINIA, ITALY) AND THE MEDITERRANEAN BELL BEAKER

Los objetos de adorno en marfil de proboscídeos del hipogeo de Padru Jossu (Sanluri, Cerdeña, Italia) y el Campaniforme mediterráneo

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ABSTRACT: In the present work, we examine the personal adornment in proboscidean ivory from the Bell Beaker period at the hypogeum of Padru Jossu, Sanluri (Sardinia, Italy) currently preserved in the Museo Civico Archeologico Villa Abbas of Sardara. For the first time, a complete study –morphological, use wear and archaeometric– of this material has been conducted. The typological study established two categories: buttons and pins. Those categories were also subdivided into three groups respectively. Technological and functional analyses were made difficult by the strong degradation of the items and the presence of glue and varnish. The archaeometric study highlighted the diverse provenances of the proboscidean ivories, suggesting a chronological difference in the geographical sources, as well as in the mobility patterns implicit in the movements of the raw material. The ivory from the older Stratum III is predominantly from the Asian elephant, and in the later Stratum II the exclusive supplier species is the African Savannah elephant. It is also important to mention that in the ensemble from Stratum III, one of the items seems related to the Eastern types of *ossi a globuli*, linking this Asian ivory with an Aegean and Oriental axis of mobility.

Key words: Bell Beaker; personal adornment items; funerary context; carved ivory; exchange networks.

RESUMEN: En el presente trabajo se han analizado los elementos de adorno personal de época campaniforme en marfil de proboscídeos del hipogeo de Padru Jossu, Sanluri (Cerdeña, Italia) que actualmente se conservan en el Museo Cívico Arqueológico Villa Abbas de Sardara (Cerdeña, Italia). Por primera vez se ha realizado un estudio completo de este material –estudio morfológico, traceológico y arqueométrico–. El estudio tipológico ha permitido establecer dos categorías: la de los botones y la de los alfileres. Las dos categorías se han subdividido en tres grupos cada una. Los análisis tecnológicos y funcionales han sido obstaculizados por la fuerte degradación de los artefactos y la presencia de pegamentos y barnices en la superficie. El estudio arqueométrico ha demostrado la diversidad de fuentes de aprovisionamiento de marfil de proboscídeos, mostrando una diferencia cronológica en el abastecimiento de esta materia prima. Mientras que en el más antiguo Estrato III el marfil es predominantemente de elefante asiático, en el más tardío Estrato II el marfil es exclusivamente de elefante africano de estepa. Así mismo, resulta interesante la aparición en

el Estrato III de un objeto probablemente emparentado con los *ossi a globuli*, cuya tipología nos transporta a los contextos egeos y orientales, asociando la presencia de marfil asiático con el Mediterráneo Oriental.

Palabras clave: Campaniforme; objetos de adorno personal; contextos funerarios; marfil tallado; redes de intercambio.

1. Introduction¹

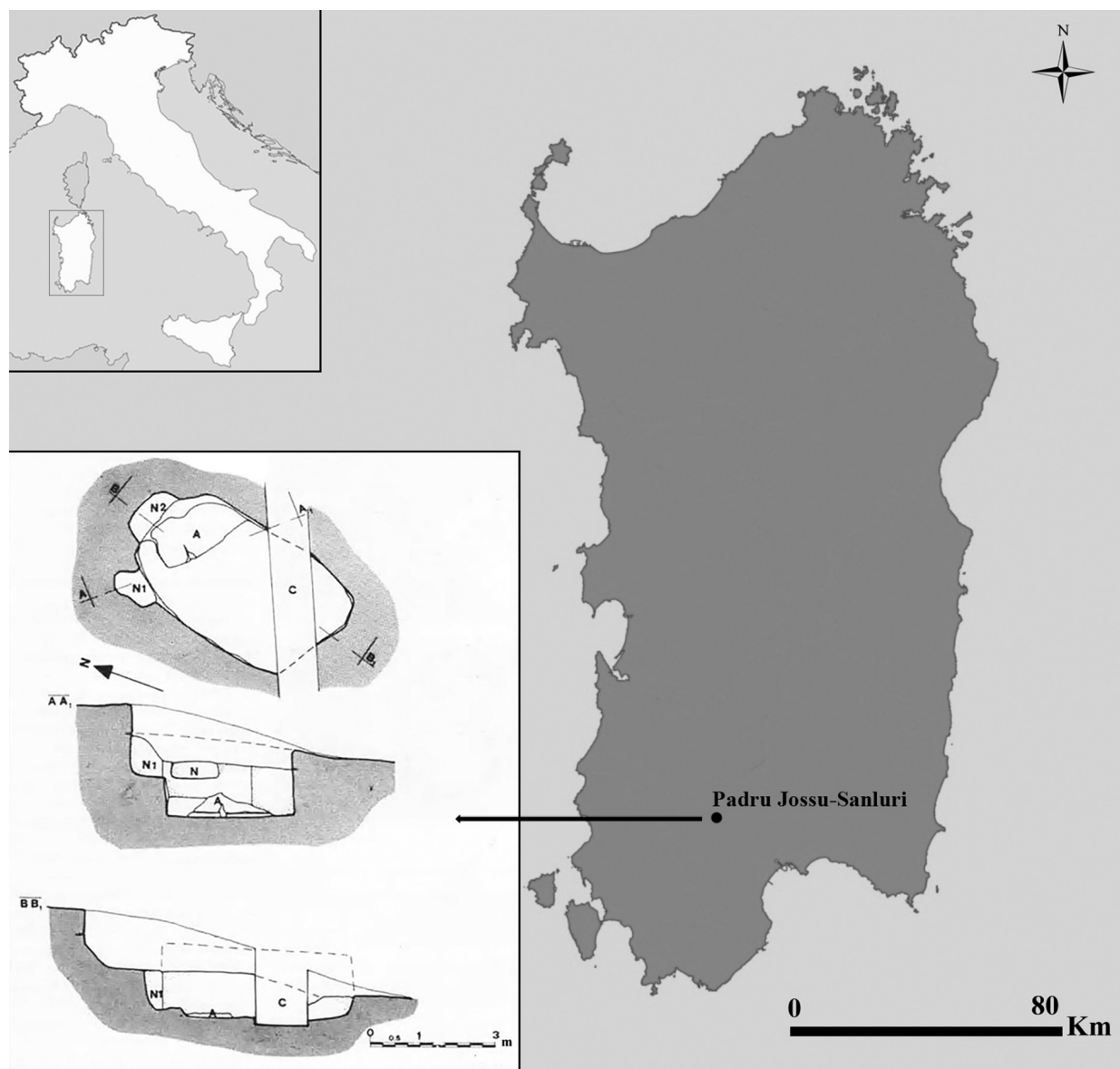


FIG. 1. *The hypogeum of Padru Jossu (Sanluri) (Sardinia, Italy): A) altar with a channel; N1-N2) niches (plan and section from Ugas, 1998: 261, fig. 1).*

¹ We would like to express our gratitude to Cooperativa Villa Abbas of Sarda, whose cooperation was essential for the

success of this project. We also want to express our gratefulness to A. Lord for his conscious revision of the English translation.

Located in Sanluri, Sardinia (Italy), the hypogeum of Padru Jossu was excavated in 1980 by G. Ugas (1982). The tomb presents (Fig. 1) a rectangular –5.10 x 3.80 m– underground chamber with roundish corners and with an E-W orientation. It was found without cover, and presented two small niches, the first one with a semi-circular base and a conical section –1.06 x 0.88 x 1.14 m–, and the second with a semi-elliptical base –1.42 x 0.41 m–. The presence of an altar with an irregular shape carved in the bed-rock is remarkable –2.15 x 1.25 x 0.16 m–, located in the northwest of the tomb, with a channel –37 x 5-7 cm–. The entrance of the tomb may have been situated in the west side or, in the case that it was a pit-access, coincident with the first niche mentioned before (Ugas, 1998: 262).

The tomb was built and used during the cultural horizon of Monte Claro. During the Bell Beaker A period –Stratum III–, the Monte Claro inhumations were carefully collected and the soil was covered with a stone layer prior the deposition of new inhumations. Later, during the Bell Beaker B period –Stratum II–, the inhumations were still numerous and accompanied with rich grave goods.

Remains of approximately 77 poorly preserved individuals, often uncomplete, were discovered (Germaná, 1982: 27; Ugas, 1998: 279). 12 belonged to Monte Claro layers, spread human bones, mainly long bones and several skulls– belonging to 17 individuals in the Stratum III –Bell Beaker A–, and 50 in the Stratum II –Bell Beaker B–, including a complete inhumation and grouped skulls covered by pebbles, while the rest of human remains were

spread. The physical anthropological studies have identified remains of children, subadults, adults and senile individuals. Concerning sexual adscription, the ratio is 50% (Germaná, 1995: 101-104; Ugas, 1982: 19-20; 1998: 279-280).

Remains of animal bones were also detected –*Ovis aries*, *Capra*, *Bos Taurus*, *Sus scrofa*, and *Canis familiaris*–, interpreted as ritual gifts or sacrifices (Sorrentino, 1982: 34-35).

In Stratum III, the ‘international style’ Beaker appeared, decorated with geometric horizontal bands, together with non-decorated, polished, slim sherds, a small copper dagger, a rectangular wrist guard and six half-moon-shaped microliths. In Stratum II, a noticeably small copper dagger was recovered, probably for ritual purposes, along with one arrowhead, three rectangular wrist guards and ten obsidian microliths in half-moon shape. Ornaments were found in both strata (Ugas, 1982: 19 and 25; 1998: 261-280).

A recent study performed on the human remains of Padru Jossu offered several radiocarbon dates, calibrated with Oxcal 4.0 (Fig. 2) (Lai, 2009: 318, tab. 1).

Padru Jossu has been interpreted as a sanctuary-tomb. Its discoverer suggested that the tomb was controlled by a single dominant group until the Bell Beaker period (Ugas, 1998: 276-277). Based on the presence of animal bones and the channel in the altar, it is presumed that ritual animal sacrifices were performed in the tomb, mostly using caprovines and suidae. The blood of the sacrificed animal would probably have flowed through this channel (Ugas, 1998: 276-77).

PADRU JOSSU, SANLURI						Chronological (BC) sequence for the Bell Beakers Horizon in the Mediterranean
Cultural attributions according UGAS	Cultural attributions according LAI	# Lab	BP	Error	Range 2σ cal BC	
Monte Claro	Monte Claro	AA72790	3912	42	2561-2234	2800-2400
Bell Beakers A	Bell Beakers	AA72152	3845	41	2463-2155	2500- 2200
Bell Beakers A	Bell Beakers	AA72153	3843	41	2463-2155	
Bell Beakers B	Bonnanaro A	AA72791	3837	41	2461-2152	2200-1900
Bell Beakers B	Bonnanaro A	AA72792	3790	41	2430-2044	

FIG. 2. *Chronology of the hypogeum of Padru Jossu, Sanluri (according to Luca Lai, analysed at Univ. of Arizona) (Lai, 2009: 318, tab. 1) and chronological sequence for the Bell Beaker Horizon at the Mediterranean.*

2. Methodology and materials

In this study, we present the adornments in proboscidean ivory from Padru Jossu, currently preserved in the *Museo Civico Archeologico Villa Abbas*, in the municipality of Sardara (Sardinia, Italy). We conducted a typological study, and use wear studies for the first time, performed with a 20x binocular lens, a 50x binocular lens, an optical 200x microscope, and an archaeometric FTIR –Fourier Transform-Infra Red spectroscopy– study.

2.1. The material: ivory

Based on its physical characteristics, ivory presents different ways to study its provenance, beyond visual examination. Also, its value as an *exotica*, and its scarceness, confers on it an important ideological meaning that must be taken into consideration (Van de Noort, 2012: 71-73).

Despite the fact that the term ivory is used to refer to elephant tusks, actually ivory is a generic word for a biomaterial composed of dentine and collagen. This material forms both the teeth and tusks of mammals, together with cement and enamel. All varieties presenting an economic and social interest or carving possibility are considered ivory (Espinoza *et al.*, 1999: 5).

All teeth have the same structure, divided into three parts: pulp cavity, the body of the tooth –composed of dentine– and the external part of the tooth, covered by enamel (Espinoza and Mann, 1999: 5-6). In the case of *Proboscidea*, ivory comes from two modified incisors that maintain the same structure, with the enamel covering only the distal extreme of the tusk (Espinoza *et al.*, 1990: 10).

The key element in order to study archaeological ivory is the dentine, as the other parts were commonly rejected during the carving process, and eliminated in the first processing of the material (Barciela, 2002: 79-81).

Dentine is a biomineralization of microchannels of a connective tissue composed by the mineral dahllite $-Ca_5(PO_4)_3(OH)-$, arranged in a proteinaceous

collagen matrix. The arrangement of dahllite microchannels structure radiates from the pulp to the external part in a pattern genetically controlled, specific for each species (Espinoza and Mann, 1999: 5; Locke, 2008: 424). This is especially important for *Proboscidea*, whose microchannels form the so-called Schreger lines and angles, which allow some level of distinction between different species (Palombo and Villa, 2001: 567-659).

Every species' dahllite microchannels grow forming periodical lamellae, that can be concentric –proboscidea, cetaceous–, wavy –hippopotamus– or undiscernible –wild boar–, serving as diagnostic feature (Espinoza and Mann, 1999: 5)

Wild boar and proboscidea ivory were found in the Padru Jossu collection by us, as well as canids' canine teeth, bones and shells, as is common in Mediterranean Late Prehistory. In this work, we exclusively take into consideration proboscidean ivory.

2.1.1. African Savannah Elephant (*Loxodonta africana africana*)

The African Savannah elephant is the biggest living species of elephant. The individuals found within Mediterranean contexts, however, have been found to show a noticeable smaller size, concurring with the Classical written sources. Therefore, and according to the works of Gautier *et al.* (1994: 7-20) and the findings of Khef el Baroud site (Bannerjee *et al.*, 2011: 113-134), it is considered that this species was the autochthonous North African elephant.

2.1.2. Dwarf elephants

Although *Palaeoloxodon falconeri*, the smallest dwarf elephant from Sicily and Malta, and other insular descendants from the continental *Palaeoloxodon antiquus* have been usually discarded in the Archaeological literature, the findings from the island of Tilos (Theodorou *et al.*, 2007: 25) confirm the existence of dwarf elephants –*Palaeoloxodon tiliensis*–

until 3500 BP, later than the chronology we are studying. We have carried out a preliminary analysis on this ivory, considering its potential presence in our corpus, and the spectrum obtained offered a similar result both with FTIR and Raman Spectroscopy to that of *P. antiquus*, due to their genetic proximity. However, no dwarf elephant ivory could be identified in our study.

2.1.3. Asian Elephant (*Elephas maximus*)

The Asian elephant was the main ivory source in antiquity, as Pliny the Elder mentions in his *Naturalis Historia* (VIII, 11). It has been identified in the Near East during Prehistory, and, despite some authors thinking it was artificially introduced during the II millennium BC (Miller, 1986: 38; Çakırlar and Ikram, 2016: 168), the appearance of fossil remains of *Elephas maximus* and its predecessor *Elephas hysudricus* in the Near East, as well as the presence of ideal ecological conditions for an elephant community (Pfälzner, 2016: 160) supports the autochthonous origin of Asian elephant ivory found in this area (Lister *et al.*, 2013: 1-10).

2.1.4. Possible provenances

In the late prehistoric Mediterranean, we must consider three supplying areas. The first is North-West Africa, up to West Libya, where the presence of elephants is confirmed until Roman times by ancient writings –Pliny the Elder mentions big populations of elephants around the Atlas Mountain– and archaeological evidence in sites like Khef el Baroud (Banerjee *et al.*, 2011: 113-134). A potential supply from *Palaeoloxodon antiquus* and other fossil ivories, present in Europe, has been discarded in the present work because it was not detected in our analysed corpus, despite the well known use of such ivory in the Iberian Peninsula during the same chronology (Schuhmacher, 2012a: 52-55).

The studies performed by Gautier and his team (Gautier *et al.*, 1994: 7-20), and research on the

materials of Khef el Baroud (Banerjee *et al.*, 2011: 113-134), in Morocco, have already demonstrated that the *Loxodonta africana africana* was the autochthonous elephant in North Africa.

The second is Egypt: *L. africana africana* was present in Lower Egypt –and not *L. africana pharaonensis*– (Ansell, 1971: 172) until the first dynastic period –IV-III millennia BC–. A comparable ivory item from the Dolmen of Matarrubilla (Valencina de la Concepción, Seville, Iberian Peninsula) resembling Predynastic Egyptian models, makes the case that such item is mainly manufactured in Asian elephant ivory (Schuhmacher, 2012a: 53-54). This, together with the fact that the vast majority of Egyptian ivory items from this chronology are carved in hippopotamus tusk (Krzyskowska, 1990: 20) make us discard Egypt as a significant source of raw ivory in our study. The inspiration of Egyptian designs should not be discarded.

The last supplying area is Syria, where the Asian elephant –*Elephas maximus asurus*–, reached the Plain of Amuq and the lower Zagros Mountains, inhabiting this area until *c.* 100 BC, whether this species was artificially introduced or it was autochthonous (Krzyskowska, 1990: 15; Pfälzner, 2016: 160; Çakırlar and Ikram, 2016: 168).

Despite some authors (Krzyskowska, 1990: 15) considering the population of this species relatively small, the references of elephant hunting in Egyptian chronicles –according to them, Tuthmose III had killed 120 elephants in the land of Niy–, the evidence from the Tomb of Rekhmire, and the presence of some ivory workshops in the Near East, like the Palace VII of Alalakh (Yener, 2007: 153), confirms this area as an important ivory supplier for the Mediterranean (Krzyskowska, 1990: 14-15; Pfälzner, 2013: 115-117). Another evidence for the eastern provenance of ivory, at least for the Aegean, is philological. In Mycenaean Greek, in the II millennium, the word for ivory is *e-re-pa*, a term related to the Hittite word *la-ab-pa-as*, referring to elephants' teeth (Lapatin, 2001). If those evidences are undoubtedly from later chronology, elephant hunting is confirmed in the Near East at least since 2400 BC, as it is evidenced at Tell Munbaqa (Pfälzner, 2013: 115).

The presence of an important number of Asian elephants' tusks in the South of the Iberian Peninsula (Schuhmacher, 2012a: 55-60; Schuhmacher and Banerjee, 2012: 289-296; Nocete *et al.*, 2013: 1579; García Sanjuán *et al.*, 2013: 612) also shows that the trade/interchange networks functioned at a greater distance and in an earlier chronology than considered before.

2.1.5. Analytical technique

Infra-Red spectroscopy is one of the most flexible techniques. At present, it can virtually analyse every kind of material, with the only requisite that, in its composition, heteronuclear molecules reactive to infrared radiation are present. Together with its non-destructive character and the fact that no special preparation of samples is needed, it places this technique as one of the most useful for heritage (Turner-Walker, 2014: 10).

Infra-red spectrometry consists in the illumination of the sample with an infra-red light beam, producing a vibration in the atomic bonds, emitting a radiation. Since two different molecules never share the same bonding arrangement, the radiation product of the excitation is always different, characteristic of each component, offering an identifiable fingerprint of it (Stuart, 2004: 10-11).

To ensure the usefulness of this technique in ivory analysis, as well as its repeatability with instruments different to the ones used in the literature (Banerjee *et al.*, 2008: 45; Banerjee and Huth, 2012: 19-25; Schuhmacher and Banerjee, 2012: 290-291; García Sanjuán *et al.*, 2013: 617), a preliminary analysis has been performed in the Charisma Laboratory of the University of Perugia using a portable Bruker Optics ALPHA-R spectrophotometer equipped with a Globar infrared radiation source, a Michelson interferometer –RockSolid(™)– and a DLATGS detector. We have studied different samples of ivories from Asian –s8– and African elephants –s1; s7 and s5–, hippopotamus –s10–, *Palaeoloxodon antiquus* –s13– and *Paleoloxodon falconeri* –s12–, property of the Natural History Museum of the University of La Sapienza of Rome (Fig. 3).

The spectra were recorded using 200 interferograms across the range 7500-375 cm⁻¹ observing a spectral resolution of 4 cm⁻¹. The correction of background absorption was carried out utilizing the reflection spectrum of a reference gold surface.

As was expected, the results were positive in the sense that they were coincident with the previous experiences (Fig. 4). Due to the use of portable instrumentation, however, the difference between the peak –*L. africana africana*– and the bank –*E. maximus*– at 1114 cm⁻¹ (Banerje *et al.*, 2008; Banerjee and Huth, 2012:

19-25; Schuhmacher and Banerjee, 2012: 290-291; García Sanjuán *et al.*, 2013: 617) was extremely narrow, and the results were similar; because of that, a principal component analysis –PCA– was performed to detect the variability between the different species (Fig. 5).

As observed, we obtained satisfactory results, with more than 99% of differentiation between

SAMPLE NAME	IVORY SOURCE	ADDITIONAL INFORMATION
S1-C-01 S2-C-01 S3-C-01 S4-C-01 S6-C-01 S7-C-01	<i>Loxodonta africana africana</i>	These are different pieces from same modern individual
S5-C-01	<i>Loxodonta africana africana</i> (young individual)	
S8-C-01 S9-C-01	<i>Elephas maximus</i>	Decorative piece-inner piece no. S9 assumed to be also the same elephant; again modern
S10-C-01	<i>Hippopotamus amphibius</i>	
S11-C-01	<i>Hippopotamus amphibius</i>	
S12-C-01	<i>Palaeoloxodon falconeri</i>	Archaeological sample
S13-C-01	<i>Palaeoloxodon antiquus</i>	Archaeological sample

FIG. 3. Known samples used at the preliminary study.

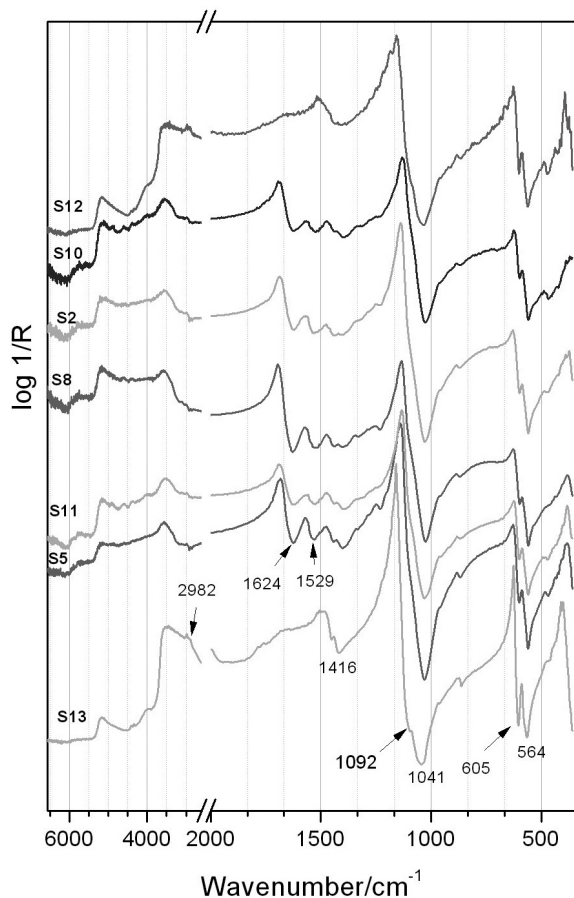
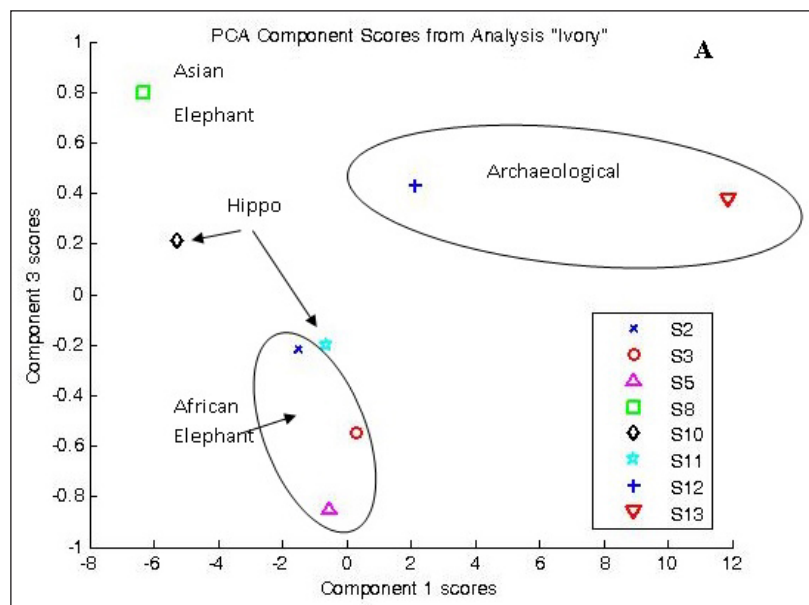


FIG. 4. Results obtained from the preliminary study performed on known ivories.



the samples, at least in the proboscidean ivory discrimination. With hippopotamus ivory, this technique seems to be ineffective. The separation of fossil samples –s12; s13– is produced by the different depositional processes rather than by compositional differences.

In conclusion, the application of the FTIR as proposed by Banerjee and his team (Banerjee *et al.*, 2008: 45) is valid even applied with portable instrumentation, and the lower resolution given by the portable instruments can be surpassed by the application of PCA.

2.1.6. Results

Thirty samples of ivory or ivory like material from the total corpus of adornments were selected to be studied by the methodology suggested above.

The conservation was extremely variable and the geometry and size of the items were also extremely complex, making the use of a collimator necessary. Also, the items were affected by the presence of unknown varnish and glue, and in some cases biodeterioration (Simpson, 2011: 41-44; Pinzari *et al.*, 2013: 1051-1052). This fact undoubtedly affected the analyses. At least two measurements were performed in every item to assure the repeatability and reliability of the spectra and, in case that variability was observed, the best quality spectrum was selected, according to its geometry.

Some spectra showed abnormal patterns, due to a major degradation or the interference of glues and varnishes mentioned above. This material has been ignored in the statistical treatment of results.

Ivory has been easily distinguished from bones by the presence of a high peak of PO_4 around 1000

FIG. 5. PCA result of known samples study.

to 1040 cm^{-1} , higher in ivories. In order to distinguish the generic elephant ivory, the pattern of the spectrum from 600 to 1800 cm^{-1} is compared with known standards that represent a fingerprint of the material (Banerjee *et al.*, 2008: 45) for ivory fingerprints in Raman Spectroscopy (Edwards *et al.*, 1997a: 49-58; 1997b: 2407). Distinguishing between African and Asian elephant ivories, as we mentioned above, is a complex issue.

The peak or bank around 1000 cm^{-1} requires a statistical validation, especially in archaeological decayed ivory, where noise produced by deterioration can hide this feature, which could even not be present due to the decaying process. However, the fact that this feature is related with the inorganic phase of ivory makes it susceptible to resist the degradation in most cases, as can be seen in the literature (Lafrenz, 2004: 159-177) and is noticed in our results.

In the band from 0 to 1200 cm^{-1} we find the inorganic phase composed by phosphates, showing the two characteristic high peaks of PO_4 . No significant differences are visible in the Padru Jossu ivories from the standards of the preliminary study.

From 1200 to 1800 cm^{-1} the organic phase is present, in which the collagen, proteinaceous content is visible. Here we can see noticeable differences from the fresh, modern ivory. Carbonates are visible in 1450 cm^{-1} in elephant ivory, as well as the carboxylic group peak, creating a characteristic pattern of two small parallel peaks. On the other hand, around 1550 cm^{-1} the amine peak visible in the fresh ivory is not present in the archaeological ivory due to the leaching out of the collagen material. In the range of 1200 - 2300 sometimes it is possible to appreciate the Amine III peak, again depending on the conservation of the sample.

After this band, in the region of 3000 cm^{-1} , we also observe the absence of the aliphatic carbon present in modern ivories. This is the most unstable of the proteinaceous components of ivory, and because of that, it was expected not to obtain a spectroscopic signal.

The decaying process of the ivory is clearly visible in the lack of collagen content in most of the items from 1800 cm^{-1} onwards. No traces of mineralization have been detected –as it is common in fossil ivory– (Edwards *et al.*, 2006: 66), and traces

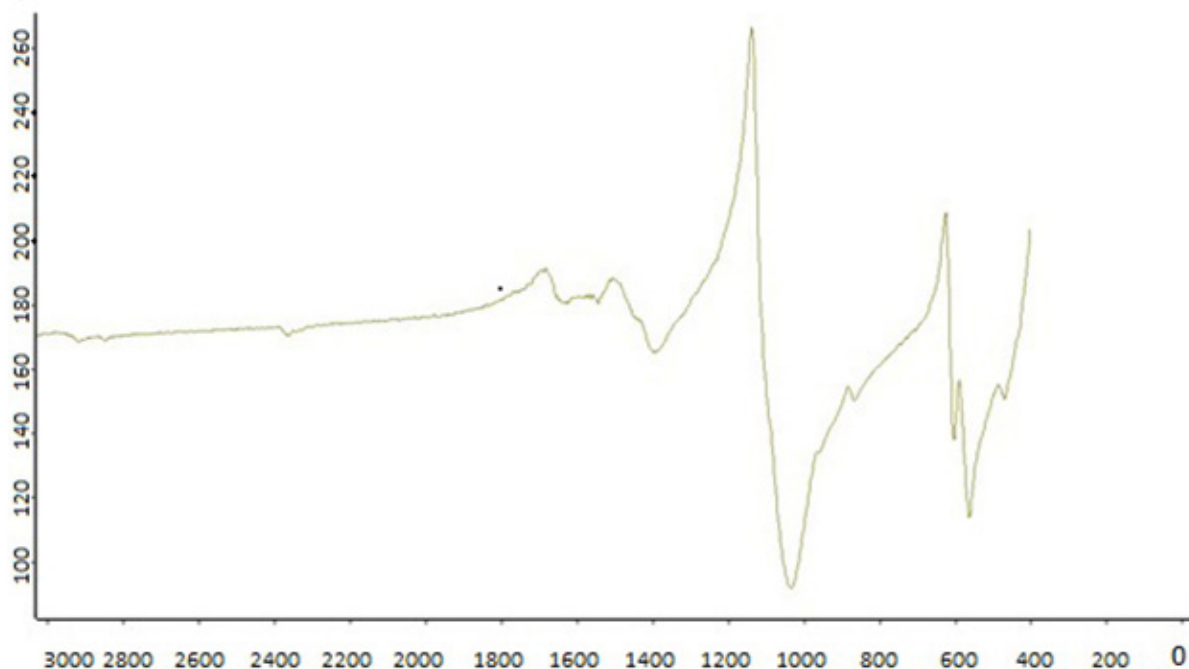


Fig. 6. African elephant ivory spectrum produced by the item 167516.

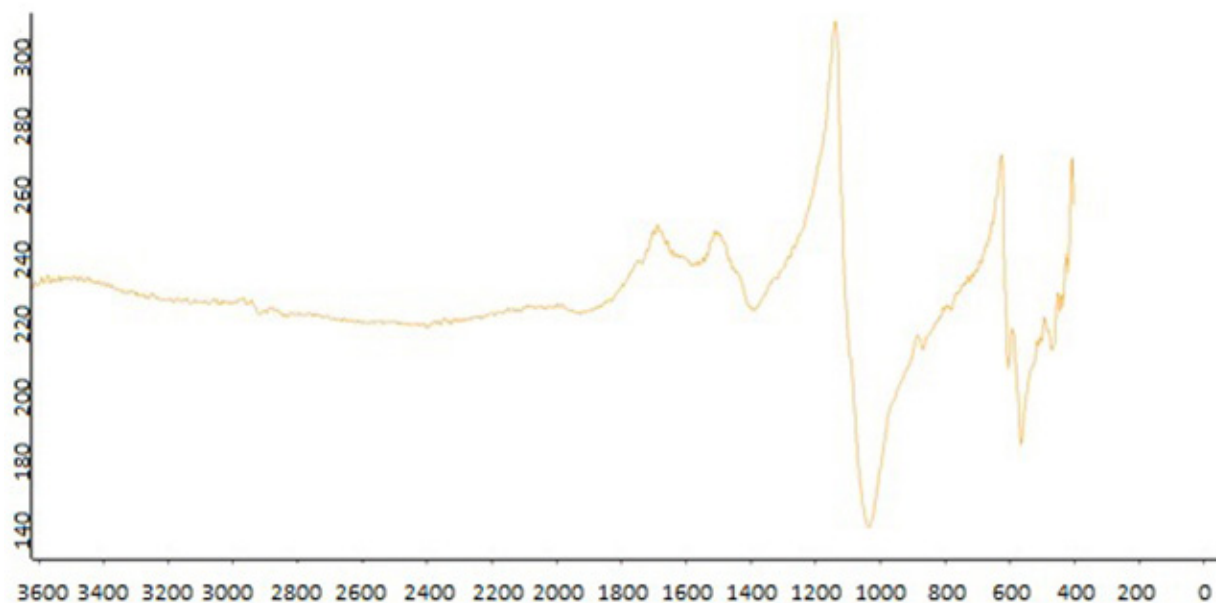


FIG. 7. Asian elephant spectrum correspondent to the item 167543.

of fungal activity and biodeterioration, although visually detected, did not significantly affect the spectra obtained. Also, there was no signal of H_2O , due to the natural desiccation of the material (Figs. 6 and 7).

These results are coincident with the studies on decayed ivories performed by Edwards and his team using Raman spectroscopy, where they noticed an important loss of the organic components (Edwards *et al.*, 2005: 713-720; 2006: 70).

As was observed in the previous preliminary analysis in the fossil samples, the archaeological elephant ivory shows in most of the cases a significant loss of organic collagen components from the band of 1800 cm^{-1} onwards. Apart from the high PO_4 peak, as a characteristic feature, elephant ivory shows a double peak approximately at 1500 and 1700 cm^{-1} , allowing preliminary criteria to differentiate it from i.e. hippopotamus ivory.

As mentioned above, the differences between *Elephas maximus* and *Loxodonta africana africana* ivories are complex and small, but a characteristic feature around 1000 cm^{-1} is visible –the variability of the exact position of the feature is produced by the differences in the items' geometries and by

the use of portable instrumentation, where the total control of reflection angle and environmental conditions is not possible–.

Finally, a total of 22 samples have offered a positive result identifiable with elephant ivory, both Asian and African. The adscription has been performed, as mentioned above, according to the visual identification of the visual features proposed by Banerjee and his team (2008: 45). After this preliminary diagnosis, we have applied a PCA based on our preliminary analyses performed on known samples. Considering also the stratigraphic position of every analysed item, a final adscription has been suggested (Fig. 8).

Loxodonta africana africana:

Ten samples have been clearly identified as *L. africana africana*: 167516; 167517; 167518; 167520; 167521; 167561; 167562; 167563 and 167564.

Elephas maximus:

Items 167507; 167510; 167550 SNP49; 167551 SNP41; 167543; 167544; 167545; 167546; 167547; 167557; 167574; 167575 and 167577 were positively

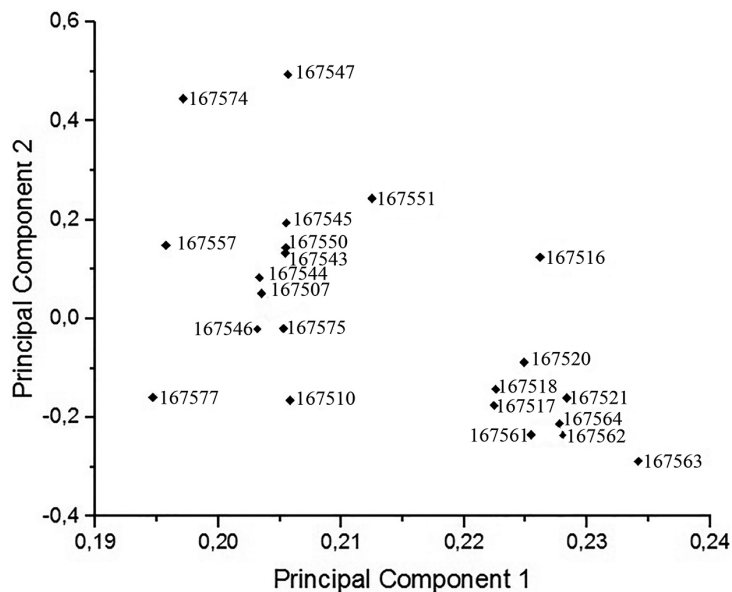


FIG. 8. Results of the PCA performed on the archaeological material.

identified as Asian elephants according to the methodology proposed by A. Banerjee and other researchers (Banerjee *et al.*, 2008: 45).

It is significant that nine of the eleven 'v'-perforation buttons from the Stratum III are coincident in their raw material—the other two did not give a conclusive spectrum due to the presence of unknown varnishes—. The extreme similarity of appearance, both physical and in the spectra given, together with its stratigraphic position, make us think that they were made from the same piece of raw Asian ivory. Because of that, we must reduce the importance of the numeric presence of Asian elephant ivory, especially in Stratum II, where it is in a significant minority. On the other hand, it is significant that the ivory from Stratum III is exclusively Asian.

2.1.7. Social significance

Ivory was an exotic material in most parts of the Mediterranean, as it was only available in restricted areas. Hippopotamus, boar tusk, sperm whale and fossil ivories have been detected in different archaeological contexts across Europe aside to

elephant ivory as substitutes (Schuhmacher, 2012a: 45-49). It would be possible to suggest a hierarchical organization of the different ivories in the different Mediterranean societies, but the research and data about this topic are still not enough to propose a theory in this direction. There are still enormous gaps in the Western Mediterranean area regarding ivory characterization, as well as in the general knowledge about this period.

In this sense, we can understand that the findings of the royal palace of Ugarit during the Late Bronze Age, where the ratio of elephant ivory is so much higher than the hippopotamus one in the rest of the site—40% of elephant ivory in the site *vs.* 85% in the palatial context—

(Gachet-Bizollon, 2007: 15; Nocete *et al.*, 2013: 1590), support the idea of the higher value of elephant ivory in comparison to other ivories. In Western Mediterranean contexts, a higher value of Asian ivory could be understood from its appearance in the more central sites like Valencina de la Concepción or Los Millares, where this ivory is clearly predominant, in opposition to peripheral areas like the central Iberian Peninsula, where the main ivory present comes from the Pleistocene species *Palaeoloxodon antiquus* (Liesau and Moreno, 2012: 87; Schuhmacher, 2012a: 48-49). This differentiation in ivory appreciation could be understood in the sense of the appreciation of a material in relation to the difficulty in obtaining it. In Anthropology, it is a well-known fact that some artefacts are appreciated because they have been part of long trips or because of its far provenance (Van der Noort, 2012: 71-73).

During the Bell Beaker phase, African elephant ivory becomes more common, characterized by a smaller size of the pieces, but a higher total amount, potentially increasing in ivory holders (Schuhmacher, 2012a: 61). This phenomenon is visible at Padru Jossu, where the Asian elephant ivory is restricted to few items in the earlier III Stratum, followed by a more generalized presence of African elephant

ivory in the later Stratum II, which may be caused by the opening of a new supply route, related to the Mediterranean Maghreb.

Ivory was of central importance to the Bell Beaker communities, as it is visible in the archaeological record of the site Camino de las Yeseras –Central Iberia– (Liesau and Blasco, 2011-2012: 218), where ivory is not only displayed in elite burials, but also submitted to ritual activities as removal and donation with other symbolic and highly valuable materials in the burials.

The display of ivory was in fact a fundamental element of the Bell Beaker social hierarchy strategy, reinforcing the visual aspects of the elites as well as their high status position by the control of the ivory supply. The high status of the ivory holders buried at Padru Jossu was confirmed and reinforced by the deposition of such a valuable material. The importance that such a rare and exotic material potentially had in exchange is also reflected in its use as prestige gifts during relational ceremonies such as banquets and intergroupal marriages (López Padilla, 2009: 20), again contributing to stress the important role played by the buried individual who held the ivory adornments.

The combination of potentially diverse social segments in the same collective burial is quite significant, as it is understandable from the different raw materials used in adornments at Padru Jossu, where shells, bones, boar tusks and different hard stones are used as adornments together with elephant ivory. This collectivism must be understood as a masking inequality strategy that was already traceable in earlier periods at Los Millares –in the South East Iberian Peninsula (Molina and Cámara, 2005: 58-59; Afonso *et al.*, 2011: 296; Calvín, 2014: 4)–, and as a way to stress the social unit instead of the individual status. Display of social personality inside the collective burial would reinforce the group identity with its own inequalities and inner contradictions, combining the fact of the collective burial with the display of personal items as a way to show a personal identity inside the group and its social memory (Laneri, 2007: 8).

This evidence suggests that the importance given to group unity is a strategy to maintain social

structures in a context of extensive social interaction between differenced groups that share a common geography, where a segment of the society is developing a new self-identity, forming themselves as an elite with ‘international’ range. The international character of Padru Jossu findings –i.e. Bell Beaker repertoire, ivory from different provenances– perfectly exemplifies this phenomenon that we could consider as an early *koine*.

Relations between Bell Beaker and oriental material are not unknown. Schuhmacher (2014: 41-50) has identified a copper pin with Cypriot origin. Considering the presence of both Asian and African ivory in Padru Jossu, this pin potentially passed through Sardinia, in relation with ivory trade, anticipating by 500 years the presence of ivory in the rest of Italy (Marcucci, 2008: 138).

2.2. Typological study

The items involved in the study have been divided into two categories: buttons and pins (Fig. 9).

2.2.1. Buttons

By buttons, we refer to items whose function was the same as present-day, due to its similar shape, although the specific morphology of some of them suggests that they were used as beads. In the Padru Jossu we have identified hemispheric buttons –group 1–, buttons with lateral, wing-shaped appendices –group 2–, and double-edged buttons –group 3– (Fig. 9).

— Hemispheric buttons (Group 1)

Hemispheric buttons are items with a semicircular section, a flat ventral side and a curved external side. The perforations are located in the ventral side.

We have studied nine hemispheric buttons (Fig. 10a) unearthed in the Stratum III of the hypogeum –167543; 167544; 167545; 167546; 167547; 167557; 167574; 167575; 167577–. There are two









TYPOLOGICAL CLASSIFICATION			
Category I BUTTONS	Group 1: Hemispheric buttons		
	Group 2: Buttons with wing-shaped appendices	<i>Type 1:</i> Buttons with sketched appendices (resembling the shape of a turtle) <i>Type 2:</i> Buttons with well-defined, flat wings <i>Type 3:</i> Buttons with hemispheric appendices	  
	Group 3: Double-edged items		
Category II PINS	Group 1: Double-tip pins		
	Group 2: Pins with sharpened tip and differentiated head		
	Group 3: Pins or pin handles with globular decoration.		

FIG. 9. *Typological classification.*

other items –167542; 167576 (Ugas, 1998: 268)– that we could not study.

In Sardinia, there are three adornment items found in the megalithic hypogeum of Bingia ‘e Monti, in Gonnostramatza (Atzeni, 1998: 248) with the same typology as the studied items. Sardinian buttons show a strong similarity with French buttons, like those from the Massif of La Clape, from the *allées couvertes* of Monze, Moure –Ventenac-Carbadès–, Boun-Marcou –Mailhac–, in the Aude region, or the item from the ossuary of Portichol –Salses–, in the Eastern Pyrenees (Arnal, 1954: 255-256; Guilaine, 1963: 825), and the buttons from the dolmen of Taizé –Deux Sèvres– in Central-West (Hebras, 1965: 145); or the buttons from the dolmens of Mons, Var en Provence (Courtin, 1976: 262-263), and with Spanish items like the buttons from La Atalayuela –Agoncillo, La Rioja– (Pérez Arrondo and López de Calle Cámara, 1986)– Villanueva de los Infantes –El Castellón, Ciudad Real– (Uscatescu, 1992: 170), the cemetery of Cuesta de la Reina,

Ciempozuelos² y (V. 3391) and el Cerro de la Virgen –Orce, Granada– (Schüle, 1980: taf. 1) or Portuguese items like one of the buttons from the Cave of São Pedro de Estoril (Gonçalves, 2005: 116). In fact, hemispheric buttons have spread widely from the Iberian Peninsula with some important centres (Portugal, Catalonia, etc.), including the Balearic Islands and South-East France below a line to the lower region of Switzerland, with extensions to Central Italy and Sardinia (Guilaine, 2015: 215).

— Buttons with wing-shaped appendices (Group 2)

In this group, we include buttons with circular, elliptic, quadrangular or rhomboidal central bodies, with two lateral appendices in a quadrangular,

² Garrido, R. (2003): *El Campaniforme en la Meseta: análisis de su contexto social, económico y ritual*. Doctoral thesis presented in 2003 in the University Complutense of Madrid, Spain, p. 324.



FIG. 10. *Category I, buttons: a) hemispheric buttons (Group 1) (67543-167547; 167557; 167574; 167575; 167577); b-h) buttons with wing shape appendices (Group 2); b) Type I buttons with sketched appendices (167516); c) intermediate version between the Types I and II (167518); d) Type II button with well-defined, flat wings (167520); e-h) Type III buttons with hemispheric appendices (167507; 167510; 167517; 167551); i) double edged items (Group III) (167521).*

rectangular, triangular, trapezoidal, or semicircular shape that could be just sketched or well formed. Concerning the terminology used for the definition

of this type of buttons, we have recently explained it in another publication (Pau, 2012a: 116; 2012b: 68-73).

The Group 2 buttons have been organized in three types according to their morphology: buttons with sketched appendices –resembling the shape of a turtle, Type 1–, buttons with well-defined, flat wings – Type 2– and buttons or beads with hemispheric appendices –Type 3–.

In Padru Jossu we found only one ivory item from the Type 1 –167516 in Stratum II (Fig. 10b)–, presenting flat-convex section and tiny quadrangular appendices, roundish margins and a ‘v’-perforation. Similar artefacts from the same chronology have been found in Sardinia, at the tomb of Bingia ‘e Monti, Gonnostramatza (Nicolis and Mottes, 1998: 303) and at the Tomb XVI of the cemetery of Su Crocifissu Mannu, Porto Torres (Ferrarese, 1974: 159-164). Furthermore, there are similar buttons from the cemetery of Anghelu Ruju, Alghero (Taramelli, 1909: 513-514), from unclear chronology. The Type 1 elements have parallels in the Portuguese buttons of Conchadas, Aljezur and Palmela (Ferrarese, 1974: 160), and with some elements from the Cave 1 of São Pedro do Estoril (Gonçalves, 2005: 117), in Portugal, but with bigger wing-shaped appendices. There are also analogies with buttons found in France, from the dolmen of Taisé –Deux Sèvres– (Hebras, 1965:145), from

the dolmens of La Lozère, Bailloud, the Massif de la Clape (Aude) (Arnal, 1954: 1954) and *Grotte Basse de la Vigne-Perdue* (Guilaine, 1963: 822), or the

dolmen of Saint-Pancrace, Bâite-Neuve, Hautes-Alpes (Lemerrier, 2004: 63). With a more elongated body, we find Italian parallels in the cave of Fontino, in Tuscany (Vigliardi, 1980: 266). Ferrarese (1974: 160) suggests a local production for the type 1, imitating the buttons with more pronounced wing-shaped wings, and proposes the hypothesis that the two small appendices of this type were residue of two bigger appendices broken during item use and restored before its deposition.

One button –167518 (Fig. 10c)– from the Stratum II of Padru Jossu (Ugas, 1998: 273) seems to be an intermediate version between the Types 1 and 2. It presents a sub elliptic, elongated body, flat-convex section, ‘v’-perforation and quadrangular appendices with roundish margins, more robust than the ones examined previously. There are four more findings belonging to this intermediate type in Sardinia, one from Bingia’e Monti, Gonnostramatza from the same chronology (Nicolis and Mottes, 1998: 303) and three from uncertain chronology found in the Tomb xxx of Anghelu Rujù, Alghero (Taramelli, 1909: 513-514).

The Type 2 buttons present a circular body with a flat-convex section and flat, marked, trapezoidal appendices, with roundish margins. There is only one element in ivory belonging to this type in Padru Jossu, in the Stratum II –167520 (Fig. 10d)–. There are also three buttons of the same type made of bone –167515; 167519; 167522 (Ugas, 1998: 272-273)–.

There are another 12 Type 2 buttons in Sardinia from the Bell Beaker and post-Bell Beaker periods, one from Capo Sant’Elia de Cagliari (Cornaggia and Calejari, 1980: 234), two buttons from Bingia’e Monti, Gonnostranza (Nicolis and Mottes, 1998: 303), two from the Tomb XIII, one from the Tomb XVII, and two from the Tomb xxx of Anghelu Rujù, Alghero, the last two also decorated with perforations (Taramelli, 1909: 504-517; Audibert, 1958: 216), probably one from Ponte Secco, Porto Torres (Contu, 1955: 32), two belonging to the Collection Doneddu, in Carbonia (Atzeni, 1995: 162) and one from the Collection Vargiu, Villasor (Cornaggia and Calejari, 1980: 234). All buttons show strong

morphologic similarities with the buttons from the Iberian Peninsula, particularly with the adornments of the Cave 1 of São Pedro do Estoril (Gonçalves, 2005: 117) and Vila Nova de São Pedro (Guilaine, 1963: 822-823), and three buttons from Andalusia, found in Peñas de los Gitanos, Montefrío, and Cerro de la Virgen, Orce, Granada (Pau and Molina, 2015: 100-101; Uscatescu, 1992: 200-202)³. Buttons with well defined, flat wings are not known in Catalonia with the exception of Tarragona region: Bobila Casals –Riudecols, Baix Camp– and the l’Heura Cave –Ulldemolins, Priorat– (Vilaseca, 1973). These do not present any association with the Bell Beaker. However, hemispheric buttons are concentrated in the northern region and these could be associated with the Beaker.

In the Type 3 we place the buttons or beads with hemispheric appendices. In Padru Jossu’s Stratum II there are six small, almost identical elements –167506-10 (Nicolis and Mottes, 1998: 328)–, but only two could be studied –167507 and 167510 (Fig. 10e-f)–. They show a well-defined central globule with a cylindrical, rectilinear perforation. The same typology is found in four adornments from Sardinia: two beads from the cemetery of Anghelu Rujù –Tombs III and XIII (Taramelli, 1904: 323-335; 1909: 413-431; Cornaggia and Calejari, 1980: 235)–, with uncertain datation, and two elements, almost cylindrical, from the Tomb of Is Calitas Soleminis (Manunza *et al.*, 2005: 150, 176) from the Early Bronze Age. In France there are two similar ornaments from the site of Tumulus de Vertempierre, Chagny –Saône-et-Loire– and of cave Barriéra, La Turbie –Alpes-Maritimes–, despite the latter shows more triangular extremities (Schuhmacher, 2012: 158-159, figs. 46 and 47). In this type we have included as well two elements, one from the Stratum II –167517– (Fig. 10g) and other from the Stratum III –167551 (Fig. 10h)–, that show an elongated globule with a central groove and integrated appendices, giving them a pseudo-cylindrical shape. Those

³ Cf. also Pau C. (2016): *Los objetos de adorno en el Mediterráneo occidental en época campaniforme y su trascendencia social*. Doctoral thesis presented in 2016 in the University of Granada, Spain, pp. 715-716.

items resemble an adornment found in Zygories –North East Peloponnese, Greece– and two from France, from La Baume-sous-la-Roche, Loisia –Jura– and Tumulus de Vertempierre, Chagny –Saône-et-Loire–, despite the last shows more roundish extremities (Schuhmacher, 2012: 158-159, fig. 46, 47). In general, we can say that type 3 ornaments, with variable extremities and perforations were widely spread from the Iberian South to Greece, across France, Sardinia and the Italian Peninsula (Marn, 1998: 371-373, fig. 55, no. 74; Schuhmacher, 2012: 158-159, figs. 46 and 47). The spreading of this typology is coincident with the presence of wrist guards, present in the Adriatic –Cetina culture– and the Aegean, overpassing the Bell Beaker phenomenon limits, and placing Sardinia as a cultural melting pot between Eastern and Western Mediterranean Basins.

— Double-edged items pins
(Group 3)

We identify as double-edged buttons the elements with elliptic shape and transversal groove to its suspension and cylindrical section. In the Stratum II of Padru Jossu there is a double edged button in ivory –167521) (Fig. 10i)–. We find the same typology in an adornment carved in shell –*Pectunculus*– in the cave of Murée de Montpezat, Provence Alpes Côte d’Azur, Alpes de Haute Provence, in France⁴.

⁴ *Ibidem*, p. 718.

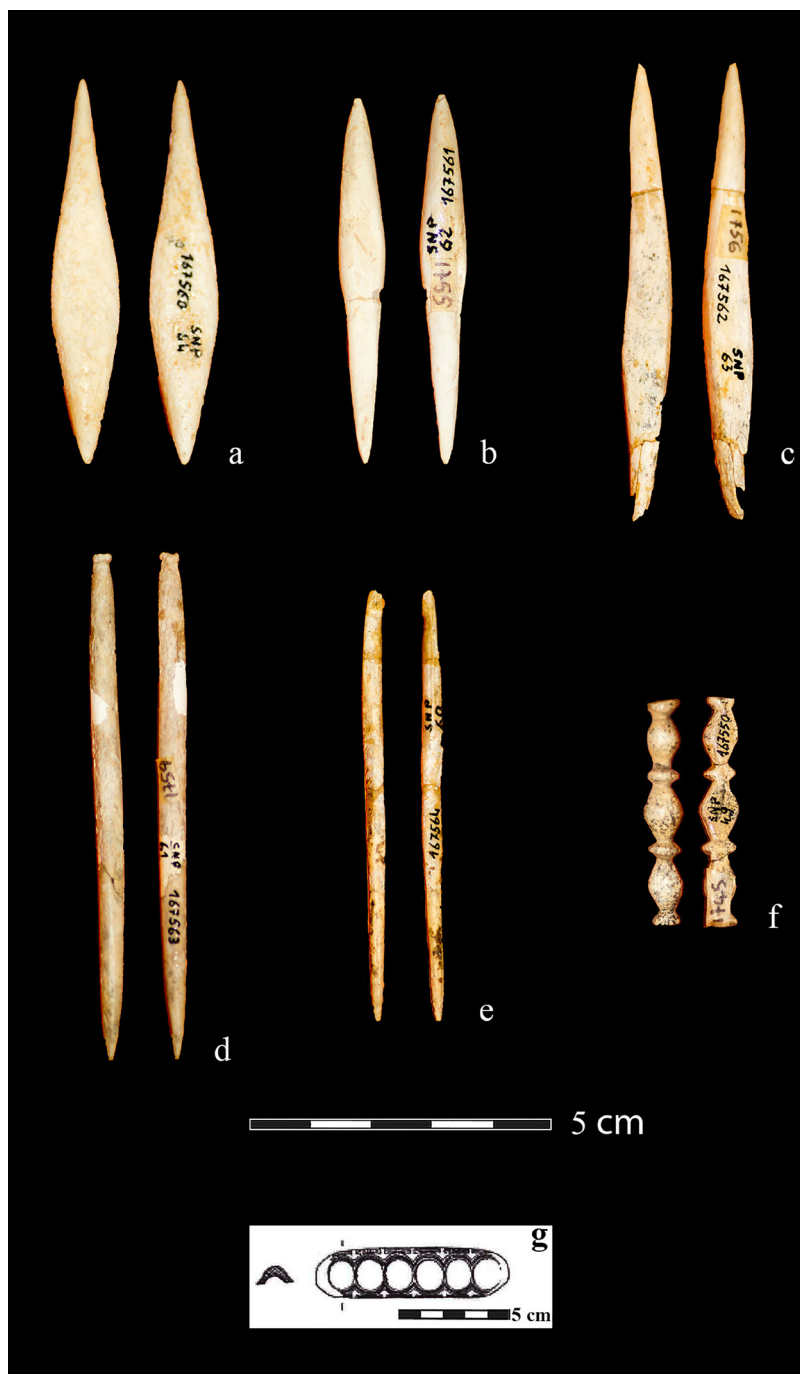


FIG. 11. *Category II, pins: a-c) double tip pins (Group 1) (167560, 167561, 167562); d-e) pins with one sharpened tip and differenced head (Group 2) (167563; 167564); f) pins or pin handles with globular decoration (Group 3) (167550); g) osso a globuli from the Hypogeum 1 of Casal Sabini (Recchia, 2010: 20, fig. 24).*

2.2.2. Pins

In this typological category we have included a set of elements with stick shape, with circular or quadrangular section, straight or with a central widening with one or two sharpened tips, with or without head. Contrary to the buttons, the studied set does not show any perforation or groove, implying use as simple brooches.

We have divided this category in three groups according to formal typology: double tip pins –Group 1–, Pins with one sharpened tip and differentiated head –Group 2–, and pins or pin handles, made of bone and with globular decoration –Group 3 (Fig. 11)–.

— Double tip pins (Group 1)

This group has sharpened tips and it is characterized by a central widening. Three items belong to this group in Padru Jossu –167560, 167561, 167562 (Fig. 11a-c)– (Ugas, 1998: 237).

This group of artefacts were amply spread in Sardinia, from the Late Eneolithic to the Early Bronze Age, during the whole Bell Beaker period and the culture of Bonnanaro. Examples of the long survival of this type during the Early Bronze Age are the elements from Is Calitas Soleminis, which preserves the typical central, rhomboidal flattening (Manunza *et al.*, 2005: 147). These pins –also interpreted as awls– are widely spread in Europe, especially in the Pyrenees (Manunza *et al.*, 2005: 147). In Iberian Peninsula they survived during El Argar horizon, –i.e. items from sites of Peñalosa and Castellón Alto, in Andalusia (Contreras *et al.*, 1997: 105)–. The survival of this type and the strong similarities between far areas has been explained, after the study of metallic, Argaric pins from Cuesta del Negro and Fuente Álamo, based on their functionality and chronologic and social factors (Pérez Ibáñez, 2011: 46-50).

— Pins with one sharpened tip and differentiated head (Group 2)

We have studied two pins from this group, with cylindrical section heads –167563; 167564–

(Fig. 11d-e) from Stratum II (Ugas, 1998: 268-269 and 273).

In Sardinia there are more items from this group, from the same chronology of Padru Jossu, i.e. one artefact with hemispheric head from Su Crucifissu Mannu, Porto Torres (Ferrarese, 1974: 165, fig. 21). Examples of this type of adornment are found in all Bell Beaker Europe, like the headed needles made of bone from the sites of Cerro de la Virgen, in Granada (Schüle, 1980: taf. 1), Zambujal and Vila Nova de São Pedro in Portugal, as well as in the Archaeological Museum of Torres Vedras. There is also a strong morphological affinity with an element from the IV or the early III millennium BC in the Cave 1 of São Pero do Estoril in Portugal (Gonçalves, 2005: 115). The parallelism with Egyptian items, often perforated, found in undefined stratigraphic positions (Vandier, 1952: 387, fig. 263) is also noticeable.

— Pins or pin handles, made of bone and with globular decoration (Group 3)

In this group we have included several objects that are usually classified as pins or pin handles, made of bone and with globular decoration. Due to its morphology, these could also be included in the family of the *ossi a globuli*, worked bone plaques obtained from long bones, with a flat base, softly curved and decorated with globules, with variable interpretations (La Rosa, 1988: 20-21). *Ossi a globuli* were spread from the Late Eneolithic to the Early Bronze Age, in the Central-East Mediterranean –Troy, Lerna, Malta– and in Southern Italy –Sicily and Apulia– (Setti and Zanini, 1996: 622-623).

In the Stratum III of Padru Jossu –Bell Beaker A, final Chalcolithic– there are about ten bone fragments with globular decoration and flat base. We have studied an ivory element –167550– (Fig. 11f) with three elliptic globules and lateral trapezoidal appendices, flat base and a flat-convex section (Nicolis and Mottes, 1998: 323).

These artefacts are not well-known in Sardinia. Together with our item, it is known a metapodial bone, perforated in one extreme and decorated with twelve globules from the Cave Taní de

Carbonia, with uncertain chrono-cultural adscription (Ferrarese y Fonzo, 1995: 97-113; Ferrarese, 1997: 546, 552, fig. 45, 50). It is similar to the segmented elements from Central-West France (Joussaume, 1976: 363) and another from Grotta S'Orreri, in Flumini Maggiore, without perforation (Gouin, 1884: 3-8). There are also two elements from Tomb XVI of Su Crucifissu Mannu cemetery, with difficult dating, carved in slim bones cut in their longitudinal axis and decorated with ten and four decreasing size globules line from the centre to the end of the item. Ferrarese Ceruti found external similarities with an adornment from the dolmen of Cabus-Gironde (Ferrarese, 1974: 164-165). The *ossi a globuli* appears in Italy, Sicily –Castelluccio, Castigione, Petraro, Sante Croci, Baravittala, Buscemi, Cava Lazzaro and Monte Casale (Militello, 2008: 137-149)–, and Apulia, in the Hypogeum 1 of Casal Sabini (Fig. 11g) (Biancofiore, 1977: 25-26; Ponzetti and Biancofiore, 1957; Cataldo, 1996; Recchia, 2010: 104-105) and in the Grotta del Pipistrello Solitario, near Grottaglie, together with Bell Beaker sherds (Coppola, 2003: 123-124 and 126; Recchia, 2010: 104-105).

The interpretation of item 167550 as a variant of the *ossi a globuli* could be an important opportunity to study East-West Mediterranean relations from the Late Chalcolithic to the Early Bronze Age, and the role played by Sardinia.

2.3. Technologies and uses

The adornments from Padru Jossu are highly degraded, showing glues, varnishes and black ink used during the restoration and classification process. That significantly obstructed the use wear analysis.

Some items –167517; 167510; 167543-47; 167557; 167574; 167575 y 167577; 167550– showed polishing traces, but it is unclear if they are product of the last elaboration stage; or they belong to use-wear –friction with textiles–. The latter option would be the most interesting as it

will confirm that the items were used prior their funeral deposition.

In the case of the item 167551, better preserved than the others, extremely thin abrasion lines appear on the surface (Fig. 12). Their shape and direction suggest that they can be traces carving techniques.

Two incisions have been identified separating the body from the wings in the item 167520

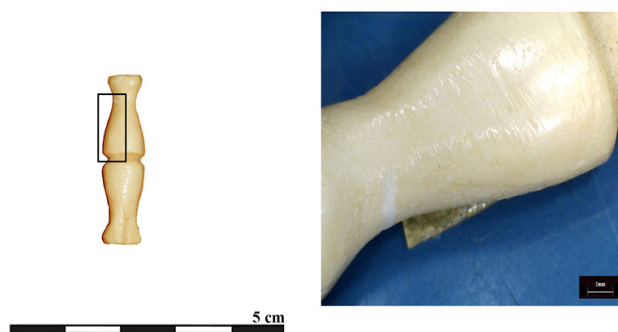


FIG. 12. Detail of the abrasion lines in button 167551.



FIG. 13. Detail of the incisions in button 167520.

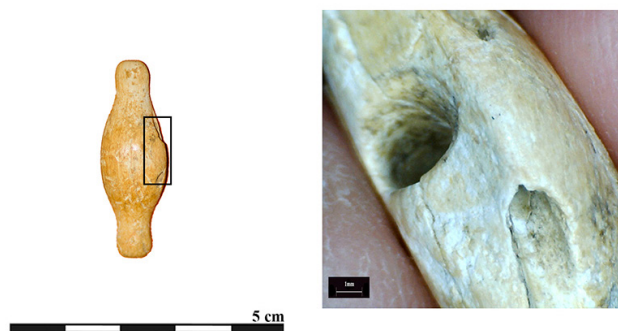


FIG. 14. Detail of the three perforations in button with wing-shape appendices 167518.

(Fig. 13). As they are very straight and present only in frontal side, they are interpreted as decorative.

The button 167518 (Fig. 14) shows three perforations, two joined in 'v' at the edge, and another rectilinear at the base, all three perforations are coincident. It is possible to suggest both the use of this item as a button, using the 'v' perforation, and as a pendant, using the rectilinear hole; we cannot discard the use of the three perforation at the same time.

There are other factors that allow us to infer how these items were used. In the small items defined as tiny, hemispheric buttons, the 'v'-perforation does not allow the pass of a needle, because of that; they are more likely beads of a necklace than buttons. Other elements suggest this interpretation, like the eleven buttons found together, associated with other necklace elements (Ugas, 1982: 23).

We consider that the adornments from the Group 2, Type 3 –buttons with hemispheric lateral appendices–, were used as beads due to their morphology and particularly their perforation, despite other researchers referring to them as pendants or buttons in alamaro, and, again, some researchers, consider this Type 3 as an evolution of the buttons from the Group 2, Type 2 (Cornaggia and Calegari, 1980: 228-232; Manunza *et al.*, 2005: 146).

We have placed the double-edged items –Group 3– in the buttons category, but not excluding the possibility of having had a different purpose; those items have also been called *bipenne* or double axe, their morphology has also been related to the double blade daggers represented in the Sardinian statues-stelae (Ugas, 1998: 273).

More complex is the interpretation of so-called pins –Category 2–. These items could have been used for hair styling or for closing and joining clothes. It is not easy to distinguish them from awls or sewing needles. Due to the strong degradation of the surfaces, it was impossible to obtain satisfactory results in their examination.

3. Conclusions and discussion

The typological study established two different categories, buttons and pins. Those categories were

also subdivided into three groups respectively. Finally the Group 2 from Category 1 includes three adornment types. The hemispheric buttons –9–, buttons with wing-shaped appendices –1–, and pins or pin handles with globular decoration –1– belong to the earlier phase, Bell Beaker A. However, the button with wing-shaped appendices 167551 from Stratum III is probably an intrusion from Stratum II (Ugas, 1998: 268). During the later Bell Beaker B phase, the hemispheric buttons are absent, but the buttons with wing-shaped appendices –6– experiment a significant increase (Fig. 15). Also belonging to this phase we have the only double-edged button, and the double-tip pins –3– appear for the first time, together with two pins with one sharpened tip and differentiated head (Fig. 15).

The selected ensemble of personal adornments found in the hypogeum of Padru Jossu shows strong typological parallels with other materials unearthed in the European area where the Bell Beaker horizon was developed. The adornments set fit with the Beaker *facies* of the Mediterranean and Southern Atlantic areas, showing the existence of relations, contacts and interchange between the different Mediterranean areas, and placing the island of Sardinia as an essential melting pot. We observe for instance that the boundary of turtle buttons does not infringe the line going from Brittany to Burgundy and Tuscany. In the same way the Northern limit of *Palme-la* points spreads from Armorique to Provence. These boundaries show networks that are characteristic of the Mediterranean-Southern Atlantic sphere of Beaker culture. The multiple parallels showed in the typological parallels, together with the presence of exotic raw material from distant areas, as Northern Africa and Near East must be understood not only in the traditional sense of prestige items trading, but suggest also a human mobility together with the material culture, as showed by Kristiansen and his team (2017), potentially creating hybrid societies in the frame of the Mediterranean connectivity discussed in this work (Kristiansen *et al.*, 2017).

The use wear study to identify the production phases and technologies has been obstructed by poor preservation. It was only possible to identify

STRATUM	PERIOD	ADORNMENTS		CATEGORIES	GROUP	TYPE	THE MATERIAL	TOTAL ADORNMENTS
III	Bell Beakers A	hemispheric buttons	167543	I	1	-	<i>Elephas maximus</i>	11
		hemispheric buttons	167544	I	1	-	<i>Elephas maximus</i>	
		hemispheric buttons	167545	I	1	-	<i>Elephas maximus</i>	
		hemispheric buttons	167546	I	1	-	<i>Elephas maximus</i>	
		hemispheric buttons	167547	I	1	-	<i>Elephas maximus</i>	
		hemispheric buttons	167557	I	1	-	<i>Elephas maximus</i>	
		hemispheric buttons	167574	I	1	-	<i>Elephas maximus</i>	
		hemispheric buttons	167575	I	1	-	<i>Elephas maximus</i>	
		hemispheric buttons	16757	I	1	-	<i>Elephas maximus</i>	
		buttons with wing-shaped appendices	167551	I	2	3	<i>Elephas maximus</i>	
		pins or pin handles with globular decoration	167550	II	3	-	<i>Elephas maximus</i>	
II	Bell Beakers B	buttons with wing-shaped appendices	167516	I	2	1	<i>Loxodonta africana africana</i>	12
		buttons with wing-shaped appendices	167518	I	2	1/2	<i>Loxodonta africana africana</i>	
		buttons with wing-shaped appendices	167520	I	2	2	<i>Loxodonta africana africana</i>	
		buttons with wing-shaped appendices	167507	I	2	3	<i>Elephas maximus</i>	
		buttons with wing-shaped appendices	167510	I	2	3	<i>Elephas maximus</i>	
		buttons with wing-shaped appendices	167517	I	2	3	<i>Loxodonta africana africana</i>	
		double edged items	167521	I	3	-	<i>Loxodonta africana africana</i>	
		double-tip pins	167560	II	1	-	<i>Elephas maximus</i>	
		double-tip pins	167561	II	1	-	<i>Loxodonta africana africana</i>	
		double-tip pins	167562	II	1	-	<i>Loxodonta africana africana</i>	
		pins with one sharpened tip and differentiated head	167563	II	2	-	<i>Loxodonta africana africana</i>	
		pins with one sharpened tip and differentiated head	167564	II	2	-	<i>Loxodonta africana africana</i>	

FIG. 15. Classification, stratigraphic position, period and raw material of studied adornments.

the last production stages in the best preserved item –167551–, while in the rest of the corpus it was impossible to differ if the polished areas had this finish due to the use of the items or to the technologies applied to the manufacture. The difficult interpretation of the items’ use, together with the scarce information available about the burials and their

associated adornments, make it extremely difficult to discern if those items were used during holders’ life, placed in the tomb only after their decease, if they were mere funerary offers, or, according to Ugas (1998: 279), offers to a deity adored at the hypogeum-sanctuary of Padru Jossu. In any case, there’s no doubt about their symbolic character,

inferred also from the exotism of the ivory used in their manufacture.

The results obtained in the archaeometric study show that the personal ivory adornments from Padru Jossu were manufactured in ivory from *Elephas maximus* and *Loxodonta africana africana* (Fig. 15). All the ivory adornments from the earliest phase (Bell Beaker A) were carved in *Elephas maximus* ivory (Fig. 15). On the other hand, during the later phase –Bell Beaker B–, we find 9 artefacts in *Loxodonta africana africana* –4 buttons with wing-shaped appendices, 1 double-edged button, 2 double-tip pins y 2 pins with one sharpened tip and differentiated head–, and 3 in *Elephas maximus* –two buttons with wing-shaped appendices, one double-tip pins–.

This information perhaps reflects the chronology of the Mediterranean ivory exchange. The exclusive presence of Asian elephant ivory in the Stratum III represents an earlier phase of raw ivory supplying from the Near East. This phase is contemporary with the Early Beaker period –Maritime style–. The presence of an *ossi a globuli-like* item is interesting. In general *ossi a globuli* are found in later context –Castelluccio–, in Italy, the Aegean and near East. The item from Padru Jossu is perhaps a kind of prototype. In Malta one parallel appears in the Tarxien Temple culture and can be contemporary with our item.

The higher number of ivory material in the Stratum II –the set of 11 hemispheric buttons from Stratum III should be considered one item, and probably manufactured from a single piece of ivory–, as well as the strong impact of the appearance of African elephant ivory, should be understood as a diversification of trade/contact routes in this later phase, product of a higher demand of local elites, as we mentioned before. The opening of the African resources of ivory to the Mediterranean centres is also coincident with the results of the later ivories from the Argaric horizon in South Eastern Iberian Peninsula (Schuhmacher and Banerjee, 2012: 292).

These results are extremely interesting due to their coincidence with the Iberian chalcolithic contexts. Those areas were considered related since

long ago. The presence of Asian ivory in Sardinia supports the idea of a Mediterranean axis of cultural relations during the III millennium BC.

A deeper approach shows that the presence of elephant ivory starts in Western Europe in the Early Chalcolithic centres of the South of the Iberian Peninsula –Valencina de la Concepción, Perdigoes, Los Millares–, with a clear dichotomy between the Southwest, where the majority comes from African elephant –La Pijotilla, Perdigoes, Zambujal, Palmela, Leceia–, and the Southeast, whose ivory is mainly from Asian elephants (Schuhmacher and Banerjee, 2012: 292-294). Valencina de la Concepción has both kinds of ivory, and also an important amount of fossil ivory, which is also common in central areas of Iberia, where ivory is mainly from *P. antiquus* (Liesau and Blasco, 2011-2012).

During the Beaker period –second half of the third millennium BC–, sperm whale ivory is present on several sites of the Tagus estuary (Schuhmacher *et al.*, 2013: 185-201). In the central area of the Iberian Peninsula, several samples of Camino de las Yeseras and two samples of Humanejos are in *Palaeoloxodon antiquus* ivory while ivory buttons of Ciempozuelos y La Magdalena are in African elephant ivory. A button with small appendages from Camino de Las Yeseras is made out of sperm whale ivory (Liesau, 2016: 72-80). This diversification in resources is coherent with demand increasing during the Bell Beaker horizon, which is the cultural phase in which the hypogeum of Padru Jossu is placed.

The presence of *E. maximus* ivory in this multiphasic context can be perfectly explained by considering Sardinia as an important intermediary step between the eastern sources of ivory and the western consumers. The *L. africana* ivory is also understandable as a product with the contacts within African contexts of the Bell Beaker culture, directly, or by Iberian intermediaries –Bell Beaker materials from Iberia, or at least from Iberian typologies are well known in Northwest Africa (Morocco), i.e. wrist guards, Bell Beaker's decorated pottery, copper daggers or Palmela arrowheads (Souville, 1977: 572-576)–.

Those analyses have a special interest for the understanding of the Bell Beaker phenomenon *per se*. It is known that there are two main geographic spheres included in this phenomenon. On one hand, in Northern and Central Europe, it is characterized by individual burials under tumuli, showing a gender code expressed by a specific orientation for male and female individuals. On the other hand, in South-Western Europe, The Bell Beaker horizon reuses the collective burials –hypogea, megaliths, burials in caves– from previous cultures. Both spheres claim for being the origin of the Bell Beaker process.

Supporters of the Oriental or Nordic hypothesis defend that the rise of the Bell Beaker horizon is inscribed in the expansion of the previous cultural horizons characterized by an individualistic expression –Yamnaya, Corded Ware– (Van der Linden, 2006). The presence of Bell Beaker’s burials in the Mediterranean Basin would correspond, from this point of view, to a reuse of the monuments devoted by the local funerary memory, but following the individual funerary patterns, according to the *orthodox* Bell Beaker’s code from the original area.

Supporters of the South European hypothesis propose several arguments. Firstly, the high number of Maritime style-Beaker –the oldest style– in some areas of the Iberian Peninsula –mainly the Bay of Lisbon–. Secondly, the progressive insertion of the Maritime Bell Beaker in the Mediterranean indigenous cultures’ productions at the end of the Neolithic, without a rupturing intrusion. Finally, the oldest C14 dating leads us to the Southern regions of the European continent (Müller and Van Willigen, 2001). This is also visible in the pottery assemblages in Northern Italy, where the common Bell Beaker’s pottery is undistinguishable from the local previous productions (Nicolis, 2001).

The findings of Padru Jossu show a reorganization of the Monte Claro burials to the Maritime Bell Beaker inhumations. The permanence of the autochthonous tradition of collective burial remains, and any replacement of this collective norm is not visible. Considering this, the findings confirm the precedence of the International Bell Beaker style –or Maritime, or Pan European– in this debate about this

culture, as well as its association with the hemispheric ‘v’-perforation buttons. This association is also attested in the south of France (Tomb 5 of La Clape, Laroque-de-Fa, Aude; Dolmen de la Madeleine d’Albesse, Monze, Aude). In Padru Jossu, the buttons with wing-shaped appendices –Group 2, Type I, II– seems to be secondarily related to the most recent bell Beaker typologies –Stratum B of Ugas–. Finally, the stratigraphy of Padru Jossu shows the anteriority of the first phase with Maritime Beaker –and other wares with ‘pointillé’ decoration– /hemispherical ‘v’-buttons/proto ossi a globuli / Asian ivory and a second phase with buttons with wing-shaped appendices / African ivory. This hypothesis must be confirmed by new investigations in other sites.

The presence of buttons carved in Asian elephant ivory in a Bell Beaker context must be inscribed in a long-distance relation already known by the Iberian pre-Bell Beaker Chalcolithic (Nocete *et al.*, 2013: 1582). This represents an additional argument to stress the filiation between the Western Mediterranean chalcolithic cultures and the emergence of the Bell Beaker horizon. There is no disruption between the two phases of an exotic material supply like ivory. Recently, this should be placed in the potential routes to reach the island of Sardinia. It would be possible to suggest a route from the receiving areas of southern Iberia to an ascent to the French *Midi* to reach the island –where the Beaker are mainly present in the western side–. It would be also possible to propose the hypothesis of a more direct contact by the African shores, followed by a stop on Sicily –where the Beaker identified are, again, mainly present in the Western side of the island (Guilaine *et al.*, 2009)–. Whatever the route was, it is evident that an ivory supplying network went through the maritime and/or terrestrial North African route to reach the western Mediterranean. This unchanging factor of ivory presence, which shows the early importance of this flowing route, shows at the same time how much work needs to be addressed in the coastal areas of the Maghreb to properly identify the archaeological mobility milestones. It is also currently impossible to exclude that artisan producers of the Western Mediterranean ivory items were

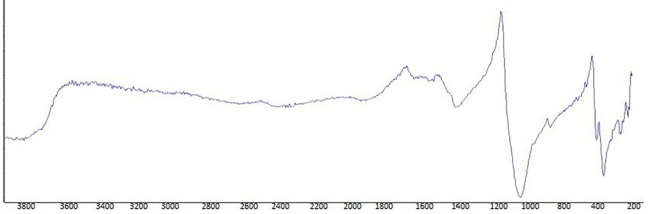
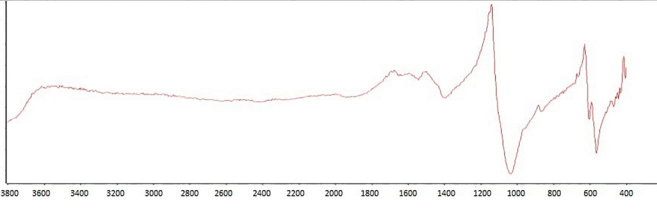
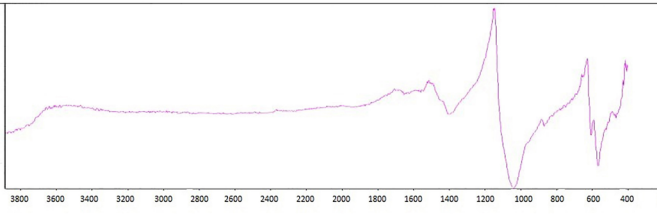
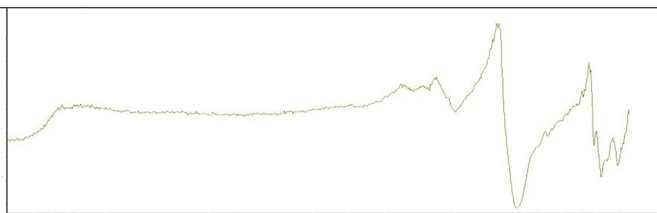
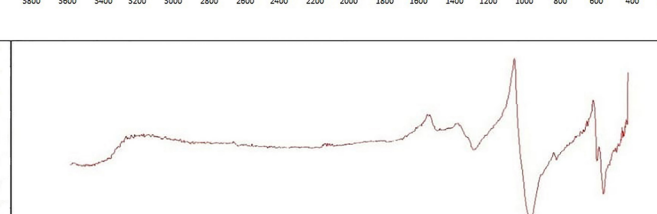
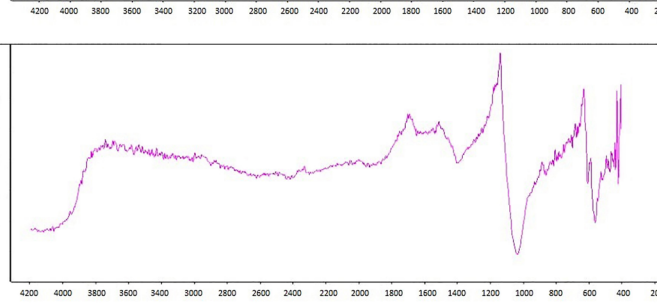
specialists from Africa or the Near East, holders of the skills to work this material.

Finally, the demonstration of these North African relations could restart the never-ending debate about the appearance of the Maritime Bell

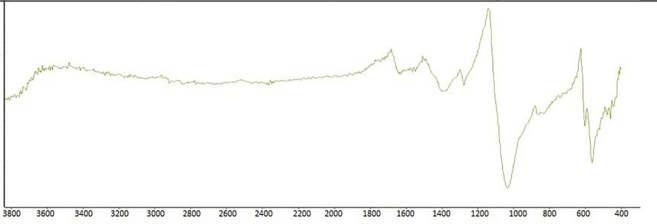
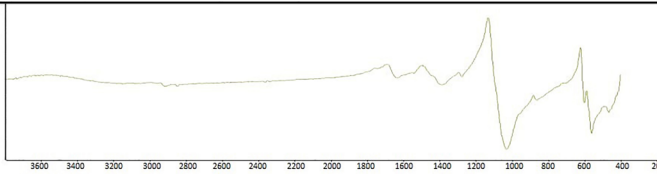
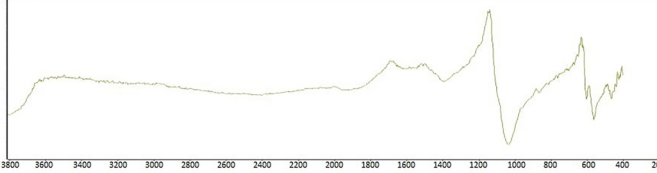
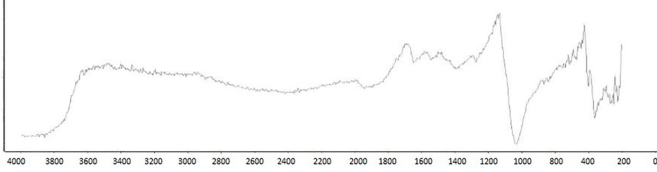
Beaker, characterized by the original comb-impressed decoration. No European Neolithic horizon shows this decorative typology, while it is strongly present in the North of Africa since the Early Neolithic.

APPENDIX

POSITIVE SPECTRA OBTAINED		
Reference	Spectrum	Identification
167516		<i>Loxodonta africana africana</i>
167517		<i>Loxodonta africana africana</i>
167518		<i>Loxodonta africana africana</i>
167520		<i>Loxodonta africana africana</i>
167521		<i>Loxodonta africana africana</i>

167561		<i>Loxodonta africana africana</i>
167562		<i>Loxodonta africana africana</i>
167563		<i>Loxodonta africana africana</i>
167364		<i>Loxodonta africana africana</i>
167507		<i>Elephas maximus</i>
167510		<i>Elephas maximus</i>

<p>167550 SNP49</p>		<p><i>Elephas maximus</i></p>
<p>167551 SNP41</p>		<p><i>Elephas maximus</i></p>
<p>167543</p>		<p><i>Elephas maximus</i></p>
<p>167544</p>		<p><i>Elephas maximus</i></p>
<p>167545</p>		<p><i>Elephas maximus</i></p>
<p>167546</p>		<p><i>Elephas maximus</i></p>
<p>167547</p>		<p><i>Elephas maximus</i></p>

167557		<i>Elephas maximus</i>
167574		<i>Elephas maximus</i>
167575		<i>Elephas maximus</i>
167577		<i>Elephas maximus</i>

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