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1 **Ornaments from the Magdalenian burial area in El Mirón Cave (Cantabria, northern**  
2 **Spain). Were they grave goods?**

3

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5

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13

14 **Abstract**

15

16 El Mirón Cave, located in northern Atlantic Iberia, has produced important evidence of  
17 human occupation during the Lower Magdalenian (19-17.5 cal kya). Among the finds dating to  
18 this period is that of a disturbed primary burial of an adult woman. The excavation of the small  
19 area around the burial yielded a considerable number of ornamental items (mainly shell beads),  
20 but the actual association of any of them with the interment is problematic. The results of our  
21 study of the perforated marine shells and mammal teeth suggest that the ornamental objects were  
22 not grave goods, but rather were simply artifacts present in the occupation layers in this part of  
23 the cave. The materials used to make ornaments were gathered by collecting shells along the  
24 Late Glacial shore and by hunting ungulates. The perforation techniques used were similar to  
25 those found at contemporary sites in the Franco-Cantabrian region and the appearance of various  
26 elements from the manufacturing operatory chain indicates that some of the ornaments were  
27 made at the site. It was also possible to determine that some of the shells were used—probably  
28 suspended or attached to other objects. From a functional standpoint, the ornaments probably  
29 played not only an aesthetic role, but also a symbolic one, facilitating communication and  
30 exchanges among human groups.

31

32 **Keywords:** Shell beads; perforated mammal teeth; Upper Paleolithic; ornaments; Magdalenian;  
33 human burial.

34

## 35 **1. Introduction**

36

37 In recent years, a new explanatory model has stressed the importance of marine resources  
38 among human populations of the Middle and Upper Paleolithic (Bailey and Flemming, 2008;  
39 Bicho and Haws, 2008; see also Straus and Clark, 1986). This model is derived from evidence  
40 that has been recovered from many sites (among other places) along the Atlantic and  
41 Mediterranean shores and contrasts with the traditional view that these resources had only  
42 become important in the Late Glacial (Colonese et al., 2011; Gutiérrez-Zugasti et al., 2011).  
43 Among the marine resources used by humans were mollusks that had various uses-- not only for  
44 food and tools (e.g. Bailey and Craighead, 2003; Cuenca-Solana et al. 2014), but also for  
45 symbolic and ideological purposes as ornaments (Álvarez-Fernández, 2006; Taborin, 1993).

46 Marine shells have been used as ornaments by humans since at least about 80 kya, as  
47 attested in Grotte des Pigeons (Morocco) (Bouzouggar et al., 2007) and Blombos Cave (South  
48 Africa) (d'Errico et al., 2005). The appearance of ornamental use of shells has been related with  
49 the development of greater capacity on the part of anatomically modern humans for expressive  
50 behavior relative to earlier hominins, and the evidence currently suggests that this first happened  
51 in Africa. This led to some scholars to defend the idea that the use of objects of symbolic  
52 character in Western Eurasia dated to the beginnings of the Upper Paleolithic (ca. 40 cal kya)  
53 (Álvarez-Fernández and Joris, 2008). However, current evidence is challenging this statement  
54 showing examples of possible symbolic behavior on the part of Neandertal populations in  
55 Europe (e.g. García-Díez et al., 2013; Morin and Laroulandie, 2012; Peresani et al., 2011, 2013;  
56 Rodríguez-Vidal et al., 2014; Zilhão et al., 2010), and contributing to the current debate on the  
57 relative capacities of Neandertals and *H. sapiens sapiens* (e.g., Caron et al., 2011; Mellars, 2010;  
58 Rendu et al., 2014; Soressi et al., 2013; Zilhão, 2007; Zilhão and d'Errico, 1999).

59 During the Upper Paleolithic shells, along with other materials—especially bones and  
60 teeth of animals (mammals, fish and birds), antler, ivory, and minerals were commonly used for  
61 the fabrication of ornaments (Álvarez-Fernández, 2006). The use of these elements was related  
62 to the symbolic world of hunter-gatherer groups. Shell beads in particular have been defined as

63 objects that identified human groups (Kuhn et al., 2001; Stiner, 1999, 2003), social status  
64 (Vanhaeren and d'Errico, 2005), social and personal identities (White, 2007), and even ethno-  
65 linguistic groups (Vanhaeren and d'Errico, 2006).

66 El Mirón Cave, located in the northern Atlantic zone of the Iberian Peninsula, has  
67 produced significant evidence of human occupations during the Lower Magdalenian (19-17.5 cal  
68 kya). In addition to rich residential deposits, the excavations uncovered the disturbed, but  
69 substantially complete burial of an adult woman that is described in all its aspects in this special  
70 issue of *JAS* (Straus and González Morales, this issue). This find is the first of its kind on the  
71 Iberian Peninsula and one of the very few ever to be discovered in Western Europe (Orschiedt,  
72 2013). The excavation of the area where the burial was located yielded a considerable number of  
73 ornamental elements (mostly shell beads), but their actual association with the interment is not  
74 clear. Generally, personal ornaments appear in differentiated contexts during the Upper  
75 Paleolithic: habitation areas and funerary areas. In the former they are usually dispersed and  
76 found together with remains of subsistence activities (e.g. Tatá et al., 2014) or in shell deposits  
77 that may or may not be associated with hearths (Álvarez-Fernández, 2006; Gutiérrez-Zugasti et  
78 al., 2013), while in funerary contexts they are found in close physical association with the human  
79 remains (e.g., in St.-Germain-la-Rivière [see Vanhaeren and d'Errico, 2005]).

80 It is fundamental to obtain information on the acquisition, transformation and use of  
81 ornaments by Upper Paleolithic forager groups in order to understand their symbolic world.  
82 Together with the technological activity related to ornament manufacture is their symbolic  
83 function, and the study of both aspects provides a more complete vision of the social relations  
84 that existed among such groups. The principal objectives of this article are to 1) determine  
85 whether the ornamental objects found in El Mirón Cave had any actual relationship with the  
86 Magdalenian burial or rather simply with the habitation layers into which the grave had been dug  
87 at the rear of the cave vestibule, and 2) establish the technical, functional and possible social  
88 characteristics of the identified ornaments. To do this, we analyzed the species represented in the  
89 whole shell assemblage and their characteristics, the taphonomic alterations that the shells had  
90 undergone, and the attributes of the perforated elements, their spatial distribution and  
91 morphometrics.

92

## 93 **2 El Mirón Cave and the Magdalenian burial**

94

95 El Mirón Cave is located at about 255 m above present sea level in the middle valley of  
96 the Asón River, in the central sector of the Cantabrian region of Spain (Fig. 1). The large cave  
97 mouth faces West and dominates the Asón valley at its confluence with the Calera and Gándara  
98 rivers from the steep side of Mount Pando. The site is about 20 km from the present shore of the  
99 Bay of Biscay at the mouth of the Asón, and would have been some 25-30 km from the shore  
100 during the Oldest Dryas, at the time of the Lower Magdalenian. The site was excavated by  
101 teams directed by Lawrence G. Straus and Manuel R. González Morales between 1996 and 2013.  
102 It contains a very long cultural sequence, with especially impressive occupation levels pertaining  
103 to the Cantabrian Lower Magdalenian. The excavations of these levels were conducted in the  
104 outer vestibule (Cabin area) and vestibule rear (Corral area), connected by the Mid-Vestibule  
105 Trench (González-Morales and Straus, 2009; Straus and González Morales, 2012).

106 The disturbed but primary human burial was excavated between 2010-2013 at the rear of  
107 the vestibule in a narrow area separated from the Corral area and the cave wall by a large  
108 engraved and ochre-stained block (Fig. 1). It is the first substantially complete Magdalenian  
109 burial to be found on the Iberian Peninsula. In this area, parts of meter-squares X5-7 and Y5-7  
110 were dug (see Straus and González Morales, this issue, for a detailed discussion of the  
111 excavation, stratigraphy and radiocarbon chronology). Levels 501 and 502, although they yielded  
112 artifacts of clear Magdalenian attribution (including an antler harpoon barb in 502), were  
113 disturbed in recent times (probably by shepherds), as they contained modern artifacts such as  
114 shards of glass. The rest of the layers in the area were intact, beside the existence of the pit that  
115 had been dug in Lower Magdalenian times for the interment of the corpse. The human remains  
116 were mainly associated with intensely red ochre-stained Level 504 (dated to 18.9-18.7 cal kya) in  
117 square X7, subsquares B+D and adjacent subsquares. However, the rest of the area dug between  
118 the engraved block and the rear cave vestibule wall contained human habitation deposits that  
119 evidenced subsistence and flint-knapping activities (see articles respectively on mammalian  
120 fauna and artifacts by Marín-Arroyo and Geiling and by Fontes et al., in this issue). The skeleton,  
121 corresponding to an adult woman (see Carretero et al., this issue), was deposited during the  
122 formation of Level 504 in a pit that affected both that layer and underlying Level 505 (c. 18.9 cal  
123 kya). According to the taphonomic study of the human remains, the corpse would have been laid  
124 down in flexed, lateral position in a small pit dug into the sediments. After it had become

125 skeletonized, it was slightly disturbed by a carnivore and finally certain large bones (including  
126 the cranium) were apparently removed by humans for transport to another (unknown) location,  
127 while the carnivore-gnawed tibia, mandible and several smaller bones were (re-)stained with  
128 ochre and reburied (Marín-Arroyo, this issue).

129

### 130 **3. Materials and methods**

131

132 The materials analyzed here were recovered during the excavation campaigns of 2010,  
133 2011 and 2013 and come from levels 502, 503, 504, 505 and 506 in squares X5-7 and Y5-7.  
134 The marine mollusks and other aquatic organisms (e.g., sea urchins) were taxonomically  
135 identified using specialized manuals (Poppe and Goto 1991, 1993) and the comparative  
136 collection of one of the authors (IGZ). In terms of systematics, we used the nomenclature  
137 proposed by the World Register of Marine Species (WORMS) for marine mollusks  
138 (<http://www.marinespecies.org/aphia.php?p=taxdetails&id=140293>). The few perforated  
139 mammal teeth were anatomically and taxonomically identified with the help of the reference  
140 collection of the Bioarchaeology lab at the IIPC (Cantabria, Spain). With respect to measures of  
141 abundance, we calculated absolute frequencies by Numbers of Identified Specimens (NISP) and  
142 Minimum Numbers of Individuals (MNI). To obtain the MNI for shells we used a method based  
143 on the creation of categories of levels of fragmentation, developed from patterns of mollusk  
144 disarticulation (Gutiérrez-Zugasti, 2011a; Moreno, 1994). Given the small number of ornamental  
145 objects that were piece-plotted with 3-dimensional coordinates during the excavation, the spatial  
146 distribution of the ornaments was analyzed using the subsquare (50x50 cm) information of each  
147 find.

148 The complete teeth and shells, as well as the substantial shell fragments used in the MNI  
149 calculations were examined for taphonomic alterations. The shells were observed with a Leica  
150 S8 APO binocular microscope. In order to evaluate the state of conservation, each shell was  
151 inspected using the method proposed by Yanes et al. (2012), with some modifications. The  
152 taphonomic descriptors used in the analysis were carbonate coating, manganese staining,  
153 biodegradation (loss of proteins), burning, color loss and ornamentation loss. The taphonomic  
154 study was conducted using three scoring variables as to the degree of weathering: 1=poor  
155 preservation; 0.5=intermediate preservation; 0=good preservation. The total taphonomic grade

156 (TTG) was scored for each shell and for the whole assemblage as the mean of all taphonomic  
157 features. Finally, the index of total fragmentation (FI) per level was calculated using the  
158 MNI/NISP ratio (Gutiérrez-Zugasti, 2011a).

159 The marine shells and teeth were measured with a digital caliper to the nearest 0.1 mm.  
160 Only the taxa that had complete or minimally fragmented shells were subjected to detailed  
161 biometric analysis. In the case of *Littorina obtusata* we measured the length, total width, width  
162 of the first whorl and the aperture width, while in the case of *Trivia* sp. we measured the length  
163 and width of the shell, following the conventions in the scientific literature (Gutiérrez-Zugasti,  
164 2009; Rigaud et al., 2014). The ranges of measurements were compared with those from other  
165 assemblages, both modern and archeological, in order to evaluate any possible intentional  
166 selection of sizes of items to be used for ornaments.

167 All the items that could have been used as ornaments were also measured and inspected  
168 under the microscope at different magnifications. We did an even more exhaustive analysis of  
169 those shells and teeth that have perforations or evidence of having been used as personal  
170 ornaments. In these cases we measured the perforation holes, documented the presence of ochre  
171 and noted traces of use-wear on the shells. Then we compared any alterations with those  
172 published in several specialized works (d'Errico et al., 1993; Taborin, 1993; Vanhaeren and  
173 d'Errico, 2002; Vanhaeren et al., 2005) in order to infer the techniques that could have been used  
174 to make the holes and to establish the existence or not of wear-traces related to the use of the  
175 shells in question. In order to analyze the perforations we used macroscopic observation and  
176 microscopy with the same binocular instrument at 5/80X, as well as with a Leica DM 2500M  
177 metallographic microscope for possible wear-traces between 50/200X. To photograph the shells,  
178 we used a Canon digital camera mounted on the microscopes.

179

## 180 **4. Results**

181

### 182 **4.1 Species representation**

183

184 The analyzed excavation units produced a total of 157 remains of marine shells. Among  
185 them, 17 taxa were identified (Table 1). Four of them were identified at the species level (the  
186 bivalve *Solen marginatus* Pulteney, 1799; and the marine gastropods *Littorina littorea*

187 [Linnaeus, 1758], *Littorina obtusata* [Linnaeus, 1758] and *Nucella lapillus* [Linnaeus, 1758]),  
188 ten at genus level (the bivalves *Cerastoderma* sp., *Mytilus* sp., and *Pecten* sp.; and the marine  
189 gastropods *Cyclope* sp., *Littorina* sp., *Nassarius* sp., *Patella* sp., *Trivia* sp., *Turritella* sp.; the  
190 scaphopod *Antalis* sp.), one at order level (Camarodonta) and two at class level (Bivalvia and  
191 Gastropoda). Among the perforated mammal teeth we identified two taxa: red deer (*Cervus*  
192 *elaphus*) and goat (presumably ibex) (*Capra* cf. *pyrenaica*).

193 The collection of marine shells and mammal teeth is dominated by taxa that were  
194 generally utilized for ornaments in Western Europe during the Upper Paleolithic (Álvarez-  
195 Fernández, 2006), although it also includes mollusks that are usually exclusively used for food,  
196 such as the razor shell (*Solen marginatus*), mussel *Mytilus* sp., and sea urchins from the  
197 Camarodonta Order. The numbers of marine shells are similar in all the levels, though slightly  
198 greater in Levels 504 and 505. The gastropods are better represented than the bivalves in the  
199 whole sequence of levels. The identified taxa generally inhabit rocky zones or intertidal  
200 sand/mud zones, although some also inhabit the infratidal fringe (e.g., *Antalis* sp., *Pecten* sp.).  
201 Similarly, most of the taxa can be found both along the open shore and in estuaries, although  
202 there are some that live in exclusively one or the other of these habitats (e.g., *Antalis* sp. and  
203 *Turritella* sp. are mostly estuarine, while *Trivia* sp. and Camarodonta are usually found along  
204 open coasts).

205

#### 206 4.1 Shell taphonomy

207

208 The TTG index reflects that the shells in all the levels display an intermediate state of  
209 preservation, with values centered around 0.5 (Fig. 2). However we did observe a pattern of  
210 progressive deterioration of the shells from the higher to the lower levels (from 0.47 in Level 502  
211 to 0.64 in Level 506). Similarly the IF (fragmentation index) does not display extreme values in  
212 any level, but the pattern is slightly different than for the TTG, since Levels 502 (which is  
213 mixed) and 503 (which is intact) showed higher and lower indices of fragmentation respectively.

214 The most frequently observed taphonomic processes are manganese staining,  
215 biodegradation, color loss, and ornamentation loss (Fig. 3). The last three display the same trends  
216 throughout the stratigraphic sequence (the oldest levels display a higher grade of deterioration  
217 than the more recent ones), while manganese staining is less common on shells from Level



218 504—the burial deposit. This suggests that the presence of scarce decomposing organic matter  
219 during the formation of this level, in accordance with what has been observed on both the human  
220 and large mammal bones from Level 504 (Marín-Arroyo, this issue; Marín-Arroyo and Geiling,  
221 this issue). Other processes such as carbonate coating and burning are hardly attested among the  
222 shells.

223 The analysis of taphonomic alterations allowed us to identify some case of bioerosion,  
224 which indicates that some shells had been collected after the mollusks had died. Most of the  
225 shells display traces of ochre on both their external and internal surfaces. In some cases the ochre  
226 appears on breaks (both anthropic and natural), a fact which suggests that the shells were already  
227 broken when the ochre powder was deposited. The same is true for the manganese which  
228 habitually occurs on breaks. In addition, when the two kinds of mineral staining on the same  
229 shell, the manganese is always on top of the ochre, proving its antiquity.

230

### 231 **4.3 Shell and tooth ornaments**

232

233 Among the items that were transformed into ornaments, there are two types: shell beads  
234 and mammal teeth. From the 157 shell remains recorded in this study, a total of 47 whole and  
235 fragmentary shells belonging to nine taxa have been identified as ornamental objects (Table 2).  
236 Among the marine shells, 16 gastropods and bivalves display anthropic perforations (Fig. 4).  
237 Among the scaphopods we identified 31 whole or fragmentary manufactured beads with breaks  
238 that are either longitudinal or transversal to the long axis of the shell (Fig. 5). There are three  
239 terrestrial mammal teeth with perforations (one atrophied red deer canine, a juvenile ibex right  
240 incisor and an adult ibex right incisor with the perforation broken) (Fig 6). Apart from the shell  
241 beads, another 24 complete shells or smaller fragments belonging without traces of human  
242 manipulation (except for the presence of ochre in the surface of 12 of them) have been also  
243 identified as potential ornaments (Table 3; Fig. 7). They could have been collected to be  
244 transformed into beads and then discarded at the site or perhaps they are fragments of broken  
245 beads. Among the shells, 33 ornaments and 12 potential ornaments are stained with ochre. The  
246 presence of ochre in the surface of these shells suggests their use in symbolic activities.

247 The ornamental assemblage from post-burial Levels 503 and 502 is quite limited and is  
248 made up of marine and terrestrial species that are habitually found in Magdalenian deposits in

249 Western Europe (*Cyclope* in 503 and *Cerastoderma* and a red deer canine in 502). The level with  
250 the most ornaments is 505, followed by 504 and 506, and the most abundant shell beads belong  
251 to the taxa *L. obtusata*, *Trivia* sp., *Antalis* sp., *Nassarius* sp. and *N. lapillus* (Table 2). In general,  
252 the composition of the ornamental assemblages is quite homogeneous, with almost all the same  
253 species appearing in all three of these levels.

254

#### 255 4.4 Morphometrics

256

257 Only two taxa had well preserved individuals, thus permitting detailed morphometric  
258 analysis: *L. obtusata* (n=10) and *Trivia* sp. (n=4). In both cases the average length of the  
259 perforated shells (*L. obtusata*=10.1 mm; *Trivia*=10.5 mm) is slightly greater than that of the  
260 non-perforated shells (*L. obtusata*=7.8 mm; *Trivia*=8.6 mm). The distributions of sizes of these  
261 two species were compared with those of reference collections from La Concha Beach in  
262 Santander for *L. obtusata* and from Cubelas (San Ciprián, Lugo, Galicia) for *Trivia* (data from  
263 Álvarez-Fernández, 2006). The results show that the specimens of *L. obtusata* from El Mirón  
264 cover most of the range of sizes among modern shells, with only one being clearly larger (Fig.  
265 8A). As for *Trivia*, three individuals fall within the group of the largest modern specimens and  
266 one is of average size (Fig. 8B).

267

#### 268 4.5 Technology and use wear

269

270 The perforations of *L. obtusata* shells have a regular shape and flat surface on which one  
271 can see striations that are oblique to the axis of the shell (Fig. 9: #13, #14). This striated surface  
272 is the result of rubbing the shell against an abrasive object, probably a piece of sandstone. The  
273 same kinds of traces are found on the three broken specimens of *Nucella* (e.g. Fig. 9: #20), the  
274 two of *Nassarius* (one of them with three perforations, see Fig. 9: #17a, 17b and 17c), and one of  
275 *Cerastoderma* (Fig. 9: #1). The *Trivia* shells have regular, circular perforations whose edges are  
276 perpendicular to the surface of the shell (Fig. 9: #15a, #15b). Two shells have double  
277 perforations, with a hole at each end, while the third shell has only one small perforation (0.7 x  
278 0.7 mm) at one end, but not exactly in the same position than the other two shells, which raise  
279 some doubts about its anthropogenic origin. Given the characteristics of *Trivia* shells, the holes

280 must have been made from the exterior surface with a sharp object such as a stone borer or bone  
281 awl. Despite its poor state of preservation of the *Cyclope* shell, we were able to observe a hole of  
282 similar characteristics as those of the *Trivia* shells (Fig. 9: #3). In the case of the scaphopods, we  
283 found evidence of sawing of the shells to obtain tube-shaped beads (Fig. 10). Among the  
284 recovered fragments is one that has been sawed in its posterior portion (the thinnest part, usually  
285 discarded because of its small natural hole, see Figs. 5 and 10: #38) and two others that could be  
286 refitted (# 23 and 24). An irregular fracture on the edge of the anterior end has been identified in  
287 some individuals of *Antalis* (Fig. 5). This is probably related to the position of the shells with  
288 respect to one another in a composite ornament, with each successive bead being fitted into its  
289 neighbor along the string. This layout, together with twisting caused by suspension and  
290 movement of the ornament would have caused the breakage of this part of the shell.

291 The perforations on the red deer canine and on the juvenile ibex incisor are on the root  
292 and were made by scraping the root followed by rotary drilling with a lithic borer. In both cases  
293 we could see the scrape marks and many striations in several directions that were made in the  
294 process of preparation and drilling the holes (Fig. 6). The perforation of the adult ibex incisor is  
295 broken and the overall preservation of the piece is not good, but nevertheless we could see  
296 striations that the hole was also made by rotation with a small stone tool.

297 About 23% of the shell beads bear clear traces of wear in their holes, mainly in the form  
298 of smoothed edges at the perforations and/or polish traces (Table 2; Fig. 9). A considerable  
299 number (28%) also present polish traces that could be or not directly tied to shell use, since  
300 similar polishes appear on other zones of the shell surfaces. However, given the lack of  
301 experimental controls we were not able to distinguish if they are wear traces or post-depositional  
302 weathering. The rest of the whole and fragmentary shells (49%) show no traces of use. The  
303 perforated red deer canine shows wear traces in the perimeter of the hole while the juvenile ibex  
304 incisor presents a thorough preparation of the hole (including a small platform perpendicular to  
305 the length axis of the tooth and a rounded groove longitudinal to that axis). In both cases these  
306 marks are probably related to the attachment/suspension of the teeth.

307

#### 308 **4.6 Spatial distribution**

309

310 The analysis of the spatial distribution of the ornaments helped to determine their  
311 locations vis à vis the burial, which was centered on subsquares B and D of square /X7 (Fig. 11).  
312 Levels 502 (disturbed) and 503 (intact) were above the burial layer, so objects found in them  
313 were clearly not related to the burial. In Level 504 the ornaments were distributed among X6,  
314 X7, Y5 and Y6 (the latter squares being fairly remote from the burial). Only one item (the  
315 perforated ibex incisor from X7 subsquare D) was from the area occupied by the burial. In Level  
316 505, the spatial distribution of perforated objects is very homogeneous throughout four squares:  
317 X7, Y7, Y6 and Y7, only the first two of which were in the immediate burial area. All the  
318 perforated items from Level 506 were from one subsquare (X7 C), but this level was only dug in  
319 a very small area in X7 (and did not exist in the northern part of X7 due to the presence of a  
320 sloping bedrock ledge there).

321

## 322 **5. Discussion**

323

### 324 **5.1 The burial area shell and tooth ornaments: were they “grave goods”?**

325

326 Levels 502-506 in El Mirón Cave, located in the area of the discovery of a Magdalenian-  
327 age human burial (Marín-Arroyo, this issue; Straus and González Morales, this issue) yielded a  
328 collection of ornamental elements made from marine shells and ungulate teeth. However, the  
329 spatial analysis of the items shows that only one element came from the burial layer (504) in the  
330 area of the burial pit in square X7 B+D. The rest of the objects came from areas outside the  
331 burial area, in zones clearly related to subsistence and flint knapping activities of the Lower  
332 Magdalenian inhabitants of the cave (see Marín-Arroyo and Geiling, this issue; and Fontes et al.,  
333 this issue). This would seem to indicate that there was no (or almost no) relationship between the  
334 ornaments and the burial, which is the same conclusion that has been reached with regard to the  
335 faunal remains and the osseous and lithic artifacts from Level 504 (with the possible exception of  
336 a large quartz crystal). The presence of beads in this area of the cave was related to the conduct  
337 of normal, daily activities (and losses or discards), notably, we argue, as material remains of  
338 social relations among the living. Such objects were frequently found in the Lower (and other  
339 Magdalenian and Solutrean) levels throughout the other excavation areas of the cave in purely  
340 residential contexts (Straus et al., 2011). The presence of a perforated ibex incisor in the burial

341 pit might not either be actually related to the interment, since it could have been originally in the  
342 Level 504 (or 505) fill that was dug into to make the narrow, shallow grave. In addition, the  
343 homogeneity of the ornamental assemblages from levels 504, 505 and 506 also supports the  
344 hypothesis that the beads were not related to the burial. The taphonomic alterations do not  
345 suggest the existence of different processes affecting the shells of Level 504 relative to the other  
346 levels, save perhaps for a higher incidence of manganese precipitation. Thus the presence of  
347 ornaments in this area of the site must be interpreted from a non-funerary perspective, just as in  
348 the case of other Lower Magdalenian living areas in the cave.

349

## 350 **5.2 Acquisition of raw materials**

351

352 The animal species that were used to make beads are all ones that are characteristic of the  
353 Cantabrian region, except the specimen of *Cyclope* sp. from Level 503, whose origin is  
354 Mediterranean. This species can be found today along the Cantabrian coast, but it is an  
355 allochthonous mollusk, having been introduced recently in association with the oyster-farming  
356 industry (Arias et al., 2012; Bachelet et al., 2004). The presence of Mediterranean species among  
357 the ornamental shell assemblages of the Upper Paleolithic in northern Atlantic Spain is sparse,  
358 but not insignificant. Various specimens of *Cyclope pellucida* were found in the Magdalenian of  
359 Tito Bustillo Cave (eastern Asturias), one of *Zonaria pyrum* in La Garma A (central Cantabria),  
360 and a specimen of *Homalopoma sanguineum* in El Mirón Level 17 (Lower Magdalenian—  
361 contemporaneous with the burial layer, 504) (Álvarez-Fernández, 2006). The presence of this  
362 species suggest the existence of networks of exchange among hunter-gatherer groups of the  
363 Mediterranean and Cantabrian regions (probably via the Ebro Valley, along which there are  
364 Magdalenian sites, see Utrilla et al., 2012) or exchange relationships with other groups in contact  
365 with Mediterranean bands.

366 As no fossil shells were identified, the acquisition of most of the shells used for  
367 ornaments was probably done along the Cantabrian shore, possibly around the paleo-mouth of  
368 the Asón River. At the time of the Lower Magdalenian the site would have been about 25-30 km  
369 from the early Late Glacial shore, proving that it was humans who transported the shells to the  
370 cave. Evidence from numerous Upper Paleolithic ornament assemblages indicates that the  
371 collection of dead shells (sometimes even fossil shells) to make beads was a habitual practice

372 (e.g. Gutiérrez-Zugasti et al., 2013; Stiner et al., 2013; Taborin, 1993). Because of the bioerosion  
373 on the surfaces of some of the shells, they must have been collected dead, though we cannot  
374 determine whether they came from one or several kinds of thanatocenoses. In the case of  
375 perforated teeth, the two identified species (red deer and ibex) lived in the surroundings of El  
376 Mirón and were hunted by Lower Magdalenian people, as attested by the archeofaunal  
377 assemblage from Level 504 (see Marín-Arroyo and Geiling, this issue). Thus the teeth were  
378 probably obtained from carcasses that were killed and eaten by the inhabitants of the site at the  
379 time.

380 As regards the selection of shell sizes, among the specimens of *L. obtusata* only one has  
381 dimensions comparable to ones from Magdalenian assemblages like that of Urtiaga (Levels E+F)  
382 in Guipúzcoa, whose assemblage of shells displays a marked selection for the biggest specimens  
383 (Álvarez-Fernández, 2006; Rigaud et al., 2014). However, the rest of the individual unperforated  
384 shells in the El Mirón assemblage are smaller, though within the range of sizes that have been  
385 documented both in other Upper Paleolithic sites and along the present day Cantabrian coast  
386 (Álvarez-Fernández, 2006). On the other hand, comparison between the sizes of the perforated  
387 and non-perforated shells suggests a slight preference for larger shells with which to make beads.  
388 Generally the decrease in shell size through time has been explained either by sea-surface  
389 temperature rise or by the pressure of human exploitation (Bailey and Craighead, 2003;  
390 Gutiérrez-Zugasti, 2011b; Straus and Clark, 1986). As in many other sites in Western Europe,  
391 the species used for ornaments in El Mirón came from various kinds of thanatocenoses, so they  
392 were not subjected to the impact of human exploitation which, in any case was not especially  
393 intensive yet in the Magdalenian of Cantabria (Gutiérrez-Zugasti et al., 2011b). This means that  
394 human pressure does not seem to have played an important role in determining the sizes of shells  
395 that were available for selection. Furthermore, the climatic conditions of the Lower Magdalenian  
396 were too rigorous to suggest that there was any climatic reason for size decrease in *L. obtusata* at  
397 this time. In any case, although it is possible that variations in local ecological conditions along  
398 the Cantabrian coast could have played a role in the sizes of shells available to humans, the  
399 results of our study suggest that there was no preference for the largest shells in bead-making,  
400 since perforated and non-perforated *Littorina* shells are of the same sizes. On the other hand, in  
401 the case of *Trivia*, comparisons both with archeological shells and with modern collections  
402 (Álvarez-Fernández, 2006) of both El Mirón perforated and non-perforated shells suggest that

403 the site's inhabitants selected the biggest shells for fabrication of ornaments. This distinction  
404 between the non-selection of large *Littorina* shells and the selection of large *Trivia* shells could  
405 be explained by the existence of more favorable ecological conditions for *Trivia* in the area  
406 where people were collecting shells at the time, which in turn would have permitted the  
407 formation of thanatocenoses with bigger individuals than in the case of *Littorina*. However,  
408 human choices and social practices can provide alternative explanations. Possible aesthetic  
409 choices of the artisans could have led them to associate large and small shells in the same  
410 beadwork, maybe organized according to a size gradient or a codified alternation of sizes.  
411 It can also be proposed that group composition included adult and children and that small shells  
412 were dedicated to children while larger shells were used for adults. Size reduction of personal  
413 ornaments crafted for children has already been proposed in the case of the Magdalenian burial  
414 in the type site of La Madeleine (Vanhaeren and d'Errico 2001). The Lower Magdalenian levels  
415 in El Mirón Cave evidence a wealth of materials of all types that have been interpreted as the  
416 products of repeated, multi-functional, residential occupations of the site. The complex  
417 composition of the groups represented would fit with the residential function of the site.

418

### 419 **5.3 Technology and use**

420

421 The perforation techniques used to make the shell beads at El Mirón (abrasion and  
422 percussion/pressure) are very habitual for the manufacture of ornamental shells throughout  
423 Western Europe in the Upper Paleolithic (Álvarez-Fernández, 2006; Taborin, 1993). The  
424 presence of manufacturing debris (principally fragments of *Antalis*) and several shell beads  
425 without wear traces, indicate that at least some of the ornaments could have been made at the  
426 site. The manufacture of shell (and tooth) beads—symbolic artifacts-- here would fit in very well  
427 with the overall picture of the site multifaceted occupations.

428 Only some pieces have clear wear-traces, probably related to the suspension/attachment  
429 of the shells. Several other shells display traces of wear around the hole that are similar to wear  
430 traces on other zones of shell surfaces. We cannot rule out the possibility that taphonomic  
431 alterations that occurred during biostratinomic or diagenetic phases of the shells' existence were  
432 responsible for these wear traces. The presence of traces on various parts of the shells could be  
433 related to tying the beads in different ways. White (2007) has pointed out that these materials are

434 usually associated with body ornaments from a traditional typo-morphological perspective, while  
435 ethnographic examples suggest that they could have been used as non-body-ornament objects  
436 adapted for suspension or attachment on baskets, bags, blankets, dwellings, etc. Experimental  
437 studies have demonstrated that different kinds of use-wear are produced when different systems  
438 for stringing the shells together are used, and that some of those systems produce wear traces in  
439 various parts of the shells (Vanhaeren et al., 2013). However, considering the limited number  
440 and quality of the use-wear recorded on El Mirón shells, and the previously published  
441 experimental data, it is not possible to make any accurate assumption on the function of the  
442 shells.

443

#### 444 **5.4 Social implications**

445

446 Currently available ethnographic evidence supports the idea that the ethnic dimension of  
447 human groups can be recognized through the use of different bead types and by their  
448 combination and arrangement on the body and on other objects such as clothing. Thus  
449 understanding the meaning of the ornaments could be shared by one or more neighboring groups.  
450 This would allow or facilitate the communication of social identity of people bearing the  
451 ornaments as members of the same group, gender or other grouping related to age, marital  
452 status, role in society, etc. (Kuhn et al., 2001, 2009; Vanhaeren and d'Errico, 2006).

453 In El Mirón, both the species used to make ornaments and the manufacturing processes  
454 are similar to those that are documented at Upper Paleolithic sites throughout Western Europe,  
455 especially in the Franco-Cantabrian region (Álvarez-Fernández, 2006). This fact suggests that  
456 the Magdalenian human groups shared the same technological tradition for the manufacture of  
457 ornaments and that those ornaments may have had the same general sorts of social meanings as  
458 is documented in the ethnographic record of recent forager societies. The presence of  
459 Mediterranean species in Cantabrian sites including El Mirón suggests the existence of a network  
460 of contacts among Magdalenian bands (see Schwendler, 2004). These contacts could have  
461 occurred during travels related to the subsistence strategies but also during social get-togethers  
462 (“aggregations”), as has been argued for the Lower Magdalenian site of Altamira (Conkey,  
463 1980), which is linked to El Mirón by the presence of striation-engraved red deer scapulae



464 (González Morales and Straus, 2009). The ornamental objects could have served to facilitate  
465 communication among members of different bands, and thus social relations and exchanges.

466

## 467 **6. Conclusions**

468

469 The results of this study of the marine shells and perforated ungulate teeth in El Mirón  
470 Cave suggest that the beads (with the remotely possible exception of a perforated ibex incisor)  
471 were not grave goods deposited with the Magdalenian burial. On the contrary, they were no  
472 doubt objects lost during residential occupations of this area at the rear of the cave vestibule  
473 before and after the time of the burial. The raw materials for making the beads were all easily  
474 obtainable by the Lower Magdalenian inhabitants of the site (with the exception of a shell of  
475 Mediterranean origin) either by collection along the Bay of Biscay shore or by hunting normal  
476 game animals near the cave. The perforation techniques used are like those found at other  
477 contemporary sites in the Franco-Cantabrian region, suggesting the existence of a widespread,  
478 well-established technological tradition across a very large area. The discovery of several  
479 remains of the manufacturing operatory chain and shells without wear traces suggests that some  
480 of the beads were made on-site, a fact that supports the hypothesis that El Mirón was used as a  
481 multi-purpose site during the Lower Magdalenian. We were also able to determine the presence  
482 of wear-traces on some of the shells, confirming that they were utilized as personal ornaments.  
483 From a functional standpoint, the ornaments probably played not only an aesthetic role, but also  
484 a social one in the facilitation of communication among different groups, including interpersonal  
485 relationships and exchanges of all sorts—from trade, to information-sharing, to intermarriage.

486

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488

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739

740 **Figure captions**

741

742 Fig. 1: Location of El Mirón Cave (above). The plan of the site (below) shows excavation areas,  
743 including the burial area and the burial pit (Marín-Arroyo and Geiling, this issue).

744

745 Fig. 2: Total Taphonomic Grade (TTG) and Fragmentation Index (FI) of marine shells from  
746 levels 502-506. Note the progressive decrease of the TTG from older to younger levels, while the  
747 FI is higher (better preservation) in Level 503 and similar for the rest of levels.

748

749 Fig. 3: Recorded taphonomic alterations in marine taxa from levels 502-506. Biodegradation,  
750 manganese staining, color loss and ornamentation loss present the higher TTG (Total  
751 Taphonomic Grade) (poorer shell preservation), while carbonate coating and burning are  
752 scarcely represented.

753

754 Fig. 4: Complete and fragmentary shell beads from levels 502-506 showing perforations: 1:  
755 *Cerastoderma* sp.; 3: *Cyclope* sp.; 4, 12, 13, 14, 47: *Littorina obtusata*; 5, 15, 16: *Trivia* sp.; 6,  
756 19, 20: *Nucella lapillus*; 17, 18, 48: *Nassarius* sp. Numbers referred to Table 2.

757

758 Fig. 5: Shell beads made on *Antalis* sp. and manufacturing debris. Numbers referred to Table 2.

759

760 Fig. 6: General and detailed views of perforated teeth: Left) atrophied red deer canine; Right)  
761 juvenile ibex right incisor; and Center) adult ibex right incisor with the perforation broken.  
762 Numbers referred to Table 2.

763

764 Fig. 7: Additional shells identified as potential ornaments. 51, 52, 53, 57, 62, 70, 71, 72, 73:  
765 *Littorina obtusata*; 54: *Littorina* sp.; 55: Gastropoda sp.; 56: *Cyclope* sp.; 58, 59, 63, 64: *Trivia*  
766 sp.; 60, 65: *Nassarius* sp.; 61: Bivalvia sp; 66, 74: *Turritella* sp.; 67, 68, 69: *Pecten* sp. Numbers  
767 referred to Table 3.

768

769 Fig. 8: Morphometric data from archaeological specimens of *Littorina obtusata* (A) and *Trivia*  
770 sp. (B) of El Mirón compared to modern reference collections from La Concha beach  
771 (Santander) and Cubelas beach (Galicia) respectively. Black triangles: perforated shells; Black  
772 circles: non perforated shells; Grey and white circles: modern reference collection (after Álvarez-  
773 Fernández, 2006).

774  
775 Fig. 9: Detailed view of perforations made by abrasion on *L. obtusata* (#13, 14), *N. lapillus*  
776 (#20), *Nassarius* sp. (#17a, 17b, 17c) and *Cerastoderma* sp. (#1); and percussion/pression on  
777 *Trivia* sp. (#15a, 15b) and *Cyclope* sp (#3). White rectangles are showing use wear traces in the  
778 perforations.

779  
780 Fig. 10: Examples of *Antalis* sp. (#25, 36, 38) with evidence of sawing. Top: view of the whole  
781 shells; Bottom: detailed view of the areas with traces of sawing.

782  
783 Fig. 11: Spatial distribution by subsquares of shell and tooth ornaments from levels 502-506.

784  
785 **Table captions**

786  
787 Table 1: Marine taxa from levels 502-506 at the burial area in El Mirón Cave and abundance in  
788 terms of Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI).

789  
790 Table 2: Morphometric data (mm), presence/absence of ochre stains, perforation metrics (mm),  
791 modification type and presence/absence of use wear of shell and tooth ornaments from levels  
792 502-506. Black circles in the use column refer to clearly identified use wear traces, while the  
793 asterisk represent the occurrence of polishing of ambiguous origin (either anthropogenic or  
794 natural).

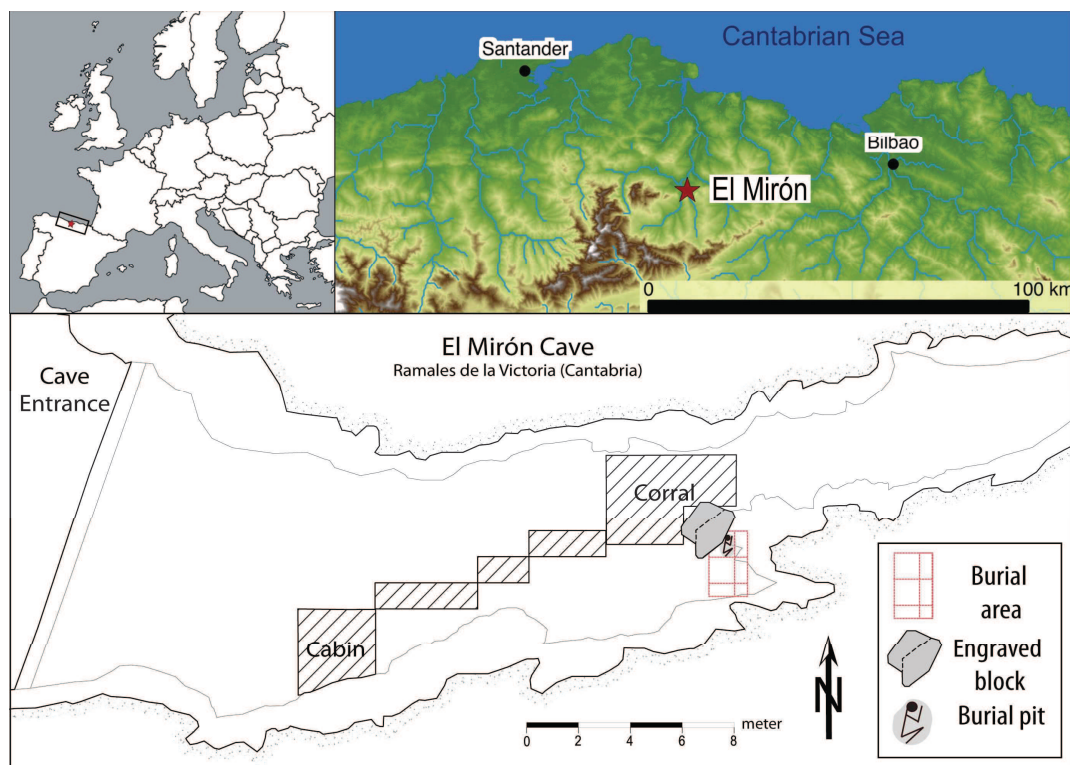
795  
796 Table 3: Morphometric data (mm) and presence/absence of ochre stains in whole and  
797 fragmentary shells from levels 502-506 considered potential ornaments.

	502		503		504		505		506	
	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI
<b>Marine bivalves</b>										
<i>Bivalvia</i> sp.					3	2	1	1		
<i>Cerastoderma</i> sp.	2	1			1	1				
<i>Mytilus</i> sp.	5	1			1	1				
<i>Pecten</i> sp.							4	1		
<i>Solen marginatus</i>			1	1						
<b>Total Bivalves</b>	<b>7</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>4</b>	<b>5</b>	<b>2</b>		
<b>Gastropods</b>										
<i>Cyclope</i> sp.			2	2						
<i>Gastropoda</i> sp.			1	1						
<i>Littorina littorea</i>	2	1	4	3	8	2	1	1	1	1
<i>Littorina obtusata</i>	1	1	6	2	7	2	7	6	17	5
<i>Littorina</i> sp.	3	1	1	1			1	1	1	1
<i>Nassarius</i> sp.					1	1	3	2	1	1
<i>Nucella lapillus</i>	1	1			2	1	2	2		
<i>Patella</i> sp.			1	1	3	2				
<i>Trivia</i> sp.					3	2	4	3		
<i>Turritella</i> sp.							1	1	1	1
<b>Total gastropods</b>	<b>7</b>	<b>4</b>	<b>14</b>	<b>9</b>	<b>24</b>	<b>10</b>	<b>19</b>	<b>16</b>	<b>21</b>	<b>9</b>
<b>Scaphopods</b>										
<i>Antalis</i> sp.					4	2	29	14	1	1
<b>Echinoderms</b>										
<i>Camarodonta</i>					2	1	2	1		
<b>Unidentifiable</b>	6	2	1	1	1	1	7	2	1	1
<b>TOTAL</b>	<b>20</b>	<b>8</b>	<b>16</b>	<b>11</b>	<b>36</b>	<b>18</b>	<b>62</b>	<b>35</b>	<b>23</b>	<b>11</b>

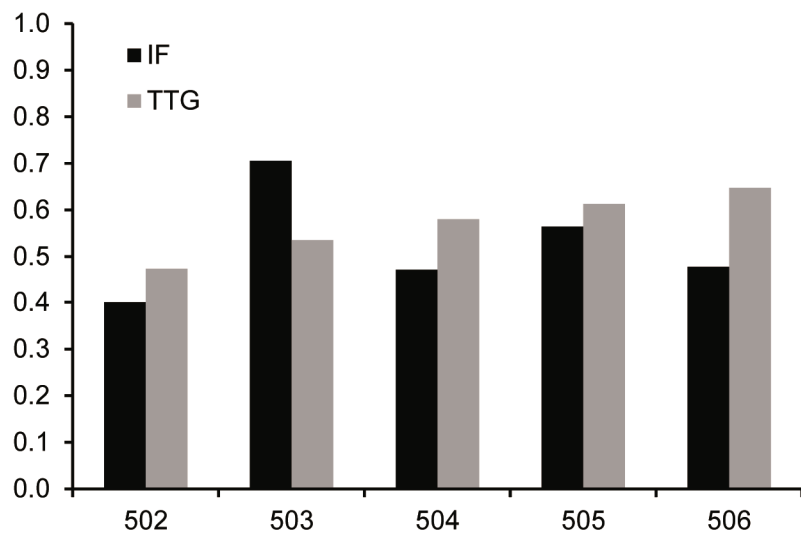
Sample ID	Species	Level	Shells and teeth				Perforation				
			Length	Width	Spire width	Aperture width	Ochre	Lmax	Lmin	Modification type	Use wear
1	<i>Cerastoderma</i> sp.	502	28	26			•	2,3	1,4	Abrasion	•
2	<i>Cervus elaphus</i>	502	19,2	11,6			•	2,9	1,9	Rotation	•
3	<i>Cyclope</i> sp.	503	4,9	6,4			•	4,8	2,7	Percussion	*
4	<i>Littorina obtusata</i>	504	8,5	8	4,3	4,6	•	4	2,7	Abrasion	•
5	<i>Trivia</i> sp.	504	7,3	5,8			•	0,7	0,7	Percussion	
6	<i>Nucella lapillus</i>	504					•			Abrasion	
7	<i>Antalis</i> sp.	504	11,9	2,9			•			Serrated	
8	<i>Antalis</i> sp.	504	8	3,1			•			Serrated	*
9	<i>Antalis</i> sp.	504	8,3	3			•			Serrated	*
10	<i>Antalis</i> sp.	504	3,2	3,3			•				
11	<i>Capra pyrenaica</i>	504	23,8	7						Rotation	
12	<i>Littorina obtusata</i>	505	11,4	9,2	6,8	5,6				Percussion	
13	<i>Littorina obtusata</i>	505	10	10,8	5,6	6	•	3,7	3,3	Abrasion	•
14	<i>Littorina obtusata</i>	505	6,5	6,5	3,4	3,8		3,2	1,9	Abrasion	•
15	<i>Trivia</i> sp.	505	10,6	7,9			•	3,5/3,4	2,2/2,6	Percussion	•
16	<i>Trivia</i> sp.	505	10,4	7,3				3,2/3,3	2,7/2,8	Percussion	•
17	<i>Nassarius</i> sp.	505	8	4,9		3,1	•	2,2/2/3,4	2/1,4/2,9	Abrasion	•
18	<i>Nassarius</i> sp.	505	10,4	5		3,8	•	3,8	2,7	Percussion	*
19	<i>Nucella lapillus</i>	505					•			Abrasion	•
20	<i>Nucella lapillus</i>	505					•			Abrasion	•
21	<i>Antalis</i> sp.	505	3,1	2,3			•			Serrated	*
22	<i>Antalis</i> sp.	505	4,9	3,6			•			Serrated	*
23	<i>Antalis</i> sp.	505	10,3	3,3			•			Serrated	*
24	<i>Antalis</i> sp.	505	3,1	2,6			•			Serrated	*
25	<i>Antalis</i> sp.	505	7,4	2,8			•			Serrated	*
26	<i>Antalis</i> sp.	505	5,1	3,3			•			Serrated	*
27	<i>Antalis</i> sp.	505	6,5	3,5			•				
28	<i>Antalis</i> sp.	505	3,6	2,5			•				
29	<i>Antalis</i> sp.	505	3,3	3,2			•				
30	<i>Antalis</i> sp.	505	6,6	3,6			•			Serrated?	*
31	<i>Antalis</i> sp.	505	2,6	3,3			•				
32	<i>Antalis</i> sp.	505	3,1	3,4			•				
33	<i>Antalis</i> sp.	505	7,5	2,6			•				
34	<i>Antalis</i> sp.	505	3,3	2,8							
35	<i>Antalis</i> sp.	505	5,2	3,8			•			Serrated	•
36	<i>Antalis</i> sp.	505	3,1	2,3			•			Serrated	*

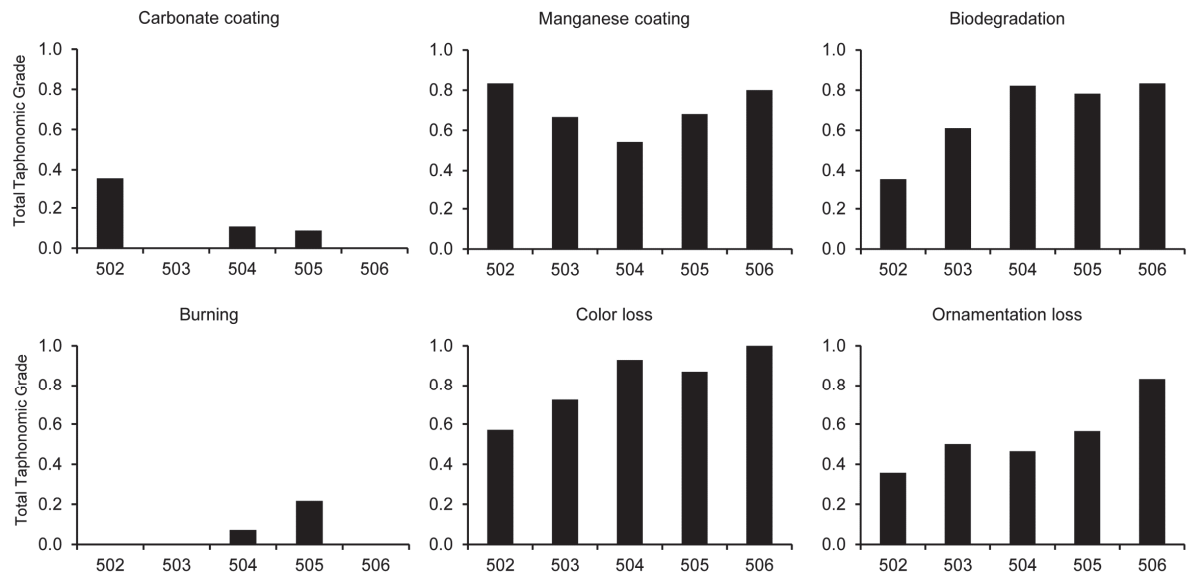


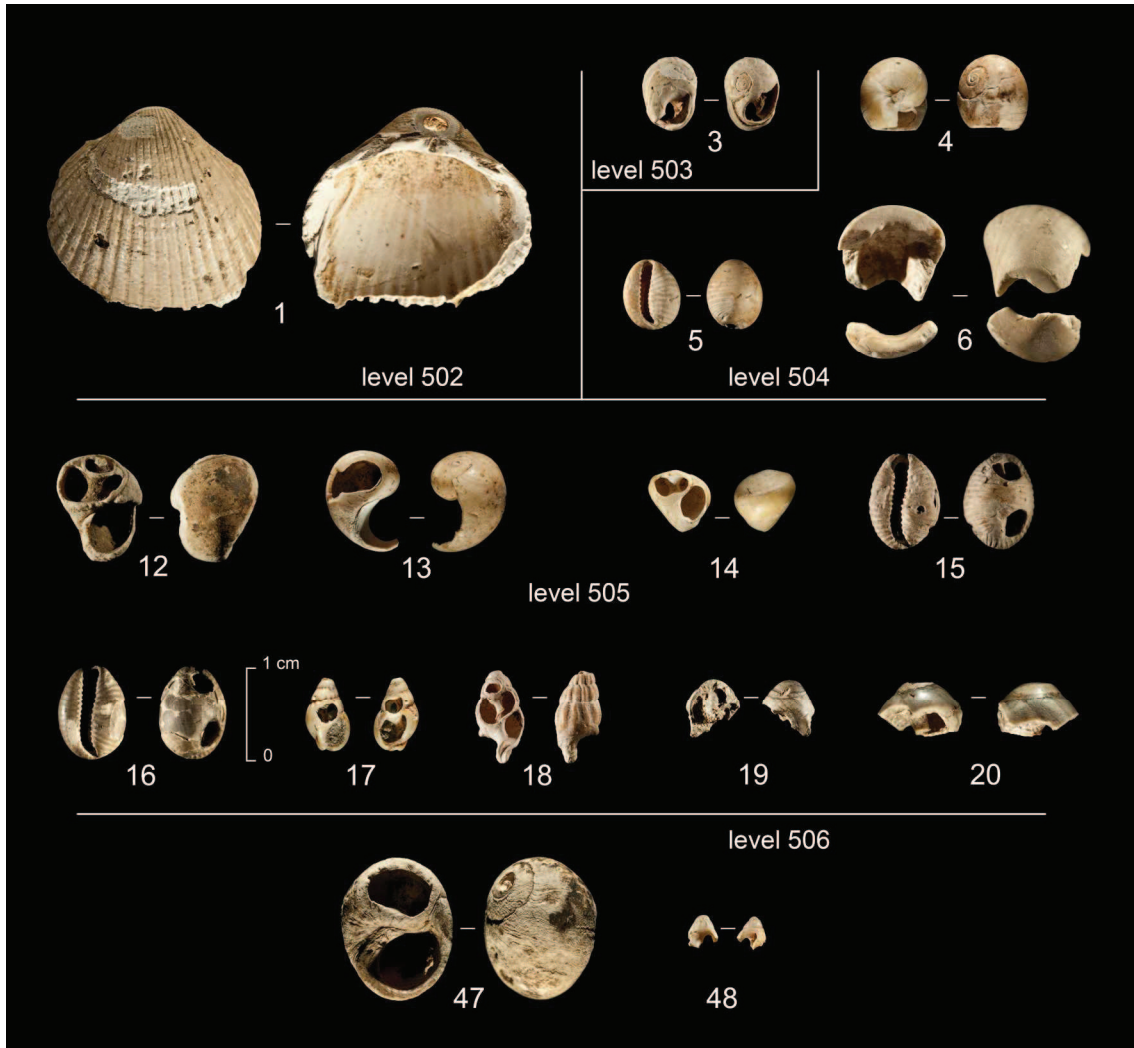
Sample ID	Species	Level	Length	Width	Spire width	Aperture width	Ochre
51	<i>Littorina obtusata</i>	502	6,8	5,5	2,5	3	•
52	<i>Littorina obtusata</i>	503	6,6	7,2	3,5	3,9	•
53	<i>Littorina obtusata</i>	503					•
54	<i>Littorina</i> sp.	503					
55	Gastropoda sp.	503					
56	<i>Cyclope</i> sp.	503					•
57	<i>Littorina obtusata</i>	504	10,2	9	5,2	5,2	•
58	<i>Trivia</i> sp.	504					•
59	<i>Trivia</i> sp.	504					
60	<i>Nassarius</i> sp.	504					•
61	<i>Bivalvia</i> sp.	504					
62	<i>Littorina obtusata</i>	505					
63	<i>Trivia</i> sp.	505					•
64	<i>Trivia</i> sp.	505	10	8			•
65	<i>Nassarius</i> sp.	505					
66	<i>Turritella</i> sp.	505					•
67	<i>Pecten</i> sp.	505					•
68	<i>Pecten</i> sp.	505					
69	<i>Pecten</i> sp.	505					•
70	<i>Littorina obtusata</i>	506	7,6	7	3,7	3,9	
71	<i>Littorina obtusata</i>	506	8	7,1	3,6	3,9	
72	<i>Littorina obtusata</i>	506					
73	<i>Littorina obtusata</i>	506					
74	<i>Turritella</i> sp.	506					



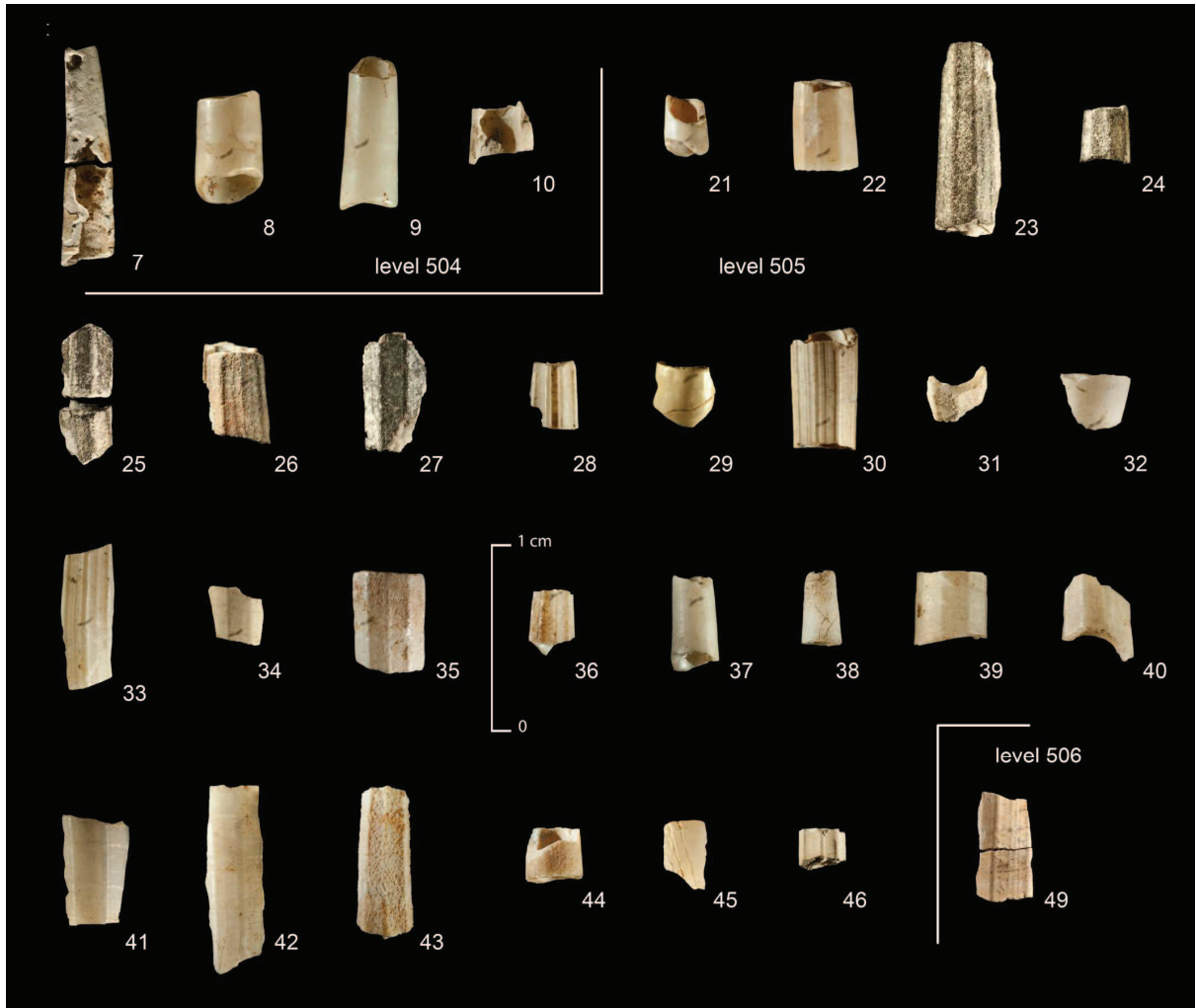




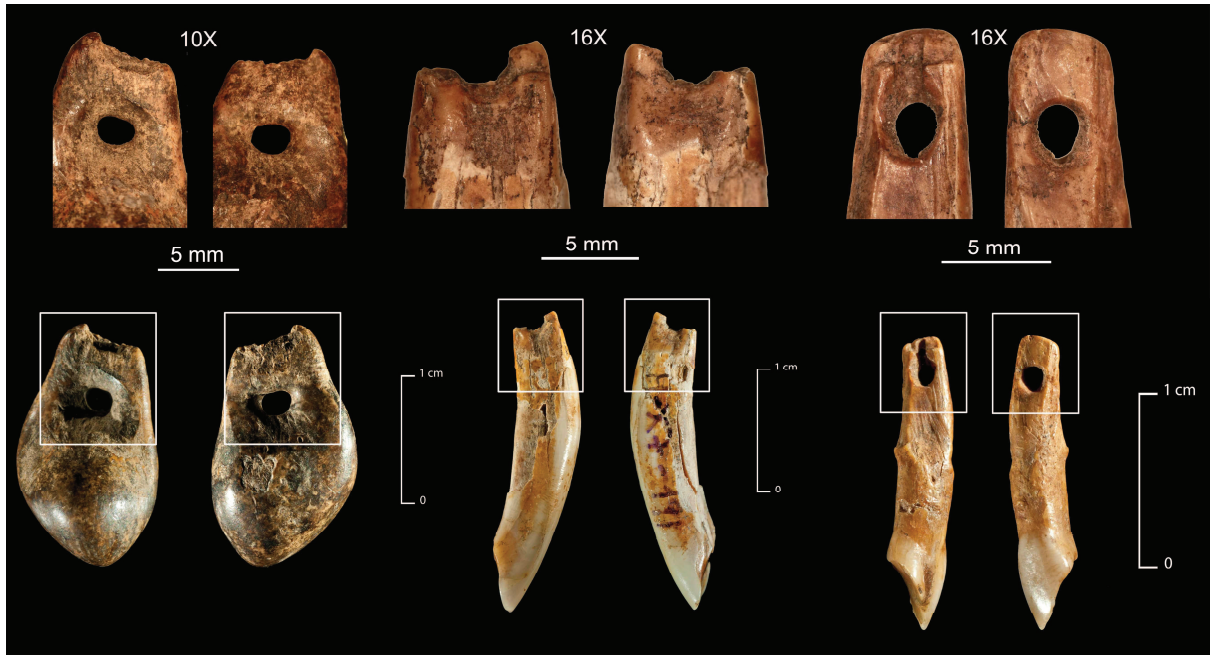




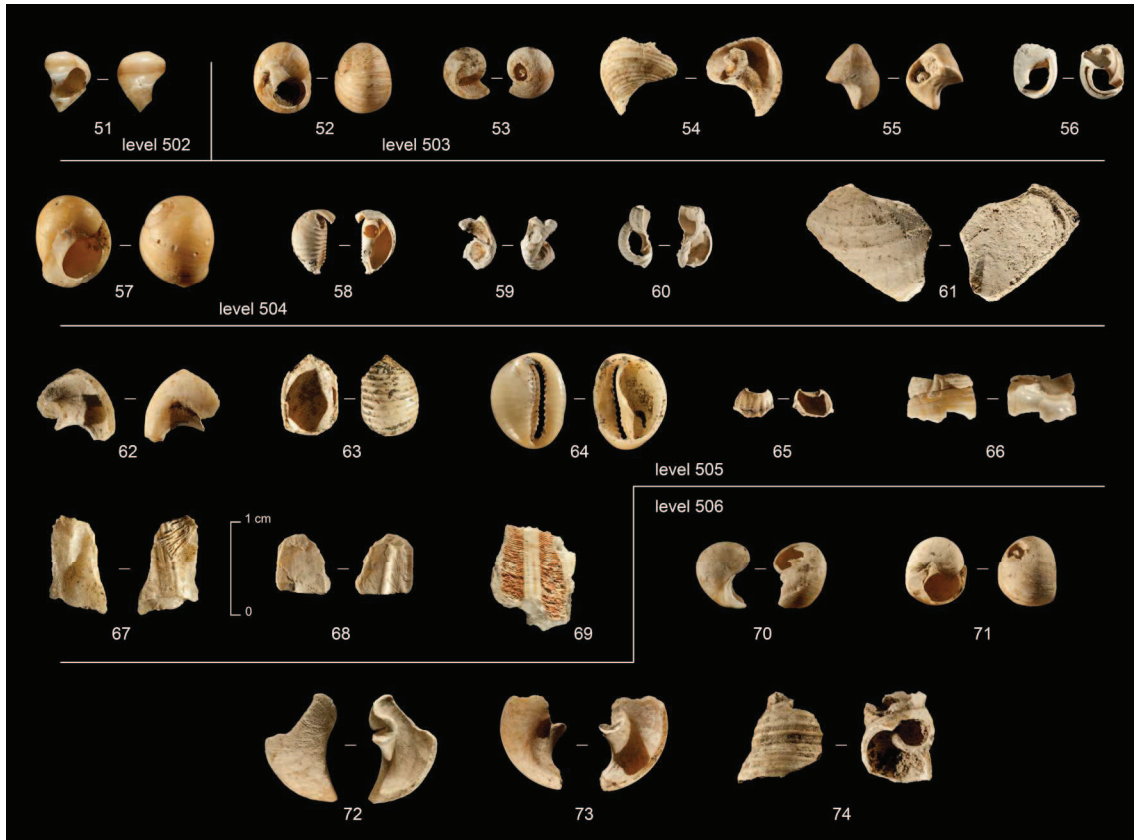
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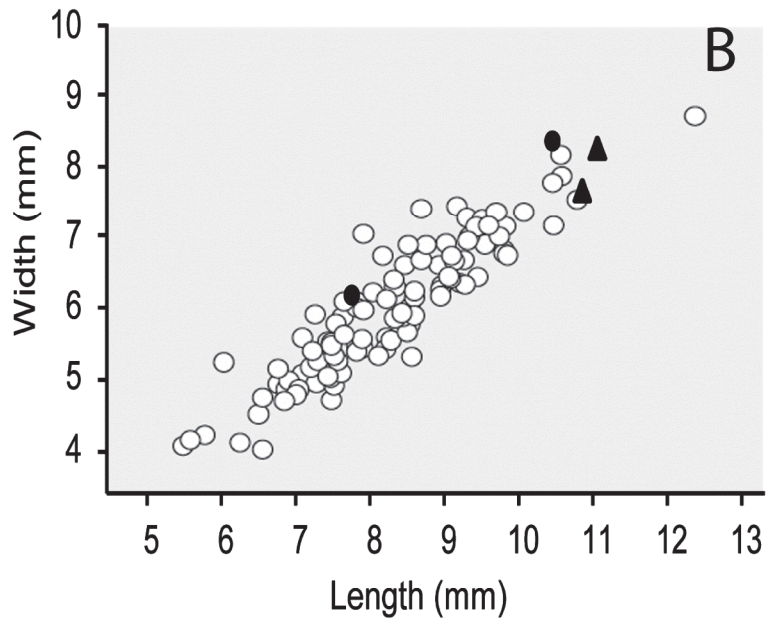
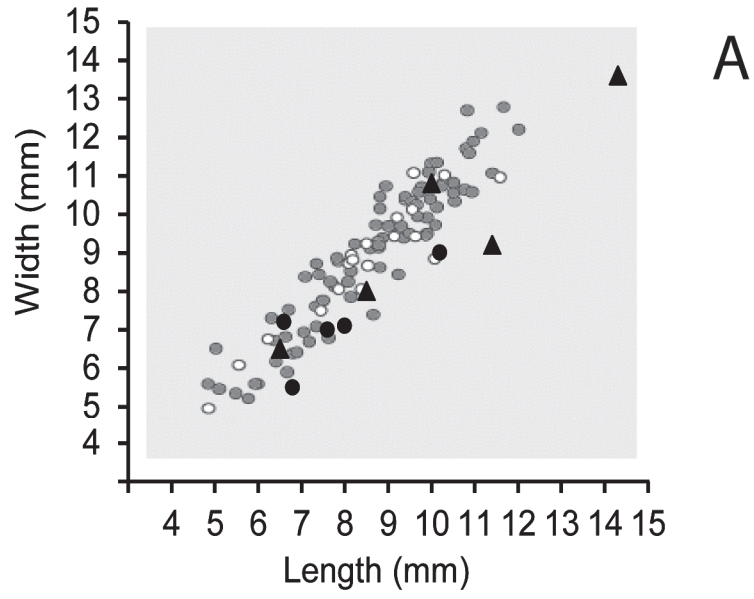


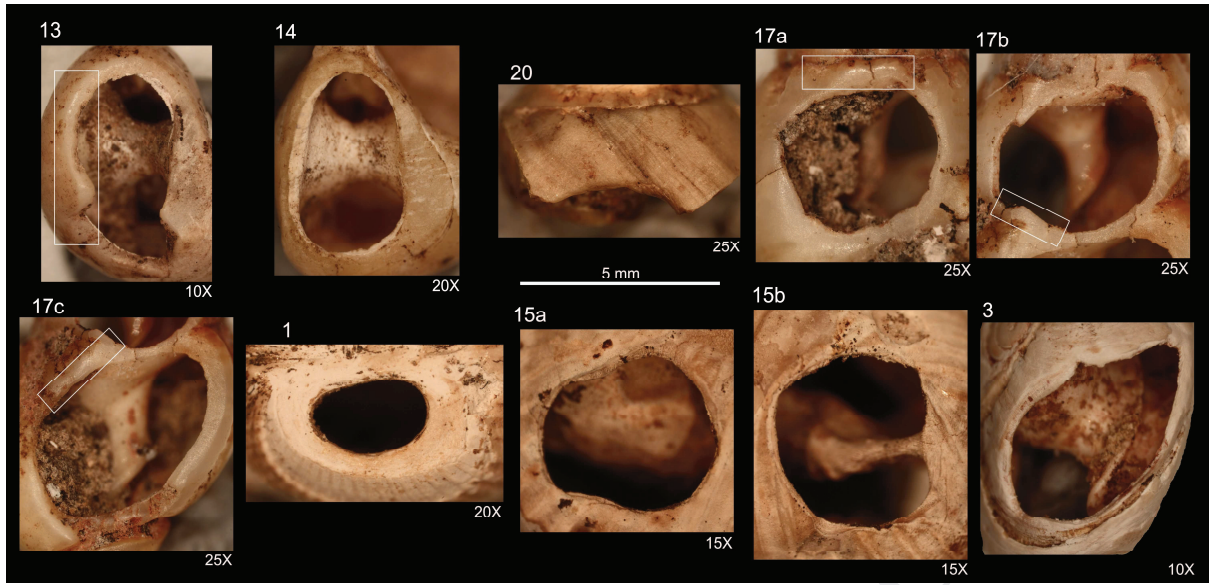
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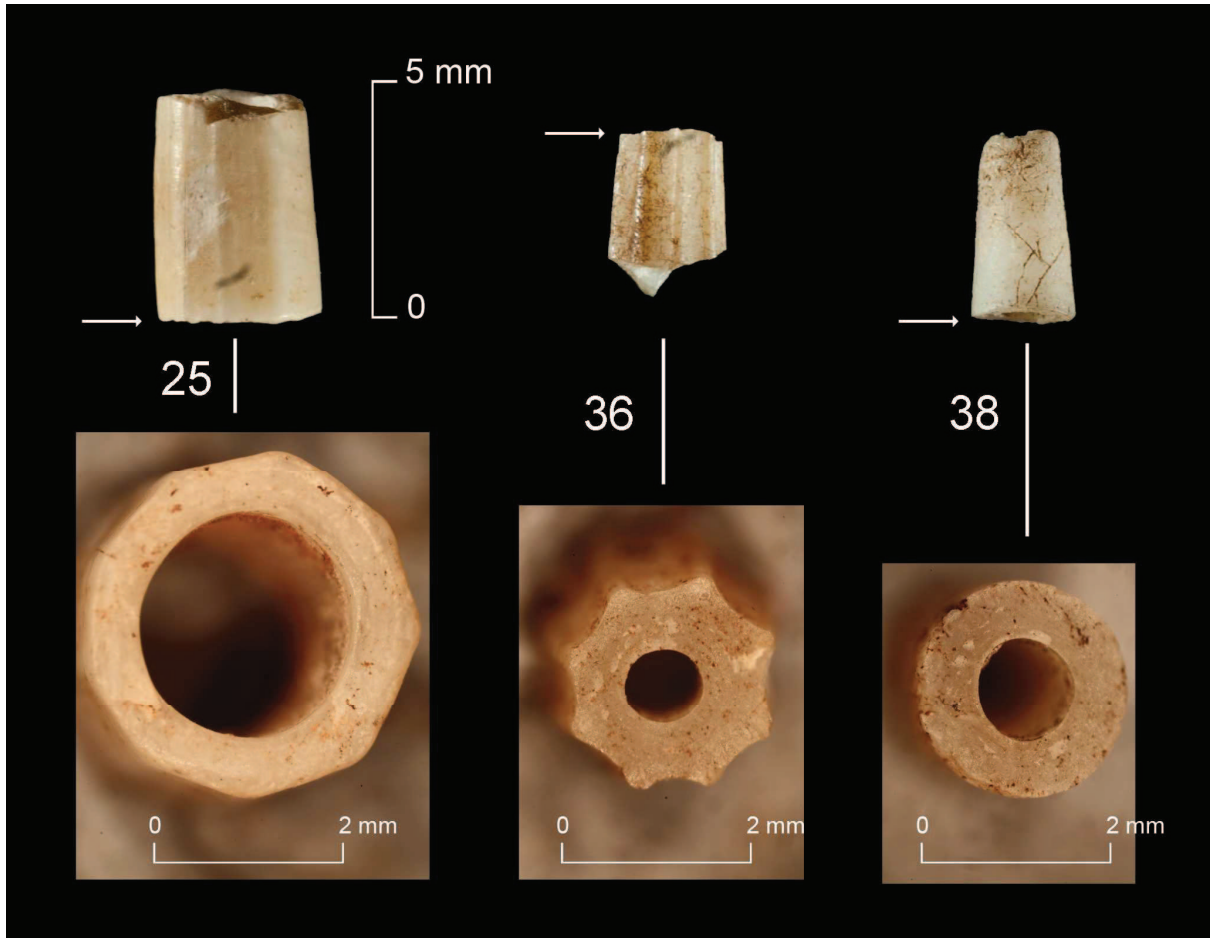
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6	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
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5	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
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**Highlights**

- A Lower Magdalenian burial of an adult woman was excavated at El Mirón Cave.
- Perforated shells and teeth from the Magdalenian burial area were not grave goods.
- Ornamental objects were related to habitation levels.
- Ornaments played a social role facilitating communication and exchanges among humans.