

1 *The management of symbolic raw materials*
2 *in the Late Upper Paleolithic of South-Western France:*
3 *a shell ornaments perspective*
4

5 *S. Rigaud¹, J. O'Hara², L. Charles³, E. Man-Estier⁴, P. Paillet⁵*

6
7 ¹Centre National de la Recherche Scientifique, UMR 5199 - PACEA, Université de
8 Bordeaux, Bâtiment B2, Allée Geoffroy Saint-Hilaire, 33615 Pessac, France. srigaud@u-
9 bordeaux.fr

10 ²Center for the Study of Human Origins, New York University, 25 Waverly Place, New
11 York, NY 10003, U.S.A.

12 ³Muséum de Bordeaux, 5 place Bardineau, 33000 Bordeaux, France.

13 ⁴Direction régionale des Affaires culturelles de Bretagne – Service régional de
14 l'Archéologie, Campus de Beaulieu, avenue du Professeur Foulon, 35000 Rennes et UMR
15 6566 CReAAH, Université de Rennes 1.

16 ⁵Muséum national d'Histoire naturelle, UMR 7194 – HNHP, Département "Homme-
17 Environnement", Musée de l'Homme, 17 place du Trocadéro, 75116 Paris, France.
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20 **Abstract**

21 Personal ornaments manufactured on marine and fossil shell are a significant element of
22 Upper Palaeolithic symbolic material culture, and are often found at considerable distances
23 from Pleistocene coastlines or relevant fossil deposits. Here, we report on a significant
24 collection of shell objects (n=377) from the Upper Magdalenian site of Rochereil
25 (Dordogne, France). Despite the location of the site at more than 200km from the
26 Pleistocene coast, the majority of the shells recovered here are unmodified, suggesting that
27 transport and ~~possibly caching~~accumulation of shell raw material was an important
28 component in the production of symbolic technologies some 16-15,000 years ago. A
29 detailed comparative and microscopic reanalysis of this assemblage explores which species
30 were selected, examines technological and taphonomic modification of the material, and
31 compares this collection with the use of similar shell ornaments in the wider Magdalenian
32 world.

33

34 **Key words:** Magdalenian, shell ornaments, microscopy, use-wear, technology,
35 symbolism, social networks

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37 The land-use strategies and social networks of Paleolithic societies are often investigated
38 through proxies such as lithic raw material transport, alongside the evaluation of stone
39 toolkit maintenance and reduction rates at landscape scales (Andrefsky, 2009; Cowan,
40 1999; Jones et al., 2003; Kelly, 1995). Spatial variation in hunting and gathering strategies
41 has also been investigated to explore the mobility and territories of past societies (Binford,
42 1980; Delagnes and Rendu, 2011; O'Shea et al., 2013). Complicating the issue, however,
43 is the ethnographic observation that historic forager range sizes and interaction spheres
44 often extend significantly beyond what is required for subsistence (Goldschmidt, 1951;
45 Kroeber, 1922; Sharp, 1952; Spencer and Gillen, 1927; Thomson, 1949). In the
46 archaeological record, personal ornaments are commonly used to explore these extensive
47 networks of exchange and circulation, which appear to greatly exceed in scale the
48 subsistence or economic requirements of forager societies (Álvarez-Fernández, 2001;
49 Eriksen, 2002; Fullola et al., 2007; Rigaud, 2014; Rigaud and Gutiérrez-Zugasti, 2016;
50 Taborin, 1993; Whallon, 2006). In addition to the identification of allochthonous raw
51 material, information about where exactly past foragers procured, used, and discarded their
52 personal ornaments allows us to explore different aspects of these complex systems of
53 territorial organization, and the associated social behaviors (Rigaud et al., 2014).
54 The discovery of hundreds of marine shells (n=377) at the site of Rochereil, in Dordogne
55 region of south-west France (Jude, 1960), presents an ideal opportunity for investigating
56 this phenomenon. This shell accumulation, discovered in deposits attributed to the Upper
57 Magdalenian, provides new data on raw material procurement and management strategies
58 developed by Late Upper Palaeolithic hunter-gatherers. The presence of a very small
59 number of modified shell beads, alongside several hundred unmodified shells which
60 feature no evidence for use as elements of ornamentation, is unlike any known
61 archaeological shell accumulation.
62 Here, we investigate the social and economic behavior responsible for such an
63 accumulation, and suggest models for the economic, technological, and social organization
64 of Upper Paleolithic societies in south-west France.
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66 **Archaeological context and objectives**

67 The cave of Rochereil (Grand-Brassac, Dordogne) is part of a karstic system in the
68 Coniacian limestone cliffs along the right bank of the Dronne River (Figure 1).

69 The cave consists of one main gallery (12m long, 2-3m wide and 5.5m high) which forms
70 a semicircular chamber. The cave is oriented to the south-east, and opens onto a 3.5m²
71 terrace (Jude, 1960).

72 The site was discovered in 1906 (Ricard, 1906), and quarried in 1912 and 1921 to access
73 the sediments inside the cave (Delluc and Delluc, 2005; Man-Estier and Paillet, 2013;
74 Paillet and Man-Estier, 2014). From 1937-1947, the site was then excavated by P.-E. Jude

75 and J. Cruveiller, who provide the first and only spatial records of material at the site (Jude,
76 1960; Jude and Cruveiller, 1938), as a number of subsequent clandestine excavations

77 unfortunately erased any remaining archaeological deposits in the cave. ~~No precise
78 fieldfindspot information is unavailable, the sediment was not sieved and records only the
79 attribution of the material to one of the archaeological stratum layers is provided in the
80 literature (Jude 1960). While the sediment was not screened. However, collection of the~~

81 ~~material on the field was likely exhaustive~~ the excavation seems to have been meticulous
82 and comprehensive, as recent water-sieving screening of the old excavation's backdirt with
83 a 4mm mesh has not not allowed the discovery resulted in the recovery of other additional

84 shell remains (P. Paillet, unpublished).
85 Jude and Cruveiller identified 4 discrete sedimentary layers during their decade-long
86 sequence of excavations. Directly above bedrock, a 0.8m thick sterile layer (Layer I) was

87 identified. Layer II, approximately 0.4m thick, overlies this sterile layer, and was
88 subdivided into units IIa and IIb. The material recovered in this layer is attributed to the
89 Upper Magdalenian, and is the subject of this paper. Layer III (1.8m thick) revealed several

90 rich assemblages attributed to the Early Azilian, Final Azilian, and Laborian complexes.
91 Due to the thickness of the layer, Jude subdivided Layer III into three subunits (IIIa, IIIb,
92 IIIc), but reanalysis of the material indicates significant mixing of material between the

93 sub-units (Langlais et al., 2014). Finally, Layer IV comprised a 2m thick layer of humic
94 sediment devoid of archaeological material.
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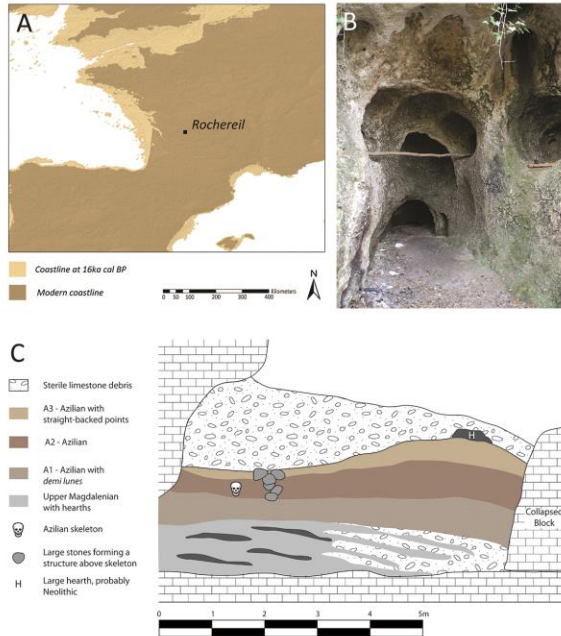


Figure 1: Location of the site of Rochereil (A); photograph of the cave entrance of Rochereil (B); stratigraphy of Rochereil redraw from Jude and Cruveiller 1938 (C).

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100 This study focuses on recently reevaluated material recovered from Layer II (Langlais et
101 al., 2016; Man-Estier and Paillet, 2013; Paillet, 2014). Archaeological material including
102 stone and bone tools, faunal remains, and portable art is abundant in this layer. A number
103 of personal ornaments comprising perforated fossil and marine shells, modified mammal
104 teeth (2 bovid incisors and 4 reindeer incisors), and one short, conical pendant made from
105 reindeer antler, have been identified (Jude, 1960; Taborin, 1992). In addition, several
106 hundred marine shells, apparently unmodified, were also recovered from this layer. ~~These~~
107 ~~shells were never~~ have not been previously studied, and only a with just a list of the material
108 was provided published by Y. Taborin without no functional evaluation of data-function
109 (Taborin 1992). A number of reasons could explain the presence of unperforated shells
110 within archaeological sites may have be related to many various functions collections
111 (Dupont, 2019), which we will explore below.

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112 Our analysis will characterize the taxonomic diversity of the shell assemblage, examine
113 shell modification and preservation, and identify the source of the material. We explore
114 potential shell selection and collection strategies, contextualize the assemblage within
115 wider Magdalenian shell selection patterns, and consider the motives of the Magdalenian
116 groups in accumulating this assemblage.

117 Method

118 Taxonomic identification

119 Taxonomic identification of the shells involved two steps: the characterization of general
120 shape for class determination (e.g. Scaphopoda, Gasteropoda, Bivalvia), followed by
121 examination ~~of the shape and ornamentation of for~~ scaphopods and bivalves (Poppe &
122 Goto, 1993), ~~and along with examination~~ of the number of whorls, ~~and~~ the form of the
123 aperture, lip, ventral and dorsal sides, and ornamentation ~~of gastropods~~ to determine genus
124 or species ~~of the gastropods~~ (Harasewych and Moretzsohn, 2010; Poppe and Goto, 1993).
125 The nomenclature employed here adopts classifications available in ~~the~~ Molluscabase
126 (~~https://www.molluscabase.org/CLEMAM-database-(Check-List-of-European-Marine~~
127 ~~Mollusca-Database-<http://www.somali.asso.fr/clemam/index>, search performed on~~
128 ~~7/08/2017~~), the Paleobiology database (~~paleobiodb.org [http://www.paleodb.org/cgi-](http://www.paleodb.org/cgi-bin/bridge.pl)~~
129 ~~bin/bridge.pl, search performed on 7/08/2017~~), ~~the World Register of Marine Species~~
130 ~~(<http://www.marinespecies.org/index.php>, search performed on 7/08/2017)~~ and the
131 "Biodiversity Heritage Library" for fossil species (~~https://www.biodiversitylibrary.org/~~).
132 A review of the configuration and distribution of regional biotopes particular to each shell
133 species and fossil outcrops of appropriate age revealed probable procurement location(s).

134

135 Morphological and morphometric analyses

136 Variation between natural populations and archaeological samples indicate the extent to
137 which human choices were responsible for the accumulation. To pursue this question,
138 morphometric variables (shell length and width, width of the spire and aperture) were
139 recorded on the archaeological material, where post-depositional breakage permitted.
140 Morphometric analysis was performed using the most frequently measured attributes for
141 each species, and occasionally differed from species to species.

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142 To explore size selection strategies, modern and fossil reference collections of scaphopods
 143 (*Dentalium* sp.) and two modern reference collections of gastropods, were compiled (Table
 144 1, Table 1). The shells were hand-collected from thanatocenoses (death assemblages) along
 145 the Atlantic coast. All shells visible to the naked eye were collected on the shore. The
 146 reference collections consist of 339 *Dentalium vulgare*/*Antalis vulgaris* collected in the
 147 Arcachon Basin (Vanhaeren, 2002; Vanhaeren and d'Errico, 2001), 244 fossil scaphopods,
 148 referred to *Dentalium* sp. from the Miocene outcrop of Saucats Geological reserve
 149 (Vanhaeren, 2002; Vanhaeren and d'Errico, 2001), and 70 *Tritia reticulata* and 101
 150 *Ocenebra erinaceuse* collected at Châtelailillon and Moëze. Marine reference collections
 151 were made by 2 collectors, during collected over 45 minutes on each two beaches targeted
 152 for their relative proximity with to Rochereil.

Specie	Attribution	Location	Number	Reference
<i>Dentalium vulgare</i> / <i>Antalis vulgaris</i>	Modern	Arcachon	339	Vanhaeren 2002
<i>Dentalium</i> sp.	Miocene	Saucats	244	Vanhaeren 2002
<i>Tritia reticulata</i>	Modern	Boucholeur, Châtelailillon	54	.
<i>Tritia reticulata</i>	Modern	Plage de plaisance, Moëze	16	.
<i>Ocenebra erinaceuse</i>	Modern	Boucholeur, Châtelailillon	67	.
<i>Ocenebra erinaceuse</i>	Modern	Plage de plaisance, Moëze	34	.

154 Table 1: Modern and fossil reference collections used for the analysis of the shells of
 155 Rochereil.

156
 157 **Microscopic analysis**

158 Shell surfaces exhibit microscopic modifications attesting to processes occurring either
 159 during the life of the mollusk or post-mortem. In cases of shells collected and/or modified
 160 by prehistoric groups, microscopic analyses provide information relevant to the
 161 environment in which shells were collected, as well as subsequent taphonomic and
 162 anthropogenic modifications (d'Errico et al., 2005; Dupont, 2006; Taborin, 1998;
 163 Vanhaeren et al., 2013). A Motic SMZ-168 microscope equipped with a Jenoptik ProgRes-
 164 CT3 digital camera was used to document surface modifications on each shell. Artefacts
 165 were examined at magnifications between 4x and 40x. The presence, location, and degree of
 166 natural modifications impeding microscopic analysis (calcite deposits, cracks) were
 167 recorded for each specimen, alongside the degree of preservation of the shell's original

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168 shape and ornamentation. Natural and anthropogenic modifications such as fractures, use-
169 wear, modifications produced by suspension (e.g. perforations, residues, incisions) were
170 also systematically recorded on each part of the shells (apex, spire whorls, aperture, lip,
171 umbo, ventral margin, dorsal and ventral sides).
172 Taphonomical and anthropic modifications were identified based on experimental and
173 reference data available in the literature (Avezuela Aristu et al., 2011; Benghiat et al.,
174 2009; d'Errico et al., 1993; Dietl and Kelley, 2006; Gorzelak et al., 2013; Kubicka et al.,
175 2017; Lescinsky et al., 2002; O'Hara, 2017; Peschaux, 2012; Rogalla et al., 2007; Rojas
176 and Dietl, 2015; Tátá et al., 2014).

177 Regional comparison

178 The Rochereil assemblage was referred to a database of Magdalenian ornaments from
179 across Franco-Cantabria compiled from a combination of excavations reports, published
180 literature (Álvarez Fernández, 2006; Taborin, 1993), and first-hand analyses of other
181 collections (O'Hara, 2017). This georeferenced database records the presence of 87
182 different bead-types in over 200 discrete ornament-bearing layers from 85 sites across
183 Franco-Cantabria. Where possible, archaeological layers were attributed to the Lower,
184 Middle, Upper, or Final Magdalenian. Mapping of ornament distribution was performed
185 using ESRI ArcGIS 10.4.1 and the ETOPO1 Global relief model (Amante and Eakins,
186 2009), with Late Pleistocene coastlines positioned at 90m below modern sea level
187 (Lambeck et al., 2014; Lambeck and Chappel, 2001).

188

189 Results

190 Shell identification

191 377 shells belonging to at least 9 different species, including gastropods, bivalves and
192 scaphopods, were identified in the material attributed to Layer II (Table 2, Figure 2, Figure
193 3, Figure 3). Eight Muricidae belonging to the species *Ocenebra erinacea* were identified
194 (Figure 2, n°3). These gastropod shells bear five to eight whorls, an oval aperture, and a
195 well-developed siphonal canal equal to aperture length. Sutures are deep and sinuous. The
196 species is attested along both Atlantic and Mediterranean shores in the Pleistocene.

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197 217 Nassariidae are attributed to the species *Tritia reticulata* (formerly termed *Nassarius*
198 *reticulatus*, *Nassa reticulata* or *Hinia reticulata*) (Figure 2, n°1). This gastropod
199 shell is conical, featuring of axial ribs containing 7 to 9 whorls, and is also present along
200 Atlantic and the Mediterranean coasts (Poppe and Goto, 1991).

201 Three other Nassariidae belong to the species *Tritia gibbosula* (previously *Arcularia*
202 *gibbosula* or *Nassarius gibbosulus*). The shell of this taxon features five or six whorls with
203 a large body whorl, flattened and widened at the sides. This species is currently extant
204 solely along southern Mediterranean shores, but there are historic accounts of its presence
205 on Southern French coasts (Granger, 1880). Paleontological data suggest that *Tritia*
206 *gibbosula* is limited to warm waters, and so was not present along French coasts, either
207 Atlantic or Mediterranean, during the Pleistocene (Moshkovitz, 1968). A fossil origin for
208 these shells (Figure 2, n°4), presumably from Mediterranean Pliocene deposits,
209 seems most likely (Taborin 1992), but its sporadic presence along the French
210 Mediterranean coast during the Pleistocene cannot be excluded.

211 ~~The scaphopods (n=217) generally present a smooth surface without striations (Figure 2, n°2). The~~
212 ~~scaphopods (n=217) generally present a smooth surface at the anterior end and weak longitudinal~~
213 ~~striations at the posterior end (Figure 2, n°2). Several scaphopods species with similar shape and~~
214 ~~surfaces were present along both the Mediterranean and Atlantic shores during the Pleistocene and~~
215 ~~can also be found in Miocene fossil deposits from the south-west of France (Cossmann and Peyrot,~~
216 ~~1915 : Poppe and Goto, 1993). Formerly in the generic genus *Dentalium*, ~~main~~ most recent species~~
217 ~~from European shores are now attributed to the genus *Antalis*. The Rochereil specimens are~~
218 ~~moremost likely *Antalis vulgaris*, but may be also a mix of several species that we group under the~~
219 ~~generic name *Dentalium* sp.~~

220 ~~Several species of *Dentalium* with regular surfaces were present along both the~~
221 ~~Mediterranean and Atlantic shores during the Pleistocene (Cossmann and Peyrot, 1934;~~
222 ~~Poppe and Goto, 1993), and can also be found in Miocene fossil deposits from the south-~~
223 ~~west of France.~~

224 One of the two valves of Glycymerididae presents an oval form but with a surface rounded
225 and smoothed by post-depositional processes (Figure 3, n°11). The absence of anatomical
226 features impedes identification of species. The other small valve presents a regular
227 morphology, round in outline, convex, and slightly longer than it is wide (Figure 3, n°3),
228 probably corresponding to *Glycymeris glycymeris* which is present along modern Atlantic
229 and Mediterranean shores (Poppe and Goto, 1993):-

230 Among the four valves possibly belonging to the Cardiidae family, two valves are clearly
231 fossil specimens (Figure 3, n°7, 8) and present anatomical features suggesting they do not

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232 belong to the same species. Fossil Cardiidae are present in the Miocene deposits of south-
 233 west France (Michel et al., 2012), but shells at Rochereil present a yellowish surface patina
 234 which differs markedly from the Miocene fossils (Cahuzac and Chaix, 1996; Parize et al.,
 235 2008), and also from other specimens in the archaeological collection, which are
 236 characterized by a whiter coloration (Figure 3). The yellowish color echoes the natural
 237 coloration of the surrounding Coniacian limestone of the cave. Limestone weathering is a
 238 well-known phenomenon in Perigordian karstic contexts, with erosion of the surrounding
 239 rock a significant contributing agent to sediment formation in caves and rockshelters
 240 (Texier, 2006). With this in mind, close examination suggests a local origin from within
 241 the eroding limestone for these two shells. The two remaining Cardiidae specimens are
 242 convex, feature radial ribs, a crenulated edge, and the adductor scar and lateral tooth are
 243 still visible (Figure 3, n°9, 10). The morphology of these shells probably corresponds to
 244 the modern species *Cerastoderma edule*, present along both Atlantic and Mediterranean
 245 coasts (Poppe and Goto, 1993).

246 A large fragment of a bivalve presents significant exfoliation on the external surface. Fine
 247 radiating ridges, larger ribs, and intervening grooves are still visible on the limited
 248 preserved areas, suggesting the shell belongs to the taxon *Pecten maximus* (Figure 3, n°6).
 249 This species is exclusively present along Atlantic shores. A fragment of a fossil valve from
 250 a large species within the genus *Spondylus*, from a big size species, with fine radial ribs,
 251 scalysquamate, at the marginal side, probably belonging to the genus *Spondylus*, is also
 252 present in the collection (Figure 3, n°4). The yellowish patina suggests an
 253 autochthonous origin similar to the two fossil Cardiidae. Two fragments of *Mytilus* sp.
 254 cannot be taxonomically attributed to species (Figure 3, n°1, 2). One further
 255 fragment of unidentified bivalve is also present (Figure 3, n°5), but comparison
 256 with previously published inventories show that 3 shell species are missing from the current
 257 collection (Table 2, Jude, 1960; Taborin, 1992). The long history of curation of the
 258 collection may explain discrepancies between previously published material and the
 259 material currently present in the collection.

260 In summary, *Dentalium* sp. (n=138) and *Tritia reticulata* (n=217) are the most abundant
 261 taxa in the material, followed by *Ocenebra erinacea* (n=8), *Cardiidae* indet.sp. (n=4),

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- Commenté [SR1]:** Mention that all the specimens currently present in the collection material are shown in figures 2 and 3
Add a sentence saying that considering the long curation history of the collection it is likely that some material has been lost for various reasons (temporary exhibition out of the museum, material moved from excavator office to other facilities, as often observed on old collections)
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262 *Tritia gibbosula* (n=3), *Glycymeris* sp. (n=2), *Mytilus* sp. (n=2), a single specimens of
263 *Pecten maximus* and *Spondylus* sp. and one unidentified fragment of bivalve.
264

Jude 1960	Taborin 1992	This study		
Species	Species	Species	N	Figure
•	<i>Arcularia gibbosula</i>	<i>Tritia gibbosula</i>	3	Fig.2 n°4
<i>Cardium edule</i>	<i>Cerastoderma edule</i>	<i>Cerastoderma edule.</i>	2	Fig.3 n°9, 10
•	•	Fossil Cardiidae	2	Fig.3 n°7, 8
•	<i>Dentalium</i> sp.	<i>Dentalium</i> sp.	138	Fig.32 n°2
<i>Pectunculus glycymeris</i>	<i>Glycymeris</i> sp.	<i>Glycymeris</i> sp.	2	Fig.2 n°3, 11
<i>Nassa reticulata</i>	<i>Hinia reticulata</i>	<i>Tritia reticulata</i>	217	Fig.2 n°1
•	<i>Mitra dufresnei</i>	•	•	
•	<i>Semicassis saburon</i>	•	•	
•	<i>Tritonalia erinacea</i>	<i>Ocenebra erinacea</i> ^{USA}	8	Fig.2 n°3
•	<i>Turritella</i> sp.	•	•	
<i>Pecten maximus</i>	•	<i>Pecten maximus</i>	1	Fig.3 n°6
<i>Mytilus edulis</i>	•	<i>Mytilus</i> sp.	1	Fig.3 n°1
<i>Mytilus galloprovincialis</i>	•	<i>Mytilus</i> sp.	1	Fig.3 n°2
•	•	<i>Spondylus</i> sp.	1	Fig.3 n°4
•	•	Bivalve <i>indet.</i>	1	Fig.3 n°5

Table 2: Shell species identified in the Upper Magdalenian layer II of Rochereil.

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Figure 2: Gastropods and scaphopods recovered in the Upper Magdalenian from Rochereil. 1) *Tritia reticulata*, 2) *Dentalium* sp., 3) *Ocenebra erinacea*^{USA}, 4) *Tritia gibbosula*.



271
272 Figure 3: Bivalves recovered in the Upper Magdalenian from Rochereil. 1, 2) *Mytilus* sp., 3, 11) *Glycymeris*
273 sp., 4) *Spondylus* sp., 5) indet., 6) *Pecten maximus*, 7-8) *Cardiidae* indet., 9-10) *Cerastoderma edule*.

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275 Morphometric, technological and use-wear analyses

276 The fragments of the bivalves *Mytilus* sp., *Pecten maximus*, *Spondylus* sp. and the two
277 fossil *Cardiidae* show no anthropogenic modification.

278 The two *Glycymeris* sp. shells feature a perforation at the umbo. The location and smoothed
279 edges of the perforation correspond to natural modifications resulting from surf action

280 (Cabral and Martins, 2016; Rogalla et al., 2007). Use-wear analysis reveals no evidence

281 for the use of these natural perforations in suspension. The larger *Glycymeris* sp. is covered
282 in a red residue, with a relatively plastic, centimeter-thick red compound firmly adhering

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283 to the interior of the shell, concentrated at the umbo (Figure 3). The residue
 284 comprises a heterogeneous texture composed of a combination of coarse, rounded, red and
 285 black grains, cemented in a dark red powder matrix. Microscopic analysis reveals that the
 286 ventral side of the shell bears multiple short, thin striations (Figure 4b-d). These striations
 287 run sub-parallel to the ventral margin of the shell, indicating they were produced by the
 288 repeated application of a sharp lithic point in circular gestures. The surface of the red
 289 residue also shows multiple thin parallel striations, indicating that the surface was scraped
 290 (Figure 4e,f).

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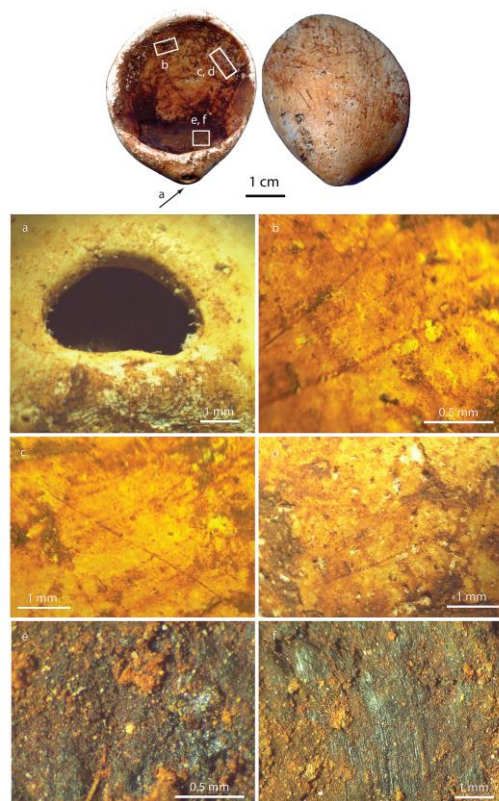
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Figure 4: Natural perforation present on the umbo of a *Glycymeris* shell (a), striations on the ventral margin of the shells (b-d), close view of the red compound (e), and parallel striations present on the surface of the residue (f).

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296 A single *Cerastoderma edule* also shows anthropic modifications. A groove, located on the
297 dorsal side near the umbo, was created through multiple parallel striations organized
298 transversely to the maximum length of the shell. The thin “V” shaped profile of the
299 striations and the regular edges indicate they were produced with a sharp point (Figure
300 5, Figure 5a, b). Just above the groove, a small, irregular perforation with obliquely rounded
301 edges attests of the predation of this valve by a naticid ~~or a~~ worm (Cabral et al. 2015, Rojas
302 and Dietl, 2015).

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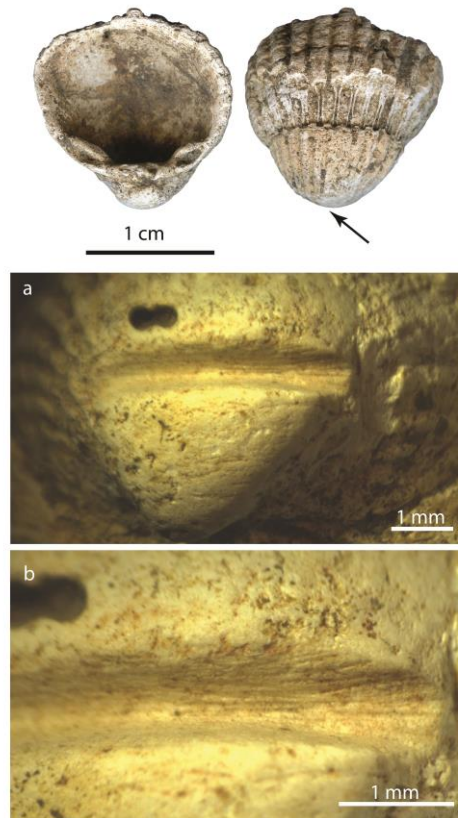
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305 Figure 5: Transversal groove made with a lithic tool observed on the umbo of the *Cerastoderma edule*
306 from Rochereil (a, b). The perforation has a natural origin.

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308 Two of the three *Tritia gibbosula* show breakage on the dorsal side, close to the aperture
309 (Figure 2Figure 2). The surface alterations present on the shell, visible in the intense
310 exfoliation of the surface, preclude identification of its origin. Another shell presents a
311 perforation on the ventral side (Figure 2Figure 2, Figure 6Figure 6), with the maximum
312 length of the oval perforation (4.16 mm) oriented along the longitudinal axis of the shell.
313 Microscopic analysis identifies multiple short striations, positioned around the perforation,
314 but transverse to its edge (Figure 6Figure 6a-c). None of these incisions present any side-
315 striations along their inner surface. Reference data indicate that similar striations can be
316 produced by applying a pointed tool in a single movement along the surface of the shell
317 (Joordens et al., 2014). The perforation itself truncates the transverse striations, indicating
318 that the surface was grooved before being perforated. The perforation is oval and its
319 maximum diameter oriented toward the extremities of the striations. The edge of the
320 perforation is irregular and presents micro-removals all around. Experimental reproduction
321 of anthropic perforations indicate that direct pressure and indirect percussion produce
322 similar fractures (d'Errico et al., 1993; Tátá et al., 2014). The presence of two different
323 categories of modification indicates that the perforation was created by grooving the
324 ventral side of the shell using a sharp pointed tool, followed by percussion or pressure.
325 Similar perforation techniques have been documented in other contexts (Peschaux, 2012).
326 A set of short, thin parallel striations is also visible on the left side of the aperture, when
327 facing the ventral side of the shell, apex upward. The striations are oriented perpendicular
328 to the longitudinal axis of the shell. This modification is associated with the intense
329 smoothing and polishing of the surface of the shell (Figure 6Figure 6d, e). Use-wear present
330 on the ventral side indicates the shell was attached with the ventral side in contact with a
331 slightly abrasive surface.

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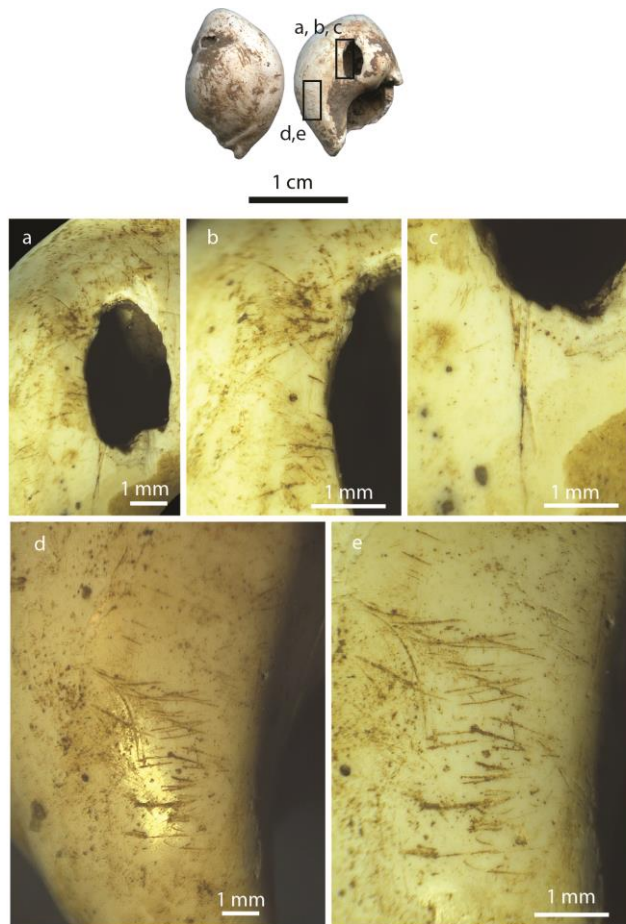
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333
 334 **Figure 6: Short striations present around the perforation of the *Tritia gibbosula* (a-c) and use-wear on**
 335 **the ventral side close to the aperture (d, e).**

336 ▲
 337 One specimen of *Ocenebra erinaceus* presents a small (3.2 mm) perforation located on
 338 the ventral side of the fourth whorl (Figure 2). The location, conical shape, and smooth
 339 edges of the perforation suggests natural perforation due to predation (Dietl and Kelley,
 340 2006; Gorzelak et al., 2013; Rojas and Dietl, 2015). Another specimen presents a large
 341 perforation on the ventral side of each of the three first whorls (Figure 2). Such alteration

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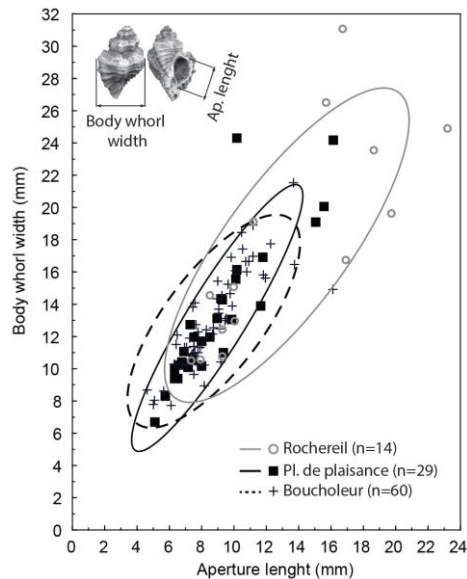
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342 is frequently documented on gastropods modified by surf action (Gorzalak et al., 2013).
 343 No other modification is observed on the shells.
 344 Morphometric analysis of these shells reveals that the specimens from Rochereil differ
 345 significantly from the modern reference collections (Mann-Whitney U test $p < 0.01$). The
 346 smallest specimens present in modern collections fall outside the range of variability of the
 347 shells from Rochereil, and four of the shells from Rochereil are larger than the largest shells
 348 from the reference collections (Figure 7 Figure 7).



350
 351 **Figure 7: Scatterplot plot the aperture length and body whorl width registered on the modern reference**
 352 **collections of *Ocenebra erinacea* and the specimens from Rochereil attributed to the Upper Magdalenian.**

353
 354 Of the 217 *Tritia reticulata* shells, 24 are perforated (Figure 8 Figure 8A). Perforations are
 355 mainly observed on the dorsal side of the last whorl, but several small perforations are also
 356 observed on the ventral side, and sometimes close to the apex on either the ventral or dorsal
 357 side. Post-depositional alterations and recent exfoliation present on many of the
 358 perforations precludes identifying their origin, and so taphonomic processes cannot be
 359 completely excluded (Gorzalak et al., 2013), but two specimens bear clear anthropic
 360 modifications in the form of sub-parallel longitudinal striations located at either extremity

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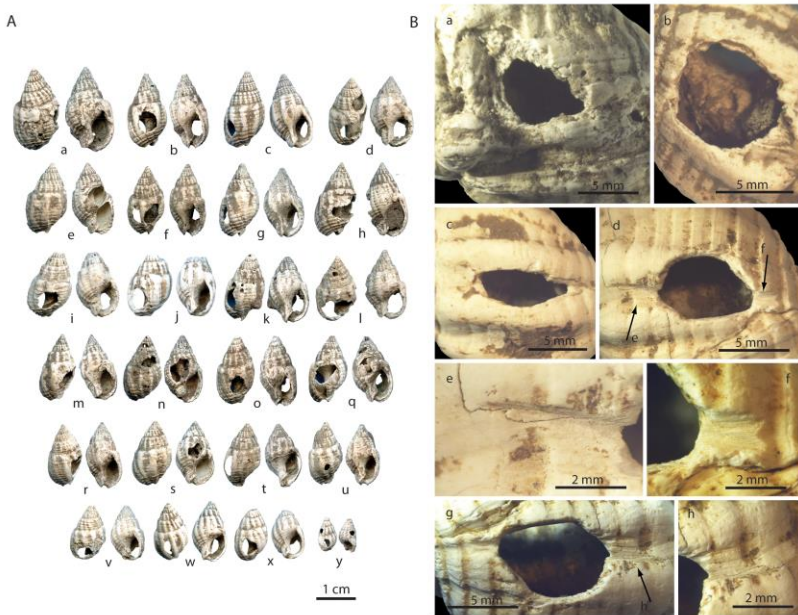
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361 of the oval perforation (Figure 8A, t, w, Figure 8B, d-h). These
 362 perforations are located on the dorsal side of the last whorl, very close to the aperture; other
 363 perforations located in the same place with a similar shape may have been crafted using
 364 the same technique, but post depositional alteration of the surface of the objects has erased
 365 any technical traces of the perforation process (Figure 8A, c, f, g, Figure 8B, c). As with the *O. erinacea*,
 366 the measurements recorded on the *T. reticulata* shells
 367 from Rochereil differ significantly from those of the modern reference collections (Mann-
 368 Whitney U test $p < 0.01$). The archaeological shells fall mainly within the range of
 369 variability of the modern reference collections (Figure 9), but the largest shells in
 370 the reference collections do not correspond to the Rochereil material. The size of the two
 371 specimens perforated by scraping, however, falls within the range of variability of the
 372 unmodified shells from Rochereil.
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 375 **Figure 8: A) perforated *Tritia reticulata*, B) macrophotos of the perforations: probable anthropogenic**
 376 **dorsal perforations on the last spire whorl (a, b), dorsal anthropogenic perforations with longitudinal**
 377 **striations made by scraping the last spire whorl (c-h).**

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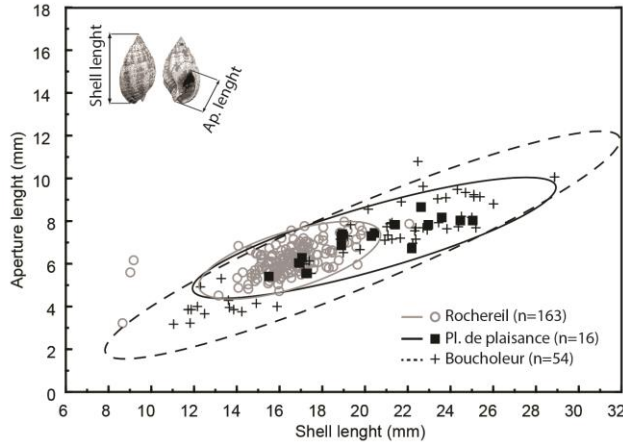


Figure 9: Scatterplot of the length and aperture length registered on the *Tritia reticulata* from the modern reference collections and the specimens from Rochereil attributed to the Upper Magdalenian.

Microscopic analysis of the 138 *Dentalium* sp. showed that 59% of the scaphopods featured an intact proximal-anterior extremity, and 29% an intact distal-posterior extremity. Extremities that are not intact present various morphologies, including lip fractures, rounded ends, irregular fractures, straight fractures and step fractures (following the classification of Vanhaeren and d’Errico 2001, Table 3, Figure 10), corresponding to natural fractures observed on modern and fossil reference collections (Vanhaeren, 2002; Vanhaeren and d’Errico, 2001).

Morphology	Extremity	
	% Proximal	% Distal
Intact	59.12	29.19
Round end	6.57	13.14
“Step” fracture	4.38	10.22
Straight fracture	24.09	6.57
Lip fracture	1.46	17.52
Irregular fracture	3.65	22.63

Table 3: Extremity morphologies observed on the *Dentalium* sp. from Rochereil.

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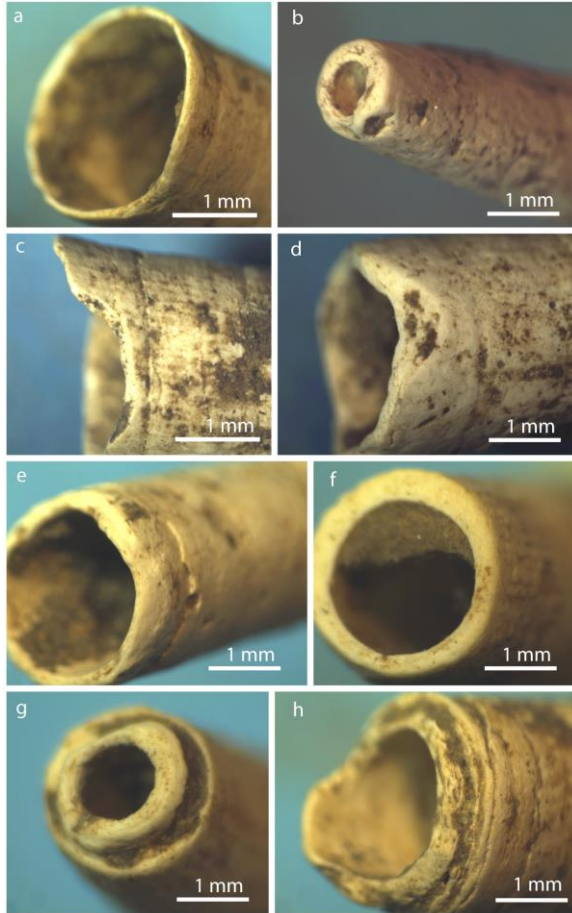


Figure 10: Morphology of the extremities of the Dentalium from Rochereil: a) distal-anterior intact extremity, b) proximal-posterior intact extremity, c) Lip fracture, d) irregular fracture, e) rounded end, f) straight fracture, g) proximal-posterior step fracture, h) distal-anterior step fracture (according to the classification established by Vanhaeren and d'Errico 2001).

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427 *Dentalium* from modern and fossil reference collections present a conical, slightly curved
 428 shape, with the shell length 7 to 12 times the maximum diameter (Peppe and Goto, 1993).
 429 By comparison, the length of the scaphopods from Rochereil is, on average, 5 times greater
 430 than their maximum diameter meaning the scaphopods from Rochereil are shorter than the
 431 shell those from the reference collections (Table 4 Table 4).

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	N	Mean	Minimum	Maximum	Std.Dev.
Max. Diam.	137	3.49	1.99	4.24	0.31
Min. Diam.	137	1.80	0.80	3.58	0.40
Length	137	19.18	10.34	26.62	3.00

Table 4: Measurements recorded on the *Dentalium* sp. From Rochereil.

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The *Dentalium* shells from Rochereil generally fall within the range of variability of the modern reference collection, although the smaller *Dentalium* shells present in the modern and fossil reference collection are not observed within the Rochereil collection (Figure 11, Figure 11). Moreover, the larger and longer scaphopods from Rochereil fall outside the size range observed in the fossil reference collection.

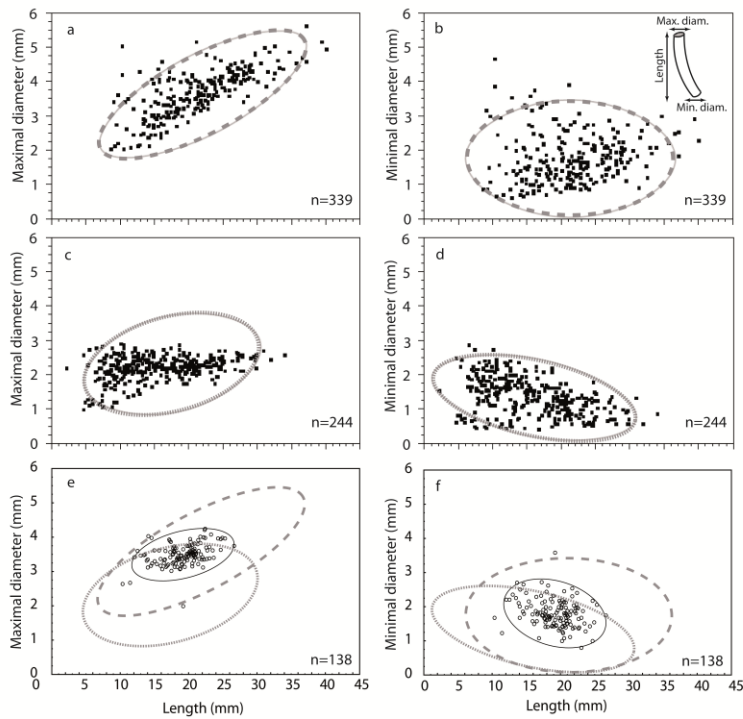


Figure 11: Scatterplot of the length and both maximal and minimal diameters of the *Dentalium* sp. From the modern reference collection (a, b), fossil reference collection (c, d) and (e, f), comparison between the confidence ellipse (black) of the archaeological *Dentalium* sp. And those from modern and fossil (dotted lines) shells (confidence ellipses= 95%).

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Regional comparison

The two shell types recovered in the greatest number from Rochereil, *Tritia reticulata* and *Dentalium* sp., were plotted alongside other examples of the same and similar shells

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452 recovered from throughout the Magdalenian, to provide a spatial context to their use as
 453 ornaments. *Tritia reticulata* has been identified at 42 separate Magdalenian sites, whereas
 454 shells of either *Dentalium* sp. Or of the closely related genus *Antalis* have been recovered
 455 from at least 76 sites (Figure 12Figure 12). Both ornament types are quite common
 456 throughout the Franco-Cantabrian Magdalenian, their frequency remaining relatively
 457 consistent from the Lower Magdalenian through to the Upper and Final Magdalenian.

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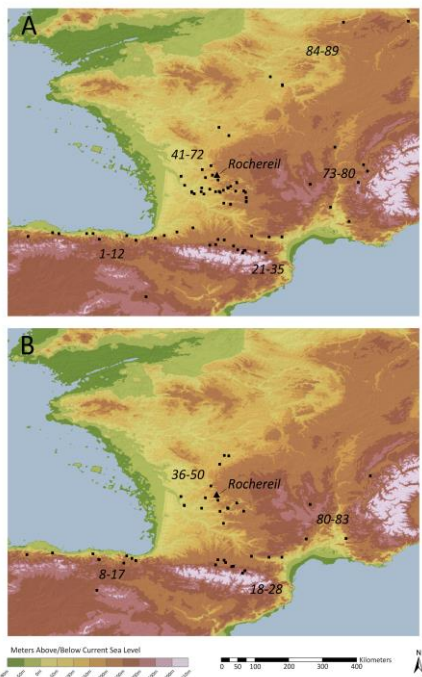


Figure 12: Distribution of *Dentalium* sp. (A) and *Tritia reticulata* (B) at Lower, Middle and Upper Magdalenian archaeological deposits across Western Europe. Map created using ETOPO1 digital relief model (Amante and Eakins 2009) and ESRI ArcMap 10.4.1. Sea levels estimated at -90m for approximately 16ka cal BP (Lambeck and Chappel 2001; Lambeck et al. 2014). Site key: 1: Las Caldas; 2: Cueto de la Mina; 3: El Juyo; 4: Pena del Diablo 2; 5: Berroberria; 6: Isturitz; 7: Vidon; 8: Tito Bustillo; 9: La Garma A; 10: El Miron; 11: Lumentxa; 12: Erralla; 13: Cueva Oscura de Ania; 14: El Horno; 15: Chaves; 16: Bolinkoba; 17: Urtiaga; 18: La Tourasse; 19: Montfort; 20: Rhodes II; 21: Gourdan; 22: Grotte des Harpons; 23: Mas d'Azil; 24: Enlene; 25: La Vache; 26: Canecaude; 27: Gazel; 28: Tournal; 29: Lortet; 30: Massat; 31: Bedheilac; 32: Belvis; 33: Grotte de l'Œuil; 34: Petite Grotte de Bize; 35: Aurensan; 36: Le Souci; 37: Laugerie Basse; 38: Les Faldets; 39: La Marche; 40: Angles sur l'Anglin; 41: Roc de Marcamps; 42: Le Placard; 43: Badegoule; 44: Chancejade; 45: Cap Blanc; 46: Crabajlat; 47: Lachaud; 48: Combe Cullier; 49: Cassegros; 50: Abri Fritsch; 51: La Pique; 52: La Chaire a Calvin; 53: Grand Moulin de Lugasson; 54: Faustin; 55: Le Morin; 56: Gare de Couze; 57: Jambancs; 58: Lestruque; 59: Abri Reverdit; 60: Le Flageolet II; 61: Les Marseilles; 62: Jolivet; 63: Pech de la Boissière; 64: Abri Murat; 65:

490 Bruniquel-Lafaye; 66: Le Courbet; 67: Petit Cloup Barrat; 68: Gare de Conduche; 69: Abri de la
 491 Bergerie; 70: St Remy sur Creuse; 71: Les Fees; 72: La Madeleine; 73: Colombier; 74: Abri Souberas;
 492 75: La Passagère; 76: Jean Pierre; 77: St Thibaud de Couz; 78: Grotte des Romains; 79: Solutre; 80:
 493 Rond du Barry; 81: La Roque; 82: Chinchon; 83: Douatres; 84: Goyet; 85: Gonnersdorf; 86:
 494 Andernach; 87: Ville St Jacques; 88: Pincevent; 89: Etiolles.

495

496 The use of *Tritia gibbosula* shells for personal ornamentation has a long history in
 497 Palaeolithic personal ornamentation (Bar-Yosef Mayer, 2015; Boric and Cristiani, 2019;
 498 Soler Mayor, 1990; Soler Mayor et al., 2019), but is unknown in the Lower and Middle
 499 Magdalenian. Its use as an ornament is attested in the Upper Magdalenian, but appears

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500 to be a phenomenon limited to northern Aquitaine and the Quercy (O'Hara, 2017;
501 Taborin, 1993), where this bead type is found at six sites (Figure 13).
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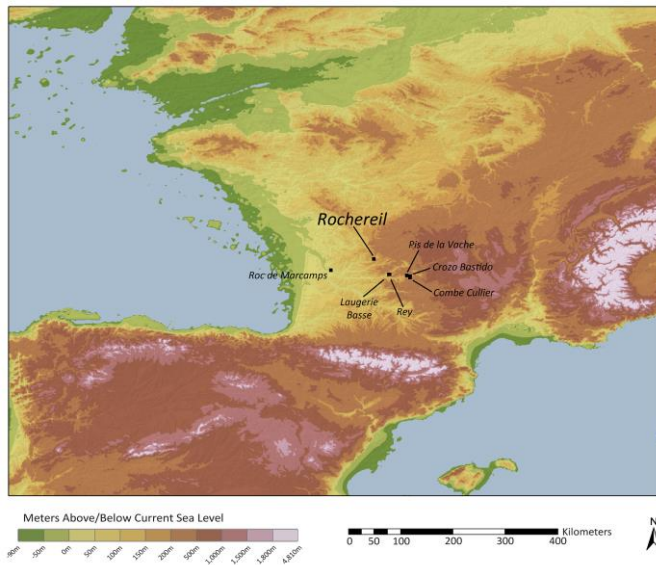


Figure 13: Distribution of shells of *Tritia gibbosula* in Magdalenian archaeological deposits across Western Europe. Map created using ETOPO1 digital relief model (Amante and Eakins 2009) and ESRI ArcMap 10.4.1. Sea levels estimated at -90m for approximately 16ka cal BP (Lambeck and Chappel 2001; Lambeck et al. 2014).

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524 *Cerastoderma Sp.* and *Glycymeris Sp.* shell ornaments are ubiquitous throughout the
525 Upper Palaeolithic of south-west of Europe (e.g. Taborin 1993, O'Hara 2017), but never
526 in large quantities. On the other hand, *Ocenebra* is rarely encountered in Magdalenian
527 contexts; examples are reported from the Creswellian (cf. Upper Magdalenian) layers at
528 Gough's Cave (Donovan, 1955), but it does not seem to have been a significant element
529 in Magdalenian symbolic culture.

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530 Discussion

531 Origin of the material

532 The two fossil specimens of *Cardiidae* and the *Spondylus Sp.* recovered from the Upper
533 Magdalenian occupation of Rochereil present a patina on the surface that suggests a local
534 origin in the surrounding karstic limestone. The absence of anthropic modification on these
535 shells suggests they were naturally deposited in the cave sediment, and not intentionally
536 introduced by Magdalenian occupants. Most of the other shell species present at the site
537 were available along Atlantic and/or the Mediterranean shores during the Pleistocene

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538 (Taborin, 1993). Rochereil is currently 130km from the coast; during the site's occupation
539 some 16-15,000 years ago, however, sea-levels were 90m lower than the today
540 (Galparsoro et al., 2010; Lambeck et al., 2002; Lambeck and Chappel, 2001), leaving
541 the site approximately 200km from the Atlantic shore and 350km from the Mediterranean
542 coast. Given post-depositional alterations have erased many diagnostic features, it is not
543 clear whether the scaphopods or *Tritia gibbosula* are coastal or fossil in origin. A possible
544 origin in Miocene deposits can be proposed for the *Dentalium*; fossil specimens very
545 similar in shape and size are documented in the Miocene crags (Aquitainian and Burdigalian
546 stratotypes) located in the Aquitaine Basin (Cossmann and Peyrot, 1915³⁴), less than 90km
547 from the site, ~~but an Atlantic origin is not~~cannot be excluded. The closest known source
548 of fossils of *Tritia gibbosula* is the Pliocene fossil outcrops in the Aude and Hérault, 300km
549 to the south-east (Taborin, 1993).

550 The location of the site at more than 200km from the shores and Pliocene fossil outcrops
551 indicate that most of the shells accumulated at Rochereil have an allochthonous origin. The
552 presence of one species extant exclusively in the Atlantic (*Pecten maximus*), and one
553 species exclusively present in the Mediterranean (*Tritia gibbosula*), indicates the
554 exploitation of two different catchment areas. Stone raw materials identified at Rochereil
555 are ~~generally mainly~~ local in origin (Duchadeau-Kervazo, 1986). This pattern echoes a
556 general trend observed in the Aquitaine Basin during the Upper Magdalenian: most of the
557 lithic raw materials are locally acquired, with a small amount of exogenous raw materials
558 coming from the Poitou, Charente and Massif Central, areas located at the North-West and
559 East of the Aquitaine Basin (Gourc et al., 2016; Langlais et al., 2016; M Langlais et al.,
560 2014; Langlais and Laroulandie, 2014). Some flint types originating in the Charente are
561 occasionally found in southern sites, but Mediterranean lithic raw materials are never found
562 in more northern regions (Langlais et al., 2016). Differences between lithic and shell
563 catchment areas suggest that the shells and the stone raw materials were acquired through
564 two different acquisition networks. In the ethnographic record, objects found at
565 considerable distances from source often attest to non-utilitarian mobility, or to exchange
566 (Binford, 1978; Hayden, 1981). This long-distance transport of resources across the
567 landscape may be motivated by social and ideological concerns, often partially motivated
568 by the gathering of information from neighboring groups (Newlander, 2017; Speth et al.,

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569 2013). While distance from source cannot be directly correlated with likelihood of indirect
570 acquisition or exchange (Hughes, 2011), in the case of Rochereil, the existence of two
571 geographically distinct networks of acquisition, one for stone and another for shell
572 procurement, suggests that the group indirectly acquired, at least partially, one of the two
573 resources.

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574 **Function of the shells**

575 The location of the site at a considerable distance from either coast indicates that the
576 mollusks were not collected live for consumption. The accumulation of a red compound in
577 one valve of *Glycymeris*, along with the evidence on the interior of the shell for the scraping
578 or mixing of that compound with a lithic point, suggests that this specimen was used as an
579 ochre container. No trace of this red compound was found on the rest of the shell collection,
580 and we suggest this *Glycymeris* specimen be considered functionally distinct from the rest
581 of the assemblage; the composition of this red compound of the subject of ongoing analysis.
582 The manufacture of a hole for suspension identified on one *Cerastoderma edule*, one *Tritia*
583 *gibbosula* and two *Tritia reticulata*, on the other hand, suggest their use as personal
584 ornaments. Use-wear identified on the perforated *Tritia gibbosula* suggests that the shell
585 was introduced to the site having already been transformed into a bead, and may have been
586 accidentally lost. Technological analysis does not identify anthropogenic modification on
587 the scaphopods, however, or on the *Ocenebra erinacea*~~usa~~.

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588 Morphometric analysis indicates that the *Ocenebra erinacea*~~usa~~ from Rochereil are
589 significantly larger than those in the modern reference collections. Morphometric analysis
590 also indicates that the smaller *Dentalium sp.* present in the modern and fossil reference
591 collections are not observed within the Rochereil collection. Furthermore, morphometric
592 analysis shows that the large shells naturally present in modern reference collections are
593 outside the size range of the *Tritia reticulata* from Rochereil.

594 Two factors, environmental conditions and human selection, may be responsible for the
595 size differences observed between the archaeological material and the reference
596 collections. The study of archaeological shell middens show that sShell size tends to
597 decrease with increased sea surface temperatures during the Pleistocene (Álvarez-
598 Fernández, 2011; Gutiérrez-Zugasti, 2011). Visible during interstadial phases, this
599 phenomenon becomes more pronounced at the beginning of the Holocene (Álvarez-

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600 Fernández, 2011; Gutiérrez-Zugasti, 2011). Local intertidal environments and sea
601 temperature variations can also influence the intra-species size variability (Avaca et al.,
602 2013; Fisher et al., 2009). The relatively large size of the Pleistocene *Ocenebra*
603 *erinaceus* at Rochereil fits the climatic hypothesis, and therefore preferential selection is
604 not necessarily evidenced. On the other hand, the significantly smaller size of the
605 archaeological *Tritia reticulata* when compared to the modern examples does not
606 correspond to the climatic hypothesis. The absence of larger specimens may be explained
607 by intra-species variability between discrete populations. An alternative suggestion is that
608 the archaeological *Tritia reticulata* were deliberately sorted before their introduction to the
609 site, and larger shells excluded from the assemblage.

610 The size of the *Dentalium* sp. from Rochereil falls within the range of variability of the
611 modern and Miocene reference collections, but the smallest scaphopods present in the two
612 reference collections are absent from the archaeological assemblage. Absence of the
613 smaller scaphopods again suggests that the shells were sorted before they were brought to
614 the site, and that larger individuals were preferentially selected.

615 We propose that the most parsimonious explanation for the presence of unmodified shells
616 is that the objects were collected with the intention of being transformed into ornaments,
617 but were deposited before modification. While shells of *Ocenebra* are not well-represented
618 in Magdalenian contexts, modified shells of *T. reticulata* and *Antalis* are well-known
619 elements of Magdalenian cultures of personal ornamentation.

620 ~~The fact that most of the shells recovered from Rochereil were unmodified suggests that~~
621 ~~the objects were collected with the intention of being transformed into ornaments, but were~~
622 ~~abandoned before modification.~~ Two hypotheses may explain ~~this pattern~~ their presence at
623 Rochereil: 1) the shells ~~from Rochereil~~ represent an accumulation of raw material stored
624 for subsequent transformation and use; or 2) the shells were considered inappropriate for
625 the manufacture of personal ornaments and were abandoned in the cave. We reject the
626 second hypothesis due to the presence of modified *Tritia reticulata* within the same size
627 range as the unmodified specimens, also indicatinges that the unmodified shells
628 accumulated at the site were of an appropriate size for perforation as beads.

629 The ~~storage-shell accumulation~~ hypothesis is ~~is further supported suggestion~~ by the exclusion
630 of the smaller scaphopods, which may correspond to the requirement for *Dentalium* sp.

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631 with a wide enough circumference for embroidery with a bone needle (Vanhaeren and
632 d'Errico, 2001). ~~The presence of modified *Tritia reticulata* within the same size range as~~
633 ~~the unmodified specimens also indicates that the shells accumulated at the site were of an~~
634 ~~appropriate size for perforation as beads.~~
635

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636 Regional synthesis

637 The shell material at Rochereil is a mixture of *taxa* widely used throughout the
638 Magdalenian (*Cerastoderma* sp., *Glycymeris* sp., *Mytilus* sp.) and other types restricted to
639 the region surrounding the site (*O. erinacea*~~usa~~, *T. gibbosula*). The presence of *Tritia*
640 *gibbosula* at Rochereil is noteworthy, as it is chronologically and geographically restricted
641 to a small number of Upper Magdalenian sites in northern Aquitaine and the Quercy
642 (Figure 13), raising the possibility of a local ornament tradition within a regionally discrete
643 population. Conversely, the two *taxa* which dominate this assemblage, *Dentalium* sp. and
644 *Tritia reticulata*, are both well-represented throughout the Magdalenian (O'Hara, 2017).

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645 Shells of either *Dentalium* sp. or the closely related genus *Antalis* (the two being often
646 conflated) were identified at 76 Magdalenian occupations, at least 40 of which may be
647 attributed to the Upper Magdalenian. Whether of fossil or marine origin, no other purpose
648 besides ornamentation is known for these objects. Shells of *Tritia reticulata* are also
649 commonly used as personal ornaments, and are attested at 42 separate Magdalenian sites,
650 15 of which could be restricted to Upper Magdalenian occupations. The presence of the
651 same shell types at so many sites, frequently several hundred kilometers from their source,
652 suggests a complex array of relationships interlinking procurement and exchange as objects
653 travel across the landscape. These individual episodes of exchange, involving not just
654 collaboration but also the shared symbolic valorization of specific shell materials, are
655 integral to the wider social economies that constitute the Magdalenian as a cultural
656 complex.

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657 Rochereil appears typically consistent in the ornament types favored, featuring a shell
658 assemblage that is at once diverse, but also highly coherent with shell assemblages
659 recovered from other Magdalenian sites in Aquitaine and to a lesser extent the
660 Pyrenees and Vasco-Cantabria (e.g. Álvarez Fernández, 2006; Taborin, 1992, 2007;
661 Alix 2003; Ladier & Welté 1993; Ladier, Welté & Lambert 1994). What makes the

662 Rochereil assemblage particularly noteworthy is the sheer number of unmodified
663 specimens, which suggests the existence of ~~a caching or storing~~ accumulation
664 phase in the procurement chain, with the perforation and modification of the objects
665 occurring at a later point in the sequence. The presence of similar bead types at
666 contemporaneous sites in the same region ~~may suggest~~ that Rochereil ~~belongs to as~~
667 a ~~network of interactions involved in the diffusion and sharing of common styles and~~
668 ~~symbols within the Upper Magdalenian communities of the region. central site in the~~
669 ~~process of manufacture and diffusion of the beads throughout the area.~~
670

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671 Conclusions

672 The technological, morphometric and use-wear analysis of the shells from Rochereil
673 identify for the first time a location dedicated to shell material accumulation ~~and storage~~
674 during the Upper Magdalenian of the Aquitaine basin. The accumulation at Rochereil of
675 raw materials of both fossil and marine origin implies a degree of scheduling in the gradual
676 collection ~~and storage~~ of the shells before modification. ~~Caching or A~~ accumulation sites
677 such as this must therefore be integrated into our understanding of the “structured poses”
678 of the aggregation/dispersion cycle by which we often imagine Magdalenian annual
679 mobility strategies (Conkey et al., 1980; Rivero, 2014).

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680 While the manufacture, modification and configuration of personal ornaments in the
681 Paleolithic have each received valuable scholarly attention (e.g. White 1997, d’Errico et
682 al., 2015; Vanhaeren et al., 2013), shell procurement has not. We must begin to consider
683 the nature of Magdalenian procurement strategies of unmodified shells from either fossil
684 or marine contexts (Rigaud et al. 2019, 2021). Embedded procurement is commonly
685 invoked when referring to resources available within a group’s foraging range (Binford,
686 1980). The evidence from Rochereil suggests ~~that that ‘embedded caching’ is perhaps a~~
687 ~~useful adjacent concept which should be considered. This term refers to a specific aspect~~
688 ~~of mobility involved in a deviation-indiversion from normal-regular~~ foraging activities
689 and related mobility in order to deposit or retrieve accumulated raw materials, ~~or perhaps~~
690 ~~the incorporation of such activity as embedded within regular foraging patterns at sites like~~
691 Rochereil. When reconstructing the procurement of exotic raw materials, scholars

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692 frequently compare systems of direct procurement with those of inter-group or down-the-
693 line exchange (e.g. Hart et al., 2017; Newlander, 2017; Whallon, 2006, ~~Wiessner 1977,~~
694 ~~1982~~). ~~'Embedded caching' complicates this dichotomy, as +~~The evidence from Rochereil
695 ~~complicates this dichotomy and~~ suggests that exotic materials can be accumulated over an
696 extended period of time and subsequently transformed, used, or exchanged as opportunities
697 to do so arise. In this sense, the *chaîne opératoire* of ornament production is a segmented
698 process of decision making which begins long before the actual physical modification of
699 the object.

700 The accumulation ~~—and control—~~ of a large amount of allochthonous raw materials
701 indicates the occupants of Rochereil were integrated within regional interaction spheres
702 with groups sharing the same aesthetic standards. The large-scale dispersal of similar
703 materials attests to the mobility of the occupants of Rochereil, and their contacts with other
704 communities. The exchanges and potential gifting of personal ornaments likely contributed
705 to a powerful social strategy to maintain cultural cohesiveness between communities, and
706 stimulated flexibility and reciprocity between groups.

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Mis en forme : Français (France)

Mis en forme : Anglais (États-Unis)

Mis en forme : Normal, Retrait : Gauche : 0 cm,
Suspendu : 1,25 cm

Mis en forme : Anglais (États-Unis)

Code de champ modifié

Mis en forme : Anglais (États-Unis)

Mis en forme : Français (France)

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Mis en forme : Anglais (États-Unis)

Mis en forme : Normal, Retrait : Gauche : 0 cm,
Suspendu : 1,25 cm

Mis en forme : Français (France)

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Mis en forme : Anglais (États-Unis)

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Mis en forme : Normal, Retrait : Gauche : 0 cm,
Suspendu : 1,25 cm

Mis en forme : Anglais (États-Unis)

Mis en forme : Police :Cambria

Mis en forme : Anglais (États-Unis)