



Caching up with the study of the procurement of symbolic raw materials in the Upper Palaeolithic

Beatrice Demarchi based on reviews by *Begoña Soler Mayor*, *Catherine Dupont* and *Lawrence Straus*

A recommendation of:

Open Access

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

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Solange Rigaud, John O'Hara, Laurent Charles, Elena Man-Estier, Patrick Paillet (2022), SocArXiv, z7pqq, ver. 4 peer-reviewed and recommended by Peer Community in Archaeology. <https://doi.org/10.31235/osf.io/z7pqq>

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The manuscript "The management of symbolic raw materials in the Late Upper Paleolithic of South-Western France: a shell ornaments perspective" by Solange Rigaud and colleagues (Rigaud et al. 2022) is a perfect demonstration that appropriate scientific methodologies can be used effectively in order to enhance the historical value of findings from "old" collections, despite the lack of secure stratigraphic and contextual data. The shell assemblage (n = 377) investigated here (from Rochereil,

Dordogne) had been excavated during the first half of the 20th century (Jude 1960) and reported in 1993 (Taborin 1993), but only this recent analysis revealed that it was composed of largely unmodified mollusc shells, most of allochthonous origin. Rigaud et al. interpret this finding as the raw materials used to produce personal ornaments. This is especially significant, because the focus of research has been on the manufacture, use and exchange of personal ornaments in prehistory, much less so on the procurement of the raw materials. As such, the manuscript adds substantially to the growing literature on Magdalenian social networks.

The authors carried out detailed taxonomic analysis based on morphological and morphometric characteristics and identified at least nine different species, including *Dentalium* sp., *Ocenebra erinaceus*, *Tritia reticulata* and *T. gibbosula*, as well as some bivalve specimens (*Mytilus*, *Glycymeris*, *Spondylus*, *Pecten*). Most of the species are commonly found in personal ornament assemblages from the Magdalenian, reflecting intentional selection (also shown by the size sorting of some of the taxa), and cultural continuity. However, microscopic examinations revealed securely-identified anthropogenic modifications on a very limited number of specimens: one *Glycymeris* valve (used as an ochre container), one *Cardiidae* valve (presence of a groove), one perforated *Tritia gibbosula* and two perforated *Tritia reticulata* bearing striations. The authors interpret this combination of anthropogenic vs natural “signals” as signifying that the assemblage represents raw material selected and stored for further processing.

Assessing the provenance and age of the shells is therefore paramount: the shells found at Rochereil belong to species that can be found on both the Atlantic and Mediterranean coasts. Assuming that molluscan taxa distribution in the past is comparable to that for the present day, this implies the exploitation of two catchment areas and long-distance transportation to the site: taking sea-level changes into account, during the Magdalenian the Mediterranean used to lie at a distance of 350 km from Rochereil, and the Atlantic was not significantly closer (~200 km). Importantly, exploitation of fossil shells cannot be discounted on the basis of the data presented here; direct dating of some of the specimens (e.g. by radiocarbon, or amino acid racemisation geochronology) would be beneficial to

clarify this issue and in general to improve chronological control on the accumulation of shells. Nonetheless, the authors argue that the closest fossil deposits also lie more than 200 km away from the site, thus the material is allochthonous in origin.

In synthesis, the Rochereil assemblage represents an important step towards a better understanding of the procurement chain and of the production of ornaments during the European Upper Palaeolithic.

References

Jude, P. E. (1960). *La grotte de Rochereil: station magdalénienne et azilienne*, Masson.

Rigaud, S., O'Hara, J., Charles, L., Man-Estier, E. and Paillet, P. (2022) The management of symbolic raw materials in the Late Upper Paleolithic of South-Western France: a shell ornaments perspective. SocArXiv, z7pqg, ver. 4 peer-reviewed and recommended by Peer community in Archaeology. <https://doi.org/10.31235/osf.io/z7pqg>

Taborin, Y. (1993). *La parure en coquillage au Paléolithique*, CNRS éditions.

Evaluation round #1

DOI or URL of the preprint: <https://doi.org/10.31235/osf.io/z7pqq>

Author's Reply, 18 Aug 2022

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We are grateful to the 3 reviewers who have helped us to improve the paper. All their suggestions have been considered and the article modified accordingly. Our comments to the suggestions are written in italic bellow.

Reviewer 1

I will suggest adding a term referring to symbolism, since the important symbolic contribution of this set is highlighted, as well as the term social network, the main subject of the work. *Key words have been added*

From introduction, the works cited in this section do not include Whallon (2006), which the authors mention at the end of the paper, as refer to the relationship between ornament and mobility *Reference has been added*

The methodology is correct and adequate. In this section on microscope analysis, a detailed list of experimental work is given. Maybe the paper of Avezuela et al (2011), which presents a detailed experimentation on the gastropod *Littorina obtusata*, could also be taken into account. *The reference has been added*

Regarding *Tritia gibbosula*, we can note as on the French Mediterranean coast, in southern Europe it is also present in the Gravettian levels of Cova Beneito (Muro, Alicante)(Soler, 2019) and in Solutrean and Magdalenian levels of Cova del Parpalló (Gandia, Valencia) (Soler, 2015 and Soler y Aura, e.p.). Further east, in Croatia, it appears in Palaeolithic and Mesolithic levels of Vela Spila site (Boric and Cristini, 2018), evidence for long-term regional and diachronic differences and similarities in types of body adornment among foragers of the European area. *Ref added but not for Coval del Parpallo, N. gibbosolus is only mentioned for layer II attributed to the Final Solutrean.*

Table 2 shows the list of pieces from the three studies carried out at different times in level II of this site. We note that Taborin (1992) describes at least 3 species that do not appear in the current study. *We have added to the text "The long history of curation of the collection may explain discrepancies between previously published material and the material currently present in the collection." All the material currently present in the collection is shown in figures 2 and 3.*

From morphometric, technological and use-wear analysis we would note the accurate work do in this part, especially in the perforation's description. The Kubicka (2017) paper could help in the study to discriminate predation holes because it is a review of animal predation perforations and their implications for the archaeological record that may provide some more concrete input to this work.

We have added the Kubicka 2017 reference in the method section. However, the authors focus on the perforation location to help discriminate between human-made versus predator holes on shells. In our own study, we use a combination of criteria based on taphonomic data and experimental data including hole location but also morphology of the hole, edges, presence of use-wear or tool marks (cutting, percussion...). The location of the hole alone shows a large degree of variability, as shown in the Kubicka paper, and is not a criterion that can be used on its own for identifying perforation origin on shells.

Regarding the use of ochre, it's only mentioned in a *Glycimeris* described as a container. None of the ochre shells show traces of dye? It is quite common that when traces of dye appear, the do not appear on a single piece. In case

there are no traces of dye in any of the other pieces, we consider that this should be mentioned. It will be interesting to know the composition and origin of this ochre.

No other evidence of ochre is observed on the material. The residue in the Glycymeris is of an important volume, very thick and first results (SEM, Raman, Xrf) show a complex composition. This piece is still under study and is not part of the personal ornament material. It will be published in a separate paper and its analysis required additional time. We have added to the text "No trace of this red compound was found on the rest of the shell collection, and we suggest this Glycymeris specimen be considered functionally distinct from the rest of the assemblage; the composition of this red compound of the subject of ongoing analysis."

In line 339 it is said that in 213 remains, no anthropogenic action can be determinate due it post-depositional alterations. If they are so important, perhaps they should be described in detail. It would be useful to have this information in an annex.

This is not what we say. It is written :

Of the 217 Tritia reticulata shells, 24 are perforated (Figure 8A). Perforations are mainly observed on the dorsal side of the last whorl, but several small perforations are also observed on the ventral side, and sometimes close to the apex on either the ventral or dorsal side. Post-depositional alterations and recent exfoliation present on many of the perforations precludes identifying their origin, and so taphonomic processes cannot be completely excluded (Gorzela et al., 2013).

Our stat is that 24 specimens show a modification (anthropogenic or taphonomic). Other individuals are not perforated at all.

From discussion

The authors propose us two hypotheses to the raw material Rochefield accumulation, but more hypotheses are possible; we do not know what the ultimate meaning of these pieces is. The second hypothesis is clearly unacceptable because of the support proves to be adequate in on other perforated pieces.

We agree, the second hypothesis is not sustainable for the reason the reviewer provides, and so we support the accumulation hypothesis. In the text we also reject alimentary use of the shells due to distance from coast. On the other hand, T. reticulata and Antalis are widely known and accepted as personal ornaments across the European Paleolithic, and so we propose the interpretation of the unmodified shells as ornament blanks is the most parsimonious one.

From conclusions, in line 652 the quotation from White, 1997 does not appear in the final bibliography. We should add the ref or remove the citation *Reference added*

Finally, it is remarkable the attention paid to the procurement strategies of these objects. Nevertheless, we would need more evidences to know that Rochereil is a central place in the manufacturing process, control and diffusion of these pieces throughout the area. *the sentence has been rephrased*

Also the number of Tritia unperforated is remarkable, considering the number of pieces of that size that we needed for a single necklace, a cap or a garment, the interpretation of storage for the whole area is, at the very least, an idea for discussion. *we have changed storage for accumulation everywhere in the text.*

In short, it cannot be ruled out that they could be, for example, elements designs for a single necklace. *We agree, but whether those shells were dedicated to an individual arrangement or were individually distributed does not change our discussion regarding procurement strategy, functional hypothesis and scheduling of the manufacturing process. Our aim is to stay parsimonious in our demonstration and to avoid any speculation regarding the precise social function of the shells within the Magdalenian communities, as our data mostly document raw material economy and society mobility and network of contacts.*

The proposal of the term embedded catching to explain a specific aspect of mobility is interesting to talk about connected societies based on movement and information exchange. The work of Romano, Lozano and Fernández-López de Pablo, 2021 is an interesting work on the reconstruction of prehistoric social networks and cultural transmission. The Rochefiel data suggest such interaction and exchange, although we certainly would not hypothesize the number of undrilled pieces as an accumulation and control of subsequent distribution as the only

possible hypothesis.

Cache, control, embeded catching are concepts we have removed from the new version of the manuscript

The consideration of Rochefield as an aggregation site, as Conkey described, need more justification, the record of this site is not comparable to Isturitz or Altamira.

We do not qualify Rochereil as an aggregation site. Our sentence "Accumulation sites such as this must therefore be integrated into our understanding of the "structured poses" of the aggregation/dispersion cycle by which we often imagine Magdalenian annual mobility strategies (Conkey et al., 1980; Rivero, 2014)." suggests that Rochereil is part of the variability of sites used by mobile foragers for their various activities including specific location for symbolic productions.

Review C. Dupont

A main comment we have after reading the paper is: is the caching of raw material the only hypothesis you can propose? *Caching has been removed from the text*

- were the intact shells found in a certain form of accumulation? *We explain below that little information on object provenience is available*

- which argument are in favour of a caching? - *cf. supra*

Are there other raw materials evocate caching? *cf. supra*

A second comment is about the used modern collections. Some of them are represented by less than 60 individuals. It is difficult to use them as a reference for a whole population. *At least one of the two reference collections for each shell species reach 60 specimens (or nearly). cf bellow*

I suggest bibliographical references below. Although general references are given to describe the geographical origin of shells, it will be more relevant to give more precise references for each species and information (location, fossil or not, usual sizes...). *We have added references*

Abstract

The abstract is concise and presents the main findings of the study. The term "raw material" can induce that the shells are raw material to make an object. See if you keep only this hypothesis according to the comments. *Abstract has been modified but we keep the hypothesis of the shells as raw material (cf discussion bellow)*

Introduction

Was the Rochereil collection knew from Vanhaeren and Taborin when they wrote their syntheses: did these two researchers known the shells from Rochereil's excavation, did they interpret them No. *We have precise in the text. "These shells have not been previously studied, with just a list of material published without evaluation of function (Taborin 1992)." "*

Line 44 erase A.L. *done*

Archaeological context and objectives

The different stages are describe but what about the sampling (with water, sieving, size of the mesh...). The authors write about "spatial records", but nothing is said about the spatial organisation of these shells.

we have added : "Precise findspot information is unavailable, and records only attribute material to archaeological stratum (Jude 1960). While the sediment was not screened, the excavation seems to have been meticulous and comprehensive, as recent water-screening of the backdirt with a 4mm mesh has not resulted in the recovery of additional shell remains (P. Paillet, unpublished)." "

Lines 79-88 are difficult to understand with the figure 1, because the number of the layer are not clearly mentioned on the legend of the stratigraphy of figure 1. *fixed*

Taxinomy

L111-112 The criteria used for bivalve determination are lacking. *text modified accordingly*

L119 A more recent check of Latin names can be interesting. Some of them can change regularly. *We have checked recent nomenclature and changes the text accordingly*

L119 "Biodiversity Heritage Library": reference? *reference added*

<https://www.biodiversitylibrary.org/>

Morphological and morphometric analyses

L135 “naked eye” English. Maybe “by sight”? *naked eye is ok*

L137-140 Explain a little more: why have you chose these reference collections? How have they been chosen and collected? *We have added to the text : “Marine reference collections were made by 2 collectors, collected over 45 minutes on two beaches targeted for their relative proximity to Rochereil.”*

L140 *Ocenebra erinacea* The Latin name is *Ocenebra erinacea modified accordingly*

Table 1 With less than 60 individuals it is difficult to use a modern collection. This number is not efficient to describe a population. *For each shell species at least one of the reference collections reaches 60 specimens (or nearly).*

Microscopic analysis

taphonomic and anthropogenic modifications: can you explain how you did that more precisely? Have you done a systematic analysis in sharing the shell into different parts? *We have recorded modifications on each anatomical part of the shells (apex, spire whorls, aperture, lip, umbo, ventral margin, dorsal and ventral sides). Considering the characteristic of the assemblage (mostly unmodified shells) and the limit in interpreting the results due to the context and excavation, record and sampling field methods, a more specific and time consuming methodology would not have been relevant.*

Results

Shell identification

L177 377 shells: precise which ones there are: all shells intact and modified?

Yes, functional analysis comes in the following section

L177 “to Layer II” : what about shells from other layers? *no other shells in other layers*

L183 “shores in the Pleistocene.” Reference / You cite the references in the methodology but we need more precise references for each origin of raw material. *References have been added*

However, few data are available on natural Pleistocene shell deposits. New approaches may fill this blank in our knowledge on past shell species distribution, as the recent paper of Bosso et al (The rise and fall of an alien: why the successful colonizer Littorina saxatilis failed to invade the Mediterranean Sea) in which ECNM is used to map the past distribution of a shell species, but this is not the purpose of the present paper.

L184-187 Why don’t you test the shape of the *Tritia reticulata*? It can be a good mean to know if all of them are coming from the same coast. As this species is polymorph, it can be difficult to compare the archaeological collection to the modern collection

Even if the morphology of the shell brings additional information, the main and useful information for the present study is the allochthonous origin of the material demonstrated in the paper. Tritia nitida is very similar to T. reticulata and has sometimes been described under the name. T. reticulata in the literature. In the case of Rochereil the two species may be present in the collection but as they can share the same biotope, the main information of the paper (allochthonous origin of the material) remains unchanged.

L185 “gastropod shell is conical, featuring of axial ribs containing 7 to 9 whorls, and is also 186 present along Atlantic and the Mediterranean coasts.” *references added*

L195-197 references *added*

L198-202 references *added*

L209 “Among the four valves possibly belonging to the Cardiidae family” *possibly has been removed*

L225 references *added*

L230 “probably belonging to the genus *Spondylus*” explain which criteria you use to say that? *probably removed, description of the shell improved in the text*

L235 “comparison with previously published inventories show that 3 shell species are missing from the current collection” The reverse is also true, some of the shells in your inventory had not been identified. How do you explain this? *We do not explain it (and cf. above), all the shells currently present in the material are shown in photos in our article. The studies of Jude and Taborin do not provide exhaustive iconography of the material, preventing any comparison. the text has been improved.*

L254-255 “The fragments of the bivalves *Mytilus* sp., *Pecten maximus*, *Spondylus* sp. and the two fossil Cardiidae show no anthropogenic modification.” The edges are not used or eroded? *No.*

L279 Is the size of perforations not small for natices’ predation? *No based on Rojas reference. Some worms can do double perforations.*

Another reference maybe with complementary parameters: Cabral J.P., Monteiro-Rodrigues S. 2015 - Orifícios de predação em conchas de moluscos marinhos. Um modelo experimental para o estudo de perfurações em conchas

arqueológicas La Investigación Arqueomalacológica en la Península Ibérica: Nuevas Aportaciones, in Gutiérrez-Zugastil I., Cuenca Solana D., Gonzalez Morales M.R. (dir.), Actas de la IV Reunion de Arqueomalacologia de la Peninsula Iberica, Santander, 22-24 mai 2014, Santander, Nadir Ediciones, p. 241-250

text modified and reference added

L309 (Figure 6d, e) / L268 space or not *fixed*

L317 size of the natural perforation *fixed*

L323-327 Are you sure that the shape is stable for the murex? Have you got sufficient shells to work on such comparison?

https://www.researchgate.net/publication/237730687_Comparative_morphology_of_Pliocene_Quaternary_and_Recent_shells_of_Ocenebra_erinaceus_Linnaeus_1758_and_O_brevirobusta_Houart_2000_Mollusca_Muricidae_Ocenebrae_reflections_on_the_intra-_and_interspe

The publication of V. Berrou includes shells coming from a large geographic extent from Normandy to Morocco and the Mediterranean shores. In the present study, we have focused on the shore located at a shorter distance from the site. Our aim is not to discuss Pleistocene natural shell populations variability but to infer anthropogenic selection of the shells according to their size. One of our reference murex samples reaches 60 individuals which is a good size sample. However, in any case, the low number of Murex within the archaeological collection is a limit for the statistical analysis. We have dealt with what we have, trying to keep a balanced methodology and research aims considering sample size and chose the most parsimonious hypotheses.

L364 Why tusk shells are animals and have an orientation: anterior and posterior. Why do you use proximal and distal? *modified in the text*

L408-409: reference for fossil specimens? *reference removed.*

L409 “By comparison, the length of the scaphopods from Rochereil is, on average, 5 times greater than their maximum diameter (Table 4).” Please precise your idea? What is the consequence of such difference? *It means that the scaphopods from Rochereil are shorter than the shells from the reference collections, short sentence added to the text*

L417 Moreover, the “rare?” larger and longer scaphopods from Rochereil fall outside the size range observed in the fossil reference collection. *rare has been removed*

Regional comparison

A your description of Rochereil is mainly based on sizes of shells: are there other archaeological collections with such data? no. very few authors deal with shell size. *Most of the published studies focus on sourcing, functional analyses and taphonomy of the surfaces of the shells.*

Tables and figures

Table 2 Problem with the reference of the figure for Glycymeris / line associated to the symbol ° for figure Tritia reticulata *fixed*

Figures: The orientations of shells should be the same. The columella of gastropod should be vertical when photographed one by one. See orientation for bivalves. *fixed*

Figure 3: italic for the last name *fixed*

Figure 4 italic “striations on the ventral margin of the shells” Only the margin? I see them on the extern part of the shell but not only on the margin.

yes, they are not of the same origin. those external striations are more large, less deep and may be post depositional. This shell will be published in a dedicated publication with the residue analysis.

Figure 8: orientation with vertical columella. *fixed*

Figure 9: The shape of this shell is dependant of its environment. Difficult to describe this figure with so few data. *cf comment above about T. nitida*

Figure 10: italic/ posterior and anterior would be better. *fixed*

Figure 11: italic *fixed*

Discussion

L513-515: “The absence of anthropic modification on these shells suggests they were naturally deposited in the cave sediment, and not intentionally introduced by Magdalenian occupants.” Why do you say that? Have you

stratigraphic difference between these shells and the other ones? Have you other elements from the karstic limestone near these shells?

As shown in the site presentation, Rochereil has not been excavated according to modern excavation standards. Provenience data are missing, and no spatial recording of the material is available. We mention in the article the fossil origin, the patina, the absence of anthropic modification, and we consider the natural presence of Miocene fossil shells in the Miocene karsts of the region. The most parsimonious hypothesis is the natural origin of those specific shells. Archaeological literature is polluted with dubious objects interpreted as personal ornaments based on poor functional, technological, taphonomic, and use wear data (see Rigaud et al. 2009). Here we secure the anthropogenic assemblage by excluding any other artifacts for which no secure data support an anthropic accumulation.

L524 similar: on which criteria? *A possible Atlantic origin has been added to the text*

L535 generally or mainly? *yes mainly, changed in the text*

L538 The region is "Poitou-Charentes" and now Nouvelle Aquitaine. *We are using geographic areas instead of administrative regions.*

L556 "The location of the site at a considerable distance from either coast indicates that the mollusks were not collected live for consumption." Are they known to be eaten after archaeological records? *Even if they had been eaten at some sites, it does not weaken the argument provided here.*

L575-576 Precise that this result is based on archaeological observations and that it is an hypothesis. *The sentence has been modified accordingly*

L578-580: reference *ref added*

L567-568 There are references on murex. Examples: Berrou V., Merle D., Dommergues J.-L., Crônier C. & Néraudeau D. 2004. — Comparativemorphology of Pliocene, Quaternary and Recent shells of *Ocenebra erinaceus* (Linnaeus, 1758) and *O. brevirobusta* Houart, 2000 (Mollusca, Muricidae, Ocenebrinae): reflections on the intra- and interspecific variations. *Geodiversitas* 26 (2) : 263-295. [CL1] / Fossil and recent Muricidae of the world, Merle, Didier Editeur : ConchBooks. Hackenheim, Germany, 2011 [CL2]. Can you verify if there are data on their size and shapes? *We have checked. No data available*

L593-594 "The fact that most of the shells recovered from Rochereil were unmodified suggests that the objects were collected with the intention of being transformed into ornaments," I am not agree with this consequence. It is not because that these shells are unmodified that human have preview to do it.

*The article provides several argument for ornamentation: selection of the larger scaphopods, the human made perforation on few *T. reticulata*, the evidence that shell's introduction into the site was not for consumption (shore too far from the site), the common use of similar shell species as personal ornaments at other contemporaneous archaeological sites, no evidence of other function for those shell species in the archaeological record.*

L599 3) are waiting to be exchange? 4) Personal collection? *Yes, many uses and functions of perforated shells may be guessed. We prefer to keep a parsimonious hypothesis concerning their use as personal ornaments, without mentioning any possible individual or inter-individual functions that would be pure speculation.*

L593-599 Have you got data that can may the difference between a storage or a personal collection? Are there concentrated shells in context? Were all species mixed at Rochereil when they were discovered? Maybe a reference that can interested your paper. It is about unmodified shells. There is a mention to the Taborin's observation that is linked to your paper. Dupont C., 2019- Archaeological evidence for collecting empty shells along the French Atlantic coast: A major activity for coastal populations. *Journal of Ethnobiology*. 39(2), 223-239, <https://doi.org/10.2993/0278-0771-39.2.223>

thank you for the reference, it has been added to the 'objectives' section.

*This is a very interesting paper that shows clear differences between the assemblages shown in the paper and our present study. For the wall decoration, no selection by the size is demonstrated and only perforations from a taphonomical origin are present in few specimens. moreover the shell species used for wall decoration are mostly not used for personal ornamentation according to the litterataure. At rochereil we have evidence of human made modification on the *T. reticulata*,, selection of the dentalium by their size, and the use of similar species at other contemporaneous sites for personal ornamentations.*

For the child 'Tresor', the malacospectra is more diverse than at Rochereil, with few specimens per species, and it includes many shells not commonly used as personal ornaments in the archaeological record.

Moreover, the author is using the context of discovery, including precise spatial data for the Tresor and pieces of walls with shells still embedded in the mortar. We cannot expect such data for paleolithic sites and when considering mobile foragers. That is why here we provide more precise technological, morphometric data and regional comparisons to support our claim, data not provided in the Dupont 2019 paper.

Conclusions

L644 "storage" How do you define this term after your data? *storage has been removed from the text*

L646 “before modification”: necessary? *we have keep it as we insist on the arguments provided all along the text to justify the shells were dedicated to be used as personal ornaments*

L 657 ‘embedded caching’ How do you define this term after your data? *removed from the text*

L659 “a deviation in normal” excessive: what is normality? Can’t we consider populations as a diversity? Deviation is a negative word for me, a value judgment. *change for diversion*

References

L504 Taborin 1993: reference? *fixed*

L632 Taborin 2007 reference? *fixed*

L652 White 1997: reference? *fixed*

L712/ L723/ L728-729/ L741 italic *fixed*

L826 & ? *fixed*

L848 Sandrine ? *fixed*

L936 abbreviation? *fixed*

References of a same author are not in a chronological order *fixed*

Reviewed by Lawrence Straus, 19 May 2022 06:50

My only suggestions are that the authors cite and use the seminal works of Polly Wiessner on the hxaro networks of southern Africa (shells traded over long distances from the coasts by San foraging peoples), *References added* that they provide more information on why Rochereil might have been a central node (and important place) in such networks (because of geographical position, avenues of communication, physical characteristics of the cave vis a vis other Upper Magdalenian sites in this core area of UM settlement in SW France), *this sentence has been removed* and that they explain why the taxonomic name *Dentalium* is used (I had thought it had been replaced by *Antalis*---a footnote is in order explaining this). *text modified*

Decision by [Beatrice Demarchi](#), 15 Jul 2022

Dear Authors

We now have three reviews for your study and I am pleased to say that they all find the paper of high quality and certainly worthy of publication - I agree with the reviewers.

I would ask you to revise the manuscript within one month, according to the comments of the three reviewers, and to submit the revised preprint, along with a detailed point-by-point response. I shall be happy to recommend it, pending suitable revision.

Looking forward to receiving your revised manuscript.

Kinds regards

Beatrice

Reviewed by [Begoña Soler Mayor](#), 01 Jun 2022

The Rigaud *et alii* paper, is a very interesting contribution to the study of Magdalenian ornament from SW France. It provides new data and analyses that will undoubtedly contribute to a better understanding of this type of material. The unusual fact of finding a huge number of unperforated pieces gives it a specific relevance that suggest new interpretations, as well as the fact that it focuses on the mode of acquisition of this raw material.

The following are some minor issues that could be considered when publishing this paper:

Title and abstract, both are correct, clearly describing the content and objectives of the article. In the Keyword, I will suggest adding a term referring to symbolism, since the important symbolic contribution of this set is highlighted, as well as the term social network, the main subject of the work.

From introduction, the works cited in this section do not include Whallon (2006), which the authors mention at the end of the paper, as refer to the relationship between ornament and mobility.

The **methodology** is correct and adequate. In this section on microscope analysis, a detailed list of experimental work is given. Maybe the paper of Avezuela et al (2011), which presents a detailed experimentation on the gastropod *Littorina obtusata*, could also be taken into account.

Regarding *Tritia gibbosula*, we can note as on the French Mediterranean coast, in southern Europe it is also present in the Gravettian levels of Cova Beneito (Muro, Alicante)(Soler, 2019) and in Solutrean and Magdalenian levels of Cova del Parpalló (Gandia, Valencia) (Soler, 2015 and Soler y Aura, e.p.). Further east, in Croatia, it appears in Palaeolithic and Mesolithic levels of Vela Spila site (Boric and Cristini, 2018), evidence for long-term regional and diachronic differences and similarities in types of body adornment among foragers of the European area.

Table 2 shows the list of pieces from the three studies carried out at different times in level II of this site. We note that Taborin (1992) describes at least 3 species that do not appear in the current study.

From morphometric, technological and use-wear analysis we would note the accurate work do in this part, especially in the perforation's description. The Kubicka (2017) paper could help in the study to discriminate predation holes because it is a review of animal predation perforations and their implications for the archaeological record that may provide some more concrete input to this work.

Regarding the use of ochre, it's only mentioned in a *Glycimeris* described as a container. None of the ochre shells show traces of dye? It is quite common that when traces of dye appear, the do not appear on a single piece. In case there are no traces of dye in any of the other pieces, we consider that this should be mentioned. It will be interesting to know the composition and origin of this ochre.

In line 339 it is said that in 213 remains, no anthropogenic action can be determinate due it post-depositional alterations. If they are so important, perhaps they should be described in detail. It would be useful to have this information in an annex.

From discussion

The authors propose us two hypotheses to the raw material Rochefield accumulation, but more hypotheses are possible; we do not know what the ultimate meaning of these pieces is. The second hypothesis is clearly unacceptable because of the support proves to be adequate in on other perforated pieces.

From **conclusions**, in line 652 the quotation from White, 1997 does not appear in the final bibliography.

Finally, it is remarkable the attention paid to the procurement strategies of these objects. Nevertheless, we would need more evidences to know that Rochereil is a central place in the manufacturing process, control and diffusion of these pieces throughout the area. Also the number of *Tritia* unperforated is remarkable, considering the number of pieces of that size that we needed for a single necklace, a cap or a garment, the interpretation of storage for the whole area is, at the very least, an idea for discussion. Examples of the need for hundreds of beads to make a single object or to apply them to clothing can be found in burials, where the pieces are brought in their context of use; for example the burial of Sungir, with more than 5000 pieces, or the hundreds of pieces found in the skull of the young man discovered at the site of Arene Candide. In short, it cannot be ruled out that they could be, for example, elements designs for a single necklace.

The proposal of the term embedded catching to explain a specific aspect of mobility is interesting to talk about connected societies based on movement and information exchange. The work of Romano, Lozano and Fernández-López de Pablo, 2021 is an interesting work on the reconstruction of prehistoric social networks and cultural transmission. The Rochefiel data suggest such interaction and exchange, although we certainly would not

hypothesize the number of undrilled pieces as an accumulation and control of subsequent distribution as the only possible hypothesis.

The consideration of Rochefield as an aggregation site, as Conkey described, need more justification, the record of this site is not comparable to Isturitz or Altamira.

The **bibliography** used is ample and correct; we have already mentioned some citation that would be good to incorporate.

In sum, this manuscript is a welcome contribution to the knowledge of the record of Magdalenian SW France and analysis of shell ornaments data.

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Reviewed by [Catherine Dupont](#), 15 Jul 2022

The paper is dedicated to both intact and perforated shells found in a major site of the south-west of the France, the one of Rochereil. The study is well detailed and is a major contribution of our knowledge on shells accumulated by Humans in the Palaeolithic, especially the Late Upper Palaeolithic. We anoted the text for a better understanding of our comments.

A main comment we have after reading the paper is: is the caching of raw material the only hypothesis you can propose?

- were the intact shells found in a certain form of accumulation?
- which argument are in favour of a caching?
- can't these shells have been used without modifications (exchange, personal collection...)?
- Are there other raw materials evocate caching?

A second comment is about the used modern collections. Some of them are represented by less than 60 individuals. It is difficult to use them as a reference for a whole population. I suggest bibliographical references below.

Although general references are given to describe the geographical origin of shells, it will be more relevant to give more precise references for each species and information (location, fossil or not, usual sizes...).

The other comments are below. The paper is interesting and the only aim of my comments is to make it better. If some of my comments are unadapt, don't hesitate to explain it.

The paper has to be published after consideration of my comments.

Title

The paper is mainly on the site of Rochereil even if the authors compare their results to other sites. The name of this site should be mention on the title.

Abstract

The abstract is concise and presents the main findings of the study. The term "raw material" can induce that the shells are raw material to make an object. See if you keep only this hypothesis according to the comments.

Introduction

The **introduction clearly explains the motivation** for the study.

The **research question is clearly presented**.

I am not a specialist of the Paleolithic but, it would be really interesting and important to place this study in the state of research of the Palaeolithic ornaments in the South-Western France, and at the second scale to the one of the Late Upper Paleolithic. Was the Rochereil collection known from Vanhaeren and Taborin when they wrote their syntheses: did these two researchers know the shells from Rochereil's excavation, did they interpret them... How this paper answer to new questions according these two or other important syntheses (new data, new methods...)?

Line 44 erase A.L.

Archaeological context and objectives

The different stages are describe but what about the sampling (with water, sieving, size of the mesh...). The authors write about "spatial records", but nothing is said about the spatial organisation of these shells.

Lines 79-88 are difficult to understand with the figure 1, because the number of the layer are not clearly mentioned on the legend of the stratigraphy of figure 1.

Taxinomy

L111-112 The criteria used for bivalve determination are lacking.

L119 A more recent check of Latin names can be interesting. Some of them can change regularly.

L119 "Biodiversity Heritage Library": reference?

Morphological and morphometric analyses

L135 "naked eye" English. Maybe "by sight"?

L137-140 Explain a little more: why have you chose these reference collections? How have they been chosen and collected?

L140 *Ocenebra erinacea* The Latin name is *Ocenebra erinaceus*

Table 1 With less than 60 individuals it is difficult to us a modern collection. This number is not efficient to describe a population.

Microscopic analysis

L146-151 "taphonomic and anthropogenic modifications": can you explain how you did that more precisely? Have you done a systematic analysis in sharing the shell into different parts?

Results

Shell identification

L177 377 shells: precise which ones there are: all shells intact and modified?

L177 “to Layer II” : what about shells from other layers?

L183 “shores in the Pleistocene.” Reference / You cite the references in the methodology but we need more precise references for each origin of raw material.

L184-187 Why don’t you test the shape of the *Tritia reticulata*? It can be a good mean to know if all of them are coming from the same coast. As this species is polymorph, it can be difficult to compare the archaeological collection to modern collection.

http://www.patrimoniocultural.gov.pt/media/uploads/trabalhosdearqueologia/51/estudo_complementar.pdf

DUPONT C., 2011 – Chapitre EC. Etude complémentaire : les invertébrés marins du « concheiro » de Toledo (Lourinhã, Portugal). In : Araújo A.C. (ed.), O concheiro de Toledo no contexto do Mesolítico inicial di litoral da Estremadura. Trabalhos de Arqueologia, n°51, ISSN 0871-2581, 185-227. /LAPORTE L., DUPONT C., GRUET Y., COURTAUD P., DUDAY H., QUESNEL L., LEFEUVRE J.Y., BAMBAGIONI F., MIALHE V., ROBIN K., 2021- Les coquilles marines de la nécropole mésolithique de La Vergne (Saint-Jean-d’Angély, Charente-Maritime, France) : de leur collecte à la mise en scène des corps humains. Gallia Préhistoire, 61, mis en ligne le 02 juillet 2021, <http://journals.openedition.org/galliap/2160>

L185 “gastropod shell is conical, featuring of axial ribs containing 7 to 9 whorls, and is also 186 present along Atlantic and the Mediterranean coasts.” References

L195-197 references

L198-202 references

L209 “Among the four valves possibly belonging to the Cardiidae family” Why possibly?

L225 references

L230 “probably belonging to the genus Spondylus” explain which criteria you use to say that?

L235 “comparison with previously published inventories show that 3 shell species are missing from the current collection” The reverse is also true, some of the shells in your inventory had not been identified. How do you explain this?

L254-255 “The fragments of the bivalves *Mytilus* sp., *Pecten maximus*, *Spondylus* sp. and the two fossil Cardiidae show no anthropogenic modification.” The edges are not used or eroded?

L279 Is the size of perforations not small for natices’ predation? Some worms can do double perforations. Another reference maybe with complementary parameters: Cabral J.P., Monteiro-Rodrigues S. 2015 - Orifícios de predação em conchas de moluscos marinhos. Um modelo experimental para o estudo de perfurações em conchas arqueológicas La Investigación Arqueomalacológica en la Península Ibérica: Nuevas Aportaciones, in Gutiérrez-Zugastil I., Cuenca Solana D., Gonzalez Morales M.R. (dir.), Actas de la IV Reunion de Arqueomalacologia de la Peninsula Iberica, Santander, 22-24 mai 2014, Santander, Nadir Ediciones, p. 241-250.

L309 (Figure 6d, e) / L268 space or not

L317 size of the natural perforation

L323-327 Are you sure that the shape is stable for the murex? Have you got sufficient shells to work on such comparison?

https://www.researchgate.net/publication/237730687_Comparative_morphology_of_Pliocene_Quaternary_and_Recent_shells_of_Ocenebra_erinaceus_Linnaeus_1758_and_O_brevirobusta_Houart_2000_Mollusca_Muricidae_Ocenebrinae_reflections_on_the_intra-_and_interspe

L364 Why tusk shells are animals and have an orientation: anterior and posterior. Why do you use proximal and distal?

L408-409: reference for fossil specimens?

L409 “By comparison, the length of the scaphopods from Rochereil is, on average, 5 times greater than their maximum diameter (Table 4).” Please precise your idea? What is the consequence of such difference?

L417 Moreover, the “rare?” larger and longer scaphopods from Rochereil fall outside the size range observed in the fossil reference collection.

Regional comparison

As your description of Rochereil is mainly based on sizes of shells: are there other archaeological collections with such data?

Tables and figures

Table 2 Problem with the reference of the figure for *Glycymeris* / line associated to the symbol ° for figure *Tritia reticulata*

Figures: The orientations of shells should be the same. The columella of gastropod should be vertical when photographed one by one. See orientation for bivalves.

Figure 3: italic for the last name

Figure 4 italic “striations on the ventral margin of the shells” Only the margin? I see them on the external part of the shell but not only on the margin.

Figure 8: orientation with vertical columella.

Figure 9: The shape of this shell is dependant of its environment. Difficult to describe this figure with so few data.

Figure 10: italic/ posterior and anterior would be better.

Figure 11: italic

Discussion

L513-515: “The absence of anthropic modification on these shells suggests they were naturally deposited in the cave sediment, and not intentionally introduced by Magdalenian occupants.” Why do you say that? Have you stratigraphic difference between these shells and the other ones? Have you other elements from the karstic limestone near these shells?

L524 similar: on which criteria?

L535 generally or mainly?

L538 The region is “Poitou-Charentes”

L556 “The location of the site at a considerable distance from either coast indicates that the mollusks were not collected live for consumption.” Are they known to be eaten after archaeological records?

L575-576 Precise that this result is based on archaeological observations and that it is an hypothesis.

L578-580: reference

L567-568 There are references on murex. Examples: Berrou V., Merle D., Dommergues J.-L., Crônier C. & Néraudeau D. 2004. — Comparativemorphology of Pliocene, Quaternary and Recent shells of *Ocenebra erinaceus* (Linnaeus, 1758) and *O. brevirobusta* Houart, 2000 (Mollusca, Muricidae, Ocenebrinae): reflections on the intra- and interspecific variations. *Geodiversitas* 26 (2) : 263-295. / Fossil and recent Muricidae of the world, Merle, Didier Editeur : ConchBooks. Hackenheim, Germany, 2011. Can you verify if there are data on their size and shapes?

L593-594 “The fact that most of the shells recovered from Rochereil were unmodified suggests that the objects **were collected with the intention of being transformed into ornaments,**” I am not agree with this consequence. It is not because that these shells are unmodified that human have preview to do it.

L599 3) are waiting to be exchange? 4) Personal collection?

L593-599 Have you got data that can may the difference between a storage or a personal collection? Are there concentrated shells in context? Were all species mixed at Rochereil when they were discovered? Maybe a reference that can interested your paper. It is about unmodified shells. There is a mention to the Taborin’s observation that is linked to your paper. Dupont C., 2019- Archaeological evidence for collecting empty shells along the French Atlantic coast: A major activity for coastal populations. *Journal of Ethnobiology*. 39(2), 223-239, <https://doi.org/10.2993/0278-0771-39.2.223>

Conclusions

L644 “storage” How do you define this term after your data?

L646 “before modification”: necessary?

L 657 ‘embedded caching’ How do you define this term after your data?

L659 “a deviation in normal” excessive: what is normality? Can’t we consider populations as a diversity? Deviation is a negative word for me, a value judgment.

References

L504 Taborin 1993: reference?

L632 Taborin 2007 reference?

L652 White 1997: reference?

L712/ L723/ L728-729/ L741 italic

L826 & ?

L848 Sandrine ?

L936 abbreviation?

References of a same author are not in a chronological order

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Reviewed by [Lawrence Straus](#), 19 May 2022

This is an important, well-explained, illustrated and documented manuscript, very deserving of publication. It adds substantially to the growing literature on Magdalenian social networks and trade (involving shells, fossils, works of portable art, lithic raw materials especially flint, exotic items, etc.).

My only suggestions are that the authors cite and use the seminal works of Polly Wiessner on the hvaro networks of southern Africa (shells traded over long distances from the coasts by San foraging peoples), that they provide more information on why Rochereil might have been a central node (and important place) in such networks (because of geographical position, avenues of communication, physical characteristics of the cave vis a vis other Upper Magdalenian sites in this core area of UM settlement in SW France), and that they explain why the taxonomic name *Dentalium* is used (I had thought it had been replaced by *Antalis*---a footnote is in order explaining this). Some further discussion of Rochereil as a possible aggregation site would be nice to have, but the article is really good especially from an empirical standpoint. Clearly there were sites that were “special” because of the large numbers of shells (and other personal ornaments) in the Magdalenian and Rochereil is one, but it does stand out by its large number of non-perforated “raw materials”. I wonder if other such sites could be deduced from the record (in the works of Taborin or Alvarez, for example), and if any of the super-rich shell sites have evidence of in-situ shell transformation (i.e., debris, failed/broken items in large numbers). It might be good to add a reference to the works of David Cuenca on the use of shells for scraping.

At any rate, Bravo!