Dear Donatella Usai and Jonathan Hanna,

Thank you for handling the peer-review process of our manuscript and for this first editorial decision.

We want to thank the three reviewers for the very useful comments and input on our manuscript. It really makes our paper better to have integrated all these comments and suggestions. We thank the native English speakers for helping us improve the language.

Please find attached the version with track changes, and below the point by point answer to reviewers with our answers written in blue.

All the best

Alain Queffelec on behalf of all co-authors

Review by Laura Kozuch

This is a very important work, and it applies innovative, comprehensive, and good methods towards an understanding of the topic. The authors present a good review of current bead drilling research from Europe and the Caribbean. Most importantly, this focuses on bead crafting without using metal tools. Much research shows how stone beads are made with metal tools but methods for making beads without metal has rarely been discussed and is not well understood.
The authors demonstrate that a cactus drill tip was probably used. This coincides with the Chumash tribe on the California coast using sea lion whiskers (Arnold and Rachal 2002). I wonder whether *pitahaya* cactus spines (*Acanthocereus tetragonus*) may have been used.
This corroborates my own research on the types of materials needed to drill through very hard materials (Kozuch 2021, 2022). Some beads are sometimes up to 6 or 7 centimeters long and could not have been drilled with chert or other stone drill tips. The numbers shell beads found at Cahokia in the heart of North America are astounding and the shells used have high Mohs (5.5) values also. I can send the authors copies of my publications if authors have trouble locating them.
We thank Laura Kozuch for her comments about our work. We did not know the papers she mentioned since we only looked for articles about lithic hard materials, since even hard shell is softer than quartz. Nevertheless, knowing of the sea lion whiskers study is very interesting, and the protocol for precise shape measurements of perforations too, even if probably overly precise for our study with a few dozens of beads, of different types, from several archaeological sites located on different islands.

Line 24: “First Ceramic communities” should be “Early.” Done
Line 28: Delete the negative symbol in front of 400; should be “400 cal. BC…” Done
Line 37: New paragraph should begin with sentence, “Raw materials…” Done
Line 43: Use “Quartz” as the first word in the sentence rather than “It…” Done
Line 64: change word “resumed” to “summarized.” Resume means to begin again. Done
Line 66: Wow! Amazing amount of time to drill a bead. Yes indeed, this is partly the reason why we began this research!
Line 75: Please don’t use the word “stigmata” as this word has religious meaning. Use “microwear” instead throughout. Done
They correctly note (lines 90 and 91) that there is a “scarcity of elements from the chaîne opératoire, represented by only 6 small amethyst flakes and 5 rock crystal flakes and crystals.” This supports the hypothesis that beads were drilled with biological materials, not stone. Note that some editors prefer that whole numbers below 10 be written out: “five” instead of “5.” We added a precision: the elements of the chaîne opératoire of quartz beads is scarce, but these sites have flint and other lithic raw materials flakes, blades etc.

Table 1: I don't know the term "Bitronconical." Maybe they intend "biconical," meaning "two cones?" Two truncated cones joined at the wide ends. Two truncated cones joined at the narrow ends are also biconical.

We modified Table 1 accordingly.

The shapes of archaeological bead drill holes are *prima facie* evidence that the drilling method they propose (with cactus spines) is the correct one for longer beads. It is possible that disk beads and beads with drill holes less than one centimeter long may have been drilled by stones drill bits. Disk and smaller beads exhibit widely conical drill holes (higher than 7 degrees).

Line 97: Heading should be titled "Methods" not "Method" Done

There should be a sub-heading before line 98 titled, "Imaging Archaeological Beads" Done, and we added a sub-heading "Experimentation" later in the Methods part.

Line 109: wording is awkward. "It also allows to overcome the…" should be changed to "This technique overcomes the constraints of 2D while eliminating the need for elastomer impressions." I hope that does not change the intent. Thank you this sentence is much better this way.

Line 111: "In this study four amethyst beads…" They need to state they are archaeological beads and not reproductions. "In this study four *archaeological* amethyst beads…" Done

Paragraph beginning on line 114 should have its own sub-heading, "Bead replication experiments." I also think the first sentence in this paragraph more properly belongs in the literature review or in the introduction section. We decided to let this sentence here since it introdeuces the fact that we had to make a choice for the experimental work.

Line 117: The archer drill is known as a bow drill. The authors may want to state that or change their terms. Line 120 "archer" needs to change to "bow" throughout. Done, thank you for pointing this.

Figure 5 is great! Note that a vise can be made with wood and string. Thank you. Yes it would have been great to try with a more relevant vise, but in the end we think it would not have changed anything, except that the drilling would have been even longer probably, and maybe less regular too?

Line 130: "perforation performance" should be "perforation effectiveness." Done

Line 134: I disagree that hardness of the drill tip needs to be equal to the material being drilled. The other drilling aids (grit, oil and/or water) help to overcome the lower hardness of the drill tip. My opinion only. We tried to make our sentence clearer by modifying it. Now it reads: "The drill bits and abrasives were selected according to two criteria: their hardness, which must be at least equal to that of quartz for one of them, and their compatibility with the archaeological record".

Line 138: A new paragraph is needed for the sentence beginning, "For the organic drills…" We think this sentence is still related to this paragraph since it is about the materials used for the experimentation. We tried to make it clearer, now it reads: "As for the the organic drills to be used with the hard abrasives, we used bone, wood and vegetable thorns".

Line 180: I don't understand the four types of perforations (or drill holes as I call them). I think(?) rectilinear might better be described as narrow angle, such as 1 or 2 degrees (1 to 2°).

Maybe you mean cylindrical? You might want to define these four terms, as I am also unclear what you mean by chamfered.
Line 198: It is better to be more precise in the language used to describe the drill holes. I have quantified the drill hole shapes of longer barrel-shaped beads using a mathematical frustum equation (Kozuch 2021). This allows for more precision when describing the shape of the drill hole. Sometimes the holes have almost parallel sides, other times they are more like two cones joined at the narrow ends.
https://mathworld.wolfram.com/ConicalFrustum.html
We changed our "rectilinear" term to "cylindrical" through the manuscript, and gave a description of what we call "chamfered": cylindrical with a larger diameter at the beginning. Measuring very precisely the angles of the perforation is, in our opinion, out of the scope of this article, but could be interesting in the future if we have the chance to have many more beads where such precise measurements could be statistically analyzed.

Line 199: Sentence beginning, "Long acquisitions…" I don't understand the intent of this sentence. Do you mean, "Long scan times?" Long amounts of time being scanned in the X-ray microtomography machine? Please clarify. We tried to clarify the sentence, which now reads: "Long scanning times centered on the perforation are required to obtain 3D models with sufficient resolution to observe them on big beads like GD-01-003 (Figure 9), since the resolution automatically drops when one wants to scan a bigger volume."

Line 210: These are casts of the drill holes, right? You should say "elastomer casts" instead of "impressions." I'm sure this is a simple translation problem. *Cast* is defined as - to give a shape to (a substance) by pouring in liquid or plastic form into a mold and letting harden without pressure. It can also be used as a noun, e.g., a cast of the drill holes. Please change all instances of "impressions" to "cast." Done throughout the manuscript, thank you for this correction.

Figure 13: I would add (lines 228 to 232) that this may illustrate the flexibility of the drill shaft; that it's probably made from biological materials (cactus spine). We think that these multiple angles of perforation are also visible on beads drilled with copper drill bits or other hard materials. We think that this is not due to the flexibility of the spine.

Line 244: Replace sentence beginning with "Other…" with this, "Bead drill holes made with experimental chert drills create wide, conical and short perforations." The text now reads "Bead drill holes made with experimental chert and obsidian drills create wide, conical and short perforation, unlike the archaeological ones (Figure 15)."

Line 248: I would add that the shape of drill holes made with chert or stone have greater degree angles (>7°?) than those made from biological drill tips which result in more parallel sided drill holes (cylindrical?). See previous answer

Lines 255-256: I would suggest that for beads drilled with bone or wood, that the drill holes were started with chert drills, then mostly accomplished with bone or wood drill tips. It is indeed a possibility, that we did not test. It could be tested in the future.

Line 259: "Inverted cone shapes..." You mean partial or truncated cones. These are frustums and you may want to point that out.
https://mathworld.wolfram.com/ConicalFrustum.html
Thank you we did not know this term. It is indeed frustums. We modified the sentence, which now reads: "Residual frustums are observed at the end of both casts" and we also changed the caption of Figure 15.

Line 260: Change “(i.e., at the bottom of the hole)” to (i.e., point at which the cactus drill tip was drilling into the amethyst).” Done

Line 270: 215 hours for one drill hole. Fantastic! Thank you!

Line 298: Again, please ensure you are clear regarding definitions of rectilinear and chamfered. I think you mean drill holes with small angles such as one degree (cylindrical?). Please define conical. How many degrees would make a drill hole conical? Ten degrees or 20? Maybe use a protractor. I’ve used a goniometer which is more commonly used by medical doctors.
We do not want to be so precise in this study because we would be able to infer things from such precise measurements for the number of beads of each type we do have currently in our sample.

Line 311: The word “stigmata” should be “microwear.” Please see Richard Yerkes important publications involving microwear. Done

Line 359: Use of river cane, which is widely available, serves well as a shaft to hold a drill bit in North America. See Kozuch 2022. Species name is *Arundinaria gigantea*. This species may not have existed in the Caribbean, so I suggest *Guadua amplexifolia* which is native to the neotropics.
https://en.wikipedia.org/wiki/Guadua#Distribution_and_habitats
Also, people may have obtained bamboo or river cane by barter or travel, but I really like the cactus spine option.
We thank the reviewer for this suggestion. While probably many plants may have been used to produce a straight and rigid shaft to hold drill bits, it would still necessitate to have an efficient drill bit. We tried other hard vegetal parts as drill bits, and they were not efficient, but of course we did not try all possible materials. Using a vegetal for the shaft and another one for the drill bit when a single material is efficient as a long drill bit makes it more likely than a composite (and probably fragile) system.

Line 363: Again, a simple vise made of two pieces of wood held together at the ends with string would be sufficient. See above
We added this precision, the text now reads: “Then, the bead holding system remains to be determined even if it can be as simple as two pieces of wood held together with strings at both ends, especially concerning its position in relation to the person who drills.”

Review by Anonymous Reviewer

The paper presents the innovative study of the drilling technique applied to perforate hard stone (amethyst and rock crystal) beads from six sites in the Lesser Antilles. The research complements general archaeological observations with detailed data obtained from rigorous experimental replication studies. For this reason, the paper is not only interesting from a regional perspective but also offers important methodological insights.

Although the study is detailed and rigorous, the manuscript has some minor issues that need to be addressed before it is accepted for publication.

First, I recommend that the authors submit the text to a native English speaker for linguistic review. I reviewed most issues in the first pages but highlighted only the major mistakes and wrong technical terms in the following pages.

We thank the reviewer for his strong input in the edition of our English language: very much appreciated. We think that following these advice and the others from other reviewers and one of the recommenders, the minor language issues that probably remain in the new version are not prohibitive. One has to keep in mind the additional work that writing a paper in English is for non-native researchers, and that the global research effort must take this into account (e.g. Hanauer et al., 2019; Pérez Ortega, 2020; Ramírez-Castañeda, 2020). Clearly the reviewer had this in mind, providing us with many useful suggestion, thank you again.

Second, I recommend the authors include a short description of the sites and a map indicating their location. The studied artefacts, in fact, are completely deprived of any contextual information, which is important for the readers, either specialists in Caribbean archaeology or interested in bead and technological studies.

Given the already high number of figures in the article and the fact that these beads have been mostly already published by our same group of authors, recently, and in open access, we did not think it was necessary to add such a map and site description and only cited these works. We followed the reviewer's advice and added a map as Figure 1, and a precision about the fact that all sites are from the Early Ceramic Age in the Caribbean, and that the beads come from midden deposits and burials. But we think that this article does not need a description of each site, most of them being already described recently in the cited papers.

That said, the abstract is concise and presents the study's state-of-the-art, primary datasets, and results. The introduction explains the motivation for the study, describing relevant recent and past research performed in the field, the main research questions, and the hypotheses to be validated. The description of the materials and methods at the basis of the research is comprehensive and detailed, allowing other scholars to replicate the study and/or apply the same method to their materials. I only recommend the authors elaborate more on the X-ray microtomography, an innovative component of the paper.

We added some more description of the 3D model so that one can see the benefits of this work. We plan to work on the 3D model to extract the diameter of the perforation, its circularity etc. in the future, but did not integrate this in this first article.

Results are solid and well described, with only a few minor issues I indicated in the PDF attached to this general review. The tables and figures are clear. I only recommend a few minor improvements, also indicated in the PDF.

All references are cited in the final bibliography. I only noticed a few issues, also I indicated in the PDF. In general, they are updated and allow going back to the information sources at the basis of the paper, both historical and methodological. In some methodological parts, however, there are several repetitions of the same list of papers, which could likely be selected with more attention to the specific topic they

have to represent. However, this is a very minor issue. In other cases, archaeological case studies are indicated to represent ethnographic research instead. This issue must be corrected. Also for these cases, the authors can see my comments in the annotated PDF.

All considered, the paper can be accepted for publication after these minor issues have been addressed and solved, either corrected or disputed by the authors, with recommendations for a linguistic review and sites description.

We thank the reviewer for his thorough review and all the precious advice he gave us in the pdf, which we followed.

Hanauer, D.I., Sheridan, C.L., Englander, K., 2019. Linguistic Injustice in the Writing of Research Articles in English as a Second Language: Data From Taiwanese and Mexican Researchers. Written Communication 36, 136–154. https://doi.org/10.1177/0741088318804821
Pérez Ortega, R., 2020. Science's English dominance hinders diversity—but the community can work toward change. Science | AAAS.
Ramírez-Castañeda, V., 2020. Disadvantages in preparing and publishing scientific papers caused by the dominance of the English language in science: The case of Colombian researchers in biological sciences. PLOS ONE 15, e0238372. https://doi.org/10.1371/journal.pone.0238372

Review by Stefano Viola

General remarks

The article describes a very well structured and applied research in a geographical area that is practically devoid of techno-functional studies on ornamental elements. To my knowledge, techno-functional studies of Central and South American parures are very few and recent (the last 20 years), although they do lead to the knowledge of exceptional cultural contexts. I find this contribution extremely brilliant for several reasons:

- The research question is original.
- The methodology is well described and well applied,
- The iconographic apparatus is definitely beautiful and very evocative.
- The analytical techniques used are very effective and powerful.

The research group not only presents very beautiful and extremely well-documented material (I stress that all the figures are very beautiful, well-focused and in high definition), but also uses a set of observation and analysis techniques (optical, electron and 'replication techniques' with elastomers and digital) that is heterogeneous, complementary and well coordinated in the different levels of study (low and high power approach). This is not insignificant, as the *parure* is often not studied so comprehensively from a methodological point of view.

The depth of the regional scientific project should also be emphasised. This contribution follows on from previous works that deal with both the issues of raw materials (by through archaeometric analysis) and aspects of the contexts and manufacture of the objects. In clear continuation of these is the main topic of the present work: the understanding, no longer of general manufacturing sequences, but of a more specific aspect related to the perforation of hard stone beads.

For prehistoric times (better said in societies without writing), the use of organic materials in everyday life is a known fact, but these are 'visible' objects. The present work deals with something that is invisible, or almost invisible, to archaeological investigation. Convincingly demonstrating the use of such ephemeral tools is uncommon and, in my opinion, the strength of the contribution lies in the methodology followed: rigorous in its analysis as in its experimental section.

One of the shortcomings of this field of study is that it is very differentiated according to the individual researchers (different terminology and conventions, documentation and analytical techniques that are not always easy to compare, few databases for comparison of technological and functional aspects, etc.). The present contribution seems to me to be a decisive step towards the explication of a research programme that has as its focus the study of ancient ornaments in their multiple cultural aspects.

The other comments are listed below and represent some minor issues (suggestions) that may be considered at the time of publication of this document. The article is brilliant and very interesting. The sole purpose of my comments is to improve it (if some of my comments are not adequate, do not hesitate to explain it).

In the end, I have to say that I would have described some aspects very differently, but I don't think it is right to get into matters of personal style even when they concern more technical and operational aspects. The different contributions must be written to represent the logical-scientific choices and styles of each particular research group.The reviews in which I have been involved have always tried to make me write the paper in the style of the reviewers and according to their technical convictions, thus deeply affecting my final message. By trying to communicate within a unified methodological framework shared by colleagues, the reader should be able to read your specific approach to the study of *parure*.

If requested in the future, I remain at the authors' disposal for any requests or suggestions.

We sincerely thank Stefano Viola for this very kind words about our research. We also want to thank him to let us write our paper the way we want, since we also think that more diversity in the writing, the approaches and the style is welcome in scientific literature.

Title

It seems to me a good title because it describes the content exactly and localizes well the space and chronological period of the research topic. Perhaps I would add a final sentence such as: *...through a technological and experimental approach* (or something similar), to be clear about the method of analysis to readers

We added the words “Technological” and “experimental” in the title, so that this information is integrated in the title, without making it too long.

Abstract (L10)

The abstract is synoptic and comprehensive. It precisely addresses all the different themes found in the work and suggests, without affecting the reader`s curiosity, the interesting final results.

Thank you for this comment.

Introduction (L11-81)

It seems clear to me and summarizes the issue well. In particular, we understand the knowledge gap, especially in drilling techniques, and therefore the originality of the contribution.

L.22-23. I feel that the "value" of technological analysis is somewhat minimized and is reduced to more practical than cultural characters. I feel I can say that technical gestures (and finished products) incorporate and materialize symbolic-cultural aspects. Technology is such a basic aspect of a society's daily life that it is not just the totality of the various stages in the life of objects (acquisition of raw material, production, use and/or exchange) but a tangible manifestation of the construction and dissemination of certain constituent elements of society, in a view that considers the creation and transformation of technologies within social contexts as a true social phenomenon (eg. see: Dobres 2010, Archaeologies of technology). In particular, technical choices regarding drilling may have a strong cultural significance that may reflect an evolution over time or a mechanism of individualization among groups (Granger, Lévêque 1997, *Parure castelperronienne et aurignacienne: étude de trois séries inédites de dents percées et comparaisons*).

L24-. 41. Not being a native English speaker myself, I do not comment on the writing of the text (grammar, spelling, etc.) and the chrono-cultural aspects of the Antilles region. My personal impression is that the text is well written as well as the 'archaeological' synthesis is clear, effective and precise.

NOTE 1. I completely agree with the approach that sees the chemical-physical characteristics of the worked material as the real discriminator for technological analysis (and not secondary qualitative characteristics such as colour, which are more important for cultural and typological interpretation).

L54. I would better specify that it is a lithic point fragment (Cody 1991, p. 595, fig. 5??).

We modified the sentence, which now reads: “A fragment of a lithic point interpreted as a drill of less than a centimeter associated with a broken amethyst bead was found in Pearls (Grenada) and is very briefly described (Cody, 1991)”.

L63. Cody 1990 is wrong citation, not present in bibliography.

Corrected

Personal suggestion: in the future test the possible use of coral drill bits in drilling activities because I have the impression that perhaps for speeding up certain drilling stages or for not very long drillings they could be a good auxiliary tool. *“In addition to stone, coral material was also collected to be used as tools (table 4.5). Among the collected pieces, a small portion displayed evidence of use-wear, predominantly in the form of abraded areas present on restricted parts of the often fragmented items. Identified species exhibiting such use-wear are in the majority Acropora palmata, Acropora cervicornis, and Porites sp. In addition, only a single Montastrea annularis artefact was identified. The cylinder-shaped branches with a slightly pointed top of the Acropora cerviconis coral almost all display parts with abraded areas completely surrounding the branch, suggesting that the tools were used as drilling devices. Rare pieces, however, exhibit abraded surfaces on one side only, suggesting use as an active abrading tool, e.g. a rasp (see also Steenvoorden 1992)”* (after Knippenberg S. 2006, *Stone artefact production and exchange among the northern Lesser Antilles*, pp. 135-136; 142).

We thank the reviewer for this suggestion. Despite knowing quite well the work of S. Knippenberg, this sentence was unknown to us so far. Coral could be a potential material for drilling but it seems quite clear that it could not be resistant and thin enough to be used as drill bit to produce long and fine perforations. It could indeed be used, with an abrasive, as drill bit for shell perforation, or short perforations in rocks.

Material and Methods (82-160)

L90. the crystal flakes are 6 (in the table) but 5 in the text.

Table 1 does not contain the number of flakes, only the finished beads (broken or not) and the blanks (not finished but clearly future beads).

L93, fig. 1. Very beautiful and very successful table. Very successful HD photo assemblages, the typological, technological details and the characteristics of the raw materials are clearly visible. Perhaps in the case of the finds with a through-hole (e.g. GD-01-016 and GD-01014) the shape of the perforations could be indicated in some way. I also find the schematic drawings of the pieces very well done, but they have some slight inaccuracies (GD-05-002, GD-05-001) and do not correspond perfectly with the photos of the originals. I suggest making explicit somewhere the graphic conventions followed (e.g. fracture, abrasions, etc.) in order to try to disseminate a uniform methodology for representing the *parure/jewellery*, which, at present, is still a very differentiated field of investigation according to the styles and personal choices of the researchers.
L94, fig. 2. As in fig. 1. Some slight inaccuracies in the schematic drawings (GD-02-012, GD-02-034, GD-02-035) that do not correspond perfectly with the photos of the originals. In particular for GD-02-035, the schematic graphical representation of the upper face does not seem to give the same information as on the photo. In my opinion, there is a chamfer/bevel missing along the left edge and a chip towards the top edge.
L95, fig. 3. As in fig. 1.
L96, fig. 4. As in fig. 1.
We thank the reviewer for looking in detail at these figures and for his suggestion. We think that the slight discrepancies between the drawing and the photos is due to the parallaxe modification of the photo compared with the drawing that has been made based on flatbed scanner images. We do think these very minor differences do not hamper the interest of the drawings compared with the photos, and we wanted to published the high quality photos instead of the flatbed scanner images.

L99. I suggest indicating the type of elastomer used and with which technique it was used (I assume with a dispenser gun). Done

L114. Somewhere in the methodology I suggest you put the bibliographic reference for the descriptive criteria of the perforations: e.g. regular contour, sub-regular etc. (e.g. see Hoareau, Beyries 2022, *Insight into use-wear development on shell beads.* p.118, fig. 3; Bonnardin 2009, *La parure funéraire au Néolithique ancien dans les Bassins parisien et rhénan*). We did not use any standardized description protocol,

L108. For X-ray microtomography, I think it is worth mentioning the very few studies in the field of *parure* that are applying this set of techniques (eg: Yang et al 2011, *A new 3D information acquisition method of micro-drilling marks on ancient perforated stone bead through micro-CT*)
We thank the reviewer for pointing us at this article, which we not know. We added a sentence in the X-Ray microtomography method section: “It has already been used, albeit rarely, for studies of archaeological beads (Falci et al., 2020; Yang et al., 2011)”.

117. I apologise but do not know the cultural context so I have a question; can you rule out the use of the pump drill? on hard stones, the weight of the flywheel stabilises the drilling operation well (eg.: Groman-Yaroslavski, Bar-Yosef Mayer 2015*, Lapidary technology revealed by functional analysis of carnelian beads from the early Neolithic site of Nahal Hemar Cave, southern Levant*). Rotation speed is also an important factor, particularly when machining hard stone (of course I agree with the arc drill experiment). In certain objects (eg.: GD-02-034, GD-02-035), the morphology of the margins of the hole appears quite circular. This may suggest a fairly low rotation speed even if the perforated thickness is significant.
Fast reciprocating motion (arc drill) produces an ovalised drill cone (Ricou, Esnard 2000, *Utilisation des galets ouvragés du site de Ponzhezières à Saint-Georgesd'Oleron (Charente-Maritime)*). The same opinion is held by J. A. Gwinnett and L. Gorelick, who believe that during the use of an arc drill, even the mere vibration of the rod without the axis moving produces a hole that is wider at the top, conical and slightly oval (Gwinnett, Gorelick 1990, *Rounded traingles in flavian coiffures reconsidered*) - L263, also for this quotation I consider your statement to be correct. It should be noted, however, that any drill used non-vertically tends to produce ovalised contours (Bessac 1986, *L'outillage traditionnel du tailleur de pierre. De l'Antiquité à nos jours*).

This is a very interesting point. We must admit that the type of drill, bow or pump, was not our main interest in this work. We modified the text so that it know reads: "One of the most effective systems for our experiments is the bow drill (Figure 6), which we used. Other mechanical drills can be effective, like the pump drill, but we did not test it."

L124, fig. 5. The locking system is certainly effective, but it is not compatible with antique systems. I criticise it not because it is modern (in many cases certain variables are irrelevant) but for two reasons: if you clamp the pieces in the manner illustrated, you tension the piece in a way that is completely different from any hypothetical locking system (I imagine you have encountered a fair amount of fracturing). Furthermore, a very interesting phase is when the drill pierces the last diaphragm on the opposite side (critical phase). For this reason, there are various systems to avoid fracturing the worked object. For example: in thin objects, bipolar drilling (SM-02-087) is still applied; or the artefact is placed on a soft surface (wood) to support the face under the tension of vertical and roundabout forces (maybe in SM-02-091).
Regarding the drill rod, in the future, I suggest you select and possibly straighten (with steam) the wooden support better. A very relevant diagnostic feature to distinguish the different types of motion (and therefore mechanism) is the degree of ovalisation of the hole as it is related to the speed of drilling. Now, a shaft that is not perfectly vertical (but also an imprecise blocking of the stone drill) can deform the hole and make interpretation more difficult.
This is very interesting but, truly, the scope of this experimental drilling was not to test every possible variable. As also pointed out by another reviewer, we could have mentioned some plausible locking systems but we tried to keep the number of variables quite low so that we can try multiple abrasives and drill bits. It would be very interesting in the future to replicate the process (more than 200 hours!) with a more archaeologically plausible system, that is for sure.

L130.The lubricant issue is more complex but extremely elusive. Lubricants can be various (water, oil, grease, etc.) and are the most ephemeral aspect of the whole manufacturing sequence as their traces are almost impossible to find archaeologically. By their nature, they are generally liquid substances, forming a thin layer between the tool and the worked material. The subject is closely interconnected with the theme of abrasives and perforation to reduce the friction and wear of the instrument. In the interests of your contribution, I would not change what you have written as it would take you too far off topic.
Sure the lubricant is another topic that would be so interesting to work on, the literature is probably gigantic in the tribology journals.

L133. Personally, I would add pressure force.
To make the sentence clearer, we added "of the drilled material", and now the sentence reads: "From a mechanical point of view, the volume loss of the future bead, per unit length, during a perforation, depends on three main physical factors of the drilled material: toughness (ability of a material to resist fracturing), hardness (resistance of a sample surface to penetration) and abrasion resistance (Sela and Roux, 2000)".

L137. I would add an example that is morphologically consistent, the perforators created with burin spall. For example, at the Italian site of Benefizio, Structure 11 - archaeological example, dating from the Middle Neolithic, a production site for steatite ornaments. The drill tips are made from elongated flakes, lamellae or on *coup de burin*. Drilling was probably carried out with the use of bow or pump drills (Mazzieri et al. . 2007, *Parma-Benefizio, struttura 11: remains of a workshop for the production of steatite necklace ornaments from the Middle Neolithic*).
In the micro-point version, something similar can be found (points with a quadrangular or polygonal cross-section) in North America and used on semi-hard and hard stone (eg. Cahokia, USA, Mississipian period, Linder, Folb 1998, *Lopuch 3 and microdrills: site report and use-wear analysis*).
L139. I also suggest sea urchin spines. In general, provide a minimum of bibliographic comparison to motivate your choice. The concept is that we cannot test indefinitely and, therefore, experimental tests should be carried out as far as possible in a manner compatible with the local archaeological and cultural record.
Surely other materials could have been tried, but we couldn't try everything and, for sure, we did not think about sea urchin spines.

L147-160. I find the experiments carried out, in a very controlled style, are interesting and well explained (which allows comparison between colleagues). Thank you

Results (161-190)

L167-175. The sequence of manufacture is clear and well summarised. I suggest inserting some reference (even if only photographic) to justify the statements. That is to say, what technical character suggests to you that perforations always occur after the *mise en forme*?
You deal with several morphological types together (in theory for each type the sequence should be described), so it seems to me that your intention is to give a general theoretical sequence. If that is the case, that is fine, but I would still add some details that refer to the specifics of some finds in your local corpus. In alternative even just refer to your older work (e.g. Queffelec, et al. 2018, p. 279, fig. 8; Queffelec, et al. 2020, p. 32).
Surely the goal here was to give a general view of the *chaîne opératoire*, since the article clearly focuses on the drilling technique. We added a sentence at the end of this paragraph: "More precise description and drawings can be found in previous works (Queffelec et al., 2018, Queffelec et al., 2020)."

L193-217. I would put in one or two lines a minimum of comparison between the two analytical techniques (X-ray and SEM associated with elastomers).
We added some lines about the comparison at the end of the section about observations of archaeological perforations. Clearly the 3D models could be analyzed with more details, using the strength of 3D, but at this moment this was more a proof of concept than a 3D study.

L214. I would also put a reference to the photograph of the face of the object illustrated in Fig. 1. If you look at the morphology of the edge of the hole, you can see a small asymmetry typical of the use.
At line 214 the description concerns the figure 12, in which we can see SEM images of casts from beads from the Hope Estate site, which is photographed in figure 3. We are not sure to see any asymmetry of the edge of the hole of beads SM-02-077 and SM-02-080 in the figure 3. Given this potential error, we decided not to add any sentence here.

L222. Figure 11. Another indicator of use (or light reaming!) could be the isolated, long, narrow stripes running along the axis of perforation seen in the upper right image.
We agree with the reviewer, the sentence now reads: "The resulting smooth surfaces are also visible on the casts of GD-01-003 (Figure 11, C) and MA-02-033 (Figure 12), as well as a long stripe on MA-02-033 cast (Figure 12)".

L234. there are 10 perforation axes. It may be useful to know that with the pump drill it is easier to continue working even when changing the drilling angle (this is a characteristic of the pump drill). Obviously, the result is a change in the hole with at least half of the margin becoming elongated (i.e. half oval).
(SM-02-077) Perhaps a slight inclination can also be seen by looking at the margins of the hole (Fig. 3, top face). The outline (there are two non-concentric half-arcs) is quite asymmetrical and ovalised in the lower left quadrant.
We modified the caption of Figure 13 with "axes" instead of "angles".

L237-241- For the sake of completeness at least a bibliographical citation could perhaps fit.
This sentence being in the Results part of the manuscript, we think it does not necessitate a reference, since we describe our own results.

L242-246. I appreciate the comparison test, but it must be said that even the characteristics of the striations on the hole walls do not correspond to the use of a lithic point (they are very fine and thin). I find the image showing the fragmentation pattern of lithic tips with an elongated active part interesting. They are a first criterion for the functional recognition of the object.
L261. is the abrasive powder amethyst or quartz? In figure 16 it is written quartz and seems more correct to me. Perhaps recheck lines 257-263 for more correspondence with the legend in Figure 16.
It is quartz indeed, on a mineralogical point of view, even if it is crushed amethysts that we used as abrasive. But amethyst is just purple quartz. We modified the main text to change "amethyst" by "quartz", and kept the caption of figure 16 unchanged.

Discussion (291-377)

L331-333. From an experimental point of view, your statement is very significant. I think you are right when you point out that your test does not have a high degree of compatibility with antique procedures (industrial vice). I think that to be more sure of the statement you should also determine the type of abrasive used in antiquity and test only with that (See the work of Emiliano Melgar, eg. Melgar Tisoc, Solis Ciriaco 2009, *Caracterización de huellas de manufactura en objetos lapidarios de obsidiana del Templo Mayor de Tenochtitlan*). Different abrasive sands have very different wear resistance and this greatly influences the way the drill bits advance.

Another aspect, which ties in with the system and the difficulties of blocking, concerns the succession of steps in the *chaine operatoire*. That is, it is one thing if you finish the shaping and then drill, it is another if you drill a pebble and then perform the shaping. Or you produce a thick plate, drill and then perform the shaping. The 3 different sequences have very different difficulties and locking systems and can greatly affect the regularity of the drilling. If you drill a small plate (or a short discoidal, or a cylindrical one), maintaining the same angle of incidence is very easy, but if you drill a spheroidal bead it changes a lot.

Thank you for these comments, many more experiments would be useful, for sure, but as we stated, the time used to make a single perforation of 10 mm prevent us from testing many more protocols.

Parallel to your hypothesis of the reuse of the amethyst, as pure methodological speculation, it could indicate that semi-processed artefacts arrived at the site but had already been shaped.

I would remind you that drilling is the most risky moment of the whole process. Thus, often in thin discoid beads or cylindrical beads the perforation occurs early, while in pendants or thick discoid beads it is postponed.

Finally, in the specifics of parures, the mobility of raw materials and their circulation system is much studied and may hold surprises touching the symbolic and 'value' sphere (I point out as a recent example: Ahola et al 2022, *Materialising the social Relationships of Hunther-Gathers*).

L356. the subject of reuse is very interesting and vast. Little investigated but there are studies on the subject. I suggest you cite at least one bibliographic source. Your work is really good but written like this it seems you have shed light on a lot of issues which is not always true (my personal impression). For example, reuse in ornament production has been dealt with by others before (e.g. Gazzola 2007, *La produccion de cuentas en piedras verdes en los talleres lapidarios de La Ventilla, Teotihuacan*; Vidale, Shar 1990, *Zahr-Muhra: soapstone-cutting in contemporary Baluchistan and Sind*).

We thank the review for pointing us to these interesting references. We added at the end of the paragraph these two sentences: “This possibility to crush rock to use it as abrasive has been already evidenced (Gazzola, 2007). It adds to other potential uses of these wastes, which can make it disappear from the archaeological record, as homeopathic powder for example, as demonstrated in other context (Vidale and Shar, 1990).”

Conclusion (378-406)

I find that the conclusions are very clear.

References

See L63