PROCESSING *UNIO* SP. VALVES FOR ADORNMENTS AT THE GUMELNIȚA COMMUNITIES (MILL. V BC): ARCHAEOLOGICAL AND EXPERIMENTAL DATA

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Introduction

The importance of aquatic resources as a food source for Chalcolithic communities located in the proximity of major waterways has been documented in specialised studies.[1] These resources appear to have had a nutritional as well as a technological and social significance. Communities in southern Romania exploited freshwater bivalves of the *Unio* species for food and their valves for the manufacture of ornaments and tools.

At the Gumelnița tell settlements north of the Danube (fig. 1), such ornaments, in various stages of processing, were discovered in different occupational contexts (table 1, fig. 2). The analysis of publications regarding contemporary sites south of the Danube did not provide us with information on the technological use of *Unio* valves and thus, we are unable to make comparisons of raw materials, technological transformation, and use-wear between the two geographical areas.

In the present study we analyse a particular category of ornaments – circular beads found in the Gumelnița tell settlements – in order to reconstruct the technological process of valve transformation as well as the methods used for attaching beads. The recovered pieces were in different stages of processing and use, from splinters detached from the valve to finished items with an advanced degree of use-wear. This suggests that the processing was done in the settlements, and that the objects were subsequently used for adornment by community members. In addition, stocks of finished circular beads without traces of use-wear were found, suggesting careful management, allowing for the replacement of damaged or lost beads, if necessary. The selection of *Unio* sp. for this purpose was

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[1] Adrian Bălăşescu, Valentin Radu, and Dragoş Moise, *Omul şi mediul animal între mileniile VII-IV î.e.n. la Dunărea de Jos* [The Man and the Animal Environment Between the 7th and 4th Millennia BC on the Lower Danube] (Târgoviște: Editura Cetatea de Scaun, 2005); Stéphanie Bréhard et al., "Food Supply Strategies in the Romanian Eneolithic: Sheep/Goat Husbandry and Fishing Activities from Hârşova Tell and Borduşani-Popină (5th Millennium BC)," *EJA* 17, no. 3 (2014): 407-433; Valentin Radu et al., "Harvesting Molluscs in the Eneolithic: A Study of Freshwater Bivalve Accumulations from the Tell Settlements of Borduşani-Popină and Hârşova (Romania, 5th Millennium BC)," *Environ. Archaeol.* 21, no. 4 (2016): 334-350.

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https://doi.org/10.29302/auash.2020.25.1.2.

not random; these communities had quick access to this source of raw materials. As demonstrated by a series of isotopic analyses, freshwater mussels were collected near the site.[2]

Chrono-cultural framework

The Chalcolithic communities of the Kodjadermen-Gumelnița-Karanovo VI cultural complex expanded over a large geographical area in Southeast Europe (from the Carpathian Mountains to the Aegean Sea) during the period between 4600/4500 and 3900 cal BC.[3] This expansion has been documented at various tell settlements. Numerous radiometric data have been published:[4] at Hârșova, radiocarbon dates indicate an interval of 4686-4486 cal BC,[5] at Borduşani-Popină 4490-4263 cal BC,[6] at Căscioarele 4450-4264 cal BC,[7] at Sultana-Malu Roşu 4539-4365 cal BC and 4174-3961 cal BC,[8] at Gumelnița 4331-4060 cal BC,[9] and at Vitănești, 4354-4231 cal BC.[10] Funerary activity has been documented as well, with radiocarbon dates published for Sultana-Malu Roşu (4614-4406 cal BC),[11] Vărăști (4451-4331 cal BC[12]) and Gumelnița (4535-4513 cal BC and 4181-4179 cal

[2] Jorune Sakalauskaite et al., "'Palaeoshellomics' Reveals the Use of Freshwater Mother-of-Pearl in Prehistory," *eLife* 8 (2019): e45644, https://doi.org/10.7554/eLife.45644; Karina Apolinarska and Aldona Kurzawska, "Can Stable Isotopes of Carbon and Oxygen be Used to Determine the Origin of Freshwater Shells Used in Neolithic Ornaments from Central Europe?," *Archaeol Anthropol Sci* 12 (2020), https://doi.org/10.1007/s12520-019-00978-2.

[3] Cătălin Lazăr, Monica Mărgărit, and Valentin Radu, "Between Dominant Ideologies and Techno-economical Constraints: *Spondylus* Ornaments from the Balkans in the 5th Millennium BC," in *Interchange in Pre- and Protohistory. Case Studies in Iberia, Romania, Turkey and Israel*, eds. Ana Rosa Cruz and Juan Francisco Gibaja (Oxford: BAR International Series 2891, 2018), 5-21.

[4] See also Cătălin Bem, "Noi propuneri pentru o schiță cronologică a eneoliticului românesc" [New Proposals for a Chronological Sketch of the Romanian Eneolithic], *Pontica* 33-34 (2001): 25-121; Stéphanie Bréhard and Adrian Bălășescu, "What's Behind the Tell Phenomenon?," *JAS* 39, no. 10 (2012): 3167-3183; Agathe Reingruber, "Absolute and Relative Chronologies in the Lower Danube Area During the 5th Millennium BC," in *Neolithic and Copper Age between the Carpathians and the Aegean Sea Chronologies and Technologies from the 6th to the 4th Millennium BCE*, eds. Svend Hansen et al. (Bonn: Habelt-Verlag, 2015), 301-324.

[5] Monica Mărgărit, Valentin Radu, and Dragomir Popovici, "From Operculum to Bead: Production of Pearls from Opercular Bones of *Cyprinus carpio* in the Romanian Eneolithic," *Environ. Archaeol.* 21, no. 4 (2016): 351-360.

[6] Rosalind Gillis et al., "Sophisticated Cattle Dairy Husbandry at Borduşani-Popina (Romania, Fifth Millennium BC): The Evidence from Complementary Analysis of Mortality Profiles and Stable Isotopes," *World Archaeol.* 45 (2013): 447-472.

[7] Lazăr, Mărgărit, and Radu, "Between Dominant Ideologies and Techno-economical Constraints."

[8] Cătălin Lazăr, Monica Mărgărit, and Adrian Bălășescu, "Dogs, Jaws, and Other Stories: Two Symbolic Objects Made of Dog Mandibles from Southeastern Europe," *JFA* 41, no. 1 (2016): 101-117.

[9] Cătălin Lazăr et al., "Gumelnița: Research Results of the 2018 and 2019 Fieldwork Seasons," *RCAN* VI (2020): 13-100.

[10] Arne Ludwig et al., "Coat Color Variation at the Beginning of Horse Domestication," *Science* 324, no. 5926 (2009): 485; Bréhard and Bălășescu, "What's Behind the Tell Phenomenon?"

[11] Lazăr, Mărgărit, and Radu, "Between Dominant Ideologies and Techno-economical Constraints."

[12] Ibid.

BC[13]).

This cultural complex is characterised by the emergence of tell settlements, sometimes surrounded by defensive structures, with dwellings arranged in parallel rows,[14] as well as by changes in the meat component of the diet,[15] funerary inventories that appear to reflect social hierarchies,[16] the use of copper as a raw material,[17] and lithic production characterised by long flint blades.[18]

Table 1. Northern Danube Gumelnița sites with cylindrical beads made of *Unio* sp. valve

No.	Site	Waste	Blank	Preform	Finished pieces	Total number of pieces
1	Borduşani-Popină[19]	-	-	1	2	3

[13] Lazăr et al., "Gumelnița: research results of the 2018 and 2019 fieldwork seasons."

[14] Mircea Petrescu-Dîmbovița, "Eneoliticul dezvoltat" [The Middle Eneolithic], in *Istoria românilor* [The History of the Romanians], vol. I. *Moştenirea timpurilor îndepărtate* [The Legacy of distant Times], eds. Mircea Petrescu-Dîmbovița and Alexandru Vulpe (Bucharest: Editura Enciclopedică, 2001), 154-168; Cornelia Magda Lazarovici and Gheorghe Lazarovici, *Arhitectura neoliticului şi epocii cuprului din România* [The Architecture of the Neolithic and of the Copper Age in Romania], vol. 2 [Bibliotheca Archaeologica Moldaviae 6] (Iași: Trinitas, 2007); Dragomir Popovici, "Copper Age Traditions North of the Danube River," in *The Lost World of Old Europe. The Danube Valley, 5000-3500 BC.*, eds. David W Anthony and Jennifer Y Chi (New York: Princeton University Press, 2010), 112-127; Cristian Eduard Ștefan, *Settlement Types and Enclosure in the Gumelnița Culture* (Târgoviște: Editura Cetatea de Scaun, 2010).

[15] Bréhard and Bălăşescu, "What's Behind the Tell Phenomenon?."

[16] John Chapman, J., "Social Inequality on Bulgarian Tells and the Varna Problem," in *The Social Archaeology of Houses*, ed. Ross Samson (Edinburgh: Edinburgh University Press, 1990), 49-92; Vladimir Slavchev, "The Varna Eneolithic Cemetery in the Context of the Late Copper Age in the East Balkans," in *The Lost World of Old Europe*, 193-210; Arne Windler, Rainer Thiele, and Johannes Müller, "Increasing Inequality in Chalcolithic Southeast Europe: The Case of Durankulak," *JAS* 40, no. 1 (2013): 204-210.

[17] Alasdair Whittle, *Europe in the Neolithic. The Creation of New Worlds* (Cambridge: Cambridge University Press, 1996); Julian Thomas, *Understanding the Neolithic* (London: Routledge, 1999); Douglass Bailey, *Balkan Prehistory: Exclusion, Incorporation and Identity* (London: Routledge, 2000).

[18] Laurence Manolakakis, "La production de l'outillage lithique dans les sociétés hiérarchisées de l'Enéolithique en Bulgarie: évolution, traditions culturelles et spécialisation du travail," (PhD diss., Panthéon-Sorbonne University, 1994); Idem, "So Long Blades… : Materiality and Symbolism in the North-Eastern Balkan Copper Age," in *European Archaeology. Identities & Migrations. Hommages à Jean-Paul Demoule*, eds. Laurence Manolakakis, Nathan Schlanger and Anick Coudart (Leiden: Sidestone Press, 2017), 265-285.

[19] Monica Mărgărit and Valentin Radu, "The Use of Autochthonous Aquatic Resources in the Technologies of Gumelnița Communities/Utilizarea resurselor acvatice autohtone în tehnologiile comunităților Gumelnița," in *An Overview of the Exploitation of Hard Animal Materials During the Neolithic and Chalcolithic/ O privire asupra exploatării materiilor dure animale de-a lungul*

2	Căscioarele-Ostrovel[20]	4	-	-	39	43
3	Gumelnița[21]	-	-	1	4	5
4	Hârșova[22]	-	-	11	7	21
5	Luncavița[23]	?	?	?	-	?
6	Măriuța[24]				1	1
7	Pietrele[25]	-	1	-	c. 100	c. 100
8	Sultana – Malu Roșu[26]	-	-	1	7	8
9	Vidra[27]	-	-	-	37	37
10	Vitănești[28]		-	2	-	2

Raw material

Unio is a freshwater mussel whose body is protected by two valves with an elliptical morphology, similar in shape and size (fig. 3 top). Two shell structure types – nacreous and prismatic – are present in Unionids; they have a dark greenish-brown periostracum.[29] The prismatic layer is thin and is usually abraded or dissolved in the umbonal region. The surface of the section of each prism has a scaly appearance, due to the outcropping of many thin membranes of intracrystalline organic matrix within each prism. Nacre forms the innermost

neoliticului și calcoliticului, eds. Monica Mărgărit, Gaelle Le Dosseur, and Aline Averbouh (Târgoviște: Editura Cetatea de Scaun, 2014), 221-240.

[20] Eugen Comșa, "Parures néolithiques en coquillages marins découverts en territoire roumain," *Dacia* N.S. 17(1973): 61-76; Monica Mărgărit, "Personal Adornments in the Romanian Eneolithic: Local *versus* Exotic Raw Materials," *Quat. Int* 539(2020): 49-61.

[21] Vladimir Dumitrescu, "Découvertes de Gumelnița," *Dacia* I (1924): 325-342; Idem, "Fouilles de Gumelnița," *Dacia* II (1925): 29-103; Lazăr et al., "Gumelnița: Research Results of the 2018 and 2019 Fieldwork Seasons," 13-100.

[22] Monica Mărgărit and Dragomir Popovici, "From Block to Finished Object. Function of the Personal Ornaments in the Eneolithic Settlement from Hârșova-Tell (Constanța County, Romania)," *AAC* XLVII (2012): 91-114.

[23] Bălăşescu, Radu, and Moise, *Omul şi mediul animal între mileniile VII-IV î.e.n.*

[24] Monica Mărgărit, Valentin Parnic and Adrian Bălășescu, "L'industrie en matières dures animales de l'habitat Gumelnița de Măriuța (département de Călăraşi)," *Dacia* N.S. LVIII (2014): 29-64.

[25] Dumitru Berciu, "Cercetări și descoperiri arheologice în regiunea București" [Archaeological Research and Discoveries in the Bucharest Region], *MCA* II (1956): 491-562; Monica Mărgărit and Meda Toderaș, "Industria materiilor dure animale din tell-ul gumelnițean de la Pietrele. Reevaluarea vechilor colecții arheologice" [The Industry of Animal Hard Materials from the Gumelnița Tell from Pietrele. The Reassessment of Old Archeological Collections], *MCA* XV (2019): 61-80.

[26] Lazăr, Mărgărit, and Radu, "Between Dominant Ideologies and Techno-economical Constraints."

[27] Monica Mărgărit and Camelia-Mirela Vintilă, "Podoabe și figurine confecționate din materii dure animale descoperite în așezarea eneolitică de la Vidra (jud. Ilfov)," *SPre* 15 (2018): 73-105.

[28] Mărgărit and Radu, "The Use of Autochthonous Aquatic Resources."

[29] Lucian Pârvulescu, *Sistemica și biologia nevertebratelor acelomate. Ghid practic* [Systematics and Biology of the Acoelomate Invertebrates. Practical guide] (Cluj-Napoca: Editura Bioflux, 2010).

shell layer. The tablets building up the sheet nacre in this layer have irregular or rounded outlines and are frequently arranged into rosette-like patterns.[30] These valves have a hard structure[31] that makes them difficult to process, but that provides durability to ornaments.

Collecting *Unio* bivalves could be a daily activity during the summer, the quantities available depending on various factors. Because these bivalves have certain ecological requirements (substrate, turbidity and speed of water circulation), they are not present in all water basins. The connection with a main arm or a river and the water level influence their density. High densities, which allow for the collection of large quantities of bivalves, are found only when water levels are low. At Chalcolithic sites located along the Danube, such conditions occur only towards the end of summer.[32]

As a food source, bivalve harvesting was very important to the economy of the communities established along the Danube. Studies focused on the tell settlements of Hârșova and Bordușani have demonstrated the importance of molluscs in the food strategies adopted by the inhabitants of these sites (they mainly consumed mammals in winter, and bivalves and fish in summer). The harvesting of impressive quantities of bivalves (500 kg) has also been documented, probably for consumption during feasts (fig. 3, bottom).[33]

Materials and Methods

1. *Archaeological assemblages*

Personal adornments manufactured from *Unio* sp. valves are documented frequently at the Gumelnița settlements of Hârşova and Borduşani-Popină,[34] Sultana-Malu Roșu,[35] Vităneşti,[36] Măriuța,[37] Luncavița,[38] Pietrele,[39] Căscioarele-

[30] John David Taylor, William James Kennedy, and Anthony Hall, "The Shell Structure and Mineralogy of the Bivalvia," *Bulletin of the British Museum (Natural History). Zoology*, Suppl. 3 (1969).

[31] Andrew P. Jackson, Julian F. V. Vincent, and Jeffrey M. Turner, "Comparison of Nacre with Other Ceramic Composites," *J. Mater. Sci.* 25 (1990): 3173-3178.

[32] Valentin Radu, *Le Néolithique de la Roumanie Méridionale: Exploitation des ressources aquatiques dans les cultures Boian et Gumelnita* (Sarrebruk: Edition Universitaires Européennes, 2011); Mărgărit and Radu, "The Use of Autochthonous Aquatic Resources."

[33] Bălăşescu, Radu, and Moise, *Omul şi mediul animal între mileniile VII-IV î.e.n.*; Bréhard and Bălăşescu, "What's Behind the Tell Phenomenon?"; Bréhard et al., "Food Supply Strategies in the Romanian Eneolithic"; Radu et al., "Harvesting Molluscs in the Eneolithic."

[34] Mărgărit and Popovici, "From Block to Finished Object."

[35] Lazăr, Mărgărit, and Radu, "Between Dominant Ideologies and Techno-economical Constraints."

[36] Monica Mărgărit, *Personal Adornments in the Prehistory of the Northern Danube Area: From Aesthetic to Socio-Cultural Symbol* (Târgovişte: Editura Cetatea de Scaun, 2019).

[37] Mărgărit, Parnic, and Bălăşescu, "L'industrie en matières dures animales de l'habitat Gumelnița de Măriuța."

[38] Bălăşescu, Radu, and Moise, *Omul şi mediul animal între mileniile VII-IV î.e.n. la Dunărea de Jos.*

[39] Berciu, "Cercetări şi descoperiri arheologice în regiunea Bucureşti"; Mărgărit and Toderaş, "Industria materiilor dure animale din tell-ul gumelniţean de la Pietrele."

Ostrovel,[40] and Gumelniţa (fig. 1; table 1).[41] From each of these sites, a blank of local origin, obtained as a sub-product of the gathering process, was chosen. We identified pieces belonging to various transformation stages, from irregular splinters/fragments to finished beads, the latter having been used as personal adornments. There are two types of cylindrical beads: predominant are those of large size (average diameter: 18-14.5 mm, average thickness: 3.2-2.2 mm), the other type constitutes beads with a much smaller diameter, such as those found in the settlement of Vidra (see below).

The presence of these different stages allowed us to reconstruct the entire operational scheme. A subrectangular fragment from the area immediately below the umbo (fig. 4/E) was identified as belonging to the first stage of the transformation process. It was discovered at the Pietrele tell settlement[42] and preserves marks from cutting by sawing (fig. 4/F-G). This indicates that obtaining the blanks was not achieved by fracturing (the percussion of the valve to obtain irregular flakes) but by extraction (cutting each blank individually with a predetermined shape and dimensions in mind). On this particular piece, perforation or shaping had not yet been initiated; therefore, it is most likely debitage waste. Its presence suggests that beads were manufactured at the site. The identification of both debitage waste and finished pieces in the same location at the site allows us to advance the hypothesis that these items were kept there, in order to replace fractured or lost ornaments.

By contrast, at the Căscioarele settlement, we identified four irregularly shaped valve fragments (fig. 5/A), exhibiting no technological marks, which could have constituted waste from the bead manufacturing process (the fragments were recovered from the same contexts as the finished pieces). The absence of cutting marks may indicate fracturing as the debitage method, and not extraction like at Pietrele. Another example of the same type of blank (fig. 6/A) was found at the Hârşova tell settlement. It was also created through direct percussion of the valve (fig. 6/B-C). This is an important find, because it represents the next step in the transformation of a blank into a preform. Centrally, a perforation by rotation was initiated, but the procedure was not finished (fig. 6/D).

We do not know if this sequence is valid for all sites. Another variant of the technological scheme may include the realisation of perforations at the level of the valve as a first stage, after which blanks can be obtained starting from these perforations. However, from an economic point of view, the cost is lower if blanks are created that can later be perforated, because if the blank is perforated and then cut, there is a possibility that the material will come off in an

[40] Mărgărit, "Personal Adornments in the Romanian Eneolithic."

[41] Dumitrescu, "Découvertes de Gumelniţa"; Idem, "Fouilles de Gumelniţa"; Lazăr et al., "Gumelniţa: Research Results of the 2018 and 2019 Fieldwork Seasons."

[42] Mărgărit and Toderaş, "Industria materiilor dure animale din tell-ul gumelniţean de la Pietrele."

unintended direction, which may affect the part that is already drilled. The energy deposited/consumed is much higher in case of failure.

The perforation procedure was completed in the case of five pieces that were also recovered from the tell settlement of Hârșova (fig. 6/E). As an observation, we must specify that in all the analysed specimens, the perforation was performed bifacially. The perforation is more flared on the inferior side, indicating that the procedure was initiated on this side (fig. 6/G-H) and the perforation was only widened on the external side. Based on the experiments we performed, the details of the procedure are determined by the convex-concave shape of the blank; it can be held in place more easily with the interior side up, which facilitates the drilling procedure.

We also identified items representing an intermediary manufacturing stage (five pieces from Hârșova, two from Vităneşti, one from Borduşani-Popină, and one from Sultana-Malu Roșu) (fig. 6/F). This stage included perforation by rotation and regularisation by abrasion of the fracture edges (fig. 6/I). The latter action had just been initiated on the items under discussion, but the pieces never reached the finished manufacturing stage. The final stage (fig. 6/J) consisted of the shaping of the circumference of the piece by abrasion (fig. 6/K-L), in order to render a circular morphology to the edges and reduce the size of the pieces. In some cases, abrasion was also applied to the exterior of the artefact, in order to thin the piece.

According to D. Berciu,[43] over 100 beads made from *Unio* valves were discovered at the tell settlement of Pietrele. All items were heavily fired (fig. 4/A), giving them a black colour. The circular shape was achieved by the abrasion of the edge contour (fig. 4/B, J) and the central perforation was realised through bifacial rotation, initiated from the inferior side (fig. 4/C-D). The burning process destroyed superficial marks, especially those of a use-wear nature. However, there are indications of wear on these pieces as a result of the change in volume (fig. 4/H-I). The perforation is deformed in a small area, and the deformation is associated with the appearance of a small depression at the periphery of the perforation (fig. 4/K-L) and with a thinning of the bead wall (fig. 4/M).

At Căscioarele, the study of the archaeological assemblage allowed us to identify 36 circular beads and bead fragments from a single archaeological context (fig. 5/B-C), associated with the four subrectangular valve fragments described above. These items do not exhibit any use-wear marks (fig. 5/D-H). Therefore, we posit they were not used. However, spots of ochre (fig. 5/I) were identified on their surfaces, indicating they were likely painted. This archaeological context suggests the existence of a storage location for these objects, meant as a source for the replacement of broken or lost items. Moreover,

[43] Berciu, "Cercetări și descoperiri arheologice în regiunea București."

we can assume that this was also the location where the ornaments were manufactured, given the association with the waste valve fragments.

Only one other bead from Căscioarele (from a different archaeological context than the objects described above, fig. 5/J) was identified with certainty as having been strung and worn as an ornament. Rotation scratches have disappeared from this object, and the perforation is deformed on one side, alongside the appearance of a small depression, characterised by a smoothed surface (fig. 5/L). In addition, abrasions marks are almost absent, and a macroscopic polish can be observed on the surface (fig. 5/K).

The assemblage of 37 circular beads from the Vidra settlement (fig. 7/A) is notable. Their sizes are very similar (diameter: 7.8-7 mm, thickness: 2.2-1.2 mm), suggesting the serial production of these pieces. The technological procedures used to manufacture these items appear to be identical to those described above (fig. 7/B-C). The degree of use-wear is variable among the items: on some objects it is almost non-existent (with rotation marks preserved) (fig. 7/D), while on others it is more advanced, with small deformations of the perforation (fig. 7/E-F) and thinning of the wall between the perforation and the debitage edge (fig. 7/G).[44]

2. *Methodology*

The methodology used in this study relies on macroscopic and microscopic analysis of the technological and use-wear marks found on the archaeological items, aided by experimental data. The personal ornaments were microscopically examined using a Keyence VHX-600 digital microscope, with magnifications ranging from 30x to 150x. Cylindrical beads discovered in the settlement of Pietrele were examined with a Stereomicroscope Nikon SMZ 1000, with magnifications ranging from 15x to 30x. The analytical criteria for the technological and functional interpretations were established by referring to recent publications on the use of personal ornaments in prehistoric contexts.[45]

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[44] Mărgărit and Vintilă, "Podoabe și figurine confecționate din materii dure animale."

[45] Sandrine Bonnardin, *La parure funéraire au Néolithique ancien dans les Bassins parisien et rhénan Rubané, Hinkelstein et Villeneuve-Saint-Germain* (Paris: Societé Préhistorique Française, 2009); Solange Rigaud, "La parure: traceur de la géographie culturelle et des dynamiques de peuplement au passage Mésolithique-Néolithique en Europe" (PhD diss., Bordeaux 1 University, 2011); Eadem, "Les objets de parure associés au dépôt funéraire mésolithique de Große Ofnet: implications pour la compréhension de l'organisation sociale des dernières sociétés de chasseurs-cueilleurs du Jura Souabe," *Anthropozoologica* 48, no. 2 (2013): 207-230; Emanuela Cristiani and Dusan Borić, "8500-Year-Old Late Mesolithic Garment Embroidery from Vlasac (Serbia): Technological, Use-Wear and Residue Analyses," *JAS* 39, no. 11 (2012): 3450-3469; Marian Vanhaeren et al., "Thinking Strings: Additional Evidence for Personal Ornament Use in the Middle Stone Age at Blombos Cave, South Africa," *J. Hum. Evol.* 64, no. 6 (2013): 500-517; Emanuela Cristiani, Ivana Živaljević, and Dusan Borić, "Residue Analysis and Ornament Suspension Techniques in Prehistory: Cyprinid Pharyngeal Teeth Beads from Late Mesolithic Burials at Vlasac (Serbia)," *JAS* 46 (2014): 292-310; Frederico Tátá et al., "Shell Bead Production in the Upper Paleolithic of Vale Boi (SW Portugal): An Experimental Perspective," *JAS* 42 (2014): 29-41; Solange

3. *Experimental programme*

Based on these archaeological observations, an experimental programme was developed, through which we hoped to record all the relevant variables (technological process, time required for each operation, tools used, macro-marks visible on experimental artifacts, type of finished piece obtained and their number; how to fasten ornaments; time of use of the ornaments; evolution of use-wear), for the purpose of evaluating the costs invested in the manufacture of these types of pieces, from collection of the blanks to utilisation. Following production, the pieces were suspended by a thread and worn continuously for one year, in order to observe how the perforation deformed over time. Comparing the experimental beads with the archaeological ones, we were able to establish the validity of our hypotheses (fastening on a thread in composite ornaments *versus* individual sewing) regarding the methods for attaching these ornaments.

Unio sp. valves were collected from the sediments left on the riverbank by the waters of Danube (along one of Danube's arms), when the water level was low. Usually, valves cannot be collected earlier than August/September. We identified areas of thanatocoenosis (death assemblages), which allowed for the collection of around 40 bivalves in only 10 minutes. Acquisition would have been much simpler for the archaeological specimens, because the valves were obtained from food remains. The species was used in an opportunistic manner: first as an important source of nourishment, and then as a source for beads, by recovering valves from domestic waste.

The time period during which certain species can be gathered can offer indications regarding the time when these pieces were manufactured and, perhaps, their manner of utilisation. It must be emphasized that the raw material furnished by aquatic resources is, generally, hydrated. This characteristic is important, especially for the processing of bivalve shells. *Unio* valves lose more than 11% of their weight after drying.[46] During the experiments, it became clear that the *Unio* valves could not be kept, one year to another, in order to be processed.[47] We attempted to process a few valves that had been in the

Rigaud, Francesco d'Errico, and Marian Vanhaeren, "Ornaments Reveal Resistance of North European Cultures to the Spread of Farming," *PLoS ONE* 10, no. 4 (2015): e0121166, doi:10.1371/journal.pone.0121166; Michelle C. Langley, Sue O'Connor, and Elena Piotto, "42,000-Year-Old Worked and Pigment-Stained *Nautilus* Shell from Jerimalai (Timor-Leste): Evidence for an Early coastal Adaptation in ISEA," *J. Hum. Evol.* 97 (2016): 1-16; Geoffrey Clark et al., "Shell Beads as Markers of Oceanic Dispersal: A Rare *Cypraeidae* Ornament Type from the Mariana Islands," in *Archaeology of Portable Art: Southeast Asian, Pacific and Australian Perspectives*, eds. Michelle Langley et al. (London: Routledge, 2018), 142-161; Catarina Guzzo Falci et al., "New Insights into Use-Wear Development in Bodily Ornaments Through the Study of Ethnographic Collections," *J. Archaeol. Method Theory* 26, no. 2 (2019): 755-805.

[46] Radu, *Le Néolithique de la Roumanie Méridionale.*

[47] Monica Mărgărit, "Testing the Endurance of Prehistoric Adornments: Raw Materials from the Aquatic Environment," *JAS* 70 (2016): 66-81.

environment for several years and were severely dehydrated, and found that direct percussion under these conditions results in the irregular breaking of these valves into small fragments with significant exfoliations. We were unable to recover blanks for bead manufacturing from the dehydrated valves using this method. We also attempted to obtain blanks by sawing, which resulted in an exfoliation in successive layers, and no blanks for beads. The same phenomenon can also be observed in the case of perforation, which causes exfoliations on the surface. This phenomenon of exfoliation is not documented among the archaeological pieces. Therefore, it is clear that processing took place shortly after gathering, and based on the data above, it may be hypothesized that processing took place occasionally throughout summer with potentially a higher intensity at the end of the warm season.

Based on observations of the prehistoric artifacts, two debitage methods were applied to obtain blanks: fracturing by percussion (fig. 8/A) and extraction by cutting (sawing) (fig. 8/B). In our experiment using the first method, the valve was fractured with a wooden hammer, resulting in several irregular splinters, from which suitably sized specimens were selected to be transformed into ornaments. This method is very fast (3-4 seconds) but not very productive, because the fracturing cannot be controlled (the number of resulting blanks cannot be determined) and the blanks are irregular in shape. However, we must emphasize that prehistoric artisans had much more experience and probably had much better control over the process of valve percussion, resulting in increased efficiency (more regular blanks and minimal loss of raw materials). The second method, consisting of the application of a bifacial sawing, takes longer (approximately 10 minutes in our experiment), but the blanks have predefined shapes and sizes, and their number can be estimated.

The second technological stage consisted of the perforation of the blanks (fig. 8/C), which was done by alternative bifacial rotation, as we observed in the archaeological specimens. A blank can be perforated in approximately 5 minutes. Finished items can be obtained through rigorous abrasion (fig. 8/D). A strong abrasive stone (respectively a piece of sandstone) is needed for this process. We periodically added water to speed up the friction procedure. Abrasion was applied to the debitage edge and the external side for approximately 10 minutes. In our experiment to obtain one particular shape (large ornaments, 15 mm average diameter) it took approximately 25 minutes to produce a piece (fig. 8/E). Next, the pieces were joined together in a bracelet and, periodically, the evolution of use-wear was evaluated.

Results and discussion

In terms of use-wear on archaeological pieces, traces were visible especially on the perforation area. Thus, the first manufacturing stage is represented by

perforations present on unfinished items with well-marked perforation traces and a raw perforation edge, which has not yet acquired a perfectly circular aspect. A second stage was identified among some of the finished items, represented by the blurring of the manufacturing marks in various areas and inside perforations, which correspond to their use as adornments. Finally, a third phase consists of the removal of rotation marks and the appearance of a polished area around the perforation (and sometimes even a small depression), probably following prolonged rubbing against the thread used for suspension (fig. 4/J-M, 5/J-L, 6/M, 7/E-G, fig. 9/A).

To identify whether a similar evolution of wear occurred among the experimental specimens, we performed a microscopic analysis after six months of use. The rotation marks had almost completely disappeared, and a significant wear area developed, the perforation being deformed at the point where it constantly rubs against the thread used to attach the object. The abrasion marks had begun to attenuate. After one year, the wear was very advanced: the items had acquired a strong macroscopic polish, accompanied by the disappearance of all technological traces. Moreover, the perforations had a circular morphology, lacking specific rotation grooves. The disappearance of the rotation striations along the entire edge (fig. 9/B) of the perforation supports the hypothesis of a mobile clasping system (in bracelets) over that of a fixed one (for example individually sewn pieces). And indeed, due to the shape and dimensions of some of the pieces, a button function can be assumed, which involved the fixed and individual sewing of the pieces. Such a grip would have led to the appearance of two types of marks: being a fixed grip, the rotation striations would not have disappeared along its entire edge, and a well-defined depression area would have formed, which would have affected the perforation wall, as the pressure area of the thread. These types of wear have not been documented among the archaeological pieces, except possibly in a few of the objects discovered at the Pietrele site.

The last phase of our experiment consisted of a comparison between the experimental pieces (at the beginning and during the experiment) and the archaeological ones. The appearance of the perforations on the items in advanced stages of processing that we still considered preforms is very similar to the perforations of the experimental items that had not yet been suspended. These findings support our hypothesis that a stock of unused beads was kept, ready to be used at any time to make ornaments (bracelets, necklaces) or to replace lost or broken beads. In addition, among the archaeological pieces used, various degrees of wear are visible, corresponding to different periods of suspension. The evolution of wear of the archaeological pieces is similar to that present among the experimental pieces (disappearance of technological marks, deformation of the initial volume of the perforation and even of the whole piece, as well as

macroscopic polish) supporting the hypothesis that these beads were used like bracelets/necklaces.

The presence of all stages of the technological transformation process, as well as the different degrees of use-wear observed in the finished items suggest that the entire life cycle of these objects took place on site, from processing to consumption and loss or abandonment. In some cases, the existence of several ornaments of the same type (in terms of raw material and degree of processing) in a single archaeological complex (e.g., the Căscioarele site) was documented, suggesting the possibility of a processing area (workshops?), or a storage area for ornaments.

Based on the existence of several similar pieces in a single archaeological context, we wonder if we cannot conclude the existence of a craft specialisation. What is certain is that the artisans who created the analysed ornaments were very familiar with the mechanical properties of the raw materials, probably the result of experience gained over time, perhaps passed down from generation to generation. The first argument would be that the raw materials were processed fresh. We have already illustrated the fact that, among the archaeological specimens, we did not identify the exfoliation and fracturing associated with valve dehydration. The second argument would be the cost invested (in time) in processing these ornaments: up to 25 minutes, using a rather complicated technological process. Did all the members of the community have the time and skill to perform this task, or was the processing done by craftspeople specialised in the production of ornaments?

Another issue worth discussing is the possibility of an annual model for the production and consumption cycle of these ornaments. Based on our own experiment, it is clear that the raw materials were gathered during the summer season. We also assume processing of the valves took place shortly after harvest, based on our observations regarding the radical modification of the mechanical properties as a result of the drying process. In conclusion, it is possible to delimit, with some certainty, a seasonal cycle for the processing of ornaments in settlements.

Another aspect we want to discuss is the durability of these ornaments. Our experiment has shown that, although seemingly fragile, these ornaments are perfectly functional for several years. Moreover, there is a clear similarity between the archaeological and experimental artefacts in terms of wear marks. This experimental collection aimed to help us better understand the way in which wear evolves during the item's use cycle and, implicitly, the patterns observed on the archaeological specimens. The experiment discussed here will continue until these personal adornments become unusable, in order to evaluate their life cycle.

Finally, we would like to discuss the social/cultural value of these ornaments. For example, in the tell settlement of Hârșova,[48] most of the pieces were identified in levels of household waste, which may signify their abandonment, perhaps after they lost their functionality (the breaking of the thread, the fracture of some of the component items, the loss of significance, etc.). They may have marked a moment in the life of an individual, after which the objects lost significance and were thrown away. Many examples of this situation have been documented in ethnological studies. Among the Wano people (Indonesia), for example, the first hunting trophies (mandible, beak, claws, teeth) obtained by a young man are kept and worn as a necklace in order to demonstrate his ability as a hunter, until, a few years later, they are thrown away, in favour of other forms of asserting a certain social image.[49]

Similar ornaments have been documented among the neighbouring Cucuteni culture (c. 4650-3450 cal BC),[50] at the sites of Izvoare, Frumușica, Scânteia, Ruginoasa, Fulgeriș,[51] and Ariușd.[52] In more distant territories, *Unio* valve ornaments have been identified at the sites of Çatalhöyük,[53] Sitagroi,[54]

[48] Mărgărit and Popovici, "From Block to finished Object."

[49] Pierre Pétrequin, "Perdu ou jetés ? Les objets de parure du Néolithique de Chalain et Clairvaux (Jura, France)," in *Tradition und Innovation. Prähistorische Archäologic als historische Wissenschaft. Festschrift für Christian Strahm*, ed. Barbara Fritsch (Rahden: Verlag Marie Leidorf, 1998), 183-200.

[50] Bem, "Noi propuneri pentru o schiță cronologică a eneoliticului românesc."

[51] Senica Țurcanu, "Consideraţii privind obiectele de podoabă realizate din cochilii de moluște în cadrul complexului cultural Cucuteni-Tripolie" [Considerations for Ornaments Made from Mollusk Shells within the Cucuteni-Tripolie Cultural Complex], in *De Hominus Primordis. Studia in honorem professoris Vasile Chirica*, eds. George Bodi, Mihaela Danu, and Radu Pîrnău (Iași: Editura Universităţii Al. I. Cuza, 2013), 169-194.

[52] Diana-Maria Sztancs, "Around Black Sea in Prehistory: Neolithic and Copper Age Adornments Discovered in Romania and Ukraine", in *Challenges and Opportunities for a Multilateral Cooperation. First International Conference on EU and Black Sea Regions*, eds. Antonello Biagini, Constantin Hlihor, and Andrea Carteny (Bagheria: Giovanni Mineo Editore, 2012), 199-208; Diana-Maria Sztancs and Corneliu Beldiman, "The Ariuşd (Erősd) - Cucuteni Culture: Osseous Materials Artefacts," in *L'impact anthropique sur l'environnement durant le Néo-Énéolithique du sud-est de l'Europe. In Honorem Dr. Gheorghe Dumitroaia*, eds. Constantin Preoteasa and Dorin Nicola (Piatra Neamț: Bibliotheca Memoriae Antiquitatis XXXI, 2014), 239-282.

[53] Daniella E. Bar-Yosef Mayer, "Mollusc Exploitation at Çatalhöyük," in *Humans and Landscapes of Çatalhöyük. Reports from the 2000–2008 Seasons* [Çatalhöyük Research Project Series Volume 8, BIAA Monograph No. 47], ed. Ian Hodder (Ankara: British Institute at Ankara, 2013), 329-338.

[54] Marianna Nikolaidou, "Items of Adornment," in *Prehistoric Sitagroi: Excavations in Northeast Greece, 1968-1970 (vol. II)*, eds. Ernestine S. Elster and Collin Renfrew (Los Angeles: Cotsen Institute of Archaeology, University of California, 2003), 331-360.

Dispilio,[55] and Mureybet.[56]

Similar ornaments have also been documented in the Chalcolithic necropolis of Decea Mureșului[57] and at the necropolis of Mariupol in the Dniper-Don area.[58] Ornaments made from this raw material are present in tombs dating to the second half of the 5th millennium BC, attributed to the Brześć Kujawski culture[59] (Poland). They have also been documented in Khvalynsk[60] Eneolithic cemeteries (Northern Caspian region, 4900-4200 cal BC). Similar ornaments are present in more recent funerary contexts as well (Early Bronze Age, the beginning of the 3rd millennium BC),[61] for example in the funerary inventory of a tomb in Șoimești (Romania).

Based on currently available data, these ornaments have not been found in funerary contexts at the Gumelnița sites north of the Danube. In this area, the ornaments do not appear to be linked with social status, in which case they would have been included in burials for use in the afterlife. Instead, they appear to be everyday ornaments. Their symbolism is thus different from that of other prehistoric cultures in the territory of Poland or in the Caspian Sea area, where circular beads made from the *Unio* valve are present in the necropolises.

Perhaps this situation is also due to the fact that, starting in the 5th millennium BC, ornaments were mainly made from *Spondylus* valve, which, unlike *Unio*, may possess this connection with the afterlife, as they have been documented in funerary contexts.[62] The picture of Gumelnița culture becomes

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[55] Fotis Ifantidis, "Shell Personal Ornaments," in *Shell Assemblage Analysis of the Neolithic Lakeside Settlement of Dispilio, Kastoria. The Eastern Sector*, eds. Rena Veropoulidou and Fotis Ifantidis (Thessaloniki: Institute for Aegean Prehistory, 2005), 49-94; Idem, *Πρακτικές Προσωπικής Κόσμησης στη Νεολιθική Ελλάδα / Practices of Personal Adornment in Neolithic Greece* (Oxford: Archaeopress, 2019).

[56] Claudina Maréchal and Hala Alarashi, "Les éléments de parure de Mureybet," in *Le site néolithique de Tell Mureybet (Syrie du Nord). En hommage à Jacques Cauvin*, vol. II, ed. Juan Jose Ibañez [BAR International Series 1843] (Oxford: Archaeopress, 2008), 575-617.

[57] Sztancs, "Around Black Sea."

[58] Nataliia Mykhailova, "Personal Ornaments of the Children in the Mariupol Type Cemeteries (Ukraine) ", in *Beauty and the Eye of the Beholder. Personal Adornments Across the Millennia,* eds. Monica Mărgărit and Adina Boroneanț (Târgoviște: Editura Cetatea de Scaun), 371-382.

[59] Apolinarska and Kurzawska, "Can Stable Isotopes of Carbon and Oxygen …?".

[60] Irina V Kirillova et al., "The Origin of Objects of Invertebrate Descent from the Khvalynsk Eneolithic Cemeteries (Northern Caspian Region)," *Quat. Int* 465 (2018): 142-151.

[61] Alin Frînculeasa et al., "Between Worlds and Elites at the Beginning of the Early Bronze Age in the Lower Danube Basin: A Pluridisciplinary Approach to Personal Ornaments," *Archaeol Anthropol Sci* 12, no. 9, https://doi.org/10.1007/s12520-020-01177-0.

[62] E.g., Monica Mărgărit, "Shell Adornments from the Hamangia Cemetery excavated at Cernavoda – Columbia D. Techno-Typological Analysis", in *HOMINES, FUNERA, ASTRA. Proceedings of the International Symposium on Funerary Anthropology (5-8 June 2011) Alba Iulia*, eds. Raluca Kogalniceanu et al. [BAR International Series 2410] (Oxford: Archaeopress, 2012), 97-106; Monica Mărgărit and Mădălina Dimache, "Personal Adornments from the Eneolithic Necropolis of Chirnogi-Suvita Iorgulescu (Romania): A Picture of Symbolism in Prehistoric Communities," *Doc.*

more clear through study of the use of other local raw materials, including circular beads of *Cyprinus carpio* opercular bones (Hârșova),[63] perforated valves of *Cardium* sp. (Hârșova, Sultana-Malu Roșu),[64] and perforated shells of *Lithoglyphus naticoides* (Pietrele-Gorgana, Sultana-Malu Roșu).[65] Examples of the latter corresponding to the earlier stages of manufacture are sporadically encountered, which indicates that the use of local resources for such ornaments took place, especially during times when the exploitation of aquatic resources increased significantly for the Gumelnița culture, compared to previous periods.[66]

Conclusion

Our experiments illustrate how experimental archaeology can contribute, in tandem with technological and use-wear analysis, to the reconstruction and understanding of the ways of life (whether economic, technological or cultural) of Gumelnița communities. The experiments were designed to gain insights into the technological stages of processing and to shed light on the patterns observed on archaeological beads. Moreover, a rigorously executed experimental programme, following every stage in the process, can accurately reconstruct the fastening system and approximate period of use of archaeological pieces. Our study also enhances the knowledge of the exploitation of aquatic resources and raises questions about their procurement and especially their economic and cultural significance within Gumelnița communities.

Acknowledgement

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Praehist. XLVI (2019): 398-413; Lazăr, Mărgărit, and Radu, "Between Dominant Ideologies and Techno-economical Constraints."

[63] Mărgărit, Radu, and Popovici, "From Operculum to Bead."

[64] Mărgărit and Popovici, "From Block to Finished Object"; Lazăr, Mărgărit, and Radu, "Between Dominant Ideologies and Techno-economical Constraints."

[65] Berciu, "Cercetări și descoperiri arheologice în regiunea București"; Cătălin Lazăr, Monica Mărgărit, and Valentin Radu, "Evidence for the Production and Use of *Lithoglyphus naticoides* Beads in Europe During the Holocene: The Case of Sultana-Malu Roșu Site (Romania)," *Quat. Int* 472 (2018): 84-96.

[66] Radu, *Le Néolithique de la Roumanie Méridionale*.

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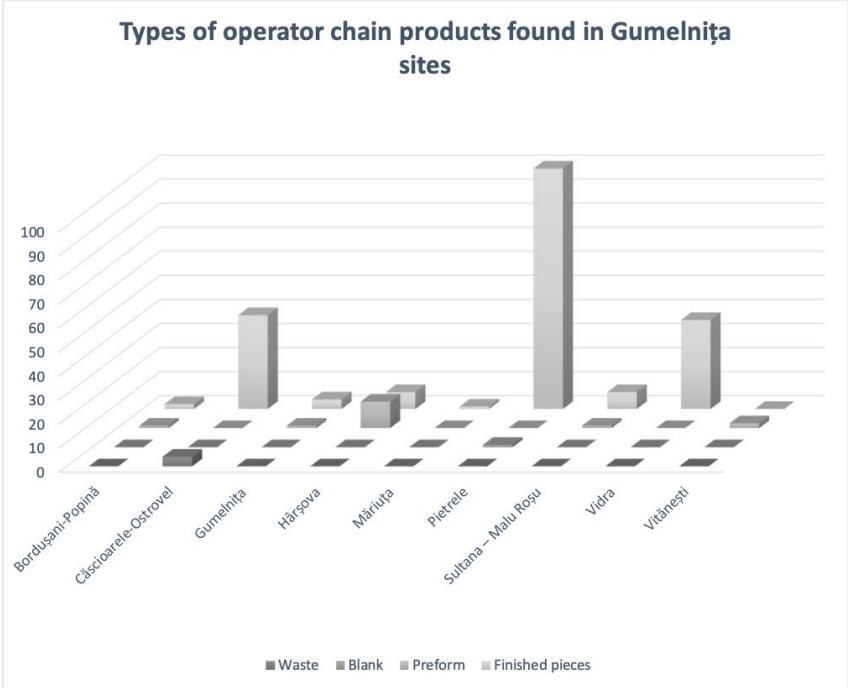

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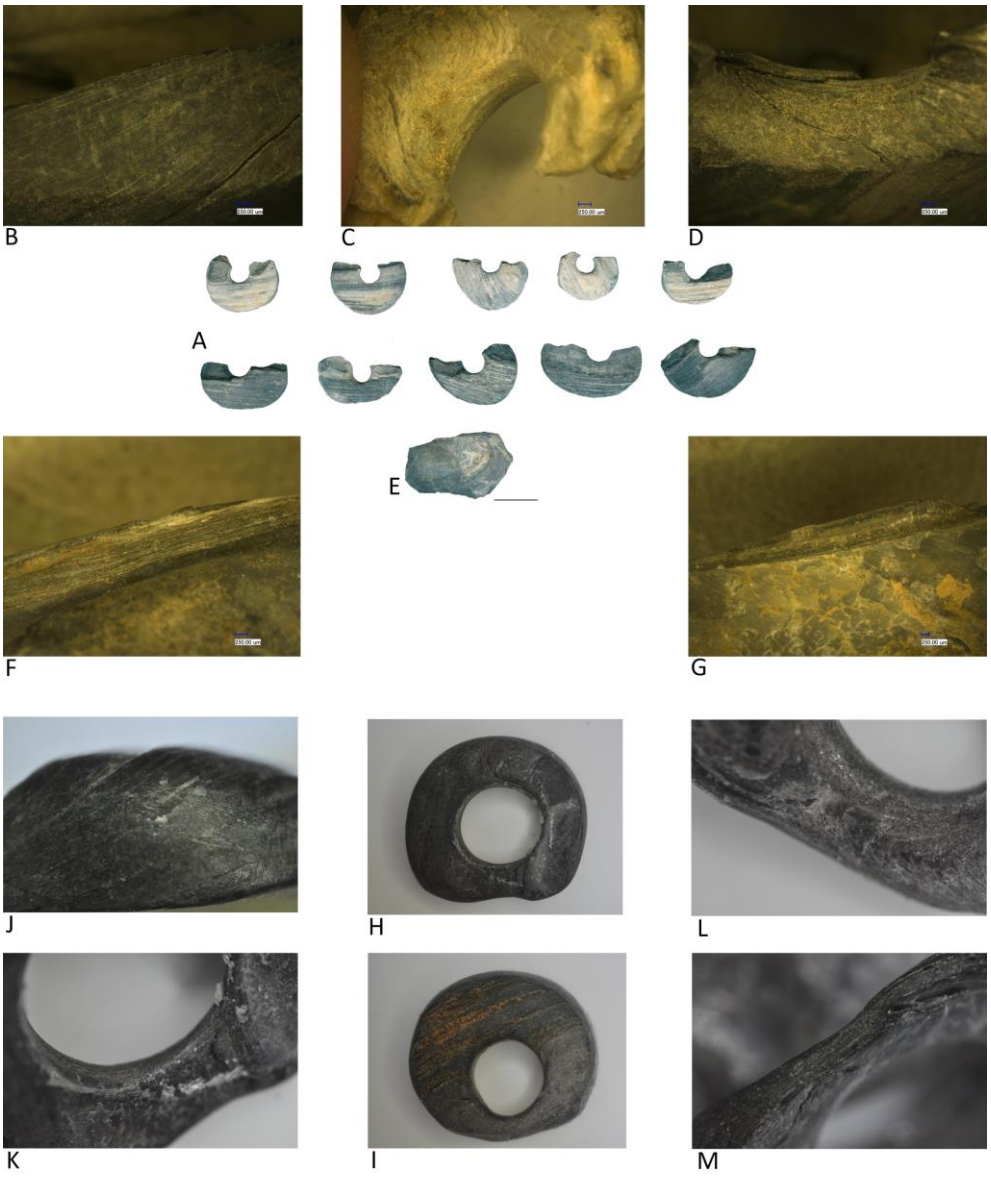

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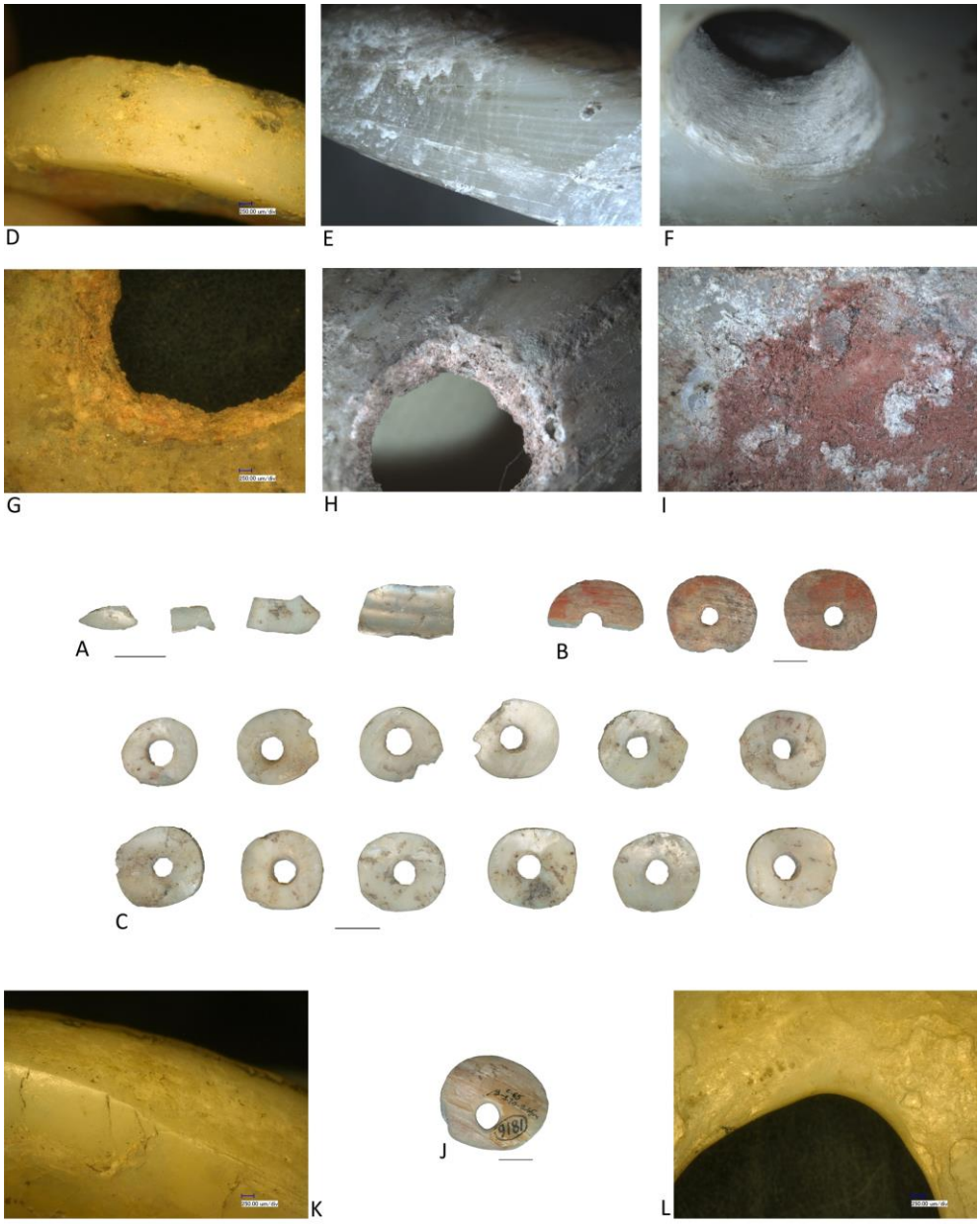

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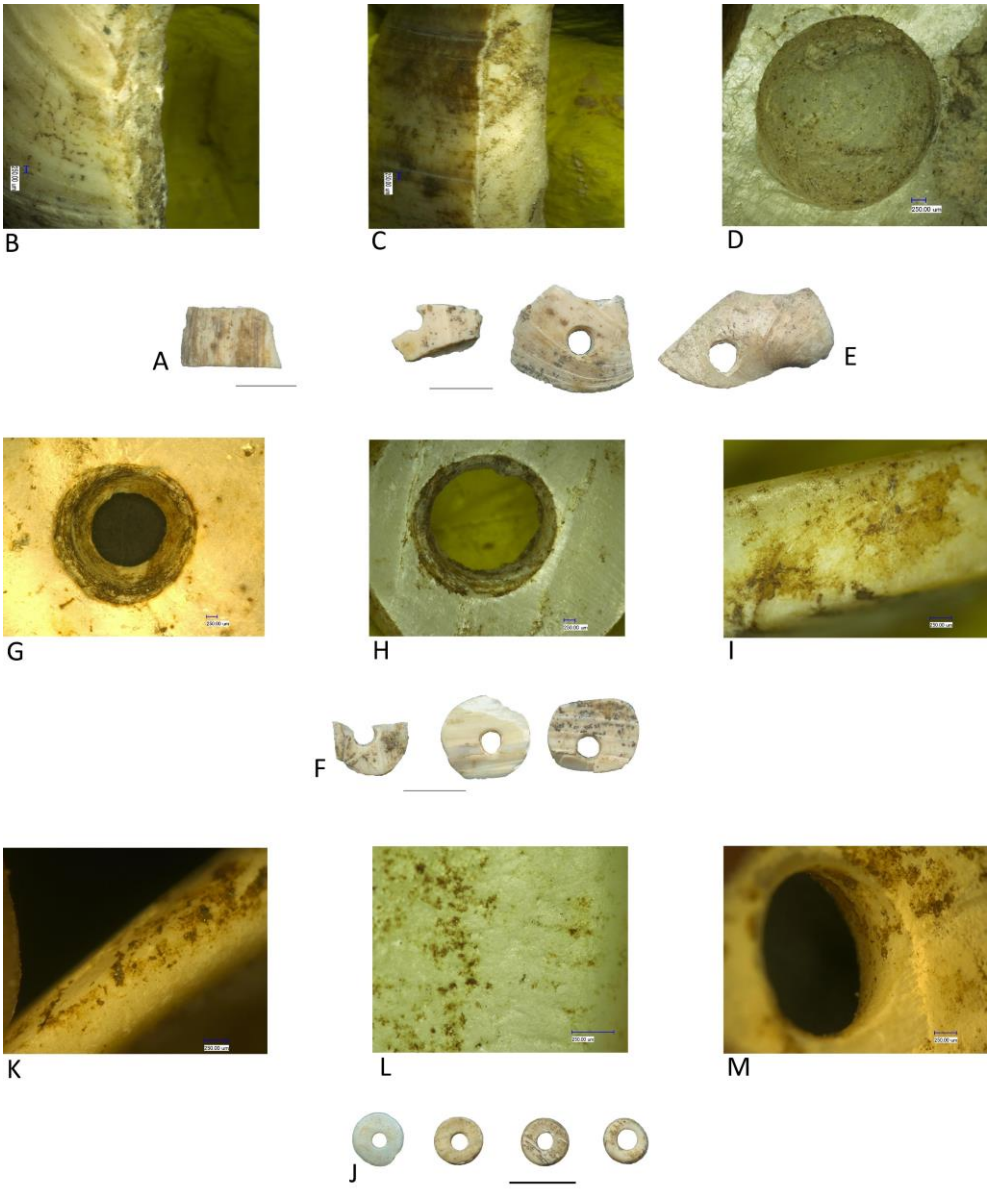

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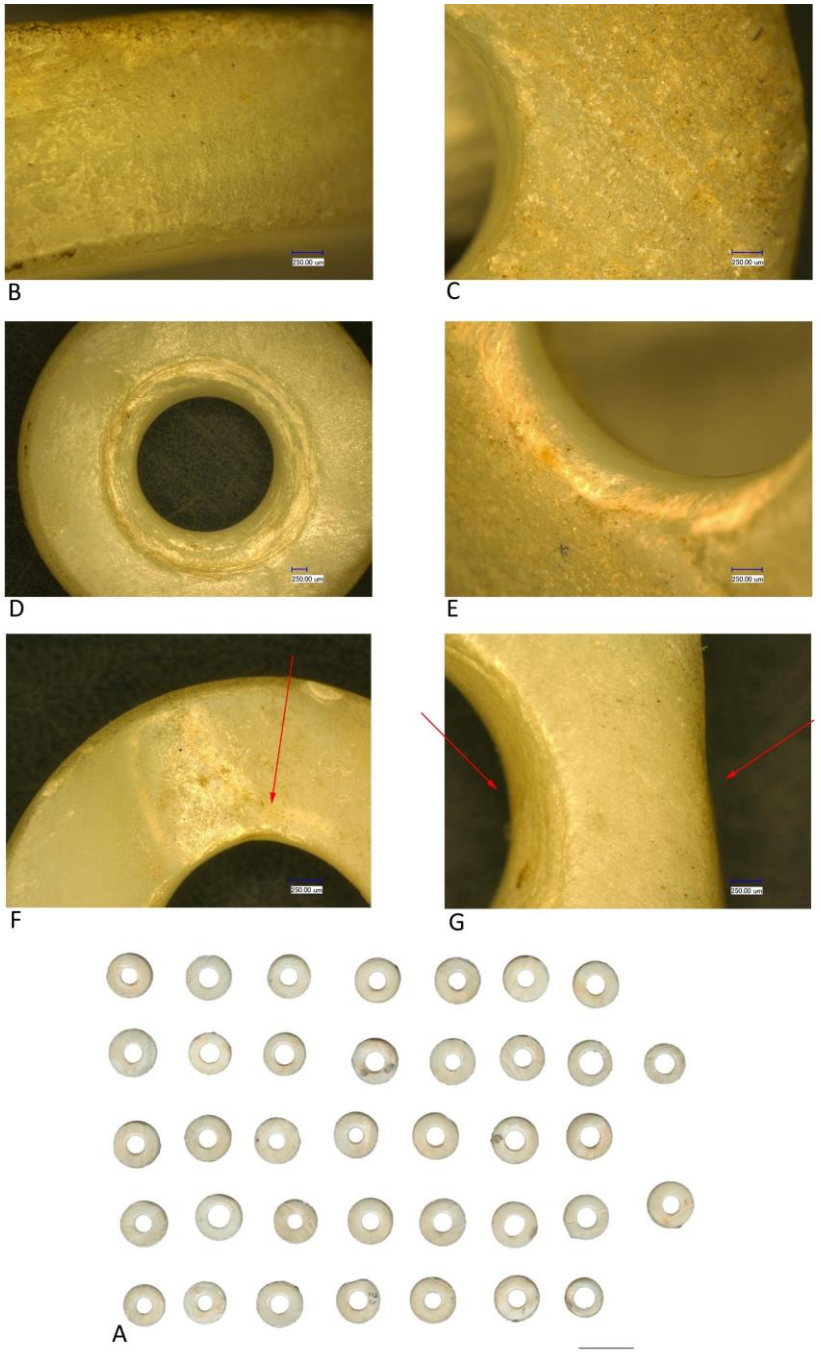

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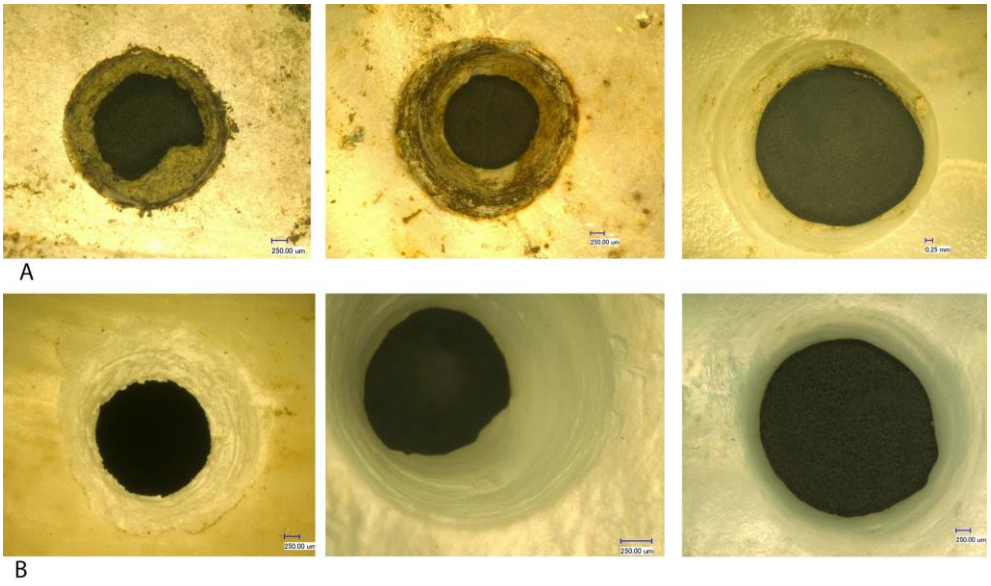

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