Elements of Ornaments in Non-Burial Contexts: Investigations on Raw-Materials, Production, and Use-Wear

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Introduction

Among the excavated burials at Ba`ja, several have revealed ornaments associated with the skeletal remains of the buried individuals. Thus far, the necklace discovered in the child burial (CG7, Loc. C1:46) in Room CR36.1 has been analysed and reconstructed (Alarashi b this volume), and the ornaments discovered in the burial of a young adult man (CG10, Loc. C10:408) have been studied partly until now (Gebel *et al.* 2017; Benz *et al.* 2019). To better assess the ornamental practices of the inhabitants of Ba`ja and to provide an overview regarding their production and use processes, a comprehensive selection of items discovered in other non-funerary contexts and from different areas of the settlement found between 1997 and 2018 (Table 1) were studied (for contextual information of the objects, see Alarashi and Benz this volume: Appendix 1).[1]

Except for the sandstone rings that are regarded as "commodity coupons" (Gebel 2010), and fossil unpierced shells that are considered as ecofacts (pers. comm. H.G.K. Gebel), a total of 208 ornamental items were available for this study and registered in a database. These include beads, pendants, shell rings, raw minerals, preforms, manufacturing debris and unmodified "fresh"[2] seashells. Most of the stone and shell beads from Ba`ja are common to those uncovered in other Pre-Pottery Neolithic B (PPNB) sites in the region (*e.g.*, Hauptmann 2004; Hermansen 2004; Cerón-Carrasco 2007; Abu Laban 2014) and more widely found in the Levant (*e.g.*, Bar-Yosef Mayer 1997; Bar-Yosef Mayer and Porat 2008; Alarashi 2014; Spatz *et al.* 2014; Alarashi *et al.* 2018). The results presented here concern the whole assemblage that was initially examined in the Ba`ja Dig House in Beidha. Part of this assemblage (n=119) was exported[3] to France (CNRS-CEPAM-Nice) for detailed study and further analyses.

Table 1 The assemblage of the investigated ornamental items from Ba`ja, excluding burial finds. Distribution and frequency of material categories per area of excavation.

Material	Area A	B	C	D	F	Test Unit 3	Test Unit 5	Total
Shell		51	62	57	2	1	1	174
Ostrich shell			1	1				2
Bone				1				1
Stone	1	6	12	7	1			27
Marl			2	1		1		4
Total	**1**	**57**	**77**	**67**	**3**	**2**	**1**	**208**

[1] Objects that were handed over to the museum at the end of former excavation seasons were not available for the investigations.

[2] As opposed to the fossilised complete shells.

[3] Export with a loan agreement from the Jordanian authorities (Permit N° 12/5/274). All items were returned to the Department of Antiquities on 28th, September 2021.

Benz M., Gresky J., Purschwitz C. and Gebel H.G.K. (eds.), *Death in Ba`ja. Sepulchral Identity and Symbolism in an Early Neolithic Community of the Transjordanian Highlands. Household and Death in Ba`ja* 2.
bibliotheca neolithica Asiae meridionalis et occidentalis. 2023. Berlin: ex oriente.
DOI: https://doi.org/10.11588/propylaeum.1224.c16950

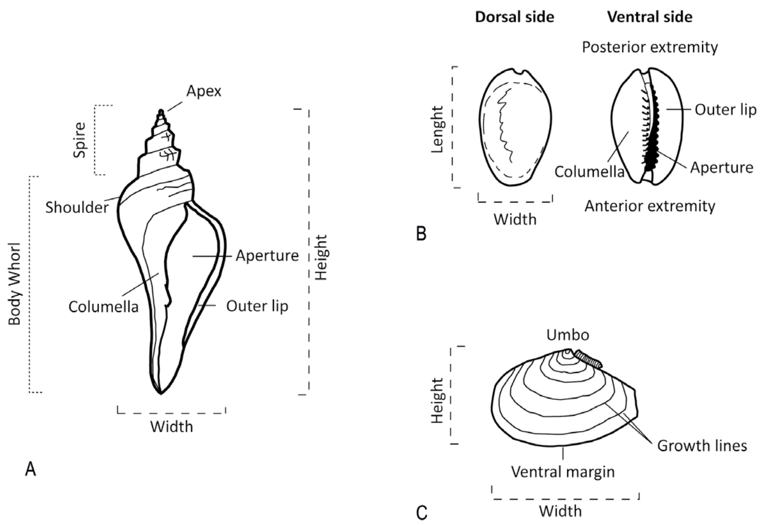

Fig. 1 Nomenclature: *A-B* for gastropods and *C* for bivalves. (Design: H. Alarashi, Ba`ja N.P.)

Methods

Taxonomic and Material Determination

Comparing the malacological referential of actual and fossil specimens of Cataliotti-Valdina (CEPAM, Nice) allowed for the taxonomical identification of the shells – at least to the level of genus. The nomenclature was verified using the online World Register of Marine Species (WoRMS 2021). The preliminary identifications of the stone objects were confirmed by non-destructive X-Ray Fluorescence (XRF) analyses conducted by Manfred Martin and Melissa Gerlitzki at the Landesamt für Geologie, Rohstoffe und Bergbau Freiburg (see their contribution this volume). This method was also applied on some beads for which it was uncertain whether the raw material was a stone or shell. Recognition of objects as marl is based on the identification of Hans Georg K. Gebel from a series of analyses made on items from Basta (Hermansen 2004).

Cleaning

Except for the fragile objects which were handled as little as possible, all the specimens were cleaned. The cleaning procedure was conducted under a binocular. It involved japing the loose sediment with a wood stick from the surfaces and from the sinuous zones, and removing it by blowing using a fine straw or by adding drops of water. The remaining particles and sediment were gathered or soaked up with a cotton bud. Direct water flow was sometimes used to clean well preserved objects made of resistant stones.

The surfaces of many objects are covered with solid layers of unknown sediments (not yet analysed) which were unremoved during the cleaning to prevent damages. They might contain residues of pigments, string or tissue fibres, gluing substance, *etc*., or might also be the result of a post-depositional phenomenon.

Nomenclature, Conventions, and Method of Classification

The nomenclature used to designate: the anatomical parts of the shells (Fig. 1), the features of the beads and rings, the orientations and measurements and the typological classification adapts established conventions by Alarashi (2014). The use of the term "mother-of-pearl" (here abbreviated in figures and tables by MOP), refers generally to the nacreous part of *Pinctada*[4] valve. Ornaments conserving the general natural shape of the shells are oriented and measured according to biologic conventions.

The finished ornaments are classified into three categories of forms: anatomical, geometrical, and specific. The first comprises objects conserving the natural shape of the material, or those imitating anatomical shapes (*e.g.,* tooth imitation using stone or bone). Imitations of anatomical forms have not been attested at Ba`ja so far. The geometrical category includes objects the shape of which was transformed

[4] Species names are written according to general nomenclature in italics. However, for the sake of readability "sp." is omitted in the text but not in the tables and captions.

according to a simple geometrical volume (torus, cube, cylinder, sphere, ellipse, *etc*.). The specific category comprises objects of specific shapes (*e.g.,* double pointed longitudinal plugs).

Documentation

A database was created to register the contextual information of all the objects, their state of preservation, type, material and measurements. Initially, each object was described in a study sheet designed to document and map any anthropogenic modifications (technic and use traces). Taphonomic alterations, such as natural erosion and modification of shored shells (predator or backwash piercings or fracturing, *cf.* Dupont 2006), were assessed through comparisons with the above mentioned malacological referential and with a personal collection. The typological differentiation applies the morphometric criteria established by the author (Alarashi 2014). The study of the technical pieces (preforms, unfinished objects, wastes, working accidents, *etc*.) allowed for the identification of the technical stigmas observed on the finished objects. Interpretation of the technical traces was also based on comparisons with experimental references (Alarashi 2010: 201, 2014, 2021).

The objects were observed under a binocular stereoscope (*Euromex SteroBlue* 0.7X-45X) at the field's lab, and with a macroscope (*Leica* Z16 APO 0.7X-90X) at the CEPAM CNRS laboratory (University of Nice, Côte d'Azur). The entire assemblage was 2D scanned on both sides for most of the objects. Finally to facilitate their microscopic

Table 2 Shell species identified and frequency of specimen within the studied assemblage. N=number of artefacts, * freshwater snails.

Class	Family	Species	Origin	N
Bivalvia	Cardiidae	*Cardium* sp.	?	2
Bivalvia	Cardiidae	*Cerastoderma glaucum* (Bruguière, 1789)	Mediterranean	1
Bivalvia	Glycymerididae	*Glycymeris* sp.	?	2
Bivalvia	Pteriidae	*Pinctada margaritifera* (Linnaeus, 1758)	Red Sea	14
Bivalvia	Pteriidae	*Pinctada* sp.	Red Sea	52
Bivalvia	Tridacninae	*Tridacna* sp.	Red Sea	10
Gastropoda	Conidae	*Conus parvatus* (Walls, 1979)	Red Sea	4
Gastropoda	Conidae	*Conus taeniatus* (Hwass in Bruguière, 1792)	Red Sea	4
Gastropoda	Conidae	*Conus textile* (Linnaeus, 1758)	Red Sea	2
Gastropoda	Conidae	*Conus* sp.	?	9
Gastropoda	Conidae?	*Conus* sp.	?	3
Gastropoda	Cypraeidae	*Naria nebrites* (Melvill, 1888)	Red Sea	7
Gastropoda	Cypraeidae	*Naria turdus* (Lamarck, 1810)	Red Sea	4
Gastropoda	Nassariidae?	?	?	1
Gastropoda	Naticidae	*Polinices mammilla* (Linnaeus, 1758)	Red Sea	2
Gastropoda	Neritidae	*Nerita sanguinolenta* (Menke, 1829)	Red Sea	28
Gastropoda	Neritidae	*Nerita polita* (Récluz, 1841)	Red Sea	17
Gastropoda	Neritidae	*Nerita* sp.	Red Sea	3
Gastropoda	Olividae	*Ancilla* sp.	Red Sea	2
Gastropoda	Strombidae	*Conomurex fasciatus* (Born, 1778)	Red Sea	3
Gastropoda	Strombidae	*Strombus* sp.	?	1
Gastropoda	Torchidae	*Clanculus pharaonius* (Linnaeus, 1758)	Red Sea	1
Gastropoda	Melanopsidae*	*Melanopsis* sp.	?	1
Scaphopoda	Scaphopoda	*Dentalium* (?) sp.	?	1
Total				**174**

analyses, the perforations of resistant and well-preserved tubular stone beads were casted using high resolution silicone (*Coltene President Jet* light body).

Results

Unlike most of the graves' ornaments, shell and stone beads found in non-funerary contexts at Ba`ja are well preserved which facilitated our macro- and microscopic analyses. However, the nacreous structures of the mother-of-pearl objects are fragile and for many unpreserved. Therefore, these objects were handled as delicately as possible to avoid their detoriation.

Organic-Based and Mineral Raw Materials

Shell Species

A large diversity of marine shells was exploited for ornaments at Ba`ja (Fig. 2). In the assemblage, these are represented by at least thirteen families and more than fifteen species. Within Conidae (Fig. 2p-r), Neritidae (Fig. 2j-o) and Cypraeidae families (Fig. 2a-e), several species were identified (Table 2), all originated from the Red Sea, except for undetermined *Conus* that may have come from the Mediterranean. The other gastropod families, Nassariidae (Fig. 2h), Naticidae (Fig. 2f-g), Olividae (Fig. 2s-t), Strombidae (Fig. 2u-v) and Torchidae (Fig. 2i) are represented by few specimens (1 to 4) and are all from the Red Sea.

Bivalves are dominated by *Pinctada margaritifera* (Pteriidae) (Fig. 8a-c). These shells occur at different sizes in their natural habitat, reaching up to 25cm in diameter (Lindner 2005). One left valve (Fig. 8a) and eight large fragments (matrices) (Fig. 8b-c) were counted in the assemblage. The presence of large portions of rings (diameter of at least 8cm) extracted from *Pinctada* valves, indicates that large specimens were also brought to the site. The assemblage contains also few a Cardiidae (Fig. 2x,z) and Glycymerididae (Fig. 2y) valves, originating from the Mediterranean Sea.

Several beads and rings were made from a soft white, sometimes slightly chalky material that integrates translucent and parallel beige stripes (Figs. 3e, 10d, 13e). XRF analyses of one sample revealed a very high amount of aragonite, indicating that this material was extracted from shells. Similar beads identified as made from *Tridacna* bivalves (pers. comm. H.G.K Gebel, reported from D. Reese's study) are recurrent at Basta. Recent proteomic analyses made on identical beads from Ba`ja confirmed that these beads were made from *Tridacna* (Alarashi b this volume: Table 2, Figs. 11-12). Finally, only one *Dentalium* (Fig. 2w) is recorded in the assemblage although *Dentalium* shells in Basta were also found quite frequently in burial contexts.

Other Organic-Based Materials

Besides shells, the assemblage contains a small, long bone[5] (Fig. 10l) from an unidentified small mammal (pers. comm. L. Gourichon) as well as a raw fragment and a disc bead from an ostrich eggshell (a *Struthio camelus syriacus* sub-species, Fig. 3b). The disc bead was XRF analysed and identified as limestone of possibly coral origin at the Landesamt für Geologie, Rohstoffe und Bergbau, Freiburg. However, the aspect of the inner surface is identical to the mosaic-like pores' inner surface of ostrich eggshell (Sauer 1972; Wei *et al.* 2017). It was therefore identified as ostrich eggshell.

Minerals

Nine of the 32 mineral-based objects were analysed by XRF (Table 3; Gerlitzki and Martin this volume). These elements have diverse colours, aspects, and physical properties characteristic of the mineral groups to which they belong (Table 3). Two types of sandstones were used. One beige (inner side) and ochre (on the surface) – very fine-grained (Fig. 3p); and the other grey, coarse-grained and looks more resistant (Fig. 3r).

The group of carbonates contains: one bead (other than the up-cited ostrich eggshell) identified as limestone – possibly coral-based (Fig. 10n), one of limestone or sandstone (coral sand), and one of limestone, possibly marble (Fig. 3h). Two unanalysed additional items are likely limestone as well. Marl paste was also used (Fig. 3s-u). Three mineral species of the so-called "greenstones" were identified: turquoise (Fig. 3k,m), chrysocolla (Fig. 3j,n-o) and amazonite (Fig. 3f). A fragment of an unworked copper ore was also recorded.

[5] Ornaments made from bones are studied by Bilal Abuhelaleh. Only one tubular bead was available in the assemblage.

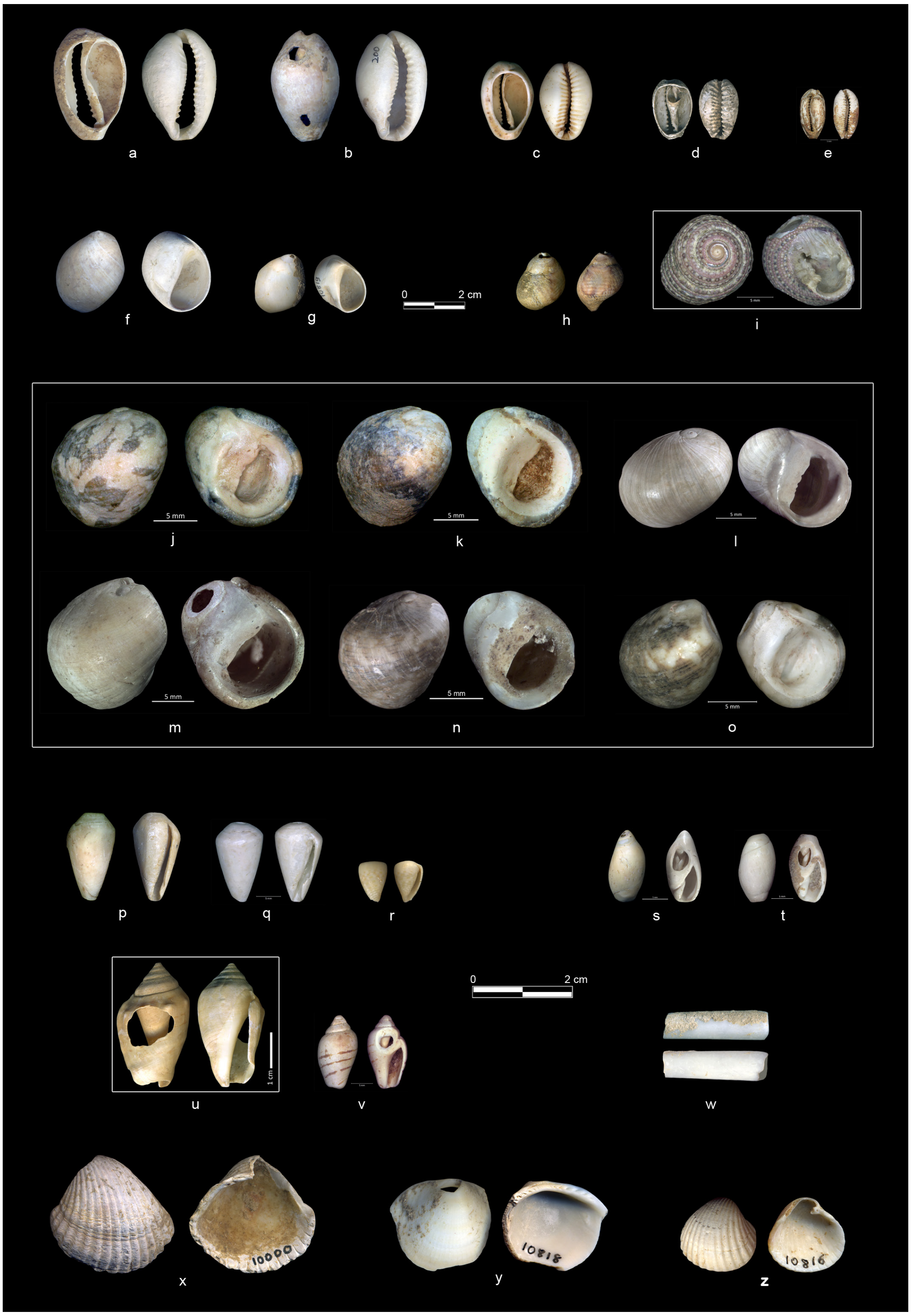

Fig. 2 Shell species and anatomical types. Shell species: *a-b Naria turdus*; *c-e Naria nebrites*; *f-g Polinices mammilla*; *h Nassarius* (?); *i Clanculus pharaonius*; *j*, *k*, *m*, *n Nerita sanguinolenta*; *l*, *o Nerita polita*; *p*, *q Conus taeniatus*; *r Conus parvatus*; *s*, *t Ancilla* sp.; *u Conomurex fasciatus*; *v Strombus* sp.; *x Cerastoderma glaucum*; *y Glycymeris* sp. Anatomical types: *a*, *c*, *d*, *e* cowries with removed dorsum; *b* cowrie with holed dorsum; *f*, *g Natica* holed body whorl; *h Nassarius* sp. holed body whorl (? unfinished piercing); *i Clanculus* sp. holed body whorl; *j-o Nerita* sp. holed spire; *p-r Conus* sp. holed apex; *s-t Ancilla* sp. holed body whorl; *u-v Strombus* sp. holed body whorl; *x-z Cardium* sp. holed umbo; *y Glycimeris* sp. holed umbo. Corresponding find and study numbers: *a* (0213, 128); *b* (0200, 135); *c* (40803, 131); *d* (30002, 133); *e* (10805, 188); *f* (60842, 138); *g* (10819, 148); *h* (20814, 147); *i* (20802, 144); *j* (0206, 28); *k* (10004, 6); *l* (0212, 52); *m* (100811, 127b); *n* (20218, 46); *o* (20800, 44); *p* (20817, 14); *q* (0804.1-2, 161a); *r* (100808, 154); *s* (100801, 125c); *t* (0803, 58); *u* (100806, 146a); *v* (30001, 151); *w* (30801, 150); *x* (10000, 152); *y* (10818, 155); *z* (10819, 141). (Photos: H. Alarashi, Ba`ja N.P.)

Table 3 Frequency of specimens according to the identified minerals and the state of transformation of the studied assemblage.

Mineral Materials		Hardness	Colour Diversity	Bead	Raw Material	XRF
Sandstone		<4	Ochre, purple, grey	4		
Carbonates	Limestone - coral based (?)		Light orange	1		1
	Limestone/ sandstone (coral sand)		Black anthracite	1		1
	Limestone marble type (?)		Light beige	1		1
	Limestone		White, grey	2		
	Marl		Light grey, brown	4		
Copper ores	Chrysocolla	≤4	Mottled green and brown	2		2
	Copper indet.		Copper green		1	
Phosphates	Turquoise	5-6	Blue, light green	5		2
Silicates	Amazonite		Light blue-green to grey	1		1
Chalcedony	Carnelian	>6	Dark red	1	8	1
Total				**22**	**9**	**9**

The chalcedony group is represented by carnelian (Fig. 3i), a dark reddish translucent microcrystalline variety of quartz, for which one bead and eight raw nodules and fragments were registered.

Our investigation about the potential sources of raw materials is ongoing. Yet we can say straightaway, that neither turquoise, chrysocolla, other copper ores, nor amazonite are available in the immediate environment of Ba`ja (Hauptmann 2004). To better identify the provenience of the marl, sandstone, and carbonate based ornamental elements, analyses and comparisons with geological samples from local regional sources will be needed.

Forms and Types

At Ba`ja, the ornaments belong to three general categories of forms. Shells were exploited for the anatomical and geometric, stones for the geometric and marl for specific forms. Some beads from Burial CG9 seem to be made of marl (see Alarashi and Benz this volume: Table 1) but their identification is preliminary.

Morphotypes were distinguished for each category (Table 4). Those of the anatomic forms correspond to the determined taxa and to the location of the piercing (Fig. 2). Geometric and specific morphotypes are distinguishable based on morphometric criteria, and from the number and position of the holes. The hole[6] and the perforation are the main hanging devices of the objects. Yet, it cannot be excluded that some of them were glued, sewn, or tied up with strings onto substrates that have disappeared.

Anatomic Types

One type is distinguished per shell genus (Table 4), but an exception was made for cowries that comprise two types: one with the removed *dorsum* (Fig. 2a,c-e), which is the dominant type (n=10), and the other with a double pierced *dorsum* (Fig. 2b), which was recorded by only one shell. Aside from the small *Conus parvatus* (Fig. 2r), shell beads at Ba`ja have a main axis exceeding 10mm. Large-sized shells (main axis >25mm) are restricted to two *Naria* (Fig. 2a-b), one *Conomurex* (Fig. 2u) and two *Polinices* shells (Fig. 2f-g). Significant variability in the size of shell beads from the same type (Fig. 3) could be explained either by the presence of different species of the same genus (*e.g.*, *Conus*), by individuals of different ages (adult *vs.* juvenile) or by sex (sexual dimorphism?).

[6] The hole consists in piercing the surface of the material to create an opening, while perforation consists in digging deep into the material to create a path within the mass.

Fig. 3 Shell and mineral-based objects of geometric and singular shapes: *a-r* geometric shapes; *a-b* disc beads from MOP and ostrich eggshell; *c-d*, *q* cut-conus beads; *e-f* sub-cylindrical *Tridacna* sp. and amazonite beads; *g*, *h*, *i*, *o* barrel-shaped respectively *Tridacna* sp., limestone, carnelian and chrysocolla beads; *j* chrysocolla rectangular compact bead; *k* turquoise sub-oval pendant; *l* *Tridacna* sp.; *m-n* double perforated compact objects "button"; *p*, *r* sandstone pointed rings; *s-u* singular shapes, marl "lip-plugs".
Corresponding find and study numbers: *a* (60835, 158); *b* (10801, 157); *c* (100807, 145); *d* (100800, 125b); *e* (20830, 171); *f* (30800, 66); *g* (20841, 156); *h* (60833, 164); *i* (100804, 168); *j* (0804.1-2, 161b); *k* (60836, 162); *l* (40802, 70); *m* (100809, 169); *n* (0406, 160); *o* (0805, 159); *p* (60438, 60); *q* 100801.125a); *r* (60437, 61); *s* (10809, 63); *t* (1626, 64); *u* (1627, 62). (Photos: H. Alarashi)

Table 4 Identified morphotypes and their frequency within the studied assemblage according to the material category. OES=ostrich-egg shell

Form	Morphotype	Shell	Stone	Marl	Bone	OES
Anatomic	Valves pierced umbo (Fig. 2x-z)	4				
	Conus pierced apex (Fig. 2p-r)	11				
	Cowrie removed dorsum (Fig. 2a,c-e)	10				
	Cowrie pierced dorsum (Fig. 2b)	1				
	Polinices sp. pierced whorl (Fig. 2f-g)	2				
	Nerita sp. pierced spire (Fig. 2j-o)	48				
	Ancilla sp. pierced whorl (Fig. 2s-t)	2				
	Conomurex sp. pierced whorl (Fig. 2u-v)	2				
	Clanculus sp. pierced whorl (Fig. 2i)	1				
Geometric	Disc bead (Fig. 3a-b)	5	2			1
	Double perforated disc bead (Fig. 5y)	1				
	Single and multi-perforated polygon (Fig. 5u-v)	2				
	Cut *Conus* bead (Fig. 3c-d,q)	4				
	Cylindrical bead (Figs. 2w, 3e-f)	6	1			
	Sub-elliptic (barrel) bead (Figs. 3g-i,o, 9n)	1	7			
	Flat polygonal bead (Fig. 3l)	1				
	Compact cuboid bead (Fig. 3j)		3			
	Double perforated compact bead (Fig. 3m-n)		2			
	Flat ring (Fig. 5f-t)	27	1			
	Tubular ring (Fig. 5a-e)	18				
	Pointed rim ring (Figs. 3p,r, 5z)	1	2			
Specific	Longitudinal plug biconvex ends (Fig. 3s-u)			4		

Geometric Types

Several typological families pertain to the category of geometric forms (Table 4). Except for some rings, the objects of this category are generally small.

Objects with a single centred short perforation (disc beads): These small items have sub-circular shapes. In this assemblage, they occur in mother-of-pearl and ostrich eggshells (Fig. 3a-b), and in soft carbonate stones. In burials, disc beads occur in more colourful materials such as red calcite, turquoise, sandstones, marl, or other "greenstones".

Objects with a single decentred short perforation (pendants): The typological family of pendants is under-represented. Only one small flat sub-oval turquoise pendant was counted (Fig. 3k). The same type and material was recorded however twice, in a burial of a young adult along with a third specimen made from carnelian (Benz *et al*. 2019: Fig. 13.1-3).

Objects with a single centred long perforation (beads): This large typological family contains three groups of beads: tubular, flat and compact.

Tubular beads are made from shell, bone, and stone (Table 4). Three types are distinguished within the assemblage: sub-oval (barrel-shaped) (Figs. 3g-i,o, 10n); cylindrical (Figs. 2w, 3e-f) and cut *Conus* short beads (Fig. 3c-d). Cylindrical and barrel-shaped beads (n=230) made from stripped white *Tridacna* shells (Fig. 3e) were the second most abundant type used in the composition of the child's necklace from the Burial CG7, Loc. C1:46 (Alarashi b this volume: Table 5). In the studied sample they are represented by only four items. Among the stone beads, two are quite exceptional. One is made from carnelian (Fig. 3i), which is a rarely employed material

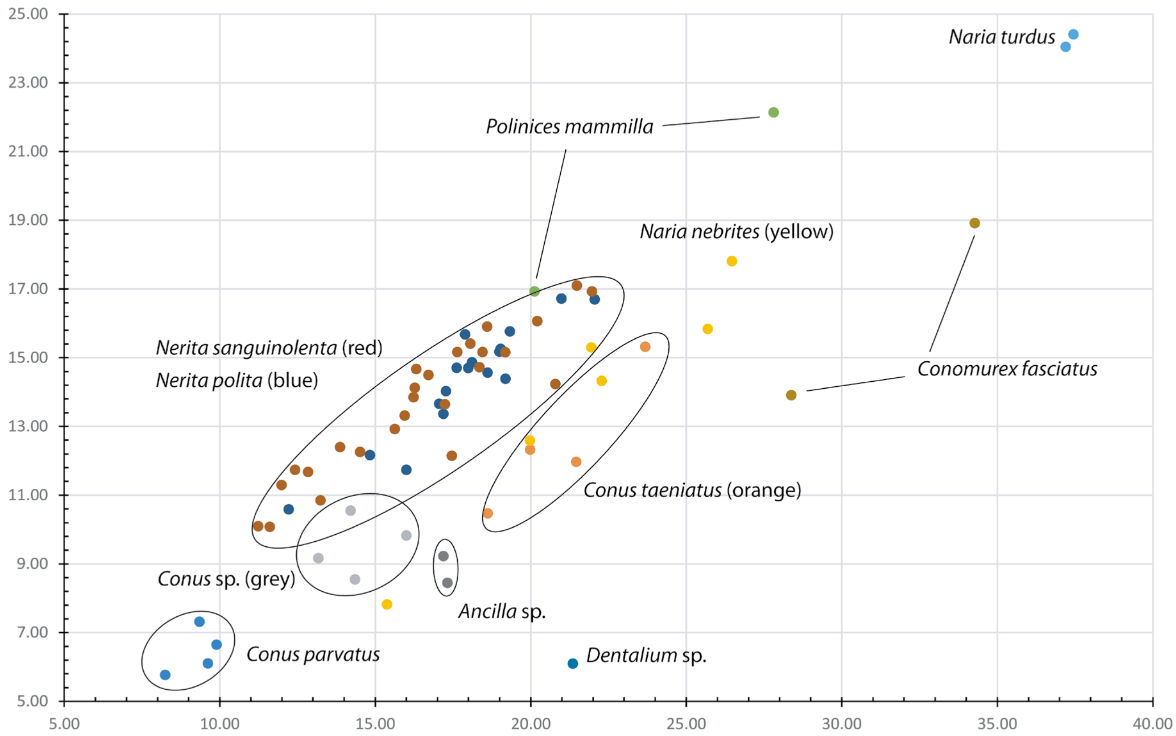

Fig. 4 Sizes of the identified species of the pierced shells represented by the ratio of length to width. (Graph: H. Alarashi, Ba`ja N.P.)

for beads in the southern Levant, and the other made from a common material, chrysocolla, but has an unfinished perforation (Fig. 3o). Tubular "greenstone" beads, probably chrysocolla, are recorded in some burials.

Flat beads appear quite frequently in burials (especially in those excavated in 2018 and 2019), and only one shell bead of polygonal shape represents this group within the assemblage (Fig. 4l). In the child Burial CG7 (Loc. C1:46), a total of seven small flat sub-oval beads, made from red calcite, were used for the composition of the necklace.

Compact beads were exclusively made from "greenstones" (Fig. 4j). Their shape is sub-cuboid or sub-spherical. The sub-spherical type is represented by two almost identical dark grey hematite beads found in the child's burial (Loc. C1:46).

Double perforated objects ("buttons" or "spacers"): This family contains two groups of probably distinct functionalities: objects with double centred (close) perforations, commonly known as "buttons"; and objects with double bilateral distanced perforations, sometimes named "spacers". The latter is absent from the assemblage, but represented by a hematite black example used in the child's necklace (Loc. C1:46). Buttons were made of mother-of-pearl and stones. The former use disc-shaped supports and are attested in the assemblage by a unique item with a serrated, decorated outline (Fig. 5y). This type exists at the contemporary site of Basta on stone anhydrite discs (Hermansen in prep.: Plates 4 and 8.3). Simple disc-shaped buttons do not occur in this assemblage, but have been discovered previously at the site (Gebel 2001: Fig. 11). Stone buttons at Ba`ja employ the cuboid or ellipsoid volumes similar to those of compact beads (*cf.* supra) and likewise, they are exclusively made from "greenstones" (Fig. 3m-n) within the non-funerary assemblage collected so far.

Mother-of-pearl *varia*: These are mother-of-pearl polygonal fragments with curved edges and multiple perforations – quite common at Ba`ja and Basta. The assemblage contains one example with slightly decentred perforation that might have been used as a pendant (Fig. 5u). Another sub-triangular example with four perforations, two of which were broken, is also part of this group (Fig. 5v). Types within this group are hard to distinguish because of the high variability of shapes, number, and location of perforation(s). Such variability is likely due to the technoeconomic management of remaining manufacturing debris or of broken items (*cf.* infra).

Rings: Despite the high fragmentation rate within the rings (Fig. 5), it was possible to distinguish three groups: the flat, the narrow and the pointed rings (Fig. 6).

Flat rings: most of the rings pertaining to this group are made from *Pinctada* mother-of-pearl (Fig. 5f-t). The width of the flat surface, measured between the inner and the outer diameter, varies between 2 and 18.9mm, proportionally with the diameter. Only one ring is complete. It has the inner diameter of about 12mm (Fig. 5g). The largest ring of the assemblage has a diameter estimated to be at least 9cm, based on the measurement of the remaining portion (Fig. 5t). The flat rings can bear one or more perforations (Fig. 5m,q). It is however unclear whether these were made while creating the ring or subsequently after the breakage – as for repairing the ring or for recycling ring portions.

Decorated rings exhibit quite complex shapes; the external diameter can bear up to four engraved outgrowths distributed equally. Each has a group of three or more equidistant perforations. They occur in burials at Ba`ja (Gebel and Hermansen 2001: Fig. 7; Alarashi b this volume: Fig. 18) and Basta (Gebel 2002: Fig. 10), and can be considered as a type belonging to the flat group. The assemblage contains two sophistically engraved mother-of-pearl fragments (Fig. 5w-x) that might have been broken from the outgrowths of decorated rings.

Narrow rings are sub-circular rings that have, unlike the flat rings, slightly high walls of rectangular or planoconvex sections. They are cut from large *Conus* shells (Fig. 5a-c) or shaped from a *Tridacna* valve (Fig. 5d-e). The height of the ring walls ranges from between 3 and 6.34mm, and their inner diameter between 13 and 19mm.

Pointed rings have two pointed extremities, with one more pronounced than the other. The large extremity generally bears two close perforations. The studied assemblage offers only one small example made from mother-of-pearl (Fig. 5z). Complete and large specimens are more recurrent in funerary contexts. For instance, the same type in two different sizes was discovered in 2019 in Burial CG11 in Room CR17. They were attributed to an infant (n° 101). Another large example was uncovered in the collective Burial DG1, published by Gebel and Hermansen (2001: Fig. 7). Mother-of-pearl *Pinctada* is used to create rings from this group (Fig. 5z). Examples discovered in burials (unstudied yet) would also be made from the same shells, along with other valves such as *Glycymeris* (Dimitrijević and Tripkovic 2006). This taxon is thus far not recorded at Ba`ja, but it occurs in other PPN sites in the southern Levant (Abu Laban 2014; Spatz *et al.* 2014: Table 16.1). Finally, pointed rings were also made of sandstone (Fig. 4p,r), although they do not bear perforations.

Specific Forms

The assemblage contains three objects modelled from marl paste and interpreted as lip plugs (H.G.K. Gebel, pers. comm., Alarashi and Benz this volume: Appendix 1). They have an elongated oval shape with planoconvex extensions and are slightly pointed from each extremity (Fig. 3s-u). Only one example is complete (Fig. 3u) as the other two have fractures on different parts. Their height ranges between 21.5 and 27.9mm and they are relatively heavy. A larger (and heavier?) example has been published by Gebel (2001: Fig. 11).

Techniques and Manufacturing Methods

Supports chosen for beads at Ba`ja are manufactured either by simple piercing or by the application of successive technical stages including roughing, shaping, drilling, and finishing.

Shells' Piercing Techniques

Shells gathered from the seashores might have been already pierced by natural phenomena. This is probably the case of four cowries, two bivalves (Fig. 7p), one *Nerita* and one *Strombus* shells. Identified piercing techniques include grinding, sawing, indirect percussion, pressure, and flexion (Table 5).

Grinding is by far the most commonly applied technique. It produces a flat surface, called facet – full of parallel striae around the hole. Grinding facets were identified on the spire of *Nerita* shells (Fig. 7b-c), on the columellar shoulder of one *Polinices* shell (Fig. 7f), on the *apex* (Fig. 7g), and on the body whorl of *Conus*, *Ancilla* (Fig. 7d) and *Strombus* shells (Fig. 7e). It was probably applied on one *Cerastoderma* valve as well (Fig. 7o).

Fig. 5 MOP objects: *a-t* portions of rings, *g* complete specimen; *a-e* tubular rings; *f-t* flat rings; *u-v* ornamental elements; *w-x* decorated outgrowth of engraved rings (?); *y* decorated disc "button"; *z* double perforated pointed ring.
Corresponding find and study numbers: *a* (0805, 109); *b* (0407, 112); *c* (10807, 111); *d* (10808, 113); *e* (60400.2, 79); *f* (60439, 184); *g* (0404.1-2, 183); *h* (0412, 114); *i* (0413, 107b); *j* (60404, 105); *k* (20214, 104); *l* (10813, 103); *m* (10402, 115); *n* (60403.1, 106); *o* (20215, 124); *p* (20410, 120); *q* (0406.1-4, 87); *r* (60445, 84a); *s* (20209, 89a); *t* (100400, 100); *u* (10403, 68); *v* (2076, 69); *w* (60400, 71); *x* (60442, 76); *y* (0410, 67); *z* (0411, 72). (Photos: H. Alarashi, Ba`ja N.P.)

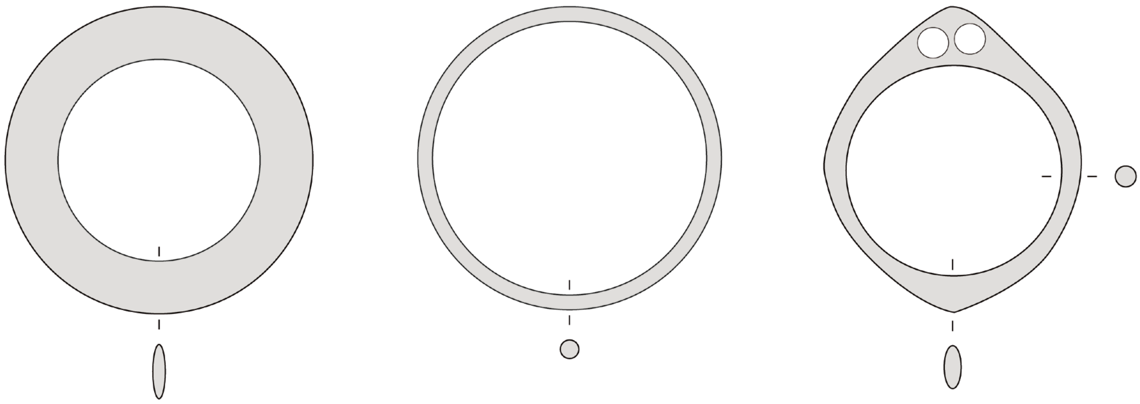

Fig. 6 Schematic drawing representing, from left to right, the flat, the narrow, and the pointed main types of MOP rings at Ba`ja. (Drawing: H. Alarashi, Ba`ja N.P.)

Table 5 Identified piercing techniques of shell beads sorted per taxonomic family.

Piercing Techniques	Grinding	Sawing	Indirect Percussion	Pressure	Percussion or Pressure	Bending	Indet.	Natural
Cerastoderma sp.	1						2	
Glycymeris sp.	1							1
Conus sp.	9							1
Naria sp.	1	1	1				8	
Nassarius ? sp.	1							
Polinices sp.	1			1				
Nerita sp.	32		1		2		2	1
Ancilla sp.	2							
Strombus sp.	2				1			
Clanculus sp.					1		1	
Dentalium sp.						1		

Grinding traces are identified for one cowrie shell, showing a perfectly flat opening (Fig. 2a). The inner whorl of the cowrie is missing, except for the edge that bears grinding traces and negatives of shell removals. The latter are also observed on the inner side of the edges of the hole. This suggests that previous to the grinding, the *dorsum* was removed by direct or indirect percussion, or that the cowrie was collected with an already naturally pierced/ destroyed *dorsum*. Grinding was applied to eliminate the irregularities of the opening.

The sawing technique was applied to remove the *dorsum* on at least one cowrie shell. The openings created on the dorsal side by this technique have generally large edges, inside of which well-marked sawing striations are observed (Fig. 7h-i). The edge of the hole is not as perfectly flat as those produced by grinding. This reflects slight changes in the direction used of the cutting tool. On the lateral surfaces of the cowries, accidental sawing striations parallel to the edge confirm the diagnostic traces of the sawing technique (Fig. 7i). Based on experimentations, such striations are produced when the tool slips from the cutting groove. The inner whorl was deliberately removed, and sawing traces are occasionally observed on its remaining edge (Fig. 7j).

The pressure technique is suggested for one Naticidae shell (Fig. 7k). This technique is particularly effective for piercing thin-shelled specimens. Pressure by bending was probably applied to cut the extremities of one *Dentalium* shell.

Indirect percussion was applied to pierce twice the thick-shelled *dorsum* of a cowrie

Fig. 7 Technical and use-wear traces observed on shell beads from Ba`ja: *a-c* grinding facets on *Nerita* sp.; *d Ancilla* sp.; *e Strombus* sp.; *f Policenis* sp.; *g Conus* sp. and on *o* a *Cerastoderma* sp.; *a* enlarged ground hole on *Nerita* sp.; *n* grinding facet on an unpierced *Nassarius*? sp.; *h* sawing striations on the perforation edge; *i* lateral side; *j* internal whorl of cowrie shells; *k* traces of indirect percussion on *Naticidae*, see the use-wear notch (blue arrow); *l* indirect percussion on a cowry shell, see small piercing on the internal whorl (blue arrow); *m* percussion or pressure (?) on *Clanculus* sp.; *p* natural hole(?) on a valve, see use-wear notches (blue arrows).
Corresponding find and study numbers: *a* (0800, 41); *b* (30807, 35); *c* (20800, 44); *d* (0803, 58); *e* (30001, 151); *f* (60842, 138); *g* (0802, 59); *h* and *i* (40800, 129); *j* (40803, 131); *k* (10819, 148); *l* (0200, 135); *m* (20802, 144); *n* (20814, 147); *o* (10816, 141); *p* (10818, 155). (Photos: H. Alarashi, Ba`ja N.P.)

(Fig. 7l). This technique produces relatively small and quite irregular holes. Typical impact points associated with removals are visible all around the perimeter of one hole with the surrounding area of the other hole being covered with a fine yellowish deposit, impact points and removals are not visible. Yet, the edge is irregular, and a tiny piercing is observable on the inner whorl (Fig. 7l blue arrow). The latter, located almost exactly in the centre of the irregular large hole, indicates the use of a pointed tool.

The combining of techniques during the piercing process might have been a very common practice. At Ba`ja, holes obtained by grinding (Fig. 7b) were enlarged either by rotation of a tool inside the hole, by pressure or by indirect percussion. The use-wear observed on the rims of the holes made it difficult to distinguish which of these techniques were used to enlarge the hole (Fig. 7a). Some *Nerita* shells have small irregular holes (the smallest has 1.06mm of diameter) suggesting that they were not enlarged (Fig. 7b), or that the piercing process was unfinished. Finally, the grinding process of a *Nassarius* was interrupted at a quite advanced stage, just before the obtention of the hole (Fig. 7n).

To sum up, shell beads at Ba`ja were mainly pierced by grinding, but also occasionally by other techniques. Interestingly, while the techniques can vary for *Nerita* and cowrie shells, the location of the piercings remains the same. Finally, it seems that naturally pierced shells were also collected.

Elaborate Manufacturing Methods

Multi-stage manufacturing processes described here concern all the geometrical and the specific types.

<u>Rings:</u> in addition to the sandstones employed in the creation of thousands of rings at Ba`ja, a range of shells were used to create various types.

<u>Mother-of-pearl:</u> *Pinctada margaritifera* valves, mother-of-pearl fragments, debris and finished objects (Fig. 8) suggest ornament manufacturing at the site. Microscopic analyses allowed a hypothetical reconstruction of the simple flat rings' manufacturing method (Fig. 9). Future experimentations are planned in order to detail technique(s) within each stage, and to estimate the level of technicity as well as the time investment required.

At least five objects with recognisable features of *Pinctada* valves (Fig. 8a-e) called here "matrices" were prepared, in order to extract the mother-of-pearl supports (rings or others). The first stage consists of removing the *periostracum* layer on the outer surface to exhibit the mother-of-pearl (Fig. 8a). This operation was made by careful grinding as indicated by groups of parallel small striations on the *periostracum* side (Fig. 8a: detail). In one case, a disc-shaped support was extracted before removing the *periostracum* (Fig. 8c). The second stage is the incision of a disc shape on the inner concave surface of the shell. Many fragments show the outlines of the extracted discs (Fig. 8b-c,e-f). Two ways of extraction are possible: a) incising a circle and scraping inside in order to cut a large disc, and then repeating the same operation on the extracted disc to empty it and create the ring (Fig. 9a); b) starting by cutting a small disc inside the shell, thus creating the inner edge of the ring, then, after deciding the width of the ring, engraving and cutting the external edge (Fig. 9a). The choice of either option is probably determined by the size and the type of the ring. Sub-parallel well-marked cutting, scraping, and incising striations are observed on the inner and external edges of the rings (Fig. 8j-k). Large debris, wastes, or discs obtained after the extraction of the ring are converted into diverse products or kept for further use. The final stage after the extraction of the ring would consist of polishing and smoothing irregular surfaces. Small disc beads, polygonal pendants, and other elements made from mother-of-pearl can be considered as secondary products resulting from ring production.

<u>*Tridacna*:</u> at least four portions of rings were shaped from *Tridacna* shells (Figs. 5d-e, 10d). The raw material used is identical to the one used for the tubular beads (Fig. 10e). Shaping traces were undetected as these rings show relatively intense use (*cf.* infra).

<u>Sandstone:</u> two pointed-type rings were shaped by grinding and scraping a flat small slab of sandstone. On the complete item (Fig. 3p), traces of scraping all over the surfaces are still visible. The other object (Fig. 3r) shows small facets of grinding and scraping traces inside the perforation.

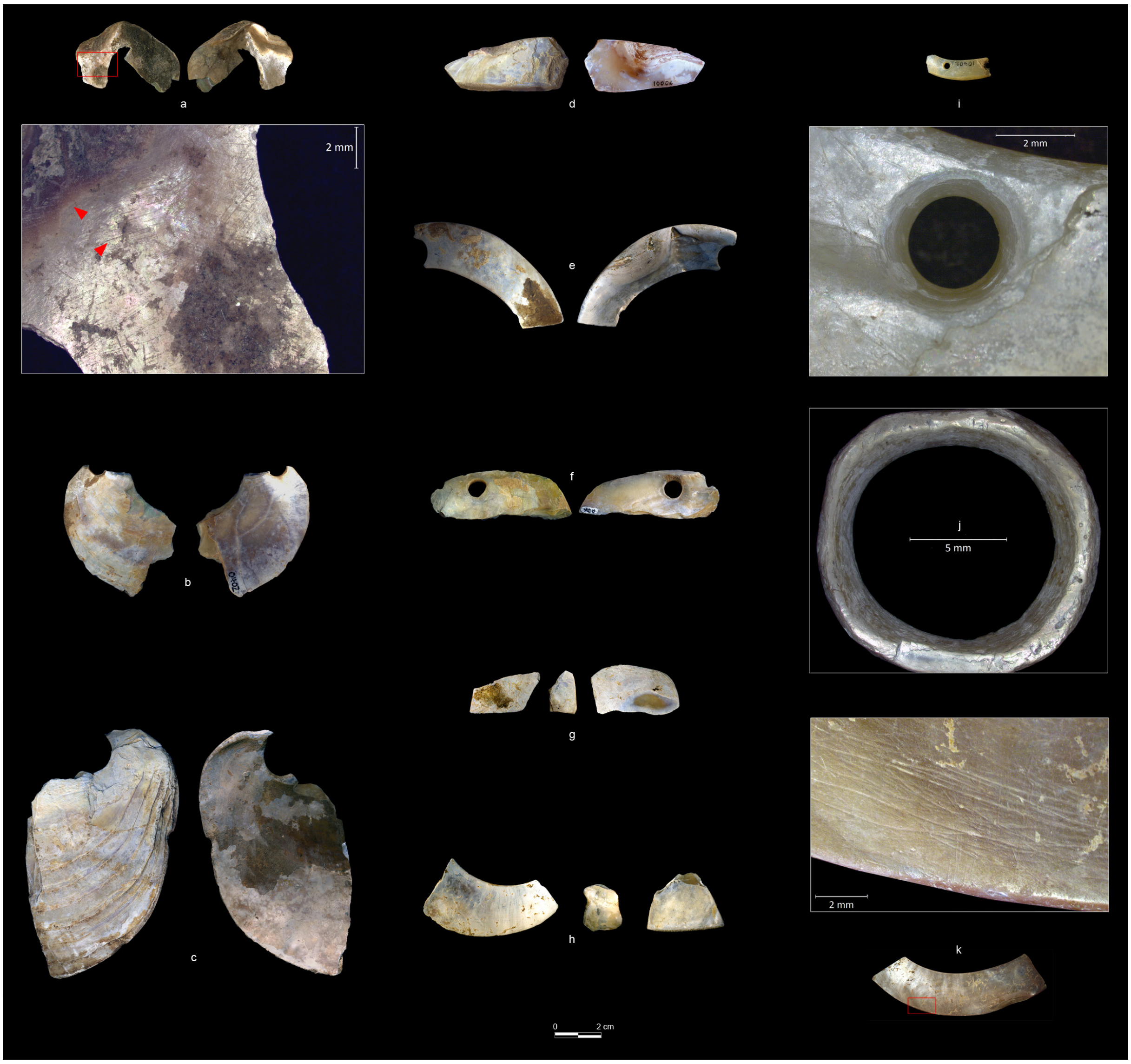

Fig. 8 *Pinctada* sp. technical pieces and final products with indications of manufacturing traces: *a-c Pinctada* sp. valves "matrix"; *e-f* fragments with extraction marks; *g-h Pinctada* sp. debris (?); *i* perforated ring portion; *j* complete ring; *k* portion of a large ring with traces of abrasion of periostracum.
Corresponding find and study numbers: *a* (10003, 149); *b* (0402, 91); *c* (100405, 179); *d* (10006, 77); *e* (60400.2, 79); *f* (0400, 88); *g* (60445, 84a, b, c); *h left* (60431, 85); *h center* (60434, 86); *h right* (60403, 89); *i* (10402, 115); *j* (0404.1-2, 183); *k* (100400, 100). (Photos: H. Alarashi, Ba`ja N.P.)

Disc beads, disc buttons, and the turquoise pendant: These are flat objects shaped from mother-of-pearl, carbonates, and turquoise.

Mother-of-pearl disc beads (Fig. 4a) show grinding traces on their circumference. After their extraction from the shell, their edges were regularised and smoothed. All the disc beads of the assemblage have very regular, almost perfect circular circumferences. This is also the case of the reddish disc beads found in the child's Burial CG7, Loc. C1:46 (Alarashi b this volume: Fig. 21). Such a regularity is probably the result of batch grinding (grinding several discs at the same time), which also produces a standardised size.

The drilling technique of the mother-of-pearl is certainly the same for all types of objects including disc beads. The drilling is always made from both sides (bipolar perforation), thus producing a biconical section (*e.g.,* Fig. 8i). Some perforations are enlarged so that the biconical section becomes almost cylindric (Fig. 3a). The circumference of the perforation is generally very regular (circular shape), and parallel marked striations can be observed on the walls of perforations. Based on these characteristics,

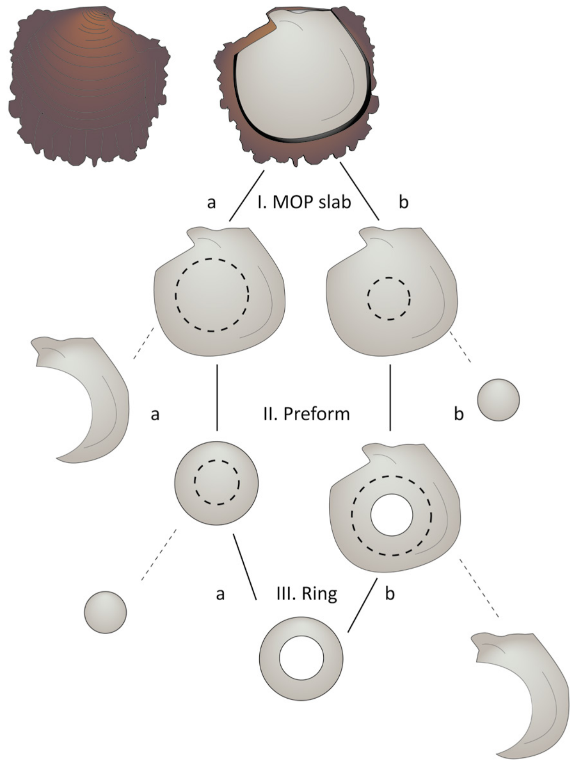

Fig. 9 Schematic drawing proposing the main manufacturing stages of *Pinctada* sp. simple rings. (Drawing: H. Alarashi, Ba`ja N.P.)

the drilling was made by either using a hafted drill bit rotated quickly between both hands, or by using a mechanical drill – for instance a bow-drill. A double perforated disc bead (Fig. 5y), probably used as a button, shows similar traces of manufacture as the simple disc beads, except that the circumference was entirely decorated with parallel incisions, exhibiting an original serrated edge. These incisions were made by sawing with a sharp cutting tool.

Carbonates: one bead shows a polished smooth face, while the other is very rough, probably because of a transversal breakage. The latter is grey-black in colour and was obviously burned, which might have caused the breakage of the bead (?). Grinding traces were observed on the circumference and on the preserved face of the disc. They are interrupted by the drilling marks, meaning that the perforation was made after the shaping of the bead. The other disc bead, the ostrich eggshell one (Fig. 3b), shows a bipolar perforation, subsequently enlarged by eliminating the junction intersection.

Turquoise: the shape of this pendant (Fig. 3k) is the result of grinding. The circumference is marked by adjacent grinding facets full of parallel oblique striations. The preservation of these traces indicates that the finishing stage, which usually consists of the application of a fine polish to smooth the surfaces, was not performed. The drilling was bipolar and mechanical, as attested by the parallel striations. Dark red particles of quartz (?) can be observed on the perforation walls and on the surface around the perforation (Fig. 10j). The drilling was successful despite the hardness of the stone at this location (?).

<u>*Conus* slice beads:</u> after the removal of the *apex* by grinding (Fig. 10a), *Conus* shells of different sizes were cut horizontally by sawing (Figs. 3c-d,q, 10b). Distal parts of cut *Conus* are absent from the assemblage. A few cut *Conus* shells (n=5) were used in the child's necklace in Burial CG7, Loc. C1:46.

<u>Flat, tubular, and compact beads:</u> flat beads were rather rare at Ba`ja. The polygonal shape of a *Tridacna* flat bead (Fig. 3l) was obtained by grinding; striations and facets are still visible on its surfaces. The perforation is broken, has a bi-conical section and was obtained by bipolar deviated drilling. The deviation of the drilling did not cause the breakage since the edges of the perforation show intense use-wear (contextual information are given in Appendix 1). The breakage was most likely caused by accident during use.

Tubular beads: cylindrical and sub-oval tubular beads are made from *Tridacna* (Fig. 3e, g), carbonates (Figs. 3h, 10n), chrysocolla (Fig. 3o), amazonite (Fig. 3f), and carnelian (Fig. 3i). The compact items are those made of turquoise (Figs. 3m, 10k) or chrysocolla (Fig. 3j,n) and include the single and double perforated beads and buttons. The white stripped tubular beads were cut in order to show the different patterns of the natural strips. These are available in three general orientations regarding the major axis of the bead: perpendicular, parallel, and oblique. The choice of exhibiting one or another pattern could have implied technical constraints, resulting in adaptations or variations in the extraction and shaping techniques. While the absence of raw materials and unfinished beads make it difficult to verify this hypothesis, further experiments might offer interesting answers. On the tubular beads, grinding striations are hardly visible under the microscope (Fig. 10g), except for the unfinished chrysocolla cylindrical bead (Fig. 3o), the surface of which is covered with juxtaposed grinding facets. This is also true for one compact broken turquoise bead and one complete chrysocolla bead (Fig. 3j). Drilling striations

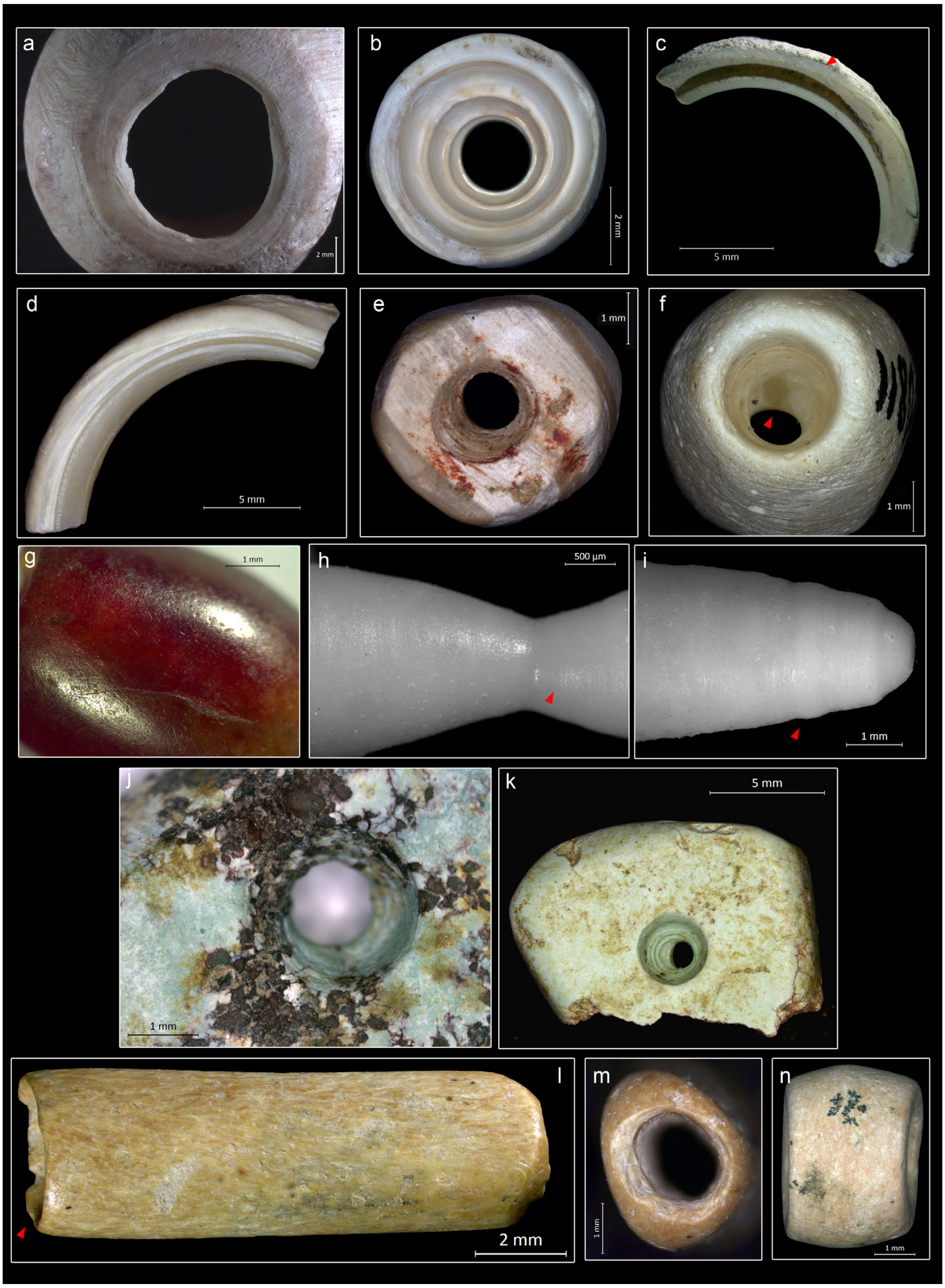

Fig. 10 Technical and use-wear marks observed on shell, stone, and bone beads from Ba`ja: *a* grinding traces on the apex of a *Conus* sp.; *b* sawing of the whole part of a *Conus* sp.; *c* sawing striations on a *Conus* sp. broken ring; *d* portion of *Tridacna* sp. ring; *e-f* bi-polar perforation on *Tridacna* sp. tubular beads, note the red pigment residues on the perforation area in *e* and *f* use-wear rounding on the junction area (red arrow) inside the perforation; *g* obliterated grinding striations on a carnelian bead; *h* silicone cast of the bi-polar perforation of the carnelian bead, note the sub-conical section, the almost perfectly aligned perforation channels, and the shiny polish next to the junction area; *i* silicone cast of a chrysocolla unfinished bead; note the well-marked striations indicative of a retouched drill bit; *j-k* drilling marks on a turquoise objects; *l-m* worked long bone with intensive use-wear marks; *n* carbonate-based short bead.
Corresponding find and study numbers: *a* (100801, 125a); *b* (100807, 145); *c* (10805, 109); *d* (n.d., 97); *e* (20830, 171); *f* (20841, 156); *g* (100804, 168); *j* (60836, 162); *k* (60800.2, 158); *l* and *m* (10815, 178); *n* (40801, 167). (Photos: H. Alarashi, Ba`ja N.P.)

are regular and parallel, and well-marked on the *Tridacna* (Fig. 10e-f), carbonates, turquoise, and chrysocolla perforation walls. The drilling technique is rapid, certainly made by a bow-drill. The silicone impression (cast) of one perforation side measures almost 10mm. It has a conical section and is perfectly straight, indicating the high stability of the drilling action. The end of the drilling is marked with grooves (Fig. 10j) suggesting that the drilling tip had a retouched cutting edge. Similar stigmas were produced experimentally on serpentine stone (Alarashi and Pichon 2018).

The perforation of the carnelian bead was first obtained by knocking the ground surface in order to create a shallow pit, from where the drilling can start, thus avoiding the slipperiness of the drilling tip. The removal of small chips and negatives are observed around the circumference of the perforation on both sides (Fig. 3i). The perforation is biconical and slightly deviated (Fig. 10h), and the drilling striations are very regular and extremely fine. The walls of the perforation are more polished near the junction area (meeting line of the bipolar drilling). The diameters and the length of perforations in the tubular beads at Ba`ja indicate that the drilling tips were quite small. The one used in the drilling of the chrysocolla unfinished bead (Fig. 3o) is among the longest (≈10mm) of the entire assemblage. The flint tools that were used to drill the perforations could have been straight small tips, made for instance from burin spalls.

<u>The marl “lip-plugs”:</u> The surface of these objects is covered with a fine sandy deposit preventing the observation of traces. Some broken areas exhibit the inner consistence of the material, which is a homogenous beige-coloured paste different from the surface itself (Fig. 3t). Judging from the morphology of the objects and from the cracks on the surface, the shape was most likely obtained by modelling a malleable wet paste that was dried (heating?) afterwards.

Use-Wear and Display Systems

The macro- and microscopic observations of the objects have revealed several patterns of use-wear correlated to the raw materials or the morphotypes, or both. On the one hand, the use of the items has affected the surfaces of the objects, as evidenced by random curvilineal striations, accidental scratches, impact points, or more rarely cracks in the raw material. On the other hand, broken objects are quite common within the assemblage. The breakages seem to have been produced accidently. Intensive use-wear of the kind that weakens and erodes the material progressively until its fracture, is not documented.

Pierced Shells

The location of the holes on the shells depends on the type and is rather standardised. For example, *Nerita* shells are systematically pierced on the spire, *Conus* on the *apex* and *Cyprea* on the *dorsum*. Small variations in the location are observed for the *Nerita* shells; with the spire being relatively large, the hole could be located according to different angles and places (*e.g.*, Fig. 2m,o). Such variations do not influence the display system significantly. However sometimes, shells have additional holes indicating a different functionality (*cf.* infra).

<u>*Nerita* beads:</u> the group of *Nerita* shells is composed of 48 specimens from which ten are unpierced. Regardless of the degree of irregularity of the rim of perforations and the variations in the diameters, all the holes present rounded rims (Fig. 7a-c) with variable extension of polish. In other words, all the pierced *Nerita* shells were used. The polish and roundness were caused by repeated friction using a string. In some cases (n=21), the polish is extended to include the whole perforated area (Fig. 7a). The grinding striations were erased at different levels: slightly (n=8, Fig. 7c), intensively (n=13, Fig. 7b) or completely (n=4, Fig. 7a).

The rounding and the polish of the rims of perforations are generally homogenous, with no specific sectors more intensely used than others, nor are there deep notches created by localised/fixed friction of the string. It is possible that the string was thick enough (thereby in contact with the rims of the hole), which can sometimes stabilise light objects when hanged without making knots of interlacement.

For many shells (n=24), the *labrum* presents a small fracture or notch (Fig. 11) found almost systematically at the same location. This pattern is observed on both the pierced and unpierced shells. When no fracture is observed, a strong rounding and polish is observed at the same place on the *labrum* (Fig. 11B). The alteration of the *periostracum* on the body whorl at the most convex surface, as well as on the spire around the perforation surface, is another interesting observation. Again, this is also the case for the unpierced shells (8 out of 10).

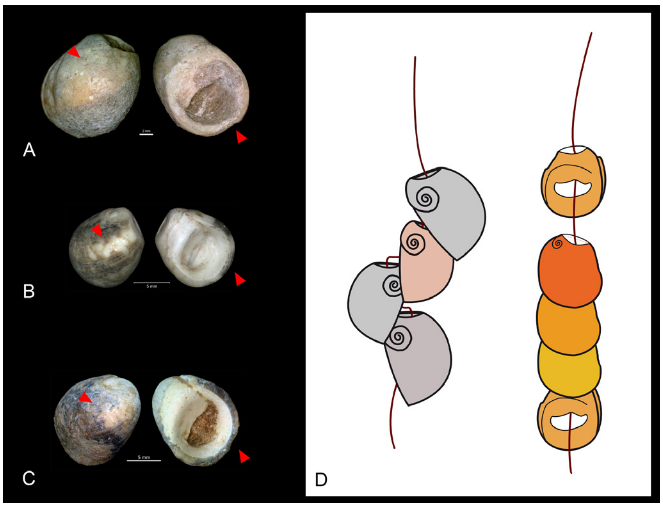

Fig. 11 *A-C* Use-wear traces on *Nerita* sp. shells and *D* schematic drawing proposing their hanging system.
Corresponding find and study numbers: *a* (20827, 10); *b* (20800, 44); *c* (10004, 6). (Photo and drawing: H. Alarashi, Ba`ja N.P.)

In terms of display system, the notched *labrum*, and the pattern of alteration of the *periostracum* would be produced when a series of shells were strung together or piled one over the other (Fig. 11D). This happened after a test experiment: strung on the same string one after the other according to the same orientation and without separation between them, the spire of one shell was found in contact with the *labrum* and the natural aperture of the next one. With friction, this provokes mutual stigmas. *Nerita* shells of the assemblage belong to different contexts (Appendix 1) and no pierced specimens were found together. However, this specific arrangement of *Nertia* was observed in a recently excavated burial (CG9, Loc. CR.28.2:122a). The technological and use-wear analyses that are planned in the near future will give more clues about the display systems of *Nerita* shells.

While the piled or interlocked shells provide a possible scenario that could explain the use pattern of the pierced *Nerita*, it is hard to explain how and why the unpierced shells have similar stigmas. Without holes, the fixation system is certainly necessarily based on setting, glowing/gagging with strings or a combination of systems. Yet, fixing these shells will stabilise them and prevent friction. Many *Nerita* shells, including unpierced ones, present surfaces covered with unidentified residuals (glowing gums, pigments, both, others?) (Fig. 11a,c). These are observed around the perforation, on the body whorl and inside the natural aperture. Analyses of these residuals will probably be helpful to give explanations and allow assessing whether the unpierced *Nerita* were used or not. The presence of unpierced *Nerita* shells in burials could also help in understanding the display systems of these items. It should be mentioned finally that several unpierced *Nerita* shells of the assemblage were found in the same context (Alarashi and Benz this volume: Appendix 1).

Conus beads: from 13 *Conus* shells, twelve have a holed *apex*. Their rims are rounded homogenously and are smooth (Fig. 7g). *Conus* beads were probably strung freely (no knots or interlacing). In a single case, a second piercing was made on the body whorl (Fig. 12h). The edges of the whorl are irregular but rounded and slightly polished, suggesting its use, probably synchronically with the hole on the *apex*. This hypothesis is supported by a relatively shiny polish on the surface, separating both holes. The shell was most likely tied to something by a stitch (?), using this hole – as suggested by the local polish that was also recorded around the perforation area.

One unpierced *Conus* has contrasted areas in terms of preservation (Fig. 12g). While the *periostracum* layer of the body whorl of the shell is well preserved with a shiny aspect and natural decoration, the spire and the natural aperture present a mat surface with erased colours and natural decoration. No technical traces were observed on this shell.

Cowrie beads: among the eleven cowrie shells recorded in the assemblage, three are broken labial fragments. The technical traces related to the complete removal of the *dorsum* are partially erased. The large dorsal openings allow attaching the bead by one or both extremities, as attested in several PPNB sites of the Near East (Alarashi 2010; Alarashi *et al.* 2018). Yet unlike these, no intensive use-wear traces such as notches or fractures were detected on the perforation area. Although use-wear marks are underdeveloped, the choice and the logic for the location of the holes in both types (removed *dorsum* and double holed *dorsum*) suggests that the extremities of the cowrie shells were essential for the display system. For instance, with the removed *dorsum* cowries could have been fixed on a support or a cloth (Fig. 13B). This could also be the case of the cowrie with a pierced *dorsum*, as a polish was observed between the holes and the shell's extremities. The holes have very irregular rims, but they are rounded and polished.

Other Shells and one Bone Item

The *Ancilla* and *Strombus* shells pierced on the body whorl present smooth surfaces around the holes, accompanied with relatively shiny polish (Fig. 7d-e). The grinding traces on one *Ancilla* shell are completely erased while on the other, a residual layer covers part of the grinding facet surrounding the hole and the inner surface of the shell. The *apex* of this shell is missing, providing a secondary small hole. The synchronised use of both holes was not possible to document. The location of the hole near the natural aperture suggests that the opposite side of the shell was the one displayed.

Naticidae shells have relatively large piercings. On one of the two specimens, the hole seems barely used as its rims are very little rounded, presenting a restricted narrow polish (Fig. 7f). The other shell shows a more intense polish especially on the lower edge, at the closest point to the natural aperture. At the same location a notch is observed (Fig. 7k). The shell was likely tied to a support with a string, like the *Polinices* of Nahal Hemar that were discovered stitched to a tissue (Bar-Yosef 1985: 9). On the example from Ba`ja, the area around the upper part of the hole and the inner surface of the *labrum* are covered with the same residual layer observed on the cowries, on the *Ancilla*, and on the *Nerita* shells.

The hole of the unique *Clanculus* shell of the assemblage exhibits the surface of the nacre under the natural "mosaic-like" motifs of the *periostracum* shell layer (Fig. 7m). The rims are rounded on the upper part, and chipped on the lower part, closest to the natural aperture. The area between the hole and the aperture presents a shiny polish. Actual specimens of this species have very attractive natural ornamentation and colours. The archaeological specimen was most likely displayed to show these natural attributes that are still well preserved, although the colours have faded.

The pierced umbo of bivalve shells has very smooth and rounded rims (Fig. 7o-p). A notch, juxtaposing the rim of the hole, is observed in one case (Fig. 7p). Its formation is due to repeated friction with the sting. On this same shell, residues are distributed at different places around the hole and on the inside corner of the rim.

Finally, two tubular beads discovered in different areas – a *Dentalium* shell (Figs. 2w, 12d) and a small long bone (Fig. 10l-m), present the same pattern of use-wear. Both have one end larger than the other. The edges of the large end are completely rounded and are interrupted with some chips, and shiny extended polish is observed on the outer and inner surfaces. The walls of the opening were clearly thinned. These stigmas are typical of interlocking or staking of one bead inside another or having one aligned to it. *Dentalium* and bone beads were certainly used as part of ornamental compositions such as a necklace, a bracelet, *etc*.

Shaped Shells and Stones

Rings: a total of 49 items were recognised as portions of rings and among them only two are complete. The high frequency of breakage of rings made from mother-of-pearl during the early stages of use is to be expected considering the fragility of this material. Mother-of-pearl rings seem to have been little used before their breakage. The naturally smooth and shiny surfaces present scratches and random impacts (Fig. 8j). Grinding striations of the *periostracum* layer are still detectable on the majority of the items when residues did not invade the surface. The cut and worked areas became smooth with a polish produced by use, as observed on the rounded edges. The assemblage contains at least three fragments of a simple flat ring which refit together. One part was probably broken during

Fig. 12 Technical and use-wear traces on shell and stone items: *a* decorated button disc with use-wear marks between the perforations and on both faces; *b* MOP pointed double perforated ring with use-wear traces between the perforation and thinning traces due to tight fixing (red arrows); *c* *Tridacna* sp. flat bead with broken perforation due to intensive use-wear (?); *d* *Dentalium* sp. bead with intensive use-wear due to interlocking with other object (?); *e* multiperforated MOP item with traces of use around the large perforation; *f* double perforated turquoise compact bead with use-wear traces on the bridge between the perforations; *g* unpierced *Conus* sp. with contrasted preservation of periostracum layer between the spire and the body whorl; *h* double pierced *Conus* sp. with possibly simultaneous use of both holes (stitched on cloth?).
Corresponding find and study numbers: *a* (0410, 67); *b* (0411, 72); *c* (40802, 70); *d* (30801, 150); *e* (2076, 69); *f* (100809, 169); *g* (100801, 125d); *h* (20811, 3b). (Photos: H. Alarashi, Ba`ja N.P.)

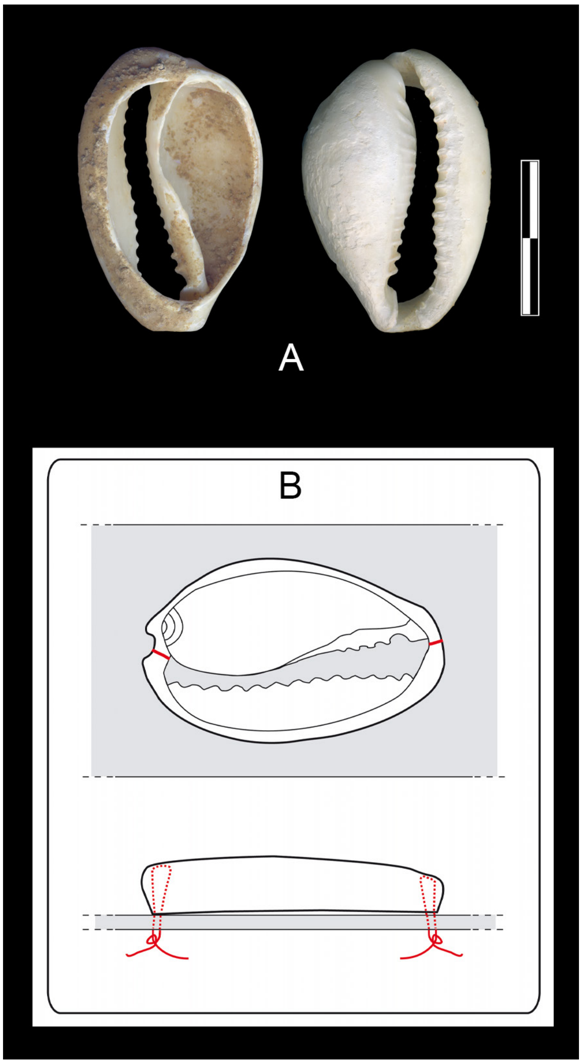

Fig. 13 *A* cowrie shell bead , *B* drawing proposing the fixing system by stitches on a support (clothes, bags, *etc*.).
Corresponding find and study number (0213, 128).
(Drawing: H. Alarashi, Ba`ja N.P.)

the excavation, but another presents an ancient fracture, as attested by the crusted sediments inside the fracture layers (Fig. 5s). The portions were probably kept together for further reparation or recycling.

Display systems of the rings were affected by the size, the weight, and the type. Based on finds in burials, complex rings with decorative attributes (Alarashi b this volume: Fig. 18) were most likely used as medallion or a "master-piece" from a necklace. Pointed double perforated rings could have been used as "brooch" or "pins" stitched to a cloth, or as spacers for ornaments. Depending on the size, simple flat rings may have been used as bangles displayed on the wrist or on the arm. The ring part of the double perforated pointed ring is broken. Intensive shiny polish with important thinning of the lateral edges of the holes (Fig. 12b) indicate that the ring was fixed to a support using both perforations. The "bridge" area between the small perforations is slightly concave, and the circularity of one hole shows an enlargement towards the other. On the other surface, the grinding striations are partially erased on the "bridge", and the lateral edges of the holes are also thinned. Such stigmas were undoubtedly produced by threading through interlacing. The miraculously complete mother-of-pearl ring (Fig. 8j) presents general rounding of the cut edges and partial erosion of the grinding traces. The homogeneity of traces and the calibre of the object suggest its hanging freely on a string. *Tridacna* rings, and to a lesser extent the *Conus* rings, have rounded edges and very smoothed surfaces with little or no technical traces remaining (Fig. 10d,j). The inner surface generally has a shinier polish than the outer surface.

<u>The cut *Conus* beads:</u> patterns of use-wear recorded on the cut *Conus* shells are similar to those of other shell beads simply pierced. One specimen reveals intense shiny polish inside the shell, especially around the *apex* hole and on the edges of the inner spiralled whorl. This polish is less intense on the cut edge of the shell (Fig. 10b). Such a polish could have been produced by prolonged friction with a softer material such as a string made of leather. One can imagine the presence of a string knot inside the shell. In this sense, it is possible that this bead was used as a button closer or as a buckle of a necklace. The knot is made on the end of the string to lock the bead inside. The other end of the string could have been formed as a buckle in order to be passed around the *Conus* bead and thereby close the ornament. The unique shape of the *Conus* bead makes it possible to hide the string knot inside, thus providing a more aesthetic display of the ornament. The other hypothesis is that the localised polish inside the shell was produced by friction with another bead that had slipped inside it. A series of cut *Conus* beads were discovered aligned in a burial excavated in 2019. Their use-wear analyses and their position within the ornamental composition will give important information about the use of this type of beads.

<u>Shell disc, tubular, and flat beads:</u> this group consists of five mother-of-pearl disc beads, one ostrich eggshell bead, four *Tridacna* tubular

beads and one *Tridacna* flat bead. Because the layers of mother-of-pearl are fragile for the majority of the disc beads, only one item was microscopically analysed. It presents homogenous rounding of the perforation rims and moderate intensity of polish inside the perforation. Shaping traces are partially erased. This disc bead was found in the same locus (Loc. BNR27:100) as one carbonate white translucent barrel-shaped bead. The flat turquoise pendant was also found in this locus, although while cleaning the wall. Interestingly, the other four mother-of-pearl disc beads were found in groups of two. The ostrich eggshell disc bead is quite unique within the assemblage (Fig. 3b). As with the previous objects, it shows little intensity and has homogenous rounding and polishing of the rims and edges.

Within the group of *Tridacna* tubular beads, one is badly preserved, and the other is broken (Fig. 3g). The rims of the perforations of the beads are rounded (Fig. 10e-f). The walls of the perforations show partial erasure of the drilling striations as well as a polish and rounding of the junction area (Fig. 10f: red arrow). The surfaces of the beads contain scratches which were more marked on the white mat striped material. Two beads discovered at the same locus (Burial DG1, Loc. D11/12/21/22:26) present a homogenous distribution of use-wear traces, suggesting they were freely strung – probably within the same composition. Moreover, both exhibit red, persistent remains of pigment inside the perforation and on the perforation surfaces (Fig. 10e). At this stage of research, the occurrence of pigment on the beads could be explained by: the use of a pigmented string, the contact or leaning on pigmented clothes, or contamination by dispersal of a pigmented liquid which is specific for ritual contexts – just to mention the most probable explanations.

The *Tridacna* flat bead (Fig. 3l) shows an unusual use-wear pattern within the assemblage. One of its polygonal faces is smooth, mat, and slightly polished in the centre and on the grinding facets near the edges. Within the facets, the grinding striations are barely conserved. The other polygonal face is broken on the perforation axis, thus exhibiting the remaining part of it. This face is more polished than the other (Fig. 12c). The grinding traces of this surface are however best preserved within the lateral facets. The rims of the perforation are extremely blunt and polished on both ends. The drilling striations inside the walls of the perforation channels are preserved differently. They are more intensively erased for one channel than on the other. At the same time, the fracture of the perforation is largest on the first. The junction area of both channels was smoothed and polished. These traces indicate that the bead was used before the breakage of the perforation. Such a breakage might have occurred by accident. The unaligned perforation channels might have provoked the uneven use or friction, or both, of the string with the walls of the perforation.

<u>Shell "buttons" and other by-products:</u> Among these items, one was found with a subcircular shape and a serrated outline (Fig. 12a). The perforations are very close and the bridge between them shows eroded mother-of-pearl layers. These layers are also eroded and highly polished at specific locations between the upper perforation and the outline of the object. The serrated aspect juxtaposing these areas is very eroded, their surfaces are polished, and the colour became even slightly yellowish. The object was certainly tied firmly to something using one perforation. The same string, or a separated one, was used between both perforations and on both faces, probably passing it several times. Based on these traces, the object could have been used as a "closing button", as a row spacer, or as "brooch".

Two polygonal items, probably produced from ring production waste, represent small perforations (Fig. 5u-v). For one of them, residues did not allow reliable evaluation of use wear. For the other object, only one face was observable. This item has three small perforations located very close to the edge, and which were distributed at relatively even distances. Among them, two are broken. A fourth larger perforation is situated between the lateral preserved small perforation and the middle broken one. The closest side of the perforation rim to the external edges of the object presents rounding and polish. The area between the edge of the object and the small perforation was thinned (Fig. 12e). These use-wear traces on both complete perforations indicate their use, although without evidence about their synchronised use. This item might have been used at two different times and the three small perforations may have served to fix the object on a support. After the breakage, a "new" perforation was drilled anticipatorily far from the edge. The object might then have been worn in a different way (pendant?).

Stone disc and tubular beads and one pendant: Although presenting different intensities of use-wear, the group of stone disc and tubular beads, as well as the unique turquoise pendant all show homogenous rounding of the perforation rims and homogenous polish in the perforation areas – suggesting that these items were simply strung together, probably as part of ornamental compositions. Amazonite (Fig. 4f) and carnelian (Figs. 4i, 10g) beads are among the most intensively used stones as attested by the completely smooth rounded edges, shiny polish, and the complete erasure of the technical traces.

As for the calcite reddish disc beads from the child's Burial CG7, Loc. C1:46, they were discovered in sets of two and up to several tens. They were used as garment beads of the ornamental composition. The preliminary examination shows very little use-wear traces, which were probably developed from repeated manipulation of the beads during the manufacture, composition, and the display of the ornament.

Stone compact single beads and buttons: These objects are made from chrysocolla and turquoise. On one chrysocolla finished item, the grinding traces are still well preserved although relatively flattened and polished. The double perforated turquoise bead ("button") exhibits general smoothing of the surfaces without polishing. On both faces, the bridge area between the perforations is smoothed. The use of a string between the perforations has provoked their enlargement in this area (Fig. 12f). Both perforations were probably used to fix the object on a support.

Definition of the Ornamental Tradition

Raw Materials and Types' Choices

Shells and stones are the main material categories that were exploited for ornaments during the Neolithic in the Near East. During the Late PPNB, as the ornamental traditions of northern Mesopotamia were dominated by the use of mineral varieties, those of southern Levant excel at exploiting marine shells. This is precisely the case at Ba`ja: most of the beads and pendants were made from gastropod and bivalve shells.

Ornaments made from osseous materials have drastically decreased since the Natufian (Le Dosseur 2008), leaving room for colourful and bright shells and stones, which were imported from elsewhere. Bone beads were generally rare at Ba`ja. Yet, several concentrations were found. One was composed of 28 tubular beads, apparently the composing elements of a chain discovered in a non-funerary context. Ten bone beads from Burial CG6, Loc. CR6:41, and a few unstudied bone beads of the collective Burial CG1, Loc. C10:152 could not be studied during the *Household and Death Project*. Rarification of bone items is also observed in Late PPNB sites in northern Mesopotamia, such as Tell Halula and Abu Hureyra (Alarashi 2014) and in the central Levant, such as 'Ain Ghazal (Al Nahar 2014: Fig. 3) and Ramad (de Contenson 2000). The decline of the use of animal bones for ornaments finds its explanation in the changes of relationships between humans and animals during the process of animal domestication (Le Dosseur 2010). While the Natufian and PPNA beads and pendants were made from the bones and teeth of hunted animals (for which the obtention of raw materials implied significant efforts), the increased availability of osseous materials made possible by animal domestication since the Middle PPNB would have devalued or reduced their importance, and reoriented the choice towards other exotic materials. This hypothesis needs to be examined in the light of consistent data from Levantine sites and systematic taxonomic identification of bones. It seems however that when bone beads are present at PPNB sites, they are made from bones of hunted animals (Alarashi 2014).

A large spectrum of marine shells was available for bead making at Ba`ja, yet it appears limited compared to the diversity of species used at Basta (Hermansen in prep.), at the Middle PPNB sites such as Shkārat Msaied (Abu Laban 2014), or at Ayn Abū Nukhaylah (Spatz *et al.* 2014). The identified shell species mostly originated from the Red Sea, in which the Gulf of Aqaba represents a rich natural habitat of several species – such as those of Cypreidae (Heiman 2002; Alarashi *et al.* 2018) and Neritidae. Among the identified molluscs, few have edible flesh like *Nerita polita* (Kalei 2017). However, their presence at the site in small amounts rules out any dietary purpose.

While the natural form constituted the main interest in collecting some shell species (*e.g.*, *Nerita* or cowries), others were clearly preferred because their material was transformable into new shapes (*Pinctada* or *Tridacna*). Some even satisfy both interests (*Conus*): used as natural forms and as raw material. Shells represent 81% of the studied assemblage. Geographical proximity to marine or geological sources, or to centres of production would not explain properly the percentage of shells in relation to stones. Following the neighbouring factor's logic, "greenstones" should be dominant at Ba`ja, as several geological sources are closer to the village than any marine sources.

Most of the identified shells originated from the Red Sea. Mediterranean species are restricted to a few *Cerastoderma glaucum,* and probably the *Glycymeris* and maybe some *Conus*. Tubular shell beads were made from *Tridacna* valves. Similar beads were also recovered at Basta (Hermansen 2004), a site where fragments of valves and manufacturing debris were also attested. The proteomic (ZooMs) analyses applied on three shell tubular beads found in a burial context (CG9, F.no. 110825) was successful. They confirmed that these beads were made from marine shells – precisely from *Tridacna* valves. Because of the preserved proteins, the *Tridacna* valves exploited were most likely not fossilised, and thus were obtained from the marine environment of the Red Sea (probably from the seashores).

Turquoise beads are the most frequent among the "greenstones" group at Ba`ja. The most known turquoise sources are those of southwestern Sinai, although other sources to the east of the Red Sea are mentioned too (Hauptmann 2004; Pfeiffer 2013). Isotopic analyses of geological and archaeological samples of turquoise (Hull *et al.* 2008) today allow the identification of the source. Such analyses appear crucial in the case of Ba`ja, as several turquoise qualities occur at the site (Gerlitzki and Martin this volume: Table 1, Figs. 1, 3).

Chrysocolla stones seem to be obtained from Faynan and Timna outcrops (Gerlitzki and Martin this volume: Table 2). As for the amazonite, mentioned sources are in the Northern Arabic Peninsula and in Egypt (Fabiano *et al.* 2004). The closest known primary sources of carnelian to the Levant are the Armenian volcanic sources (Brunet 2009), but presumably carnelian is available in the southern Levant too, occurring as secondary deposits in the form of pebbles in riverbeds or ancient river terraces. The middle Euphrates and the Nile valleys are among the sources where samples have been gathered and constitute part of the author's personal reference collection (unpublished work). Between these major valleys, the only sources of carnelian are mentioned for the southern Levant in Wadi Rum and in the Sinai Desert (Rollefson *et al.* 1991; Groman-Yaroslavski and Bar-Yosef Mayer 2015). Carnelian bead workshops dated to the Late Neolithic are abundant in the northwestern Arabian Oasis of Tayma (Purschwitz 2017). Presumably, carnelian is available in this region too. The carnelian nodules and fragments from Ba`ja resemble rolling pebbles. They were likely obtained from secondary deposits transported by water. In sum, although geochemical and taxonomical identification of raw materials used for bead-making at Ba`ja needs to be refined, we can already confirm that the majority were obtained from non-local sources, which is one of the main characteristics of the Late PPNB ornamental traditions in the Near East (Alarashi 2014, 2016; Alarashi *et al.* 2018).

In terms of types, beads of Ba`ja show similarities with other Late PPNB ornamental traditions, precisely in the use of *Nerita*, *Conus*, and cowrie beads as well as the disc, tubular, and the double perforated beads. The scarcity of pendants in this period is a characteristic of the Late PPNB, also in other regions of the Near East. The flat beads of Ba`ja are also among the most representative ornaments of the Late PPNB. However, those of Ba`ja are quite distinct from flat beads that are typical for the end of the PPNB in Northern Mesopotamia (Alarashi 2016). They are smaller and made exclusively of softer materials, including shell bivalves, which is a unique characteristic observed for Ba`ja and Basta thus far. Another particularity is the typological diversity of rings and the presence of non-standardised mother-of-pearl "by-products".

Bead-Making Activities: Skills and Technoeconomic Behaviour

About 14% of the assemblage of Ba`ja are considered "technical objects" (Table 6). Namely, these are unfinished objects or manufacturing debris, but also include unmodified (or unused[7]) shells and stones. Observing the volume before the transformation (nodules, rolling pebbles, extracted fragments from geological veins, *etc.*) helps to understand the manufacturing

[7] Unpierced *Nerita* shells are excluded from the 14% "technical objects" as they might have been used without piercing (gluing, attaching?).

methods. Bead-making activities were therefore part of the artisanal occupations at Ba`ja. Yet, these likely concern specific materials and/ or types recorded at the site. For instance, piercing gastropods was performed at the village. High skills or particular tools are not required for these simple piercing operations. In terms of frequency per excavated area, no specific distribution of pierced gastropod is observed, except from cowrie shells that were almost all found in area C (Table 6; Appendix 1). Interestingly, cowrie shells occur at Ba`ja only as finished objects. Were they manufactured at the site or brought/ obtained as already pierced objects? At Basta, three "unholed" *Cypraea* along with many others (+65) which were holed, ground-down, and *dorsum* fragments (manufacturing debris?), are recorded by D. Reese (pers. comm.: working unpublished document shared by H.G.K. Gebel). The study of the recently discovered sets of cowrie shells in a burial of four children (CR. 28.2: 122a-b, 123a-b) will clarify the "status" of cowries, which were quite in demand shells by the Late PPNB Neolithic farming communities (Ridout-Sharpe 2015; Alarashi *et al.* 2018).

The traceological analyses of the technical pieces and of the finished objects allowed the identification of the basic *chaîne opératoire* (major stages) of the mother-of-pearl rings. The successful production of such objects, in particular the engraved decorated rings, represent the high skills of the craftsman, taking into account the technical difficulties imposed by the complexity of the form and decorative pattern (number of the manufacturing stages and time required), the size of the ring, and the qualities of the shell (thickness, resistance). Engraved rings from Ba`ja (and Basta) are quite large (Fig. 5s-t), all the more if the outermost diameter is reconstructed by taking into account the external borders of the outgrowth. This means that the chosen shells were very large in order to allow the extraction of blanks large enough to produce such large rings. In other words, the size of the ring could have been determined by the size of the shell. Therefore, the acquisition of large *Pinctada* valves was clearly subject to a selection, rather than to an opportunistic gathering of specimens on seashores. This implies specific knowledge regarding the natural habitat of these molluscs and consequently, a certain level of control over both the acquisition and the distribution modalities. In this sense the craftsmen of Ba`ja who have transformed these shells into rings and other products appear to have an important role to play, also in material acquisition and thereby in the circulation networks between the Red Sea and Ba`ja. Obviously, the production of the large, engraved mother-of-pearl rings, such as the one found in the child's Burial CG7, Loc. C1:46 (Alarashi b this volume: Figs. 17-18), was conducted by specialised individuals who had sufficient skills and experience, an appropriate tool kit, but also access to nice large valves of *Pinctada* shells.

The frequency of finished *Pinctada* rings is relatively constant within the three intensively excavated areas (B, C, and D) (Table 6). However, the number of technical pieces is higher in area B. This trend needs to be carefully examined before interpretation, as many factors might have interfered, not to mention the low number of objects. Comparisons with patterns of distribution and with frequency of *Pinctada* items at Basta would be interesting too. Another important aspect of the shell rings' production is the technoeconomic management of mother-of-pearl as a raw material. Fragments that remained after the ring extraction served as supports for beads, pendants, buttons, and small sized rings. These were manufactured according to common types that occur in other materials (stone for instance), such as disc-beads or buttons.

In addition to the rings that exist as standard recurrent types at the site, there are more "free style" elements or by-products. In fact, these follow the shape and the size of the fragment that generally still bear the curved cuttings, corresponding to the extraction of rings. Unworked fragments were kept for further use as fractures, and damaged rings were quite frequent. This technoeconomic behaviour highlights the value of mother-of-pearl as a raw material. Last but not least, it should be emphasised that crafting mother-of-pearl is one of the main characteristics that define the Late PPNB ornamental tradition in the southern Levant to which Ba`ja and Basta belong.

From Object to Ornament, from Functionalities to Functions

This study has revealed the diversity of forms, types, colours, sizes, and raw materials of the beads found at Ba`ja. These beads represent most of the elements used in the composition of necklaces, belts, bracelets, or garment items that can be identified as such, verified

Table 6 Distribution of finished objects, raw materials, and technical pieces of the investigated assemblage according to the excavated areas (except for items of Burial CG7, Loc. C1:46, that would cause an enormous bias).

Area	Material	Finished	Finished?	Unpierced	Raw	Technical Pieces	Sub-Total	Total
A	Sandstone	1					**1**	**1**
B	*Conus* sp.	4					**4**	**57**
	Nerita sp.	13		1			**14**	
	Pinctada sp.	15				12	**27**	
	Polinices sp.	1					**1**	
	Tridacna sp.	2					**2**	
	Strombus sp.	1					**1**	
	Cerastoderma sp.	1					**1**	
	Glycymeris sp.	1					**1**	
	Sandstone	1					**1**	
	Carbonates	3					**3**	
	Turquoise	2					**2**	
C	*Ancilla* sp.	1					**1**	**77**
	Conus sp.	4		1			**5**	
	Cowrie	10					**10**	
	Nerita sp.	12		6			**18**	
	Pinctada sp.	19				4	**23**	
	Tridacna sp.	3					**3**	
	Strombus sp.	1		1			**2**	
	Ostrich eggshell				1		**1**	
	Carbonates	2					**2**	
	Carnelian				6		**6**	
	Chrysocolla	1				1	**2**	
	Turquoise	1					**1**	
	Copper ore?				1		**1**	
	Marl	2					**2**	
D	*Ancilla* sp.	1					**1**	**67**
	Clanculus sp.	1					**1**	
	Conus sp.	11		1			**12**	
	Cowrie	1					**1**	
	Melanopsis sp.			1			**1**	
	Nassarius? sp.			1			**1**	
	Nerita sp.	13		3			**16**	
	Pinctada sp.	13				2	**15**	
	Polinices sp.	1					**1**	
	Tridacna sp.	4					**4**	
	Strombus sp.	1					**1**	
	Cerastoderma sp.	2					**2**	
	Glycymeris sp.	1					**1**	
	Ostrich eggshell	1					**1**	
	Carnelian	1			2		**3**	
	Turquoise	1	1				**2**	
	Sandstone	2					**2**	
	Marl	1					**1**	
	Bone	1					**1**	
F	*Dentalium* sp.	1					**1**	**3**
	Nerita sp.	1					**1**	
	Amazonite	1					**1**	
Test unit 3	Conus	1					**1**	**2**
	Marl	1					**1**	
Test unit 5	*Pinctada* sp.	1					**1**	**1**
Total		**163**	**1**	**15**	**11**	**19**	**208**	**208**

by their position on the human skeletons, their arrangement and organisation, and to their use-wear analyses.

Although none of these ornaments has been completely analysed in-depth, it appears obvious that ornaments significantly vary from one burial to another (Benz *et al.* 2023; this volume). These variations are based on various combinations of the beads and rings presented in this report. In other words, it seems that the inhabitants of Ba`ja created different ornaments using common components or bead types and rings. The study of this variability of design and the display of ornaments at the level of the buried population of Ba`ja is crucial to explore the social organisation of the group.

All the finished beads of the investigated assemblage bear use-wear traces. Certain patterns of use suggest that some beads were parts of ornaments. However, the assemblage is composed of isolated beads discovered in different archaeological contexts with burials being excluded. In some cases, a few items (2 or more) were found in the same locus (Table 6, Appendix 1).

While finds in burials provide evidence of the involvement of body ornaments in burial rituals, beads discovered in non-funerary contexts are less informative about their functions during a lifetime, and the rhythms of their use (daily or occasionally during life ceremonies). Are they different from those used for death? Were some ornaments explicitly manufactured for specific occasions, including burial rituals? The extraordinary character of some ornaments such as the one found on the child in Burial CG7 (Loc. C1:46) makes it seem improbable for daily use.

Preliminary results show different degrees of use according to the type and material of the bead. For instance, stone items, such as the black hematite double perforated buckle (Alarashi b this volume: Fig. 15), show traces indicative of intensive use. Turquoise beads also appear to have rounded edges and smooth surfaces with homogenous erosion of the technical stigmata from the surfaces and inside the perforations. As for the red calcite disc beads and the tubular shell beads, detailed microscopic observation is required to assess the presence and intensity of use-wear. The engraved mother-of-pearl ring found in the same burial is very poorly preserved. It was not possible to properly assess the use traces. However, given the techno-economic investment in the elaboration of this object, its delicate shape, large size, and the fragility of the mother-of-pearl, it is reasonable to think that such objects were used on specific occasions.

Stone beads found at Ba`ja are small and quite few in comparison to shells. However, they have generally vivid colours that offer interesting contrasts, when associated with whitish shells and integrated "strategically" between sets of identical beads. In other words, a few stone beads are able to enhance the visual impact and attractiveness of the ornamental compositions.

Conclusion

This detailed report on the isolated objects found in different non-funerary contexts at Ba`ja was necessary to assess the diversity of objects used at the site and to provide crucial information to better understand the selection of ornaments in funerary assemblages. The study of ornaments from the burials will help to determine whether some types are exclusive to burial contexts or not (Alarashi and Benz this volume: Tables 1-3).

Based on finds from burials, the inhabitants of Ba`ja had common bead types and rings that they used in very different combinations to create different body ornaments. These variations at the level of the composite ornament express different ideas, social statutes, or identities, and it seems, that some objects, namely the mother-of-pearl rings, may have indicated age groups. Moreover, the most lavishly decorated individuals were children, whereas adults received other grave good types but hardly any beads. In contrast, the few bone beads uncovered in burials were exclusively associated to adults (Benz *et al.* this volume).

Several questions are raised by this study:
- what are the types and the materials processed at the site, and which required high skills for their manufacture?
- what kind of ornaments were used on a daily basis and which were reserved for special occasions?
- in light of the results of this study, how can we define the ornamental tradition of Ba`ja?

Inhabitants of Ba`ja were clearly inclined to use exotic shells and stones to create their ornaments. These materials provided a wide and attractive range of colours, decorative patterns, forms, shapes, and sizes – thereby a great scope for craftsmanship.

The "exotic" characteristics of the body ornaments displayed by the inhabitants of Ba`ja are undeniable while clearly reflecting contemporaneity with the common Neolithic symbolic and artistic repertoire. In this sense, body ornaments of Ba`ja reflect a high interconnectivity with the local and supra-regional Late PPNB cultures, which contrasts with the remote environmental setting of the village and its difficult accessibility (Gebel and Bienert 1997). Mother-of-pearl rings raise interesting questions regarding the social organisation of the actors involved in their production that has required the acquisition/ distribution of raw shells, their transformation and the "consuming"/ displaying of the final products. Further studies of finds associated with the deceased will contribute to the understanding of underlaying relationships between these actors.

Acknowledgements

Part of this research has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 846097 "MSCA-IF PRECIOUS". We are grateful to the German Research Foundation for their funds (BO 1599/14-1; BO 1599/16-1); our thanks are also due to Dominik Bonatz, Head of the Institute for Near Eastern Archaeology, Free University, Berlin and private sponsors of ex oriente e.V., Berlin. We acknowledge the logistic support of the laboratory of CEPAM (CNRS, University Côte d'Azur, Nice), the IMF-CSIC and the group of Archaeology of Social Dynamics and the team of the new museum of Petra in Jordan. Finally, we sincerely acknowledge the ex oriente association and the Ba`ja Neolithic Project that made this research possible.

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Appendix 1

Contextual information of the studied objects

Link: https://www.exoriente.org/baja/archive/