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EXPLOITATION OF MARINE SHELLS AT ROMAN JERASH (JORDAN)

Abstract: The Jerash archaeological site holds great significance as one of the most prominent Roman sites in the Middle East. In our research paper, we present an assortment of marine shells discovered in the northern region of the Jerash archaeological site during the University of Jordan's excavations from 2017 to 2019. We analyze the shells to determine their species. Additionally, we document the human modifications of the shells in order to reconstruct their possible use. The number of shells is small, but their value is heightened by the variety of species represented and the human modifications observed. The most frequently found shell are 12 murex (11 are *Bolinus brandaris*). Some shells exhibit perforations, which could be attributed to various purposes such as adornments, the production of cosmetics, or souvenirs.

Keywords: Jerash; Roman period; Marine shells

1. The Jerash site

Jerash is situated approximately 50km north of Amman, the modern capital city of Jordan, 95km from the Mediterranean, and 315km from the Red Sea (all as-the-crow flies distances). The modern name of this ancient city, Jerash, can be traced back to a Nabataean inscription found at Petra, where it is mentioned as Garshu/Jarshu (Starcky 1965). In historical sources and epigraphic evidence, the Greek version of the name, Gerasa, is frequently noted (Pliny, *NH* v.74; Welles 1938; Zayadine 1986; Lichtenberger 2003; Kennedy 2007; Raja 2012). Jerash is renowned as one of the finest examples of Roman cities in the Near East, making it an immensely captivating site for archaeological exploration in the region. Over a century of archaeological research conducted here has recovered a rich history of human settlement, ranging from the Bronze Age to the present day (Kraeling 1938; Zayadine 1986; Kennedy 2007; Lichtenberger and Raja 2016). The origins of Jerash are believed to date back to the Late Hellenistic period when it was founded by Antiochus IV (175-164 BC) and named Antiochia at the Chrysorrhoas, meaning "Golden River" (Spijkerman 1978; Seigne 1992a; Lichtenberger 2003). While artifacts such as pottery, glass, and coins have been discovered through archaeological research, there is limited evidence to fully comprehend the nature and extent of the Hellenistic phase (Kennedy 2007; Raja 2012). It is thought that the Hellenistic origins of Jerash can be traced at the "Camp Hill" area (Pl. 1), with the earliest phase being the Temple of Zeus, which dates to the Late Hellenistic period (Seigne 1989, 1992a, 1992b; Lichtenberger 2003; Raja 2012, 2015).

Jerash had a population of 20,000 to 25,000 people. Epigraphic evidence within the city suggests that Greek was the common language spoken, while Latin was used in formal contexts. The archaeological, architectural, and epigraphic evidence as a whole indicates that Jerash was influenced by a regional variant of the Graeco-Roman culture that was prevalent throughout the Mediterranean during the Early Roman period (Kennedy 2007).

It is worth noting that the main monuments of the city, which dominate the central and southern areas, have been the primary focus of archaeological work over the past century. The northern part of Jerash, particularly the northwestern and northeastern sections, had been largely overlooked until recently.

Only two archaeological projects have been conducted in this part of the city, revealing its significant archaeological potential. The first project, the "Danish-German Jerash Northwest Quarter Project," conducted between 2011 and

2017, aimed to explore the settlement history of the northwestern quarter of Jerash. The results demonstrated that the Northwest Quarter played a crucial role in the city's urban and domestic life, and it was found to have developed much earlier than previously believed, with extensive building activity taking place as early as the 1st century AD (Lichtenberger and Raja 2019). The second project, the Jordan University Excavations, took place in the area south of the Northern Gate in 2017-2019.

1.1. The contexts of the shells

The excavations conducted in the southern part of the investigated area focused on three areas, Areas A, B, and C (see Pl. 1: 2). Area B yielded a rectangular Roman building consisting of three rooms dated to 2nd century AD, as determined by the coins (Shiyyab and Bauzou 2021). Among these rooms, the westernmost one exhibited a circular shape, while the two adjacent rooms towards the east were rectangular and square in design, respectively. Adjacent to these rooms to the north, there was a narrow corridor.

The definitive function of this building has not yet been determined due to several factors. First, the excavation is still ongoing, and a complete understanding of the site has not been achieved. Second, the building's complex history, which involves its construction during the Roman period and subsequent modifications during the Islamic period, has altered its original characteristics, particularly in the southern portion. These modifications have significantly transformed the building, making it challenging to ascertain its function during the Roman period. Further analysis and examination will be required to shed more light on its original purpose.

North of the rectangular Roman/Early Islamic building, a distinct structure has been discovered, comprising two areas labeled A and C. These areas exhibit differing elevations, suggesting the possibility that they may not be interconnected and could potentially represent two separate buildings. The vertical disparity between them exceeds two meters (see Pl. 1: 2).

In the lower part, there is a wall extending from south to north, and in close proximity to this wall, six shells were found. The presence of various artifacts, particularly coins, on the floor adjacent to this wall provides evidence that it was constructed during the Roman period.

Due to the ongoing excavation, a definitive conclusion regarding the nature and function of the building has not yet been reached. However, preliminary

studies of pottery and coins found in the lower stratigraphy and on the floor indicate a Roman date for the building.

1.2. The marine shells

Marine shells have been discovered in various layers within both Areas A and B. In Area A, ten shells were found within the northern building. In Area B, seven shells were found. No specific concentration of shells was observed.

The shells were found with a range of artifacts, including pottery sherds, bone fragments, and valuable objects such as coins, bone and ivory tools, and clay masks. The combination of structural remains and high-value objects suggests the importance of these areas.

Jerash produced various shell species which are rarely found in Jordanian excavations. The primary objectives of our paper are: first, to identify the species of shells which will allow us to determine the source of the shells; second, to document human modifications; and third, to reconstruct the probable use of the modified shells as source of food, jewelry, or other. Finally we hope to reconstruct the lifestyle of those who once inhabited Jerash during the Roman period.

2. Material and methods

The identifications of the shells were carried out using comparative anatomy. The classification of the taxa adheres to the standards established by the World Register of Marine Species (WoRMS Editorial Board 2020).

To document human and natural modifications on the shells, a Leica EZ4 HD stereomicroscope was utilized. This high-definition microscope allowed for the detailed examination of the various modifications on the shells, both those resulting from human activities and those occurring naturally (Lyman 1994; Claassen 1998).

The data collected from the shells, including the perforations, were analyzed to gain insights into the techniques employed by humans in creating these perforations. This information contributes to understanding how ancient populations used the shells (Trubitt 2003; Kubicka *et al.* 2017).

In addition, comparative studies were undertaken, drawing upon published research focused on the Roman and Byzantine periods. It provided valuable insights for reconstructing the characteristics and potential uses of the shells

(Wilson and Tébar Megías 2008; Kubicka *et al.* 2017). By integrating previous research with the observed modifications of the shells, a more comprehensive understanding of their cultural and functional significance can be achieved (Trubitt 2003).

3. Results

3.1. Taxonomy

The recorded shells (Table 1) encompass at least five genera. Among the bivalves, the identified genera include ark shells (Arcidae), bittersweet clams (Glycymeridae), and true oysters (Ostreidae). For gastropods, there are a cowrie (Cypraeidae) and murex (Muricidae).

The main form is murex (*Bolinus brandaris*), with a total of 11 specimens (64%). Additionally, one highly eroded shell could be either a *Bolinus* or a closely related species (*Hexaplex trunculus*).

There are two valves of *Glycymeris*; one valve may belong to *Glycymeris* cf. *nummaria*.

Other shells include a burnt ark shell (*Anadara* cf. *uropigimelana*), a common oyster (*Ostrea edulis*), and a brown or lurid cowrie (*Luria lurida*). These finds are visually represented in Pl. 2: 1 and summarized in the table.

Table 1. Table of shells from Jerash

	Family	Genus and Species	Number
Bivalvia	Arcidae	*Anadara* cf. *uropigimelana*	1
	Glycymeridae	*Glycymeris* cf. *nummaria*	1
		Glycymeris sp.	1
	Ostreidae	*Ostrea edulis*	1
Gastropoda	Cypraeidae	*Luria lurida*	1
	Muricidae	*Bolinus brandaris*	11
		Bolinus or *Hexaplex*	1
Total			17

3.2. Specimens

Sh. 1: *Bolinus* shell, which is water-worn but mostly intact except for the broken siphonal canal (Pl. 2: 2). It exhibits a distinct perforated hole with a subcircular shape. The maximum diameter of the hole measures 5.75mm. Additionally, there are noticeable traces of perforation around the internal boundary of the hole and edge wear on the hole margin.

It is likely that the shell was intentionally perforated to be strung. We note cut marks of a flat tool used as a first step, followed by drilling to produce the hole. Drill marks are visible and the margin of the hole is smoothed. This suggests that the shell may have been used in decorative or functional contexts, such as being incorporated into jewelry or other ornamental items.

Sh. 2: *Bolinus* shell complete, fresh, and well-preserved. Potential use-wear is visible near the siphonal canal at the distal end of the shell. Surface smoothed and polished along the siphonal canal of the shell.

This suggests that the shell may have been subjected to some activity or usage, resulting in clear signs of wear in that area. The nature of the use or wear can provide insights into the function or purpose of the shell.

Sh. 3: *Bolinus* shell exhibiting signs of water-wear and a large hole on the body whorl (Pl. 3: 1). Upon closer examination, it appears that the hole was created through indirect percussion, possibly using a flat tool (Cristiani *et al.* 2020: comparable to samples 26-28 in Figs. 1 and 2C). Additionally, incomplete perforations can be observed on the surface of the shell, which has resulted in percussion fractures on the aperture. These fractures are likely a result of the tip of a flat tool being used to make the perforation.

The siphonal canal is broken. This combination of features suggests intentional human manipulation of the shell, possibly for functional or decorative purposes.

Sh. 4: *Glycymeris* sp. valve displaying signs of water-wear and with a natural hole at the umbo (shell "beak") (Pl. 3: 2). The diameter of the hole is approximately 5mm. It is evident that the edge of the hole has undergone significant abrasion. Notably, the edge of the hole appears to have been artificially elongated, possibly due to the use of a thread or similar material used to string the shell.

Despite the wear and elongation of the hole, the shell itself is well preserved. However, a few fractures can be seen on the ventral margin. These fractures could have occurred naturally or may have resulted from human handling or other factors.

The combination of the natural hole, the abrasion patterns, and the elongation of the hole's edge provide indications of intentional human modification and use of the shell, potentially for decorative or functional purposes.

Sh. 5: *Glycymeris* cf. *nummaria* valve, water-worn, with a natural hole at the umbo, characterized by a subcircular shape that is enlarged in its dorsal part (Pl. 4: 1). The maximum diameter of the hole is 2.4mm. The edge of the hole shows signs of abrasion and enlargement, likely caused by using a thread or similar material to string the shell.

Sh. 6: *Luria* complete, unmodified, and rather well preserved.

Sh. 7: *Bolinus* shell exhibiting irregular breakage along its lip, likely due to the removal of the flesh. Despite the broken lip, the shell is well-preserved, indicating that it has not undergone significant degradation or damage.

Sh. 8: *Bolinus* shell, almost complete and well-preserved, with a broken siphonal canal.

Sh. 9: *Bolinus* shell with an irregularly broken aperture, commonly occurring when removing the flesh, like Sh. 7. However, despite the breakage along the aperture and a broken siphonal canal, the shell is generally well-preserved and almost complete.

Sh. 10: *Ostrea* left valve (Pl. 4: 2). The valve is well-preserved, retaining its overall shape. A slightly pitted exterior can be seen upon close examination, indicating minor surface irregularities or indentations. Cutting traces are visible on the interior. Also, small chips are noted along the edges of the shell.

Sh. 11: Muricidae shell, either a *Bolinus* or a *Hexaplex*. It is impossible to determine the genus due to extensive erosion and fragmentation. The specimen retains the columella, distal lip, but lacks the apex, and its body is open.

Sh. 12: *Bolinus* shell, water-worn (Pl. 5: 1). The shell exhibits two holes on the posterior part of the body whorl. One of these holes is irregularly shaped and measures 6.4mm in diameter. The second hole is sub-square shaped with a maximum diameter of 4.5mm.

Both holes display sharp cut marks along their edges, indicating the possibility of being made using a flat tool for perforation. Additionally, certain areas around the edges of the holes appear smoothed from the inside, suggesting that the shell may have been attached or suspended using a thread. While the shell itself is well-preserved, it should be noted that the aperture and the siphonal canal have sustained damage and are broken (Pl. 5: 1).

Sh. 13: *Anadara* cf. *uropigimelana* left valve (Pl. 5: 2). The shell shows marine erosion traces and a large irregular opening below the umbo. Upon closer

inspection from a dorsal view, a sharp cutting trace is observed along the edge of the hole. This cutting trace could potentially be attributed to the use of a flat and sharp tool to create the opening.

Sh. 14-16: *Bolinus* shells. The shells are remarkably well-preserved and maintain a nearly intact and pristine condition, except for some damage to the siphonal canal.

Sh. 17: *Bolinus* shell, water-worn, The shell displays a sub-circular hole on the upper mid-body, measuring 5.7mm (Pl. 6). The edges of the holes do not show perforation cutting marks and edges are smoothed and shiny. Despite the broken siphonal canal, the shell is nearly complete, with no major damage or missing parts.

3.3. Surface modifications

Among the shells excavated, seven specimens of *Bolinus*, *Glycymeris*, and *Anadara* have perforations. Two types of perforations were observed. The first type was created using rounded nail tools, as seen in Sh. 1 and Sh. 17. In specimens Sh. 4 and Sh. 5, the perforations are initially rounded, but the holes have been elongated through the circulation of a thread used to suspend the shell (Pl. 3: 1, 4: 1, 6).

The second type of perforation observed indicates the use of a tool with an almost flat section, as seen in Sh. 13 (Pl. 5: 2). Additionally, some shells, such as Sh. 12 and Sh. 3, display a sub-squared section near the aperture, indicating the presence of a percussion trace. It suggests that a tool with a sub-squared section was used to create these perforations (Pl. 3: 2, 5: 1).

Based on the limited number of fresh shells found at Jerash, particularly considering that some of these shells are not edible (such as *Luria*), it is unlikely that shells were a significant food source. Instead, the shells at Jerash were likely used for decorative or symbolic purposes.

The presence of water-worn shells, including *Bolinus*, *Glycymeris*, and *Anadara*, indicates that these shells were collected when they were already empty and washed up on the shore. The water-wear patterns suggest that the shells underwent natural processes of erosion and smoothing due to exposure to water and wave action.

4. Discussion

4.1. Provenance and shell-collection strategies

Bolinus brandaris is known to inhabit soft bottoms, including sandy or muddy areas, within the Mediterranean region. These animals can be found in various habitats, from intertidal waters to depths of up to 50m. *Bolinus* are typically caught through diving or by using baited traps (Ruscillo 2006; Alfaro and Mylona 2014). These methods are commonly employed to capture murex for various purposes, including dye/pigment production, commercial use, cultural practices, or modern research studies.

Ostrea edulis, commonly known as the European flat oyster, is found in the northeast Atlantic, Mediterranean, and Black Seas. It has a long history of being extensively farmed and exported, with records dating back to before the Roman period. This oyster can be either farmed or found in the wild, and it thrives in various intertidal ecosystems ranging from estuarine areas to exposed shores. It prefers attaching itself to hard substrates and rocks for stability and growth (Bonham and Roberts 2018).

The presence of marine erosion traces on the *Glycymeris* and *Anadara* valves suggests that they were collected empty on a shore, indicating that they were not consumed for their meat. Similarly, cowries (*Luria*) are not edible and are primarily valued for their aesthetic appeal.

The identification of Mediterranean species (*Bolinus, Glycymeris, Luria,* and *Ostrea*) suggests trade exchange between Jerash and the coast, like Caesarea and Joppa/Jaffa. The trade probably involved the exchange of various marine products, including seafood. The availability of these Mediterranean species in Jerash may indicate the importation of coastal resources and highlight the economic and trade networks between Jerash and the coast.

Shells from older excavations at Jerash were analyzed by D. S. Reese. The British excavations of 1983-1984 yielded ten Mediterranean shells, including five *Bolinus* (two of which were water-worn and had holes, while the other three were fresh), one *G. nummaria* (water-worn with a hole at the umbo), one *Ostrea* valve, two cockles (one of which was water-worn), and a *Mytilus* (mussel) fragment. Additionally, eight Red Sea *Tectus dentatus* (top shells) were found.

During the American excavations of 1982-1984, which primarily focused on the Late Byzantine and Early Islamic periods, five Mediterranean shells were studied: one burnt *Bolinus* and four *G. nummaria* (all water-worn, with two having

holes at the umbo). Additionally, six Red Sea shells were found: four cowries (three *Cypraea tigris* fragments and one unmodified *Monetaria annulus*), a black-lipped pearl oyster (*Pinctada persica*) fragment, and one turban shell (*Turbo*) operculum.

The *Anadara* valve found around 2017, a species originally from the Red Sea and now invasive in the Mediterranean, indicates connections between Jerash and the Red Sea coast. The migration of this species through the Suez Canal (opened in 1869) has resulted in its presence in the eastern Mediterranean. The *Anadara* (and the previously found *Tectus*, *Cypraea*, *Monetaria*, *Pinctada*, and *Turbo*) suggest trade or cultural connections between Jerash and the Red Sea coast, such as with Ayila-Aqaba (for Red Sea species, see Mir 1991).

4.2. Murex shells and the production of purple-dye

Large quantities of fresh murex at Mediterranean coastal sites are commonly believed to indicate the ancient production of purple-dye, with the industry found from the Late Bronze Age to the Roman period along the Levantine coast (Reese 2010; Marín-Aguilera *et al.* 2018). However, the distance between Jerash and the sea and the small number of fresh murex indicates that the murex at Jerash were not used to produce dye or pigment.

4.3. Shell adornments, cosmetics and tokens

Numerous shells here exhibit intentional perforations. Two distinct types of perforation have been identified, suggesting that these shells were likely utilized in different ways, potentially serving as ornamental pendants or weights (Deshpande-Mukherjee *et al.* 2017). Cowrie beads typically feature perforations on their dorsal side; in some instances, the entire dorsum may be removed. Complete cowries could have functioned as small tokens, perhaps for gaming purposes (Reese 2011; Charpentier *et al.* 2014; Lidour *et al.* 2023), or simply as keepsakes or souvenirs.

Numerous marine shells have been found at archaeological sites in Jordan, such as Busayra (Reese 2002a), Tella Jawa (Reese 2002b), Umm al-Biyara (Reese 2011), Humayma (Reese 2013), Wadi at-Thamad (Reese 2017a), Pella (Reese analysis), Petra (Reese analysis), as well as at West Bank sites like Jerusalem (Reese 1995, 2017b, 2008; Ktalav 2020). Notably, these sites are situated a considerable distance away from the coast. The presence of these shells can be attributed to their transportation via commercial trade routes, specifically the caravans that connected the Mediterranean Sea and the Red Sea during the Roman period. These shells were

presumably utilized for various purposes, including as gaming pieces, ornaments, or talismans (Reese and Sease 2004; Reese 2011, 2017a; Ktalav 2020).

Another possibility should be mentioned: the use of murex shell ash in the production of cosmetics for Roman women. Archaeologists found murex (but unburnt) in conjunction with ivory and bone tools at Jerash (Shiyyab and Abuhelaleh 2021). Historical references to cosmetics production during Roman times further strengthen this hypothesis. In fact, Pliny the Elder mentions in *Natural History* (32.85) that the ash of murex shells could be combined with honey and applied to the skin daily for a week, followed by an egg-white wash on the eighth day to create a smoothing skin cream. (Olson 2009, 300).

5. Conclusion and perspectives

The presence of two types of perforations on the shells provides evidence linking the perforating tools to the shells. The rounded perforations appear to be associated with the production of pendants, suggesting an intention to create decorative items. On the other hand, the flat sharp tools may have been for the rare extraction of the animal's meat. This distinction suggests that different tools were employed for specific tasks related to the shells like food and jewelries.

The existence of specialized tools and the diversity of perforation techniques could suggest the possibility of a dedicated workshop for the production of shell pendants in Jerash. This supports the notion that the local population had access to or engaged in the manufacturing of ornamental shell pendants, potentially serving as a hub for the production or trade of these items.

From the small number of marine shells at Jerash, it is evident that a considerable range of exploitation techniques was employed.

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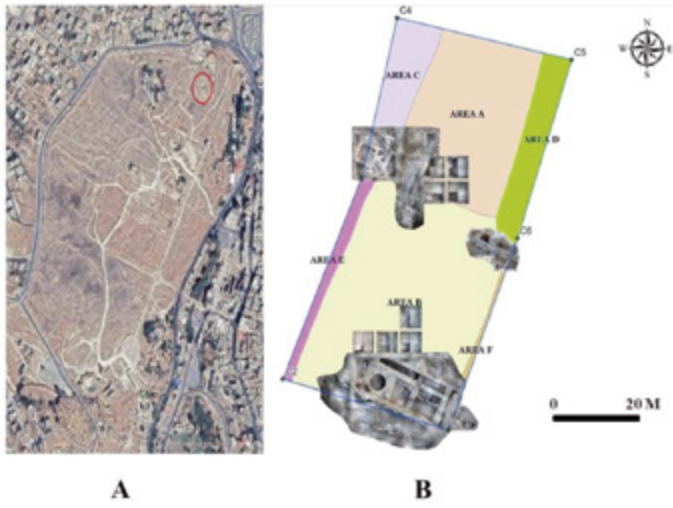
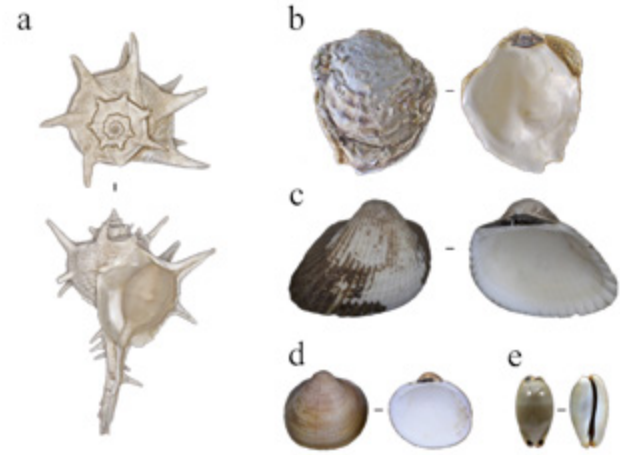


A B

2

Pl. 1: 1 – Location of Jerash

Pl. 1: 2 – A: Satellite imagery of Jerash showing the excavated area (© Google Earth); B: Photo of top plan of the excavated area in 2017-2019



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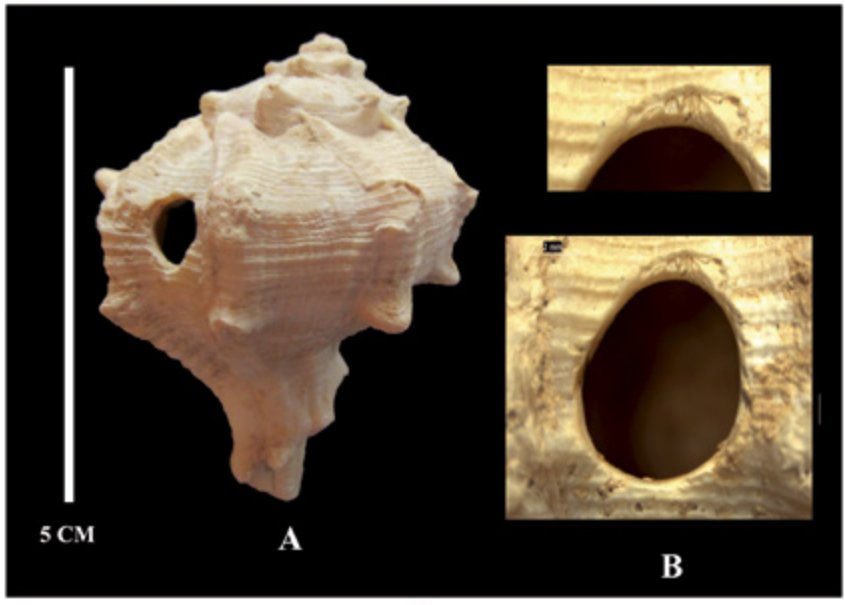

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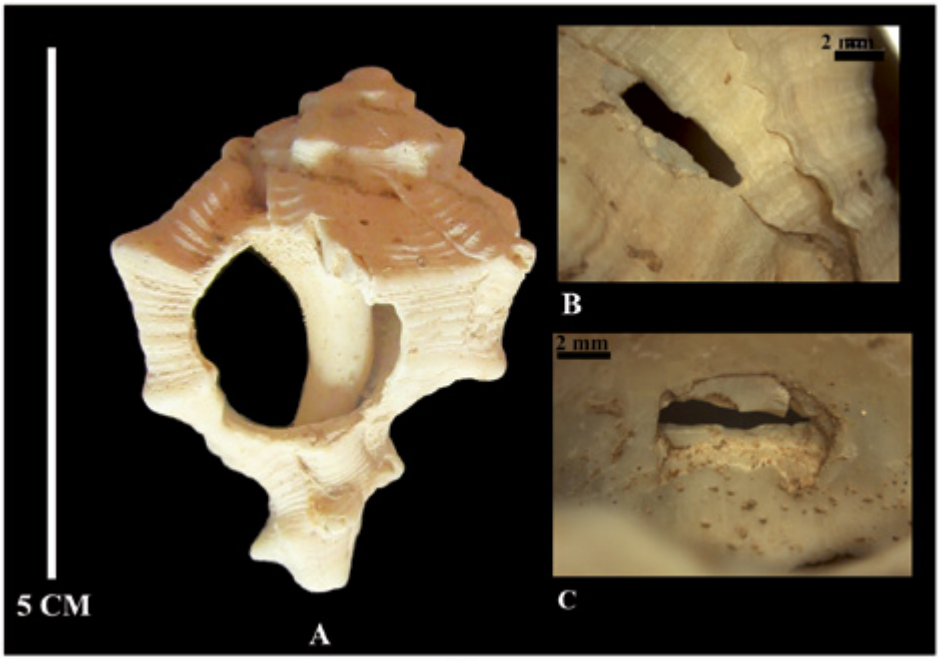
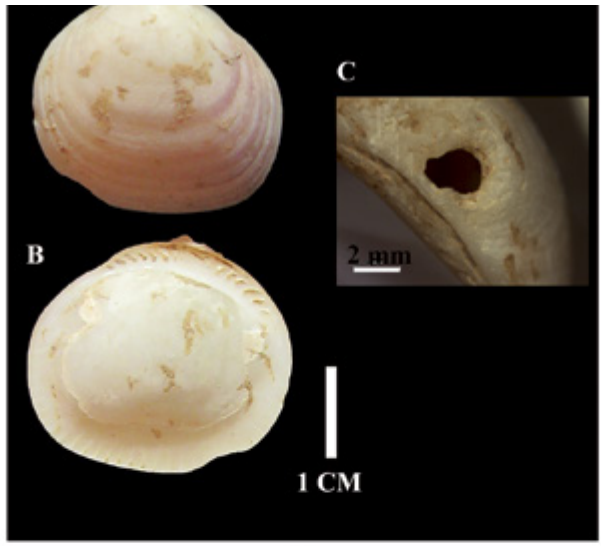
Pl. 2: 1 – Reference of marine shells analogous to archaeological specimens identified from Jerash: a. *Bolinus brandaris* (Linnaeus, 1758); b. *Ostrea edulis* (Linnaeus, 1758); c. *Anadara uropigimelana* (Bory de Saint-Vincent, 1827); d. *Glycymeris* (sp. da Costa, 1778); e. *Luria lurida* (Linnaeus, 1758)

Pl. 2: 2 – A: Sh. 1. B: Perforation detail showing cut marks of flat nail and edge wear of hole, viewed by stereomicroscopy



Pl. 3: 1 – A: Sh. 3. B & C: Percussion cut near the aperture, viewed by stereomicroscopy
Pl. 3: 2 – A: Sh. 4. B: Perforation at the umbo, viewed by stereomicroscopy



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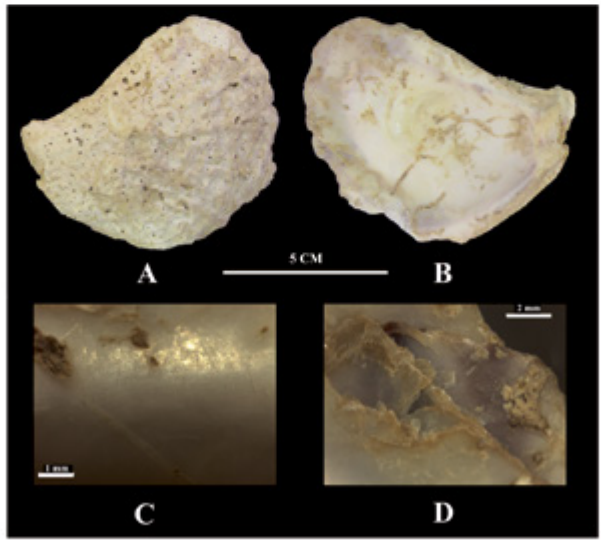

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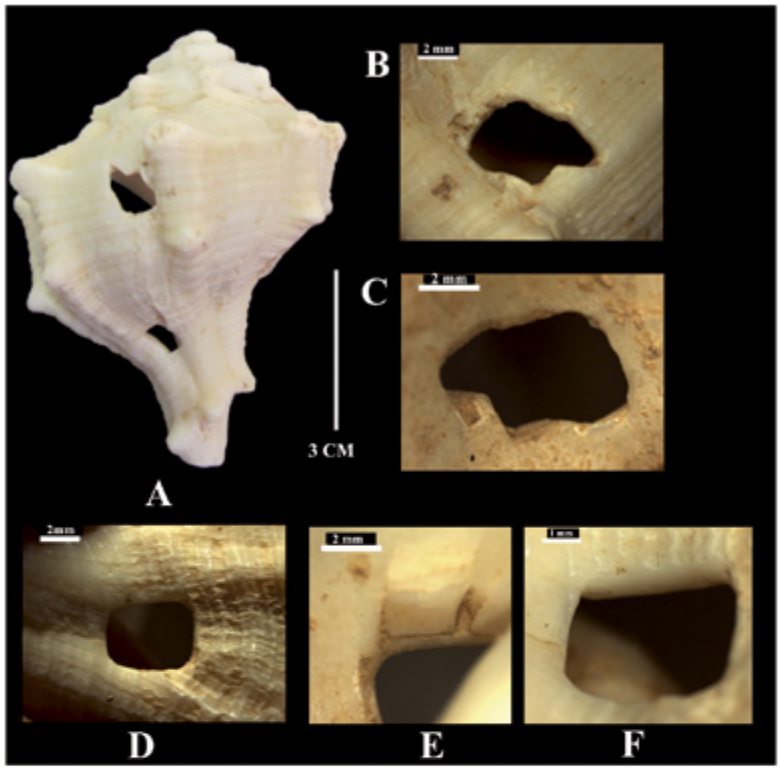
Pl. 4: 1 – Sh. 5. A: Exterior. B: Interior. C: Perforation on the umbo, viewed by stereomicroscopy

Pl. 4: 2 – A-B: Sh. 10. C-D: Cutting traces and fractures observed on the valve interior, viewed by stereomicroscopy



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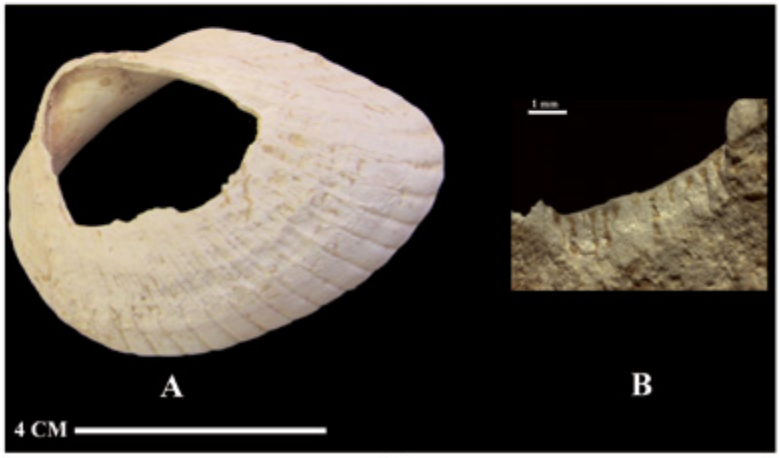

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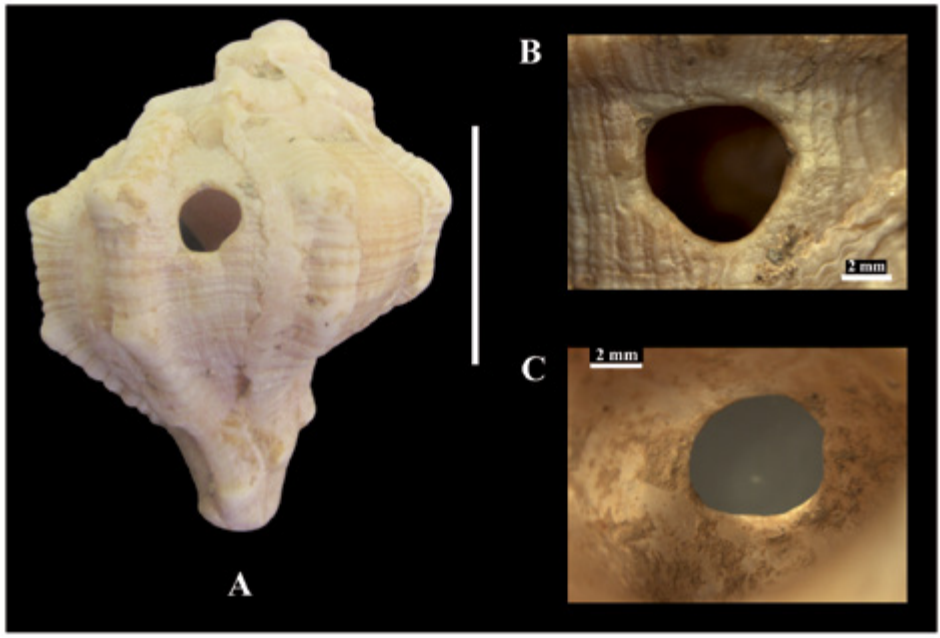
Pl. 5: 1 – A: Sh. 12. B-F: Perforations possibly made by flat sharp tool, viewed by stereomicroscopy
Pl. 5: 2 – A: Sh. 13. B: Cutting traces possibly made by a flat sharp tool, viewed by stereomicroscopy



Pl. 6 – A: Sh. 17. B: Perforation, viewed by stereomicroscopy