Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

Journal of Maritime Archaeology
https://doi.org/10.1007/s11457-021-09290-4

ORIGINAL PAPER

Pearl and Mother of Pearl in *Hispania*: Exploitation and Trade of Marine Luxury Products

Macarena Bustamante-Álvarez[1] · **Darío Bernal-Casasola**[2] · **María Ángeles Castellano-Hernández**[3]

Accepted: 14 January 2021

Abstract

This article analyses the exploitation of luxury products such as pearls and mother of pearl, a seldom-examined facet of maritime archaeology. This issue will be approached from an archaeology of production perspective, taking into account the whole chaîne opératoire, including harvesting the resource, marketing it, and mounting it in different supports. We shall also examine the meaning of these resources and some extravagant practices for which they were used during antiquity. We shall pay special attention to the artisans, as well as the production methods used to process these resources and assemble them. The study will focus on the Roman period, and *Hispania* will be used as case study. The Iberian Peninsula is surrounded by plentiful seas, but this specific issue had been paid no specific attention to date. An unpublished catalogue of jewels decorated with pearls and other ornaments is presented, which confirms the importance of these resources in ancient Roman markets.

Keywords Pearl-mother of pearl · Prestige economy · *Hispania* · Archaeology of production · Jewellery · Sea products

Introduction

The exploitation of natural resources during the Roman period has been the subject of much scholarly attention, from a number of perspectives. However, one specific aspect, perhaps because it has been regarded as the domain of other scientific disciplines—especially malacology, jewellery and glyptic—has not been examined from an economic perspective. Pearls, mother of pearl, and *byssus* (sea silk) had a great impact in classical literature but have been the subject of little archaeological perspective. This work aims to fill this gap, using the Iberian Peninsula, Roman *Hispania*, as a case study.

✉ Macarena Bustamante-Álvarez
mbustamante@ugr.es

[1] Prehistory and Archaeology Department, University of Granada, Granada, Spain

[2] History, Geography and Philosophy Department, University of Cádiz, Cádiz, Spain

[3] National Archaeological Museum, Madrid, Spain

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

Pearls, because of their general spherical shape, are an ideal adornment for necklaces, rings, and other jewellery items (Johns 1996: 86), and something similar may be said of coral. As a result, these materials are tangentially mentioned in works dealing with personal adornments, including their nature, processing, and manufacture. These materials were of great importance in antiquity and were very highly valued (Plin., *HN* 9, 54–59), being, for instance, permanent in nature, unlike perfumes (Plin. *HN* 12, 3), and they are a recurrent feature in descriptions of wealthy social environments. However, these abundant mentions in the written record stand in sharp contrast to the scarcity of archaeological evidence for pearls, which is not limited to ancient *Hispania*.

This article is divided into several sections; it begins making a general approach to the topic followed by more specific questions. This work demonstrates that the issue has great potential. In *Hispania*, the evidence for pearls and mother of pearl clearly outstrips that for coral; to date, the latter is limited to a few items in Ampurias (Tremoleda 2006: 22); these include production debris of *Corallium rubrum* in a possible workshop in the area of Neápolis (Aquilué 2006: 15), several minor parallels for which are known in the ancient world (Morel et al. 2000); and so-called sea silk or *byssus*, which was extracted from a bivalve—*Pinna nobilis*—which is currently at the point of extinction (Enegran and Meo 2017). For this reason, we decided to focus on pearls in this first approach to luxury marine materials.

Despite the large number of pearl-adorned Roman jewels known in the Iberian Peninsula, they have been subject to no specific analysis to date. Most existing publications merely deal with the typology of these objects, without taking into consideration the craftspeople that were involved in their chaîne opératoire. This is rooted in an iconography-based approach with close links with art history and iconography, for which metals and precious stones have always had priority, while pearls remained in the backseat despite the prominent role that they play in the written record.

This work begins by making a formal description of the material and presenting the specialised terminology, as well as the main source regions. A second section assesses the abundant mentions of them in the written record, emphasising the role played in wealthy environments and the extravagant practices for which they were used, which did nothing but increase their value even more. A third section deals with the craftspeople involved in the processing of these materials, especially the *margaritarii*, and epigraphic sources. Finally, we shall examine the existing evidence in *Hispania*.

Pearl Harvesting and Maritime Trade in Antiquity

Although this work focuses on the Roman period, the use of pearls goes back at least to the Neolithic. The new and recent discoveries in the south-east Arabian Peninsula offer us significant data to discuss pearl fishing in the early part of the Eastern Neolithic. Until recently, findings from burial 4 of Umm al-Quwain UAQ2 dated to *ca.* 5500 BC indicated the very early exploitation of these resources as well as their use in highly votive contexts (Charpentier et al. 2012: 2). However, recent finds of two pearls on Marawah Island (Abu Dhabi), in a stable insular settlement, date to the beginning of the sixth millennium BC, data that have surpassed the oldest chronologies yet known (Beech et al 2019: 30). At this early period, specifically at the Jebel Buhais site, a certain differentiation is observed between the pieces destined for men that appear semi-perforated and those for women that are fully perforated (Beauclair 2008: 8). Undoubtedly, these practices could suggest a high specialisation in this work, a fact that is accompanied by the possible selection of pieces

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

given the spherical perfection observed in this period (Charpentier et al. 2012: 3). Despite these data, specialists in the field do not doubt that these Neolithic finds will multiply in the future: the lack of evidence lies, on one hand, in their fragility and, on the other, in the excavation methods (Charpentier et al. 2012: 1).

Also, the use of pearls was popular by the Persian period, as the evidence dating to the fifth- and fourth-centuries BC from Susa and Pasagardae illustrates (Ogden 1982: 120, pl. 30). Often, these early references also convey interesting information about the consumption and idiosyncrasy of these products. An account of Gilgamesh's life found in Nineveh describes the hero pearl-harvesting: the pearls are referred in this account as 'flowers of immortality' and relates their harvest with heroic deeds and immortality elixirs (Carter 2005: 143). In some cuneiform texts, pearls are referred to as 'fish eyes' (During-Caspers 1983: 24). The use of pearls, like some gemstones and coral, seems to have reached Hellenistic Greece in the aftermath of Alexander's conquests. The Macedonian expansion led to the importation of Persian fashions, in which pearls appear to have featured prominently (Andrew 1996: 130).

For the ancients, the sea was a seemingly endless source of economic resources that were not limited to fish for food. Pliny referred to the 'shell-fish' which are used to 'adorn' the body (Plin. *HN* 9, 53). What was he referring to? He answers this question is his text as explained in the following paragraphs. Pearls are the result of the defensive reaction triggered by oysters when their habitat is invaded by an extraneous object. If the animal is unable to expel the object, if forms an iridescent substance to engulf it, leading ultimately to the death of the animal. They are annular in section, which is probably why, in the Roman period, they were known as *unio/unicum* (Plin. *HN* 12, 1–2 cited by Ogden 1982: 119). Romans mostly referred to pearls using the term *margarita*, also used by the Greeks, although *pina* was also used (Cic. *Nat. D.* 2, 123 and Plin. *HN* 9, 142). The term *margarita* is oriental in origin, perhaps a linguistic loan to refer to a material that was previously unknown (Pérez González 2014: 268). The term referred to the white colour of the material and to its brightness, which was compared to that of diamonds (Bartman 1999: 44; Croom 2002: 115; Vons 2000: 372–374).

Pearls and seashells caused fascination in the Roman world, which, alongside their polyvalence, increased their value and their appeal among both men and women. To add to this fascination, these materials came from very remote corners of the Empire (Sevillano-López and Soutar Moroni 2012). For instance, a 'cowrie' seashell (*Cypraea pantherina*) found in a female cremation burial in *Augusta Emerita*, dated to the first century AD and interpreted as a fertility amulet (Rodríguez-Hidalgo et al. 2013) came from the Red Sea; similar examples are found in other Mediterranean and central European sites, confirming that these items were subject to an active long-distance trade (Reese 1991).

The written record suggests that most pearls and other associated materials came from the eastern African coast and were at first the result of sporadic transactions (Rostovtzeff 1957: 131). According to Pliny, those from *Taprobana* (Sri Lanka), *Perimula* (India), *Stoidis* (Persian Gulf) (see summary in Carter 2005) were common, although, as we shall see later, Pliny tended to over-represent seashells sourced from the environments of the Arabian Peninsula and the Arabian Gulf. According to Dalby (2000: 188), the *Erythraeum*, including the Red Sea, the Indian Ocean, and the Persian Gulf, was considered the *gemmiferum mare* or *rubrum salum per excellence*. For the Romans, the seashell harvest from these seas was *lacteae gemmae*—'milk gems'—owing to their white colour. This was also the origin of *lapilli erythraei*, Red Sea gems (Mart. *Ep*. 5, 37). The sources also indicate that these materials were used to mark special days, for instance, when Horace mentions his friend's *Calenus* wedding anniversary with *Sulpicia* (Mart. *Ep*. 2, 38).

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

These lucrative products were brought from the Indian Ocean by coastal trade, taking advantage of the monsoons from as early as the Julio-Claudian period (Higgins 1980: 38; Bartman 1999: 44; Pérez González 2014: 1413). Some classical sources convey information on routes, harbours, and products. A good example is the *Periplus of the Erythraean Sea*, attributed to an Egypt-based Greek merchant (McLaughlin 2013: 110).

Historiography has also mentioned pearl harvesting in the coasts of Acarnania, Thrace, and *Mauretania* (Tassini 1992: 692). We must, however, not forget local and regional sources—both coastal and interior—which were not mentioned by the classical sources, probably as a result of the inferior quality of the material. It is also unclear why some areas, which are often mentioned in the sources, have yielded so little archaeological evidence, such as *Mauretania* (for this discussion Trakadas 2018: 271, 399–400). Maybe this is simply a matter of scale when we compare the huge amount of people and resources when fishing in open areas in comparison with the situation of a low scale provincial exploitation. An example of this is the grey pearls from *Britannia*, mentioned by Tacitus in the first century AD (Tac. *Agr*. XII, 6). According to Suetonius, they were one of the reasons that moved Julius Caesar to conquer Britain (Suet. *Iul*. 47). It was Pliny (*HN* 9, 56–57) who gave a more comprehensive account of the regions where these materials were harvested, also giving a brief description of their quality: (a) pearls from the Indian Ocean, which were of great quality and 'monstruous' in size. He also praised the 'scales' of *specularis* stones, which he refers to as being made of 'alum'. The first specimens to arrive to the Roman Empire came from *Taprobane*, *Perimula*, and *Stoidis*; (b) Arabian and Eritrean pearls, which were uniquely white. They could also be cloud-coloured; (c) Thracian Bosphorus: they were reddish and smaller in size and were products of a bivalve he calls "mays"; (d) Acarnania (Ionian coast): referred to as *pina* due to its probable origin of a mollusc called *Pinna nobilis*, they were poorly regarded because they were irregular, crude, and marble-coloured; (e) pearls from Accio, which were small; (f) pearls from *Mauretania*, which were also small; (g) pearls from *Britannia*, which were dark and gold-coloured. According to some authors, the regions from which these materials are sourced have changed little between antiquity and today (Higgins 1980: 38). By contrast, in this point, we can add new places such as the New World and South Sea fisheries that nowadays continue as the most important places for pearl exploitation.

These routes were not exclusive of the pearl trade but also conveyed other luxury products such as spices and textiles from India, Chinese silk, or aromatic plants among other items (Seland 2013: 373). This was a lucrative trade for the state, because oriental luxury products such as pearls, incense, myrrh, and some spices were specially taxed (*tetarte*) (McLaughlin 2013: 88–89). Undoubtedly, the light weight of these pieces is fundamental to understanding the profitability of the business (Schörle 2016: 46). It should also be taken in consideration that this trip involved several months of crossing and was conditioned by the seasonal meteorological changes and by the monsoon winds, hence the need for the commercialised products to be profitable (Seland 2011: 406). But, in addition, we must bear in mind the presence of a strong state investment in the conservation and preservation of the infrastructure located along the route necessary for the correct development of these commercial activities (Schörle 2016: 44).

The classical sources make no reference to pearl farming, despite the fact that oyster-farming was a well-developed economic sector (Marzano 2013: 173–197; 2015; Bardot-Cambot 2013: 197–206; Bernal-Casasola 2018). In fact, the frequent mention to the dangers involved in harvesting them, which was described by the classical authors at great length, suggests that all the pearls consumed were wild. In fact, some authors claimed that

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

those collected far from the coast and at great depths were better, because their colour was not spoiled by direct sunlight (Plin. *HN* 9, 109).

These materials were brought to Rome mostly by sea, but it must not be ruled out that those that came from especially remote regions—e.g. the Indian Ocean, the Persian Gulf, and the Red Sea—were also partially transported overland, through well-established and defended routes. These commercial contacts have left a wealth of written references, concerning both the inbound pearls and the outbound Roman products that were exchanged for them. Pliny gaily refers to the Arabian Sea as '*felicius*' because of its role as the main pearl supplier to the Roman Empire, a trade that, always according to Pliny, amounted to 100 million sestertii per year (Plin. *HN* 12, 41).

It is also known that pearls decorated Queen Ahhotep's (18th Dynasty, New Kingdom) necklace, and that mother of pearl (*Pinctada margaritifera*) discs were used by women in the pharaoh's court. The scarcity of these mentions, however, suggests that these materials were not highly regarded in Egypt. An inscription dedicated to *Bubastis*, the Greek name of the Egyptian goddess Bastet, which in the Hellenistic period was linked to Isis and maternity (*Her.* 2, 137), mentions 'two rare sea-shells without stain' (*Nuplia Pura*, that is, probably *Aplax*)—*CIL* XIV, 2215—(Rigato 2011: 45–47).

Despite these references, it seems that these materials were not widespread until the Hellenistic period and above all during Roman times. In fact, the expansion, even of iconographic representations, did not develop until Roman times (Schörle 2016: 45). They were adopted by wealthy Romans during Sulla's rule (Plin. *HN* 9, 58) and continued being used until the Late Roman and Byzantine periods (Ogden 1992: 39), when the pearl trade underwent considerable growth, as attested by the archaeological record.

Sea and River Pearls: A Luxury Product Between Extravagance and Beliefs

According to Pliny (*HN* 9, 56), pearls were valued because of their white colour and brightness, their spherical form, and their smooth surface. The largest pearls weighed as much as half an ounce (14.78 g), and they were combined with other materials to form jewels. Jewellery with mounted pearls was not only valued according to their weight. The number of pearls mounted in a piece of jewellery was a key factor in the cost (Petr. *Sat.* 67; Croom 2002: 115) and sometimes they fetched fabulous prices. For instance, the sale of Vitelius' pearls funded his trip, ordered by Galba, through lower *Germania* (Suet. *Vitel.* 7).

Little attention has been paid to the symbolic value of pearls during the Roman period. In some regions, pearls are linked to tears and, therefore, sad events in the life of individuals. However, they also have other associations, for instance, with purity and innocence, being commonly used by young people and brides (Johns 1996: 11; Puttock 2002: 103).

In the Roman period, pearls seem to have been associated with some religious cults, for instance, with Cybele, whose priests wore long pearl necklaces (Vermassen 1977: 38–39, 296). They were also closely associated with the cult of the *Magna Mater* and with the *collegii dendrophorum*, which often included or were governed by *margaritarii*, such as *Manius Publius Hilarius* and *Titicius Hylas.* There is no evidence for pearls being attributed to medicinal properties. Coral, in contrast (Plin., *HN,* 32, 2, 24), was believed to help with colds, bladder complaints, fever, blood sputum, ulcers, and eye ailments. It was also believed to have apotropaic properties, as revealed by its use to decorate helmets and

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

weapons among the Celts (Plin. *HN* 32, 2, 23); often, because of its high cost, it was simply replaced by red-coloured stones (Puttock 2002: 103).

The use of pearls was soon closely linked to wealthy and extravagant lifestyles, and their use was well reflected in the Golden Age of Roman literature (Schörle 2016: 43). Pliny (*HN* 9, 56) claims that the shoes of wealthy Romans were decorated not only with gold, but with pearls as well. Petronius (*Satyr*. 55) even expresses his opinion about the jewels that adorn a licentious woman. Horace (*Sar.* Libr. 1, 2), for his part, focuses on their use to decorate the arms and claims that the arms of women were covered in 'pearls and emeralds'. Eastern pearls soon became an almost obligatory fashion (Ov. *On cosmetics*, I, 20–26).

In addition to this, in the *Historia Augusta*, Zenobia, Queen of Palmyra, is portrayed wearing a *coclis* in her robe, a type of seashell also mentioned by Pliny (*HN* 37, 194), who gives its origin and also explains the way it was processed before it was used as a piece of jewellery: by boiling it for seven days while marinating it in honey during the night. Zenobia used it as a fibula to hold her purple robe. According to Girotti (2011: 201–202), this probably was meant to emphasise the Roman character of the garment and to feminise Zenobia, who was in a position traditionally reserved to men, as seashells were generally associated with females. This geographic space is also significant since Palmyra played a fundamental role in trade between the Mediterranean and the Indian Ocean in high Imperial times, not only in relation to maritime but also caravan trade (Seland 2013: 381; Schörle 2016: 46).

In another account, Julius Caesar was said to have paid six million *sestertii* for a pearl for *Servilia,* Brutus' mother and his favourite (Suet. *Caes*. I, 2). Julius Caesar also bought the breastplate worn by the statue in the temple of *Venux Genetrix*, which was decorated with British pearls, which were characterised by their small size and dark colour (Plin. *HN* 9, 57; Tac. *Agr*. 12, 6).

This sort of story appears in the sources time and time again; in fact, it was Julius Caesar who tried to implement laws to limit public eccentricity, exempting only those of a certain age and some festivities (Guizzardi 2009: 29). However, judging by the following anecdotes, these regulations do not seem to have been obeyed for long.

Cleopatra in a *summum exemplum luxuriae* dissolved a large pearl worth ten million *sestertii* in vinegar and drank it to win a bet with Mark Anthony, who had challenged her to eat food worth that amount in a single meal (*HN* 9, 58). Not happy with this, she tried to eat a pearl encrusted on a piece of gold, but the bet referee stopped her from doing so. The story of this pearl, however, does not end here; owing to its large size, it was cut in half and used, once Cleopatra had been defeated, as earrings for the Venus statue in the Roman Pantheon (*HN* 9, 58). The consumption of dissolved pearls was not exclusive to Cleopatra: a certain Clodius, son of Aesop, was said to have done it to try the taste (Plin. HN 9, 58), and Caligula appears to have done so repeatedly (Suet. Cal. 4, 37).

For her part, Caligula's wife, Lolia Paulina, is portrayed wearing a robe covered in pearls, worth 40 million *sestertii*—as she tried to prove showing the receipts—and some that had been taken as war booty (Plin. *HN* 9, 58). In his comments on *Gelia*, Martial claimed that some women loved their pearls more than 'their two children' or 'their lives' (Mart. *Ep*. 8, 81). Nero was said to have ordered a pearl casket to keep his first beard (Suet. *Ner.* 12), and the walls of the *Domus Aurea* were covered in large seashells and pearls (Suet. *Ner.* 31). Caracalla introduced the fashion of wearing pearl-decorated tiaras (Suet. *Galb.* 18), which inspired later Byzantine rulers, among which pearls were very popular.

The high price fetched by pearls inevitably led to counterfeit products, for instance, made of glass or simply whiteish stone, to appear on the market (Ogden 1982: 120; Andrew 1996: 134). In fact, most pearls found in the archaeological record are beads crafted out of

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

mother of pearl, which was much cheaper (Besson 2003: 01). The third-century *Stockholm Papyrus* lists some of the materials that were used in this fraud, such as lumps of mica, glue, and egg white, which could be made to greatly resemble original pearls (Ogden 1982: 13). Lists of prices and returns—for instance the *Muziris Papyrus*, which refers to the ship *Hermapollon* as well as some literary references—have allowed some price estimates to be made: it is thought that one million *sestertii* were needed to buy approximately 160 of the finest pearls (McLaughlin 2013: 94). Clearly, this business presents the binomial of being very lucrative but, in addition, involving a great risk. On many occasions, the over-cost of the transaction was accompanied by the loan application (Schörle 2016: 49).

Pearls soon became a common feature in wealthy Roman houses, and there were even servants whose job was to look after them, the *ad margarita(s)* (*CIL* VI, 7884). One example of their abundance in wealthy households is Elena's portrait in Constantine's palace at Trier. There she is represented with rich jewels and with a jewellery box where a considerable size pearl necklace is being extracted. These boxes would be very normal in the *domus* of prestigious people.

This iconographic evidence with some epigraphical examples dated to the end of the fourth century AD tells us that the production continued to be very active in Late Roman times (Pérez González 2019: appendix II, 6). This also is confirmed by the data provided by the regionary catalogues in which the confrontation between the *Curosium* and the *Notitia* attested the existence of the *porticum margaritarium* in the *Regio VIII Forum Romanum Magnum* (Valentini and Zucchetti 1940: 63–188).

Ulpianus provides other examples of the symbolic value of pearls, which are included among valuable heirlooms: (a) 'earrings, bracelets, necklaces, rings (with the exception of those used for seals), and all articles which are designed for no other purpose but the adornment of the body, to which class also belong trinkets of gold, jewels, and precious stones, for the reason that they themselves have no other use' (…). Pearls, where they are not unstrung, or any other precious stones where they can be readily detached from their settings, may be said to be included among ornaments' (*Digestorum* Lib. XXXIV, 2. 25.Ulpian 10–11); (b) 'Fillets set with pearls, as well as buckles, should rather be classed as ornaments than clothing' (*Digestorum* Lib. XXXIV, 2. 25.Ulpian.2).

Pearls also feature in religious dedications, for instance, in an inscription found in *Colonia Iulia Gemella Acci* (Guadix) (*CIL* II 3386). This inscription was carved on a pedestal dedicated to Isis which also mentions Anubis, Horus, and Apis, alongside other Nilotic figures (García y Bellido 1967: tav. XI). The inscription mentions a donation of jewels and gems by Fabia L. f. Fabiana to decorate the statue (a diadem with an exceptional *unio* pearl and six normal pearls; a pair of emerald and pearl earrings; a necklace with four rosettes decorated with 36 pearls; and a *polipsephus* ring decorated with emeralds and a pearl). A similar example is found in an inscription found in Loja (Granada) (*CIL* II, 2060), in which it is said that Postumia Aciliana had ordered in her will for a decorated statue (including pearls) to be made.

They are also often found in graves, not only during the Roman period but also earlier. The Japanese believe in Koiasu-gai, or 'easy delivery pearl', which is believed to help birth, and similar beliefs exist about the Kuba, in former Zaire (Girotti 2011: 203).

However, pearls, or rather, their abuse, could also have negative connotations, especially in relation to prostitution (Mart. *Ep*. 2, 9, 2; Petron. *Sat*. 55, 6) or with practices that were regarded as excessive and ostentatious and, therefore, un-Roman (Sen. *Dial.* 16, 3–6), and idea later adopted by Christianity (I *Timothy*, 2: 9).

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

Artists and Craftspeople: The Pearl Chaîne Opératoire

Classical sources are less eloquent when it comes to the pearl chaîne opératoire than with the description of their use in wealthy environments and extravagant practices. Pliny (*HN*, 9, 54–59) makes a brief description of pearl-working practices and the life cycle of oysters. He claims that files were used to detach them when they were attached to only one side of the shell and describes the dangers faced by the diver (*urinator*) (who were organised in corporations, as demonstrated by a second-century inscription from Ostia; who were in charge of salvaging cargoes that had accidentally fallen overboard; *Corpus Urinatorum Ostiensium*; *CIL* VI, 1872); these dangers include the shell closing, which could damage the diver's hand, sharp rocks, and 'sea dogs' or sharks. When harvesting far from the coast, Pliny says that pearl divers focused on larger specimens, while smaller ones were captured with a net. The oysters were covered in salt in a clay container to consume the meat and help the pearls fall to the bottom. Files were used to detach the pearls from the shells (Plin. *HN* 9, 109).

Another author that refers to the harvesting of sea products was Oppian (*Hal.* 615), not specifically referring to pearls but sponges. He mentions the dangers of the *urinator*'s job and his relationship with the fisherman that waited for him on the surface. Aelian (*Hist. Anim*. 10, 12) claimed that it was necessary for the sea to be calm before diving in. Tacitus also gives some information about the collection of these resources, for instance, in *Britannia,* where the molluscs were collected once dead, an activity less adventurous than in the Red Sea, where oysters were harvested while still alive (Tac. *Agr.* 12, 6).

The most highly valued pearls were those with a circular section, *margarita rotundae* or *orbiculatae* (Plin. *HN* 9, 109), although those which were tubular in section, *elenchus*, were also valuable (Plin. *HN* 9, 112).

Pearl processing began by sorting. Pearls which had one flat section were known in the classical sources as *tympanum* (Plin. *HN* 9, 109) and they were the best suited to be inserted in cabochons. The activity of perforating a pearl was known as *perforatio*, and cutting as *dissecare* (Di Giacomo 2016a, b: 52 and 57). When the pearl presented chromatic imperfections, *decolores margaritae*, or *senectae margaritae*, they were artificially corrected (Plin. *HN* 9, 115).

Afterwards, pearls were weighed and hardened (Plin. *HN* 9, 109) with urine, an activity that was carried out at different stages of the chaîne opératoire (*Papyri Graecae Holm*, Stockholm 9, 13, 22, 23, 29, 39, 43, 71, 75, 83).

Although no direct references exist to where pearls were processed, we think that they were worked at jewellers' workshops. This probably implies that pearls were encrusted in jewels that were designed *ex professo* to suit their size and shape. Some authors have regarded *margaritarii* as intermediate links in the chaîne opératoire, for they received part of the materials already processed (Di Giacomo 2016a; b: 124). Other authors place the *aurifices*, *argentarii*, and *margaritarii* in the same level as responsible for its retail sale; in front of other craftmen such as *inauratores* or *caelatores* who focused in the elaboration process (Pérez González 2019: 1013).

In this regard, pearls were similar to Baltic amber, which was delivered to the workshops in *Aquileia* as unworked lumps to be worked in their *officinae* (Calvi 2005).

The craftspeople involved in this chaîne opératoire are one of the best-known aspects of the pearl industry. Inscriptions mention a substantial number of occupations. Most of these inscriptions are funerary in nature, and they give the impression that pearl-workers

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

were a proud professional group. The inscriptions provide the following information (for an update of the epigraphical evidence see Pérez González 2014: 1013 appendix II):

(a) Their social status: e.g. *Euhodus* (*CIL* VI, 37,803) was a member of the imperial household and *margaritarius* in *Velabrum*.
(b) Their *origo:* we refer to the possible interpretation proposed by Tassini (1992: 691) and Di Giacomo (2016a, b: 235) of the inscription of L. Calpurnius Nicaei f. Cornelia Antiochus and L. Calpurnius Antiochus L. Alexa Maior (*CIL* VI, 9546 and 33,872). In this case, Tassini (1992: 691) hypothesises that the *cognomen Antiochus* was a descendant of a *peregrinus* from the Syriac region who ended up joining a Calpurnian. By contrast, Di Giacomo (2016a, b: 235) also includes the patronimic *Antiochus* considering the birthplace or the place where he has been—or even traded—(*Asia, Syria*, or *Bithynia*). Regardless where they come from, it is interesting to notice the presence of a *Calpurnian* in the eastern Egyptian desert, a place of special geostrategic importance for the eastern trade (Papi 2002: 58). In the same way, the presence of the particle *Maior* is interesting, which could tell us about a possible hierarchy within the commercial pyramid (Schörle 2016: 51).
(c) Their idiosyncrasy: according to the theory of Pérez González (2014: 274), the inscription of Geleuthi Liviae (*CIL* VI, 3981) shows us a possible invocation to Dionysus.
(d) Their function in the chaîne opératoire: see *Diogenes Sostrati margaritarius* (*CIL* VI, 5199) or *Phoebo Marciae Maxsimi ad margarita* (*CIL* VI, 7884), who were both members of security teams that kept the facilities safe.
(e) The location of their businesses: in an inscription that mentions *L(ucius) Caecilius L(uci) l(ibertus)/Plutus* it is said that he worked as *margaritarius* in the *Via Sacra* (*CIL* VI, 9545). Perhaps the only example in the *Urbs* of a *margaritarius* outside the *Via Sacra* would be a slave who worked in Livia's house as listed in the *Monumentum Liviae*. He probably would take care of these pieces (Treggiari 1975: 55).

One of the issues better examinated is the location of these workshops in Italy and especially in Rome. Traditionally, the *margaritarii* appear to have gathered around *Porticus Margaritaria*, whose toponym reflects this association. This place as a commercial space was already defined during the monarchy when Tarquinius Priscus organised architecturally this site for the development of artisan activities (Papi 2002: 45).

Following the *Forma Urbis Romae*, Lanciani (1990: 29) and Tassini (1992: 691) located the *Porticus Margaritaria* in the major portico of the *Via Sacra*, near the *atrium Vestae*, dated to the Late Neronian or Flavian period although the presence of these merchants could be even earlier (Papi 2002: 50). That is, this luxury trade was carried out in a monumental building located in the centre of the city. Other authors have pointed out that this space would be anything but ideal; the building is too spacious, making control difficult. An attractive idea argues that pearl traders moved to the vicinity of Magentius' *basilica* after the great Neronian fire (Palombi 1990: 64–65). Jordan (1885: 476), Hülsen (1982: 63) and Rodríguez Almeida (1985–86: 113) suggest a location somewhere between the *Forum Boarium* and the *Forum Holitorium*, in Reg. VII. Panciera (1970: 135–138), based on the discovery of an inscription that mentions a *margaritarius* in the area (*CIL* VI, 9545), along with the presence of other craftsmen dealing in luxury products, such as *gemmari* (*CIL* VI, 9434) and *flaturarii* (*CIL* VI, 9418). Most members of the trade were men, although there is some evidence for the participation of women, not only crafting the jewels, but selling them as well (Kampen 1981: 127; Dixon 2001: 125; 193, n. 54).

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Fig. 1 *Margaritarius* inscription from Mérida (*CIL* II, 496) (photo Museo Arqueológico Nacional, Madrid)

Concerning pearl production in the Iberian Peninsula, our only direct evidence is an inscription found in the banks of the Guadiana (*CIL* II, 496), in the city of Mérida (Fig. 1). The inscription ended up in the castle of Navas del Marqués (Ávila) and in 1903 was brought to the Museo Arqueológico Nacional, Madrid. The transcription is as follows: *D(is) M(anibus) s(acrum) Silvanus Aristaei fil(ius) ann(orum) LXXX, margaritarius, Pr[ep]is lib(erta) et heres patrono bene mer(enti) [f(aciendum)] c(uravit). H(ic) s(itus) e(st). S(it) t(ibi) t(erra) l(evis)*. This suggests that *Silvanus* was a free man who died at a ripe old age. Owing to the inland location of the inscription, he either worked with river pearls or the term *margaritarius* simply refers to his work with jewels and gemstones. Although we do not have enough evidence to affirm this hypothesis, due to the entity of Mérida, he could also have worked with foreign pearls brought to this important peninsular point. Also, his age may indicate that he was no longer active, and that his work had been carried out elsewhere.

Concerning the sale of pearls, a relief from *Dividorum Mediomatricorum* (Metz) portrays a small stall with several necklaces (*monile*) decorated with circular objects that could well be pearls (Di Giacomo 2016a, b: fig. 83).

The sources are largely silent about the maintenance of pearls after they were purchased; Pliny (*HN* 9, 112) suggests that sometimes pearls were neglected and became deteriorated. This opens the possibility that some of these luxurious items in which so much wealth was invested were restored, work that was probably carried out by the *margaritarius*. We must also consider the possibility of recycling, or adaptation to temporary fashions, which adds an extra element of complexity to the task of dating some of these pieces.

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

A Case Study: Roman Pearl Jewels in the Iberian Peninsula—Types and Products

Making a first approximation to the use of pearls and other associated materials in the Iberian Peninsula is no easy task; to date, no focused study has been undertaken in the region. Keeping in mind contexts in which pearls keep well in the archaeological record—such as Egypt or Campania—we have surveyed the record for the Early Imperial period in the Iberian Peninsula and found only a handful of examples. Most of the existing pearl—and mother of pearl—decorated items identified were women's jewels.

We have found a total of 39 examples,[1] which are geographically distributed as follows (Fig. 2): five are of unknown provenance (12.8% of the sample); 19 come from the *Tarraconensis* (48.7%); three from *Baetica* (7.7%), and 12 from *Lusitania* (30.8%). We do not think that this reflects the actual distribution pattern during the Roman period. The high value of these products and of the materials on which they were mounted means that they were often reused and redesigned, which makes provenancing them particularly difficult. A significant medieval example of this is Lothair II's (*ca.* 835–869) cross, which was found in association with cameos and pearls which were probably originally Roman in date (Barasch 2001: 15–17); a similar example is posed by the crown of King Sancho IV of Castile (*ca.* 1284–1295) (Bango 2014).

This high value, although sometimes working in favour of the survival of these items, also encouraged looting and trafficking. In such cases, the provenance of these objects may be established (with luck), but the chronology will be almost impossible to ascertain. Most whole pieces and pieces that come in pairs come from funerary contexts. Approximately, 50% of the items found in the Iberian Peninsula are earrings; 25% are necklaces that combine pearls with other gems; 17.5% correspond to fittings and other trinkets; 5% are necklaces decorated with pearls only; and 2.5% (one example) are rings. Pieces found in archaeological context account for approximately 30% of the total. In general, the contextual information is limited to the find spot of the item within the sites, but seldom is reference made to other associated finds that could help to date them with precision.

Approximately, 53% of the examples of known provenance (Figs. 4, 5, and 6, cat. nos. 13, 14, 16, 33, 34, 35, and 36) come from closed funerary contexts. Another 30% come from domestic contexts, both urban (Fig. 4, cat. no. 18) and rural (Figs. 4 and 5, cat. nos. 19, 21, and 23). The high value of these materials makes us wonder what led to them being left behind and two obvious answers emerge: they may have been intentionally hidden or simply forgotten when the owners had to flee. The remaining 15% (Figs. 4 and 5, cat. nos. 17 and 22) came from public spaces, the *forum* in *Emporiae* and the baths in *Clunia*. In this case, as well as deliberate occultation and accidental loss, we must also consider the possibility that these pearls were part of the decoration of sculptures or temple treasures.

Beginning with the most uncommon types, the only ring/*anelum* (Fig. 3, cat. no. 1) is of unknown provenance. The pearl was selected to fit the top surface of the ring, which was the first step in the chaîne opératoire. It is unclear if some sort of glue was applied or whether the pearl was filed to adapt its shape to the ring. The pearl was, however, cut in half, so it could be used to decorate two pieces. The pearl is the main decoration of the

[1] The catalogue includes 36 assemblages, because the four shoe fittings found in *Augusta Emerita* have been considered together owing to their morphological similarity (Fig. 6, cat. no. 35). In addition, it is necessary to clarify that the catalogue is divided by assemblage, that is, if a necklace is comprised of 18 pearls, they will all be considered as a single unit. This also applies to items that come in pairs, such as earrings.

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

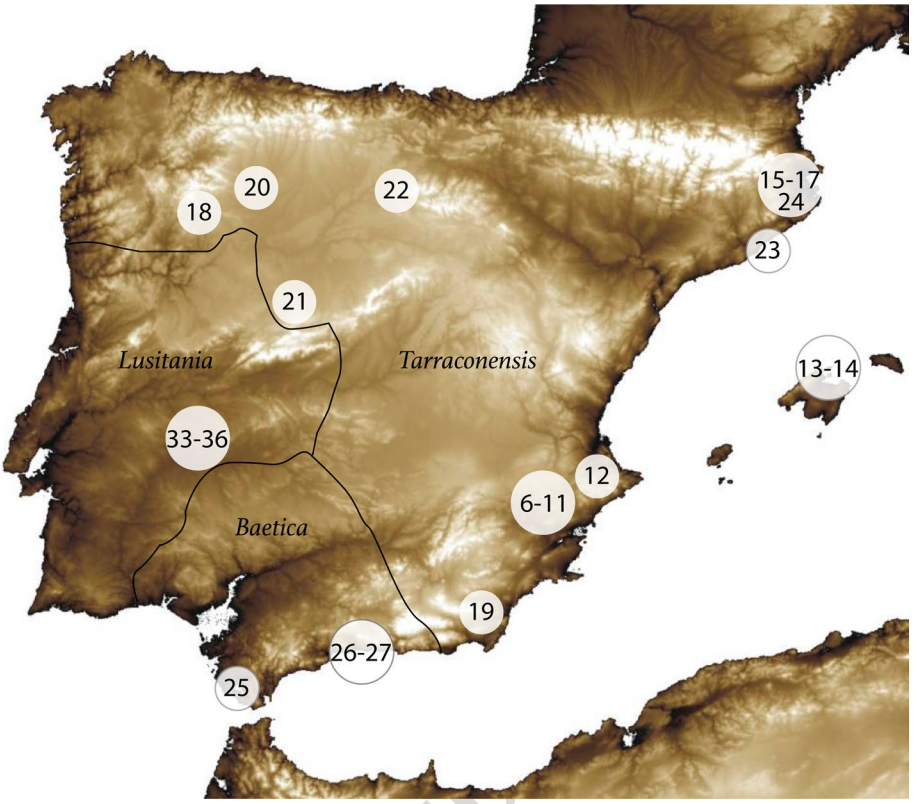

Fig. 2 Location of pearls found in archaeological contexts in Roman *Hispania*

ring. Based on parallels found near Vesuvius, specifically the *villa* of Oplontis (Di Giacomo 2016a, b, tav. XII, n. 5) it can be dated to the first or second century AD.

The second-least common pieces are necklaces decorated with nothing but pearls (Figs. 3 and 5, cat. no. 3 and 25), which are generally rather small in size. These pieces were, no doubt, very costly, not so much because of the pearls, which were selected for their small size (the first step in the chaîne opératoire, in which pearls were sorted by size, shape, and colour) but because of their laborious craftsmanship. The classical sources (Ael. *Hist. Anim.*10, 12), insist that any attempt to change their natural shape would only spoil them.

Small pearls are not suited to cabochons, which would practically hide the pearl inside. Instead, they were strung on a thread through a central perforation. The perforation would be made with a fine drill while the pearl was held firmly with some tool. A handicap for this sort of piece is that the pearls would wear out the thread over time. The two known examples in the group are dated to between the first and the third century AD, but the lack of context makes it impossible to be more precise. One of them (Fig. 5, cat. no. 25) comes from P. Paris's old excavations in *Baelo Claudia*. It is interesting to find this necklace, decorated with small and irregular pieces, which are generally regarded as river pearls, in a coastal settlement such as *Baelo Claudia*, although the evidence does not allow us to take the inference any further.

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

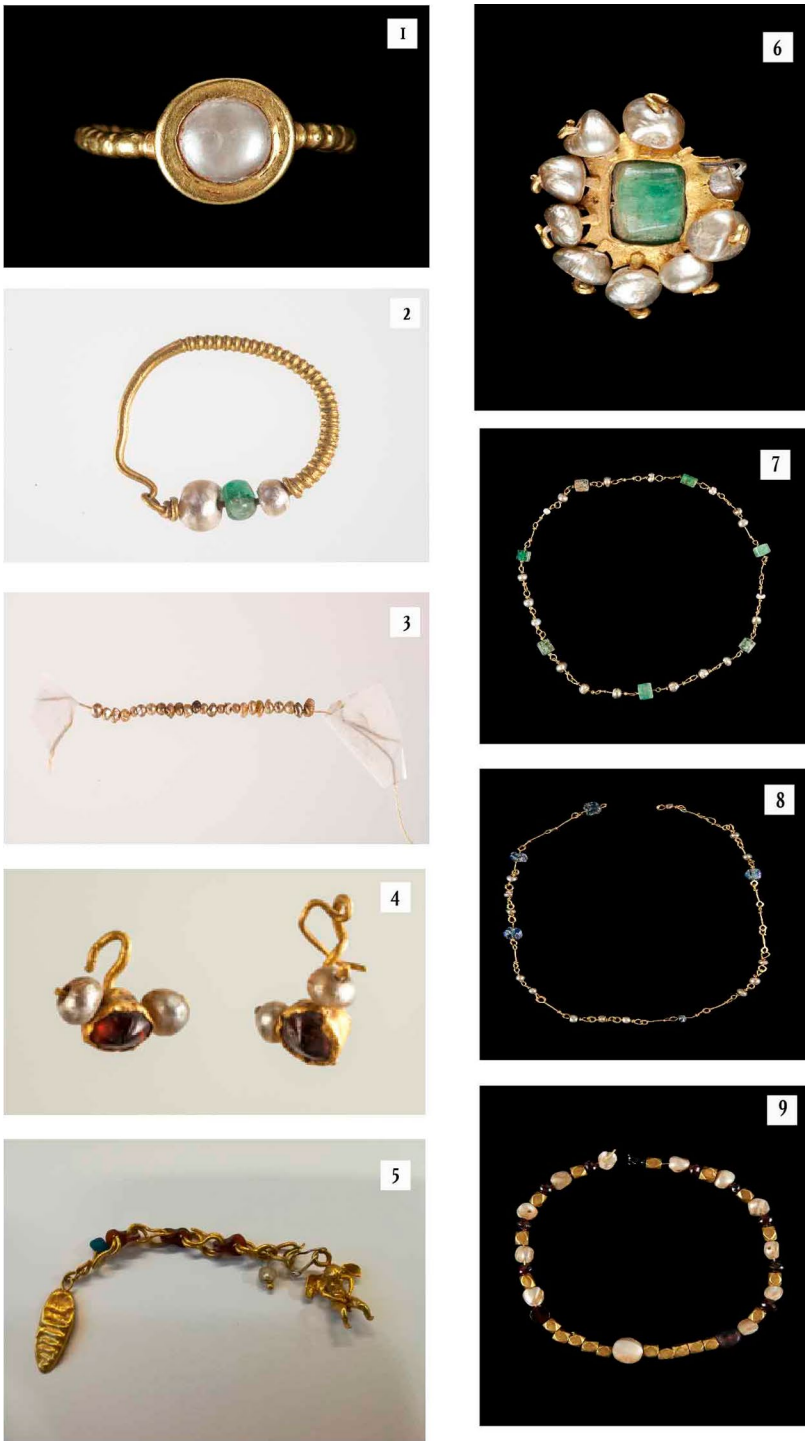

Fig. 3 Selection of Roman jewels decorated with pearls I (no. 1–9 photo courtesy of Museo Arqueológico Nacional, Madrid)

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

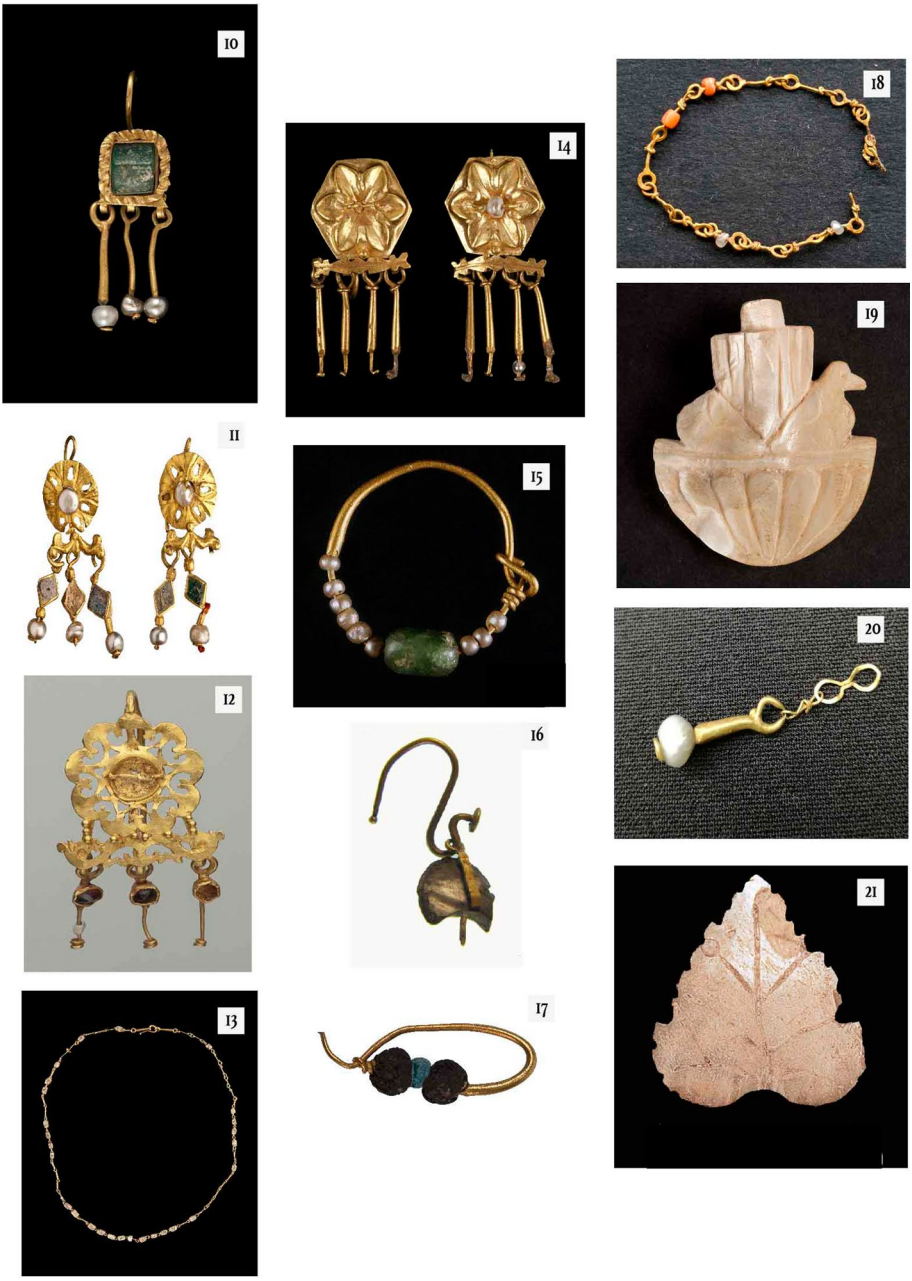

Fig. 4 Selection of Roman jewels decorated with pearls II (no. 10–14 and 19 photo courtesy of Museo Arqueológico Nacional, Madrid; no. 15–16 Courtesy of Museo Cataluña; no 17 Courtesy of Museo de Arqueología de Cataluña-Ampurias; no. 18 and 20 Courtesy of Museo of León; and no. 21, Reyes et al. 2016)

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Fig. 5 Selection of Roman jewels decorated with pearls III (no. 22 Palol 1994; no. 23 Courtesy of Proyecto Vilauba; no. 24 Courtesy of Museo de Arqueología de Cataluña—Ampurias; no. 25–30 Courtesy of Museo Arqueológico Nacional, Madrid; no. 31–33 Museo Nacional de Arte Romano; and no. 34 and 36 Consorcio de Mérida)

Concerning necklaces in which pearls are combined with other decorations, we can establish three main types:

- Hanging pearl (Fig. 3, cat. no. 5): the pearl hangs from a thread. The fact that the necklace only features one pearl makes us wonder if this was not a later addition.
- Inserted in a necklace formed by twisted gold links, which are also decorated with pieces of glass, coral, and emerald (Figs. 3, 4, and 5, cat. nos. 7, 8, 13, 18, 23, 24, and 28). In general, they combine two or three colours (mostly white, blue, amber, reddish, and green) as well as the colour of the gold chain.
- Inserted in a thread, but in combination with other materials (Figs. 3 and 5, cat. no. 9 and 32). We have an excellent example which, however, is dubious in several counts

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

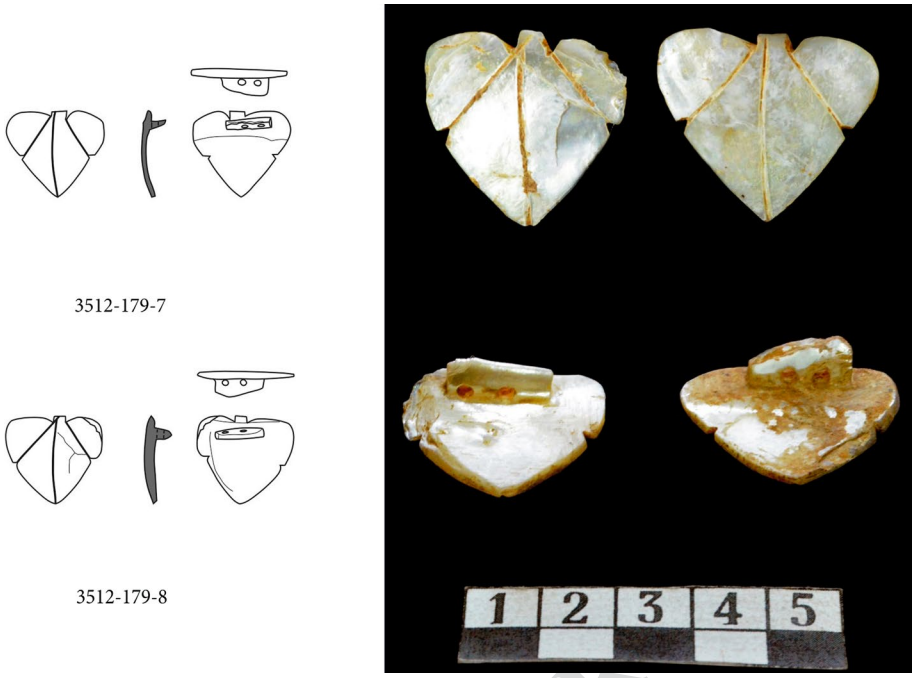

Fig. 6 Shoe decoration in mother of pearl from *Augusta Emerita* (no. 35 photo and composition Consorcio de Mérida)

(Fig. 5, cat. no. 32). All the beads that form it are made of ivory, except for those on either side of the gold clasp. The other example (Fig. 3, cat. no. 9) combines gold, pearls, garnets, and amethysts.

The pearls in all these necklaces are whole, and their full shape is visible. No treatment of the surface is evident. They were obviously selected by size and shape, and the only manipulation involved drilling the central perforation to insert the thread. The chronology of these combined necklaces ranges from the second-first century BC (Fig. 3, cat. no. 5) to the fourth century AD (the date of this example found in León is firmly grounded on its archaeological context) (Fig. 4, cat. no. 18, Burón 1995: 277). Most pieces are dated to the first and second century AD.

Without a doubt, the most common pieces are earrings. We have found 15 examples, which can be divided into four types, based on technique and composition:

- Circular ring with inserted trinkets (Figs. 3 and 4, cat. nos. 2, 15, and 17). The beads are inserted in a golden ring that can be plain or twisted. Again, different colours are used in combination (gold, green, and white).
- Short pendant with rounded central rounded flanked by pearls (Fig. 3, cat. no. 4). In this case, both earrings are preserved. The pearls are held by a gold thread. The colour combination includes amber, white, and gold. In a similar example (Fig. 5,

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

cat. no. 33) the centre of the piece is not occupied by a cabochon, but by a flower in gold.

- Rings with hanging spirals and an inserted pearl (Figs. 4 and 5, cat. no. 16, 22, 26, 27, and 34).
- Ring with a cabochon made of a stone and a pearl (Fig. 5, cat. no. 29).

The most common types are the so-called crotal (Parlasca 1969: 47; Plin. *HN* 9, 56) or 'bar' type (Doxiadis 1995: 56). This shape, also called 'tavoletta', often featured pearls (Russo 1999: 56–59). The type became fashionable in Egypt in the second century AD; some papyruses even make reference to the number of pearls mounted on the earrings, as well as to the quality of the pearls (Russo 1999: 264). In general, these earrings are formed by a horizontal rod with two or more golden threads, capped with a pearl or other form of decoration, hanging from it. The examples found in the Iberian Peninsula vary in terms of number of gold bars, the materials used, and the number of pearls. They are divided into types based on the morphology of the central piece:

- Square-shaped central cabochon with gold filigree, from which three bars decorated with pearls hang (Fig. 4, cat. no. 10).
- Plant-shaped *interrasile* piece (Figs. 4 and 5, cat. no. 11, 12, and 31) forming a flower, the centre of which is decorated by a pearl; in this type, the pearl can be accompanied by other elements, such as garnets. A gold bar, also decorated *interrasile* hangs from the bottom of the flower. The end of the bars is decorated with a cabochon, with a pearl mounted in the middle.
- Solid plant-shaped central motif (Fig. 4, cat. no. 14) with a central pearl. It is mounted on a hexagonal base. The bottom is traversed by a solid bar, from which four more bars, decorated with a pearl, hang.
- Simple *tavoletta* (Figs. 4 and 5, cat. no. 20 (maybe one of the bars) and 30), which consists of a horizontal bar, from which two vertical bars, decorated by a pearl, hang.

The use of this type was widespread in Egypt, where pearls became very popular under Roman rule (Russo 1999: 56–59), many types being represented in the portraits of El Fayum. A good example of this is Demos's portrait, in which the subject is portrayed wearing a pearl in her ear and three hanging (Russo 2011: 33–34). Our examples can be dated to the first (Fig. 4, cat. no. 10), second (Figs. 4 and 5, cat. no. 14 and 30) and third century AD (Figs. 4 and 5, cat. no. 11, 12, and 31). It is interesting to note that the *interrasile* technique appears to have been especially popular in the third century, although it remained common afterwards (Pettinau 1992: 48). In addition, our assemblage includes a fitting, which was probably originally installed on an acus, of which only the central medallion remains. It is decorated by a central emerald, a gold radial frame, and a circle of pearls (Fig. 3, cat. no. 6). In this case, the pearls are attached to a rigid gold thread.

We must also mention fittings and trinkets made with sea gastropods known as green ormer (*Halliotis tuberculata*). The first group consists of shoe fittings (*solae* or *calcei*) shaped like an olive tree leaf, found in *Augusta Emerita* (Fig. 6, cat. no. 35) (Bustamante-Álvarez and Bejarano Osorio 2018). Decorating shoes and clothing in this way was a widespread practice during the Roman period. This is mentioned by some classical authors (such as Plin. *HN*. 9, 56), some of whom criticised this habit as an eccentricity. Regardless of this, these authors still admired the ability of the *sutor* and the intrinsic value of some of the materials used, such as pearl and mother of pearl, the use of which was limited to

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

the elite. Working green ormer was a specialised craft, very different to that of the *margaritarius*, largely because the natural material was thoroughly altered in the process. The shells were first trimmed of their surface irregularities to expose the core. The examination of the examples found in Mérida suggests that they were cut with a very thin saw. Later, the outline was polished carefully to erase any tool marks. Once cut, both faces of the piece were engraved. It seems logical to think that the engraver's work began with the reverse since, once the perforations had been practised, the craftsperson would have been unable to hold the piece firmly. Engraving was carried out vertically, with a rounded burin. Work on the obverse ended with the incisions made with a thin burin, probably after the shell was heated, to make it more malleable. The reverse, however, was worked horizontally, as the orientation of the incisions clearly suggests. This outlined a protruding central space on which the holes were bored. Our pieces were found in burials (Fig. 4, cat. no. 19) dated to the first or second century AD, and they fully confirm the written record about the use of luxury materials in footwear during the Roman period.

Also, from a burial in *Augusta Emerita* is a perforated plaque also dated to the first and second century AD (Fig. 5, cat. no. 36): it is a threefold piece, whose flat reverse suggests that it was fitted on some surface, probably a wooden crate. A similar example comes from the *villa* of the Roceipón in Vera, Almería (Fig. 4, cat. no. 19). In this case, the fitting features a protuberance on the reverse, engraved with a scallop-shaped fountain on which two *anatidae* sit. The fact that the lower surface is engraved suggests that this piece would be visible from below. We think that it was part of a piece of furniture, but little more can be inferred. Based on style, it is dated to the first or second century AD. Finally, we have several examples of wall *opus sectile* (Fig. 4, cat. no. 21), whose morphology is similar to the previous examples.

Conclusions and Future Research: Pearls and Maritime Archaeology

The first thing that must be highlighted is the large number of references to pearls in classical texts and, to a lesser extent, inscriptions. This evidence is clearly the result of the increase in wealth as well as the taste for luxurious products (Schörle 2016: 43). As a result, the topic has largely been approached from a historical perspective. They are seldom mentioned in malacological studies, which generally focus on the exploitation of sea gastropods and bivalves, but not on their by-products. Pearls are mentioned in works about jewellery, although generally from an art-historical perspective, which tends to neglect their context and thus lose critical information. The first aim of this work was, therefore, to present the topic, which is in our opinion a key aspect of marine archaeology, insofar as pearls and their associated materials were chiefly sourced from the sea and were subject to an active trade, most of which was carried out by sea.

Second, we have tried to present an overview of the archaeological evidence available for *Hispania*. The catalogue includes 36 items—39 if we take into account that some of them form pairs—decorated with pearls (Table 1). This catalogue is relevant in itself, for no such exercise had been undertaken previously and illustrates how widespread these materials were in the Iberian Peninsula and the nearby islands, from *Emporiae* to *Baelo Claudia*, and from *Pollentia*, in the Balearics, to *Augusta Emerita*, far inland (Fig. 2). This shows that, like in Italy, pearls were highly valued in *Hispania*, and often featured among the possessions of elite women. It was also interesting to find the presence of a

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

margaritarius, mentioned on a gravestone, in *Augusta Emerita* (Fig. 1), the only evidence to date of the presence of these craftspeople in the Iberian Peninsula. In addition, the finds cover a wide chronological span, from the second-first century BC to the fourth century AD, which indicates that these luxury items, and their manufacture, remained popular for a long time, although their popularity seems to have peaked between the Julio-Claudian and the Antonine periods (Fig. 7).

It is significant that all of the pearls known were mounted on some sort of larger piece; that is to say, that none were found on their own. This will need to be examined in further detail. It is very likely that many pearls have gone unnoticed during excavation, especially considering that they can undergo considerable deterioration as a result of taphonomic processes.

The archaeological bibliography also pays scarce attention to pearl workshops during the Roman period. Some evidence is beginning to emerge, for instance, at Dibba al Hisn, in the south-east of the Arabian Peninsula, where several pearl species were processed—*Pinctada margaritifera* and *P. (imbricata) fucata/P. radiate*—as attested by a series of shell middens dated to between the first century BC and the first century AD (Morales-Muñiz et al. 2020). No comparable evidence has been found in the west to date, although there is little doubt that these workshops existed. The excavation of several fish-salting facilities in *Hispania*, for instance, in *Iulia Traducta* (Strait of Gibraltar) has yielded thousands of oyster shells. These oysters were exploited for their meat, which was used to make *garum*, but none of these sites present evidence for pearl-processing, even in the case of the accidentally produced ones, as we know is the case of *Ostrea edulis*; it is likely that most of these oysters were farmed, rather than caught (Bernal-Casasola 2018). The use of bio-molecular techniques has recently allowed for the identification of oyster *garum* in *Baelo Claudia* (Garnier et al. 2018), and we can only guess that oysters were a lucrative side business for the manufacturers of this famous product, an issue that is worth looking into in more detail in the future. While classic approaches argue that no pearls from oysters were caught in the Mediterranean, other bivalves also produce pearl-like concretions such as the *Pinna nobilis* and *myas,* which were indeed fished in antiquity (Marzano 2013: 170–171; 2015: 131–150); given the importance of oyster farming in Italy and the western provinces, as attested by multiple archaeological and archaeo-zoological indicators (Bernal-Casasola 2018), it is not unreasonable to assume that pearls from different marine bivalves were also exploited there, although the hard archaeological evidence is still lacking, also along the Atlantic shores. In this regard, the written references to pearls in *Mauretania* and the Aegean (Tassini 1992: 692) are especially intriguing. Unfortunately, in the Iberian Peninsula, there is not an important and well-known historical tradition in pearl cultivation that could help to understand earlier periods. Freshwater pearl fisheries in Spain should be an interesting matter of research for the near future.

Another aspect to be examined in the future is that of river pearls. Although traditionally historiography has treated them as smaller and more irregular and, therefore, less highly valued, they were still used in jewellery; we also have to consider that large round pearls of any origin are incredibly rare, and only the very wealthy could and can afford them. To prove its marine or river origin, archaeometric chemical analyses could be the option to solve the provenance problems. Unfortunately, they are not only very rare: pearls are generally encrusted in jewellery items that make analyses difficult. This is, however, a promising future research path, especially in terms of provenance (Meyer et al. 2013).

Another important issue is the decorative use of mother of pearl from bivalves and gastropods; recent studies suggest that this material was abundantly used in architectural decorations in *Hispania*, for instance, in Las Pizarras (Segovia), a site dated to the fourth

Table 1 Synoptic table of the pieces mentioned in the article

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
1	Unknown, MAN, n. 52532	*Anulum*	2nd c. AD	1.9 cm	Solid circular ring decorated with deep parallel incisions. The pearl-filled circular cabochon is on the outside edge	Castellano 2001a: 108
2	Unknown, MAN, n. 20210	*Inaures*	1st c. AD	1.6 cm	Solid circular ring decorated with striations that cover nearly the whole surface, decorated with glass beads and two small pearls, probably sourced from a river	Unpublished
3	Unknown, MAN, 52469	*Monile*	1st–3rd c. AD	4 cm	Twenty-four minute pearls with central perforations for threading	
4	Unknown, MAN 2006/52/1814	*Inaures*	1st–2nd c. AD	1.3 cm long; 1 cm wide	Pair of earrings. The only remaining parts are the circular rings decorated with glass beads, flanked by small pearls	

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
5	Unknown, MAN 20128	*Monile*	2nd–1st c. BC	8 cm	Gold, pearl, and glass beads. Fragment of necklace decorated probably with local materials. The *monile* is made with a double gold thread and eight-shaped, amber-coloured glass beads. In one end, there is a gold leaf with striations, and a small Eros, characteristically Hellenistic in style, on the other. Next to the Eros is a gold-encrusted pearl	

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
6	Elche, MAN 52553	Pin applique	1st–2nd c. AD	1.7 cm high; 1.3 cm wide	Gold, emerald, and pearls. Ten small and irregular pearls mounted on a gold base (one pearl is missing). The central square cabochon is decorated with an emerald	Castellano 1996: 59
7	Elche, MAN 52543	*Monile*	1st–2nd c. AD	35 cm long	Gold, emerald, and pearls. Incomplete necklace (the clasp is missing). The eight-shaped chain links are decorated with seven emeralds and pearls, of which eighteen survive. This type was popular all over the Empire	Castellano 1996: 60
8	Elche, MAN 52544	*Monile*	1st–2nd c. AD	28 cm long	Gold, sapphires, and pearls. Incomplete necklace (the clasp is missing). The chain is made with flat links with circular ends; the straight section of the links is decorated with sapphires and pearls, of which 13 survive	Castellano 1996: 60

Journal of Maritime Archaeology

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Table 1 (continued)

No.	Origin and deposit Typology	Chronology	Dimensions	Description	References
9	Elche, MAN 52545 *Monile*	1st–3rd c. AD	22 cm long	Gold, garnets, amethysts, and pearls. All the beads were part of a hoard found in 1776, and they have been used to reconstruct the current necklace. This includes 13 irregular pearls, 11 garnets, and two amethysts, in addition to six polyhedral gold beads	Castellano 1996: 60
10	Elche, MAN 52549 *Crotalia*	1st c. AD	3.2 cm high; 1 cm wide	Gold, emeralds, and pearls. Two-body earrings. The clasp includes a cabochon decorated with an emerald. The lower body is formed by three circular, rigid parallel threads decorated with one small river pearl each	Castellano 1996: 58
11	Elche, MAN 52550 *Crotalia*	3rd c. AD	3.8 cm high; 1.2 cm wide	Gold, glass, and pearls. Pair of two-body earrings. The upper body consists on a circular gold pointelle plate (*opus interrasile*) with a pearl in the middle; the lower body is made of three gold threads with a rhomboid cabochon decorated with a glass bead and a pearl	Castellano 1996: 58

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
12	Alicante, MAN 1969/36/3	*Crotalia*	3rd c. AD	4.3 cm high; 2.3 cm wide	Gold, garnets, and pearls. Two-body earrings, with a nine-petal rosette of *opus interrasile*. Granulated decoration and leaf motifs in gold link with the lower body, formed by garnet-decorated cabochons. The hanging pieces are decorated with pearls. The hook is a simple solid gold hook. This is a common type throughout the Empire	Castellano 2001b: lám. 1
13	*Pollentia*, MAN 1933/23/4	*Monile*	1st–2nd c. AD	43 cm long	Gold, glass bead, and pearls. The eight-shaped links thread through two pearls (the original number must have been seven). The hook is a simple gold thread	Castellano 1997: 123

Journal of Maritime Archaeology

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
14	*Pollentia*, MAN 1933/23/5	*Crotalia*	1st–2nd c. AD	3 cm high; 1.5 cm wide	Gold and pearls. Pair of two-body earrings. Two pearls are preserved (of ten). The upper body is formed by an incised gold rosette decorated by a central pearl. Four welded circular rings, each of which are decorated by a pearl, hang vertically from a horizontal bar	Castellano 1997: 124
15	Ampurias, Museo Catalunya 2360	*Inaures*	–	3 cm	Gold, jade, and pearl. Gold ring with a small jade decorative motif in the middle, flanked by sets of six and three pearls	Unpublished
16	Ampurias, Museo Catalunya	*Inaures*	2nd c. AD	4 cm	Gold and mother of pearl. Pair of two-body earrings but only one retains a pearl. The clasp is formed by a snake-shaped thread decorated with a cabochon decorated with mother of pearl	Almagro 1955: 189, lám. X, 16–17
17	Ampurias, Museo de Ampurias	*Inaures*	1st c. BC	2.9 cm	Gold, pearl, and glass bead. Solid ring decorated by a pearl flanked by two glass beads	Aquilué et al (1984): fig. 93, n. 2

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
18	Astorga, Museo de León	*Monile*	4th c. AD	7.5 cm	Gold, coral, and pearls. Chain formed by eight-shaped links. The surviving decoration elements consist of two mother of pearl beads and a pearl	Burón Álvarez 1995: 277
19	Vera, MAN 2006/52/1422	Applique	1st–2nd c. AD	5.4 cm high; 4.9 cm wide	Mother of pearl. Cup-shaped semi-circular fitting. The ends are decorated with two birds flanking a fountain-shaped motif with grooves. This type of decoration replicates Hellenistic and Roman mosaic decorations	Unpublished
20	Lancia, Museo de León 1988/01/0495	*Monile*	1st–2nd c. AD	5.4; 21; 4.9 cm wide	Gold pendant formed by several links and a gold thread decorated with a pearl	Gabo 1910: lám. 11, 2
21	Las Pizarras, Coca	Wall applique	4th c. AD	–	Over 350 plaques of various forms including volutes, circles, petals, and geometric shapes	Reyes et al. 2016
22	Clunia, Museo de Burgos	*Inaures*	2nd c. AD	5 cm high	Gold and pearls. Two-body pendant. The upper part is formed by a double, rope-like thread. The lower part is formed by a helix-shaped thread decorated by a pearl	Palol 1994

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
23	Villauba	*Monile*	2nd–3rd c. AD	36 cm long	Gold and pearls. Articulated necklace formed by 15 link-pearls. The clasp is formed by two rope-shaped threads and a loop	Castanyer and Tremoleda 1999: 277–279, fig. 171
24	Ampurias	*Monile*	2nd–3rd c. AD	–	Gold, pearls, and coral. Articulated necklace formed by at least five river pearls and seven pink collar beads. They are joined by eight-shaped links	Tremoleda 2006: 22
25	*Baelo Claudia,* MAN 2006/52/1690	*Monile*	1st–3rd c. AD	120 cm long	Pearls. Group of small pearls found in funerary contexts in *Baelo Claudia*	Unpublished
26	Almuñécar, MAN, 37761	*Inaures*	1st c. AD	5.5 cm high; 0.9 cm wide	Gold and pearls. Earring formed by two simple bodies. The central zone of the upper body consists on a simple gold ring. The clasp, a simple hook, is welded to the top edge, and two twisted threads decorated with pearls to the bottom edge	Unpublished

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
27	Almuñécar, MAN 37762	*Inaures*	1st c. AD	3.1 cm high; 0.9 wide	Gold and pearls. Two-body earrings. The hook and clasp are preserved. A twisted thread, circular in section, decorated by a pearl, hangs from the bottom edge	Unpublished
28	Extremadura, MAN 1930/106/31	*Monile*	1st–2nd c. AD	9 cm	Necklace fragment made with rhomboid-shaped, flat gold beads (four are preserved). The necklace is decorated with emeralds alternating with pearls (two of each survive)	Gil Miquel 1933: 5
29	Extremadura, MAN 1930/106/2	*Inaures*	1st–2nd c. AD	3.3 cm high	Gold, glass bead, and pearl. Gold ring, circular in section, from which hangs a square cabochon decorated by a red glass bead, in imitation of a garnet. The lower body is granulated and decorated by a pearl	Gil Miquel 1933: 5
30	Extremadura, MAN 1930/106/11	*Crotalia*	1st–2nd c. AD	3.6 cm high	Gold and pearl. Fragment of pendant. The hook is preserved. The hanging element is formed by a horizontal thread, square in section, which is decorated by a pearl	Gil Miquel 1933: 5

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
31	Extremadura, MNAR 37249	*Crotalia*	3rd c. AD	3.7 cm high; 2 cm wid	Gold, garnet, and pearls. Pair or two-body earrings. The upper part presents a rosette *opus interrasile* with cabochons decorated by garnets. The centre is decorated by a pearl. At the bottom, separated by a horizontal piece, also pointelle and leaf-shaped, four vertical elements, rhomboid in shape and decorated by red transparent garnets and a hanging pearl	Castellano 2001b: 20–21
32	Extremadura, MNAR 37248	*Monile*	3rd c. AD	0.3 cm high; 45 cm long	Ivory, gold, and pearls. Necklace formed by 181 circular beads and a tubular, incised ivory bead. The clasp is decorated by a small pearl, probably added after it was found, but which was likely part of the grave contents	Castellano 2001b: 21–22

Table 1 (continued)

No.	Origin and deposit	Typology	Chronology	Dimensions	Description	References
33	*Augusta Emerita*, MNAR	*Inaures*	1st–2nd c. AD		Gold and pearls. Earring forming a central flower (four petals) decorated by a central pearl, now lost. A small pearl hung from the middle. A thread to hang the earring from the ear is attached to the reverse	Floriano 1944
34	*Augusta Emerita*, Consorcio de Mérida	*Inaures*	1st–2nd c. AD		Gold and pearls. Air of earrings with a ring, from which a 'tear' formed by three gold beads, hang. The end is decorated by a thermo-altered pearl	Olmedo 2012: 94–95
35	*Augusta Emerita,* Consorcio de Mérida 8067, 8057 y 8101	Shoe applique	1st–2nd c. AD	*ca.* 3–3.5 cm high; *ca.* 2.5–3.2 cm wide; *ca.* 0.5–0.8 cm thick	Mother of pearl. Four fragments of olive tree leaf-shaped motifs with incised nerves. The reverse presents a double tubular perforation	Bustamante-Álvarez and Bejarano Osorio 2018
36	*Augusta Emerita,* Consorcio de Mérida	Box with applique decoration	1st–2nd c. AD	3.2 cm long; 2 cm wide in the square plate; 2 cm high the clover figurine	Mother of pearl. Square plaque with triple incision on the reverse and fitting hole; three-foil incised plaque	Unpublished

Journal of Maritime Archaeology

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

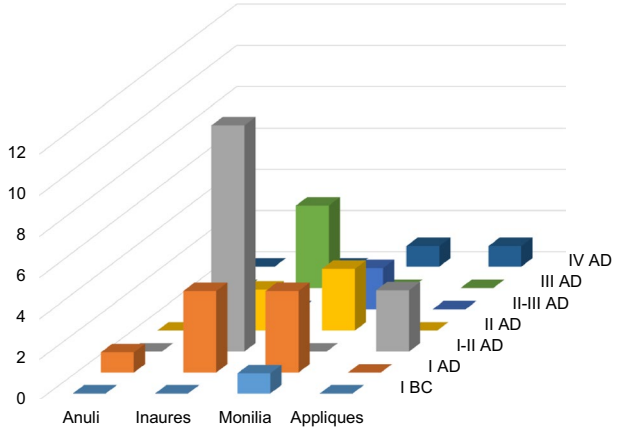

Fig. 7 Catalogue and chronological distribution of the pieces mentioned in the article (*crotalia* are included in *inaures* count)

century AD. The excavation of the site yielded a large number of fragments of *Pinctada margaritifera*, probably brought whole from the east and worked in situ, as suggested by the identification of over 280 working remain fragments, parallels for which exist in other Iberian sites (Reyes et al. 2016); we have already mentioned a number fragments found in Mérida, which were used to decorate furniture, shoes, and clothes (Bustamante-Álvarez and Bejarano Osorio 2018). Future studies should try to establish the provenance of these remains and to characterise them malacologically. This is not always easy, especially when they are polished, which sometimes makes them hard to distinguish from other materials such as bone and even stone.

It seems clear that a significant proportion of these materials arrived to the western provinces by sea, perhaps from redistribution hubs in Rome, which was the main market for them (Dubois-Pelerin 2008: 222–224). It has to be considered that India, Sri Lanka, but also the Persian Gulf could be the main sources of these pieces. In this case, Egypt and Syria would be vital to understanding this market. However, inscriptions located in the eastern desert of Egypt—specifically in the sanctuary of the god Pan—tell us of the possibility of a settlement where pearls were worked closer to the Mediterranean. Specifically, two of these inscriptions refer to a supervisor of all the mines and quarries in Egypt. In this case, pearls are included. For some authors, these data may indicate that diving for pearls took place nearby in the Red Sea but only in relation to the army presence attested on the Farasan Islands and the army's control over this product (Schörle 2016: 46–47 and 49). However, there are discordant voices affirming that simply these inscriptions refer to the control of both regional and foreign products—including pearls—that were transported up the Nile (Ogden 1992: 36). However, inscriptions located in the eastern desert of Egypt—specifically in the sanctuary of the god Pan—tell us of a craft pearl closer to the Mediterranean. Specifically, two of them refer to the figure of a supervisor of all the mines and quarries in Egypt, including pearls in the cast that may show us the diving for pearls in the near Red Sea in relation to the army presence attested in Farasan Island (Schörle 2016: 46–47 and 49). However, there are discordant voices affirming that simply both inscriptions would refer to the control of both regional and foreign products that rise the Nile (Ogden 1992: 36).

The *Periplus maris erythraei* claims that pearls reached the west through mainstream commercial channels (XXXVI) (for a new interpretation in clue of networks see Seland

Journal : SmallCondensed 11457 | Article No : 9290 | Pages : 35 | MS Code : 9290 | Dispatch : 13-2-2021

2013: 377 ff), so the fact that no pearls have been found in shipwrecks to date is surprising. However, it is known that two ships were transporting oysters when they wrecked: the Etruscan shipwreck at Cap d'Antibes, dated to approximately 540 BC and Na Guardis B, dated to AD 1–25 (Parker 1992: 101 and 207–208 and, shipwrecks 183 and 490, respectively). There is also little evidence of sea trade in precious objects: "jewellery or other treasury is rarely found" (Parker 1992: 29).

Another interesting research avenue for the future is pearl harvesting in the Atlantic coasts: references to this activity in *Britannia* and *Mauretania* are eloquent; as well as the evidence for oyster farming in *Hispania*, for instance, in the southern *Tarraconensis*—coast of Alicante—and *Baetica*—Strait of Gibraltar (Bernal-Casasola 2015), though in this last case they are not pearl oysters, just edible ones (*Ostrea edulis*). To date, the possibility that pearls could have played a role in oyster farming in these Atlantic regions has not been proposed, but this should be explored more in depth in the future. The study of pearls in the region around *Vesuvius* has shown that most of the pearls used were small and irregular, and this helps explain Pliny's claims that the use of pearls was very widespread in Roman society (Dubois-Pelerin 2008: 224). From rivers or the sea, pearls were an important resource in antiquity, and one of the most highly valued materials in Mediterranean markets; this justifies the need for a more thorough archaeological characterisation.

To conclude, and as a future line of study, it would also be of interest to calibrate the presence of counterfeits and emulations of this type of material in the Iberian Peninsula, something that must have been very frequent outside the hinterland of the neuralgic zones of its trade (Schörle 2016: 52–53).

Acknowledgements This work was carried out within the framework of project SACEIMAR (CEIJ-C04.1), Campus de Excelencia Internacional del Mar CEIMAR. It has been cofounded by Programa Operativo FEDER 2014–2020 and Consejería de Economía, Conocimiento, Empresas y Universidad, Junta de Andalucía. Project reference: FEDER-UCA18-104415 (ARQUEOESTRA); and projects GARVM III (PID2019-108948RB-I00, Gobierno de España/Feder and ARQUEOFISH (P18-FR-1483), Programa de Ayudas a la I + D + I, Plan Andaluz de Investigación, Desarrollo e Innovación (PAIDI 2020).

Data Availability This article has the pertinent authorizations for its publication.

References

Almagro BM (1955) Las necrópolis de Ampurias, vol II. Necrópolis romanas y necrópolis indígenas Monografías Ampuritanas III, Barcelona

Andrew O Jr (1996) A stylistic survey of pieces from excavated contexts. In: Calinescu A (ed) Ancient jewelry and archaeology. Indiana University Press, Indiana, pp 130–150

Aquilué X (2006) La pesca i Empúries a l'Antiguitat. In: Aquilué J, Monturiol J (ed) Pescadors de l'Antiga Empúries. Ajuntament de l'Escala. Museu d'Arqueologia de Catalunya-Empúries, L'Escala, pp 12–15

Aquilué J, Mar R, Nolla J, de Arbulo RJ, Sanmartí E (1984) El fòrum romà d'Empúries (excavacions de l'any 1982). Una aproximació arqueològica al procés històric de la romanització al nord-est de la Península Ibèrica. Monografies Emporitanes VI, Barcelona

Bango TIG (2014) La llamada corona de Sancho IV y los emblemas de poder real. Alcanate 9:261–283

Barasch M (2001) The idol in the icon: some ambiguities. In: Assmann J, Baumgarte AI (eds) Representation in religion. Brill, Leiden, pp 1–26

Bardot-Cambot A (2013) Les coquillages marins en Gaule romaine. Approche socio-économique et socio-culturelle, BAR International Series 2481, Oxford

Bartman E (1999) Portraits of Livia: imagining the imperial woman in Augustean Rome. Cambridge University Press, Cambrigde

Beauclair RD (2008) La parure funéraire de la nécropole néolithique de Jebel al-Buhais 18 (Émirats Arabes Unis). Préhistoires Méditerranéennes 18:1–17

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

Beech MJ, Howar CRT, Al Kaabi KA, El FakiMartin AAJ, Al Hameli NH, Roberts HM, Spencer P, Tomasi D, Brunet O, Crassard R (2019) Excavations at MR11 on Marawah Island (Abu Dhabi, UAE): new insight into the architecture and planning of Arabian Neolithic settlements and early evidence for pearling. Arab Archaeol Epigr 31:19–31

Bernal-Casasola D (2015) Viveros y yacimientos haliéuticos. Importancia y fragilidad del patrimonio pesquero-conservero hispanorromano. In: Jornadas La Illeta dels Banyets y los viveros romanos de la costa mediterránea española, Cuestiones de conservación (Alicante, 2014). Marq, Alicante, Actas, pp 16–41

Bernal-Casasola D (2018) Arqueología de la acuicultura en Hispania. Problemas y reflexiones. In: Bernal-Casasola D, Jiménez-Camino R (eds) Las cetariae de Ivlia Tradvcta. Resultados de las excavaciones arqueológicas en la calle San Nicolás de Algeciras (2001–2006). Universidad de Cádiz, Cádiz, pp 375–396

Besson C (2003) Pendants d'oreille romains du Musée du Louvre. Musée du Louvre, Paris

Burón Álvarez M (1995) Joyas y objetos de adorno personal. In: Astures: pueblos y culturas en la frontera del Imperio romano. Ayuntamiento de Gijón, Gijón, pp 277–278

Bustamante-Álvarez M, Bejarano Osorio AM (2018) ¿Abalorios de calzado romano en Augusta Emerita? Apuntes sobre su artesanado a partir de recientes hallazgos. Mélanges de la Casa de Velázquez 48(1):217–236

Calvi MC (2005) Le ambre romane di Aquileia. Associazione nazionale per Aquileia, Aquileia

Carter R (2005) The history and prehistory of pearling in the Persian Gulf. J Econ Soc Hist Orient 48(2):139–209

Castanyer P, Tremoleda J (1999) La vil·la romana de Vilauba. Un exemple de l'ocupació i explotació romana del territori a la comarca del Pla de l'Estany. Universidad de Gerona, Gerona

Castellano Á (1996) Joyas de La Alcudia de elche en la colección de orfebrería romana del Museo Arqueológico Nacional. Boletín del Museo Arqueológico Nacional Tomo XIV:55–62

Castellano Á (1997) Joyas romanas de Pollentia (Alcudia, Mallorca) en el Museo Arqueológico Nacional. Boletín del Museo Arqueológico Nacional Tomo 15:121–129

Castellano Á (2001a) Anillo. In: Jiménez VF, Sánchez GA (eds) La Ilusión de la belleza. Una geografía de la estética, Caja de Ahorros del Mediterráneo, Alicante, pp 108–109

Castellano Á (2001b) Nuevas piezas de orfebrería en el Museo Nacional de Arte Romano. ANAS 14:19–27

Charpentier V, Phillips CS, Méry S (2012) Pearl fishing in the ancient world: 7500 BP. Arab Archeol Epigr 23:1–6

Croom AT (2002) Roman clothing and fashion. Stroud, Gloucestershire

Dalby A (2000) Empire of pleasures. Luxury and indulgence in the roman world. Routledge, London

Di Giacomo G (2016a) Oro, pietre preziose e perle. Produzione e commercio a Roma. Quasar, Roma

Di Giacomo G (2016b) L. Calpurnius Antiochi l. Alexa Maior un 'nuovo' margaritarius de sacra via e il commercio delle perle a Roma. Archeologia Classica 67:233–278

Dixon S (2001) Reading Roman women. Sources, genres and real life. Duckworth, London

Doxiadis E (1995) The Mysterius Fayum portraits. Faces from ancient Egypt. Thames and Hudson Ltd, London

Dubois-Pelerin E (2008) Le luxe privé à Rome et en Italie au I siècle après J.-C. Centre Jean Berard, Naples

During-Caspers EC (1983) Corals, pearls and prehistoric Gulf trade. In: Proceedings of the seminar for Arabian studies, vol 13, proceedings of the sixteenth seminar for Arabian studies held at Oxford on 20th–22nd July 1982. Archeopress, Oxford, pp 21–29

Enegran HL, Meo F (2017) Treasures from the sea. Sea silk & shellfish purple dye in antiquity. Oxbow Boorks, Oxford

Floriano CA (1944) Excavaciones en Mérida. Campaña de 1934 y 1936. Archivo Español de Arqueología 17:151–186

Gabo REE (1910) Tiempos geológicos, primeras edades de la Historia. Ayuntamiento, León

García y Bellido A (1967) Les religions orientales dan l'Espagne romaine. Brill, Leiden

Garnier N, Bernal-Casasola D, Driard C, Vaz Pinto I (2018) Looking for ancient fish products through invisible biomolecular residues in the Roman production vats from the Atlantic Coast. J Marit Archaeol 13(3):285–328. https://doi.org/10.1007/s11457-018-9219-x

Gil Miquel R (1933) Zarcillos, colgantes y otras joyas de diversas épocas, Adquisiciones del MAN en 1930–1931. Blass Tipografía, Madrid, pp 3–8

Girotti B (2011) I retratti di Zenobia nella Historia Augusta: tra simbología e inventio. In: Baldini I, Morelli AL (eds) Oggeti-simbolo. Produzione, uso e significato nel mondo antico. Ante Quem, Bolonia pp 195–210

Guizzardi L (2009) Oreficeria populare a Bologna nel basso medievo. Il Carrobio 35:11–34

Higgins RA (1980) Greek and roman jewellery. Methuen, Londres

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

Hülsen C (1982) Il foro romano, Storia e Monumenti. Arbor Sapientale, Roma
Johns C (1996) The jewellery of Roman Britain. British Library, London
Jordan H (1885) Topographie der Stadt Rom in Altertum. Hansebooks, Berlín
Kampen NB (1981) Imagen and status: Roman working women in Ostia. Gerr Mann Verlag, Berlin
Lanciani R (1990) Formae Urbis Romae. Quasar, Roma
Marzano A (2013) Harvesting the sea. The exploitation of marine resources in the Roman Mediterranean. Oxford University Press, Oxford
Marzano A (2015) Sergio Orata e il Lago Lucrino: alcune considerazioni sull'allevamento di ostriche nella Campania romana. Oebalus 10:131–150
McLaughlin R (2013) The Roman empire and the Indian Ocean. Pen and Sword, Barnsley
Meyer JB, Cartier LE, Pinto-Figueroa EA, Krzemnicki MS, Hänni HA et al (2013) DNA fingerprinting of pearls to determine their origins. PLoS ONE 8(10):e75606. https://doi.org/10.1371/journal.pone.0075606
Morales-Muñiz A, Smits N, Overlaet B, Yousif JS, Llorente RL (2020) Apuntes sobre la producción de perlas en el Golfo de Arabia: Los moluscos de Dibba Al Hisn (Sharjah, Emiratos Arabes Unidos; siglos 1aC-1dC). In: Bolletí de la Societat d'Història Natural de les Balears, Actas de la V Reunión Científica de Arqueomalacología de la Península Ibérica (Palma de Mallorca, octubre de 2019), en prensa
Morel J-P, Rondi-Costanzo C, Ugolini D (2000) Corallo di ieri, corallo di oggi, Scienze e materiali del patrimonio culturale 5. Centro Universitario Europeo per i Beni Culturali, Edipuglia, Bari
Ogden J (1982) Jewellery of the ancient world. Rizzoli, Londres
Ogden J (1992) Ancient jewellery. Interpreting the past. University of California Press, Londres
Olmedo A (2012) Pendientes. In: Alba Calzado M, Álvarez Martínez JM (eds) El Consorcio y la Arqueología Emeritense. Consorcio de Mérida, Mérida, pp 94–95
Palol P (1994) Clunia. Burgos. Historia de la ciudad y guía de las excavaciones. Diputación de Burgos, Burgos
Palombi D (1990) Gli hora della Via Sacra: dagli appunti di Giacomo Boni ad una ipotesi su Nerone. Dialoghi di Archeologia Serie 3 Anno 8(1):53–72
Panciera S (1970) Tra epigrafía e topografía. Archeologia Classica 22:131–163
Papi E (2002) La turba inpia: artigiani e commercianti del Foro Romano e dintorni (I sec. a.C.—64 d.C.). J Roman Archaeol 15:45–62
Parker AJ (1992) Ancient shipwrecks of the Mediterranean and the Roman Provinces, BAR International Series 580, Oxford
Parlasca K (1969) Ritratti di mummie, I. Repertorio d'Arte dell'Egipto Greco-Romano, serie B. L'Erma di Bretschneider, Roma
Pérez González J (2014) La venta de perlas en la ciudad de Roma durante el Alto Imperio. Espacio, tiempo y forma 27:267–282
Pérez González J (2019) How Roman sumptuary specialists called themselves: a corpus-based study'. Latomus. https://doi.org/10.2143/LAT.78.4.3287640
Pettinau B (1992) L'oro. In: Pirzio L (ed) L'oro dei romani. Gioielli di eta imperiale. L'Erma di Bretschneider, Roma, pp 17–50
Puttock S (2002) Ritual significance of personal ornament in Roman Britain. BAR British series, vol 327, Oxford
Reese DS (1991) The trade of Indo-pacific shells into the Mediterranean basin and Europe. Oxf J Archaeol 10(2):159–167
Reyes O, Pérez C, Bragado MD, Araujo R, Andrés J (2016) Arquitectura romana tardoantigua: revestimiento de nácar en "villae" hispanas del siglo VI d.C. Oppidum 12:185–218
Rigato D (2011) Tra pietas e magia: gemme e preziosi offerti alle divinità. In: Baldini I, Morelli AL (eds) Oggeti-simbolo. Produzione, uso e significato nel modo antico. Ante Quem, Bolonia, pp 41–53
Rodríguez Almeida E (1985–1986) Note di topografía romana: cosmus myropola, il vicus unguentarius e i penetralia Pallados nostrae (Mart. IV, 53). Rivista dell'Instituto d'Archeologia e Storia dell'Arte S.II(VIII–IX):111–117
Rodríguez-Hidalgo A, Gibello Bravo V, Menéndez Menéndez A, Sanabria Murillo D, Sánchez Hidalgo F (2013) Un ejemplar de *Cypraea pantherina* en una tumba altoimperial de *Augusta Emerita,* Zephyrus, LXXII, julio-diciembre 2013, pp 183–193
Rostovtzeff M (1957) The social and the economic history of the Roman empire. Biblo & Tannen Booksellers & Publishers Incorporat, Oxford
Russo S (1999) I gioelli nei papiri di età romana. Ist. Papirologico G. Vitelli, Firenze
Russo S (2011) Gioelli e papiri. In: Baldini I, Morelli AL (eds) Oggeti-simbolo. Produzione, uso e significato nel modo antico. Ante Quem, Bolonia, pp 29–39
Schörle K (2016) Pearls, power, and profit. Mercantile networks and economic considerations of the pearl trade in the Roman empire. In: De Romanis A, Maiuro M (eds) Across the ocean: nine essays on Indo-Mediterranean trade. Leiden, Brill, pp 43–54

Journal : SmallCondensed 11457	Article No : 9290	Pages : 35	MS Code : 9290	Dispatch : 13-2-2021

Seland EH (2011) The Persian Gulf or the Red Sea? Two axes in ancient Indian Ocean trade, where to go and why. World Archaeol 43(3):398–409
Seland EH (2013) Networks and social cohesion in ancient Indian Ocean trade: geography, ethnicity, religión. J Glob Hist 8:373–390
Sevillano-López D, Soutar Moroni D (2012) Comercio de perlas entre los siglos II a.C. y X d.C. Boletín Geológico y Minero 123(2):139–155
Tassini P (1992) Produzione e vendita di alcune merci di lusso a Roma. In: Epigrafia della produzione e della distribuzione. Actes de la VII Rencontre franco-italienne sur la epigraphie du monde romain. École Française de Rome, Rome
Trakadas A (2018) In Mauretaniae maritimis: marine resource exploitation in a Roman North African Province. Franz Steiner Verlag, Stuttgart
Treggiari S (1975) Jobs in the household of Livia. Pap Br Sch Rome 43:48–77
Tremoleda Q (2006) Les ars de pesca a Empúries. In: Aquilué J, Monturiol J (eds) Pescadors de l'Antiga Empúries. Museo de Ampurias, L'Escala, pp 20–22
Valentini R, Zucchetti G (1940) Codice topografico della città di Roma, I. Istituto Storico Italiano per il Medioevo, Roma
Vermassen MJ (1977) Cybelles and Attis. Penguin Books, Londres
Vons J (2000) L'image de la femme dans l'ouvre de Pline l'Ancienne. Peeters, Bruselas

Ancient Sources

Cicero (1999) Sobre la naturaleza de los Dioses (A. Escobar, trad.). Biblioteca Clásica Gredos, p 269
Aelian (1990) Historia de los Animales IX–XVII (J.M. Díaz-Regañón, Traducción). Biblioteca Clásica de Gredos, Madrid
Horace (1909) Sátiras y Epístolas (G. Salinas, Traducción). Librería de Perlado, Madrid
Martial (2001a) Epigramas I (A. Ramírez, Traducción). Biblioteca Clásica de Gredos
Martial (2001b) Epigramas II (A. Fernández y A. Ramírez, Traducción). Biblioteca Clásica de Gredos
Oppian (1992) De la caza. De la pesca (C. Calvo Traducción). Biblioteca Clásica Gredos, Madrid, p 134
Ovid (1989) Sobre la cosmética del rostro femenino (V. Cristóbal Pérez). Biblioteca Clásica Gredos, Madrid, p 120
Petronius (1978) El Satiricón (L. Rubio, Traducción). Biblioteca Clásica de Gredos, Madrid
Pliny the Elder (1992) Historia Natural, Libros VII–XI (E. del Barrio *et al.* Traducción). Biblioteca Clásica Gredos, Madrid, p 308
Pliny the Elder (2010) Historia Natural, Libros XII–XVI (F. Manzanero *et al.* Traducción). Biblioteca Clásica Gredos, Madrid, p 388
Seneca D (1996) Consolaciones a Marcia, a su madre Helvia y a Polinio. Biblioteca Clásica Gredos, Madrid, p 220
Suetonius (1992) Vida de los Doce Césares (R. M. Agudo, trad.). Biblioteca Clásica Gredos, Madrid, p 167
Tacitus (1981) Agrícola·Germania·Diálogo sobre oradores (J.M. Requejo, trad.). Biblioteca Clásica Gredos, p 67
Ulpian (1836) Corpus juris civilis academicum parisiense, in quo Justiniani Institutiones, Digesta, sive Pandectae, Codex, Authenticae [...], Source gallica.bnf.fr/Bibliothèque nationale de France