From Hispania to the Chalkidiki: A Detailed Study of Transport Amphorae from the Macquarie University Museum of Ancient Cultures

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*This study considers a collection of four diverse amphorae recently acquired by the Macquarie University Museum of Ancient Cultures. Upon commencing, these ceramic vessels bore no information regarding distribution or contents and were largely unanalyzed and unpublished. This paper seeks to determine what they can reveal through a detailed study of their origins, provenance, principal contents, and potential distribution. It is hoped that this information will aid in the analysis of larger trade networks for these amphora types along with their role in the economies of the ancient Mediterranean.**

Introduction

As one of the fundamental bulk transport facilitators in antiquity, the amphora plays a large role not only in international and interregional trade, but also the local agricultural and domestic market. The four examples purchased by the Macquarie University Museum of Ancient Cultures (MAC), however, were most likely traded, transported or travelled within the international or interregional realm due to their likely marine provenance. The focus of this paper will take this into consideration rather than any potential domestic, regional or secondary use.

Discussions of shape, preservation, petrological characteristics, origin, contents, and possible distribution are presented along with an appendix of detailed measurements for each amphora. A graphical representation of the proposed date ranges for each amphora is also provided in figure 6. It is through an examination of these features that the value of exploring and analyzing de-contextualized artefacts can be seen, particularly those in museum collections with limited or no provincial data.

The latest additions to the MAC arrived with little information and only brief typological studies had been undertaken to determine vague geographical origin. The only information supplied with these four amphorae were brief notes on one vessel (MU4616), stating: "Amphora, 4th Century – Pottery amphora, of elongated form, tapering to a pointed base with two small loop handles at the neck, the rim curving, sea encrusted. Stand for mounting. Ex-collection of Mr. Sandy Nardini, founder of the Scottish Nardini Ice Cream business, given to him as a housewarming gift in the 1950's."[1] Access was generously provided to all of the amphorae periodically over the course of one year to allow hand-held study and documentation. While the preliminary results have proven useful, further scientific and petrological examination would allow for more concrete and comprehensive analyses.

MU4639 – Mendean Amphora c. 370 B.C.E.

Shape Description

This amphora has a turnip-shaped body with a sharp, somewhat carinated, shoulder (fig. 1). The rim tapers down and outwards from the lip to a sharp point and then changes direction to join the neck with a slightly concave curve. The strap-like handles attach to the long, cylindrical neck just below the rim, rising slightly and then continuing almost vertically downwards to join the body in between the base of the neck and shoulder. The body tapers down from the shoulders and flows into a short-stemmed, flaring or splayed toe with a deep depression underneath (appx. 1.1). It also includes a small carination near its base in the form of a thickened and raised band of clay.

Figure 1: Mendean Amphora (MU4639)

Preservation

This vessel is almost completely intact, with only small chips and pieces missing from the outer lip in multiple locations. It is thoroughly encrusted with marine sediment and concretion covering approximately 70% of the vessel thus making further analysis of the state of preservation somewhat difficult in certain areas.

Fabric and Petrological Characteristics

The body is a dark, rich red color with some sections moving to a golden yellow shade, the darker areas being those most likely covered by silt. The neck is a lighter greyish-brown or tan color only going as far as a light red on one side. There are many coarse inclusions evident and pockmarks visible on the outer layer from the firing process. It should be noted that due to the heavily encrusted nature of the vessel, without creating a fresh break, it was difficult to fully observe the nature of the fabric. While some sections of MU4639 can be identified with Whitbread's most common color of 5YR 6/6 (reddish yellow), the majority of the vessel is a darker hue with the 'light red' sections closer to 2.5YR 6/6.[2] Whitbread has also identified two distinct classes of fabric relating to Mendean amphorae and, without scientific petrological analysis, MU4639 fits most closely with Class 1.[3] While the two classes are very similar, Class 1 has a rougher texture with distinct bimodal grain size and many inclusions closely identifiable with MU4639.[4]

Origin

This vessel provides an interesting mixture of morphological characteristics suggesting two possible origins. The neck, body and toe are almost identical to those Mendean amphorae analyzed by Whitbread suggesting a Mendean provenance.[5] The rim, however, is not rolled as the Mendean examples show; it is more similar to the Graeco-Italic forms found at Euesperides by Göransson.[6] It is perhaps the evidence from the Porticello shipwreck which most conclusively shows MU4639 to be Mendean in origin.[7] The handles from MU4639 are not quite vertical but also not an S-curve, hence, the vessel falls somewhere between Eiseman's Type 1.A and 1.C amphora, possibly Type 1.B.[8]

Date

Mendean amphorae are dated between the second half of the fifth to the late fourth century B.C.E.[9] This relatively brief time span is likely due to the region's history and relatively quick synoecism that resulted in the creation of Kassandreia;[10] or it may rather simply be due to a lack of excavated and published examples of later Mendean amphorae. MU4639 appears to fall within this brief chronology. As there are no visible stamps or other inscriptions or *dipinti*, dating must be solely based upon morphology and comparison with other relatively securely dated forms. The *communis opinio* with regard to dating Mendean amphorae focuses on the fact that they began, in the late fifth century B.C.E., with a shorter, squatter body and neck and a more round overall figure which developed in a relatively short time period to a more elongated and angular shape.[11] Based on this trend, MU4639 can be seen to date *later* than the Porticello Mendean amphorae and amphora U13:1 from the Athenian Agora (both dated to the early fourth century) and *earlier* than amphora R13:11 from the Athenian Agora (dated no later than 351 B.C.E. based upon a closed deposit created by the construction of the Maussolleion of Halikarnassos).[12] From the angular and relatively long morphology of MU4639, yet still somewhat thick as compared to R13:11, it should be concluded that MU4639 fits somewhere midway between the aforementioned examples, perhaps c. 370 B.C.E.

Principal Contents

It should first be recognised that MU4639 bears large-scale concretion over its surface suggesting that it was found in a marine context. While this may not narrow down

whether it was being re-used or still contained its principal and original contents, it suggests that it was last used actively in trade on board a shipping vessel.[13] The area surrounding Mende was known famously in ancient times for its wine[14] and it is logical to assume that a large proportion of, if not all, Mendean amphorae were used originally for the transportation of this commodity. There are no remaining signs of content residue or sealant on the interior of the vessel and without further detailed scientific examination it is difficult to determine exactly what it last held. Taking into account previous publications and finds, however, it can be hypothesised that MU4639 contained wine.[15]

Distribution and Provenance

It must first be recognised that very little is known of the production and distribution of Mendean amphorae, however, details regarding their distribution and trading routes can be extrapolated from known finds. Numerous examples have been found in deposits at the Athenian Agora along with those on the Alonnesos, Porticello, and El Sec shipwrecks.[16] On the other end of the spectrum, finds have been made from settlements in the lower Dnieper Valley in the Black Sea Littoral region.[17] Interestingly finds from this location are often found in burials of the wealthy Scythian aristocracy and royalty (being rare in ordinary burials) possibly as remains from a funerary feast and are hence very well preserved.[18] It can therefore be seen that Mendean amphorae were used across the Mediterranean in ancient times, being found in the far-west near Majorca to the far north-east region of the Black Sea. This simply demonstrates that without detailed biological study of the encrustations and concretion on MU4639, and further scientific and petrological investigation, no conclusive agreement can be met on the provenance of the amphora.

MU4666 – (Corinthian) 'B' Amphora/Graeco-Italic Intermediate Form c. 325-300 B.C.E.

Shape Description

The body is a globular turnip shape with a sharp carination at the shoulder (fig. 2). The solid-made 'peg' toe is also joined to the body at a sharp angle and has a flat and angular base. The strap-like handles attach just below the rim, are slightly arched at their peak and then flow vertically down to attach again midway up the shoulder (appx.1.2). The rim is a flattened disc shape with a slight concave shape on its underside and a slightly rounded lip. It is important to note that there is evidence of sealant in two locations: first, inside the vessel in limited patches of a black color which are fading yet still visible to the naked eye and second, on the top surface of the rim and appearing as a crystalline, black concretion,

Figure 2: 'B' Amphora (MU4666)

possibly used as a glue to adhere a stopper to seal the vessel.[19] These residues can most closely be identified as pine pitch; however, further scientific analysis may prove otherwise. Clues to the manufacture of this vessel may be gained from the interior of the neck, where strong parallel lines indicate wheel-made craftsmanship.[20]

Preservation

MU4666 is a completely intact amphora, with only slight damage occurring at the join between one handle and the shoulder. There is fairly limited concretion on the vessel (covering approximately 30% of the entire vessel), yet small encrustations are prevalent, particularly clustered around the shoulder and neck, with a fairly large formation under one handle.

Fabric and Petrological Characteristics

The fabric is a reddish-tan color in the limited sections where encrustation and discoloration have not occurred, similar to that of Farnsworth's red-colored "buff with rosy overtones".[21] When split vertically downwards, from rim to toe, half of the vessel appears a cream or white color while the other half is brown or golden yellow. Similarly, the concretions appear as a white color or a stained golden yellow color. This may serve to indicate which side of the amphora was partially buried by sediment whilst in situ in a marine context. The fabric is composed of very fine grains when compared to other vessels, such as MU4639, and has a smooth, well-finished texture. Similarly, the joins appear well made, with evidence of smoothing marks and care taken to ensure a quality finish. These characteristics appear to indicate that MU4666 belongs to Whitbread's Corinthian Type B Fabric Class 4, a fine-grained extension of Class 3, which is a pink to reddish yellow (5YR 7/4 to 5YR 7/6) refiring to a reddish brown (2.5YR 4/4) with grain-size about 0.03-0.04mm.[22]

Origin

It is perhaps the results of Göransson's excavations at Euesperides that most clearly suggest MU4666 to be of Corinthian type B (or a 'B' Amphora).[23] The difficulty then lies in determining the exact origin of this example without having access to full petrographic and microscopic study. The origins of 'B' amphorae, as recently re-labelled by Göransson,[24] have been debated since the early 1900s and only recently have scientific studies begun to shed some light on where they may truly belong. In the 1970s, Neutron Activation Analysis (NAA) was used on pottery from both Corinth and Corfu (the two most likely candidates for the origin of this type) and established that Corinthian-type pottery was definitely manufactured in Corfu (ancient Corcyra). While earlier publications had concluded that all 'B' amphorae should have the same production centre (as no stylistic change is evident from those found in Corinth, Corfu, Athens or farther abroad), archaeological and scientific evidence now suggests that at least some of these vessels were in fact manufactured in Corinth as well.[25] Indeed, more recent investigations using optical microscopy have confirmed an Aegean provenance for 'B' amphorae (most likely Corinthian), but have not discarded the possibility of a Corcyrean provenance due to certain similarities found with the results of the NAA studies.[26] Excavations at Euesperides (ancient Cyrenaica) have revealed that local imitations of 'B' amphorae did exist and that these were not limited to North Africa but may have also included Magna Graecia and Sicily.[27] Therefore, as Koehler has recently observed, it seems inescapable that the Corinthian B/Corcyrean type was produced in several places and without a full petrographic examination in thin-section and comparison to Whitbread's results from both Corinth and Corcyra, it is virtually impossible to determine exactly where MU4666 was produced.[28]

Intermediary and Evolutionary Details Specific to MU4666

While MU4666 can fairly confidently be identified as a 'B' amphora, certain morphological details suggest an alternate attribution, one that must be considered when analysing this piece and are included here for the benefit of future studies. The body, handles, shoulder, and toe of MU4666 bear close resemblance to certain Graeco-Italic types, or MGS types (Magna Graecia and Sicily), and finds off Sicily at the Secca di Capistello wreck that have been attributed as "Graeco-Italic" are also very similar.[29] Upon consultation of Will's Graeco-Italic forms, MU4666 aligns (morphologically) most closely to her Form A.[30] The rim of MU4666, however, is not the typical "duckbill" shape of the Graeco-Italic amphora rather it is almost completely flat on top and has only a curved underside: much more similar to a 'B' amphora. It is, therefore, possible that MU4666 is an intermediary or evolutionary piece, part of the transitional or overlapping phase from 'B' amphorae to Graeco-Italic. It has previously been suggested that 'B' amphorae were (one of) the predecessors of Graeco-Italic amphorae, with Will suggesting a morphological link between 'B' amphorae and her Graeco-Italic Form A amphorae and Van der Mersch noting a similarity between his MGS III amphorae and 'B' amphorae of the second half of the fifth century B.C.E.[31]

Additionally, Göransson has compiled a collection of "intermediary" types from the finds at Euesperides suggesting an evolutionary typology and many of these also bear similarities with MU4666.[32] It could be concluded that these similarities, and those characteristics on MU4666, are potentially due to vessels being manufactured in a location where 'B' amphorae and Graeco-Italic workshops worked side by side or even combined and hence concepts and styles were free-flowing between contemporary types.[33] The conclusion that MU4666 is potentially an intermediate type, while relevant and important to consider, should not distract from the fact that it still holds many features of a 'B' amphora. Additional research is necessary before committing to this hypothesis and time needs to be spent observing the full similarities and differences between 'B' amphorae and Graeco-Italic forms, in particular relation to their manufacture and places of origin.

Date

'B' amphorae are thought to have been manufactured in the last quarter of the sixth century B.C.E. until the second century B.C.E.[34] Early examples appear very round, almost cylindrical in shape and as time passes there is a general tendency to become longer and slimmer, with the handles and neck increasing in height.[35] The Hellenistic wreck at Seriphos (*Karavi*) provided an example from the third quarter of the third century B.C.E. that is noticeably slimmer and with longer handles than MU4666.[36] Catalogue numbers 111 and 133 from the excavations at Euesperides both have an unusually flat upper face of the rim and a disc-like appearance similar to MU4666, even more so in the latter, and have been dated between 325-250 B.C.E. suggesting that it is likely that MU4666 falls within this period.[37] The accentuated peg-toe of MU4666 also suggests origins c. 325 B.C.E. as later examples have less distinction between toe and body and the join follows the line of the body into the toe, quite unlike MU4666.[38] Finally, Whitbread concludes that Class 3 and 4 fabrics are exclusive to the late fourth and early third centuries B.C.E., while Classes 1 and 2 belong to earlier periods and the beginning of the typology.[39] Thus, MU4666 made of Class 4 fabric, may belong to the period after 350 B.C.E. MU4666 can be dated, therefore, to the century between 350-250 B.C.E. in terms of relative typology and fabric; and can further tentatively be dated to c. 325-300 B.C.E. based on extrapolations of rim, toe, and handle morphological evolution.

Principal Contents

Koehler has suggested wine as the most likely contents of 'B' amphorae.[40] This is supported both by the fact that the interiors of 'B' amphorae have often been found to have been coated with a resinous pitch-like substance (probably pine pitch as in MU4666) to limit seepage through the porous fabric, and by the fact that Athenaeus describes Corcyrean wine as "...a pleasant wine, when old", clearly showing that Corcyra produced quality, renowned wine in antiquity.[41] It is believed that Koehler made this assumption based on her belief that Corinthian Type A amphorae were designed for olive oil only and similarly 'B' amphorae for wine only.[42] This can also fit in with the theory that Corcyra manufactured these amphorae. If Corinth did not produce a good quality wine itself, as Athenaeus has suggested,[43] it may have imported wine from Corcyra in these 'B' amphorae, hence explaining the large numbers of Corcyrean-exported 'B' amphorae found at Corinth alongside their local produce.[44] Finally, the general morphological shape of 'B' amphorae, with their useful peg-toe, small mouth, and defined lip for controlled pouring further suggests that wine was the most likely principal contents of 'B' amphorae.[45]

Distribution and Provenance

'B' amphorae are known to have been widespread during their production period, particularly throughout Greater Hellas and also along the North African coast from Alexandria to Veggazi and Carthage.[46] Particular concentrations have been found during excavations at the Athenian Agora and this seems reasonable as it was a major trading hub with connections to both Corinth and Corcyra.[47] In an anonymous passage from the Aristotelian corpus the trade in Corcyrean amphorae is described, amongst others, at a market in the neighbourhood of the Mentores, between Histria (*Istrai*) on the Black Sea and Liburnian territory.[48] This may provide evidence for extensive northern overland trade in these amphorae as well as maritime.[49] While it is difficult to ascribe a more concrete provenance to MU4666 without the aid of scientific investigation and more detailed petrological study, it can be concluded that, as it was found in a marine context, this example might have travelled between Corcyra and Corinth or through another major Greek trading port within Greater Hellas, such as Athens. Further biological analysis of the encrustations found on the vessel may reveal a general latitude upon which the vessel was submerged as these are known to vary depending upon their position in the northern or southern Mediterranean.[50]

MU4640 – Pascual 1 Amphora c. 50 B.C.E.–80 C.E.[51]

Shape Description

MU4640 has an ovoid body with a long rim, neck and elongated toe (Appx. 1.3). The toe is a slightly splayed peg toe and the rim is thickened in a slightly everted (or funnelled) collar shape (fig. 3).

Figure 3: Pascual Amphora (MU4640)

Figure 4: Pascual Amphora (MU4640) - Rim and Handle Detail

It has a significant carination along its lower edge where it joins the neck and has a rounded upper edge. The handles begin below the rim's lower edge and attach midway up the shoulder of the vessel. They are strap-like, almost rectangular, in profile and have a deep groove running down the middle of the outside edge (fig. 4). There is evidence of stoppering on the interior of the neck just before the shoulder, where an indent or shallow mark approximately 1.0cm wide can be observed with residues of glue or sealant within, most likely to cement the stoppering mechanism in place and provide a hermetic seal. Thick parallel lines running around the interior of the rim and neck and continuing to the shoulder suggest manufacture and construction on a potter's wheel (fig. 4).

Preservation

This example is largely intact with no missing pieces. There are, however, many cuts, scratches and other deep grooves of a random nature on the mid and lower body created post-manufacture (fig. 3). In addition to this, concretion and small-scale encrustation covers approximately 50% of the exterior of the vessel.

Fabric and Petrological Characteristics

The sections of the vessel unaffected by concretion reveal a light reddish/orange to creamy white or buff-tan colored fabric with some sections moving to a light pink. This is most comparable with 5YR 8/4 moving to a lighter 5YR 8/2 on the upper neck and rim. A closer examination reveals a very fine, hard fabric, with quartz inclusions and fine crystalline structures.[52]

Origin

From a purely morphological perspective this piece has two possible origins, the most likely being presented here.[53] The vertical groove on the handles and the ovoid body strongly suggest that this vessel belongs to the Pascual 1 family of amphorae, a copy of the more common Dressel 1B type (fig. 4). Kilns known to have produced this form have been found around the north-eastern coastal zone of Spain, in the Catalan, and more specifically, modern Barcelona region.[54] It has also been suggested that this form was manufactured in Gaul at a variety of sites including Aspiran, Montans, and Corneilhan.[55]

Date

This form is known to have been in existence from the second half of the first century B.C.E. and is thought to have ceased, on the one hand, sometime between 40 and 79 C.E. or, on the other, to have continued into the Trajanic period.[56] The majority of forms are found in Augustan and Tiberian contexts and it is rare to date a Pascual vessel outside of these periods.[57] Without a specific Pascual 1 typology for comparison it is difficult to refine the date of MU4640 any further than late first century B.C.E. to mid-first century C.E. It could be suggested, however, that due to the quality of workmanship and highly developed and technical nature of MU4640 that it may fit into the second half of this date range, closer to the end of Pascual 1 amphora manufacture.

Principal Contents

The probable inspiration and model for the Pascual 1 form was the pre-existing Dressel 1B amphora which was used to transport wine throughout the Roman world. It would therefore make sense that the Pascual types, with their similar morphological shape and design, should be used for a similar purpose. Indeed, the general geographical location of their manufacture in *Hispania Tarraconensis* was famed for its wine.[58] Additionally, examples of Pascual 1 amphorae have been found undisturbed in marine contexts with intact pitch or resin interior linings (similar to those residues found at the neck of MU4640), used predominantly on wine-carrying vessels as it would spoil olive oil.[59] While there is very limited remaining evidence for an interior lining in MU4640, it is likely that this would have deteriorated over time, particularly when exposed to dry terrestrial conditions since being lifted from its original marine context.

Distribution and Provenance

The Pascual 1 form is seen as somewhat of a regional imitation of the more widespread and 'international' Dressel 1B type.[60] Paralleling this, its distribution pattern reflects a 'regional distribution' for the Pascual 1 form rather than an Empire-wide distribution, like the Dressel 1B.[61] The form, however, was popular for its brief lifespan and distribution is evident throughout the Western Roman Empire, reaching Britain, Germany, France, Italy, and Africa from its source in Spain.[62] This pattern is slightly atypical when compared to the common trend of amphora distribution over water, as it focuses on increased terrestrial transportation. Indeed, the Narbonne-Bordeaux route, via *Aquitania*, appears to have been an important means of distribution to the northwest and was vital to the continual wine supply from the coastal Catalan region to Britain and other north-western colonies.[63]

This widespread distribution, along with the lack of detailed scientific study, makes it difficult to determine a provenance of any kind for MU4640 with any confidence. The concretions and small-scale barnacle encrustations reveal that it was discovered in a marine context and, if being used for its primary purpose (transporting wine from the coastal Catalan region or Gaul), it may be suggested that its trading route may have passed through the western Mediterranean Sea or even the Bay of Biscay or English Channel; en route to North Africa or Britain respectively. Further scientific biological analysis on the marine encrustations may serve to narrow this down to one generalised geographical region and potentially reveal the trade route on which MU4640 was travelling.

Figure 5: Africana 1 Amphora (MU4616)

MU4616 – Africana 1 Amphora c. 180-380 C.E.[64]

Shape Description

This amphora has a long, cylindrical body with a short neck, a rounded shoulder with a slight carination at its peak, and two strap-shaped ear or loop handles (appx. 1.4 and fig. 5). The handles join just below the rim and finish midway up the shoulder and there is a small separation between handle and upper neck where the join has aged. The rim has a rolled lip and is thickened and everted on the outer face and flat or concave on the inside.[65] There is a distinct joining line between lower rim and neck. It has a solid spike or pointed toe flowing from the lower body.

Preservation

This example is completely intact with no damage or missing pieces and only a small separation, due to deterioration, between one handle and the upper neck. The vessel is thoroughly encrusted on one side of the body with the remains of medium to large mollusc-like organisms and concretion covering approximately 50% of the vessel's surface.

Fabric and Petrological Characteristics

The fabric of MU4616 has minimal inclusions and is of a fine, sandy nature with black and white grains evident. The vessel was likely discovered partially under sediment as the fabric is discolored to an almost black shade in some sections on half of the body. Between these black discolorations, a rich red-brown to ochre fabric emerges as the vessel's original color. This has faded to a grey shade on the top half and then to a cream and almost white color on the encrusted side of the vessel. The multi-colored nature of this vessel's fabric, most likely due to the marine conditions in situ, also includes pinkish, tan, and greenish sections between encrustations. This does not make an analysis purely by hand specimen examination completely accurate or reliable. If valid information is sought regarding the fabric of MU4616 destructive petrological studies will need to be undertaken in thin section on fresh breaks without the hindrance of encrustation, concretion and discoloration. The apparent 'original' fabric of the vessel, however, is most closely identified with 10R 4/3, yet it is difficult to determine a more accurate Munsell reading without wider comparison along the rest of the vessel. Gibbins states that most Africana 1 amphorae of this form oxidize brick-red (2.5R 6/6) with a black outer zone and white limestone 'flecks' visible to the naked eye (up to 0.5mm across).[66] The white inclusions are certainly evident in MU4616, however, it is difficult to determine whether the black coloration occurred when the vessel was fired or due to post-depositional marine activity.

Origin

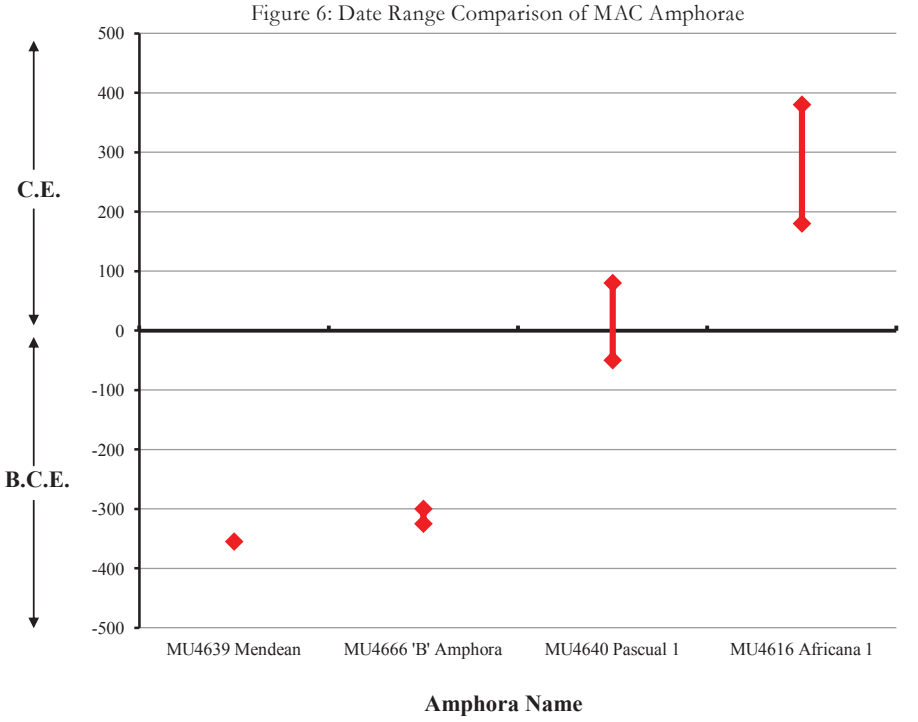
MU4616 is immediately recognisable as an African-type and further typological study reveals it to be an Africana 1 amphora. A number of these were found on the Plemmirio wreck and this, along with finds from Roman Britain and Italy, have created a solid foundation for research into the origin and manufacture of this particular form of amphora. The Plemmirio Africana 1 amphorae have fabric consistent with 'central Tunisian ware' and the limestone inclusions along with the black colorations similar to MU4616 are particularly evident in pottery produced from the coastal area around Salakta (ancient Sullechtum).[67] Some finds of this form from Ostia also bear stamps mentioning the coastal towns of Leptis Minor and Hadrumetum and others include a *tria nomina* formula along with a place name.[68] Production is also attested at Carthage, Acholla, Hr Ben Hassine, Thaenae, Nabeul, and Oued el Akarit.[69] It appears, therefore, that the entire Sahel region of central Tunisia (Roman Byzacena) was producing this type. Without epigraphic evidence it is fairly difficult to determine the exact origin of an Africana 1 amphora as the regional geology of coastal Tunisia is fairly uniform with limited distinctive features.[70] Results of kiln surveys

have not helped much in differentiation, only showing that Africana 1 amphorae were produced at several east Tunisian port sites, including Sullechtum, in nucleated urban and peri-urban locations.[71] It appears that the most decisive method in determining exact origin of these amphorae is to use Instrumental Neutron Activation Analysis (INAA) technology and compare samples from both kiln sites and unknown amphorae.[72] Without the help of more advanced scientific technology, it is difficult to decisively determine the origin of MU4616. It is safest to conclude that the vessel was most likely manufactured along the eastern Tunisian coastline.

Date

Evidence from Rome suggests that Africana 1 amphorae were first produced around the middle of the first century C.E. and variants of the form continued until the late fourth century C.E.[73] Production is thought to have reached its peak in the second half of the second century or early third century C.E. with large scale export beginning during the 170s C.E. under the Emperors Marcus Aurelius and Verus.[74] This was again bolstered after 193 C.E. with the accession of Septimius Severus who not only supported his native North Africa but may have instituted free oil handouts in Rome.[75] This mass production is thought to have lasted until at least 220 C.E.[76] A detailed typological and morphological analysis reveals MU4616 to fit somewhere between the Africana 1 and Africana 2 chronology. It has the rim, handles and body of an Africana 1 amphora, however, the toe is elongated and rounded at the bottom (not abruptly ending to form a flatter base as the early-mid Africana 1 examples show). This, and the fact that it flows smoothly from the body, align more with the early Africana 2a examples.[77]

Figure 6: Date Range Comparison of MAC Amphorae



Principal Contents

There is no evidence of an interior coating inside MU4616. Africana 1 sherds have been found on the Plemmirio wreck with adhering olive pits and, similarly, none of these examples have evidence of an interior lining.[78] As stated by Gibbins, this is consistent with the proposition that resin contaminates oil.[79] Thus, it would not seem a coincidence that the four main areas identified with large-scale Africana 1 production identify closely with major zones of olive oil cultivation.[80] Further confirmation may be reached by using scientific techniques, such as gas chromatography or DNA testing on residues, to test for traces of oil in the walls of the vessel.[81] Additionally, the narrow mouth and large volume of the body would have allowed the controlled pouring and distribution of mass quantities of liquid, important factors when considering the antique distribution and transport of such a widespread and necessary commodity as olive oil.

Distribution and Provenance

Due to the relatively long production period of Africana 1 amphorae, they had the opportunity to travel large distances and are predominantly found across the Mediterranean. They are commonly distributed throughout the Western Mediterranean but examples have also been attested as far as Britain and Knossos.[82] Indeed, the demanding oil market in Britain during this period allowed profitable export to those distant provinces from North Africa.[83] It is more pertinent in relation to MU4616, however, to study the locations of wrecks with Africana 1 amphorae on board as MU4616 was itself likely found in a marine context. Gibbins states that at least thirty wrecks are known with Africana 1 or 2A amphorae in situ and that these are mainly concentrated in the western Mediterranean, with a single exception of one off western Turkey.[84] According to his distribution map, there are four Africana 1 wrecks off Sicily, three off Tyrrhenian Italy, one off southern Sardinia, and two in the Adriatic; one off the coastline of Venetia and one just off eastern Calabria.[85] The study of the Plemmirio wreck with its large cargo of Africana 1 amphorae has revealed a potential trading route for this form which travels via eastern Sicily, the Strait of Messina and onto the Italian western coast.[86] While this only outlines one possibility for where MU4616 may have been found, it gives a general sense of how Africana 1 amphorae were traded. Originating in a Northern African port they travelled via many island trading points with potential for trade before reaching their chief destination and consequent large-scale unloading.

Summary of the Evidence

Through a combination of typological study, handheld macroscopic petrological analysis, and a comparison to known finds and distributions of relevant amphorae, it has been possible to determine the date, origin, principal contents, distribution, and a hypothetical provenance for all four of the previously unstudied MAC amphorae. Three of the four amphorae most likely carried wine, while the remaining vessel, MU4616, carried olive oil. The amphorae can also be seen to have been manufactured across a wide range of time, with two examples from various stages of the fourth century B.C.E. (MU4639 and MU4666), one from the mid-first century B.C.E. to the late first century C.E. (MU4616) and one from the late second to late fourth century C.E. (MU4640) (Fig. 6). It is hoped that these conclusions, along with the more detailed data presented above, will not only be of assistance to the MAC's catalogue and database but also to future scholars researching these types of amphorae and what can be determined from an analysis of their morphology and fabric.

It would be worthwhile, in future studies, to investigate using microscopic and other more detailed scientific petrological methods on fresh breaks and in thin section to provide comparable and more accurate and verifiable dating and provenance results. These techniques, however, are recognised to be destructive and the museum's continued preservation of artifacts is a high priority and of equal value to academia.

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Endnotes:

1 Thanks to Karl Van Dyke, Director of the MAC, for access to these records.
2 Whitbread 1995, 201.
3 See Whitbread 1995, 201-3 for a discussion on Class 1 and 2 Mendean fabrics and their identification.
4 Whitbread 1995, 201-2.
5 Whitbread 1995, 198.
6 cf. Göransson 2007, 124 (particularly fig. 218).
7 For more detail on the Porticello Mendean amphorae, see Eiseman 1973, 13-23, esp. 13-15.
8 To date, I am not convinced that MU4639 can be completely aligned with Eiseman's Type 1.B due to the vast differences in other typological characteristics (shoulder, rim and missing toe). cf. Eiseman 1973, 13-14.
9 Whitbread 1995, 198.
10 cf. Grace 1949, 178; Lawall 2005, 384.
11 This putative development can be traced through various publications showing amphorae from the Athenian Agora excavations and the Alonnesos, Porticello, and El Sec shipwrecks. See Eiseman 1973; Cerdá and Arribas 1987; Whitbread 1995, 198-200; Lawall 1998, 2000, 2005, 2010.
12 On the closed deposit created by the construction of the Maussolleion of Halikarnassos, see Lawall 2005, 45. The Mendean amphora from the El Sec shipwreck has also been placed in this general period, however, its dating is somewhat controversial and it is thought to be 20-30 years older than the rest of the cargo and possibly in re-use along with errors in photography and drawing multiplying dating problems (Lawall 2005, 45 & 53-4).
13 This theory relies on the assumption that MU4639 was not found in context with an underwater, flooded, ancient settlement site and hence may not have been in active trade circulation.
14 Athenaeus praises Mendean wine stating it is "what the gods piss in their soft beds" and refers to the design of a new type of amphora specifically for the export of this produce (Athenaeus, I.29, I.31 & XI.784). In his case against Lacritus, Demosthenes also mentions a cargo of 3000 jars of Mendean wine loaded at either Mende or Scione (Demosthenes, Against Lacritus [XXXV], 10).
15 See Eiseman 1973; Whitbread 1995, 198-203; Karjaka 2007, 133-41.
16 The Porticello and the El Sec shipwrecks being located in the Straits of Messina and just off Majorca in Spain respectively and the Alonnesos near the island of its naming in the Aegean.
17 For full detail on these finds and excavations, see Karjaka 2007, 133-41. Sites included in this study range from large forts to small villages among which some of the best known are Kamenskoe Gorodišče, Lysaja Gora, Kapulovskoe, Sovutina Skelja, Pervomaevka, Černeča, and Belozerskoe.
18 Karjaka 2007, 140.
19 Sealant would not have been necessary on an

outer surface of the vessel such as this, hence the suggestion of using it as a glue to adhere a stopper. Zemer (1977, 90, n. 235) has suggested that hermetic sealing was accomplished through the combination of clay stoppers and tree resin and three jars dating to the Persian period found by Dr E. Stern at Tel Mevorakh suggest this to be true.

20 As supported by Görasson (2007, 91) who states that 'B' amphorae were wheel-made from the sixth century until the third century B.C.E.

21 Farnsworth 1970, 10-11.

22 Whitbread 1995, 277-8.

23 On the 'B' amphorae from Euesperides, see: Göransson 2007, 88-115.

24 cf. Göransson (2007, 88-93) for a full discussion on why they should be termed 'B amphorae' rather than Corinthian type B amphorae, particularly p. 93.

25 Including the excavation of a kiln complex in the early 1990s at Figareto on Corfu by K. Preta-Alexandri and D. Kourkoumelis. The finds of over 3000 amphora sherds fitting a Corinthian B typology with some including monographic devices, such as an eight or sixteen pointed star, ivy leaves, a bunch of grapes, and an amphora similar to those found on Corcyrean coins strongly suggested a Corcyrean origin for B amphora: Farnsworth, Perlman, and Asaro 1977, 455-6; Kourkoumelis, 1990, 45. For more on the NAA study, see: Farnsworth, Perlman and Asaro 1977, 455-68.

26 Barone et al. 2002, 174.

27 cf. Göransson 2007, 76 & 82.

28 Koehler 1992.

29 I must thank Alba Mazza and Sebastiano Tusa for this suggestion and the connection with the Sicilian wrecks, which was raised during personal correspondence. The MGS amphora typology was established by Van der Mersch and is numbered from I to VI with a chronology spanning from the late fifth century to the first century B.C.E: Göransson 2007, 115. For more on the MGS typology, see Van der Mersch 1994, 59-92. For the finds around Sicily, see the website for the Museo Archeologico di Lipari, in particular the images of the "Shipwrecks of Lipari" and the Graeco-Italic amphorae from the Secca di Capistello wreck (<http://www.regione.sicilia.it/beniculturali/museolipari/pagina.asp?Idsez4=1>).

30 Large quantities of Form a jars have been found in and around Sicily and this may suggest a Sicilian origin. Their date range is thought to be between the latter fourth and early third centuries B.C.E.: Will 1982, 341-44.

31 See in particular: Will 1982, 341, n. 4; Van der Mersch 1994, 71, n. 120.

32 Göransson (2007, 118 & 120-21) has defined these as those which share morphological characteristics with Will Form A/MGS IV-V and B amphorae but to varying degrees so that some are more like 'B' amphorae whereas others are more similar to Graeco-Italic amphorae. Those closest to MU4666 are catalogue numbers 206, 207 & 208.

33 This has also been suggested by Göransson (2007, 119) who has shown how 'B' amphorae were produced in the western Mediterranean at locations such as Sicily, Euesperides, the Adriatic coast, and the Calabrian Ionic coast; all locations that are also known to have manufactured Graeco-Italic amphora.

34 Whitbread 1995, 258.

35 This has been mainly observed in the examples found at Euesperides (cf. Göransson 2007), but also in those found in context with the wreck at Seriphos (see following note).

36 Kazianes, Simossi and Haniotes 1990, 227-8.

37 Göransson 2007, 78 & 98.

38 Göransson 2007, 110.

39 Whitbread 1995, 278-9.

40 Koehler 1978, 6.

41 This observation relies, therefore, upon the assumption that Corcyra produced B amphorae: Athenaeus, I.33; Koehler 1978, 6; Whitbread 1995, 260; Göransson 2007, 89.

42 Göransson 2007, 92.

43 Athenaeus quotes the Middle and New Comedy writer Alexis (c. 375-275 B.C.E.) in a fragment describing Corinthian wine as "torturous": Athenaeus, I.30.

44 Whitbread 1995.

45 For further discussion of this in connection to Graeco-Italic amphorae and the relationship between these two types, see Whitbread 1995, 92.

46 Kazianes, Simossi and Haniotes 1990, 228.

47 cf. Farnsworth, Perlman, and Asaro's article (1977, 463) on finds from Corfu in the Athenian Agora. The difficulty in conducting an ancient maritime voyage to Corcyra from Athens (particularly around the notoriously treacherous southern tip of the Peloponnesos, Cape Maleas) has been made clear by Thomas Hillard in personal correspondence.

48 Anonymous, Aristotelian corpus; Fraser 1972, 276; Whitbread 1995, 260.

49 The Mentores appear as a shadowy group and very little is known concerning them with almost no reference in modern scholarship. From Fraser's description (1972, 276) there is some speculation regarding where they should be placed and this makes determining whether or not amphorae travelled into the hinterland difficult.

50 I am thankful to Sebastiano Tusa and his colleague Alba Mazza for this suggestion, and would recommend future studies in these vessels to investigate this aspect in detail as it has great potential for revealing further provenance and distribution data.

51 Also known as Peacock and Williams Class 6.

52 This fits with Carreté's description of Dressel 1 amphorae containing well-sorted subangular quartz grains normally under 0.40mm in size, together with small irregular pieces of cryptocrystalline limestone. It is also similar to Peacock and Williams' description of Pascual 1 amphora petrology with discrete grains of quartz and feldspar and flecks of mica. For more detail on the petrology of Dressel 1 amphorae see Carreté, Keay and Millet 1995; Keay and Williams

2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=324&CFID=69943&CFTOKEN=E529B207-F3D5-4627-A0DEF8CCF0B03EF6. For Pascual 1 amphorae, see Peacock and Williams 1986, 93-5; Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=268&CFID=69943&CFTOKEN=E529B207-F3D5-4627-A0DEF8CCF0B03EF6.

53 The other possibility is that this vessel could be attributed as a Dressel 1B amphora. The evidence weighs in favour of the Pascual attribution, however, as the 'grooved' handles are not present in known Dressel 1B examples and this style of rim is more common on Pascual 1 vessels along with the smoother shoulder carination and rounder profile.

54 Peacock and Willliams 1986, 93; Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=268&CFID=69943&CFTOKEN=E529B207-F3D5-4627-A0DEF8CCF0B03EF6.

55 Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=268&CFID=69943&CFTOKEN=E529B207-F3D5-4627-A0DEF8CCF0B03EF6.

56 Tchernia 1971, 52-4; Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=268&CFID=69943&CFTOKEN=E529B207-F3D5-4627-A0DEF8CCF0B03EF6.

57 Woolf 1992, 285.

58 Tchernia 1986; Trott and Tomalin 2003, 13.

59 The Pascual 1 vessel found at Saint Alban's Head Ledge in Dorset, England is a particularly well preserved example of this type, including a thick coating of pitch or resin inside. See Parham and Fitzpatrick 2013, 193.

60 Throckmorton (1987, 68) believes it was a "provincial derivative of the Dressel 1" type.

61 Woolf 1992, 287.

62 Tchernia 1986.

63 The importance of this route as a shortcut from the Mediterranean to the Atlantic (via the Bay of Biscay) should not be underestimated and this certainly assisted in the widespread distribution of Pascual 1 amphorae. Carreras also believes the Narbonne-Bordeaux route to have been closely linked to the distribution of Pascual 1 amphorae. See: Carreras' contribution, in: Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=268&CFID=69943&CFTOKEN=E529B207-F3D5-4627-A0DEF8CCF0B03EF6.

64 Also known as: Africana Piccolo/Ostia IV/Keay IV/Beltrán 57/ Peacock and Williams 33.

65 For further generalised description of this trait, see the University of Southampton's Amphora Project website: Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/index.cfm.

67 Gibbins 2001, 324-5. Williams and Carreras (1995, 246) add that quartz is also a frequent inclusion to fabrics from this type.

68 Gibbins 2001, 325.

69 Williams and Carreras 1995, 246-7. For a suggestion that Thanae is also represented on the stamps of Africana 1 amphorae from Ostia, see Taylor, Robinson and Gibbins 1997, 10.

70 Panella 1982, 171-186; Bonifay 2004; Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=1&CFID=573996&CFTOKEN=39545028.

71 It has been highlighted that North African fabrics in general are rather generic and poorly distinguished from each other: Gibbins 2001, 324; Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=1&CFID=573996&CFTOKEN=39545028.

72 Gibbins 2001, 'Abstract' & 326. For the archaeomagnetic study of Sullechtum and what the kiln site reveals in terms of its own dating, see Fouzai, Casa, Ouazaa and Alvarez 2012, 1872-74.

73 cf. Gibbins 2001, 326 for an example of using this technology in context.

74 Williams and Carreras 1995, 247; Keay and Williams 2005, http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/details.cfm?id=1&CFID=573996&CFTOKEN=39545028.

75 See CIL II, 1180 for a description of Sextus Julius Possessor being ordered to assess the productivity of Spanish and African oleoculture.

76 Hist. Aug., Severus, 18.3.

77 Gibbins 2001, 328.

78 For illustration and side by side comparison of Africana 1 and 2 amphorae, see Sciallano and Sibella 1994, "Amphore Africaine I" and "Amphore Africaine II".

79 Gibbins 2001, 315.

80 Gibbins 2001, 315. Although more recent scientific analyses are proving that resins were also used in oil containers, see Romanus et al. 2009, 901 & 905. For more on the topic of how resin was used in amphorae, see Heron and Pollard 1988, 429-46.

81 Gibbins 2001, 324 & 328.

82 See Muckelroy 1978, 73.

83 A more detailed and complete list would include: Rome, Ostia, Tarraco, Fos, Antibes, Marseille, Athens, and Knossos in the Mediterranean with Bishopsgate, London, Caerleon, and Clausentum in Roman Britain and Olisipo, La Coruña and Lanzada on the Atlantic coast of Spain. Finds in northern Europe are barely documented and this form seems to be rare that far north: Williams and Carreras 1995, 247.

84 It is known that the majority of olive oil imported into Roman Britain originated in either Spain or North Africa, with other oil imports evident as a clear minority: Williams and Carreras 1995, 232.

85 Gibbins 2001, 313.

86 See Gibbins 2001, 315,fig. 3.

87 Taylor, Robinson and Gibbins 1997, 10.

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Appendix 1: Measurements and Data

Appendix 1.1:
MU4639 – Mendean Amphora c. 370 B.C.E.

Maximum Height	85.0 cm
Maximum Circumference	118.0 cm
Handle to Handle (max.)	25.5 cm
Neck Length	19.5 cm
Toe Length	5.4 cm
Toe Diameter	6.0 cm
Mouth Diameter	9.5 cm
Rim Diameter	2.0 cm
Rim Height	2.5 cm
Weight (kg)	12.2
Approx. Volume (L)	19.0
Munsell Comparison	5YR 6/6 - 2.5YR 6/6

Appendix 1.2:
MU4666 – (Corinthian) 'B' Amphora/Graeco-Italic Intermediate Form c. 325-300 B.C.E.

Maximum Height	61.0 cm
Maximum Circumference	10.5 cm
Handle to Handle (max.)	22.5 cm
Neck Length	11.5 cm
Toe Length	5.8 cm
Toe Diameter	2.7 cm
Mouth Diameter	11.5 cm
Rim Diameter	16.4 cm
Rim Height	1.9 cm
Weight (kg)	9.1
Approx. Volume (L)	21.0
Munsell Comparison	5YR 7/4 - 5YR 7/6

Appendix 1.3:
MU4640 – Pascual 1 Amphora c. 50 B.C.E.– 80 C.E.

Maximum Height	104.0 cm
Maximum Circumference	99.0 cm
Handle to Handle (max.)	22.0 cm
Neck Length	28.5 cm
Toe Length	11.5 cm
Toe Diameter	6.5 cm
Mouth Diameter	13.0 cm
Rim Diameter	2.0 cm
Rim Height	10.0 cm
Weight (kg)	18.5
Approx. Volume (L)	26.0
Munsell Comparison	5YR 8/4 - 5YR 8/2

Appendix 1.4:
MU4616 – Africana 1 Amphora c. 180-380 C.E.

Maximum Height	106.0 cm
Maximum Circumference	93.0 cm
Handle to Handle (max.)	20.0 cm
Neck Length	8.0 cm
Toe Length	8.5 cm
Toe Diameter	2.0 cm
Mouth Diameter	11.0 cm
Rim Diameter	1.5 cm
Rim Height	4.5 cm
Weight (kg)	11.1
Approx. Volume (L)	37.0
Munsell Comparison	10R 4/3