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## **A Lost Cargo: An Archaeological Study of Amphorae of a Late Roman Merchant Ship in the Western Black Sea**

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### **Abstract:**

This paper discusses the remains of a ceramic assemblage associated with the cargo of a Late Roman trading vessel, discovered by the Black Sea Maritime Archaeology Project (BSMAP) in 2017. Dating from the early 4th century AD, this previously undisturbed wreck is arguably the most comprehensive assemblage of a Late Roman trading vessel yet discovered outside of the Mediterranean. Through comparative analysis of 81 amphorae in the forward section of the wreck, this paper aims to draw further understanding of the maritime trade systems that operated between the major seas of the Eastern Roman empire.

### **Key words:**

Shipwreck, Black Sea, Underwater Cultural Heritage (UCH), Amphora, Late Roman, Trade, Exchange

### **Introduction**

Between 2015 and 2017, the Black Sea Maritime Archaeology Project (BSMAP) identified and recorded 65 shipwreck sites within the Bulgarian Exclusive Economic Zone (EEZ), each with the potential to make a significant contribution to our understanding of the Black Sea's maritime history (Pacheco-Ruiz, *et al.*, 2019). Building upon current work by members of the BSMAP team at the University of Southampton, this paper examines the ceramic cargo of a previously unknown wreck, discovered in 2017. It was found in deep waters west of the small coastal town of Sinemorets

(Синеморец) in southern Bulgaria and is designated as ‘BSMAP\_2017\_WRECK\_008’, or ‘Sinemorets A’. The wreck presents a unique opportunity to analyse the remains of a trading vessel from late antiquity and add to a growing body of literature regarding the modes of trade undertaken during the later Roman period (284-641 AD). Though the remains of the vessel are extensive, this paper focuses its analysis on the ceramic cargo found in the north of the site to evaluate our current understanding of maritime commercial systems operating within the Black Sea during late antiquity.

The remains of Sinemorets A were investigated with the use of two remotely operated vehicles (ROVs) deployed with state-of-the-art deep-water survey equipment and camera systems, specially developed for the BSMAP’s survey of underwater cultural heritage (UCH) in the Bulgarian EEZ (Pacheco-Ruiz, *et al.*, 2019). A small amount of material was recovered from the wreck site, including timber samples and a number of amphorae. However, due to the restrictions related to the Covid-19 pandemic, these physical materials were not made available for this research. As such, the methodology of the project is entirely digital, focussing on the high-resolution multi-source photogrammetric modelling of the deep-water site. This computer-based approach tested the reliability of collected data and showed the research potential of such a multi-dimensional digital archive. Radiocarbon dating was undertaken on the wood samples extracted in 2017 (courtesy of Grant, M.J., COARS, University of Southampton), which dated the construction of the vessel to around 330 AD, a time coinciding with the establishment of *Nova Roma* (New Rome) at Byzantium. As such, this 1700-year-old wreck offers a unique opportunity to expand our current understanding of maritime trade and transport between *Mare Nostrum* (the Mediterranean Sea) and *Euxeinos Pontos* (the Black Sea), in the period immediately following the Roman Tetrarchy (or “rule of four”) in 293 AD, which effectively split the empire in two.

Scholars of seafaring in Late Antiquity often emphasize the impact of the economic, religious, and geo-political divisions of the Roman Empire, promoting the 4th century as the start of a transitional phase in maritime technology that arose due to an apparent change in the modes of trade as the centres and demands of commerce shifted (Ginalis, 2017: 199; Steffy, 1994). This paper reviews this assertion, using Sinemorets A as a case study with which to interrogate our understanding of trading modes and networks of exchange in this period, showing that it belonged to an emergent system of state and private trade working symbiotically in operations through the Bosphorus. In doing so, it asks how Sinemorets A aligns with our current understanding of maritime transport and exchange in the late Roman world.

By focusing on the visible remains of 81 amphorae, investigation of the ‘lost cargo’ of this apparent merchant vessel is undertaken. Features of their typology are extrapolated from digitised replication, including their form, likely place of origin, and contents, analysed with the use of high-resolution multi-source photogrammetry modelling. The association of the apparently homologous collection of ceramics as artefacts of exchange, enables reconstruction of part of the original manifest of the ship. However, it also leads to further questions regarding the contents of the cargo, understanding the remains of amphorae to represent only a part of the commercial product being transported by the ship on its final voyage.

## Background

### *A Roman Black Sea?*

The establishment of Nova Roma at the mouth of the Bosphorus in 330 AD marked the relinquishment of Mediterranean as the *Mare Nostrum* ('Our Sea') of the Roman empire. Instead, the new imperial seat sat on the shore of a sea once regarded as *Axine* ('inhospitable') and barbaric (Strabo, 7.3.6). The Black Sea became more than the marginalised 'backwater' of the Roman Empire as it was earlier regarded in the classical texts (Doonan, 2010: 69). It was now looked upon as the *Pontis Euxinus* (the 'hospitable sea'). This marked change in the ancient literature reflected a distinct shift in attitudes as the experience of nominally Mediterranean merchants and seafarers expanded, establishing and frequenting new routes of trade by transporting products from port to port along these routes, taking 'ownership' of this eastern maritime space.

Nevertheless, even at the height of Roman power, the Black Sea never became a 'Roman Lake' like the Mediterranean. The Black Sea was arguably a 'hospitable sea' in name only; its changeable environment and seemingly unchangeable people remained 'barbaric', unwilling to reform in the ways of their western counterparts (Bekker-Nielson, 2006: 9). Resistance to the *Romanisierung* ('Romanisation') by people living on the lands of the Northern and Western shorelines formed one of the largest and longest-running military frontiers in European history. The river Danube formed a natural borderland to which Roman troops were regularly committed to defend (Bekker-Nielson, 2006: 9-10), most notably in the third and fourth centuries against invading northern Germanic tribes, principally the Goths. In this context, expansion of maritime commerce into the northern regions of the Black Sea was not undertaken to find untapped trading partners or new exotic products, but as a function of military supply, fuelling a political and cultural invasion of the lands surrounding the Black Sea.

Analysis of the Sinemorets A wreck is therefore undertaken with an understanding of its connection to the militarisation of the region. It is posited that the wrecked remains of vessels undertaking voyages through the maritime transport corridor in the fourth century, connecting the Danube frontier with the rest of Roman world, would likely be found at depths off the coast of modern-day Bulgaria. The locality of the Sinemorets A wreck thus offers significant potential. As a vessel of the early 4th century AD, its voyage was likely undertaken in relation to the 'restoration' of the *Donaulimes Moesiae* (Danubian Limes); defences that stretched approximately 4000km along the Danube frontier and were reinforced with the construction of the 'Constantine Wall' and several other major fortifications (Poulter, 2010: Wachter, 2013: 189). As such, there was demand for a regular and reliable supply of bulk products to support the militarisation of this area and provision the large number of soldiers garrisoned south of the Danube. It has been suggested that there could have been as many as 6000 to 15,000 troops stationed at forts such as Dobrudja, on the northernmost coast of modern-day Bulgaria (Petculescu, 2006: 32). Could products from Sinemorets A have been destined to supply one of these military stations?

### *Mechanisms of exchange between the Black Sea and the Mediterranean*

A growing body of evidence and literature supports the development of a 'quaestor corridor' of seaborne trade that enabled the supply of agricultural products from the eastern Mediterranean to the frontier regions of the Eastern Roman Empire in the early 4th century AD (Brennan *et al.*, 2020). The Black Sea as a maritime space was rapidly growing in importance in this period, chiefly by enabling

the growth of trade and mobility following the division of Rome in 286 AD. It was therefore pivotal as a space in which new mechanisms and modes of trade could develop (Hiebert, *et al.*, 2001). However, there is little archaeological evidence to support this based on the known sites in the eastern Mediterranean. Thus, we have only a partial image of the mechanisms of trade and exchange during this transitional period in the maritime history of late antiquity. However, as posited by Brennan *et al.*, (2019: 291), what materials we have accessed shows a complex interlinked and overlapping network of trade between the fourth to seventh centuries AD within the eastern Mediterranean and Aegean. What form and relationship this complex system took on the eastern side of the Bosphorus requires further research and interrogation of the material remains of trade, namely the vessels that undertook commercial voyages and the products they contained.

One key system of state organised trade was that of *Annona Militaris*, the state supply of grain from secure reliable localities to military infrastructures on the eastern boarder of the empire. This system formed part of the networks hypothesised to be in intense operation between the Aegean-Black Sea maritime corridor by Brennan *et al* (2019). However, despite it being a vital ‘backbone of later Roman shipping’, no wreck has been conclusively identified in association with *Annona*: a phenomenon termed the ‘annona paradox’ by McCormic (2012: 96, Brennan, *et al.*, 2020: 291-2). This may be due to certain types of bulk cargo being transported without the need for ceramic storage jars, thus leaving no trace in the underwater archaeological record. However, in the historical literature it can only be seen as a formalised system of trade in 536AD, following the creation of the administrative district *quaestura exercitus* by the emperor Justinian. Prior to this, the modes of trade enabling the bulk supply agricultural products are not well understood (Brennan, *et al.*,2020: 291).

The recently identified ‘quaestor corridor’ is based on evidence from at least 49 ancient and pre-modern shipwrecks in the northeast Mediterranean and Southern Aegean associated with the remains of products found on the coast of the north-western Black Sea, a possible artefactual record of Late Roman commercial networks that integrated with the *Annona* system (Brennan, *et al.*,2020: 321). Sinemorets A bolsters the argument for this proposed corridor by adding further evidence for a maritime supply route between the eastern Mediterranean and the southern Danube. However, it is the only contemporary shipwreck from east of the new Roman capital at Constantinople. Terrestrial archaeology has established the emergent presence of Late Roman Amphorae (LRA) types 1 and 2 from sites such as Kos and Rhodes, appearing in early 4th century contexts at Danubian forts (Brennan, *et al.*,2020: 322; Pieri, 2012: 32-34). This research thus supports the proposal that with the transfer of political power to Constantinople in 330 AD, a new epicentre of trade and commerce was formed that linked the major maritime basins of southern Europe.

### **The wrecked assemblage**

The wreck assemblage of ‘BSMAP\_2017\_WRECK\_008’, or ‘Sinemorets A’ provides a comprehensive record of a substantially sized mercantile vessel operating in the early to mid-4th century AD. Secure dating was obtained through radiocarbon analysis of wood samples extracted in 2017, established using Bayesian statistical modelling by Dr Michael J. Grant at the University of Southampton. However, this was the only material analysis able to be undertaken prior to this research. Grant’s work has enabled this vessel to be interpreted in line with a narrow historic period within which it is proposed to have operated. The Maximum Construction Date (MCD: *terminus post quem*)

estimates are shown to be between 260-470 cal. AD at a 95.4% probability (Grant, forthcoming). A complete report of the radiocarbon dating of all wrecks investigated across all seasons of the BSMAP's expeditions is forthcoming.

The area of investigation is well defined with the remains of the vessel orientated in a north-easterly direction, with structural elements of the hull clearly visible on the seabed (see Figure 1). The wreck site rests within a slightly raised bar of sedimentary material that is elevated at the centre of the hull and falls away towards the bow and stern, exposing the ends of the wreck at a greater depth. Bathymetry shows there is a round one metre variation in the depth of sediment covering the site and a relatively light covering of sediment in the area of this investigation, at the northerly end of the bow. No sedimentary materials were extracted, with only a minimally intrusive investigation carried out by the BSMAP in their extrapolation of data.

The remains of the vessel sit approximately upright on the remnants of its keel, which is only distinctly visible at the stern to the south-west of the site. Parallel aligned vertical timber framings at least 10m in width are exposed, defining the hull as if it were a 'rib-cage'. The remaining length of the vessel shows it to have been of substantial size. Approximately 24m in length, its dimensions and characteristics meet with the historic description of sizable private vessels that undertook state contracted grain supply through the *Annona* system during this period. The dimensions of the visible hull are also comparable to those of known vessels that are also hypothesised to have undertaken such voyages in the 4th century AD, such as Yassi Aba B and Marmaris B wrecks (Ginalis, 2017: 201-202).

The principal area of investigation of this research is found at the northerly bow section of the site, where at least 81 ceramic vessels were observed. While the nature of the vessel's construction, the remains of rigging and other functions of structure related to seafaring are beyond the scope of this paper, they will nevertheless be forthcoming in future publications of the BSMAP.

The structure of the bow has been partially removed during an unknown post-depositional event, however, what remains is a comprehensive assemblage of both the vessel's construction and onboard artefacts. There is little substantial damage and the area effected is relatively short when estimating length lost. Two layers of decking can be seen fore-and-aft, protruding at the damaged bow end. The upper-most layer of planking appears to extend to a large beam that segments the front section of the vessel from the mid-ship. This area appears as a clearly defined, compartmentalised area of stowage.

The relative shallowness of the sediment here also offers a useful comparison between the ceramic and wooden remains, especially in terms of understanding the stowage pattern. Among the 81 amphorae, a clear lineal pattern of six to eight rows can be, with areas of slightly greater sedimentation holding the jars in position. Here, particularly in the west of this area, there is evidence for the use of interlocked stacking, with the rims of further ceramics exposed at depths that align with the lower body of higher, more exposed amphorae. This was not unexpected but rather in keeping with the common traditions of the Roman period, the amphorae being designed in such a way to stack and maximise space (Twede, 2002: 101). However, this pattern of stacking was not continuous, and those further towards the bow of the vessel show no stacking from above or below, possibly reflecting the curved angle of the hull and subsequent reduction of space.

## Ceramic Investigation

The primary aim of this research was to establish the typology and thus origin and likely contents of the 81 ceramic vessels found in the fore section of the Sinemorets A. Following a detailed investigation of this apparently homologous ceramic assemblage, 13 amphorae were identified to be intact, 52 only partly visible, and a further 16 with significant damage. Meaningful data was still extracted from the broken vessels, enabling the precise digital extrapolation of features such as shard thickness. Eighty-one percent of the partially visible amphorae were also able to produce meaningful data regarding their physical characteristics, which helped to identify whether the assemblage is homologous.

Of the 65 amphorae contributing data to this question of identity, all appear to be uniform in type and are coherent in their dimensions and general physical attributes. These large two-handled amphorae, with a suggested average capacity of c.28 litres, are described as ‘lemon-shaped’, with ovoid bodies that come to a point at the base. Their necks are short and cylindrical with small, rounded handles attached to a rounded shoulder. They lack any notable decoration or marking other than a light ribbing pattern on the outer surface of the body, which suggests they are wheel-thrown in construction. Their description is typical of the ergonomic design of ceramic containers of late antiquity, associated with the bulk transport of products such as oil or wine.

Pottery, as one of the most common archaeological materials recovered from excavation, is of seminal importance to our understanding of antiquity, both terrestrially and from a maritime perspective. Without tangible access to the Sinemorets A assemblage, a petrological analysis of the amphorae has not been possible. A morphological analysis, however, undertaken in reference to the Standards of Pottery Studies (Barclay, *et al.*, 2016), has established a significant association with specific manufacturing traditions and points of geographic origin. Physical attributes of each of the 65 amphorae in the study, as well as more detailed case study analysis of individual ceramics within this data set, have been compared with records kept within the Archaeological Data Service (ADS) using information from the Amphorae Project (2005-2014).

Anticipating no strict uniformity in dimensions due to the handmade nature of manufacture, it was noted there are slight variations in the recorded measurements of each vessel’s body, shoulder, rim, neck, handle, and base. However, using standard deviation, the analysis confirmed that the collection is not only most probably of a single typological set but also from a single niche manufacturing area. A large and reliable data set was extrapolated from the multi-source high-resolution photogrammetry model created of the wreck site for this investigation; with a negligible 1.5% error margin. With an ‘average’ amphora able to be demonstrated through the calculation of collected values (as shown in Table 1), it was evident in case study analysis of individual amphorae that subtle variations and features were potentially significant. Being able to generate information and analyses beyond the establishment of an average from which to draw comparison with the ADS records is testament to the quality of data initially retrieved by the BSMAP team.

Amphora A-007 was one such significant case study (see Figure 2). Located in relative isolation from the rest of the assemblage, it was found lying on its side in the centre north of the area, associated with visible wooden planking due to the very shallow layer of sedimentary material in this area of the wreck site. It is not likely to be in its original orientation or locus of stowage. Undamaged, it was one of the best single examples for the digital extrapolation of data. Sitting on its body in an area shown by bathymetry to be approximately level, there was a clear view of both neck and base and the overall

shape of the vessel. However, there was also some slight pitching towards the neck and handles, suggesting a significant bagging and distention in the shape of the lower half of its body. This was made further evident by the isolation of the vessel within dense cloud modelling. Its general characteristics were typical of all others but with some notable characteristics of trend. The clarity in the basal point in the model and raw image showed it to be a shorter, stubbier example; perhaps showing greater repeated use or the characteristic style of an individual potter. A-007 was also larger in length and width than the average (see Table 2), a trend shared with A-002 and others found towards the most northerly part of the wreck site. It hints towards a potential factor of stowage tradition whereby slightly larger amphorae were loaded and placed into cargo section first, towards the bow. It is interesting to note, however, that there was no correlation between basal point and locality or the basal point and potential volume.

The two features of interest first noted A-007 as the initial artefact of case study have proved to be of potential significance in the establishment of a typology for the collective set of amphorae associated with the cargo of Sinemorets A. Examples of Late Roman Amphorae 1 (LRA1) in archive collections provide a good comparison for features such as handles, neck shape and shoulders for the Sinemorets A ceramic cargo. However, it is notable that the artifacts from this Black Sea wreckage do not present the same body form or volumetric potential as LRA1 examples in the ADS catalogue (Fulford and Peacock, 1984), which are slightly less bulbous in shape and have a less well-defined basal point than the Late Roman examples of this study. However, the potential lineage, shared cultural tradition and geographical origin warranted further investigation. The comparison confirmed a Late Roman period of origin and a likely Mediterranean or Aegean source.

Through analysis and investigation of the morphological form of the Sinemorets A amphorae, a preliminary classification for the homologous assemblage has been defined using the work of Andrei Opaïț (1991, 1996, 2004, 2014). His work proposed a typological grouping of so-called ‘bagging’ amphorae, an evolution from a cylindrical or ovular body to more rounded and distended forms in the lower body, provisionally dated to the 4th and 5th centuries AD (Opaïț, 2014: 443). The ‘Opaïț C1’ form bears close resemblance to those found in the cargo of the Sinemorets A wreck, having a well-defined rounded rim set on a cylindrical neck, short, rounded handles and an elliptical body that widens into a ‘bag’ shape before coming to a short, spiked base (See ADS.ac.uk; Opaïț, 1991; Papadopoulos, 1989: 98-100). Such a closely resembling written description is only hampered by the range in dimension sizes, of which the average width of the Sinemorets A’s amphorae (34.6cm) sits well within the range for the ‘Opaïț C1’ type, as recorded within the ADS system, but with examples from within the data sitting below the range in length (Opaïț, 1991). If this typology is correctly applied, then this collection would represent a significantly smaller variation. There are several closely resembling typologies that are linked to Opaïț’s work and can be seen within distinctions of Late Roman forms.

There are three subtypes set out by Opaïț, with the earliest corresponding to the early to mid-4th century AD, based on archaeological findings from the south coast of Anatolia (modern Turkey) (see Opaïț, 1991; Hayes, 1991: 91). However not one of the three subtypes is directly comparable to Sinemorets A’s amphorae, differing in either dimension or attribute such as an elongated neck or period of origin. Comparison with typological examples within Opaïț’s classification and with other comparable forms, such as Dressel 24 and Dressel 6B and that of early Samos-type cisterns such as Agora M273, shows a likelihood of a shared tradition and common evolution. That these forms share a close common geographic distribution suggests the amphorae of Sinemorets A originated in the southern Aegean or western Anatolia. A region Opaïț (2014) identifies changing evolutionary trends

in Late Roman Amphora types, including the transition from a ‘barrel’ to a ‘baggy’ or ‘pear’ shaped body, which developed in the ceramic traditions of the west coast of Asia Minor, the Levant, and the Aegean islands.

Furthermore, in his 2014 paper, Opait proposes a ‘Phamphylian’ type (after Grace, 1973) as the third of the ‘bagging form’ subtype variants. This form arguably bares the greatest resemblance to the Sinemorets A examples. Its characteristics broadly fit with the ‘C1’ and ‘C2’ types, specifically a short cylindrical neck and ovoid body covered in wheel-ribbings, looped-handles, thin walls, and ending in a short conical spike (Grace, 1973; Opait, 2014: 443). These characteristics are represented within the cargo of Sinemorets A and bare close resemblance to Agora M273, including examples from Yassi Ada and other Samos cistern types, cautiously placing the manufacturing area of the Sinemorets A amphorae to the islands in the south Aegean.

From the ‘type 3’ examples found in 4th century contexts at Pegasai, the dimensions of this classification can be shown to closely match that of the Sinemorets A assemblage (Opait, 2014:442-443). Being 66cm in height, 33.5cm in maximum diameter, and with a rim 10.5cm in width, it closely resembles larger examples found near the bow section of the Sinemorets wreck, such as such as A-007 (Opait, 2014: 442-443). The appearance of ribbing, conical toe, and the curvature and position of the handles present a highly comparable example without any notable divergence from the morphological analysis of the wreck’s ceramic cargo. In comparison with Opait’s ‘C’-types, the shape of the basal point is much closer to this example and the size range is a closer fit.

## Discussion

The implication of establishing a likely typology has shown a further need for greater differentiation and academic discourse in our understanding of ceramic production in the early 4th century AD. This will require building upon Opait’s work to infer further variations in traditional production techniques in line with changing trade routes during this period of political, cultural, and economic fluctuation. It is interesting to note that there appears to be no standardisation within proposed typologies of ‘bagging’ forms, but there is clear distinction from the more canonical body-shapes traditionally assigned to LRA1 types (Opait, 2014: 444). Opait hypothesises that these bagging forms can be associated closer to less standardised modes of trade; the morphology of ceramic reflecting a less formal operation (Opait, 2014: 444). If considered a representative of informal private trade, nominally the trade of wine from more exclusive locations in the Levant or Aegean islands, the locality and volume of amphorae aboard the Sinemorets A vessel may be explained. Stored in the otherwise unused cargo space at the front of the vessel, this area could have been used for the private economic gain of the captain and crew, with the amphorae representing a ‘piggyback’ trade operating through the ‘quaestor corridor’ during the early 4th century AD (Brennan *et al.*, 2020).

With a speculative typology of a Phamphylian C subtype and the reported presence of resin (cf. Pinaceae tar) on the interior of one of the recovered amphorae from the wreck, it is likely that these jars were used for the storage of a liquid product, with wine being the major commercial product exported from the eastern Mediterranean in this period (Opait, 1996: 210, 2014: 443). It’s renowned quality and perilous transport matched with its desirability, resulting in its high commercial value throughout antiquity (Pieri, 2012: 36, 39-40). Thus, the amphorae in this study were used for the



transport of high-quality wine, representing a lucrative revenue for those individuals partaking in it as a supplementary source of income.

To calculate the potential volume of product carried in this apparent ‘piggyback’ operation, there was probably no more than 130 amphorae in total stored in the fore section of the Sinemorets A vessel, based on the stowage pattern evident in the archaeological record of the site. This number of amphorae cannot be considered as a bulk cargo, especially when compared to other Late Roman deep-water wreck sites such as Knidos A or Marmaris B in the eastern Mediterranean, where the remains of hundreds of amphorae, of multiple typologies and in greater numbers, is more standard (Brennan, *et al.*, 2020).

Considering then the relationship between these amphorae and the designated space aboard they appear to hold, the ceramics account for less than 20 percent of the potential carrying capacity for the vessel, the apparently void mid-ship section being over 1.5x larger yet appearing empty. This leads to further questions of Sinemorets A’s ‘lost cargo’ and our understanding that the products must account for but a fraction of the cargo’s manifesto, even if it may not be onboard in a wholly official capacity.

## Conclusion

The significance of the Sinemorets A wreck, as an article of evidence for maritime trade between the Mediterranean and the Black Sea during the re-establishment of Roman imperial power in the East, has been demonstrated through this paper. Following examination of its lost cargo, in both a literal sense of the observable lost remains and also in the theoretical speculation of the vessel’s bulk cargo on its final voyage, consideration of the trading routes and modes being undertaken between both major maritime basins has been evaluated.

With the dimensions and characteristics of the Sinemorets A wreck meeting the description of sizable commercial vessels undertaking transport of state grain supplies between Roman imperial territories, it is possible to hypothesise that the further 80 percent of potential storage space, not represented by the homologous collection of amphorae in the fore section, was filled with an agricultural product or products. The ceramic assemblage may therefore represent the ‘piggybacking’ of the *Annona* system. With the re-centralisation of trade supplies following the founding of the Eastern Roman Empire, enterprising merchants harnessing and profiteering from the need to pass through or harbour in the southern Aegean saw an opportunity and took it. However, it is notable that this vessel passed through Constantinople, not depositing its cargo at the new capital but seemingly taking it to the destination of its agricultural supply. The rarity of good quality wine perhaps fetching a greater price in the less saturated markets of the Danube frontier.

Further research and analysis of wreck sites in the maritime corridor between the Mediterranean and the Black Sea, particularly in the straits associated with the Bosphorus, may provide a more comprehensive picture of trading modes and the regularity with which ‘piggybacked’ voyages took place. This study therefore offers new evidence and potential future avenues of research in the study of maritime trade and exchange in the early Eastern Roman empire.

Furthermore, this study has shown the potential for digital research in maritime archaeology, most notably the value of remote study and the acquisition of high-quality original data from a deep-water wreck site. As an approach to the study of underwater cultural heritage and in the deployment of digital humanities techniques, the interpretation of this site, in line with its historic and geographical context, has been best achieved by using the data accessible for study. The ability to conduct research in such a way owes to the state-of-the-art technology deployed in the Bulgarian EEZ by the BSMAP and its commercial partners in 2017, as they set a new standard for the investigation of deep-water wreck sites (Pacheco-Ruiz, *et al.*, 2019).

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**Figures with Captions:**

Figure 1)

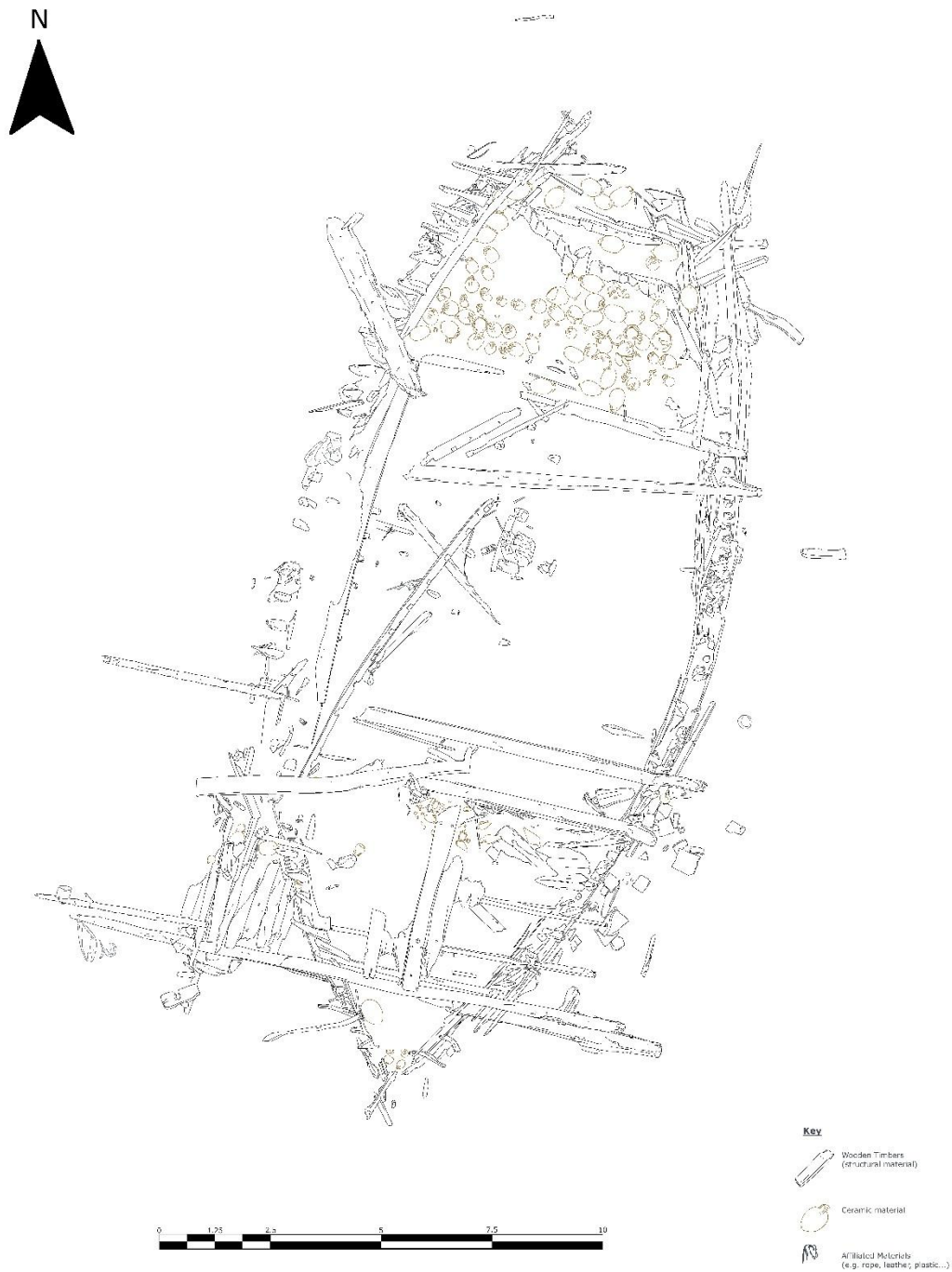


Figure 1) Illustrated site plan of Sinemorets A (BSMAP\_2017\_WRECK\_008) derived from multi-source photogrammetry model, produced from photographic and laser-scan data retrieved in 2017. (BSMAP).

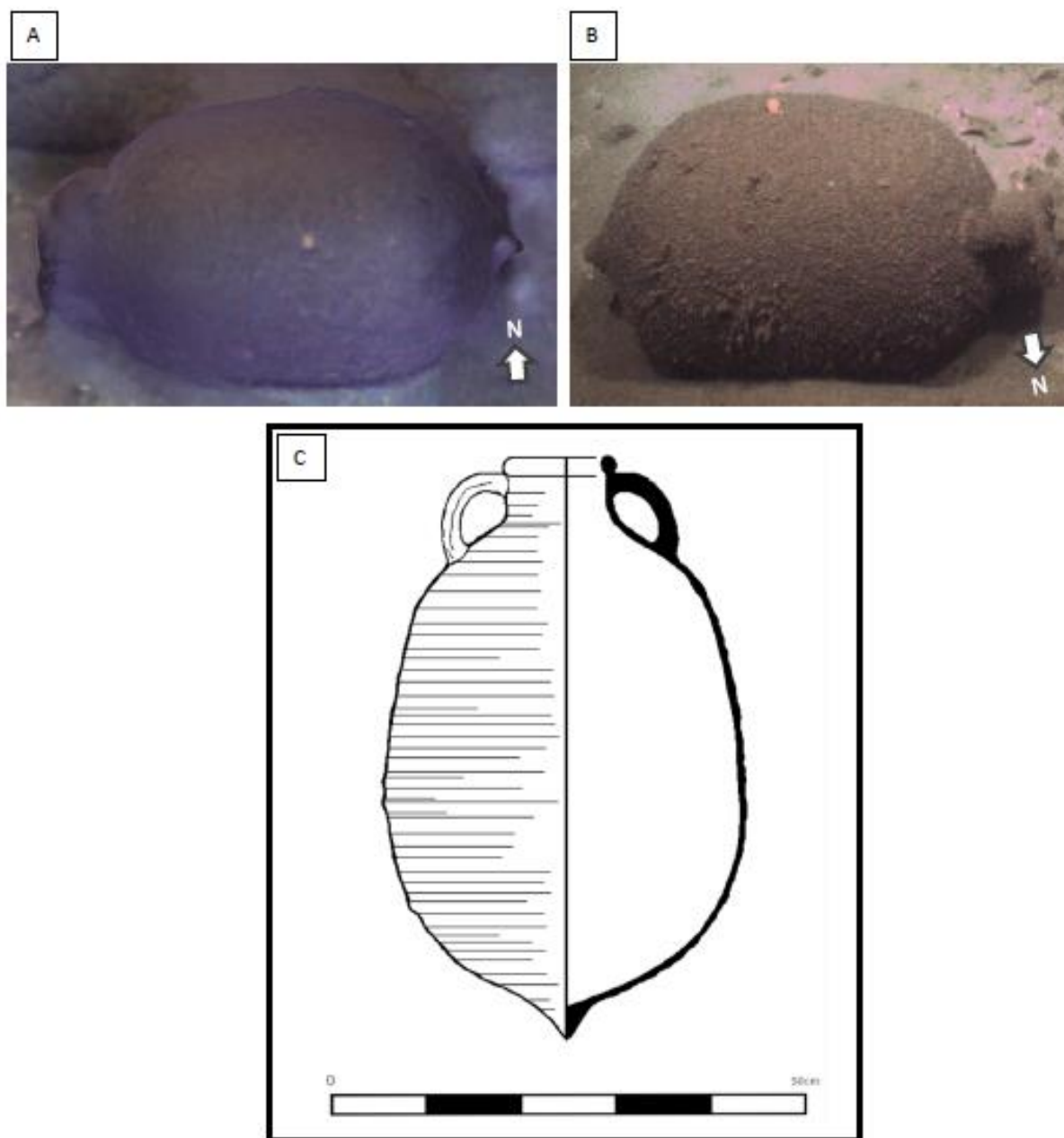


Figure 2) Amphorae A-007 of Sinemorets A wreck (BSMAP\_2017\_WRECK\_008). 2.a – North facing image of A-007 within photogrammetric model, 2.b – Southerly facing Photographic image of A-007 taken by ROV in 2017, 2.c -Scaled illustration of A-007. (BSMAP).

**Tables:**

Attribute	Average Measurement		Description
Rim	External diameter	12.5 (cm)	Gently Rounded - softly defined thick band
	Internal diameter	9.1 (cm)	
	Rim thickness	1.9 (cm)	
Shoulder	N/A		Rounded - noticeably present, supporting handles, no ridge
Handle	Width	4.0 (cm)	Curved, oval in section - from neck to shoulder
	Height	8.2 (cm)	
	Projection	4.9 (cm)	
Neck	Width	12.4 (cm)	Cylindrical
	Height	7.5 (cm)	
Body	Width	34.6 (cm)	Ovoid/ elliptical – slightly distended bottom
Base	Length	6.0 (cm)	Pointed - brought to a conical point
	Width	4.7 (cm)	
Overall length		60.0 (cm)	Recorded range between c.45 – 65 cm
Volume (external)	(approx.)	37 (L)	-
Internal Capacity	(approx.)	28 (L)	-
Weight	N/A		N/A
Fabric	N/A		N/A

Table 1) Average measurements and description of observed amphorae within the photogrammetric modelling of Sinemorets A (BSMAP\_2017\_WRECK-0008). (D. Turnbull)

Artefact Number	Length (cm)	Max Width (cm)	Neck (cm)		Rim diameter (cm)		Edge Width (cm)		Handle '1' (cm)			Handle '2' (cm)			Base Point (cm)	
			Height	Width	Ext	Int	Rim	Frag	Width	Height	Proj	Width	Height	Proj	Length	Width
A-007 (Amphora)	61.0	37.2	7.4	11.7	11.3	9.1	1.8	n/a	4.8	7.4	4.3	3.5	N/A	N/A	4.9	4.2

Table 2) Measurements of the observable characteristics of the ceramic vessel designated A (Amphora)-007 of the Sinemorets A wreck (BSMAP-2017\_WRECK\_008). (D. Turnbull)