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A Byzantine Shipwreck from Cape Stoba, Mljet, Croatia: an interim report

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The Cape Stoba shipwreck is located on the seabed off the island of Mljet in Croatia at a depth of 21–28 m. Following initial investigation in 1975, four seasons of excavation have been carried between 2010 and 2014 by the Department for Underwater Archaeology of the Croatian Conservation Institute, joined by the Department of Studi Umanistici of the Università Ca' Foscari of Venice from 2012. The wreck-site is evidenced by a cargo of nine amphora types dated to the 10th-11th century AD, produced in the Eastern Mediterranean and Black Sea area, and glassware of Levantine production. The only direct evidence of the ship itself to date, is one iron anchor.

Key words: Amphora graffiti, Byzantine amphora, Byzantine shipwreck, glass, wooden stopper, 3D site model.

The Cape Stoba shipwreck is located on the seabed off the island of Mljet in Croatia, about 35 km north-west of Dubrovnik (Fig. 1). The site lies on a rocky slope, close to the cape, from a depth of 9 m to a depth of 21–28 m. Below 21 m, the seabed becomes sandy and is covered by a thick layer of *Poseidonia Oceanica* roots (Figs 2 and 3).

The site was apparently discovered by sport divers in the 1960s, at which point amphoras and other valuable material started to be removed (Kisić, 1988: 158–62). It was reported to the authorities, and the first archaeological survey and surface collection was carried out in 1975 by the Institute for Protection of Cultural Monuments and the Maritime Museum in Dubrovnik, under the direction of Josip Luetić, Zdenko Brusić and Anica Kisić. As, according to information received from the looters, more than 30 amphoras had previously been removed and most of the remaining material was in fragments, archaeologists concluded that the site had been almost completely destroyed. Based on the material recovered, the amphoras that had previously been removed from the site and held in a private collection, and other known amphoras of the same period, Brusić was able to classify the Byzantine amphoras found in the eastern Adriatic in five groups (1976: 37–49).

A short inspection of the site was carried out in 2009 by the Department for Underwater Archaeology of the Croatian Conservation Institute, during which a whole amphora sealed with a wooden stopper was uncovered, signalling the existence of at least one intact layer of archaeological material at the site. Thanks to the support of the Ministry of Culture of the Republic of Croatia, a new campaign started in the 2010. Three test trenches, 4 m² each, were excavated in the sandy plateau beside an iron anchor. In the trenches seven whole amphoras were found beneath a thick layer of sand at a depth of 24 m. Furthermore, two small amphoras were found without stoppers, several amphora fragments, and one round ceramic flask were found in the surface

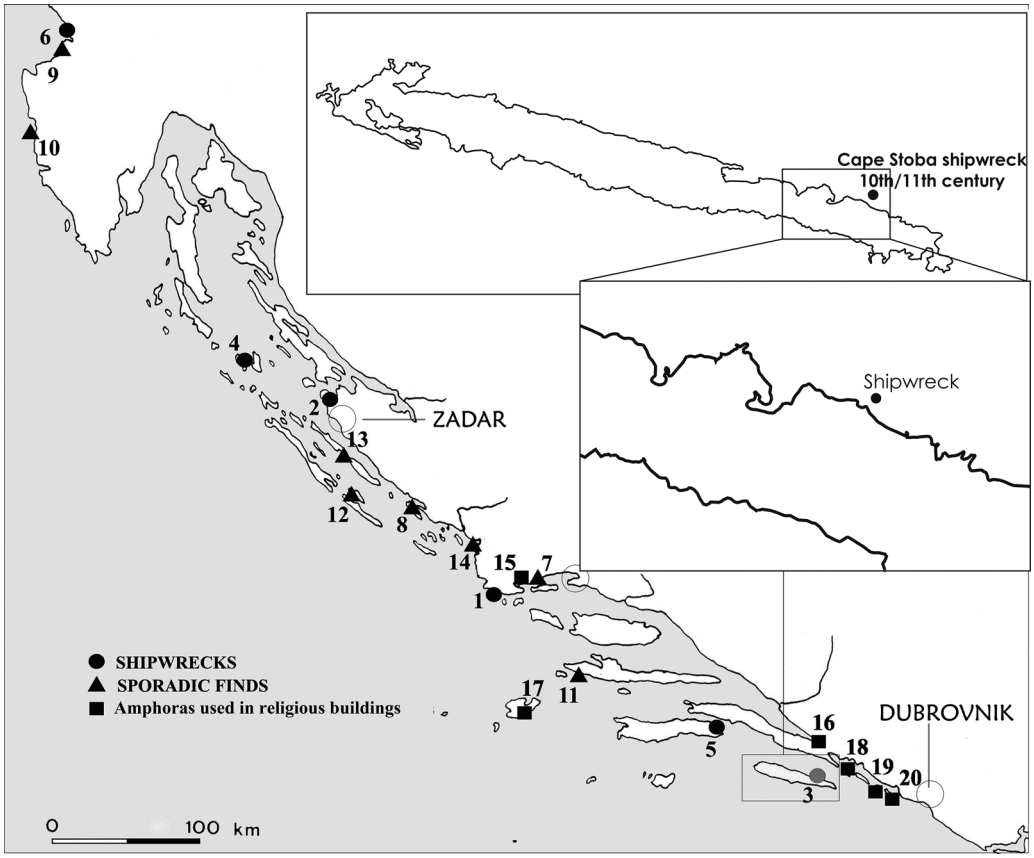

Figure 1. Underwater sites with Byzantine amphoras in the eastern Adriatic: 1. Merara islet 13th/14th c.; 2. Ždrijac near Nin 11th/12th c.; 3. Cape Stoba, island of Mljet 10th/11th c.; 4. Grebeni near island of Silba 13th/14th c.; 5. Lučnjak shallows 13th/14th c.; 6. Bay of Pijan, Savudrija 11th/12th c.; 7. Port of Trogir; 8. Island of Vele Arte near Murter; 9. Umag; 10. Poreč; 11. Port of Hvar; 12. Island of Žut; 13. Island of Ošljak near Zadar; 14. in the monastery collection on the island of Krapanj; 15. Church of St Barbara in Trogir; 16. Church of St Michael near Ston; 17. Church of St George on the island of Vis; 18. Church of St John the Baptist on Lopud; 19. Church of St Nicholas on Koločep; 20. Church of St John on Šipan. (V. Zmaić Kralj)

Figure 2. The amphora cargo from the Cape Stoba shipwreck at the bottom of the slope. (Photo: J. Kwiatkowski)

layer outside the trenches. During the 2010 campaign a total of 20 amphoras were found, nine of which were whole (Zmaić, 2015: 1043).

In 2011, the search was extended towards the northern part of the site, at a depth of 25–28 m. A 2×2 m grid of 12 squares (48 m²) was set up across a thick layer of amphoras. The depth of the surface layer, which consisted of interwoven roots of *Poseidonia* and sand, varied between 0.10 and 0.30 m. The second layer, 0.50–0.80 m thick, was composed of dark sand and the remains of amphoras and fragments of glassware. A total of 22 whole and partially preserved amphoras were found within the layer (Zmaić, 2012: 473).

Research continued in 2012, in collaboration with the Department of Studi Umanistici of the Università Ca' Foscari of Venezia. The sandy seabed around the shipwreck area slopes down to the north, making the northern part of the site about 3 m deeper than the southern part. A grid was set up on two levels, at depths of 25 m and 29 m. Another 48 amphoras were documented and extracted along with numerous glass fragments (Fig. 4).

Documentation

Since the site presents high visibility and a high homogeneity of objects—mainly amphoras—the

Figure 3. Details of multiple layers of amphoras on the Cape Stoba shipwreck. (Photo: D. Della Libera)

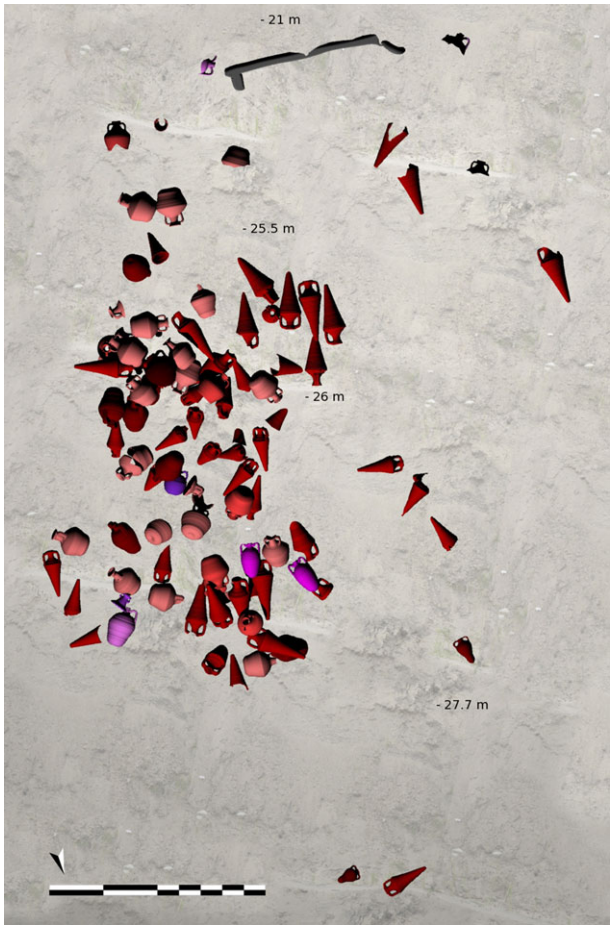

Figure 4. Plan of the wreck-site of Cape Stoba 2010–2014. Different amphora types are marked with different colours. (E. Costa)

decision was taken to record it using photogrammetry during the 2012 excavation season; visibility and readability being essential conditions for the effective use of photogrammetry. Recording was carried out by Stefano Caressa using a simple compact digital Ricoh camera with a 24 mm wide-angle lens. Photos were taken from free positions, without the camera being positioned on a rigid grid as in conventional photogrammetry. The position of the camera in the space was calculated from fixed points, supplied both by the two grids, located on two different levels, and by some targets positioned on the site. The latter were used also to measure the depth of objects relative to that of the grids. The grids were used to correct the optical distortions of the lens.

The photogrammetric rendering was graphically transformed into an analogous points system. The coordinates of each object, visible in at least two photos, were plotted. The position in space of each amphora or fragment was measured. The photogrammetric data was then 3D processed by Elisa Costa. The 3D-modelling software Rhinoceros was used to create models of each type of amphora recovered from the site, which were used for both complete and fragmentary amphoras. Each amphora model was then scaled and 'anchored' to the 3D coordinates taken from the photogrammetric survey to create a complete model of the site (Green, 2004: 202). Using the depth contours produced by the photogrammetry, the rocky slope of the seabed was modelled also. Finally, every surface was rendered, applying photo textures that reproduce the real colours of the objects (Fig 5).

This 3D model is a very realistic record of the site and allows one to analyse and study details of the cargo from any perspective. Since the amphoras lay on a steep

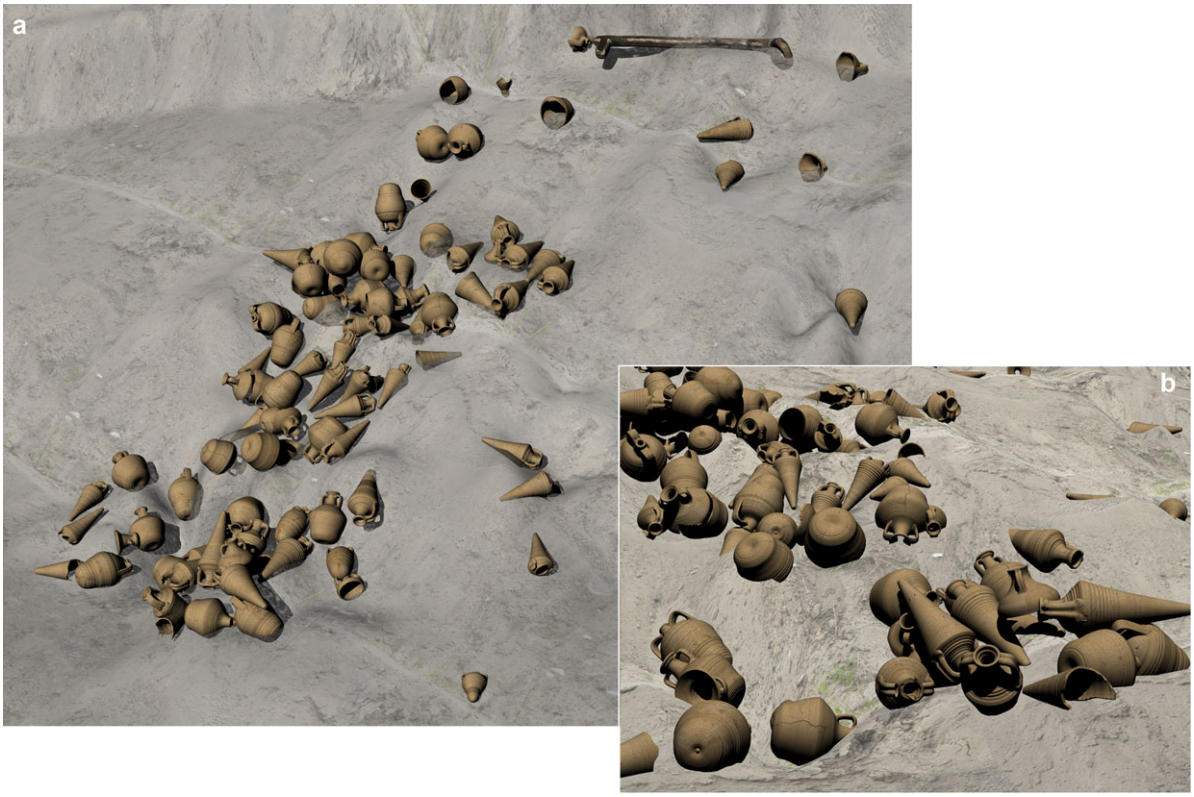

Figure 5. *a)* 3D model of the Cape Stoba shipwreck. (E. Costa); *b)* Details of the 3D model of the Cape Stoba shipwreck. (E. Costa)

slope, the model is particularly useful in allowing a better 3D perception of the site than is easily obtained from a 2D plan with depths marked.

The amphora cargo

Typologies

All amphoras from the Cape Stoba site belong to the Middle Byzantine tradition with a distinctive ribbed body, a short neck, massive, sometimes elongated handles and, in most cases, a rounded, concave or conical base. While it has proved difficult to trace the development of medieval amphoras in the western Mediterranean, the situation is quite different on the eastern part of the Byzantine Empire, especially along the coasts of the Sea of Marmara and the Black Sea, where workshops produced commercial-transport amphoras throughout the Middle Ages. A similar development can be discerned in the waters along the eastern Adriatic coast, where trade involving Byzantine amphoras lasted until the 13th and 14th centuries. This is confirmed by more than six known medieval shipwrecks with Byzantine amphora cargoes and dozens of sporadic finds. Along with the underwater finds, there are several instances of Byzantine amphoras incorporated into the domes of early medieval churches to improve their acoustics (Fig. 1). This secondary but widespread re-use of amphoras is found throughout the Byzantine Empire and significantly aids dating: the date of the building or its repairs providing a relative chronology for the vessels built into them (Bakirtzis, 1989: 77; Jurković and Turković, 2012: 133–9).

Based on the findings from the eastern Mediterranean, the Sea of Marmara and the Black Sea, the study of Byzantine ceramic containers began during the second half of the 20th century, resulting in several classifications and typologies (Demangel and Mamboury, 1939: 148–9; Brusic, 1976; Bakirtzis, 1989: 73–7; Günsenin, 1989: 267–76; Garver, 1993). However, researchers from the University of Lecce have since discovered amphora kilns in Otranto, revealing the existence of production sites also on the Apulian coast during the Middle Byzantine period (Arthur and Auriemma, 1996: 14–7).

Almost all amphoras known from the shipwreck at Cape Stoba can be divided into nine main groups with some variants and subtypes, which can be compared with the aforementioned typologies (Fig. 6)

More than 30 vessels can be attributed to Brusić's Group I (1976: 38) (Figs 6.1 and 7). They have a wide, emphasized shoulder and a slightly funnel-shaped neck. The body is 40 cm in height and gradually narrows, after the point of maximum diameter of 30 cm, to the flat base with a concave centre. According to Garver's

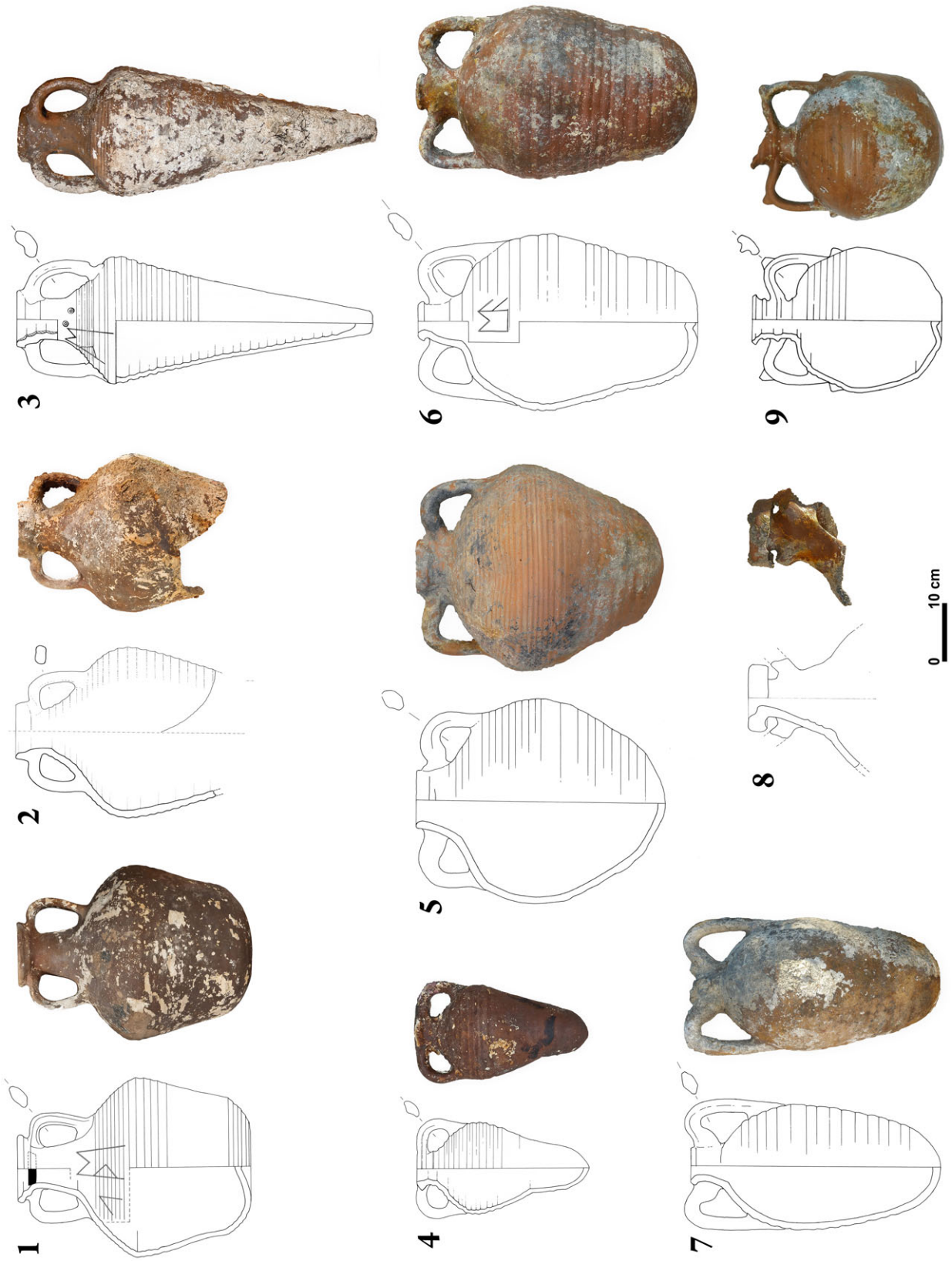

Figure 6. Types of Middle Byzantine amphoras from the Cape Stoba site. (Drawing: V. Zmaić Kralj, photo: I. Miholjek)

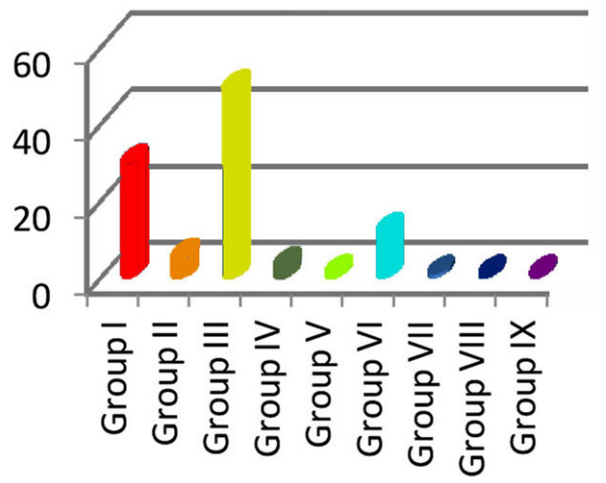

Figure 7. Prevalence of the amphoras by group from the Cape Stoba shipwreck site. (V. Zmaić Kralj).

chronological division of Byzantine amphoras from the Bodrum Museum of Underwater Archaeology, these belong to her Class 8, dated to the 9th–11th centuries, based on their similarity to amphoras discovered during a renovation of the buildings at Mangala in Istanbul, which were built at the time of Basil I (867–886) at the end of the 9th century (Garver, 1993: 152). The best-known parallels are six amphoras found on the Serçe Limanı shipwreck, dated to the 11th century (Van Doorninck, 2002: 902). More close parallels can be found at the Butrint site in Albany (Vroom, 2012: 291, fig. 7), at the Agora of Athens, dated to the 9th and 10th centuries (Robinson, 1959: 120 pls. 34, 58), and at the Saraçhane site in Istanbul in the layer dated to the 11th century (Hayes, 1992: 75, fig. 25.15) (Fig. 8). There are certain indications that these vessels may have belonged to the southern Mediterranean production, in the northern African region (Auriemma and Quiri 2007: 33, tav. 2:9).

Group II amphoras (Brusić, 1976: 39–40) are represented by only five specimens from the site (Fig. 7). They have a short neck, pear shaped recipient and massive handles which start just below the rim, and descend to the mid shoulder (Fig. 6.2). The base of the vessels varies from rounded to slightly conical. According to Garver, these amphoras belong to her Class 1, dated mainly to the 10th and the 11th centuries. Based on their similarity to amphoras discovered during a renovation of the buildings at Mangala in Istanbul (Demangel and Mamboury, 1939: 148–9), which were built at the time of Basil I (867–886) this type appears earlier, during the 9th century (Garver, 1993: 57–60). The closest parallels are amphoras from Istanbul, Kherson in the south-west Crimea, Sarkel on the Don (Jakobson, 1951: 333, fig. 6/25–27) and from Preslav in Bulgaria (Doncheva-Petkova, 1977: 193–94, pl XXX:356). In the St Sophia church at Ohrid, 13 amphoras of that form were found built into the vault, in order to improve resonance (Aleksova, 1960: 202–3; Brusić, 1976: 39) (Fig. 8). There are 16 related specimens in the collection of the Bodrum Museum of Underwater Archaeology (Garver, 1993: 6–60).

Group III Byzantine amphoras (Brusić, 1976: 38) are the most common at Cape Stoba (Figs 6.3 and 7), and more than 49 examples have been found evenly distributed across the site. These amphoras have a similar upper part to those in Groups I or II, while the body tapers in a cone shape, like the earlier Late Roman 'carrot' amphoras. Several variants of this type were found and the differences between them are related to dimensions and volume, varying between 45 and 60 cm in height, 21 to 25 cm in diameter and 5 to 7 litres in capacity. The closest parallels to this type are four amphoras built into the construction of the vaults in the Church of John the Baptist in Kerch, dated to the 9th–10th century (Jakobson, 1979: 75). A few examples of a similar type were discovered at Preslav, dated to the 10th and 11th centuries, and at a monastery complex near Karaach Teke in the east of the medieval Bulgarian state (Todorova, 2012: 18–19, 23) (Fig. 8). It seems that this amphora type represents a reminiscence of the well-known Sinopean 'carrot' amphora, which was manufactured from the 4th and throughout most of the 5th century AD (Magomedov and Didenko, 2010: 480). Most 'carrot' amphoras occur across the whole Black Sea littoral during the Late Roman period, particularly along the northern and western coast where the forms were adopted by some Heraklean and Chersonesan workshops (Opaiţ, 2010: 373). The shape, size and capacity of the Byzantine amphoras from the Cape Stoba wreck are significantly different from the Late Roman types, particularly with their distinctive massive handles attached close to the rim, a shorter neck and a flattened base.

Three whole, small piriform amphoras were found at the site (Fig. 7). They are 30–32 cm high, with a stubby neck and oval handles reaching from the rim to the shoulder where the amphora is the widest, at about 17 cm in diameter (Fig. 6.4). This type belongs to Brusić's Group IV (Brusić, 1976: 41), and Günsenin's Type XI of Byzantine amphoras (1990: 39), dating them to the 10th and 11th centuries. The closest parallels are the amphoras found on the 11th-century Serçe Limanı shipwreck, and in the Agora of Athens where they were found in the stratum dated to the 10th and 11th centuries. The same date is given for this type of amphora found in Bulgaria at Preslav and in the monastery complex near Karaach (Todorova, 2012: 19, 23) (Fig. 8).

Only one amphora from the site can be connected to a time and place of production. It has a wide piriform body and no toe at the bottom. It is 37 cm in height and 33 cm in diameter, with a stubby neck and small oval handles reaching from the rim to the shoulder (Fig. 6.5). Günsenin (1989: 269–71) included amphoras of this type in her Type I of Byzantine

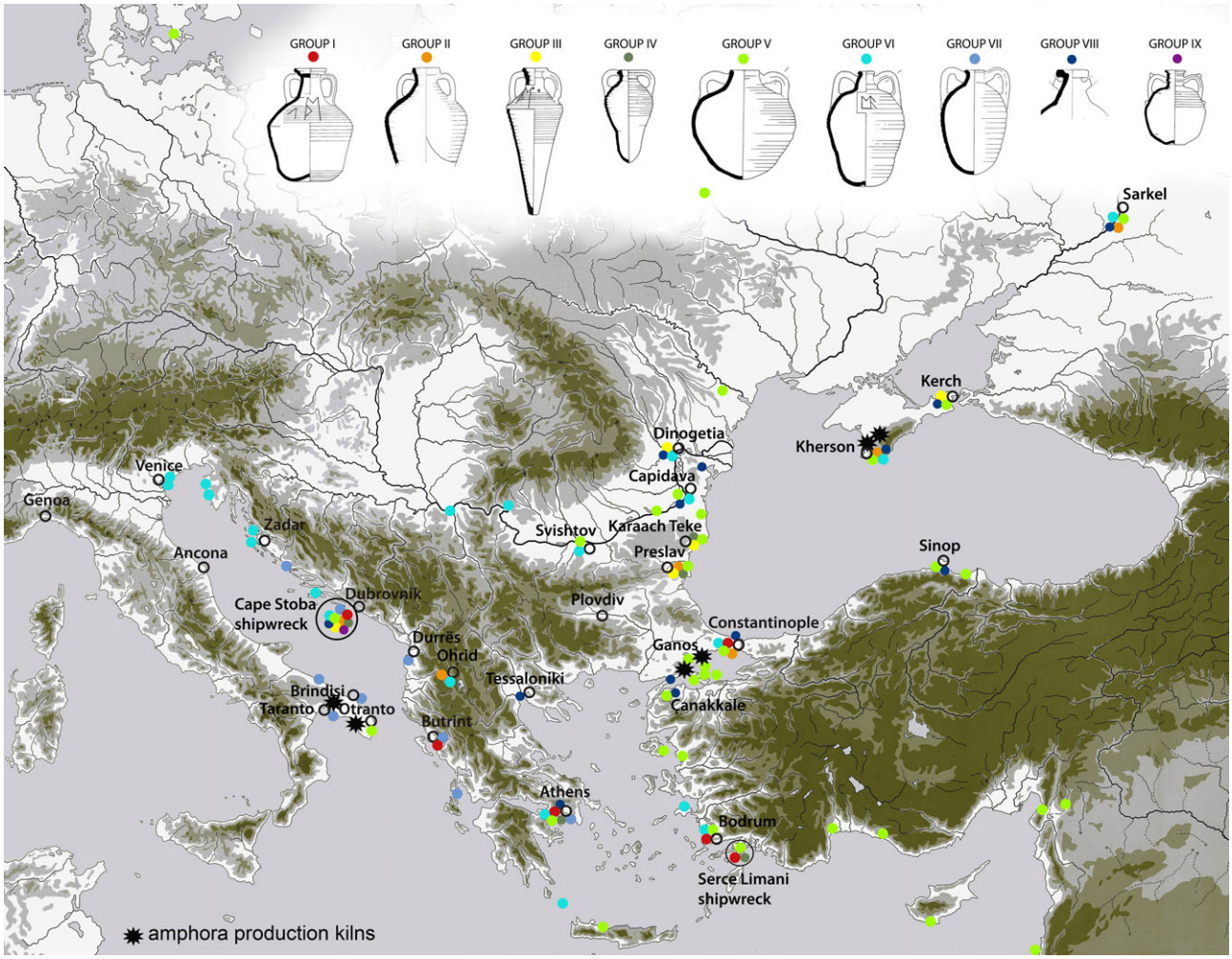

Figure 8. Distribution of Middle Byzantine amphora types found on the Cape Stoba wreck-site. (Drawing: V. Zmaić Kralj)

amphoras, and dated them to the 10th–12th centuries. She linked them to the production of wine at the Ganos monastery in the Marmara region (Günsenin, 2009: 147). The monastery was founded in the 10th century at the base of a mountain sacred to the monks in this area, comparable to those of Bithynia or Athos. From the 10th century on, the monastery was engaged in amphora production, probably for the export of locally produced wine (Günsenin, 2009, 145–6). Surveys of the region carried out in the 1990s located several amphora kiln sites at Ganos (now Gaziköy), a village on the north-west coast of the Sea of Marmara, at Chora (Hoşköy), and two sites on Marmara Island, as well as others beyond the immediate area of Ganos, that produced this type (Günsenin, 1999: 19). At the same time, underwater surveys along the Marmara islands resulted in the location of 13 Byzantine shipwrecks, eight of which were carrying Ganos amphoras (Günsenin, 2001, 117–33). The same type of amphora can be found in almost all parts of the Byzantine Empire and beyond, which suggests that Ganos wine was a part of a large-scale trading network: along the coast of Byzantine Asia Minor (see the Serçe Limanı shipwreck), on Crete and Cyprus. Internationally, they reached Egypt, the Levant, southern Italy, countries bordering the Black Sea, and inland to Sarkel, and north into Russia and Sweden (Günsenin, 2009: 152) (Fig. 8).

Twelve larger piriform amphoras were recovered from the site (Fig. 7). They have a rounded base, a short neck, thinly rolled rim and thick, oval handles that in some cases slightly overpass the rim. Dimensions vary from 40 to 45 cm in height and 25 to 35 cm in diameter (Fig. 6.6). Several variants of this type have been found at the site, and the differences can be observed in the shape of the neck, the rim, the position and height of the handle, the diameter of the body, as well as in the capacity of the vessel. According to available data, this is the most widely distributed type of Middle Byzantine amphora (Fig. 8). These vessels belong to Brusić's VA Group (Brusić, 1976: 41),

Figure 9. Cape Stoba: rounded ceramic flask (photo: R. Mosković, drawing: V. Zmaić Kralj)

Bakirtzis' Type I, dated to the period from the late 9th to the 11th century (Bakirtzis, 1989: 74–7) and Garver's Class 5, dated to the period from the 9th to the 13th century (Garver, 1993: 129–36). Similar amphoras have been found in pottery kilns in Kherson, in southern Crimea, and at other sites on the northern coast of the Black Sea, in Kerch and in Sarkel on the Don (Jakobson, 1979: 71–3) suggesting a Crimean provenance. The possibility that they were produced elsewhere along the Mediterranean coast cannot be excluded, however, since a similar type has been found at numerous sites over a vast area. For example, three such amphoras are stored in the Bodrum Museum and analogous specimens were discovered in Istanbul, at the Agora of Athens, on the island of Samos, and in the harbour at Antikythera in Greece (Coldstream and Huxley, 1972: 269–70, fig. 87.18; Garver, 1993: 135), on the Svichtov site in Bulgaria, Dinogetia and Capidava in Romania, in the Church of St Sophia in Ohrid and in Kostol and Belgrade in Serbia (Bjelajac, 1989: 113). There are many parallels on the eastern Adriatic as well: on the shipwreck in the vicinity of Nin, near the islet of Ošljak in the Zadar Channel, in the Port of Hvar, in Umag and in the bay of Pijan in Istria (Brusić, 1976: 41; 2010: 246). Some similar vessels where found at San Francesco del Deserto and at Torcello islands in the Venetian Lagoon (Toniolo, 2007: 103) (Fig. 8).

An ovoid amphora with a stubby neck and massive high-placed handles that rise slightly above the rim is represented by a single specimen from the site (Fig. 7). The amphora is relatively small, only 37 cm in height and 20 cm in diameter (Fig. 6.7). This amphora belongs to Brusić's Group VA (Brusić, 1976: 41), and to Günsenin's Type XV (1990: 308, pl. LXXXIV/3; 313, pl. LXXXVI/1). The closest parallels are amphoras embedded in the vault construction of the church of St Barbara in Trogir, from 7th decade of the 11th century (Brusić, 2010: 249; Jurković and Turković, 2012: 137) and amphoras found in Albania at the site Butrint, in the city of Durrës (ancient Dyrrhacium), in Greece on the island of Cefalonia (Scognamiglio, 1997: 18) and at the Agora in Athens in the layer dated to the 11th and 12th centuries (Günsenin, 1990: pl: LXXXVI/1). Some amphoras of similar shape have been found on the opposite coast of the Adriatic, on the area off SE Apulia at Mola di Bari, in Brindisi and at Capo San Vito near Taranto (Volpe *et al.,* 2007: 363–4) (Fig. 8). Excavations and archaeological finds at Otranto, the site of Quattro Macine, Antifano, the monastic sites of San Giovanni Malcantone, and Le Centoporte, as well as pre-disturbance surveys of the underwater sites around Apulia that took place during 1980s and 1990s, have revealed an abundance of amphoras made from a distinctly local Apulian fabric, in contexts dating from the 10th/11th to the 13th century (Arthur and Auriemma, 1996: 16). Since medieval amphora kilns were also found in Apulia (Arthur and Auriemma, 1996: 16), a future comparative petrographic analysis may reveal the origin of these products. Production of Middle Byzantine amphoras in that area can be explained by the fact that in the second half of the 9th century Apulia was returned to the Byzantines who kept it for nearly two centuries, during which time they initiated the revival of many cities prior to the arrival of the Normans in 1043. It seems that the production and exportation of surplus agricultural produce was relatively abundant in that period and the port of Otranto was a major Middle Byzantine town from which goods left Apulia and supplied other parts of the Byzantine Empire to the East (Arthur and Auriemma, 1996: 14).

Among the amphoras, one fragment of a neck was found with a base part of the handle and the distinctive broad angular rim (Fig. 6.8). Only a small part of the handles was preserved, but it is suggested that they extend above the rim. Amphoras with these characteristics belong to a type of piriform vessels with bowed handles. This type was very common and well represented in the Eastern Mediterranean and the Black Sea basin from the 10th to the 12th century,

but it is a very rare find in the Adriatic region. This is apparently the sole example of this type found on the eastern Adriatic coast. According to Günsenin's typology it belongs to the Type II b (1990: 31–4), and to Type IV in Bakirtzis' classification (Bakirtzis, 1989: 74–5). Similar examples have been found further to the west, in Thessaloniki and at the Agora in Athens. Furthermore, this type can be traced along the Black Sea basin in Kherson, Kerch, and inland up to Sarkel on the Don (Jakobson, 1979: 109–10), and in Tulcea, Dinogetia and Capidava in Romania (Barnèa, 1989: 133–4). These amphoras were found at the Mangala site in Istanbul (Demangel and Mamboury, 1939: 198), in Sinop, in Şarköy on the north coast of the Marmara Sea, as well as examples recovered from the area around the coast of Byzantine Asia Minor, stored today in the Çanakkale Museum collections (Günsenin, 1989: 270–1) (Fig. 8).

A small vessel of a specific form was found during the 2012 campaign. It has a wide, round or slightly polygonal body, 30 cm in height and 24 cm in diameter, a profiled neck with a funnel-shaped rim and a flat surface with a concave centre at the bottom (Fig. 6.9). It has four small triangular protrusion, two at the turn of the handles and two just below the point where the handles are merged with the body. Parallels for this vessel have not been yet found.

An entirely preserved, round ceramic flask was found among the amphoras. It is 18 cm in diameter, with two strap handles, a short neck and a funnel-shaped rim. Instead of a base, it had a broad flat surface on one side of the belly (Fig. 9). Similar flasks were found on sites along the Crimean coast and the hinterland of the peninsula. A clay mould for the production of such flasks was found among the amphora kilns in Trudolyubove, a site in south-west Crimea near Kherson. In a few examples of the flasks found in Crimea, the convex side of the belly was decorated with a red pattern, painted with a thick brush. Such decoration is not common in the Crimean area, but can be compared with decoration found on vessels from Alanian tombs of the northern Caucasus. It is possible that such forms suggest cultural and trade connections between Byzantine commercial centres on the northern coast of the Black Sea and nomadic populations from the north-east (Jakobson, 1979: 38–9).

Graffiti and stamps

Many of the Byzantine amphoras from the Cape Stoba shipwreck have graffiti on the upper part of the body (Fig. 10). In addition to graffiti, some amphoras were stamped before firing. A total of 47 graffiti and 14 stamps occur on 44 of the more than 100 amphoras. The graffiti can be divided into several distinct groups: single-mark and multiple-mark graffiti, Greek/Cyrillic letters, Turkic/Oghuric runes, and geometric and pictorial symbols or numerals (Collins, 2012: 95) (Fig. 11). The most common marks are X, M, and A. These symbols could be categorized

Figure 10. A graffito and stamp on the upper part of an amphora. (Photo: R. Mosković)

as a Greek/Cyrillic letters, but they also have parallels in runic alphabets and the mark X may represent a number, such as the Roman numeral ten. X appears in multiple character marks, including ligatures: XM, AX, MAX, XMΛ, XMD or NX, and the mark M appears in ligatures as well: XM, AM, MD, MP, MF, MFT, XMD. In general, the marks can be identified as symbols from various runic alphabets that were used in the area around the Black Sea, particularly in Bulgaria and the Crimea in the medieval period (Collins, 2012: 118). There are also plenty of parallels with graffiti on amphoras found on land sites around the Black Sea basin, including Kherson, Sarkel, Kiev, Aegyssus-Tulcea, Dinogetia, Pliska, Sinope, and the mouth of the Don, as well as on amphoras from Byzantine shipwrecks, including the 7th-century Yassıada shipwreck, the 11th-century Serçe Limanı shipwreck, the 13th-century Novy Svet shipwreck and the 13th-century Çamaltı Burnu shipwreck (Collins, 2012: 138). Therefore, the graffiti indicate the potential participation of several ethnic groups in Byzantine maritime trade, including the Danube and Balkan Bulgars, and the Khazars or other local Crimean populations (Collins, 2012: 107–58).

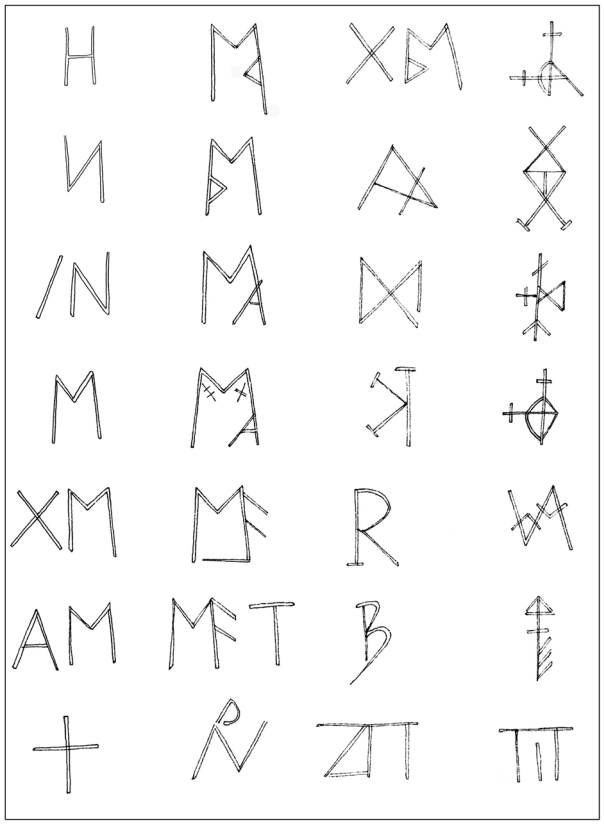

Figure 11. Graffiti from the amphoras (Drawing: V. Zmaić Kralj)

Figure 12. Cork stopper in amphora n.158. (Photo: C. Beltrame).

Three types of amphoras from the Cape Stoba shipwreck (Group I, IV, V), as well as the graffiti on them have parallels with those from the 11th-century Serçe Limanı shipwreck (Van Doorninck, 1989: 253, fig. 3.16). Among other parallels, the most frequent marks on the Serçe Limanı shipwreck is the letter M, alone or with other ligatured marks, like those on amphoras from Cape Stoba. The meaning of the graffiti on amphoras from Cape Stoba wreck has not yet been established. During transportation and distribution, graffiti had various uses: to indicate goods stored in the amphoras or their capacity, either in volume or in weight. In trade, a wide variety of individuals handled the amphoras, from the stevedores, to the officials who regulated trade (Collins, 2012: 107); therefore, these signs could also relate to those activities. On the other hand, Van Doorninck has hypothesized in his discussion of the Serçe Limanı amphoras that certain groups of graffiti appear to be marks of ownership, and belong to crew or merchants involved in the ship's last voyage, while other graffiti appear to be the potter's marks. Considering that very close parallels of those graffiti occur on medieval Bulgarian pottery and building materials, he suggests that they represented marks of seamen and potters belonging to a community of Bulgarians relocated to the north coast of the Sea of Marmara (Van Doorninck, pers. comm., September 2015).

Of more than 100 amphoras recovered, seven were still closed with stoppers. After two amphoras were opened, it was found that they contained sand up to the stopper. As their stoppers were sealed, the sand could not have washed in during their time on the seabed: the amphoras were intentionally filled with sand and possibly re-used.

Wooden stoppers

Wooden stoppers were widely used in the Roman period, as is evident for example from the Chrètienne C (Joncheray, 1975: 81–83), Grand Ribaud A (Carrazé, 1975: 31) and Dramont C (Parker, 1992: 167), shipwrecks. In the Roman amphoras, generally a clay stopper was put over the wooden one and was stamped. Also, in at least three shipwrecks of the late 12th century AD, amphoras have been found sealed with cork or simple bark stoppers, although the description is rarely supported by analysis: the Novy Svet (Black Sea) shipwreck with Günsenin's Type I and II amphoras (Morozova and Albertson, 2012: 211); the 12th–13th century AD shipwrecks of Marsala-La Bambina (Sicily) (termed 'Norman') (Purpura, 1985: 130), S. Vito Lo Capo (Sicily) (Faccenna, 2006: 40–1) and Tartous (OCSCAE, nd: 38 and pls). Pine-bark stoppers were used to seal amphoras also on the 9th-century Bozburun shipwreck (Hocker, 1999: 31) and the 11th-century Serçe Limanı shipwreck (Ward, 2004: 496). This suggests that the technique of closing amphoras with a wooden stopper was common in the Middle Ages and followed a tradition begun in the Roman period.

This technique was identified on seven containers, belonging to Groups 1 and 3, of the Cape Stoba shipwreck which were closed by stoppers made of cork oak (*Quercus suber L.*)[1] covered with a layer of resin to seal them in place (Figs 12 and 13). The stopper from amphora n.176 (Group 3) has a trapezoidal section, a diameter of maximum 58 mm, is 8 mm thick and is

Figure 13. Cork stopper with hole, from amphora n.176. (Photo: C. Beltrame)

pierced in the centre. It has traces of what seems to be pitch, but analysis of this material is still in progress, that was used to seal it in the neck of the container. The other stoppers present similar dimensions and shape, but since they are still plugging the amphoras, it is not possible to measure them. The wooden stoppers were quite cursorily worked with a small blade, as is evident from cut marks present along the edge. There is no evidence of any secondary stopper of clay over the wooden one as used in the Roman period.

Cork oak is now totally absent both from the eastern Mediterranean, the area of provenance of the amphoras and the glass cargo, and from the eastern Adriatic coast, the location where the ship sunk (Euforgen, 2015). Since cork oak was mentioned by Theophrastus (*Hist. Plant*, III, 16) and by Pliny (*Nat. Hist.,* XVI, 13), who saw it also in Greece, the evidence from the shipwreck allows us to presume that in the past—perhaps still in the period when Cape Stoba ship was at sea—it was present in the area of provenance of the cargo. Alternately, we could hypothesize the importation of cork from the central Mediterranean for this particular purpose, although this seems less likely.

On one fragment of amphora there is evidence of the use of a pottery-sherd stopper.

Dating

Parallels found in the Serçe Limanı cargo are crucial for dating the Cape Stoba shipwreck. The Serçe Limanı ship sunk in the later part of the 3rd decade of the 11th century, carrying a mixed cargo that included pottery, glassware and glass cullet, probably in transit from the Fatimid Syrian coast to a glass-making centre in Byzantine waters (Van Doorninck, 1989: 250–7; Bass, Matthews, Steffy and Van Doorninck, 2004). Among the finds on the wreck were glass weights for pan balances, used for weighing gold and silver Fatimid coins. The most recent weights are stamped with a date that corresponds to AD 1024/1025, or 1021/1022, thus they gave a chronological reference point (Van Doorninck, 2002: 902). In addition to the Serçe Limanı excavation, several examples that confirm the chronology come from excavations in the Athenian Agora (Günsenin, 1990: 287–318), where parallels for almost all the types of amphoras from the Cape Stoba shipwreck can be found in sealed strata dated to the 10th and 11th centuries.

Figure 14. Glass bowls on a high pedestal foot, mould-blown with two gathers. (Photo: R. Mosković; drawing: M. Ferri)

Glass fragments

A part of the finds consisted of glassware, found mixed among the amphoras.

At present, an estimated 50 glass vessels have been recovered, but most of them have still to be restored. Some of the glass was recovered in 1975 and is now held at the Dubrovnik Maritime Museum (Han and Brusić, 1978) where, in May 2015, they were counted, but not measured or drawn. However, most of the assemblage was been recovered during the 2010–2012 excavations. Unfortunately, the position of glass fragments was not precisely recorded during excavation and, because of the limited dimensions and its transparency, glass does not figure in the 3D model. In general, the 2010 glass finds were located between the depth of 9 m and the anchor located at 21 m, mingled with the surface materials. The 2011 and 2012 glass finds, were at a depth of 25.5–27.5 m, mixed among the amphoras.

Preliminary assessment suggests the assemblage includes four main forms: bowls, bottles, lamps, and drinking glasses or beakers. Some of them, such as bowls, are very standardized but some others, such as bottles, have many variations. The quantity of vessels suggests that this material was part of the cargo rather than objects used on board.

Bowls are the most common forms. One complete and one almost complete cup-shaped bowl were recovered. They sit on a high pedestal foot with a rough pontil mark, and are free-blown and mould-blown from two gathers (Fig. 14). While the upper part is transparent with a greenish tinge, the lower part is deep blue and, in one of the two cups, has a continuous horizontal row of ring-and-dot ornament in low relief.

Transparent green bowls have a blue flaring rim and mould-blown, ring-and-dot body with a low pushed-in foot ring. According to the foot ring diameters, there are bowls with foot rings of three different standardized sizes, ranging from 35 to 80 mm. A rim from one of

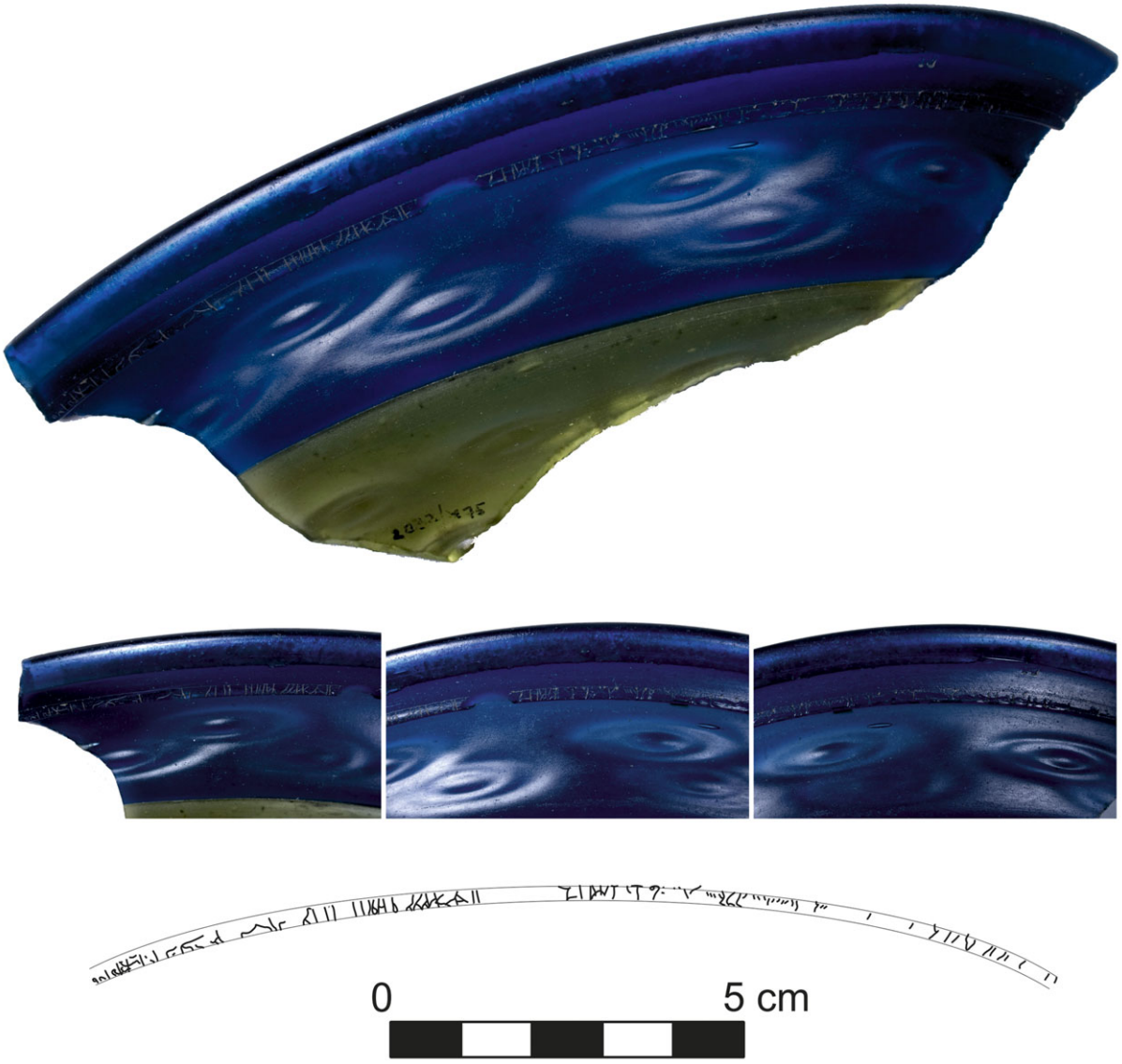

Figure 15. Incised inscription on a glass bowl-rim fragment. (Photo: R. Mosković; drawing: M. Ferri)

these bowls has a tiny inscription, not yet deciphered, incised on it (Han and Brusić, 1978: 272) (Fig. 15).

Bottles occur in many different variants (Fig. 16). Most numerous are those with one or more bulges in the neck, sometimes blown, with applied decorative threads of blue-coloured glass (Brusić, 2010: 252), or with necks shaped like a simple truncated cone, wider at the bottom than at the top; these are sometimes enriched with applied blue trails. Few of the bottles' bodies are preserved intact, but usually the shoulder curves out and down. In addition, there is at least one ewer, with a rim shaped like an inverted cone, a pinched pouring lip, and a truncated neck with applied trail decoration.

Lamps are very numerous, at least 14 had been found prior to the 2012 campaign, attested by the presence of solid beaded stems with a pontil mark on the base. The top of the stems flare, but the lamp cup is invariably missing. Moreover, wall fragments with applied handles indicate the presence of mosque lamps.

Fragments of scalloped, decorated pseudo handles, characterized by loops and curls formed by long irregular trails applied to the wall are probably also lamps (Fig. 17). This type of handle was not uncommon, and sometimes was used together with mussel-shaped mosque-lamp handles (Bass *et al.*, 2009: 413). However, a wall fragment with this wing decoration recovered in 1975 has been related to a flared neck with plain lip (Han and Brusić, 1978: 276).

Finally, beakers are very few with only two recorded prior to the 2012 campaign: one has a recurring ring-and-dot decoration and a second example, so far the

Figure 16. Bottles: with bulges in the neck and with truncated cone necks (top); ewer (bottom). (Photo: R. Mosković; drawing: M. Ferri)

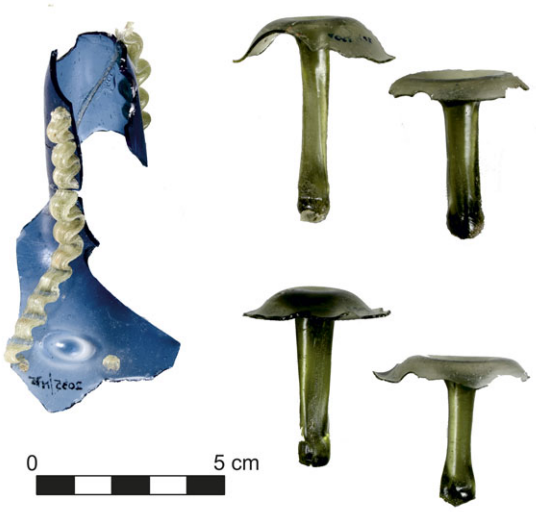

Figure 17. Handle with loops and curls formed by trails applied to the wall (left); solid beaded stems of lamps (right). (Photo: R. Mosković).

only one found of this type, has a wheel-cut decorative technique (Fig. 18). The engraved design resembles that representing an arcade found on a glass beaker dated to 900–1025 held at the Corning Museum of Glass and described as Islamic (Accession Number 64.1.24, Whitehouse, 2010, 110, fig. 115).

To sum up, the glassware from the wreck forms a very consistent group including bowls, bottles, lamps, and a distinct group of beakers. The glass fits the 11th-century date provided by the associated pottery. Further study will allow detailed discussion of the production and decoration techniques of the Cape Stoba glass finds, but we would like to stress here that they have been created using a number of complex glass-working techniques. Many of the artefacts are made of a transparent light green/yellow and blue glass with a ring-and-dot decoration, created using dip moulds. Dip moulds, usually consisting of a single beaker-shaped part are used to impart a pattern to the parison, which is then withdrawn, blown and tooled to the desired shape and size. Despite the few analogies currently available, it can be noted that this decorative technique was used in the area of Syria, as suggested by a metal mould acquired in Aleppo, possibly from Raqqa, and dated to the 9th–11th century (Kröger, 2007: 265; now in the Museum für Islamische Kunst of the Staatliche Museen zu Berlin). In fact, the ring-and-dot mould decoration is common in early Islamic glass from Nishapur (Kröger, 1995), but is rare in the Serçe Limanı glassware assemblage. Moreover, some vessels present applied trails, indicating the knowledge of another working technique and suggesting a highly specialized workshop. Neither this decorative technique nor the use of two gathers in different colours is common in the Serçe Limanı assemblage.

The artefacts recovered are of a uniformly high quality. Moreover, the same decoration is used on a variety of vessel shapes. Other than one beaker, the glass used has a similar appearance and the same colours are used throughout the collection. The homogeneity of these traits suggests that nearly all the glassware was made in the same area, or even a single workshop. The only vessel that we can exclude from the cargo is the drinking glass with wheel-cut decoration, which is extremely different from the other vessels in colour, decorative technique and shape. It is likely that this beaker may have belonged to someone on board the ship when it sank.

The glassware of the Stoba wreck was probably produced in the eastern Mediterranean, as comparisons in shape and ornamentation suggest, but it was not produced in the same workshop as the Serçe Limanı

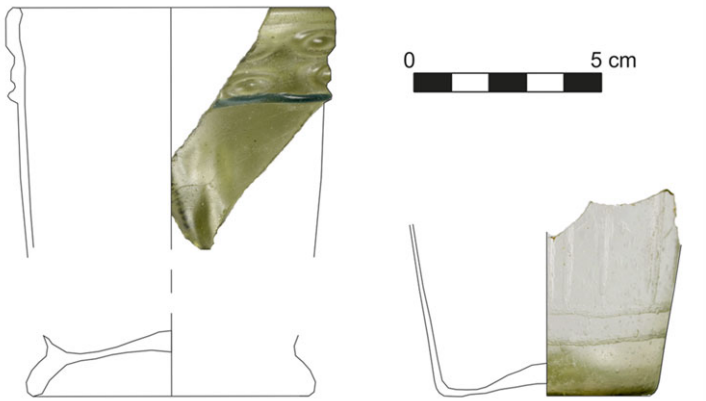

Figure 18. Drinking glasses (re-drawn from Han and Brusić 1978; photo: R. Mosković)

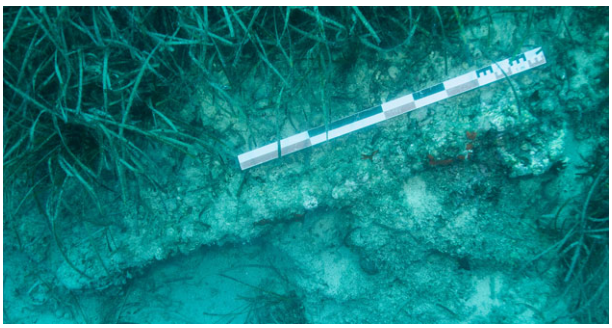

Figure 19. The iron anchor (photo: Croatian Conservation Institute)

glassware (Bass *et al.,* 2009: 413), as neither the ring-and-dot decoration nor the use of two gathers in different colours is common in the Serçe Limanı assemblage. A crucial clue in determining the place of manufacture will come from the decoding of the inscription preserved in the rim of the cup.

The ship and its equipment

Although the excavation has not yet uncovered any significant trace of the hull of the ship, it is possible that wood remains are covered by the thick deposit of amphoras and natural layers still at the bottom of the slope. Only a very small fragment of wood, of ash (*Fraxinus excelsior*)[2], was found between the amphoras, but it is not possible to determine its original use.

On the upper part of the slope, the entire shank of an iron anchor, 1.60 m long, equipped with a ring with a diameter of *c.*25 cm, is concreted to the seabed (Figs 4, 5a and 19). Since its arms are broken at the level of the crown, it is not possible to say for certain whether they formed a T- or a Y-shape, although the stump of one arm would indicate the latter. T-shaped or cruciform iron anchors begun to be used from the Late Roman period, while the Y-shape was introduced perhaps in the 10th century (Van Doorninck, 2004: 235); however, at the beginning of the 13th century both types were still in use, as documented by the Çamaltı Burnu 1 (Sea of Marmara) shipwreck (Beltrame, 2012: 222–3). Since its length is close to the maximum length of the set of nine Y-shape anchors of the Serçe Limanı shipwreck (Van Doorninck, 2004), the dimensions of the ship of Cape Stoba may be close or larger than the Serçe Limanı vessel, which was 15.66 m long.

Clusters of pebbles and gravel of various dimensions, with a diameter of *c.*20–100 mm, lying between and over the amphoras can be interpreted as ballast. The position of ballast over and among the cargo could suggest the ship capsized and invites future in-depth analysis of the formations processes of the site. Stone of similar shape and type were found also in the shipwreck of Tartous (OCSCAE, nd: 40). Geological analysis has not yet located the provenance of these stones.

Conclusions

The island of Mljet is located on a traditional trade route between the eastern and the western Mediterranean. Preliminary investigations in 1975 and systematic excavation from 2010 to 2012 of the Cape Stoba shipwreck site have enabled more than 100 amphoras and a glassware assemblage comprising approximately 50 vessels to be recovered. Nine types of amphora, probably used for the transportation of wine, were identified, most of which bear characteristics attributable to production areas around the Black Sea and the Marmara Sea, and one that can be linked to production in southern Apulia. Analogous amphora types found in the Serçe Limanı shipwreck, dated shortly after 1025, suggest that the shipwreck at Cape Stoba can be placed roughly in the same period.

Six medieval shipwrecks with amphora cargoes, and dozens of sporadic finds found on land and in the sea of Dalmatia, are evidence that the widespread use of clay containers for trade within the Byzantine

Empire was still common practice in this area. A similar situation is reflected in areas under Byzantine rule: Byzantine amphoras have been found in Albania, Greece, Bulgaria, Romania, the area around the Black and Marmara Sea as well as along the eastern Mediterranean coast, with Byzantium as the trade and commercial centre. In contrast, in part due to the widespread use of barrels for sea transportation (McCormick, 2012, 91–4), finds of Byzantine amphoras are rare and sporadic in the western Mediterranean and most of Italy from the 8th century AD onwards. Apulia is the exception, as it continued under Byzantine rule until the Norman conquest of the 11th century.

The Cape Stoba ship sunk while transporting an eastern Mediterranean cargo, most probably intended for trade with the Byzantine towns on the eastern or north Adriatic coasts. One Byzantine amphora of the Apulian type in the ship's cargo points to the possibility that the ship stopped in a harbour in southern Puglia. Alternatively, this singular container could, like the flask, have been a personal belonging of a crew member bought before this voyage.

As regards the glass cargo, the extreme homogeneity of shape, quality and decoration indicates a single production, probably in the eastern Mediterranean or Levant region. This does not preclude the possibility that the cargo of glass had passed through Byzantium, or other cities around the Sea of Marmara, before being loaded for transport to the Adriatic. In any case, this shipment of a considerable quantity of Levantine glassware found in the Adriatic Sea might enable the definition of clients and recipients in a trade system that has so far only been hypothesized.

Future investigations, using 3D photogrammetry to document the site, has the scope to complete the recovery of the cargo, thus improving the reconstruction of this failed commercial enterprise. Moreover, removal of the cargo will enable the team to look for traces of the ship, presently represented by a section of iron anchor only.

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Notes

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2. Analysis was carried out by Nili Liphschitz, Institute of Archaeology, The Botanical Laboratories, Tel Aviv University.

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