The Mazotos Shipwreck: preliminary results of the hull analysis

Stella Demesticha – Carlos de Juan

Abstract: The 4th century BC shipwreck of Mazotos lies at -44 m off the south coast of Cyprus. Archaeological work on the site started in 2007 by a team of the University of Cyprus and is still in progress. After eight excavation seasons a good part of the hull has been unburied, mainly at the fore part of the ship. Evidence thus far suggests that it was a round bottom ship, fastened with pegged mortise and tenons. Some distinctive features, such as the round bottom profile of the hull, the framing pattern, and the presence of tetrahedral recesses at the bow extremity, open the question of the ship's broader technological context, and underscore its important contribution to our knowledge on shipbuilding traditions in the eastern Mediterranean during the Classical period.

Keywords: Greek shipbuilding, shipwreck, ship construction, fourth century BCE, Cyprus

1. Introduction

The Mazotos shipwreck lies at a depth of 44 m, off the south coast of Cyprus, near the village of Mazotos (Fig. 1). The site was discovered and reported to the Authorities by recreational divers in 2006. The Archaeological Research Unit of the University of Cyprus commenced archaeological investigation at the site in 2007, first with surface survey, followed by systematic excavation since 2010 (Demesticha 2009; 2011; Demesticha *et al.* 2014; Secci *et al.* 2021). The site was initially defined by a dense oblong concentration of more than 500 visible transport amphorae; these surface finds expanded across an area of approximately 16 × 6 m, with a north-south orientation (Fig. 2).

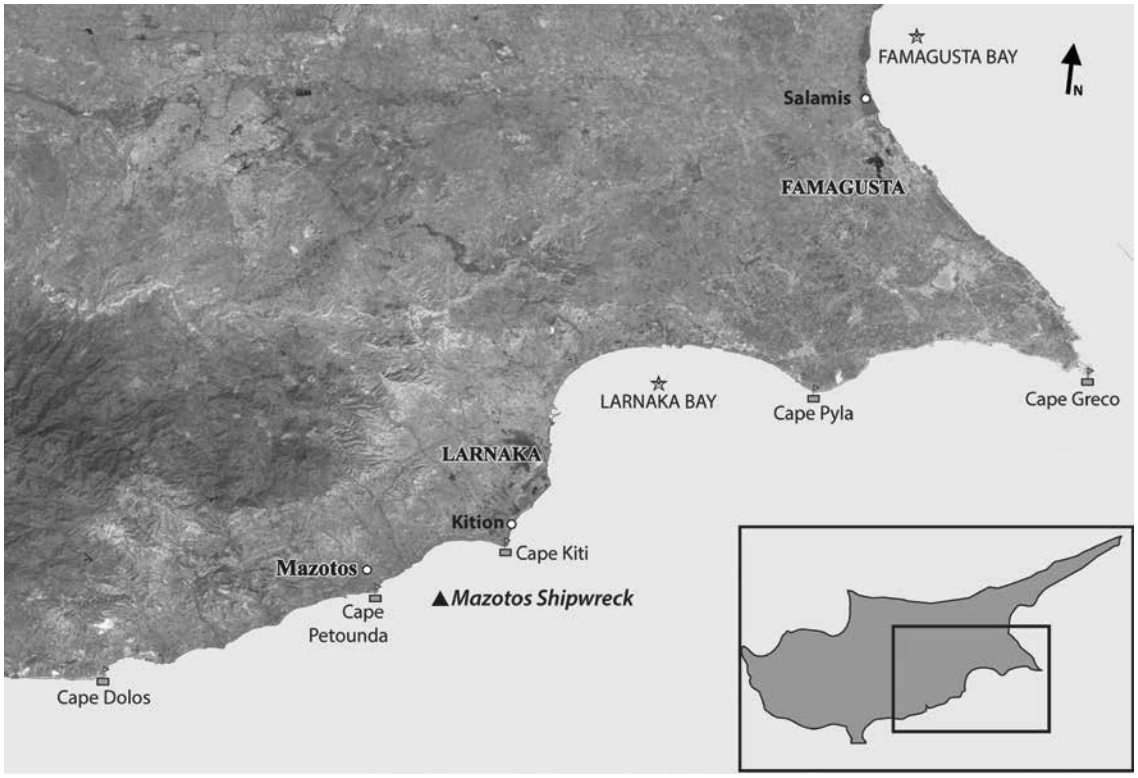

Fig. 1 Map of Cyprus showing the location of the Mazotos shipwreck (map: A. Neophytou, I. Katsouri)

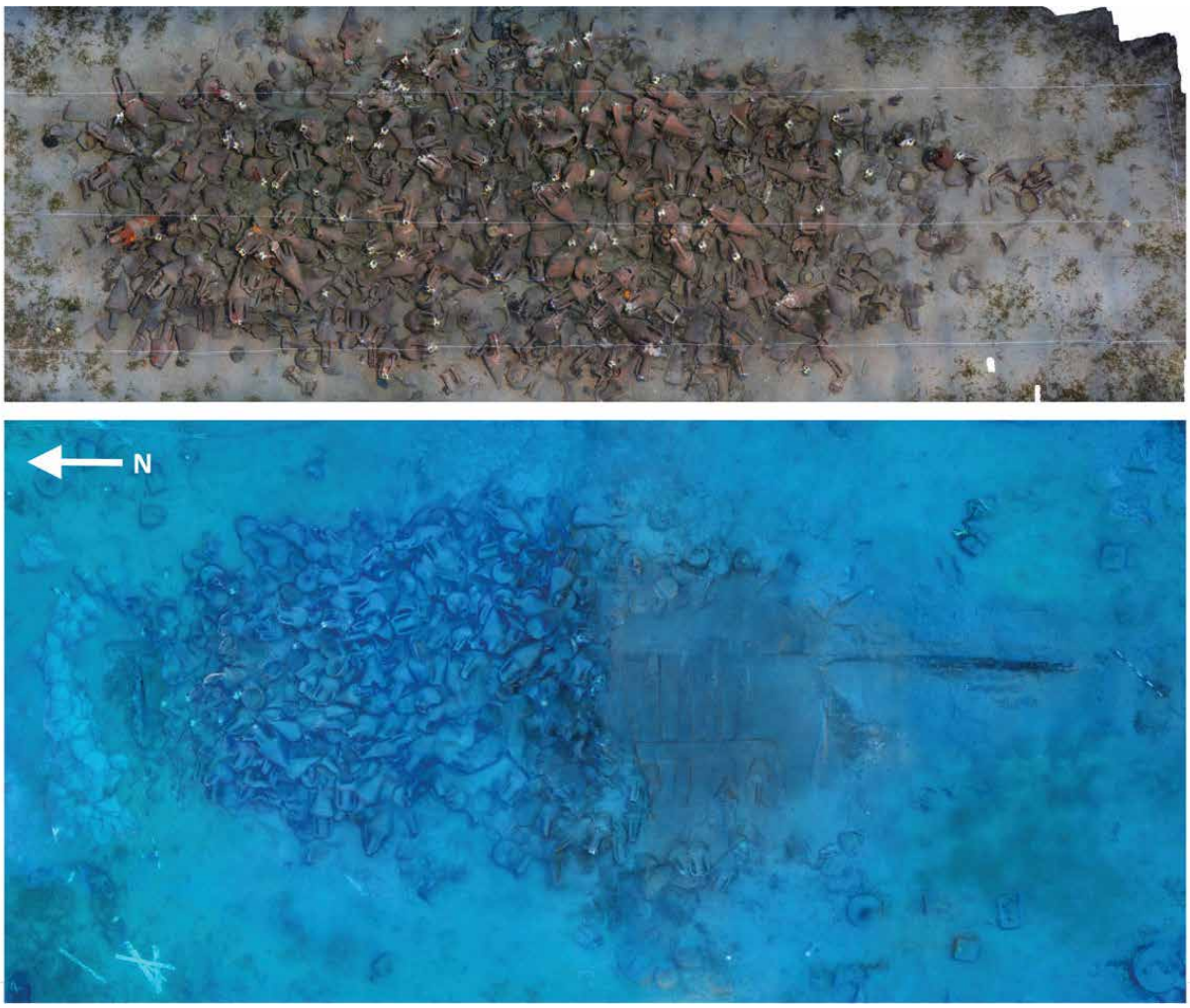

Fig. 2 Orthophotomosaics of the Mazotos shipwreck site; top: in 2007, before any excavation took place (processing: M. Vlachos; photos: B. Harzler); bottom: after 2019 field season (figure: M. Secci; photogrammetry: D. Skarlatos, M. Vlachos)

The cargo was a homogenous assemblage of transport amphorae of a well-known type from the island of Chios, in the Aegean. Their typological analysis had provided a tentative date of the site, to the middle of the fourth century BC (Demesticha 2009: 390; Demesticha 2011: 41–46). Radiocarbon dates and dendrochronology analysis were also applied to organic samples from the ship: a piece cut from a strake made of pine (*Pinus nigra*), dunnage consisting of short-lived (<5 years) complete twigs of *Lamiaceae* family, and pits from olives that were transported in Chian amphorae. A wiggle match on the ship timber suggested a minimum *terminus post quem* for the ship's launch somewhere between ca. 409–387 BCE, whereas radiocarbon dates on dunnage and olive pits yield a closely defined last voyage date range, between 390–377 BCE**,** thus pushing the originally estimated date back for about a quarter of a century (Manning *et al.* 2022).

Despite the fact that the excavation is still ongoing, the ship-shaped assemblage along with some key finds, i.e. the remains of three anchors at its southern end and the galley wares at its northern end, have allowed for the confident interpretation of the ship extremities as the bow and the stern, respectively. Most importantly, excavation has also exposed part of the wooden hull of the ancient ship. This paper is a preliminary analysis of these remains and a first attempt to place them in their nautical archaeological context.

2. The Hull Remains

Excavation has mostly progressed at the southern part of the site, where the fore part of the ship has been exposed. The hull sections include part of the keel and eight strakes, with six frames and a stringer still *in situ* (Fig. 3). At the northern end of the assemblage, which has been identified as the aft part of the ship, a smaller section of the hull was also exposed: the keel, one frame and at least five strakes extending to the west. The ship tilted to its starboard side after it reached the sea bottom, so under the western part of the assemblage (starboard) is the best part of the hull is preserved.

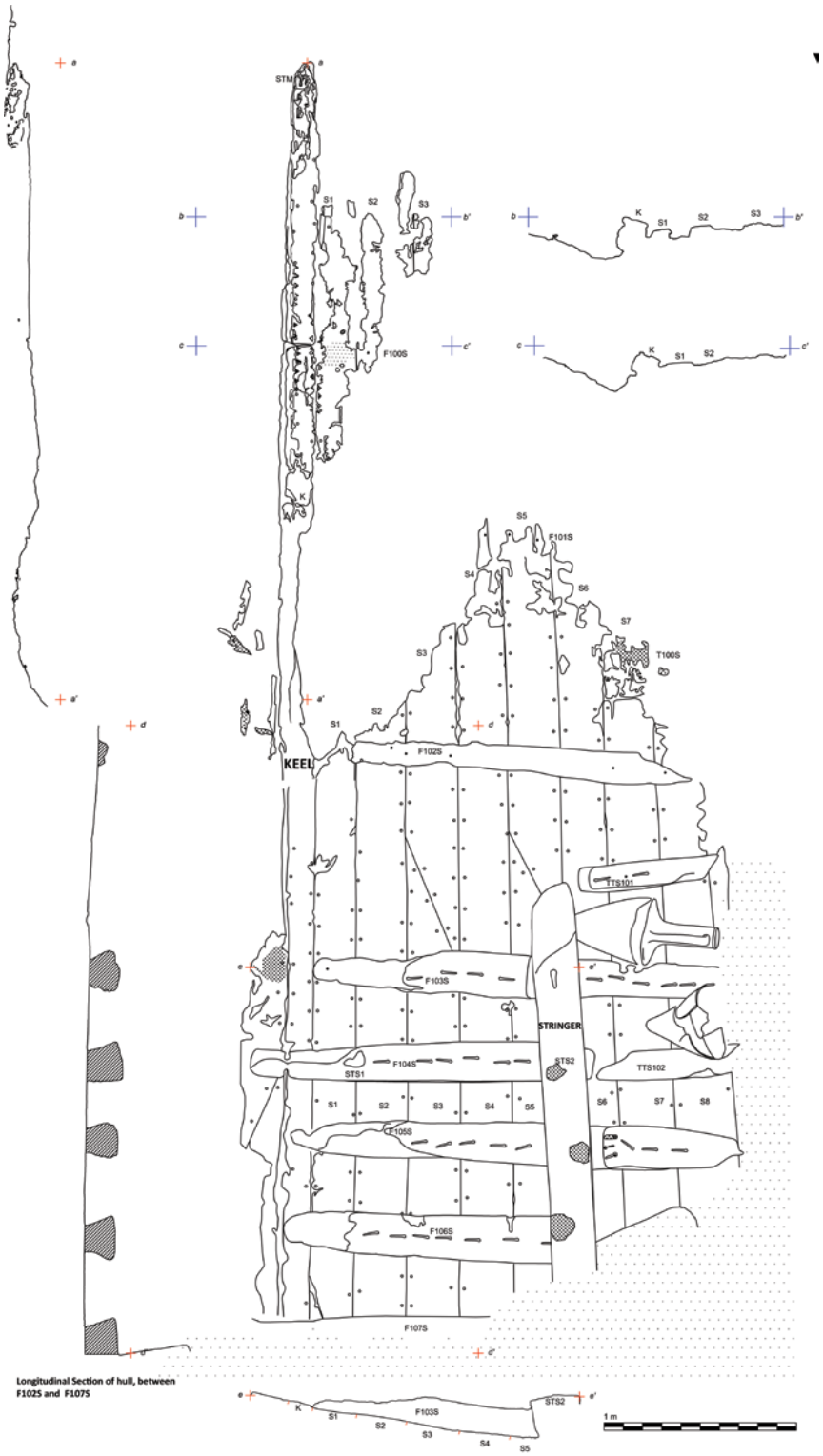

Fig. 3 Plan of the excavated hull remains of Mazotos Ship (drawing: C. De Juan)

2.1. Longitudinal elements

Stem. The first timber that was exposed, at the far southern end of the site, was the stem. It was preserved at a length of 1.47 m and it was joined to the keel with a complex locking hook-scarf, also known as a Jupiter scarf (Fig. 4). It was very eroded and *Teredo*-damaged but its section could still be measured, 13 cm sided 17 cm molded. Five almost vertical mortises were recorded: the best-preserved ones were 4 cm long and 0.9 cm thick, spaced at intervals of 4.2 cm edge to edge. They were noted on both sides, but because of the stem's poor state of preservation, it was impossible to understand if rabbets were associated with them, something that could have given a sharp profile to the vessel's bow. No joining remains of a knee above the stem were observed.

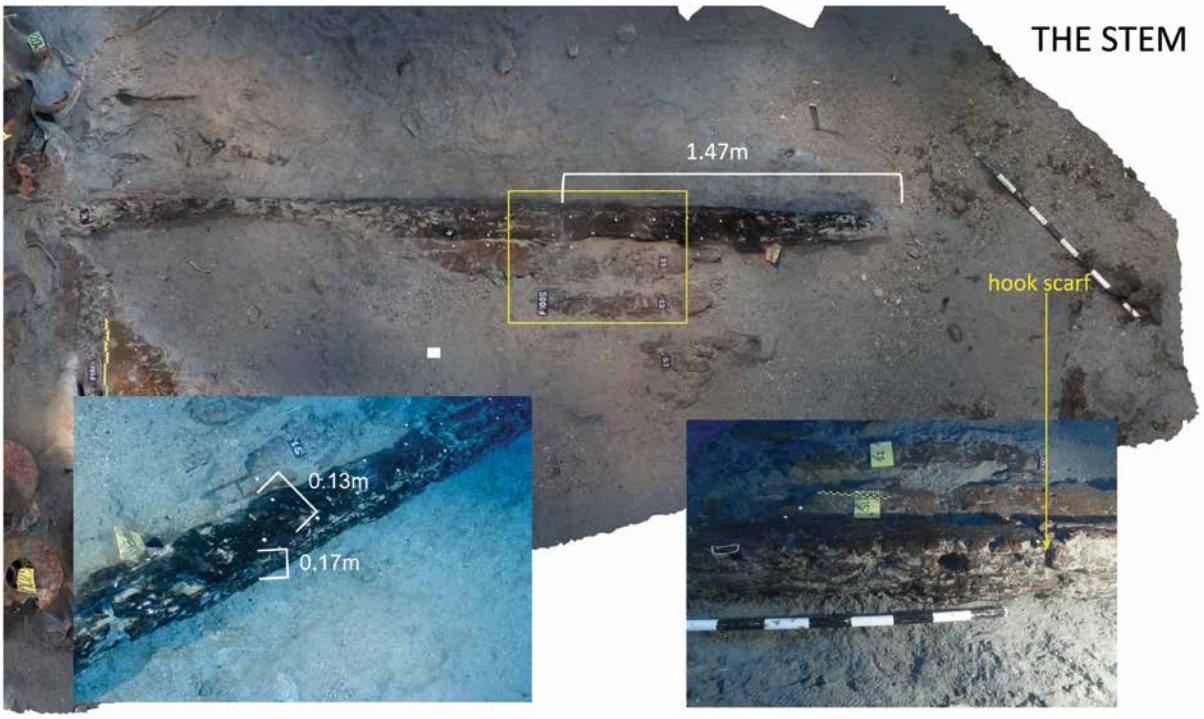

Fig. 4 The keel was joined with the stem by a hook scarf (photo: A. Kazamias)

Keel. The keel runs in a roughly north/south direction, tilted laterally in a way that its upper face slants down westerly**.** It is exposed from the hook-scarf to Frame 7 (F107S), where the latest field season ended (in 2019). It is badly eroded for 1m after the scarf, between the first and second frame (F101S–F102S), but it is better preserved closer to midships and continues under the unexcavated cargo all the way to the stern, where its broken end was exposed**.** The keel is narrower than the planks, and appears to be slightly larger in its molded than in its sided dimension (17 × 15 cm, respectively). Its lower face was too eroded in places that excavation could reach it, so the shape of its cross-section remains uncertain. An important feature, however, is that it has no rabbet or chamfer to hold the garboards.

Pegged mortise-and-tenons, opened in a quincunx pattern, were recorded by the hook-scarf. They were 8.6 cm long and 0.8 cm wide, placed 15.1 cm apart. Pegs, 1.3 cm in diameter, were placed vertically to fix the tenons.

At this same area, i.e. the joint between the stempost and the keel, more interesting features were documented, which deserve special attention. The attested plank joining technique is 'pegged mortise-and-tenons', all along the exposed part of the bow**,** but at the hook-scarf section, where the garboard strake attaches to the keel and stempost, tetrahedral recesses were clearly visible (Fig. 5). The tetrahedral recesses were opened on the keel and stem as well as on the respective, partly preserved, starboard garboard. They co-existed with mortise-and-tenons joins. Some incomplete tetrahedral notches, without perforations, were also marked on the starboard side, towards midships. Diagonal perforations, with a diameter of 8 mm, were opened inside tetrahedral recessions of 18 mm of axis, with a gap edge to edge of approximately 20 mm between them. No pre-assembling and reinforcing components, such as dowels, were found and no remains of the ligature itself were preserved. The co-existence of the two joinery techniques, coupled with the incomplete tetrahedrons and the absence of dowels, suggest a repair or an effort to reinforce some structural weakness or an incomplete juncture at the hook-scarf area.

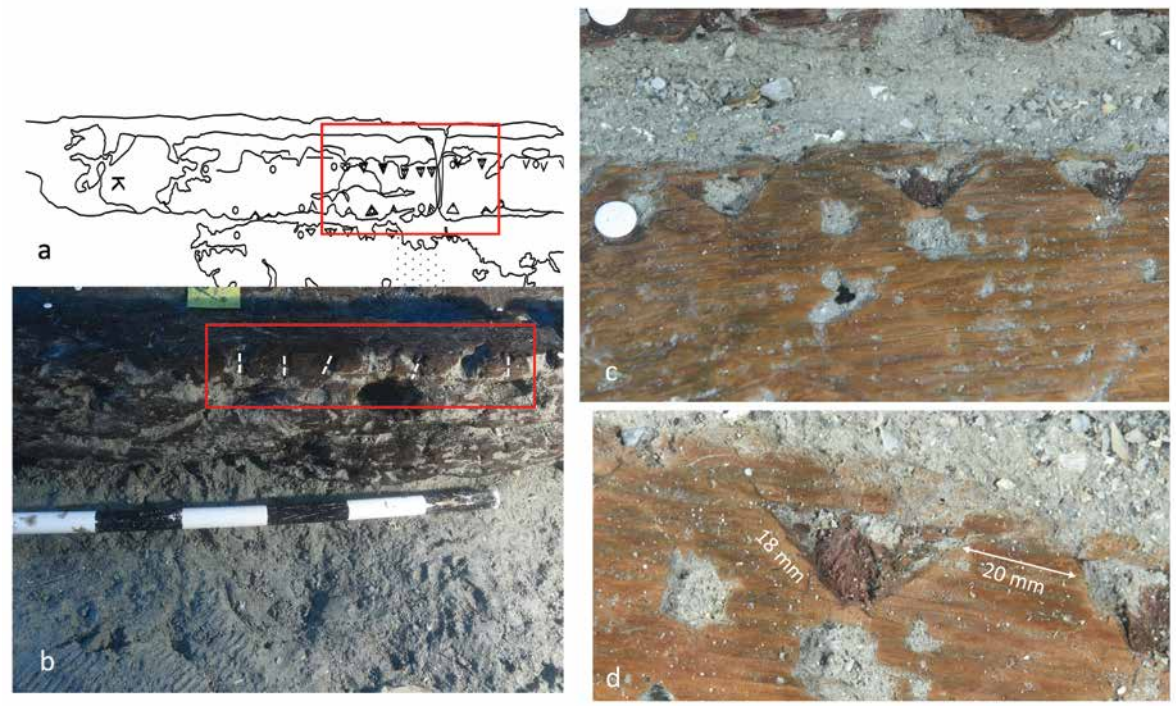

Fig. 5 The sewn parts of the Mazotos ship: a) top view of the keel-stem join (drawing: C. De Juan), b) side view of the keel; the vertical ligature grooves are marked with dash line, c) and d) details of the tetrahedral notches (photo: A. Kazamias)

Only the port side of the hook-scarf could be exposed, because no planking was preserved at this side. Despite its poor state of preservation, it was possible to identify a tenon key, placed horizontally on the hook-scarf. A false keel appeared to have been attached to it, which probably continued for about 1.5 m towards midships, but no further than Frame 2 (F102S). It was not possible to have a clear picture of the different timbers under the keel but this looked also like a repair, rather like a false keel that continued all the way to the stem.

Garboard. The starboard garboard was partially preserved at this area. Its thickness was the same as that of the rest of the recorded strakes, i.e. 4.9–5 cm. Right where the mortises changed from horizontal to vertical, its contact face was preserved for approximately 14 cm, beveled in a wide angle of 125º between its upper and lateral faces. Thanks to this carpentry work at the garboard contact face, a sharp profile was achieved at the bow, different to the almost 'flat' one at midships, from Frame 1 to 7 (F100S to F107S). From Frame 3 (F103S) the port side garboard was partially preserved as well. The angle between its contact face and the keel was close to 90º.

Stringers. Stringers were also preserved in the inner hull. Remains of the first starboard one (STR1S), were located along Strake 1, nailed to Frame 4. Also starboard, along Strake 5 (S5), a second, much better-preserved stringer was excavated, 23 cm wide and 4 cm thick. Both of them were joined to the frames with clenched nails, driven from the outside. On Stinger 2 (STR2S), four nails were recorded: one right in the center of the plank, and three closer to the sides, in a zig-zag pattern**.** The position of STR2S above hook scarves of the frames, as well as the position of the of top timbers right next to it, suggest that the turn of the bilge most possibly started from this position, i.e. from Strake 6 (S6).

Planking. In total, eight strakes were preserved at the starboard side of the bow, most of them well preserved and only minimally teredo-damaged. Strake width values range between 26 and 29 cm and their thicknesses range between 4.9 and 5 cm. They were joined with pegged mortise-and-tenons: on average, mortises, 5 × 1.2 ×12.2 cm, were placed 11.7 cm apart, edge to edge, and 17 cm center to center. The tenons fitted and filled the mortises completely, which must have left no room for sideways movement during the construction process. Pegs are regular, faceted, of conical profile; their largest diameters vary between 1.2 and 1.3 cm and the smallest ones between 0.9 and 1 cm. Most of them were placed from the inner hull.

The side faces of the planks were slightly beveled to give an angle to every single joint and thus create a round bottom midship profile (Fig. 6). That profile was very smooth from the keel to S6 and S7, where the turn of the bilge must have

begun. In S6 that angle is pronounced, as attested by the mortises' orientations. Also, the outer face of this plank could have been worked to achieve its transversal curve.

2.2. Transversal Elements

Frames. Frames have a trapezoidal cross section with beveled angles in their upper faces. Two top timbers were documented, which were smaller than the complete frames. Instead of a trapezoidal profile they both had a rounded upper face and were joined to the hull with square treenails and clenched nails. Although most of the floor timbers were eroded, Frames 4 to 7 (F104S to F107S) provided evidence that they were crossing over the keel towards the port side (Fig. 3). Two limber holes of trapezoidal profile were opened 8 cm apart, under Frame 6 (F106S), right on the keel-garboard joints, similar to those documented in laced Western Greek wrecks, such as *Cala San Vicenç* (Mallorca, Spain, 530–500 BCE) (Nieto and Santos 2008), or the round-bottom ones of Pomey's (1998) transition group 1, such as *Jules Verne 7* (Marseille, France, 525–510 BCE). The starboard one was clearly visible, while the port side one was right at the end of the preserved floor timber. It also became possible to observe a limber hole with a rectangular profile (7 × 4 cm approximately), under Frame 4 (F104S), placed in the joint between Stakes 3 and 4 (S3 and S4).

Fig. 6 Hull profile recorded on the fore part of the hull, where planking is well preserved (3D point cloud: M. Secci)

Although the study of the hull's fastening is still in progress, it was possible to identify three different fastening methods were used to join floor timbers, hook scarfs and top timbers: clenched nails, clenched nails driven through square treenails, and square treenails, all placed from outside of the hull. The nails have a square cross section that ranged between 4–5 mm, measured in the holes they left inside the planking.

As a good part of the hull remains unexcavated, it is too early to make a comprehensive assessment of the framing pattern. Moreover, the first two frames and top timber (F100S, F101S and TT100S) have disappeared completely, so it was only thanks to nail holes and oxidation residue that it became possible to distinguish the few remains of their lower faces above planking. But as excavation progressed from Frame 2 (F102S) to midships, the condition of the hull improved. Full frames from side to side (F103S, F105S and F107S) were alternating with top timbers (TTS101 and TTS102), placed from Strake 6 (S6) probably to the bulwark. The futtocks of the starboard side were connected to the floor timbers with hook scarfs, both documented in Frames 3 and 5 (F103S and F105S). Stringer 2 is positioned right above these scarves, and next to the top timbers. These arrangements indicate that the turn of the bilge most possibly started close to Stringer 2, i.e. from Strake 6. In the space between the three full frames (F103S, F105S and F107S), 45 cm on average, Frames 4 and 6 (F104S and F106S), made of different wood species and with different profile section,

were placed. It is not yet clear if they were part of the original construction or if they were added at a second stage, to reinforce the transversal carpentry towards midships.

3. Discussion

The hull of the Mazotos ship is preserved up to the turn of the bilge at its starboard side. Despite the poor state of preservation of the excavated timbers at the fore extremity of the hull, and the fact that excavation is still in progress, some distinctive shipbuilding features have already been recorded: a) two different fastening techniques, mortise-and-tenons and sewing, co-existed for about 40 cm on either side of the hook-scarf, most probably to repair a damage or to reinforce a weak part of the bow; b) the angle of the garboards as well as the profile section of the planking point towards a round bottom ship; c) the framing system is still uncertain, but it is possible that the main pattern is shaped by sparsely placed full frames, of trapezoid section, alternating with top timbers.

These features, combined in the same ship, find no parallels with shipwrecks that have been associated with the 'development phase' of the Greek shipbuilding tradition (Pomey, Rieth 2005, 163; Pomey, Boetto 2019: 27). Ships with round bottom profile, of Ionian influence, have been excavated around Marseilles, such as *Jules Verne 9* and *7* (Pomey 1995), as well as *Gela 1*, in Sicily (Benini 2001). Further into the Classical period, evidence suggests an evolution towards hull profiles with more elaborate lines and a pronounced concavity on both sides that gave them a 'wine-glass' section or a *retour du galbord*. Such hulls were fully shaped by the time of the late 4th century BCE ship of *Kyrenia* (Steffy 1985; Womer Katzev, Wylde Swiny 2022). Fifth century shipwrecks, like *Gela 2* in Sicily (450–425 BCE) (Benini 2001) and *Ma'agan Michael* in Israel (*ca.* 400 BCE) (Kahanov, Linder 2004) belong to a transitional period with a hull of 'wine-glass' section, a keel placed in a low position, in relation with the turn of the bilge, and garboards worked accordingly. The *Ma'agan Mikhael* ship is of particular importance for this discussion since it is associated with the Aegean or Ionia (Pomey, Rieth 2005: 162). Its hull lines followed the new trends of the period, namely the 'wine-glass' section (Kahanov, Linder 2004: 4–6), while the builders of the round-bottom Mazotos ship, dated a quarter of a century *later,* followed an older 'trend'. Still, similarities, such as the use of ligatures for repairs or reinforcements at the extremities, and the framing system (widely spaced full frames), could place both ships in the wider Greek tradition.

4. Conclusions

The Mazotos shipwreck, dated to the first quarter of the 4th century BCE, carried a homogenously Aegean cargo. Although it was found off the coasts of Cyprus, no finds thus far can associate it with the island or another eastern Mediterranean region, such as Egypt or the Levant. Its date places it between two important excavated ships of the Classical period, the *Ma'agan Mikhael* and the *Kyrenia.* Although the study of its particular shipbuilding features is still in progress, the Mazotos ship has already opened the discussion about the diverse shipbuilding traditions and practices of the 4th century BCE in the eastern Mediterranean.

More specifically, it does not seem to belong to the same tradition with the known 5th and 4th century ships, all with 'wine-glass' section hulls, i.e. the *Gela 2*, the *Ma'agan Mikhael* and the *Kyrenia.* Rather, according to our interpretation, all evidence recorded on the hull of the *Mazotos* ship point towards a distinctive shipbuilding 'evolution branch', characterised by the round-bottom hull lines, the use of mortise and tenons, the sparse framing system and the partial use of ligatures. Such features have already been recorded on the archaic ship of *Jules Verne 7*, excavated in Marseilles (525–510 BCE) (Pomey 1998). Given the Aegean origin of the cargo and all other artefacts excavated from Mazotos thus far, this shipbuilding tradition could be associated with the Greek world or Ionia, in particular. It is also interesting that along with these archaic elements, others, like the reinforcement of transversal carpentry towards midships, can place the ship in the transitional phase, towards Pomey's 'Hellenistic Republican Architectural Family' (1998). This suggests a parallel technological evolution, along with other attested eastern Mediterranean shibuilding traditions.

As the excavation progresses, further study of the hull elements of the Mazotos ship is expected to provide a better understanding of its construction and a better contextualisation within the archaeological record of eastern Mediterranean ships, which remains rather poor in excavated examples.

Acknowledgments

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