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The Roman Scuttled Ships and Harbour Structures of Caska, Pag Island, Croatia in their Cultural and Historical Context

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The Bay of Caska, on the Island of Pag, preserves the remains of a stratified settlement, with an important phase linked to a Roman maritime villa, the property of the senatorial family Calpurnii Pisones. After presenting the geographical and historical context of the site of Caska, the article summarizes the achievements of past archaeological research, and presents the results of the recent research carried out on land and under water. In particular, it focuses on the harbour structures, where the remains of four scuttled vessels were discovered. These vessels, three sewn boats and one mortise-and-tenon built ship, all filled with rocks, formed pier-like coastal structures. The architecture of these vessels is also discussed.

Key words: Caska, Island of Pag, scuttled ships, sewn boats, mortise-and-tenon built ship, wooden coastal structures.

It is widely accepted that the ancient Cissa, the island with the Liburnian *oppidum* mentioned by Pliny the Elder in the 1st century AD, can be identified as the island of Pag (Fig. 1), with its centre of power located in the general area of present-day Novalja. While experts continue to debate the exact position of Roman and medieval Cissa, it seems that in ancient times the Field of Novalja with its adjacent bays (Novalja, Stara Novalja, and Caska) acted as the centre of Liburnian and later Roman power.

The remains of ancient Cissa have for centuries attracted the interest of the local population and the rare visitors to the island. The first account of both on-land and submerged finds in Novalja and in the inlet of Caska is provided by the itinerary of the Venetian syndic inquisitor (Ven. *sindico inquisitore*) Zan Batista Giustinian, written in 1553 (Ljubić, 1877; Šimunković, 2011). A major advance in recording the ancient remains in the area of Novalja was made by Mijat Sabljar in 1852, a representative of the National Museum in Zagreb, who not only described but also drew with amazing precision the Roman structures in Novalja, Stara Novalja, Caska, and on the hill of Košljun (Sabljar, 1852; Mirnik, 1972).

Unfortunately, many archaeological objects from Novalja and Caska have ended up being sold in the antiquities market in Venice (Szabo, 1933; Celić, 2015) and urban development during the past two decades has destroyed important structures. Therefore, the need for systematic research aimed at preserving the rapidly disappearing archaeological record has become a priority.

Although a number of 20th-century authors wrote about the antiquities of Novalja and Caska, and gave their interpretations of the archaeological remains, little substantial fieldwork was achieved. Caska is a challenging archaeological site with much precious evidence hidden in the tidal zone where it is not possible to conduct either a typical land or underwater excavation and where natural forces can easily nullify archaeological efforts. The SE wind (*jugo*), raises the water level of the inlet and generates strong waves causing everything in the tidal zone that is unprotected from the wind to be quickly covered with gravel and mud. Caska's shallow waters conceal harbour structures built of organic materials over broad areas that cannot be easily mapped by surface surveys. On land, buried structures are overlaid with residential buildings, while standing features are without sediment or in danger of collapse. The coastal erosion that threatened the Roman inhabitants still aggresses the archaeological remains today, with no means of preventing it.

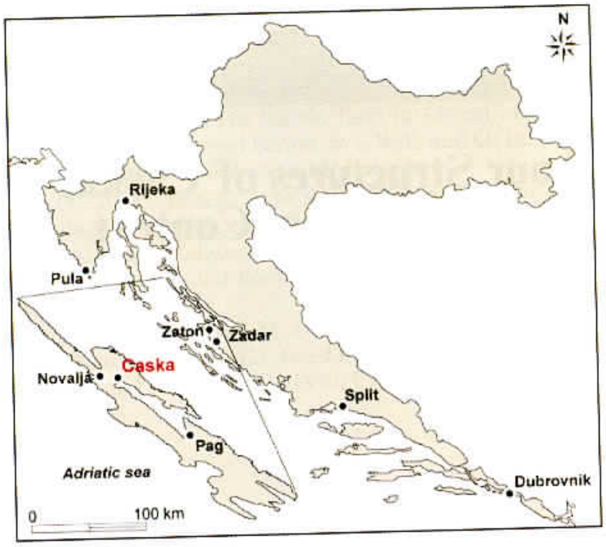

Figure 1. Location of the Bay of Caska on Pag Island (drawing V. Dumas, AMU, CNRS, CCJ).

The international project CissAntiqua, conceived in 2009 by the University of Zadar (Zadar, Croatia) and the Centre Camille Jullian (University of Aix-Marseille, CNRS, Aix-en-Provence, France), following research started in 2005, soon became an interdisciplinary scientific endeavour targeted at understanding the cultural landscape of Caska in Roman times (Čelhar, 2008; Radić Rossi, 2008a; 2010; 2011a; Radić Rossi and Boetto, 2010; 2011; Boetto and Radić Rossi, 2014; 2017; Boetto, 2016). After several centuries of intensive use in the Roman period, Caska remained an isolated place prior to modern development. The following text aims to briefly describe the geographical and historical context of the site and the study of the submerged harbour structures and scuttled ships.

Geographical context

Pag is an elongated island, extending NW–SE along the Eastern Adriatic coast (Fig. 1). It lies at the border of the Northern Croatian Littoral and Northern Dalmatia, and is separated from the mainland by the relatively narrow (3–4 km) and long (121 km) Velebit Channel. The channel is renowned for its north-eastern wind named *bura* (It. *bora*), the strongest in the Adriatic basin, and the lack of safe anchorages (Fig. 2a). As the direct consequence of the *bura* and the salty atmosphere that it creates, the eastern slopes of the island are a rocky, karstic landscape, with sparse vegetation. The impression of the island when viewed from the mainland as a desolate rock is improved when viewed from the summit of the first row of hills, from which fertile fields and small lakes in Mediterranean marshlands are revealed.

Pag is situated in the inner row of the Eastern Adriatic islands. With a surface area of 284.14 km^2 it belongs to the group of big islands (Duplančić *et al.*, 2004), in fifth position according to size after Cres, Krk, Brač, and Hvar. Geologically, the island of Pag is a part of the Dinaric complex, characterized by the alternating carbonate anticlines and flysh synclines (Magaš, 2011: 8). The syncline that separates the two anticlines runs from the Fields of Novalja and Caska to the Fields of Pag and Dinjiška. Its central part is submerged, forming the Gulf of Pag. Surrounded by the island on all sides, the Gulf is joined to the Velebit Channel, only through the narrow (1.8 km) NW–SE passage Paška Vrata (The Gate of Pag). The Gulf of Pag is about 17 km long, and up to 3.3 km wide.

The shallowest area of the Gulf, up to 18 m deep, extends to the north-west from the islet of Veli Školj, and is named the Bay of Caska. It terminates in the inlet at the settlement of Caska (Fig. 2b), which is situated to the west by the promontory of Zrće. Considering the 13 km-long passage between the Velebit Channel and Paška Vrata, and the broad unprotected Gulf sea on which southern winds raise big waves, the position of Caska does not have a geographical predisposition to have been a major port on the seafaring route. On the other hand, its north-eastern part is protected from the north-eastern wind, and lies in the immediate vicinity of the Field of Caska, and further on, the Field of Novalja.

Figure 2. a) Effect of the *bura* in the Velebit Channel (photo I. Radić Rossi, University of Zadar); b) aerial view of the Field of Novalja, with adjacent ports (photo. V. Glavaš, University of Zadar); c) view from the west of the inlet of Caska (photo L. Damelet, AMU, CNRS, CCJ).

Although Pag has a predominantly rocky landscape (86%), the island is characterized by a vast variety of vegetation, with 650 sorts of vascular plants (without counting cultivated plants), among which 45 are endemic species (Horvatić, 1963; Magaš, 2011: 23). Besides a large variety of low plants, Pag still preserves evidence of evergreen oak (*Quercus ilex* sp.) and pubescent oak (*Quercus pubescens* Willd.) forests; judging by the prevalence of forest-related toponyms, it can be presumed that in the past these species covered significantly larger areas. On the other hand, the black and Aleppo pines (*Pinus nigra, Pinus halepensis* Mill.) seem to have been planted on the island through human intervention (Magaš, 2011: 23–24). It is also worth mentioning the presence of plants such as Spanish broom (*Spartium junceum* L.), which were certainly exploited in the past for textile and rope production. Another important group of plants, related to the land and underground water resources, are the canes; their existence in most of the Pag lowlands indicates the presence of fresh water.

Nowadays, 80% of the island is used for agriculture, embracing fertile fields and rocky pastures (Magaš, 2011: 39). Fishing activity is quite poor, but in antiquity it appears to have been another significant economic resource. Organized tuna and mackerel fishing, especially in the bay of Stara Novalja and the Gulf of Pag, is remembered as a significant activity in both oral tradition and evidence such as the 19th-century watchtower, known as 'Tunera' or 'Turan', that still stands in the inlet of Caska (Fig. 2c). The production of salt is one of the main activities on the island, today concentrated in the Fields of Dinjiška and Pag. It can be presumed that this activity started much earlier, and that the presence of smaller saltpans probably characterized many other areas as well.

Considering the position of Pag at the intersection of seafaring routes that linked the northern and central Adriatic (Brusić, 1993; Arnaud, 2006), it is obvious that the western coast of the island, with the Port of Novalja to the north and the Gulf of Košljun to the south, could have provided safe natural shelters in this area. The Port of Novalja does not require a large deviation from the main route, while the Gulf of Košljun is hindered by its geographical position with respect to the island and the Sea of Vir and the Channel of Zadar. Presuming the same seafaring conditions in ancient times, Zdenko Brusić suggested that the seafaring regime in Kvarnerić made use of the Port of Novalja (Brusić, 1993: 226, note 8) (Fig. 1).

Historical context

In the 1st century AD Pliny the Elder (*NH* 3, 139–144, 150) described the Roman province of Illyria/Dalmatia. In the list of oppida on the coast and on the islands in the northern part of the convent of *Scardona*,[1] Pliny wrote: 'In that gulf, besides those previously stated, are the islands with the fortified settlements *Absortium, Arba, Crexi, Gissa Portunata*'. Although this form appears in most transcriptions of Pliny's work, the original must have been *Cissa*, and *Gissa* is a later revision (Čače, 2011: 611).

It is not easy to present a concise overview of ancient Cissa as most of the archaeological results of previous research are not fully published or deserve further study. Despite this and taking into account the data available, there is no doubt that Roman Cissa lay in the northern part of the island, and that the centre of power moved to the central city of Pag in the 12th century AD. On the other hand, it remains unclear whether the toponym in Roman times indicated a single place, the broader area, or whether it changed from one location to another over the course of centuries.

The most prominent candidates for Roman Cissa remain the inlet of Caska and the Port of Novalja (Škunca, 1991; Suić, 1996).[2] One important observation is that the archaeological remains in the inlet of Caska are largely associated with the potent Roman family of Calpurnii Pisones and their successors. While the remains found in the Port of Novalja point to a public port and urban settlement related to its location.

Regardless, most authors agree that the toponym Cissa as used in Late Antiquity indicated the urban settlement that developed around the port of present-day Novalja (Kurilić, 2011). The situation in the Early Empire remains unclear, although the idea of a private estate belonging to Calpurnii Pisones in the inlet of Caska, which lost its importance and glory in Late Antiquity, seems to be the most plausible.

It is known that the family of Calpurnii Pisones owned properties in both Histria and Liburnia (Šašel, 1963: 389; Tassaux, 1985: 153–154; Starac, 1995: 139). The Histrian properties were probably obtained after the establishment of the *Colonia Pietas Iulia Pola*, in which L. Calpurnius Piso Caesoninus was the first *duovir* mentioned in the inscription on the Gate of Hercules in Pula (Fraschetti, 1983; Tassaux, 1985: 154). Based on current archaeological finds, the Liburnian property of the other branch of the family, descending from Cn. Calpurnius Piso Frugi, is presumed to be located on Caska inlet on the island of Pag. Although there is no direct evidence, it was likely obtained in the time of the Emperor Augustus, when Cn. Calpurnius Cn. f. Piso was awarded the above mentioned *saltus in Illyrico* (Eck *et al.*, 1996: 44–45). The finds date from the end of the late republican and the earliest imperial period (Kurilić, 2011: 69), suggesting a Roman presence in the inlet in the 1st century BC.

In the local tradition, the destruction of wealthy and glorious ancient Cissa was caused by its disappearing in the sea as punishment for its inhabitants' evil acts (Crnković, 2003). The stories usually revolve around two sisters, a bad but wealthy one and a poor but good one, and end with the salvation of the good sister. They

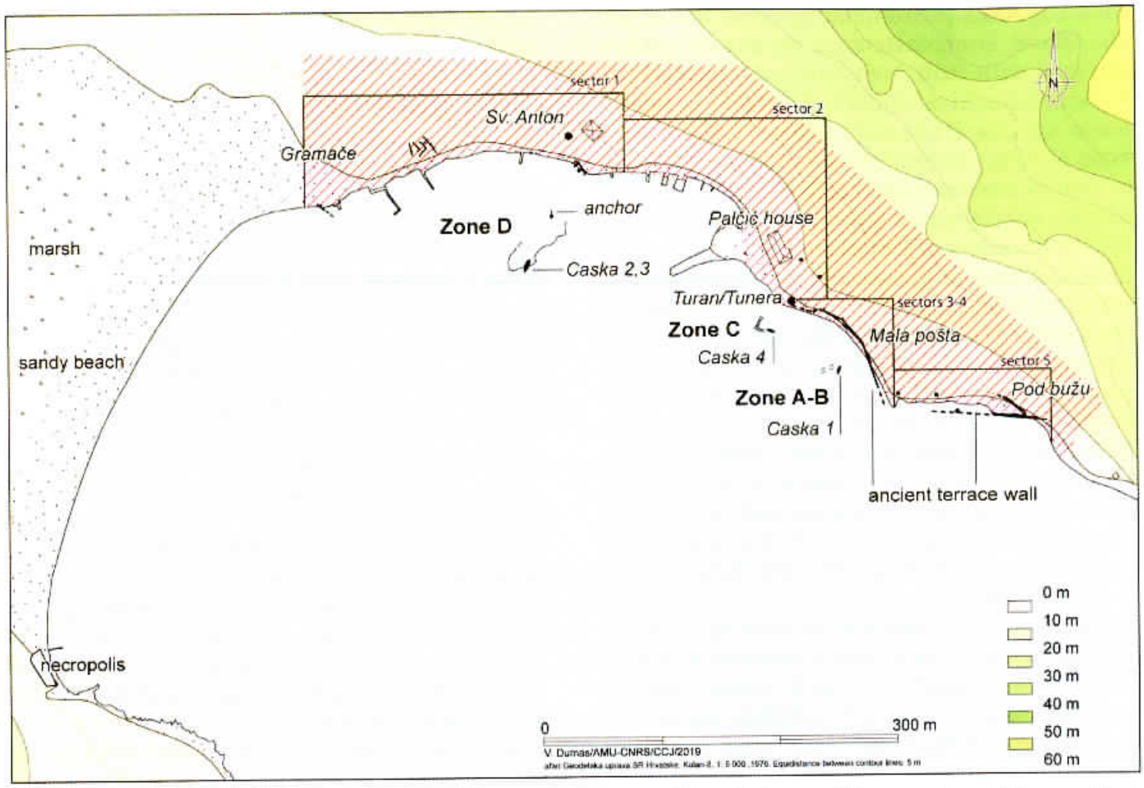

Figure 3. Zones excavated in Caska inlet. The red-hatched area gives an idea of the possible extension of the maritime Roman estate (drawing V. Dumas, AMU, CNRS, CCJ).

are deeply embedded in traditional oral narratives and folk memory of the past. Such legends of cities that disappear in dramatic events are common sea lore and are often found in conjunction with submerged coastal archaeological remains in Croatia.

Progressive sea-level change causing the partial submergence of the Roman settlement in the inlet of Caska has been shown by several scientific and archaeological investigations on land and under water (Marriner *et al.*, 2014), but we cannot be sure whether a natural catastrophic event caused drastic changes in the cultural landscape of the bay, and the abandonment of the already weakened community by the end of the 4th century AD.

A stratified settlement

The archaeological site consists of both coastal and underwater structures situated along the north-eastern coast of the inlet related to the habitation and economic area. The remains of the settlement in Caska point to one or more Roman villas, which existed from the 1st century BC to the 4th century AD.

The visible remains extend from Gramače in the vicinity of the beach, towards a vertical rock known as Gavranišće, passing across the area of Sv. Anton (St Anthony), the old house of the Palčić family, the tuna watchtower, and the inlets of Mala Pošta and Podbužu (Fig. 3). A narrow submerged 'path' leads to the nearby inlet of Klopotnica, where, at Grgurovac, a system of shallow channels or tunnels of unknown date is carved into the rock.

On the western side of the beach there is a necropolis, excavated 2003–2007, and 2012 (Kurilić, 2008; 2013) (Fig. 3), with evidence of incineration burials dated to the 1st–4th centuries AD, and two tombs with skeletal remains (Kurilić, 2007; 2008; 2013: 236). Typical burial chambers consisted of four to six *tegulae* positioned to form a roof, with one or two 'chimneys' made from two *imbrices*. The tiles were surrounded by square or rectangular stone structures (Kurilić, 2007; 2013: 236).

In the north-eastern part of the bay, close to Gramače in Sector 1 (Fig. 3), the remains of the *pars rustica* of the Roman villa were excavated in two research campaigns, carried out in 2005 and 2006 (Skelac, 2006; 2007; Grisonic and Stepan, 2018: 71–77), in advance of a house construction. It revealed the presence of a storage area (possibly a wine cellar), and a portion of a sewage system in the form of 11 m long and 1.2 m wide sewer, made of stone slabs bound with mortar, and paved with *tegulae*. Five *dolia* were set into the ground sometime in the 1st century AD, but had been broken and covered by a pavement before the second half of the 3rd century AD (Skelac, 2006: 283). The complex continued through the 4th century AD (Skelac, 2007: 316). Six stone slabs positioned in two parallel rows, suggest a wine press in the nearby 'cellar'

Figure 4. a) View of the structures in Sector 1 (photo Ph. Groscaux, AMU, CNRS, CCJ); b) drainage canal built through the terrace wall (photo Ph. Groscaux, AMU, CNRS, CCJ); c) fragment of the terrace wall (photo I. Radic Rossi, University of Zadar); d) buildings of unknown purpose above breccia slabs (photo Ph. Groscaux, AMU, CNRS, CCJ).

(Lipovac Vrkljan and Konestra, 2018: 21), which had gone out of use by the late Augustan or early Tiberian period (Grisonic and Stepan, 2018: 74).

Architectural remains in the tidal zone in front of the submerged pier in Sector 1 (Fig. 3), which are mostly now covered by modern constructions, were cleaned and recorded in 2013 (Fig. 4a). In a first phase they certainly had some production role, although their function remains unknown. In a second phase, the complex developed to the east, with the addition of a water cistern and two spaces of unknown purpose. In a third phase, the function of the structures appears to have changed and they were abandoned.

The remains of the wall (Fig. 3), considered the city wall of ancient Cissa by some (Kurilić, 2013: 232; Oštarić and Kurilić, 2013: 230–235), could be traced from Tunera to Gavranišće in Sectors 3–5. With careful inspection and archaeological research in 2011–2013, it was established that it represents a terrace wall, providing a waterfront with a well-constructed outer side (Radić Rossi and Boetto, 2012a: 511; 2012b: 617). Its foundations are 1.8 m wide, and the wall is battered. It is preserved in parts to a height of 5 m, and there are *tegulae*-paved drainage channels built through it (Fig. 4b, c). Behind one of these channels, layers of natural drainage materials were recorded, which reinforced its interpretation as a terrace wall. The wall was provided with niches, probably for hosting statues, which contributed to the monumentality of its sea façade (Radić Rossi and Boetto, 2013: 381).

Several places on the terrace behind the wall have evidence of ancient structures, still waiting to be researched. At the point between the inlets of Mala Pošta and Pod Bužu, where the terrace wall changes orientation (Fig. 3), broken slabs of breccia testify to the consequence of its destruction (Radić Rossi and Boetto, 2013: 384). The slabs had been positioned on the flysch substrate, protected by the terrace wall, and likely served as a solid foundation for buildings of unknown function. After the terrace wall was abandoned, the flysch substrate eroded and the breccia slabs fell into the sea, taking with them any built structures (Fig. 4d).

In the inlet Pod Bužu an entrance to an underground channel is incorporated into the terrace wall (Fig. 5a) (Radić Rossi and Boetto, 2013: 382–385). The side

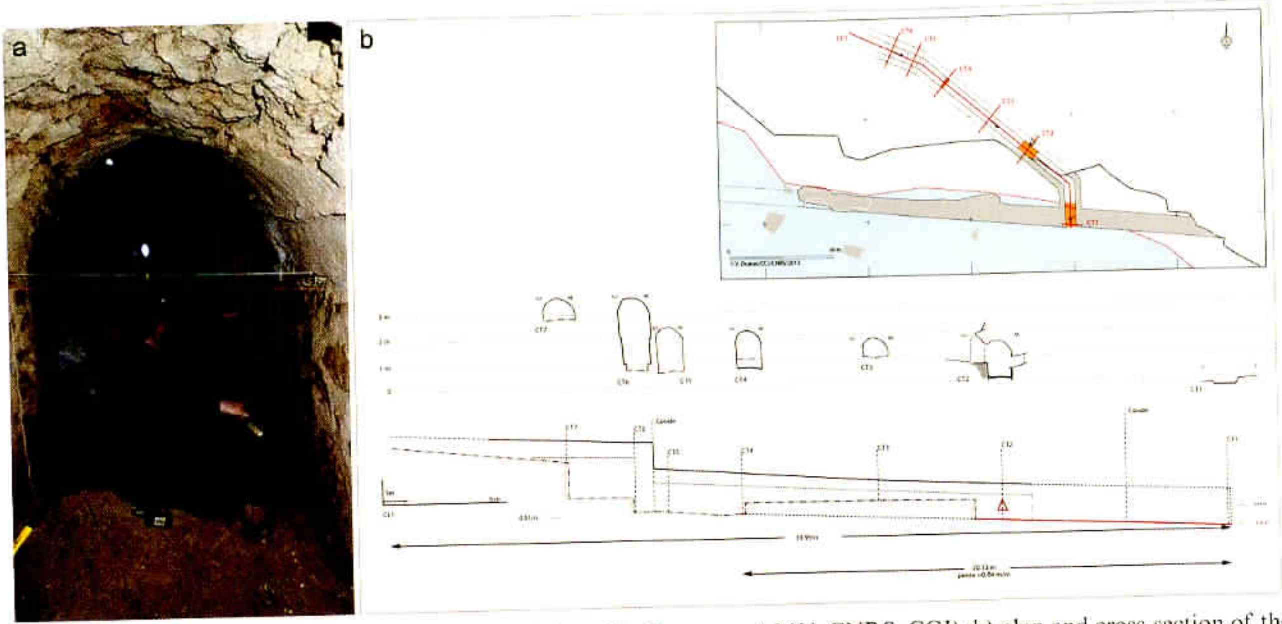

Figure 5. a) Measuring of the underground canal (photo Ph. Groscaux, AMU, CNRS, CCJ); b) plan and cross-section of the underground canal/tunnel (drawing V. Dumas, AMU, CNRS).

walls of the channel are built of stone rubble, and the vault conserves evidence of the planks used for its construction. Its floor is paved with *tegulae* positioned in pairs, and about 10 m before its end there is a small lateral channel, triangular in section, built entirely out of *tegulae*. The main channel is 1 m wide, 1.2 m high, and 23 m long. It is connected to another underground structure, 1.2 m wide, and 2.25 m high, which slightly changes the orientation towards the west. The second structure has collapsed after just 7 m, so it has not been explored entirely. The bottom of this tunnel is not paved with *tegulae* or any other construction material, and it lies about 0.7 m above the bottom of the following channel (Fig. 5b). The function of the tunnel remains unknown, although it is almost certain that it was not exclusively for drainage, but rather had a role in supply, or evacuation in critical moments.

All the coastal structures, except the necropolis and Roman villa remains, were cleaned and documented to create a topographic basis for interpreting the underwater remains.

The submerged coastal structures

The area with submerged coastal structures is spread along the north-eastern edge of the inlet of Caska, in front of the terrace wall and other visible architectural remains. Three separate zones have been identified that are rich in archaeological features. The first, in order of their discovery, is situated south-east of Tunera (Zone A-B), the second to the south-west (Zone C), and the third to the west (Zone D) (Fig. 3).

Zone A-B

The first scuttled boat, Caska 1, was discovered in 2007 in the Zone A-B, and was excavated 2009–2012 (Figs 3 and 6). The boat lay on a gentle slope, 1.5 to 2.5 m deep, oriented north-south, and about 20 m from the shore, in front of the part of the terrace wall preserved to the greatest height (Fig. 4c). The excavation trench covered an area of 184 m^2. Only a 7 m length of the bottom of the sewn hull remained, with some parts of the sides found nearby, broken from the main structure. The hull was filled with a layer of small rocks (0.10–0.15 m) between the frames, covered by a layer of bigger rocks (up to 0.50 m) (Fig. 6), and was associated with two parallel rows of vertically positioned stakes (from 40–60 mm up to 80–130 mm diameter), about 2 m apart, suggesting it was scuttled to form a pier-like shoreline structure.

The whole stake structure was filled with a thick layer of horizontally laid branches of various shapes and dimensions. It seems that the rough wooden framing, excavated over about 15 m to the west of the scuttled ship, retained an accumulation of stone blocks in place, and served as the base for an ancient waterfront.

Zone D

In 2005, a casually positioned 2 × 2 m trial trench revealed the excellently preserved wooden parts of a small Roman anchor (length 1.56 m), abandoned before being completed with a lead stock, from the 1st/2nd century AD (Figs 3 and 7), suggesting the area was of archaeological interest (Radić Rossi, 2006; Čelhar, 2008: 181–182).

Excavation continued after, in 2012, a detailed survey along the outer side of a large breakwater

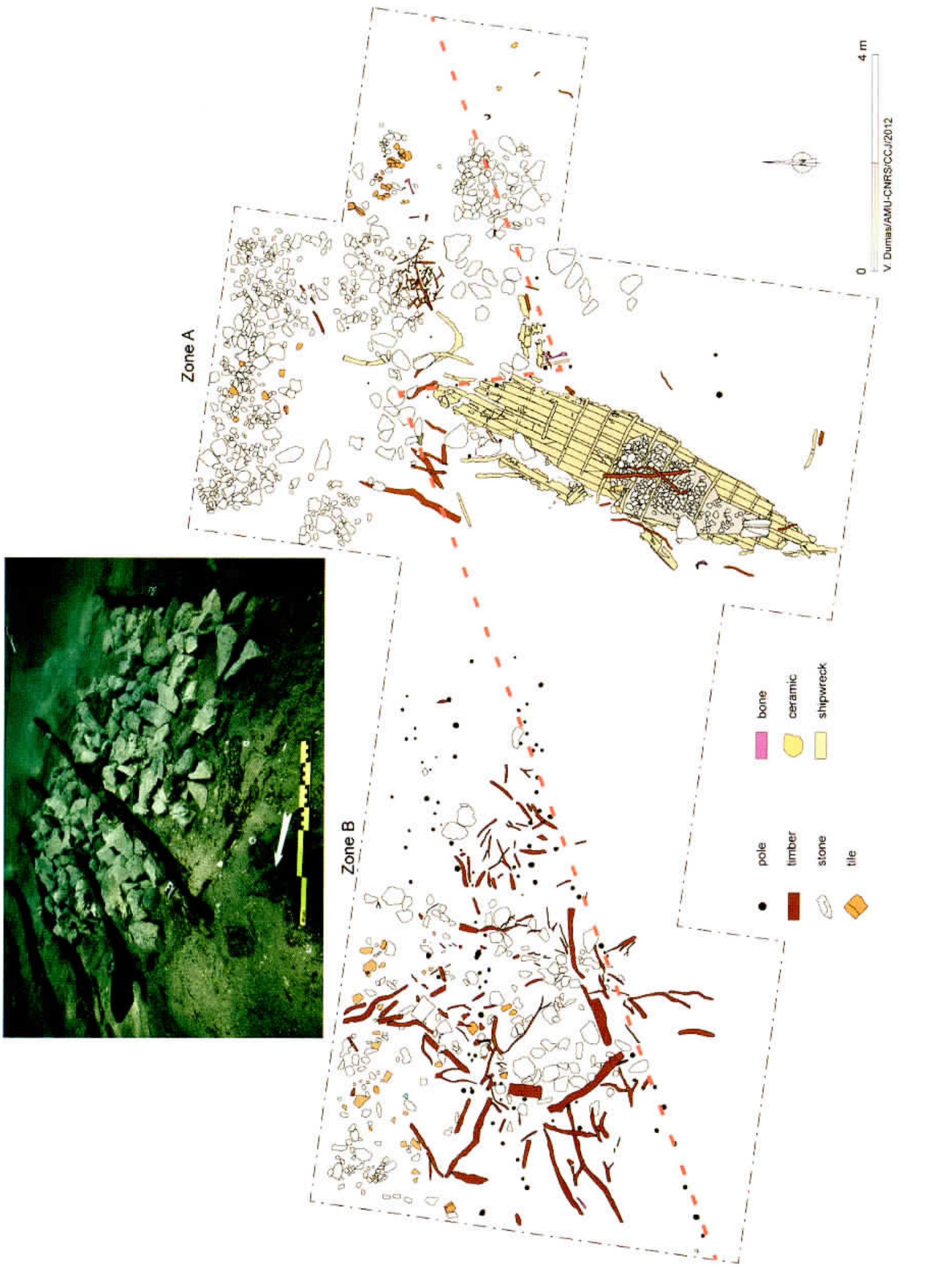

Figure 6. Zone A-B with the scuttled sewn boat Caska 1 (drawing V. Dumas, AMU, CNRS, CCJ); inset: layer of small stones covering the bottom of Caska 1 (photo L. Damelet, AMU, CNRS, CCJ).

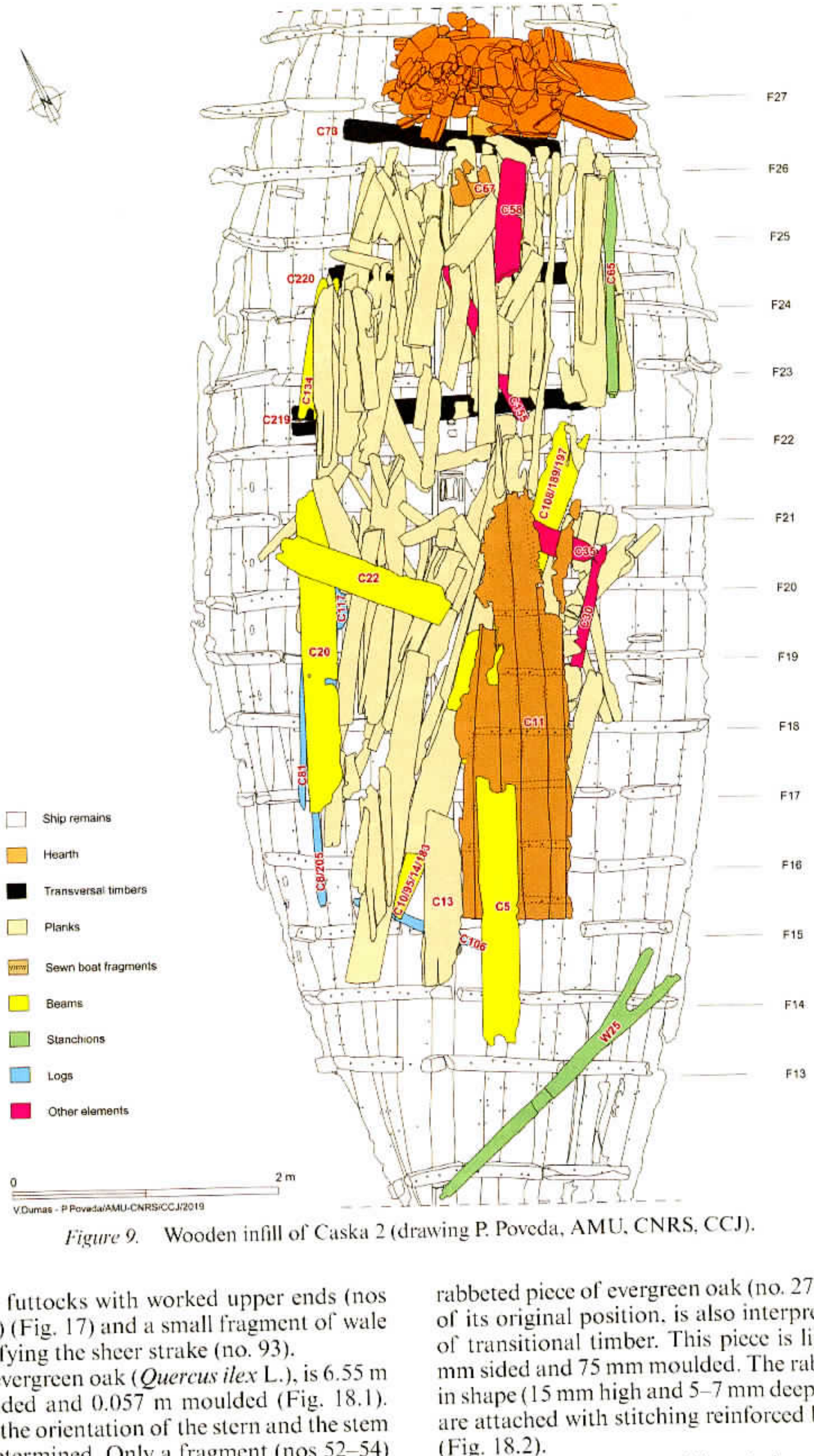

Figure 9. Wooden infill of Caska 2 (drawing P. Poveda, AMU, CNRS, CCJ).

and 946), three futtocks with worked upper ends (nos 15, 78, and 324) (Fig. 17) and a small fragment of wale probably identifying the sheer strake (no. 93).

The keel, in evergreen oak (*Quercus ilex* L.), is 6.55 m long, 0.06 m sided and 0.057 m moulded (Fig. 18.1). Unfortunately, the orientation of the stern and the stem could not be determined. Only a fragment (nos 52–54) of evergreen oak, belonging to the transitional timber of the north end is preserved (Fig. 18.3). Nevertheless, a rabbeted piece of evergreen oak (no. 27), discovered out of its original position, is also interpreted as fragment of transitional timber. This piece is lightly curved, 50 mm sided and 75 mm moulded. The rabbet is triangular in shape (15 mm high and 5–7 mm deep), and the planks are attached with stitching reinforced by a row of nails (Fig. 18.2).

The scarfs to the transitional pieces, 0.20–0.23 m in length, are locked by horizontal keys (25–28 mm wide

Figure 10. Fragment of sewn boat Caska 3 (photo D. Frka, University of Zadar).

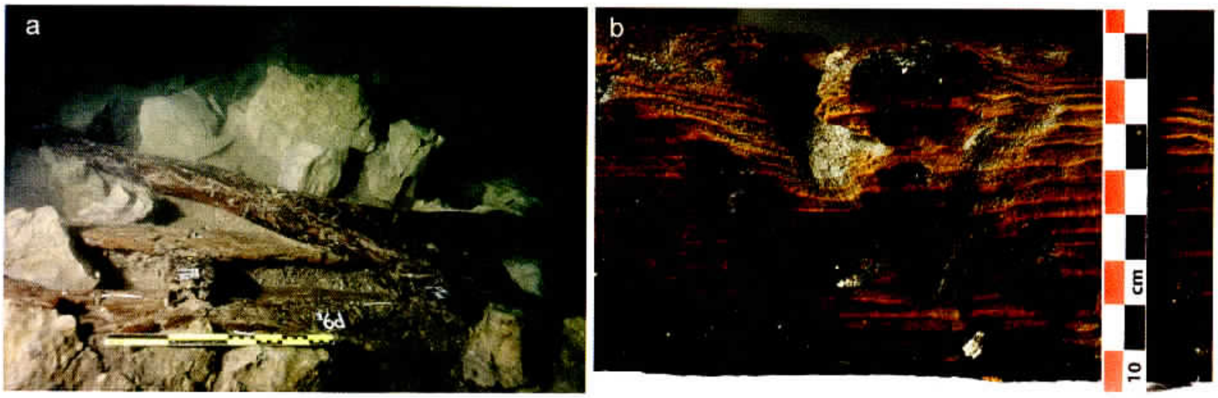

Figure 11. a) Forked stanchion (photo Ph. Groscaux, AMU, CNRS, CCJ); b) letters S·V· engraved on a timber with recesses (C30) (photo T. Seguin).

and 8–11 mm thick) and by vertical treenails (diam. 10–13 mm) (Figs 18.3 and 19). The keel is not chamfered for the garboards (Fig. 18.1). The garboards are up to 25 mm thick at the keel, to which they are attached with stitching. Two planks, connected by an oblique scarf, compose each garboard strake (P1 and P6 on the west, P11 and P37 on the east).

The ship's planks, heavily compressed by stone infill, are 15 mm thick with a maximum width of 0.16 mm. The west side of the ship is composed of 11 planks connected with oblique scarfs. This contrasts with the five preserved strakes of the east side, none of which contain a scarf, although a repair is found in the middle of the second strake (P12) between frames F7 and F9 (Fig. 15a). The planking is built using only beech (*Fagus sylvatica* L.). A small fragment of plank (no. 93), probably a wale, was found detached to the east of the shipwreck. It is 41 mm thick and 60 mm wide and is made of evergreen oak.

Planks are fastened with stitching. The presence of dowels, often driven into the edges of sewn planks to aid assembly, was not noted as the ship was not dismantled. The sewing is regular and made of simple overedge vegetal stitches (/// pattern) through oblique channels (in section) set perpendicular to the plank edges (Figs 20a and b). Only a couple of cross-stitches were noticed on the oblique scarfs as punctual reinforcement (Fig. 19). A flat braid of three strands of twisted vegetal fibres (width 5 mm) was used for the stitching. The stitches pass over a wadding pad made of vegetal fibres placed over the seam (Figs 19 and 20a). Little tapered pegs (int. diam. 6–7 mm; ext. diam. 4–5 mm) made from fir (*Abies alba* Mill.) and spaced on average centre-to-centre 24 mm, lock the stitches in the channels. The channels end at the corner of the plank face in rectangular recesses (width 5 mm, height 3–5 mm) (Fig. 20b). Vertical channels were also recorded; in which case, the internal-edge recesses protecting the

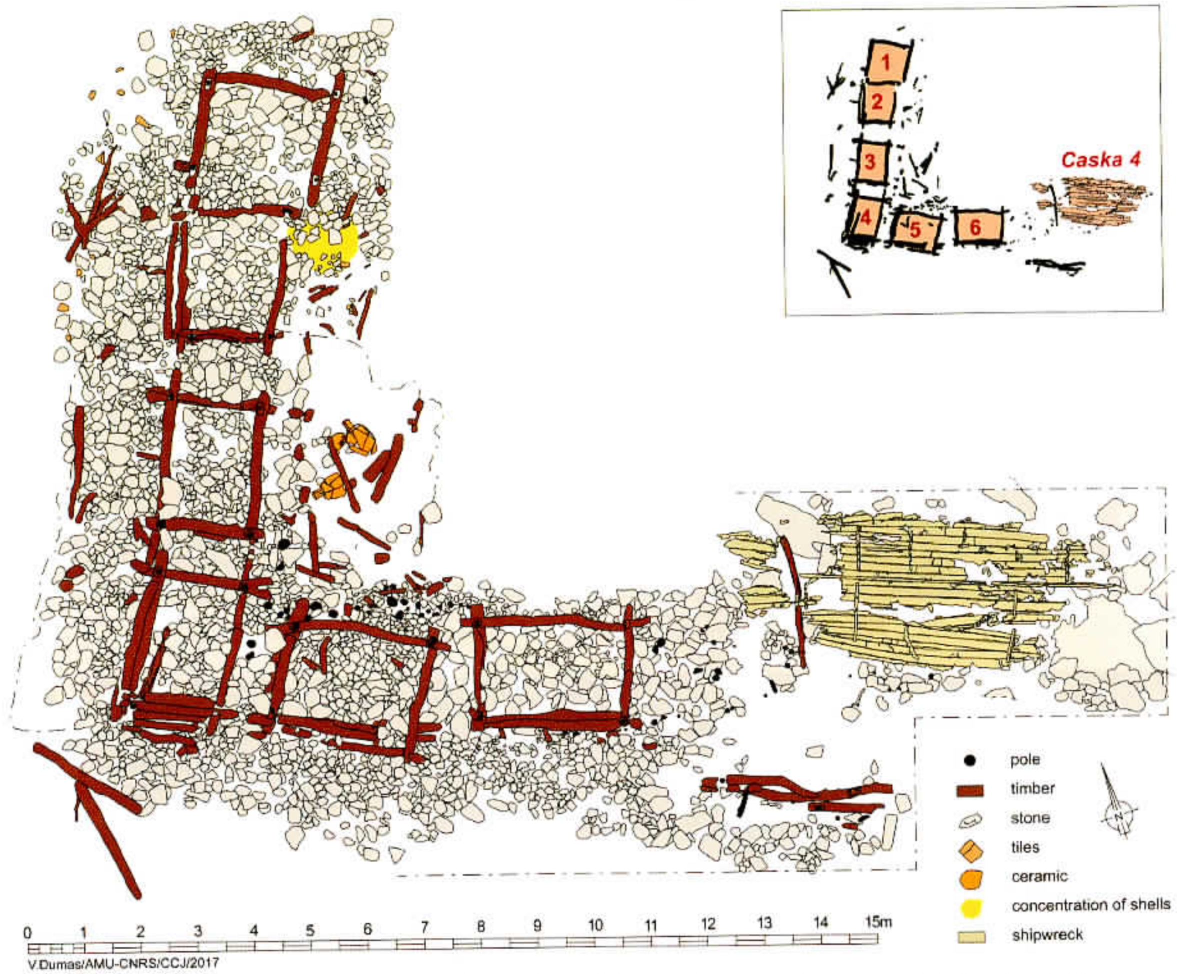

Figure 12. Zone C and the scuttled sewn boat Caska 4 (drawing V. Dumas, AMU, CNRS, CCJ).

Figure 13. a) Two layers of overlapping logs of the third enclosure; b) mortise cut at the extremity of the log and the pole used to anchor the structure; c) one of the three amphoras found in Zone C (photos Ph. Groscaux, AMU, CNRS, CCJ).

seams are very small, and a little groove was carved to lodge the stitch on the outer face of the plank. The second strake on the eastern side (P12) of Caska 1 was repaired. The 0.80 m-long repair was found in the middle of the strake between floor-timbers F7 and F9. A thick layer of pitch completed the waterproofing system.

Seven floor-timbers survived in place and the positions of seven more were identified (Figs 15a, b). The general framing pattern is a sequence of floor-timbers, probably with futtocks at their extremities. The frames are made from deciduous oak (*Quercus* sp.). Rectangular in section (45–50 mm sided and 55–65 mm moulded), the floor-timbers are spaced 0.395 m. They are not attached to the keel. The frames are fastened to the planking with tapered treenails of evergreen oak, olive tree (*Olea europea* L.), and beech, driven from the outboard (diam. 9–16 mm). Across the floor of

Figure 14. Caska 1 (photo L. Damelet, AMU, CNRS, CCJ).

the boat, the lower face of the frames is notched to avoid crushing the wadding pad placed over the plank stitching (Figs 21 and 16). These recesses along the bottom of the frames are quadrangular in shape and oversized, so as to function also as limber holes. From the turn of the bilge and up the sides of the hull, the recesses are rounded or triangular in shape and rest tightly against the wadding pad.

The most interesting pieces among the detached frames are three worked futtocks (nos 15, 78 and 324) made of deciduous oak (Fig. 17). Only one (no. 78) is complete; it measures 0.772 m in length. These three frames have rectangular sections (44 mm sided, 83 mm moulded) and their lower surfaces are carved with recesses to rest over the wadding pad. The upper ends, about 150 mm in height, presented lateral grooves 10 mm deep. In the Herculaneum boat (Italy, 1st century AD, Camardo *et al.*, 2014: 75), similar futtock ends originally rested on the sheer strake, and a washboard could have been inserted in the grooves. Hypothetically, we can assume that the Caska 1 sculpted futtocks were positioned in the room-and-space between the floor-timbers. All the loose frames are made from deciduous oak, except the V-shaped floor-timber, no. 25, shaped from a beech branch.

Caska 3

The remains of a sewn boat Caska 3 were recovered from within the scuttled mortise-and-tenon built ship Caska 2, excavated in Zone D (Fig. 9).

The remnant of Caska 3 is 3.25 m long and 0.83 m wide and composed of seven strakes of beech (*Fagus sylvatica* L.). The keel and the frames were not preserved and the planking was intentionally cut before it was put in Caska 2 (Figs 9, 10, 22). The strakes are 0.09–0.20 m wide and 12 mm thick. Three of them are stealers (P8, P9, P10a). The assembly system of the planking (sewing pattern, wadding pad) is similar to Caska 1, only the diameters of the pegs are smaller (int. diam. 4.3 mm, ext. diam. 3.8 mm) while their interval is larger (38 mm instead of 24 mm on average). Nevertheless, the pegs are also all fir (*Abies alba* Mill.), as in Caska 1.

The negative imprints of six frames are visible on a layer of protective pitch covering the planking. These traces are 0.06 m wide and spaced at 0.39 m intervals, values similar to the frames of Caska 1. One or two treenails of evergreen oak (diam. 10 mm) per strake attach the frames to the planking.

Caska 4

Caska 4 was found at the south-eastern edge of the log-built structure excavated in Zone C (Fig. 12). The remains of Caska 4 are 7 m long and 3 m wide (Figs 12 and 23). As in Caska 1 and Caska 3, the bow and stern have not been identified. The ship structure was also particularly distorted and fragmented due to the weight of the stone infill, and heavily damaged by woodworm. The remains consist of the keel, ten strakes on the northern side, eleven strakes on the southern side, and elements of six frame stations.

The keel, 45–55 mm sided and 75–114 mm moulded is made of evergreen oak (*Quercus ilex* L.), has a rectangular section without chamfers. It was broken in

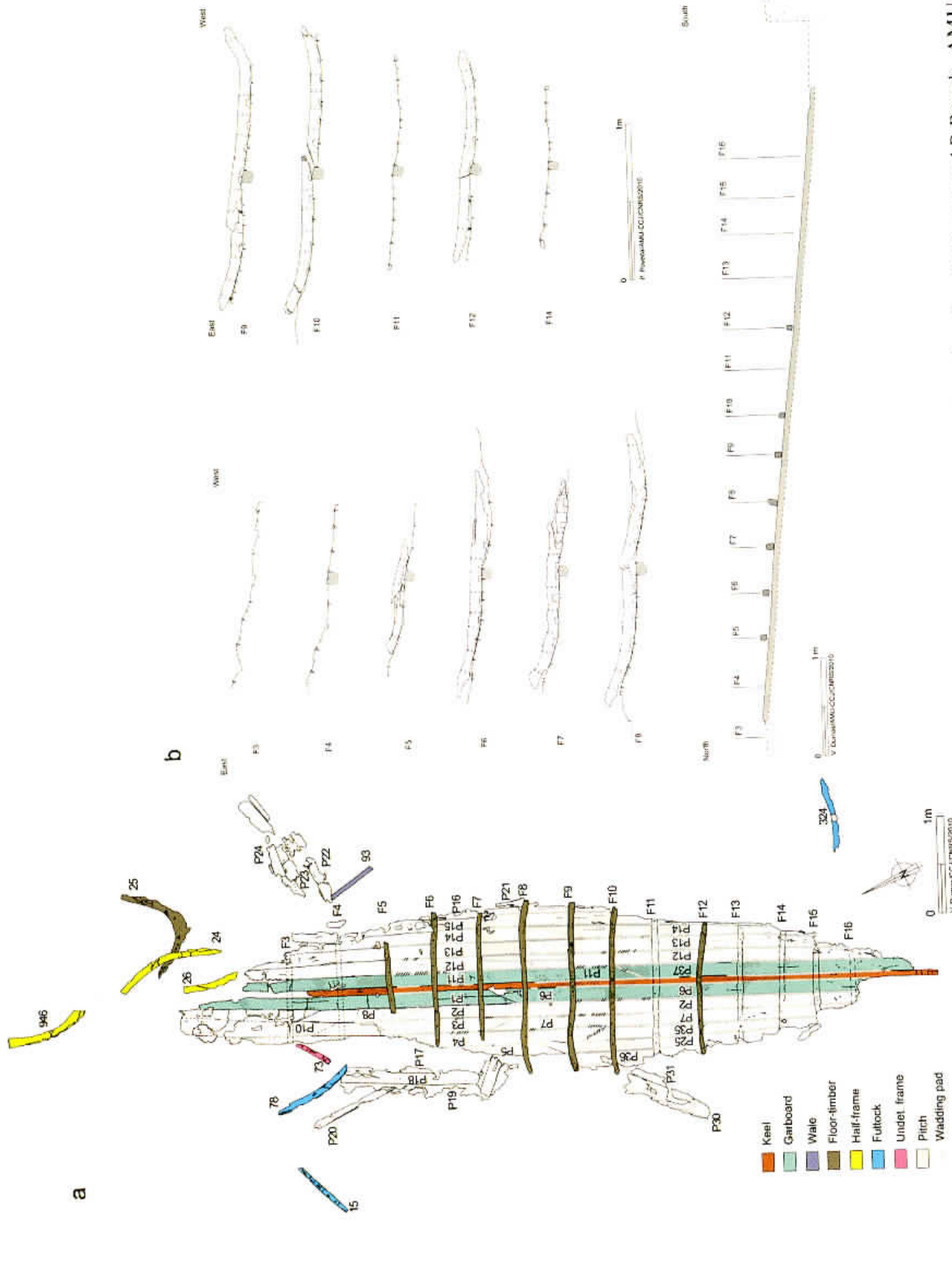

Figure 15. Caska 1: a) plan (drawing V. Dumas, AMU, CNRS, CCJ); and b) longitudinal and cross sections (drawings V. Dumas and P. Poveda, AMU, CNRS, CCJ).

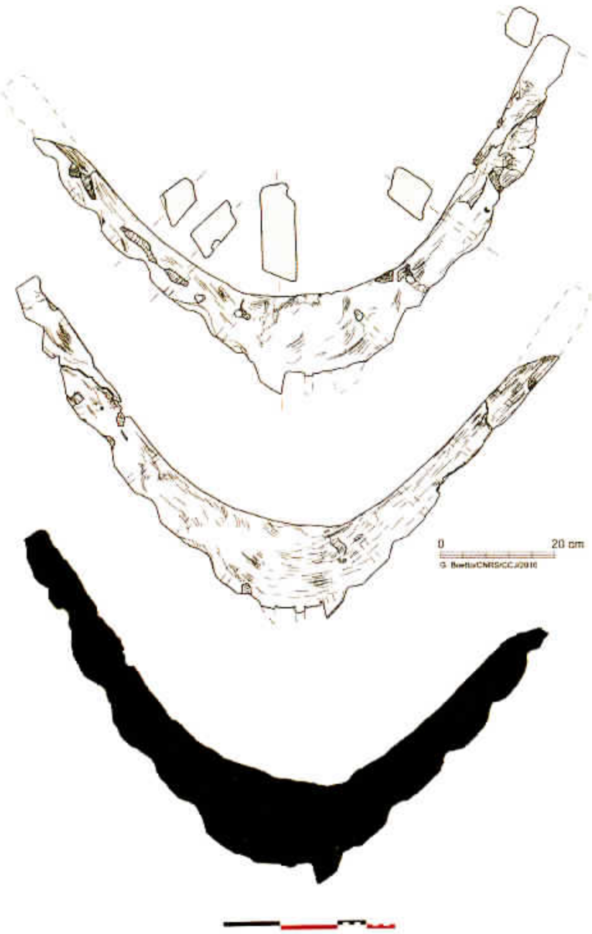

Figure 16. Caska 1: V-shaped floor-timber no. 25 (drawings G. Boetto, photo L. Damelet, AMU, CNRS, CCJ).

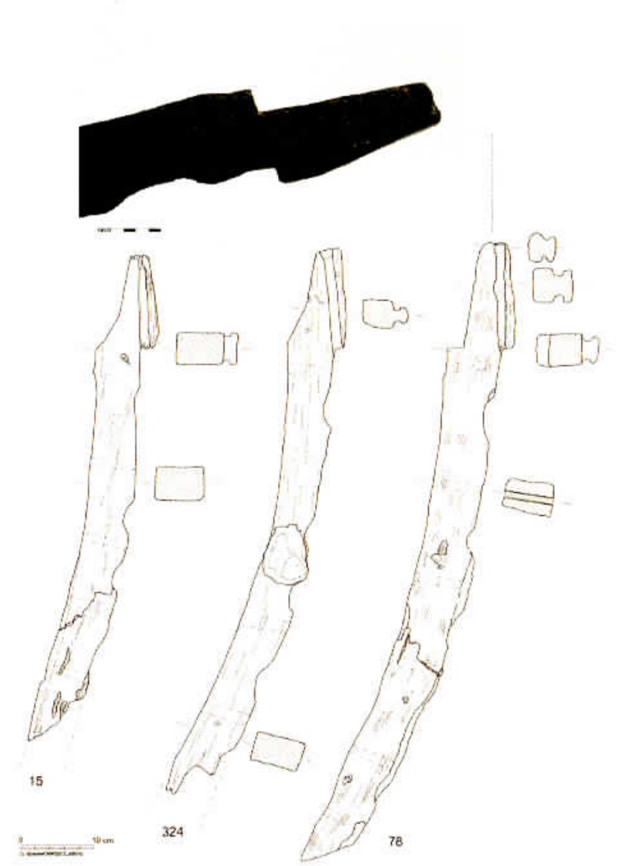

Figure 17. Caska 1: worked futtocks nos 15, 78 and 324 (drawings G. Boetto, photo L. Damelet, AMU, CNRS, CCJ).

three main pieces (K, K2, and K3), and is preserved to a total length of 5.7 m. The piece placed at the western extremity of the shipwreck (K2) is scarfed to a fragment of transitional timber (KGW), 0.15 m long, 0.045 m sided, 0.04 m moulded, made of maple (*Acer* sp.). A vertical treenail (14–16 mm) secures the scarf. The scarf to the eastern transitional piece (KGE), around 0.25 m in length, is locked by a horizontal key (19–23 mm wide and 16 mm thick) and by two vertical treenails (diam. 10 mm). The eastern transitional timber is 0.55 m long, 0.05 m sided, 0.12 m moulded, and made of deciduous oak (*Quercus* sp.).

The planking is all made of beech (*Fagus sylvatica* L.). The maximum width of the strakes is 0.16 m and the average thickness 16.5 mm. Only one strake of the southern side (P10) is thicker (29 mm). The planking does not have oblique scarfs, but stealers to reduce the width of the strakes towards the ends were noted (Fig. 23).

The sewing system, made up of simple overedge vegetal stitches (/// pattern) through oblique channels (in section), is similar to that of Caska 1 and Caska 3 (Fig. 24a). Only one small dowel (coak) made of beech, 0.044 m long and rectangular in section (8 × 5 mm), was noticed in the edge of a detached fragment of plank. It probably functioned as a pre-assembly element (Fig. 24b). Pegs that lock the stitches in the channels are 7 mm in diameter, and spaced 29 mm on average. They are made not only of fir (*Abies alba* Mill.) as in Caska 1 and Caska 3, but also of other conifer species, such as spruce (*Picea abies* L.) and larch (*Larix decidua* Mill.). The wadding pad is made of vegetal fibres. The use of pieces of textile is also attested in some seams (Fig. 24c) and in the scarf joining the keel and the transitional eastern timber (KGE) (Fig. 24d). This characteristic could be related to repairs or to the original waterproofing system. A thick layer of pitch completed the waterproofing system of the boat.

The ship remains include seven futtocks in very bad condition, made from deciduous and evergreen oak (Fig. 23). They are rectangular, 0.04–0.05 m sided and 0.072–0.10 m moulded. The base is crenelated to avoid crushing the wadding pad. The space is 0.89 m, twice that of Caska 1 and Caska 3. Three of the frames (F10, F11, and F13) are identified as floor-timbers. They were connected to the futtocks by hook scarfs, fixed by two or three vertically driven treenails (diam. 9–10 mm) (Figs 24e and 24g).

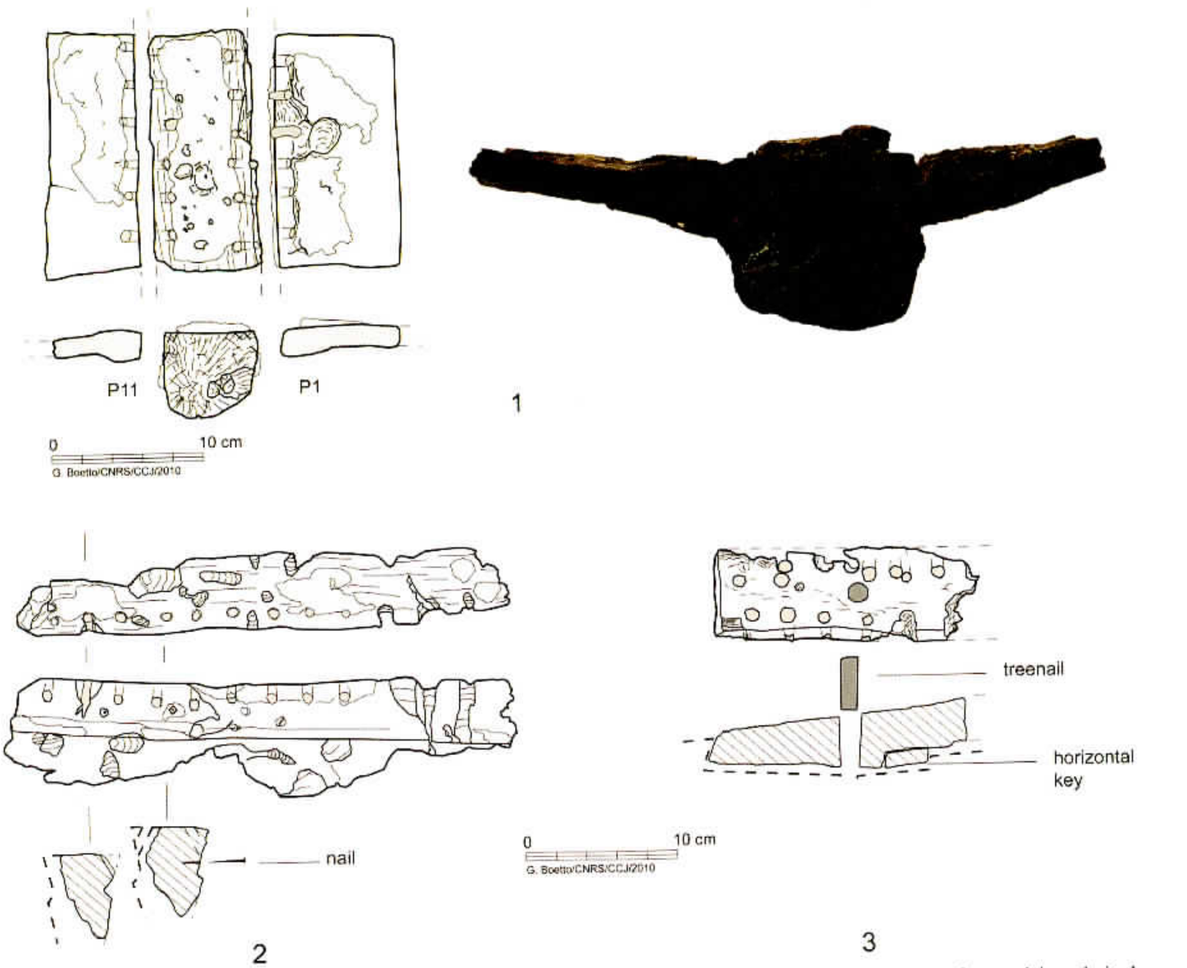

Figure 18. Caska 1: axial carpentry. 1. Section of the keel and garboards P1 and P11; 2. Fragment of transitional timber with rabbets no. 27; 3. The northern scarf in the transitional timber nos 52–54 (drawings G. Boetto; photo L. Damelet, AMU, CNRS, CCJ).

The frames are not treenailed to the planking, but exclusively assembled by an external lashing system. A flat braid of three strands of twisted vegetal fibres (width 5 mm) was used for the lashing. The lashing runs over the frame at least three times and the top of the frame was lightly carved to accommodate it (Fig. 24f). The end of the flat braid is inserted in a blind hole, drilled from the top of the frame, and locked with a small peg (depth 27 mm, diam. 6–7 mm). The braid then passes through a pair of holes arranged vertically in the planking, spaced around 0.05 m, and is locked with small pegs. The lashing loop is tied at the base of the frame. On the outer surface of the hull, the stitching is protected within a 45–50 mm-long and 7–9 mm-wide groove. The small pegs are made of fir, beech, and dogwood (*Cornus* sp.).

The mortise-and-tenon built Caska 2

The scuttled ship Caska 2 made part of the large breakwater in Zone D, reinforcing its most exposed south-eastern end (Fig. 8). The remains of Caska 2 are 13 m long and 4 m wide (Fig. 25a). The ship rested on its starboard side (east). The transverse section at the main frame is flat, with a round turn of the bilge (Fig. 25c). The longitudinal section is flat, with convex ends (Fig. 25b). The remains consist of the keel, nine strakes on each side (the ninth strake was the lower wale), 24 frames, keelson/mast-step timber, and some stringers. Two deadeyes were found near the aft end of the keelson. A hearth used for cooking, was found in the bow (Figs 25a and 29).

The keel, rectangular in section, without chamfers and made of evergreen oak (*Quercus ilex* sp.), is 8.65 m long, and 0.155 m wide (upper surface) (Fig. 26a), its height is not known because the outboard was not examined nor the keel sectioned. It is scarfed to the stern and stem transitional timbers, respectively 3 m and 2 m long in preserved length. The scarfs were not studied in detail, as the ship was not dismantled.

The transitional timber in the stern (south), made of evergreen oak, is slightly curved, 0.175 m sided and 0.22 m moulded (Fig. 25a). The rabbet is triangular,

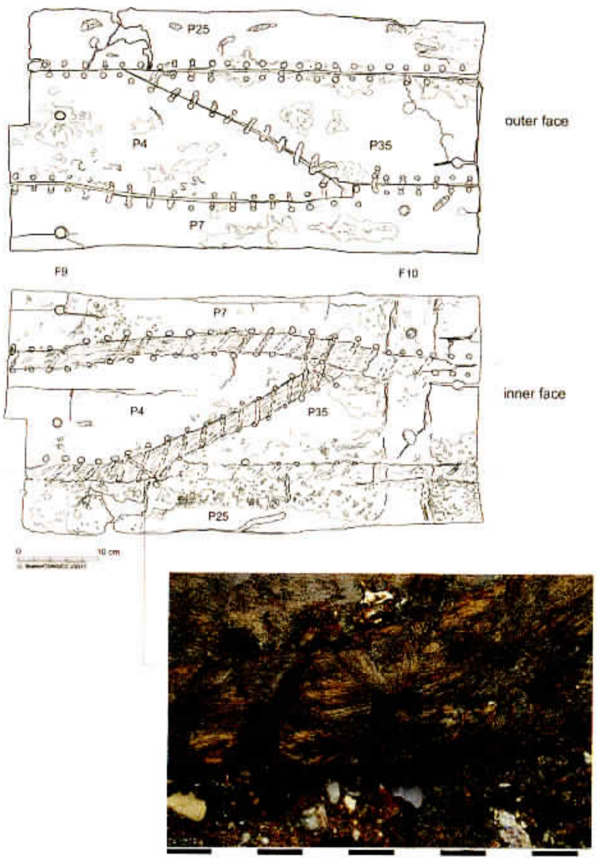

Figure 19. Caska 1: sewing pattern (drawings G. Boetto; photo L. Damelet, AMU, CNRS, CCJ).

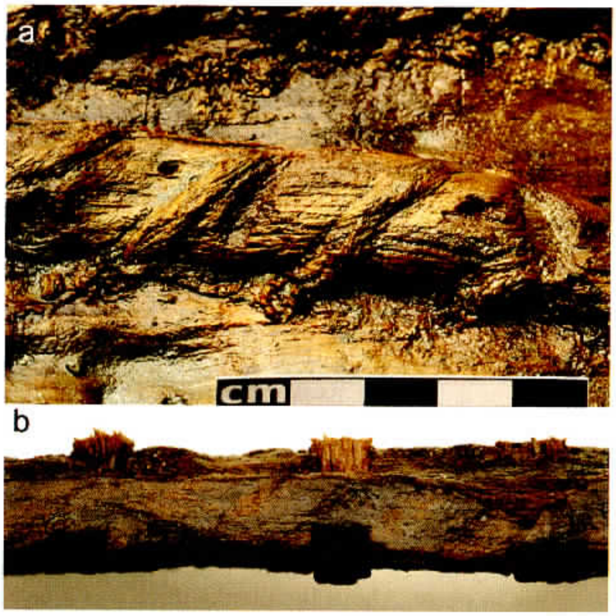

Figure 20. Caska 1: a) detail of the sewing system; b) recesses cut on the plank edges to pass and protect the stitching (photos L. Damelet, AMU, CNRS, CCJ).

80–90 mm high and 32–40 mm deep. The strakes are attached to this stern transitional timber with copper-alloy nails driven from the outside of the ship only, without use of mortise-and-tenon joinery. A rectangular recess to house a stanchion (67–70 mm x 54–60 mm, maximal depth 50 mm) is carved on the upper surface of the transitional timber (Fig. 26b) and is deeper to the north (fore) than the south (aft).

The transitional timber to the stem (north), made of an unidentified type of pine (*Pinus* sp.), is 0.17 m moulded and 0.115–0.15 m sided (Fig. 25a). The enlargement is related to the rabbet on the transitional timber (Fig. 26c). The rabbet is triangular, 40 mm high and 22 mm deep. The system of assembly of the strakes to the stem transitional timber is unknown as they were not dismantled.

The planking, mainly made of pine from the Scots-pine type and Aleppo pine/stone pine (*Pinus halepensis* Mill./*Pinus pinea* L.),[3] is composed of nine strakes on each side, of average thickness of 38 mm (range 26–48 mm) (Figs 27a and 27b). The ninth strakes (P8E and P9W) correspond to the lower wales. They are respectively 0.12 m and 0.14 m wide. As the port wale (P9W) is badly damaged, its original thickness wasn't measured, while the starboard wale (P8E) is 0.12 m thick.

The planks are joined with diagonal scarfs to form strakes and fastened with mortise-and-tenon joints. Measurements of the fasteners were taken on some detached pieces and, where possible, on the hull. The mortises are 68 mm wide, 6–12 mm thick, 65 mm deep, and spaced 0.12 m apart (side-to-side). The pegs are tapered (internal diameter 9.5 mm, external diameter 7.5 mm) and spaced 0.18 m apart (centre-to-centre). The tenons, significantly smaller than the mortises, are 34–35 mm wide and 5–7 mm thick. Their preserved length is 30–35 mm. The tenons are made of evergreen oak and pegs of ash (*Fraxinus* sp.).

Several planks were repaired with patch tenons, and rectangular, irregularly spaced openings to insert them were recorded only on the internal face of the planks. It is probable that the planking was also repaired using planks simply nailed to the frames but, as it was not possible to observe the outer side of hull, this assumption is based on the presence of small planks, as observed in the Napoli A wreck (Italy, 1st century CE, Boetto and Poveda, 2018). These small planks are associated with nailed internal reinforcements of various shapes and dimensions (Fig. 28a).

Twenty-four frames survive, mostly made of evergreen oak, on average 86 mm sided and 96 mm moulded, with room-and-space of 0.47 m (Fig. 27b), but not connected to the keel. The frames are fastened to the planking with evergreen oak treenails (17 mm average internal diameter, average space centre-to-centre 0.12 m). No nails were found, but the outer side of the planking wasn't excavated. The general framing pattern is of alternating floor-timbers, extended by futtocks without fasteners, and half-frames. Some

Figure 21. Caska 1: floor-timber F10 (photo L. Damelet, AMU, CNRS, CCJ).

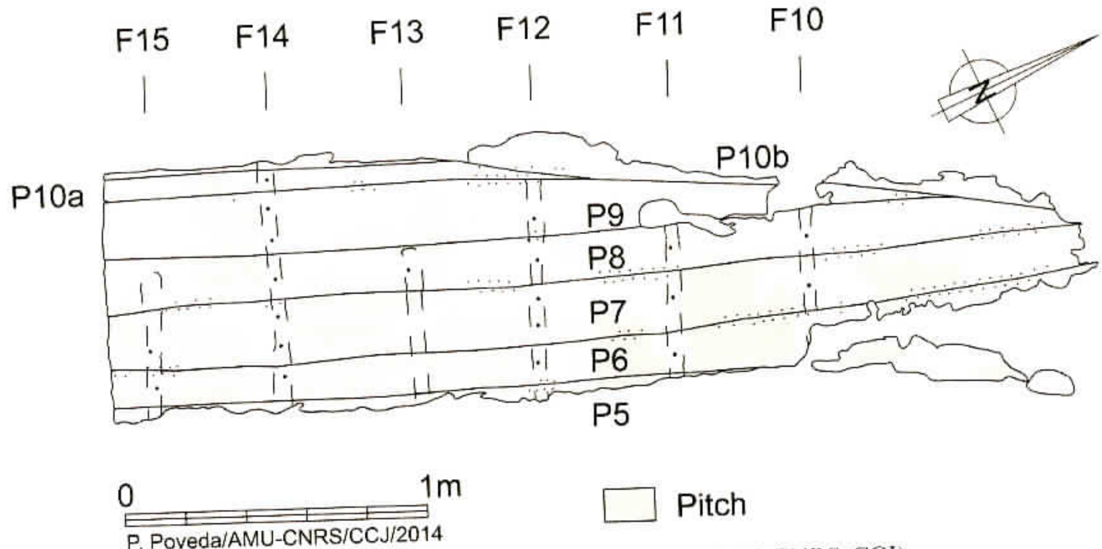

Figure 22. Caska 3: plan (drawing P. Poveda, AMU, CNRS, CCJ).

half-frames overlap amidships, with one extremity crossing the keel, so that the butt joints of the two half-frames projected beyond the central axis. Consecutive half-frames were noted at the extremities, where the ship narrows. Sequential floor-timbers and overlapped half-frames are used around the keelson/mast-step timber, thus reinforcing the hull (Fig. 27b). The frames are perforated by limber holes 35–45 mm wide, 20–54 mm high, situated beside the keel (Fig. 28b). As for the planking, the frames of the port side were repaired.

The keelson/mast-step timber, made of Aleppo pine/stone pine, 6.75 m long, 0.15 m wide and 0.115–0.14 m thick, is installed above frames F15 to F28 (Figs 25a, 25b and 27a). This timber is wider at the centre (0.20–0.22 m), related to the position of the mast-step. A series of rectangular recesses (20–80 mm deep) were cut on its lower surface to fit precisely over the recesses (10–20 mm deep) cut on the upper face of the frames (Figs 25b and 26a).

The mast-step is rectangular, 0.15 m long, 0.09 m wide, and 0.055 m deep. The forward edge was cut obliquely to facilitate raising and lowering the mast. The mast-step is flanked on three sides by rectangular recesses to house vertical planks supporting the mast (Fig. 28c). The lateral recesses are 170 mm long, 20–30 mm wide and 20–28 mm deep, while the forward recess is 175 mm long, 38 mm wide, and 20 mm deep. Two stanchion-holes were cut at a distance of 0.26 m toward the stem. The first 60 × 50 mm, and 20 mm deep, the second 56 × 47 mm, and 28 mm deep (Fig. 28c).

The remains of three stringers nailed to the frames are preserved on the east side, and two on the west side. They are 0.20–0.23 m wide and 35 mm thick on average. Three of them have mortise-and-tenon joints, demonstrating their reuse from another ship (Fig. 25a). Limber boards were not detected; probably, they were lost or removed before scuttling.

A hearth was situated above the keelson/mast-step timber, between frames F27 and F28 in the bow of the ship (Figs 25a and 29). It was not on the centreline of the ship but rather toward the starboard side. It was 0.70 m wide and 1.70 m long. A layer of planks was arranged as a base for its construction. Three planks (H1, H2/8, H3) crossed the keelson/mast-step timber and the first starboard stringer (C161/182/260), and three others (H5, H6, H7) were placed longitudinally between the first and second starboard stringers (C97) and between F27E and F28E. Some stones were intentionally placed under these planks to wedge the structure in place. Above the planks there was a layer of mortar and a layer brick. A tile flanked the hearth on the starboard side. All these elements had traces of burning.

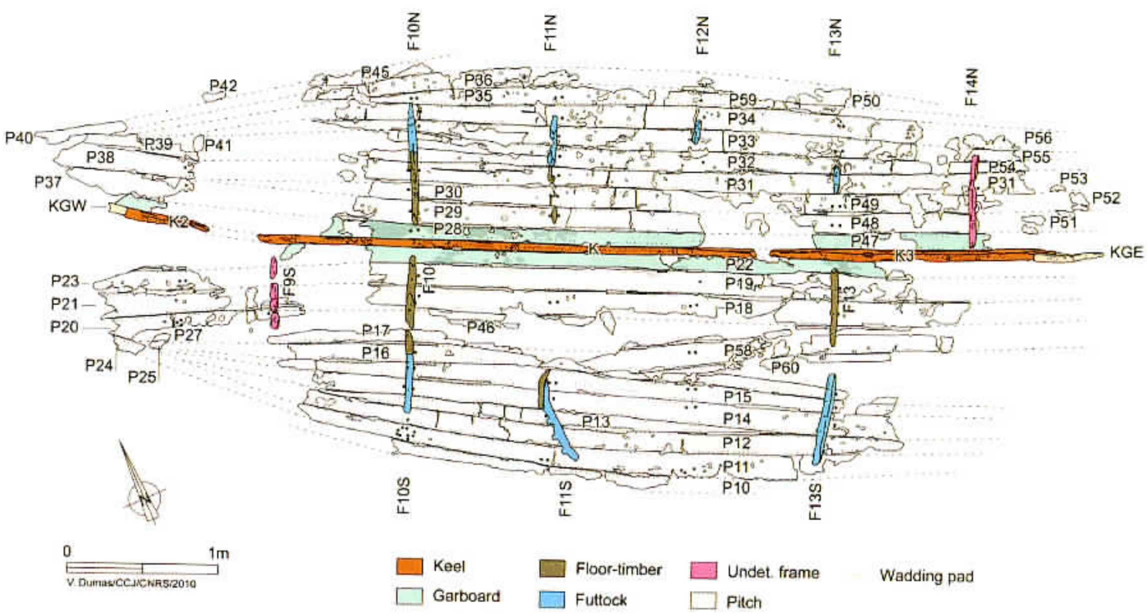

Figure 23. Caska 4: plan (drawing V. Dumas, AMU, CNRS, CCJ).

Finally, two drop-shaped, hard-wood deadeyes were found on the ship (Table 1). These objects served to secure the mast shrouds. The first (RG1) is pierced by two holes, while the second (RG2) has three-holes (Figs 25a and 30). The holes for lanyards are 22–30 mm, and the groove to house the shrouds is 22 mm wide and 6 mm deep. The deadeyes are also pierced by a couple of smaller holes (diam. 9 mm) for strop ropes. The blocks have the letter M incised in the upper extremity, near the small holes. This letter could indicate a set of deadeyes produced by the same maker. Comparative items come from the shipwrecks of Grado (Beltrame and Gaddi, 2005: 80, fig. 1), Laurons 2 (Ximénès and Moerman, 1990: 7–8, figs 2–3), and cape Glavat at the island of Mljet (Radić and Jurišić, 1993: 133, 135, fig. 16). These objects are also commonly found in harbours. One example from Dalmatia comes from Zaton, the harbour of Nin/Enona (Brusić and Domjan, 1985: 81, fig. 6.9).

Dating

The date of construction of the harbour structures and of the four vessels found in Caska is not precisely established. Dendrochronological analysis coupled with AMS mass spectrometry and wiggle matching (Pearson, 1986: 295–296) are being performed by Alba Ferreira Dominguez and Frédéric Guibal, and we hope these analyses will be able to better define the chronology of the ships (Ferreira Dominguez *et al.*, forthcoming). The AMS results offer an initial chronological framework.

The beech tree used to shape plank P3 from Caska 1 was felled between 42 and 104 AD based on the synchronisation of the 14C calibration curve, using wiggle-matching of six AMS mass spectrometry dates on six samples taken on this plank.[4] On the other hand, Caska 2 has been dated between the 1st century BC and the 1st century AD.[5] It is worth noting that this sailing ship was heavily repaired, and probably had a long life before being scuttled. Caska 1 also bear signs of ancient repairs, and as does Caska 4. The re-use of old vessels as building material seems coherent.

For the harbour structures, only two poles in Zone A-B and one log in Zone C have been subject to AMS dating. In Zone A-B, pole 22, made of evergreen oak (*Quercus ilex* L.) is dated to between AD 69 and 236,[6] while pole 65, made of cypress (*Cupressus sempervirens* L.) is dated to between AD 59 and 226.[7] The construction of the coastal structure therefore took place between the second half of the 1st and the beginning of the 3rd century AD. The ceramic and amphora sherds, although a small quantity, confirm this date, and the date of Caska 1 is coherent with this result. In Zone C, log no. 61 in enclosure 3, was dated by AMS to between 45 BC and AD 85,[8] thus placing the construction of the structure around the turn of the millennium, and probably predating the structures in Zone A-B. Finally, Caska 2 offers a *terminus post quem* for the reuse of the ship and reinforcing works of the south-western end of the breakwater in Zone D.

Conclusion

The archaeological site in the inlet of Caska is evidence of a maritime estate, which, at the beginning of the Roman Empire, probably belonged to the senatorial family Calpurnii Pisones. Based on current research we can conclude that it was provided with a monumental

Figure 24. Caska 4: a) sewing system; b) view of the outer face of a fragment of planking P52 with a horizontal dowel; c) textile used in the seams between the southern garboard (P22, on the top) and the second strake (P19); d) textile found in the scarf joining the keel and the eastern transitional timber; e) Southern part of frame F10 from the east. The futtock (to the left) is overlapping the floor-timber and two vertical treenails (yellow pins) join the two elements; f) northern part of the frame F10 and the futtock F10N. The floor-timber has large recesses on the base; g) external lashing on the top of the frame (photos L. Roux, AMU, CNRS, CCJ).

sea façade, which supported the first terrace of the south-eastern part of the complex.

The CissAntiqua project revealed the remains of ancient port structures, which consisted of a small pier made of rocks and wooden stakes (Zone A-B) in front of the terrace wall, and the structure of unknown function, which partly consisted of rectangular 'caissons' made of horizontal logs (Zone C). One sewn boat was scuttled in order to build or reinforce each structure (Caska 1 and 4). A large breakwater (Zone D), protected the inner part of the harbour from the destructive south-eastern wind. It is situated in the same area as where land excavations revealed the possible remains of the *pars rustica* of the maritime estate. The mortise-and-tenon built ship, Caska 2, was scuttled to reinforce the south-eastern end of the breakwater at the point where it was most vulnerable. The bottom of the ship was reinforced with a number of wooden elements, mostly planks, among which the remains of another sewn boat were discovered (Caska 3).

The site of Caska illustrates the techniques and materials used for the construction of port structures in submerged environments in Dalmatia during the Roman period. It provides evidence of the use of locally available materials, limestone and wood, in particular evergreen oak that, like other small trees and shrubs, was abundant on the island, and allowed relatively simple, solid constructions (foundations, sanitation, stabilization).

In Zone A-B, instead of the use of amphoras to drain marshy areas, as well attested in the Roman world, especially northern Italy (Pesavento Mattioli, 1998; Zabeo, 2016), stabilization and raising the ground

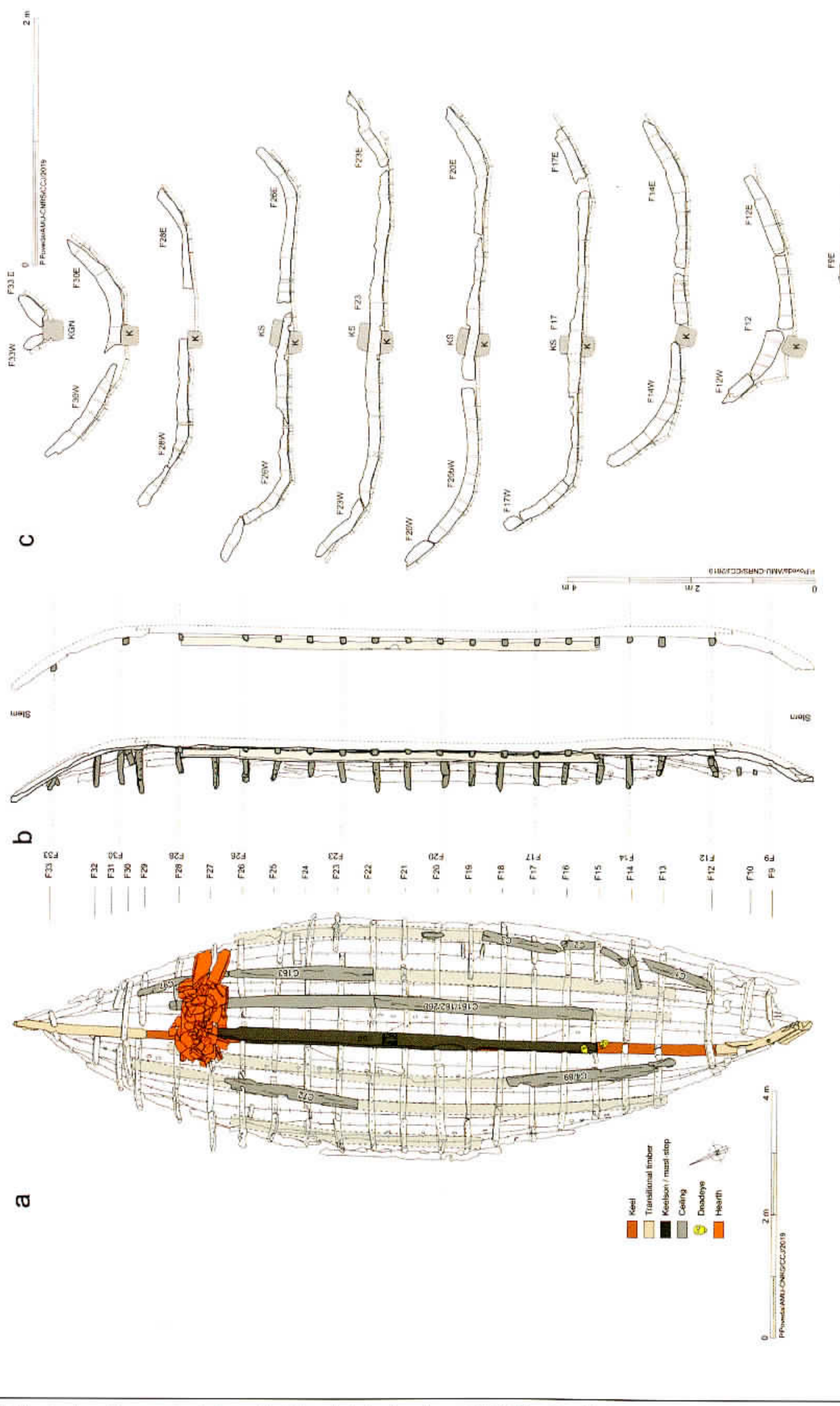

Figure 25. Caska 2: a) plan; b) longitudinal sections; and c) cross-sections (drawings P. Poveda, AMU, CNRS, CCJ).

Table 1. *Measurements of the two deadeyes from Caska 2*

	Height (mm)	Width (mm)	Thickness (mm)	Type of wood
RG1	156	109	30	plum/cherry (*Prunus* sp.)
RG2	162	120	31	dogwood (*Cornus* sp.)

level of the waterfront was carried out with wooden trunks and branches. This technique finds parallels in the drainage of marshy soils in Treviso between the second half of the 2nd century and the first half of the 1st century BC (Gambacurta and Marcassa, 2004: 87; Tirelli, 1996: 31–33), in Strasbourg from the 1st century BC (Baudoux *et al.*, 2002: 130, fig. 6.3) and Estagnon de Fos-sur-Mer for the first half of the 1st century BC (Marty *et al.*, 2016: 269). Although at Caska fagots were used in a shoreline structure rather than in a swampy area or riverbank, they would have fulfilled a similar function, allowing the drainage of muddy sediments in order to stabilize the waterfront.

The structure made of 'caissons' in Zone C is the most emblematic port structure among those that were discovered at Caska. The only similar example of a harbour structure with logs and mortises for vertical posts in Dalmatia was found in the area of the Hellenistic port near the village of Resnik at the western end of Kaštel Štafilić in the Gulf of Kaštela (Brusić, 2006: 360; 2008; Radić Rossi, 2008d: 291).

The port structure of Caska is certainly much less sophisticated from a technical point of view, compared to the examples of port structures found in the Atlantic estuarine environments, such as the Roman quays of London (Marsden, 1980: 156–157; 1994, 24–29; Milne, 1985: 55–67), or the quays recently excavated in Bordeaux, in the estuary of the Garonne River (late 1st century BC–early 1st century AD; Gerber, 2011: 86, fig. 6), and at Rezé/Ratiatum in the Loire River estuary (late 1st–mid 2nd century AD; Mouchard *et al.*, 2016). These structures, well adapted to the environmental constraints imposed by the amplitude of the tidal range, served important urban centres that are not comparable to the small coastal site of Caska. Another comparison comes from the port site of Phanagoria (Taman peninsula, Black Sea), where a port jetty was formed of caissons made up of logs and vertical posts, retaining stones and *spolia* from the city and the necropolis. It was dated between the 3rd and 4th centuries AD (Kuznetsov and Olkhovskiy, 2014; Olkhovskiy, 2016: 5152).

The site of Caska also provides fine examples of the re-use of ships and boats, a practice well established in the Roman world. The best-known example is the ship that Caligula built for transport of the obelisk that is now in the Vatican. According to the accounts of Pliny (*NH*, 16, 201–202) and Suetonius (*Claudius*, XX), this ship of exceptional size — it had a deadweight of 1300 tonnes and would have transported, in addition to the obelisk, 130,000 *modii* of lentils — was scuttled filled with pozzolana to serve as the foundation for the lighthouse of the new seaport which Claudius had built north of Ostia.

The reuse of boats in port structures is a practice attested in Toulon where two small boats with transom bows of the *horeia*-type were reused in a pier built at the end of the 1st century AD (Brun, 1999: 797–802; Boetto, 2009), and in Narbonne where a small lighter, still carrying its last cargo of amphoras, was used at the end of 4th–beginning of 5th century AD, to repair the eastern dike at the canalized mouth of the Mandirac river (Jézégou *et al.*, 2015; Sanchez *et al.*, 2016: 66, fig. 7).

This practice also finds analogy in southern Dalmatia, in Trstenik near Kaštel Sućurac, a town located in the Gulf of Kaštela between the current cities of Trogir and Split. The etymology of Trstenik derives from the Croatian term *trska* (reed) and

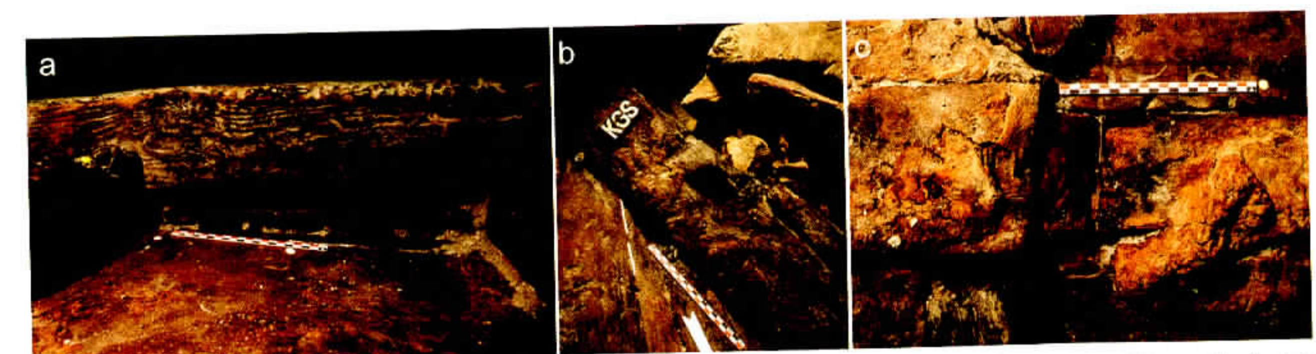

Figure 26. Caska 2: a) upper part of the keel without chamfer. The keelson/mast step is carved to accommodate on the frames and worked to allow the bilge water to circulate; b) recess on the upper surface of the stern transitional timber; c) scarf between the keel (right) and the stem transitional timber (left). Note the yellow pitch covering the hull (photos T. Seguin).

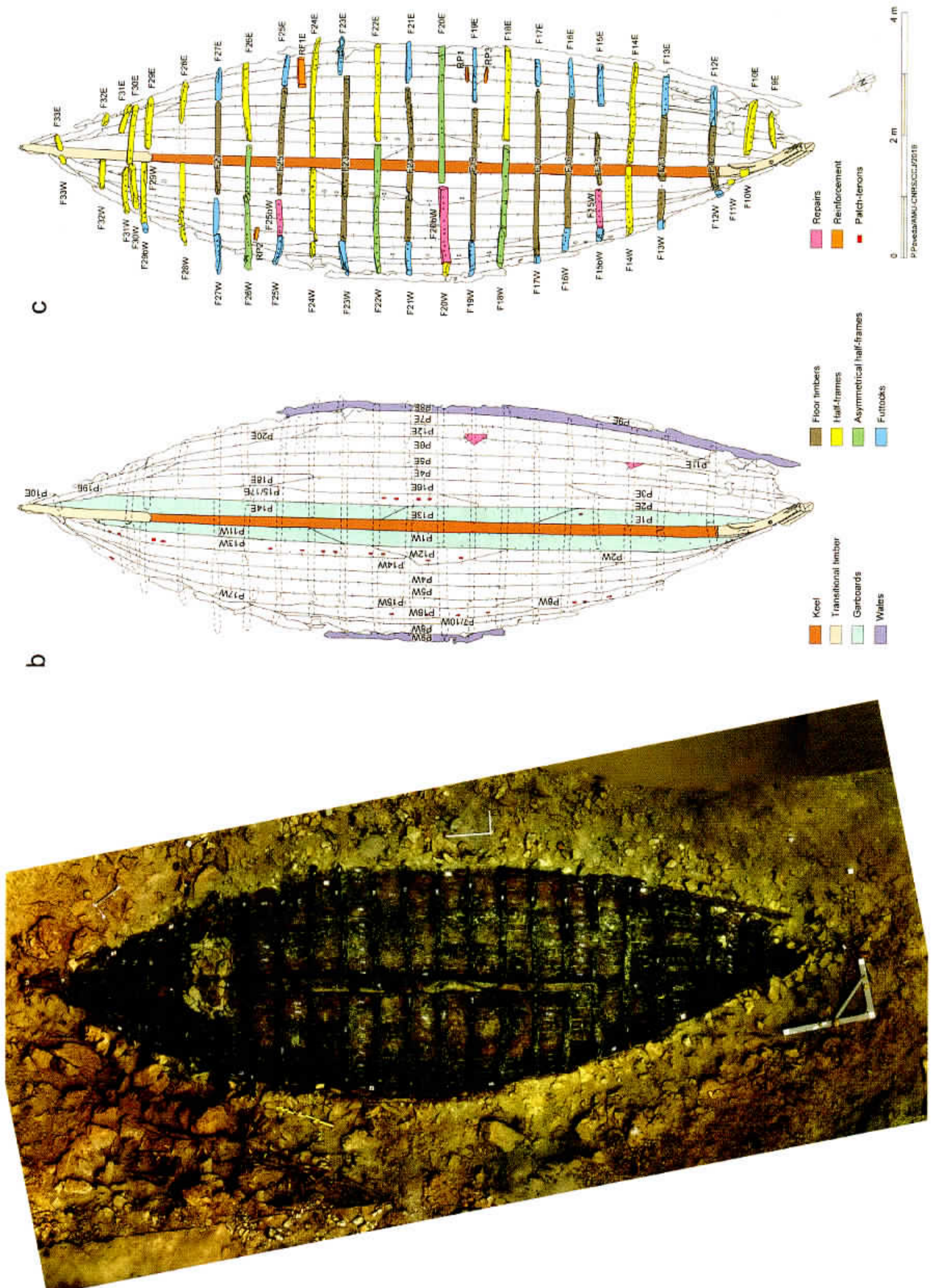

Figure 27. Caska 2: a) orthophoto of the shipwreck Caska 2 (photos T. Seguin, photogrammetry V. Dumas, AMU, CNRS, CCJ); b) plan of the planking; c) plan of the frames (drawings P. Poveda, AMU, CNRS, CCJ).

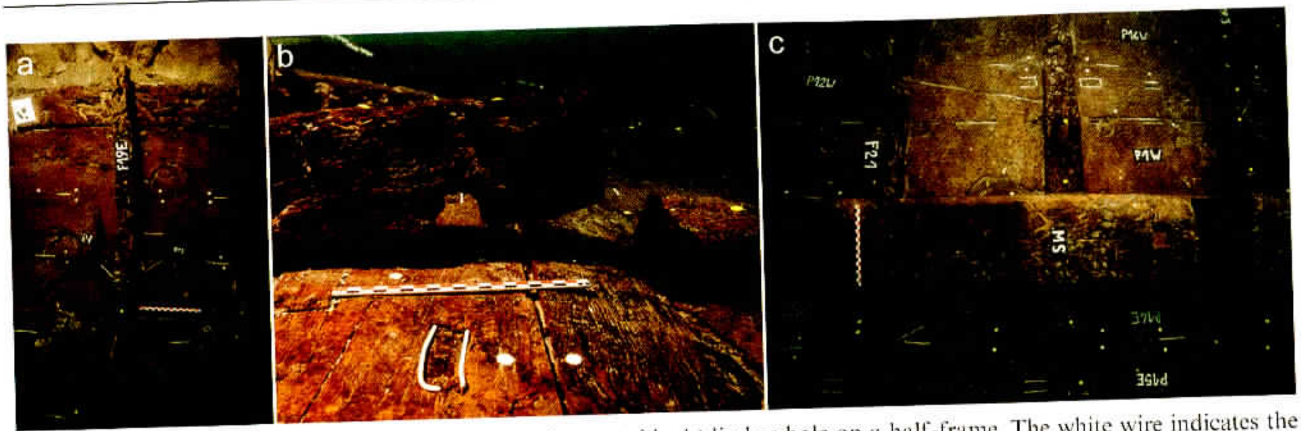

Figure 28. Caska 2: a) interior reinforcements on the port side; b) limber-hole on a half-frame. The white wire indicates the position of a patch-tenon on the garboard; c) mast step and the others recesses for stanchions on the keelson/mast-step (photos T. Seguin).

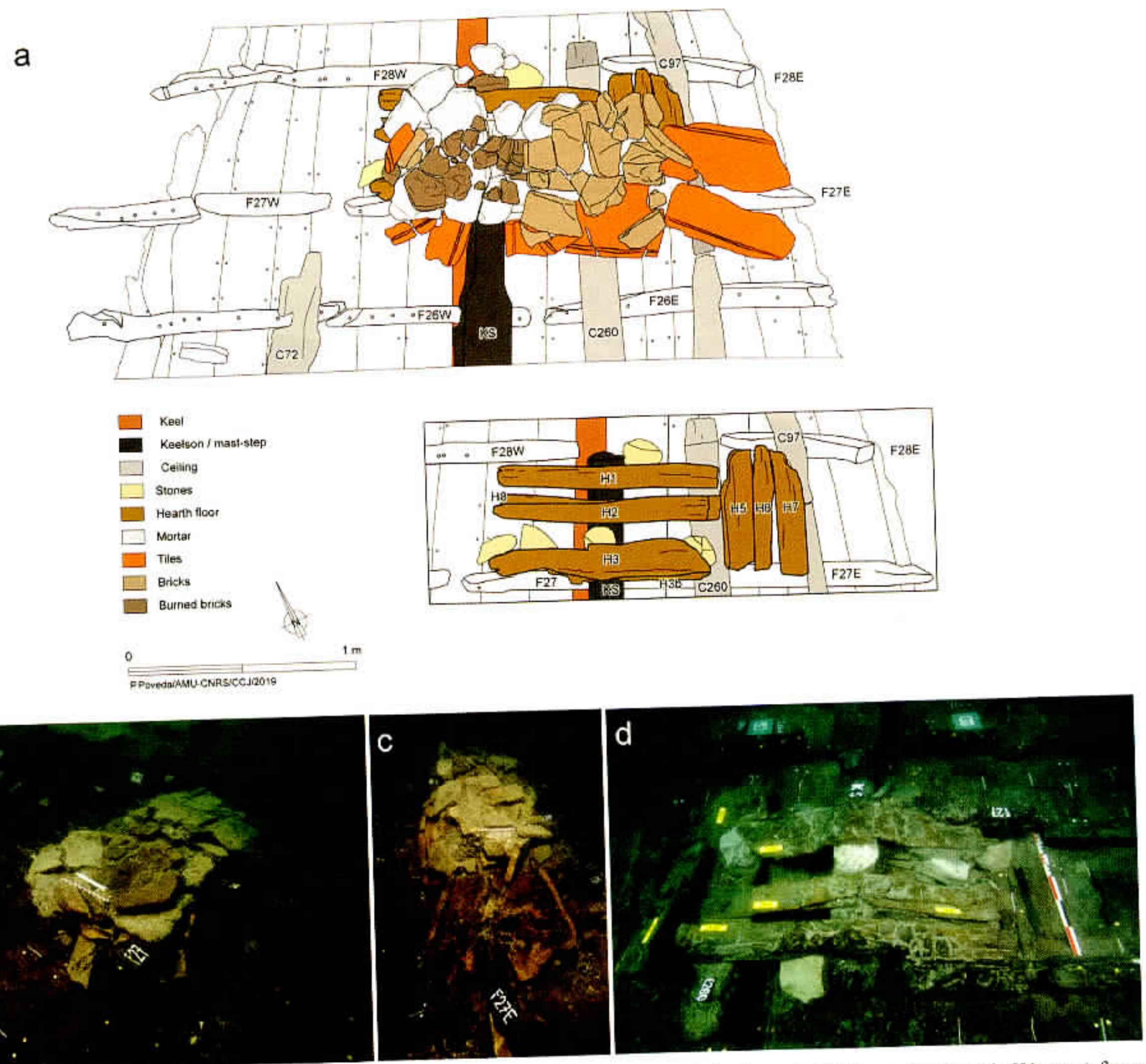

Figure 29. *Caska 2:* a) hearth (drawing P. Poveda, AMU, CNRS, CCJ); views of the hearth; b) from the South-West; c) from the East (photos T. Seguin); d) layer of planks supporting the hearth from the North (photo S. Govorčin, University of Zadar).

Figure 30. Caska 2: Two deadeyes, RG1 on the left and RG2 on the right (photos T. Seguin).

certainly indicates a marshy area, rich in fresh water. Here, a sailing ship from the Roman era, assembled by mortise-and-tenon technique, almost 15 m long, was discovered in 2006 and excavated in 2012 and 2015. This reuse of the ship is accompanied by other improvements, drainage and stabilization of the littoral with rows of posts and horizontal positioned planks, as well as a pier-like structure, containing Dressel 20 amphoras (Radić Rossi, 2007; 2008b; 2008c; 2008d; 2011b; Ruff and Radić Rossi, 2015).

Finally, the recycling of boats and ships in harbour structures attested at Caska, offers archaeologists a unique assemblage of almost contemporaneous boats and ships of different architectural and functional types, belonging to two different shipbuilding traditions. This assemblage offers an important contribution to the study of the ancient Mediterranean shipbuilding techniques. All the vessels were constructed shell-first, and their shape was based on a longitudinal strake-oriented concept (Pomey and Rieth, 2005; Pomey *et al.*, 2012). The assembly systems used (sewing and mortise-and-tenon) are clear evidence of shell-first building procedures.

Although it is difficult to reconstruct the original form of the sewn boats from Caska due to the lack of information about their longitudinal shape at the ends, the original length of Caska 1, which was the best preserved of the group, could be evaluated at 9 m. The boat was probably propelled using either sail or oars, although no traces of the propulsion system or steering devices were discovered.[9] Due to the similarity in shape, architecture, assembly pattern and use of wood species, the two other sewn boats, Caska 3 and 4, can be grouped in same architectural and functional type as Caska 1.

All three sewn boats can be ascribed to the same north-eastern Adriatic tradition of sewn-boatbuilding according to Pomey and Boetto (2019: 11–12). This tradition dates back to the Late Bronze Age (Zambratija shipwreck; Koncani Uhač *et al.*, 2017, 2019). Its survival in Roman times is related to a well-defined sailing area, characterized by a multitude of islands and an indented coast. This north-eastern Adriatic sailing area, acting as an enclosed space, served to preserve local indigenous shipbuilding tradition (Pomey and Boetto, 2019: 18–19).

The sewn boats of Caska probably had mixed propulsion (oars and sails), as they are similar to Zaton 3 (Gluščević, 2004) and Pula 2 (Boetto *et al.*, 2017), and could have belonged to the local Liburnian population, which could have been in service of the owners of the estate. They were likely used for fishing, and for the daily needs of transportation and farming activities in the Gulf of Pag. The mortise-and-tenon built ship, Caska 2, was a sailing vessel, as demonstrated by the presence of the keelson/mast-step timber still in place. Its original length is estimated at 15 m. It also demonstrates the contemporary use of mortise-and-tenon ships and sewn-boats in the same geographical area and in the same period.

This single-masted sailing ship could have been built in any shipyard of the Adriatic. By the time it was built, some of the shipyards in the region had taken up the mortise-and-tenon technique for joining the hull planking. Caska 2, well equipped for life on board (hearth in the bow area), likely served for longer-distance journeys in the Adriatic, transporting people and goods until it was too old for repair and was scuttled.

Finally, the Roman port in the inlet of Caska was not situated on a major seafaring route. It served a private estate, used for boats and ships that satisfied the essential needs of fishing and transport. Part of the goods produced could have been also conveyed by land to the ports of Novalja and Stara Novalja, as their position was more suitable for open-sea and long-distance communication. Nevertheless, the muddy seabed of Caska conserved impressive wooden remains that contribute to our understanding of Roman building techniques for harbour structures. In parallel, it offered new insights into one of the most interesting ship assemblages of Dalmatia, attesting to the persistence of ancient native shipbuilding tradition (sewing, lashing) side by side with of a more widespread Mediterranean shipbuilding technique (mortise-and-tenon).

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Notes

1. S. Čače suggests that the Pliny's *oppidum* in this case indicates the centre of the Liburnian community, with significant number of inhabitants (Čače, 2011: 610).
2. The authors do not to enter into detailed explanation of the problem, as it would take the discussion in another direction.
3. The impossibility of differentiating the wood anatomy of Scots pine (*Pinus sylvestris* L.) from that of black pine (*Pinus nigra* Arnold) and hooked pine (*Pinus uncinata* Ramond) (Schweingruber, 1990) led the dendrologists to group the taxa under the name of 'Scots pine type'. Difficulties in distinguishing between Aleppo pine and stone pine led the dendrologists to use the 'Aleppo pine/stone pine' binomial (Akkemik and Yaman, 2012: 46).
4. Samples codes from Lyon-9267-SacA-29517 to Lyon-9272, SacA-29522.
5. This date is based on two AMS dates: one performed on the keel (code Lyon-13145, SacA-45495), the other on the port side futtock F12W (code Lyon-14130, SacA-49771).
6. Sample WP7-A23, laboratory code Lyon-9273, SacA-29523.
7. Sample WP8-A31, laboratory code Lyon-9274, SacA-29524.
8. Sample Lyon-16171, SacA-56341.
9. A very similar boat was excavated in Zaton (Zaton 3), with the mast-step conserved (Glušćević, 2004). In March 2020, another sewn boat, equipped with a mast-step and belonging to the same type, has been discovered in Poreč (https://www.jutarnji.hr/kultura/art/senzacionalno-arheolosko-otkrice-ispod-rive-pronaden-2000-godina-star-rimski-sivani-brod-10252168, accessed 5 May 2020; pers. com. G. Benčić).

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