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## **Ancient scuttled ships and other harbour structures of Caska (Island of Pag, Croatia) in their cultural and historical context**

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### **Summary (100 words)**

The Bay of Caska, at the Island of Pag, preserved the remains of a multi-stratified settlement, whose important phase seems to be identifiable with a maritime villa property of the senatorial family *Calpurnii Pisones*. After presenting the geographical and historical context of the site of Caska, the article summarizes the principal achievements of past archaeological research, and presents the results of the recent research carried out on land and underwater. 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, filled with rocks, formed pier-like coastal structures. The architecture of these vessels is also discussed.

### **Key-words (6)**

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

### **Introduction**

It is widely accepted that the ancient *Cissa*, the island with the Liburnian *oppidum* mentioned by Pliny the Elder (*cf. infra*) in the 1<sup>st</sup> c. AD, should 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 Mediaeval *Cissa* (*cf. infra*), it seems that in ancient times the Field of Novalja with its adjacent bays (Novalja, Satara Novalja and Caska) acted as the main centre of the Liburnian, and later Roman power.

The remains of ancient *Cissa* have for centuries attracted the interest of the local population, and the rare visitors of the island. The first preserved notice on the land and submerged finds in Novalja and in the inlet of Caska comes from the itinerary of the Venetian syndic inquisitor (Ven. *sindico inquisitore*) Zan Batista Giustinian, written in 1553 (Ljubić, 1877; Šimunković, 2011). A big step forward in documenting the ancient remains in the area of Novalja was taken by Mijat Sabljarić in 1852. The representative of the National Museum in Zagreb not only described, but also drew with amazing precision the Roman structures in Novalja, Stara Novalja, Caska and on the hill of Košljun (Sabljarić, 1852; Mirnik, 1972).

Unfortunately, it seems that many valuable archaeological objects from Novalja and Caska in the more distant past ended up in the antiquary market in Venice (Szabo, 1933; Celić, 2015). Urban development during last two decades has destroyed some important structures, with no hope of their recovery. Therefore, the need for systematic research, aimed at preserving the rapidly disappearing archaeological information, has become the absolute priority.

Although a number of authors in the 20<sup>th</sup> century wrote about the antiquities of Novalja and Caska, providing their interpretations of the archaeological remains, little was done at the level of substantial fieldwork. Caska is a challenging, extremely demanding archaeological site, hiding precious evidence in the tidal zone, where it is not possible to conduct either a typical land or underwater excavation, and where natural forces can easily cancel all the results of the archaeological effort.<sup>1</sup> Its shallow waters hide huge amounts of organic material, used for harbour structures, which cover broad areas that cannot be easily mapped based on surface surveys. On land, underground structures are overlaid with residential buildings, or filled with sediment and in danger of collapse. The coastal erosion that threatened the Roman inhabitants today aggressively affects the archaeological remains, and there is no way to arrest it permanently.

The international project CissAntiqua, conceived in 2009 by the University of Zadar (Zadar, Croatia) and the University of Aix-Marseille, CNRS, Centre Camille Jullian (Aix-en-Provence, France), following the research initiated already in 2005, soon became an interdisciplinary scientific effort targeted to understanding the cultural landscape of Caska in Roman times (Čelhar, 2008; Radić Rossi, 2008a, 2010, 2011a; Boetto and Radić Rossi, 2014, 2017; Radić Rossi and Boetto, 2010, 2011). After several centuries of intense life, for over one millennium and a half Caska remained an isolated place. The following text aims to briefly describe the geographical and historical context of the site, and the main part of the project, directed towards the study of the submerged harbour structures and scuttled ships.

### Geographical context

The island of Pag is an elongated island, extending in a NW – SE orientation 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 (**Fig. 2**). 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. As the direct consequence of *bura* and the salty atmosphere that it creates, the eastern slopes of the island are rocky carstic landscapes, with extremely reduced vegetation. The impression of the island as a desolate rock when viewed from the mainland significantly improves after reaching the summit of the first row of hills, with fertile fields and small lakes in the form of Mediterranean marshlands.

Pag is situated in the inner row of the Eastern Adriatic islands. With its surface area of 284.14 km<sup>2</sup> it belongs to the group of big islands (Duplančić *et al.*, 2004), holding the fifth position after Cres, Krk, Brač and Hvar. Geologically, the island of Pag is a part of the Dinaric complex, characterized by the exchanging of 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 (**Fig. 1**). Surrounded by the island from all sides, the Gulf communicates with the outer sea, i.e. the Velebit Channel, just through the narrow (1 NM) passage Paška Vrata,<sup>2</sup> oriented in the NW – SE direction. The Gulf of Pag is about 9 NM long, and up to 1.8 NM wide.

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<sup>1</sup> The best illustration of this effect is the SE wind (*jugo*), which raises the water level of the inlet while generating strong waves, covering everything that has been uncovered in the tidal unprotected zone with gravel and mud.

<sup>2</sup> Literally translated, The Gate of Pag.

The shallowest area of the Gulf, to the depth of 18 m, extends to the northwest from the islet of Veli Školj, and is named the Bay of Caska. It terminates in the inlet at the settlement of Caska (**Fig. 3**), which is defined to the west by the promontory of Zrće. Considering the distance of about 7 NM (13 km) from the access from the Velebit Channel to Paška vrata, and the broad unprotected Gulf sea surface on which southern winds raise big waves, the position of Caska does not have a geographical predisposition to be a large port on the seafaring route. On the other hand, its north-eastern part is protected from the north-eastern wind, lying in the immediate vicinity of the Field of Caska, and further on, the Field of Novalja.

Although Pag is predominantly rocky landscape (86%), the island is characterized by a vast variety of vegetation, with 650 sorts of vascular plants (without counting the cultivated plants), among which 45 are endemic species (Horvatić, 1963; Magaš, 2011: 23). Besides a large variety of low plants, it is important to note that Pag still conserves the evidence of forests of the evergreen oak (*Quercus ilex*) and pubescent oak (*Quercus pubescens*). Judging by the toponyms conserved in places where there are no traces of the related forests, it could be presumed that in the past those species covered significantly larger areas. On the other hand, the black and Aleppo pines (*Pinus nigra*, *Pinus halepensis*) seem to be planted on the island through human intervention (Magaš, 2011: 23-24). It is also worth mentioning the presence of plants like Spanish broom (*Spartium junceum*), 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, agricultural surfaces cover 80% of the island, embracing the fertile fields and the rocky pastures (Magaš, 2011: 39). Fishing activity is quite poor, but in antiquity it was another significant economic resource. The organized fishing of tunas and mackerels, especially in the bay of Stara Novalja and the Gulf of Pag, is remembered as a significant activity in both oral tradition and preserved evidence like the 19<sup>th</sup> c. tuna watch tower Tunera or Turan, still preserved in the inlet of Caska (**Fig. 4**). Even the production of salt is one of the main activities on the island, although 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 salt pans characterizes many other areas as well.

Considering the position of Pag at the intersection of seafaring routes which linked the northern parts of the Adriatic with its middle area (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 the southern part of Kvarnerić. The advantage of the Port of Novalja consists of the fact that it does not require large deviations from the main route, while the Gulf of Košljun is a bit hindered by its geographical position with respect to the island and the Sea of Vir, and the following 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 1<sup>st</sup> c. AD Pliny the Elder (*N. H.* 3, 139-144, 150) described the Roman province of Illyria/Dalmatia. In the list of the towns (Lat. *oppida*)<sup>3</sup> on the coast and on the islands in the northern part of the convent of *Scardona*, Pliny wrote: “In that gulf, besides those previously stated, are the islands with the fortified settlements *Absortium, Arba, Crexi, Gissa Portunata*”.<sup>4</sup> Even if the form *Gissa* appears in most of the transcriptions of the Pliny’s work, there is no doubt that the original form must have been *Cissa*, and the form reported by most of the manuscripts is actually a later revision to the original document (Čače, 2011: 611).

It is not an easy task to present in a nutshell any comprehensive overview of ancient *Cissa* as most of the archaeological results gathered from previous researches aren’t fully published or deserve further study. Despite this and taking into account the data available to date, 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 late Mediaeval times (12<sup>th</sup> c., *cf. infra*). On the other hand, it remains unclear whether the toponym in Roman times indicated one single place, whether it referred to the broader area, or whether it changed from one location to another over the course of centuries.

The most prominent candidates for Roman *Cissa* among all the proposed interpretations remain the inlet of Caska and the Port of Novalja.<sup>5</sup> One important observation, which must be considered while evaluating all possible scenarios, is that the archaeological remnants in the inlet of Caska are largely associated with the potent Roman family of *Calpurnii Pisones* and their successors. On the other side, the remnants located in the Port of Novalja point to the public port and urban settlement in relationships to its better position within the seafaring regime in Kvarnerić as stated above.

Regardless the toponym *Cissa* in Late Antiquity certainly indicated the urban settlement, which developed around the port in present-day Novalja, most authors agree with this assertion (see Kurilić, 2011). The situation in the Early Empire remains unclear, although the idea of private property belonging to *Calpurnii Pisones* in the inlet of Caska, which lost its importance and glory in Late Antiquity, seems to be the most plausible one. The riddle of whether the Romans considered the entire territory *Cissa*, or if *Cissa* was situated in Novalja, with the villas and property in Caska simply associated with *Cissa*, cannot be solved at the moment.

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 ones 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). As already suggested based on the current archaeological finds, the Liburnian property of the other branch of the family, descending from *Cn. Calpurnius Piso Frugi*, could be presumed in the inlet of Caska on the island of Pag. Although there is no direct evidence which would point to the exact period in which it was obtained, we could suppose that it likely happened in the time of the emperor

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<sup>3</sup> 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).

<sup>4</sup> *Insulae eius sinus cum oppidis praetor supra significatas Absortium, Arba, rexi, Cissa Portunata* (Plin. *N. H.* 3, 140). Most of the copies of the Pliny’s work instead of *Cissa* state *Gissa*. On the solution to that problem see Čače, 2011: 610.

<sup>5</sup> The authors decided not to enter into detailed explanation of the problem, as it would require a lot of space, and would drive the discussion in another direction.

Augustus, when *Cn. Calpurnius Cn. f. Piso* was awarded the above mentioned *saltus in Illyrico* (Eck *et al.*, 1996: 44-45). The finds dating from the end of the late republican and the earliest imperial period (Kurilić, 2011: 69) suggest a Roman presence in the inlet in the 1<sup>st</sup> c. BC.

In the local tradition, the destruction of wealth and glorious ancient *Cissa*, was caused by its disappearing in the sea, while punished by God due to the evilness of its inhabitants (Crnković, 2003). The stories usually revolve around the bad and wealthy sister, in contrast to the good and poor one, and they end with the salvation of the good creature. They are deeply embedded in the traditional oral narrative, and are omnipresent in the local imagination of the past events. Such legends of dramatically disappearing cities are quite a common part of sea lore, and we often find them in conjunction with submerged coastal archaeological evidence.

Today, there is no further reason to debate the idea of progressive sea level changes causing the partial submerging of the ancient settlement in the inlet of Caska, as multiple scientific and archaeological investigations on land and underwater have fully confirmed the hypothesis. On the other hand, we can still not be sure whether some natural event could have caused drastic changes in the cultural landscape of the bay, causing the final abandonment of the already weakened community, which certainly occurred by the end of the 4<sup>th</sup> c. AD.

### **A multi-stratified settlement**

The archaeological site consists of both coastal and underwater structures of the living/economic area situated along the northeastern coast of the inlet, including the mysterious underground canal/tunnel ending at the position known as Pod bužu. The remains of the settlement in Caska point to one or more Roman villas, which existed from the 1<sup>st</sup> c. BC to the 4<sup>th</sup> c. AD. Great portion of the settlement on land is situated in private properties without possibility to realize systematic research. Relatively recent construction works or the action of the sea, have also destroyed ancient structures.

The visible remains extend from Gramače in the vicinity of the beach, towards the vertical rock Gavranišće<sup>6</sup>, passing across the area of Sv. Anton (St. Anthony), the Old house of the Palčić family, the tuna watching tower named Tunera or Turan, and the inlets of Mala Pošta and Podbužu (**Fig. 5**). A narrow submerged 'path' leads to the nearby inlet of Klopotnica, where, on the position Grgurovac, a system of shallow canals of unknown date is carved into the rock.

On the western side of the beach there is the necropolis, excavated from 2003 to 2007, and in 2012 (Kurilić, 2008, 2013), (**Fig. 5**). Judging upon the research results, it contains evidence of incinerated burials from the 1<sup>st</sup> to the 4<sup>th</sup> c. AD, with just two tombs with skeletal remains (Kurilić, 2007, 2008, 2013: 236). The typical burial chambers consisted in four to six *tegulae* positioned to form the roof, with one or two 'chimneys' made of two joint *imbrices*. The tiles were surrounded by square or rectangular stone structures, forming tombs of unique typology (Kurilić, 2007: 2013: 236).

In the north-eastern part of the bay, close to Gramače (**Fig. 5**), in sector 1, the remains of the *pars rustica* of the Roman villa were excavated in two research campaigns, performed in 2005 and 2006 (Skelac, 2006, 2007; Grisonic, Stepan, 2017: 71-77). The rescue research

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<sup>6</sup> Gavranišće is the name of the vertical rock at the south-eastern edge of the Bay of Caska, out of the area represented in Fig. 5.

preceded the construction of the modern house. It revealed the presence of a storage area (possibly a winery cellar), and a portion of sewage system in the form of 11 m long and 1.2 m wide sewer, made of stone slabs bound by mortar, and internally paved by *tegulae*. Five *dolia* were stuck into the soil sometimes in the 1<sup>st</sup> c. AD. They were broken apart and covered by pavement before the second half of the 3<sup>rd</sup> c. AD (Skelac, 2006: 283), and the complex continued to exist through the 4<sup>th</sup> c. AD (Skelac, 2007: 316). Judging upon the six stone slabs positioned in two parallel rows, there were also the remains of a probable wine press in the nearby 'cellar' (Lipovac Vrkljan, Konestra, 2018: 21), which ceased to exist already in late Augustan or early Tiberian period (Grisonic, Stepan, 2017: 74).

There are also architectural remains in the tidal zone in front of the big submerged pier in sector 1 (**Fig. 5**), which are mostly covered by modern constructions. They were cleaned and recorded during the research campaign 2013 (**Fig. 6**). In the first phase they certainly had some production purpose, although their real function remains unknown. In the second phase the complex developed to the east, by adding a water cistern and two spaces of unknown purpose, while in the third phase it changed its function and finally perished.

The remains of the big wall (**Fig. 5**), sometimes in bibliography considered the city wall of the ancient *Cissa* (Kurilić, 2013: 232), could be traced from Tunera to Gavranišće, in sectors 3–5. Due to the careful inspection and archaeological research performed in 2011–2013, it was established that it represents the big terrace wall, with nicely elaborated outer side (Radić Rossi, Boetto, 2012a: 511, 2012b: 617). Its fundamentals measure 1.8 m in width, and the width reduces with height. It is partly preserved up to five meters, and bares evidence of some drainage canals paved with *tegulae* (**Figs 7 and 8**). Behind one of these canals the situation allowed to document the drainage layers, which further reinforced the idea of the terrace wall. The waterfront was provided with niches, aimed probably for hosting statues, which contributed to the monumentality of the sea façade (Radić Rossi, Boetto, 2013: 381).

Based on the current state of knowledge, several places on the terrace conserve the evidence of some ancient structures, still waiting to be researched. At the point between the inlets of Mala Pošta and Pod bužu, where the terrace wall changes its orientation (**Fig. 5**), the broken breccia slabs testify to the consequence of its destruction (Radić Rossi, Boetto, 2013: 384). Once posed on the flysch base, protected by the terrace wall, they served as the solid support for some buildings of unknown function. When the terrace wall was abandoned and destroyed, the erosion took away the flysch substrate, and the breccia slabs crashed into the sea, taking with them the above built structures (**Fig. 9**).

In the inlet Pod bužu there is the access to the underground canal incorporated into the terrace wall (**Fig. 10**) (Radić Rossi, Boetto, 2013: 382–385). The side walls of the canal are built in stone rubbles, and the vault conserves the evidence of planks used for its construction. Its bottom is paved by *tegulae* positioned in pairs, and about 10 m before its end there is a small lateral canal, triangular in section, built entirely out of *tegulae*. The main canal 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 west. It collapsed just after 7 m, so, without some further effort, there is no possibility of exploring it in its integrity. 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 canal (**Fig. 11**). The function of the tunnel remains unknown, although it is almost certain that it did not serve exclusively for drainage, but had some function of supply, or evacuation in critical moments.

All the coastal structures, but necropolis and roman villa remains, were just cleaned and documented in order to create a topographic basis for the underwater remains. Therefore, they still need to be properly researched and interpreted with care, in the hope that further systematic research will bring new knowledge on the structure and organization of the ancient settlement in Caska.

### **The submerged coastal structures (harbour zone)**

The zone with submerged coastal structures develops along the north-eastern edge of the inlet of Caska, in front of the terrace wall and other visible architectural remains, in the proximity of the sea. The current state of knowledge allows us to identify three separate zones, rich in archaeological features. The first zone is situated to the south-east of Tunera (zone A-B), the second to the south-west of it (zone C) and the third one is to the west (zone D) (**Fig. 5**).<sup>7</sup>

#### ***Zone A-B***

The first scuttled boat of Caska was discovered in 2007 in the zone A-B, and was excavated in 2009-2012 (**Figs 5 and 12**). The boat named *Caska 1* lied at the gentle slope of the seabed, at the depth of 1.5 to 2.5 m, oriented north-south, and about 20 m distant from the shore, in front of the highest preserved part of the terrace wall. The excavation trench covered the area of 184 m<sup>2</sup>. Only the bottom of the hull remained in the length of 7 m, with some parts of the sides found nearby, broken and detached from the main structure. The hull was assembled by the prehistoric sewing technique (*cf. infra*) that was still in use in Roman times, probably by the local population of Liburnian origin. It was obviously scuttled in order to form a pier-like coastal structure, as it was filled with a layer of smaller rocks (10-15 cm) between the frames, covered by layer of bigger rocks (up to 50 cm) (**Figs 13**), and was associated with two parallel rows of vertically positioned poles (diameter between 4-6 cm up to 8-13 cm), about 2 m distant from each other.

The whole structure made of poles was filled with a thick layer of horizontally positioned branches of various shapes and dimensions. It seems that the rough wooden framing, excavated in the length of about 15 m to the west of the scuttled ship, kept in place the accumulation of stone blocks, and served as the basis for ancient waterfront.

#### ***Zone D***

The excavation continued in zone D, where a detailed survey in 2012, realized along the outer side of a large breakwater made of rocks, extending from north-east to south-west, revealed the presence of ship, named *Caska 2* (**Fig. 5**). The breakwater was probably associated to the structure partly preserved in tidal zone, which conserves the evidence of some not yet defined economic activity. Its orientation corresponds to the orientation of the modern structure of the same function, positioned in the vicinity of Tunera, and served as protection against the south-eastern wind (*jugo*), which in this part of the Gulf of Pag presents the main danger.

Already in 2005, the area was identified as potentially interesting for archaeological research, as the casually positioned trench of 2 x 2 m hit the excellently preserved wooden part of a small Roman anchor (length 1.56 m), abandoned before being completed with lead anchor stock (**Figs 5 and 14**).

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<sup>7</sup> The sequence of letters follows the chronological order of discoveries.



The ship was researched in 2013 – 2015, in the preserved length of 15 m, and the excavated area measured 84 m<sup>2</sup> (**Fig. 15**). It was assembled by standard Roman mortise-and-tenon shipbuilding technique. As in the case of *Caska 1*, it was filled with rocks, and scuttled with the aim of reinforcing the south-western end of the breakwater i.e. the most threatened part of the structure.

Due to the greater capacity, the bottom of the ship *Caska 2* needed to be reinforced by planks and other wooden elements of various origin thrown in the hold before the filling of rocks (**Fig 16**). A large piece of another sewn boat, named *Caska 3*, was identified among this material (**Fig. 17**) that included also a forked stanchion (**Fig. 18**), some thwarts, and several planks of fir. Worth of note is the timber with recesses (C30) bearing two letters engraved with a *signaculum*, an iron or bronze instrument. The letters S·V· separated by points and could correspond to the initials of *duo nomina* (**Fig. 19**). Unfortunately, this kind of inscriptions on timbers are rare and of difficult interpretation (Tran, 2014).

Along the western side of *Caska 2*, a wooden structure made of massive, vertically driven wooden poles, connected with longitudinal beams, probably hold the edge of the waterfront, and was further reinforced by the scuttled ship (**Figs 5 and 15**). The structure was not yet researched, pending some more accurate interpretation. It is also worthy of mentioning the great accumulation of roof tiles, which points to the possible remains of some roofed building (warehouse?), positioned at the south-western end of the breakwater.

### **Zone C**

The wooden structure in zone C, situated between the two previously described zones, was also identified in 2007. It revealed the presence of thick logs, which formed rectangular enclosures aimed to host the filling of rocks. The whole structure measures about 15 to 25 m i.e. about 375 m<sup>2</sup>, of which about 140 m<sup>2</sup> were excavated until present. The research was done in 2012-2013 and 2016-2018, resulting in the discovery of six rectangular enclosures, and another sewn boat, named *Caska 4*. The upper preserved part of the impressive structure lies today at the depth of about 1.6 m (**Figs 5 and 20**), and also in this case the scuttled ship served as the container for big accumulation of rocks.

The modular basis of this structure is a rectangular enclosure created by simply placing overlapping logs one on the top of the other, like in a “Block-Bau” construction system (**Fig. 21**). The ends of logs are provided with grooves, cut into their underside, and rectangular mortises (12-20 x 6-19 cm) in which one or, rarely, two vertical poles are inserted (diameter 3–8 cm). The mortises are greater than the poles thus offering the possibility of necessary adjustment during the construction (**Fig 22**).

Each enclosure measures around 2.5 x 1.5 m, and is filled with rocks. The logs, made of evergreen oak still provided with bark (*Quercus ilex* sp.), measure 3.5 m in length, and 20 cm in diameter. The maximum of five superposed logs was documented in the western corner, permitting the reconstruction of the original height of the structure of about 0.8–1 m. The first layer of logs rested directly on the rocky bottom. In the shallower sea the rock was cut in order to create the recesses to accommodate logs.

At this stage of research, the structure is envisioned as a succession of four enclosures perpendicular to the shore, and oriented northeast-southwest, extending for a total length of

12 meters. The southernmost enclosure is flanked to the east side by two more enclosures of the length of 8.8 m, in the shape of letter L (**Fig. 20**). Inside the structure, in the small area defined by a row of vertically driven poles, three almost complete amphorae were found (**Fig. 23**). With no evident analogies among the well-defined types, it seems that they were produced in some of the north-eastern Adriatic workshops.

From the inner side of the described structure, unusual accumulation of *murex* shells was also identified (diam. 1.2 m) (**Fig. 20**)

The continuation of the L shaped structure made of rectangular enclosures was formed of two horizontally positioned isolated logs, and the scuttled ship, preserved in the length of 7 m, and surrounded with poles. The hull was smashed under the filling of rocks, and the thin layer of sediment above the wood accelerated the decay of the hull remains. The eastern part of the structure consisted of bedrock. The whole structure leaves the impression of some operational waterfront, which was protecting some building on land, preceding today's Tunera.

## The sewn boats

### *Caska I*

As previously explained, the scuttled boat named *Caska I* made part of the pier-like wooden coastal structure, made of two parallel rows of vertically positioned poles, excavated in zone A-B (**Fig. 12**). *Caska I* was 8 m long and 1.66 m wide (**Figs 24 and 25**). The longitudinal section was flat and the transverse section at the main frame was flat, with round turn of the bilge (**Fig. 26**). The remains consisted of keel, six strakes on each side and seven floor-timbers. The traces of seven more floor-timbers (not conserved) were identified on the planking. Several loose pieces, belonging to the boat structure, were found around the shipwreck, including a fragment of rabbeted transitional timber (n° 27), a V-shape floor-timber or crotche (n° 25), three frames (n° 24, 26 and 946), three futtocks with worked upper ends (n° 15, 78 and 324) and a probable small fragment of sheer strake (n° 93).

The keel, in evergreen oak (*Quercus ilex* L.), was 6.55 m long, 6 cm sided and 5.7 cm moulded (**Fig. 27, 1**). Unfortunately, the shipwreck didn't conserve any element that could indicate the sailing direction i.e. the position of the stern and the stem. Only a fragment (n° 52-54) of evergreen oak, belonging to the transitional timber of the north extremity was conserved (**Fig. 27, 3**). Nevertheless, a rabbeted piece of evergreen oak (n° 27), discovered out of its original position, was also interpreted as fragment of transitional timber. This piece was lightly curved, 5 cm sided and 7.5 cm moulded. The rabbet was triangular in shape (15 cm high and 5-7 mm deep) and the planks were attached in it by stitching, reinforced by row of nails (**Fig. 27, 2**).

The scarfs to the transitional pieces, 20-23 cm in length, were locked by horizontal key (25-28 mm wide and 8-11 mm thick) and by vertical dowel (diam. 10-13 mm) (**Figs 27, 3 and 28**). The keel was not chamfered to the garboards (**Fig. 27, 1**), which were up to 25 mm thick next to the keel, to which they were attached by stitching. Two planks, connected by an oblique scarf, composed each garboard strake (P1 and P6 on the west, P11 and P37 on the east).

The ship's planks, heavily compressed by the filling of stones, were 15 mm thick with a maximum width of 16 cm. The west side of the ship was composed of eleven planks connected by oblique scarfs. This contrasted with the five conserved strakes of the east side, none of which contained a scarf, although a repair was found in the middle of the second

strake (P12) between frames F7 and F9 (**Fig. 25**). The planking was built homogeneously using beech (*Fagus sylvatica* L.). A small fragment of plank (n° 93), probably corresponding to wale, was found detached to the east of the shipwreck. It was 4.1 cm thick and 6 cm wide and was made of evergreen oak.

Planks were connected to each other by stitching. The presence of horizontal dowels, often driven into the edges of sewn planks in function of pre-assembly, was not noticed as the ship was not dismantled. The sewing was regular and made up of simple overedge vegetal stiches (/// pattern) through oblique channel (in section) set perpendiculary to the plank edges (**Figs 29 and 30**). Only a couple of cross-stiches were noticed on the oblique scarfs in connection with a punctual reinforcement of sewing (**Fig. 28**). The stitch was formed with a flat braid of three strands of twisted vegetal fibres (width 5 mm). The stiches passed over a wadding pad made of vegetal fibres placed over the seam (**Figs 28 and 29**). Little tapered pegs (int. diam. 6-7 mm; ext. diam. 4-5 cm) made from fir (*Abies alba* Mill.) and spaced on average centre-to-centre 24 mm, locked the stiches in the channels. The channels ended at the corner of the face of the plank in rectangular recesses (width 5 mm, height 3-5 mm) (**Fig. 30**). Vertical channels were also recorded; in those instances, the internal edges recesses for protecting the seams were very small, while a little groove was carved to lodge the stich on the outer face of the plank. It is worth of note that the second strake on the eastern side (P12) of *Caska 1* was repaired. The 80 cm long repair was found in the middle of the strake between the floor-timbers F7 and F9. A thick layer of pitch completed the waterproofing system.

Seven floor-timbers survived in place but places for seven more were identified (**Figs 25 and 26**). The general framing pattern was a sequence of floor-timbers with probable futtocks on the extremities. The frames were built from deciduous oak (*Quercus* sp.). Rectangular in section (4.5-5 cm sided and 5.5-6.5 cm moulded), the floor-timbers were spaced 39.5 cm. They were not attached to the keel. The frames were connected to the planking by tapered treenails of evergreen oak, olive tree (*Olea europea* L.) and beech, driven from the outer side of the hull (diam. 9 to 16 mm). The lower face of the frames was notched to avoid crushing the wadding pad between planks (**Figs 31 and 32**). These recesses along the bottom of the frames were quadrangular in shape and oversized, likely to facilitate their function also as limber holes. From the turn of the bilge and along the sides of the hull, the recesses became rounded or triangular in shape and rested tightly against the wadding pad.

The most interesting pieces among the unfastened frames were the three worked futtocks (n° 15, 78 and 324) made of deciduous oak (**Fig. 33**). Only one (n° 78) was complete; it measured 77.2 cm in length. These three frames had rectangular sections (8.3 cm sided, 4.4 cm moulded) and their lower surfaces were carved with recesses to rest on the wadding pad. The upper ends, about 15 cm in height, presented lateral grooves 1 cm deep. As it is possible to see in the Herculaneum boat (Italy, 1<sup>st</sup> c. AD, Camardo *et al.*, 2014: 75), the ends originally rested on the sheer strake while a washboard could have been inserted in the grooves. Hypothetically we can assume that these sculpted futtocks were located in the room-and-space between the floor-timbers. All the loose frames were made from deciduous oak, except the V-shaped floor-timber (crotches) n° 25, manufactured from a branch of beech.

### *Caska 3*

The remains of the sewn boat *Caska 3* were recovered, as already said, from the bottom of the scuttled mortise-and-tenon built ship *Caska 2*, excavated in zone D. They were found among the planks, thrown into the ship in order to support the heavy weight of the filling of rocks

(Fig. 18).

The remains of *Caska 3* were 3.25 m long and 83 cm wide and were composed of seven strakes made of beech (*Fagus sylvatica* L.). The keel and the frames were not conserved and the planking was intentionally cut, when scuttled (**Figs 16, 17 and 34**). The strakes were, on average, 9 to 20 cm wide and 1.23 cm thick. Three of them were stealers (P8, P9, P10a). The assembly system of the planking (sewing pattern, wadding pad) was similar to the one of *Caska 1*. Only the diameter of the pegs was smaller than the one of *Caska 1* (int. diam. 4.3 mm, ext. diam. 3.8 mm) while their interval was larger (3.8 cm instead of 2.4 cm on average). Nevertheless, the pegs were also homogeneously cut out of fir (*Abies alba* Mill.), as in *Caska 1*.

The negative traces of six frames were visible on the layer of protective pitch covering the planking. These traces were 6 cm wide and spaced 39 cm, a value similar to the one measured on *Caska 1*. One or two trenails of evergreen oak (diam. 10 mm) per strake attached the frames to the planking.

#### ***Caska 4***

The boat *Caska 4* was found at the south-eastern edge of the structure excavated in zone C. It consisted of rectangular enclosures made of logs, poles, freely positioned logs, scuttled boat and bedrock, which formed the rectangular operative platform (Fig. 22). The remains of *Caska 4* were 7 m long and 3 m wide (**Figs 20 and 35**). As in *Caska 1* and *Caska 3*, the sailing direction of the boat remains unknown. The structures were also particularly distorted and fragmented due to the weight of the stone filling, and heavily rotted by the xylophages. The remains consisted of the keel, ten strakes on the northern side, eleven strakes on the southern side, and elements of six frame stations.

The keel, 4.5 to 5.5 sided and 7.5 to 11.4 cm moulded was made of evergreen oak (*Quercus ilex* L.), had a rectangular section without chamfers. It was broken in three main pieces (K, K2 and K3), and preserved in total length of 5.7 m. The piece placed at the western extremity of the shipwreck (K2) was scarfed to the fragment of transitional timber (KGW), 15 cm long, 4.5 cm sided, 4 cm moulded, made of maple (*Acer* sp.). The vertical dowel (14-16 mm) secured the scarf. The scarf to the eastern transitional piece (KGE), around 25 cm in length, was locked by horizontal key (19-23 mm wide and 16 mm thick) and by two vertical dowels (diam. 10 mm). The eastern transitional timber was 55 cm long, 5 cm sided, 12 cm moulded, and made of deciduous oak (*Quercus* sp.).

The planking was homogeneously made of beech (*Fagus sylvatica* L.). The maximum width of the strakes was 16 cm and the average thickness 1.65 cm. Only one strake of the southern side (P10) was thicker (2.9 cm). The planking didn't have oblique scarfs but only stealers to reduce the width of the strakes towards the ends (**Fig. 35**).

The sewing system, made up of simple overedge vegetal stiches (/// pattern) through oblique channel (in section), was similar to the one of *Caska 1* and *Caska 3* (**Fig. 36**). Only one small horizontal dowel (coak) made of beech, 4.4 cm long and rectangular in section (8 x 5 mm), was noticed in the thickness of a detached fragment of plank. It probably functioned as pre-assembly element (**Fig. 37**). Pegs locking the stiches in the channels were 7 mm in diameter, and they were spaced 2.87 cm on average. They were 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 was made by using vegetal fibres. The use of pieces of textile was also attested in some seams (**Fig. 38**) and in the scarf joining the keel and the transitional eastern timber (KGE) (**Fig. 39**). This characteristic could be related to ancient repairs, but also to the original waterproofing system. A thick layer of pitch completed the waterproofing system of the boat.

The shipwreck conserved seven futtocks in very bad conditions, made from deciduous and evergreen oak (**Fig. 35**). They were rectangular, 4-5 cm sided and 7.2-10 cm moulded. The base was crenelated to avoid crushing of the wadding pad. The space was 89 cm, twice the value measured on *Caska 1* and *Caska 3*. Three of the frames (F10, F11 and F13) could have been identified as floor-timbers. They were connected to the futtocks by hook scarf, fixed by two or three vertically driven treenails (diam. 9-10 mm) (**Figs 40 and 41**).

The frames were not treenailed to the planking, but exclusively assembled by external lashing system. The stitch was formed with a flat braid of three strands of twisted vegetal fibres (width 5 mm). The stitch overlapped the frame at least three times and the top of the frame was lightly carved to accommodate the lashing (**Fig. 42**). The extremity of the flat braid was inserted in a blind hole, drilled from the top of the frame, then locked with small peg (depth 27 mm, diam. 6-7 mm). Then the braid passed through the planking in a couple of vertical holes, spaced around 5 cm, and here was locked by small pegs. The loop of lashing was tied at the base of the frame. On the outer surface of the hull, the stitching was protected inside a groove 4.5-5 long and 7-9 mm wide. The small pegs were made of fir, beech and dogwood (*Cornus* sp.).

### **The mortise-and-tenon built ship *Caska 2***

The scuttled ship *Caska 2* made part of the large breakwater in zone D, reinforcing its most exposed south-eastern end (**Fig. 16**). The remains of *Caska 2* were 13 m long and 4 m wide (**Fig. 43**). The ship rested on its starboard side (east). The transverse section at the main frame was flat, with round turn of the bilge (**Fig. 44**). The longitudinal section was flat, with convex extremities (**Figs 45**). The remains consisted of the keel, nine strakes on each side (the ninth strake was the lower wale), twenty-four frames, keelson/mast-step and some stringers. Two deadeyes were also found near the aft extremity of the keelson. A noteworthy find was a hearth used for cooking, situated in the bow (**Figs 43 and 46**).

The keel, rectangular in section, without chamfers and made of evergreen oak (*Quercus ilex* sp.), was 8.65 m long, and 15.5 cm sided (upper surface) (**Fig. 46**)<sup>8</sup>. It was scarfed to the stern and stem transitional timbers conserved, respectively on 3 m and 2 m in length (**Fig. 58**). The scarfs were not studied in detail, as the ship wasn't dismantled.

The transitional timber in the stern (south), made of evergreen oak, was slightly curved, 17.5 cm sided and 22 cm moulded (**Fig 43**). The rabbet was triangular in shape, 8-9 cm high and 3.2-4 cm deep. The strakes were attached to this stern transitional timber only by copper alloy nails driven from the outside of the ship, without use of mortise-and-tenon joinery. A rectangular recess to house a stanchion (6.7-7 cm x 5.4-6 cm, maximal depth 5 cm) was carved on the top of the upper surface of the transitional timber (**Fig. 47**). Its longitudinal section was deepest to the north (forward) than to the south (aft ward).

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<sup>8</sup> The height isn't known because the ship wasn't examined on the outer face nor the keel was sectioned.

The transitional timber to the stem (north), made of unidentified type of pine (*Pinus* sp.), was 17 cm moulded and 11.5 to 15 cm sided (**Fig. 43**). The enlargement was connected with the presence of the rabbet in the transitional timber (**Fig. 48**). The rabbet was triangular in shape, 4 cm high and 2.2 cm deep. The system of assembly of the strakes to the stem transitional timber is unknown due to the absence of dismantling.

The planking, mainly built of pine from the Scots pine type<sup>9</sup> and Aleppo pine/stone pine (*Pinus halepensis* Mill./*P. pinea* L.)<sup>10</sup>, was composed of nine strakes on each side, of average thickness of 3.8 cm (between 2.6 cm and 4.8 cm) (**Figs 49 and 50A**). The ninth strakes (P8E and P9W) correspond to the lower wales. They were respectively 12 cm and 14 cm wide. As the port wale (P9W) was badly damaged, its original thickness wasn't measured, while the starboard wale (P8E) was 12 cm thick.

The planks were joined with diagonal scarfs to form strakes and were connected to each other by mortise-and-tenon joints. Measurements of the fasteners were taken on some detached pieces and, where possible, on the hull. The mortises were 6.8 cm wide, 0.6-1.2 cm thick, 6.5 cm deep, and spaced 12 cm apart (side-to-side). The pegs were tapered (internal diameter 9.5 cm, external diameter 7.5 cm) and spaced 18 cm apart (centre-to-centre). The tenons, significantly smaller than the mortises, were 3.4-3.5 cm wide and 0.5-0.7 cm thick. Their conserved length was 3-3.5 cm. Tenons were made of evergreen oak and pegs of ash (*Fraxinus* sp.).

Several planks were repaired with patch tenons, and the rectangular and 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, due to the impossibility to observe the outer side of hull, this assumption is based mainly on the presence of small planks, as observed in the shipwreck Napoli A (Italy, 1<sup>st</sup> c. CE, Boetto and Poveda, 2018). These planks are associated to tackles of various shapes and dimensions nailed as internal reinforcements (**Fig. 51**).

Twenty-four frames survived, mostly made of evergreen oak, on average 8.6 cm sided and 9.6 cm moulded, with room-and-space of 47 cm (**Fig 50B**). They were not connected to the keel. The frames were connected to the planking by evergreen oak trenails (1.7 cm average internal diameter, average space centre-to-centre 12 cm). No nails were found, but the outer side of the planking wasn't excavated. The general framing pattern was of alternating floor-timbers, extended by futtocks but without fastenings between, and half-frames. Some half-frames overlapped amidships, with one extremity crossing the keel, so that the butt joints of the two half-frames projected beyond the central axis. Consecutive sequences of half-frames were noticed at the extremities, where the shapes of the ship narrow. Sequences of floor-timbers and overlapped half-frames were used at the level of keelson/mast step, thus reinforcing the hull (**Fig. 50B**). The frames were perforated by limber holes 3.5-4.5 cm wide, 2-5.4 cm high, and situated laterally to the keel (**Fig. 52**). As the planking, the frames of the port side were repaired (**Fig. 50B**).

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<sup>9</sup> 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 regroup the taxa under the name of "Scots pine type".

<sup>10</sup> 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).

The keelson/mast-step timber, made of Aleppo pine/stone pine, 6.75 m long, 15 cm wide and 11.5-14 cm thick, was installed above the frames (between F15 to F28) (Figs 43, 45 and 49). This timber was wider at the centre (20-22 cm), in connection with the presence of the mast-step. A series of rectangular recesses (2 to 8 cm deep) were cut on the lower surface to fit it precisely over the recesses (1-2 cm deep), cut on the upper face of the framing (Figs 45 and 46).

The mast-hole was rectangular, 15 cm long, 9 cm wide, and 5.5 cm deep. The forward cut was oblique to facilitate the raising and lowering of the mast. The mast-hole was flanked on three sides by rectangular recesses to house vertical planks supporting the mast (Fig. 53). The lateral recesses were 17 cm long, 2-3 cm wide and 2-2.8 cm deep, while the forward recess was 17.5 cm long, 3.8 wide and 2 cm deep. Two stanchion-holes were cut at a distance of 26 cm toward the stem. The first one was 6 x 5 cm, and 2 cm deep, the second one 5.6 x 4.7 cm, and 2.8 cm deep (Fig. 53).

The remains of three stringers nailed to the frames were preserved on the east side, and two on the west side. They were 20-23 cm wide and 3.5 thick on average. Three of them had mortise-and-tenon joints, demonstrating that those were planks reused from another ship (Fig. 43). The limber boards were not detected. Probably, they were lost or removed before scuttling.

The hearth was situated above the keelson/mast-step, between frames F27 and F28 in the bow area of the ship (Figs 43 and 55-57). It was not on the centreline of the ship; it was located instead toward the starboard side. It was 70 cm wide and 1.70 m long. A layer of planks was arranged as a foundation for its construction. Three planks (H1, H2/8, H3) crossed the keelson/mast-step 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 situated under these planks to wedge the structure. 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 fire.

Finally, the two deadeyes found on the shipwreck consisted in drop-shaped tablets of hard wood. These objects served to secure the shrouds of the mast of the ship. The first one (RG1) was pierced by two holes set alongside one another, while the second one (RG2) was three-holed (Figs 43, 58 and 59). The holes for lanyards were 2.2-3 cm, and the groove to house the shrouds were 2.2 cm wide and 0.6 cm deep. The deadeyes were also pierced by a couple of smaller holes (diam. 0.9 cm) for strop ropes. The blocks had 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 findings are also commonly found in harbours. One example from Dalmatia comes from Zaton, harbour of Nin/*Enona* (Brusić and Domjan, 1985: 81, fig. 6.9).

Fig. 59: Measurements of the two deadeyes from *Caska 2*.

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

## Dating

Unfortunately, the date of construction of the harbour structures and of the four vessels found in Caska is still not precisely established. Dendrochronological analysis coupled with AMS mass spectrometry and wiggle matching are performed by Alba Ferreira Dominguez and Frédéric Guibal, and we hope these analyses will be able to better define the chronology of ships (Ferreira Dominguez *et al.*, forthcoming). At present, some AMS analyses offered a first chronological framework.

The felling of the beech tree used to shape one plank (P3) of *Caska 1* has been dated between 42 and 104 AD on the basis of the synchronisation of the <sup>14</sup>C calibration curve, using wiggle-matching method (Pearson, 1986: 295-296) of six AMS mass spectrometry dates on six samples taken on this plank<sup>11</sup>. On the other hand, *Caska 2* has been dated between the 1<sup>st</sup> century BC and the 1<sup>st</sup> century AD<sup>12</sup>. It is worth of note that this sailing ship was heavily repaired, and probably had a long life before scuttling. *Caska 1* bear signs of ancient repairs, and probably *Caska 4* too. The 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, the pole 22, in evergreen oak (*Quercus ilex* L.) was dated between 69 and 236 AD<sup>13</sup>, while the pole 65, in cypress (*Cupressus sempervirens* L.) was dated between 59 and 226 AD<sup>14</sup>. The construction of the coastal structure therefore takes place between the second half of the 1<sup>st</sup> and the beginning of the 3<sup>rd</sup> century AD. The ceramic and amphora shards, although in small quantity, confirms this dating, and the date of *Caska 1* is coherent with this result. In zone C, the log n. 61, in enclosure 3, was dated by AMS between 45 BC and 85 AD<sup>15</sup>, thus placing the construction of the operational waterfront somewhere in the changing of era, and probably in an older date compared to the structures in zone A-B. Finally, the wreck *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 testifies to the existence of maritime estate, which at the beginning of the Roman Empire probably belonged to the senatorial family *Calpurnii Pisones*. Based on the current state of research we can conclude that it was provided by the monumental sea façade, which supported the first terrace of the south-eastern part of the complex.

Being concerned mainly with underwater research, the project *CissAntiqua* revealed the remains of ancient port structures, which in front of the terrace wall consisted of the small pier made of rocks and wooden poles (zone A-B), and the operational waterfront which partly consisted of rectangular enclosures made of horizontally positioned logs (zone C). One sewn boat per structure was scuttled in order to build and/or reinforce it (*Caska 1* and 4). Towards the bottom of the inlet there was a big breakwater (zone D), protecting the inner part of the harbour from destructive south-eastern wind. It is worth noting that it is situated in the same area where land excavations revealed the possible remains of the *pars rustica* of the maritime

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<sup>11</sup> Samples codes from Lyon-9267-SacA-29517 to Lyon-9272-SacA-29522.

<sup>12</sup> This date is based on two AMS mass spectrometry dates: one performed on the keel (code Lyon-13145-SacA-45495), the other on the port side futtock F12W (code Lyon-14130-SacA-49771).

<sup>13</sup> Sample WP7-A23, laboratory code Lyon-9273(SacA-29523).

<sup>14</sup> Sample WP8-A31, laboratory code Lyon-9274(SacA-29524)

<sup>15</sup> Sample Lyon-16171 (SacA-56341).



estate (cellar with *dolia defossa*, wine press, production structures with cistern etc.). The mortise-and-tenon built ship Caska 2 was scuttled in order to reinforce the south-eastern end of the breakwater at the point where it was threatened most. The bottom of the ship was reinforced to receive the rocks for scuttling by throwing a number of wooden elements, mostly planks, among which the remains of another sewn boat were discovered (Caska 3).

The site of Caska deserves some important considerations as it perfectly illustrates the techniques and materials used for the construction of port structures in submerged environments in Dalmatia during Roman period. It testifies to the use of locally available materials, limestone and wood, in particular evergreen oak that like other small trees and shrubs were abundant on the island of Pag, and allowed relatively simple, solid constructions (foundations, sanitation, stabilization).

In zone A-B, instead of the amphorae, well attested in the Roman world to drain marshy areas, especially in northern Italy (Pesavento Mattioli 1998; Zabeo, 2016), stabilization and drainage of the waterfront were carried out with wooden stems and branches. This technique finds parallels in the drainage of marshy soils in Treviso between the second half of the 2<sup>nd</sup> century and the first half of the 1<sup>st</sup> century BC (Gambacurta, Marcassa, 2004: 87; Tirelli, 1996: 31-33), in Strasbourg from the 1<sup>st</sup> century BC (Baudoux *et al.*, 2002: 130, fig. 63) and Estagnon de Fos-sur-Mer for the first half of the 1<sup>st</sup> century BC (Marty, Guibal, Hesnard, 2016: 269). Although Caska fagots were not used in a swampy area or near river, they had to fulfil a similar function, allowing drainage of muddy soil in order to stabilize the waterfront.

The structure made of enclosures in zone C is the most emblematic port structure among those that were discovered in Caska. The only similar example of harbor structure with logs and mortises housing vertical posts was found in the area of the Hellenistic port near the tourist 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 estuarine environments of the Atlantic, as the Roman quays of London (Marsden, 1980: 156-157, 1994, 24-29, figs. 17 and 17; Milne, 1985: 55-67), or the quays recently excavated in Bordeaux, in the estuary of the Garonne River (late 1<sup>st</sup> century BC – early 1<sup>st</sup> century AD; Gerber, 2011, 86, fig. 6, 2016) and at Rezé / *Ratiatum* in the Loire River estuary (late 1<sup>st</sup> – mid 2<sup>nd</sup> century AD; Mouchard *et al.*, 2016). These structures, well adapted to the environmental constraints imposed by the amplitude of the tidal range, served the urban centres of importance not comparable to that of the small coastal site of Caska. Another very interesting 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 3<sup>rd</sup> and 4<sup>th</sup> centuries AD (Kuznetov and Olkhovsky, 2014; Olkhovsky, 2016: 51-52).

On the other hand, the site of Caska is an exceptional example of the systematic reuse of ships and boats according to recycling practice, which was well established in the Roman world. The most famous example is certainly the ship that Caligula built for transport of the obelisk that is now in Vatican. According to the accounts of Pliny (*H.N.*, 16, 201-202) and Suetonius (Claudius, XX), this ship of exceptional size – it had deadweight of 1,300 tonnes and would have transported, in addition to the obelisk, 130,000 *modii* of lentils – was sunk by emperor

Claudius, after being filled with *pozzolana*, to serve as the foundation for the lighthouse of the new seaport which the emperor built north of Ostia.

The reuse of boats in the ports is a practice attested in Toulon where two small boats with transom bow of the *horeia*-type were reused in a pier, built at the end of the 1st century AD. J.-C. (Brun, 1999: 797-802; Boetto, 2009), and in Narbonne where a small sailboat, interpreted as being a lighter, carrying still its last cargo of amphorae, was used at the end of 4<sup>th</sup> – beginning of 5<sup>th</sup> century AD, to repair the eastern dike of the ancient mouth of the Mandirac river (Jézègou *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 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 ship is accompanied by other improvements, drainage and stabilization of the littoral made up of rows of posts and horizontally positioned planks, as well as a pier-like structure, containing Dressel 20 amphorae (Radić Rossi, 2007, 2008b, 2008c, 2008d, 2011b; Ruff, Radić Rossi, 2015).

Finally, recycling of boats and ships in harbour structures, as attested in Caska, offered to archaeologists unique assemblage of almost contemporaneous boats and ships of different architectural and functional types, and 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 the 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 extremities, the original length of *Caska 1*, which was the best preserved of the group, could be evaluated in 9 m. The boat was probably propelled using either sail or oars, although no traces of the propulsion system or steering devices were discovered on the shipwreck. Due to the similarity in shape, architecture, assembly pattern and use of wood species, the two other sewn boats of Caska, *Caska 3* and *4*, belonged to the same architectural and functional type as *Caska 1*.

All the three sewn boats could 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). It survived in Roman times, in relationship with a well-defined sailing area, characterised 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).

These sewn boats with mixed propulsion (oars and sails) could have belonged to the local Liburnian population, which could have been in service of the owners of the estate. They were used for fishing, and for daily needs of transportation and farming activities in the Gulf of Pag. On the other side, the mortise-and-tenon built ship *Caska 2* was surely a sailing vessel, as demonstrated by the presence of the keelson/mast step still in place. Its original

length could be estimated to 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.

The origin and place of construction of *Caska 2* is difficult to locate, as this one-mast sailing ship could have been built in any shipyard of the Adriatic. By the time of its building most of the shipyards already used the mortise-and-tenon technique for joining the outer planking of the hull. *Caska 2*, well equipped for life on board (hearth in the bow area), served for long-distance journeys in Adriatic. It transported people and goods until it was old enough for being scuttled.

Finally, the remains of the Roman port in the inlet of Caska do not point to the busy area, situated at the seafaring route. It served to the private estate, which used it for boats and ships that satisfied its essential needs of fishing and transport. Part of the produced goods 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, which contribute to our understanding of Roman building techniques for harbour structures. In parallel, it offered new insights in one of the most interesting ship assemblages of Dalmatia, attesting the persistence of ancient native shipbuilding tradition (sewing, lashing) by side of a more widespread Mediterranean shipbuilding technique (mortise-and-tenon).

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Fig. 1: Localisation of the Bay of Caska in the Pag island (drawing V. Dumas, AMU, CNRS, CCJ).



Fig. 2



Fig. 3



Fig. 4: View from the west of the inlet of Caska (photo L. Damelet, AMU, CNRS, CCJ).

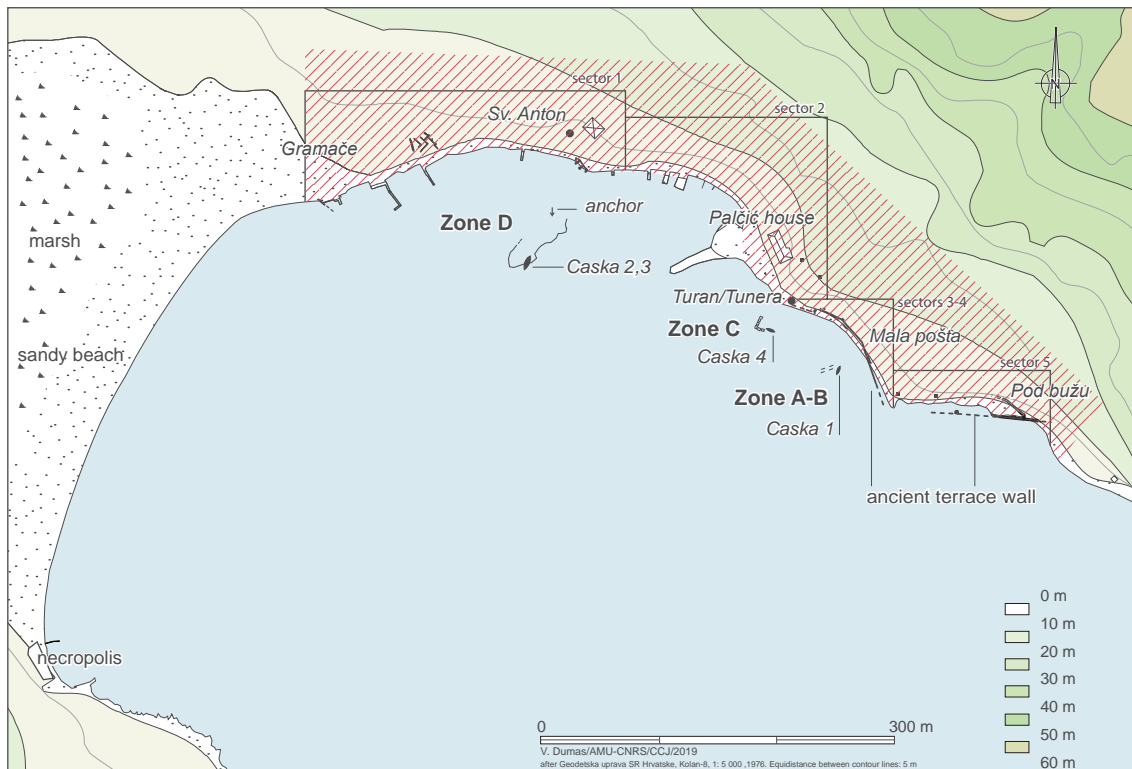


Fig. 5: Zones excavated in the Caska inlet. The red-hatched area gives an idea of the possible extension of the maritime Roman estate (drawing V. Dumas, AMU, CNRS, CCJ).



Fig. 6: View of the structures in Sector 1 (photo Ph. Groscaux, AMU, CNRS, CC)



Fig. 7: Fragment of big terrace wall (photo I. Radić Rossi, University of Zadar)



Fig. 8: Drainage canal built through the terrace wall (photo Ph. Groscaux, AMU, CNRS, CC)

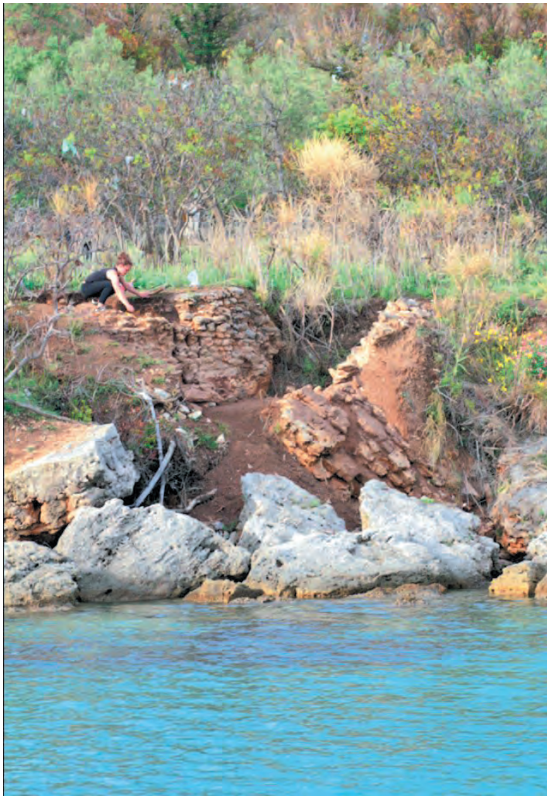


Fig. 9: Buildings of unknown purpose above the breccia slabs (photo Ph. Groscaux, AMU, CNRS, CCJ)



Fig. 11: Measuring of the underground canal (photo Ph. Groscaux, AMU, CNRS, CCJ)

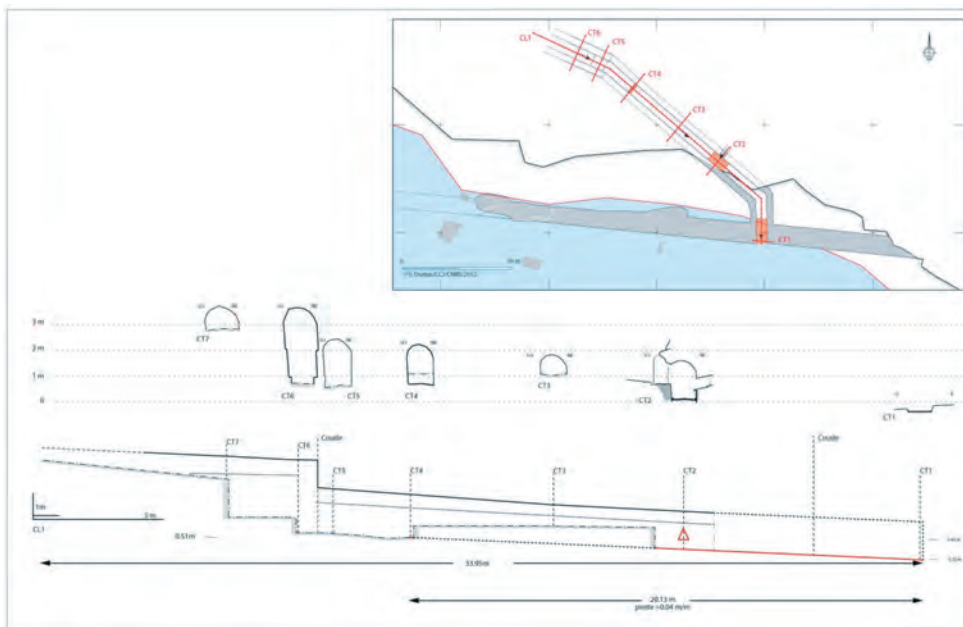


Fig. 10: Plan and cross-section of the underground canal/tunnel (drawing V. Dumas, AMU, CNRS)

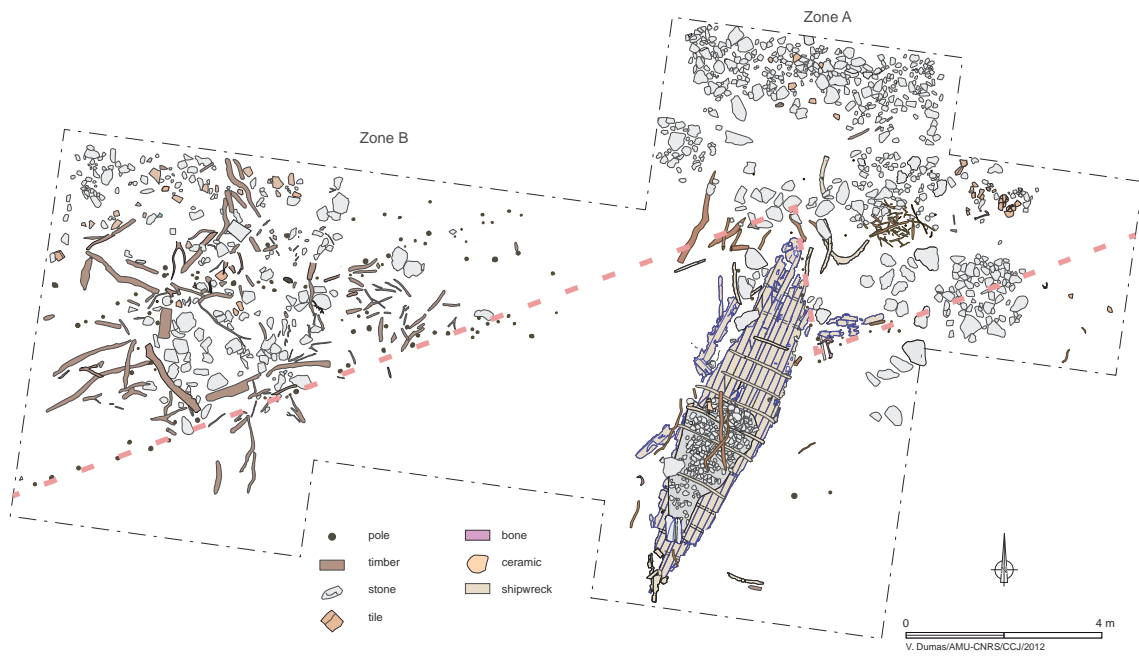


Fig. 12: The zone A-B with the scuttled sewn boat Caska 1 (drawing V. Dumas, AMU, CNRS, CCJ).

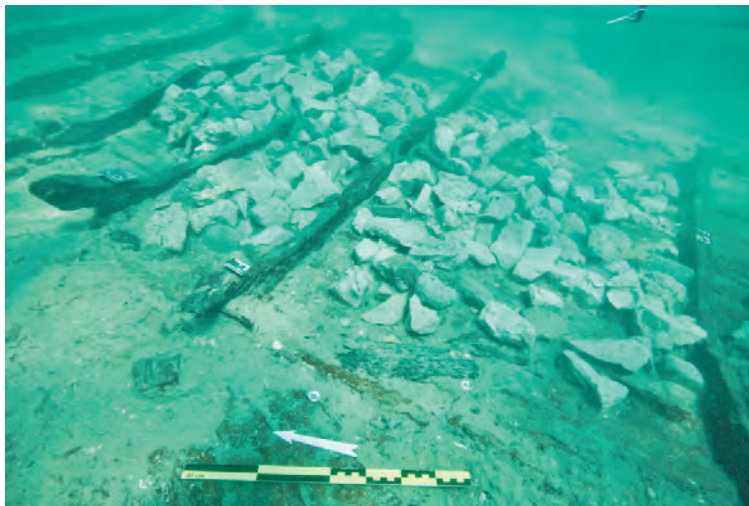


Fig. 13: The layer of small stones covering the bottom of Caska 1 (photo L. Damelet, AMU, CNRS, CCJ).

Fig. 14: The wooden anchor found in 2005  
(drawing Univ. of Zadar)

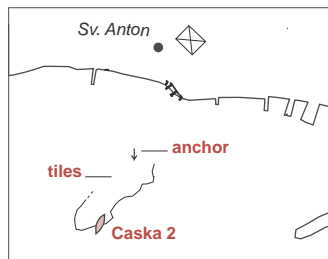
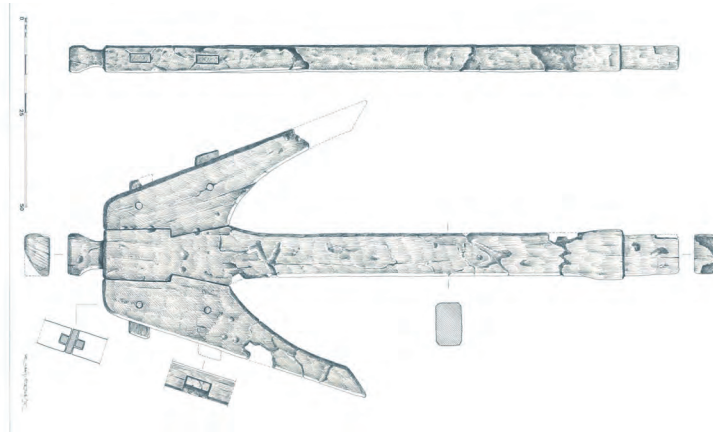


Fig. 15: The zone D with the scuttled ship Caska 2 (drawing V. Dumas and P. Poveda, AMU, CNRS, CCJ).





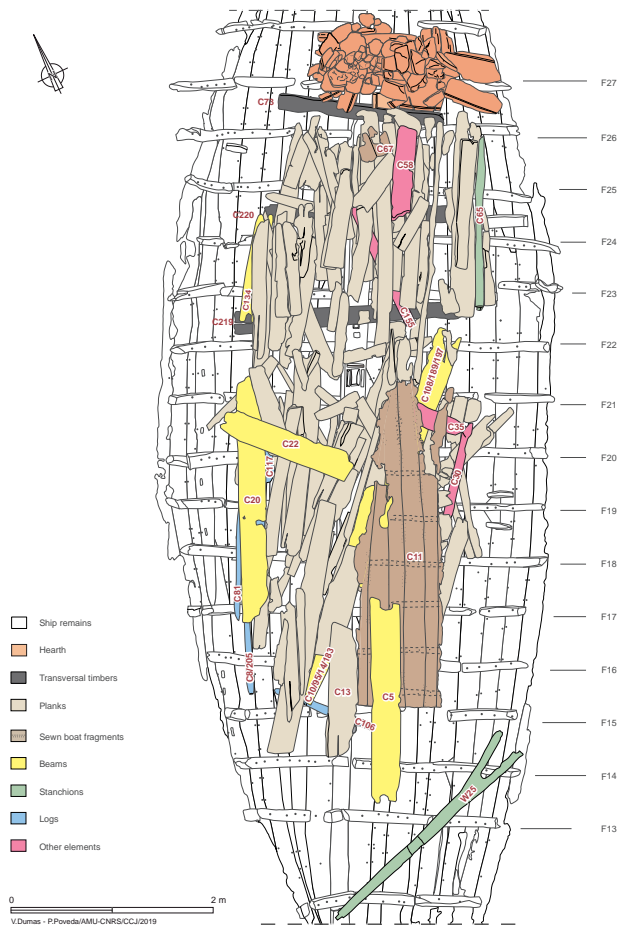


Fig. 16: The wooden infilling of Caska 2 (drawing P. Poveda, AMU, CNRS, CCJ).

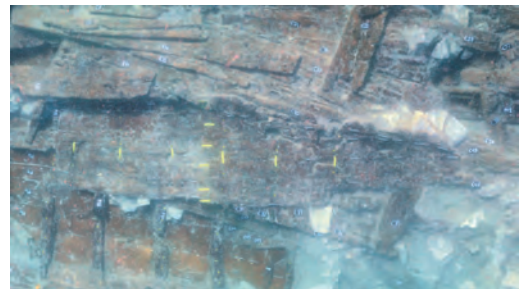


Fig. 17: The fragment of sewn boat Caska 3 (photo D. Frka, University of Zadar).



Fig. 18: The forking stanchion (photo Ph. Groscaux, AMU, CNRS, CCJ).



Fig. 19: The letters S-V engraved on the timber with recesses (C30) (photo T. Seguin).

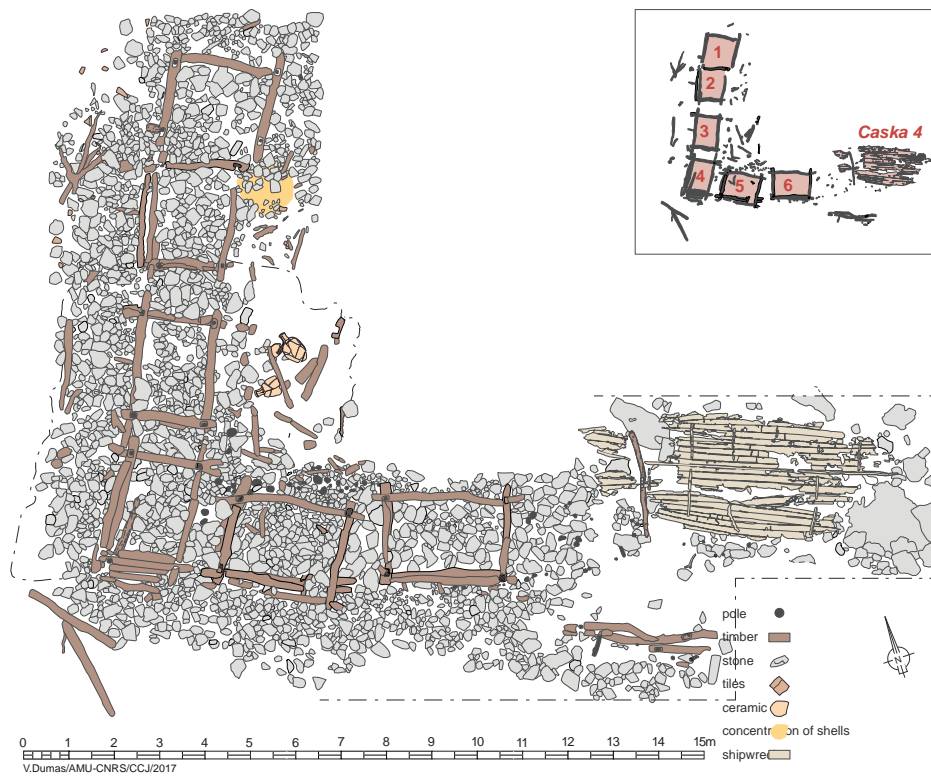


Fig. 20: The zone C and the scuttled sewn boat Caska 4 (drawing V. Dumas, AMU, CNRS, CCJ).



Fig. 21: Two lever of overlapping logs of the third enclosure (photo Ph. Groscaux, AMU, CNRS, CCJ).



Fig. 22: Mortise cut at the extremity of the log and pole for the anchoring system (photo Ph. Groscaux, AMU, CNRS, CCJ).



Fig. 23: One of the two amphorae found in zone C (photo Ph. Groscaux, AMU, CNRS, CCJ)



Fig. 24: The shipwreck Caska 1 (photo L. Damelet, AMU, CNRS, CCJ).

Fig. 25: Plan of the shipwreck Caska 1 (drawing V. Dumas, AMU, CNRS, CCJ).

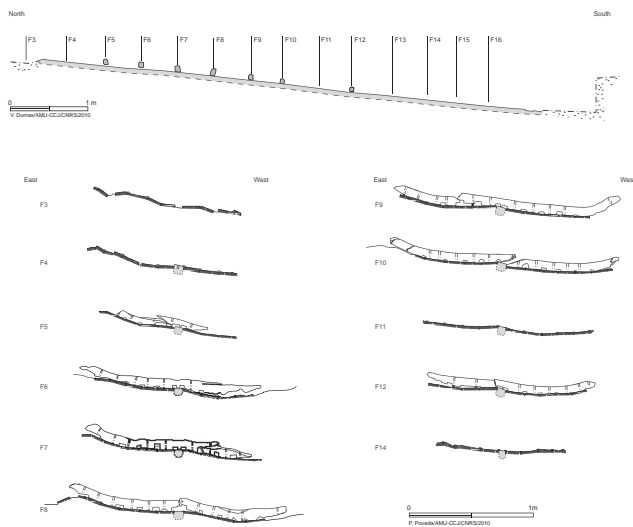
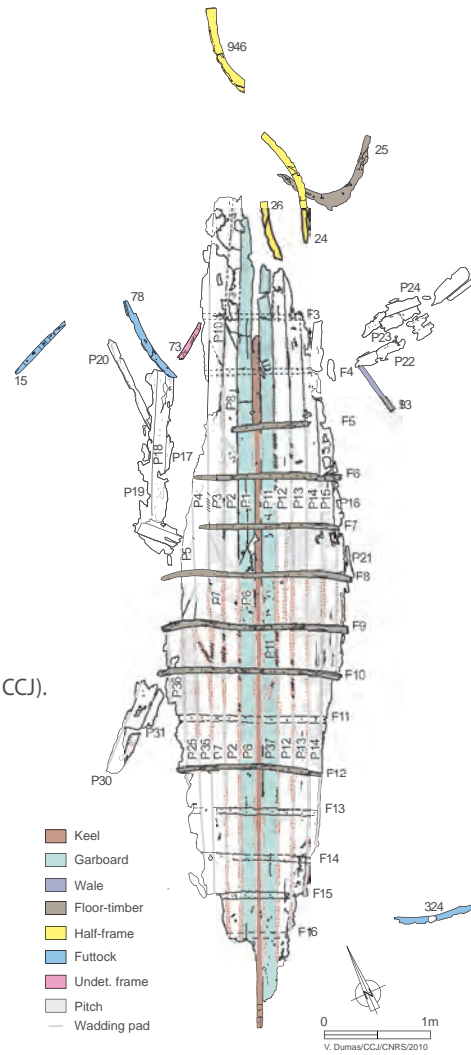


Fig. 26: Longitudinal and cross sections of Caska 1 (drawings V. Dumas & P. Poveda, AMU, CNRS, CCJ).

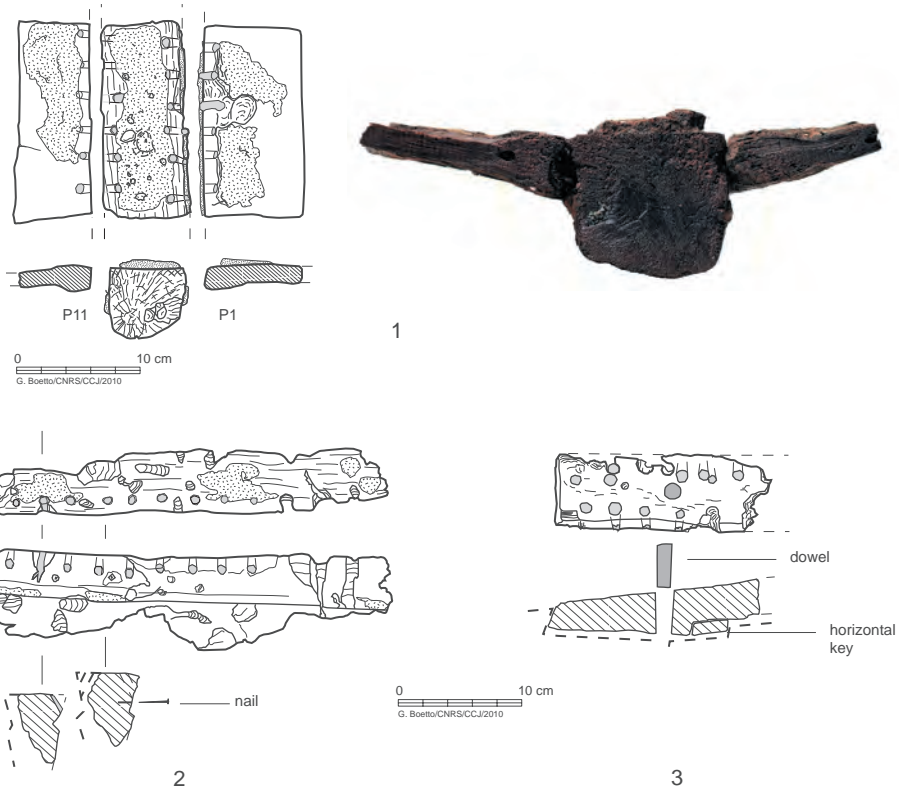


Fig. 27: The axial carpenetry: 1. Section of the keel and garboards P1 and P11;  
 2. Fragment of transitional timber with rabbets 27;  
 3. The northern scarf in the transitional timber 52-54;  
 4. The southern scarf on the keel (drawings G. Boetto; photo L. Damelet, AMU, CNRS, CCJ).

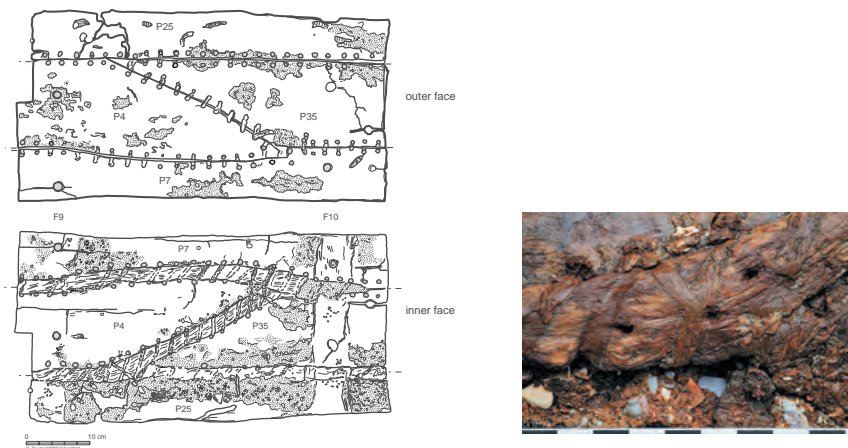


Fig. 28: The sewing pattern (drawing G. Boetto; photo L. Damelet, AMU, CNRS, CCJ).



Fig. 30: Recesses cut on the plank edges to pass and protect the stitching (photo L. Damelet, AMU, CNRS, CCJ).



Fig. 31: Floor-timber F10 (photo L. Damelet, AMU, CNRS, CCJ).

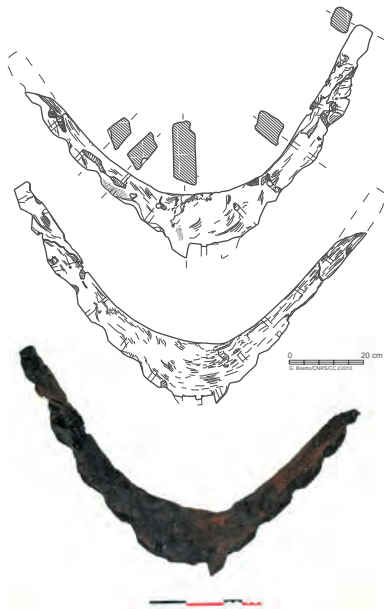


Fig. 32: V-shaped floor-timber (crotche) n° 25 (drawing G. Boetto, photo L. Damelet, AMU, CNRS, CCJ).

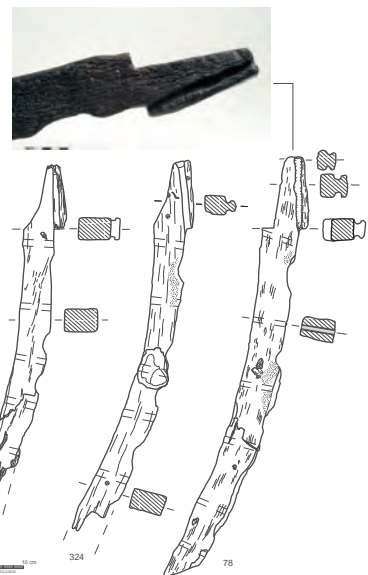


Fig. 33: The three worked futtocks (n° 15, 78 and 324) (drawings G. Boetto, photo L. Damelet, AMU, CNRS, CCJ).

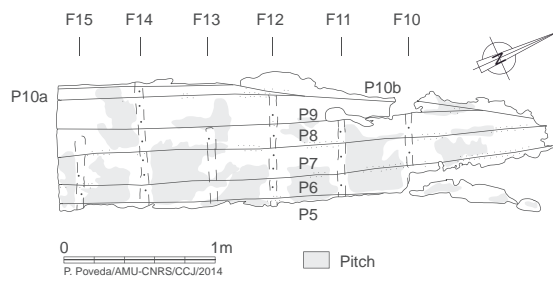


Fig. 34: Plan of the shipwreck Caska 3 (drawing P. Poveda, AMU, CNRS, CCJ).

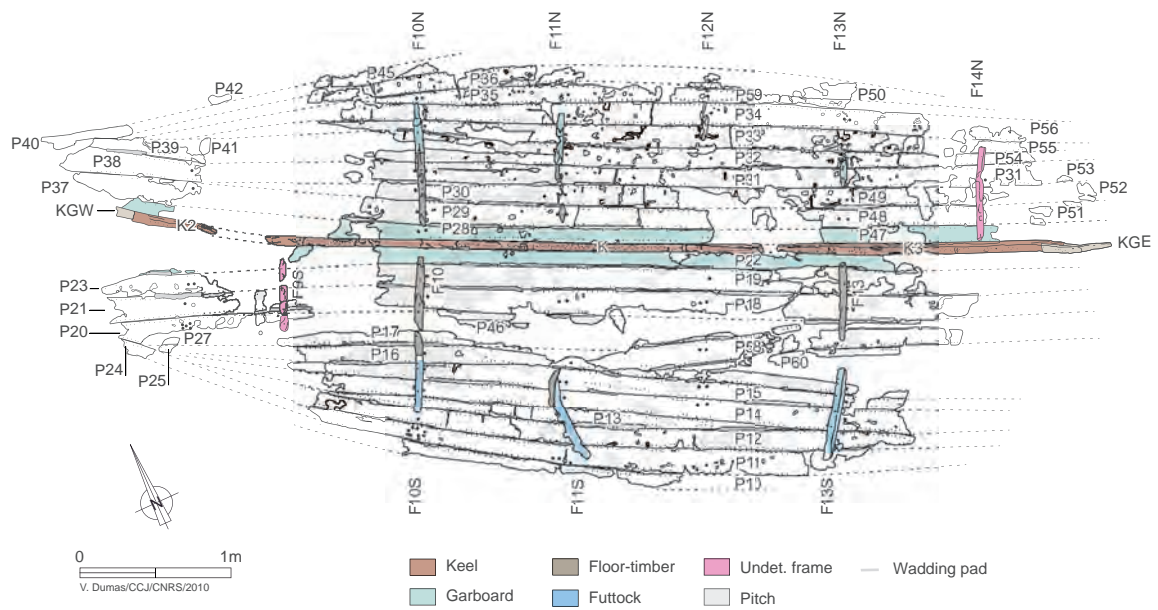


Fig. 35: Plan of the shipwreck Caska 4 (drawing V. Dumas, AMU, CNRS, CCJ).

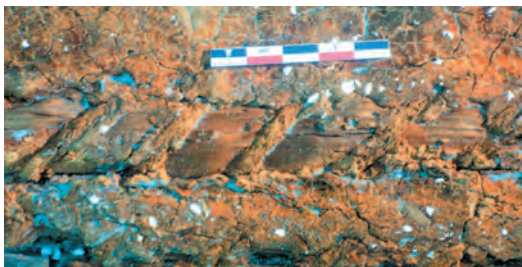


Fig. 36: The sewing system (photo L. Roux, AMU, CNRS, CCJ).



Fig. 37: View of the outer face of a fragment of planking P52 with a horizontal dowel (photo L. Roux, AMU, CNRS, CCJ).

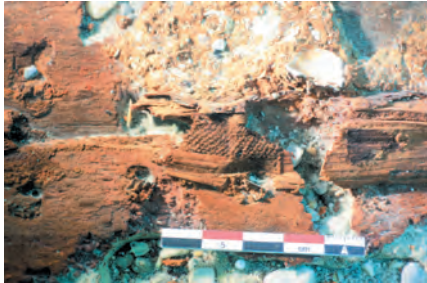


Fig. 38: Textile used in the seams between the southern garboard (P22, on the top) and the second strake (P19) (photo L. Roux, AMU, CNRS, CCJ).



Fig.39: Textile found in the scarf joining the keel and the eastern transitional timber (photo L. Roux, AMU, CNRS, CCJ).

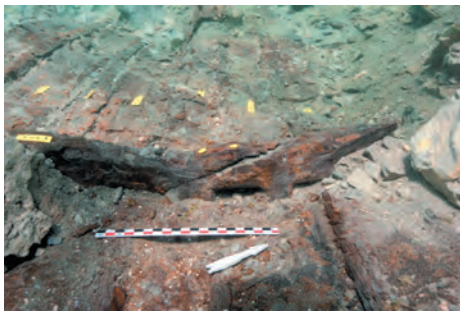


Fig. 40: Southern part of frame F10 from the East. The futtock (at the left) is overlapping the floor-timber and two vertical treenails (yellow pins) join the two elements (photo L. Roux, AMU, CNRS, CCJ).



Fig. 41: Northern part of the frame F10 and the futtock F10N: the floor-timber has large recesses on the base (photo L. Roux, AMU, CNRS, CCJ).



Fig. 42: External lashing on the top of the frame (photo L. Roux, AMU, CNRS, CCJ).

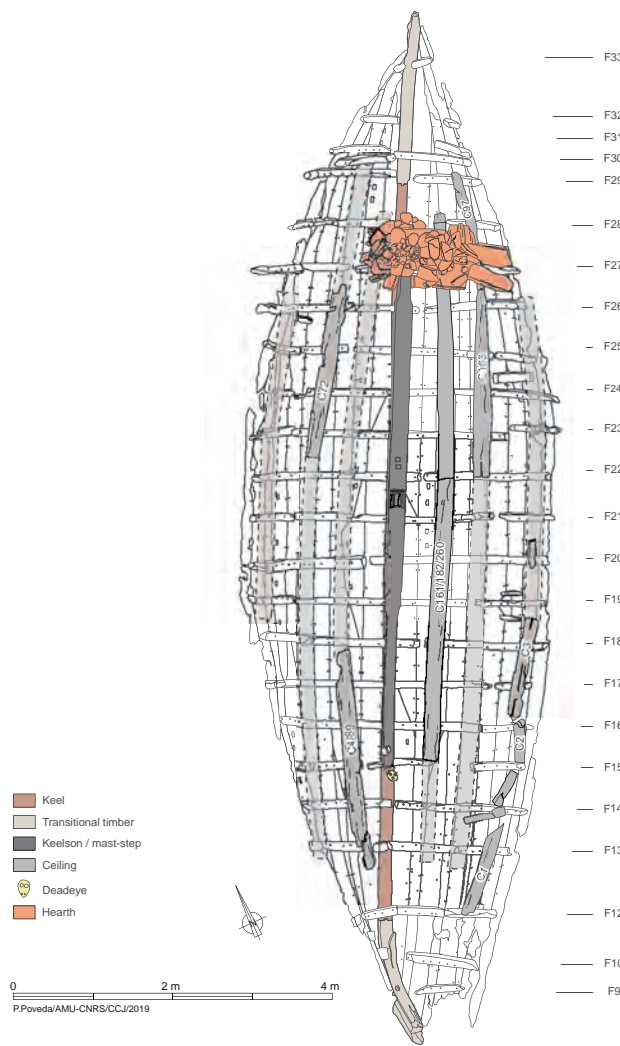


Fig. 43: Plan of the shipwreck Caska 2 (drawing P. Poveda, AMU, CNRS, CCJ).

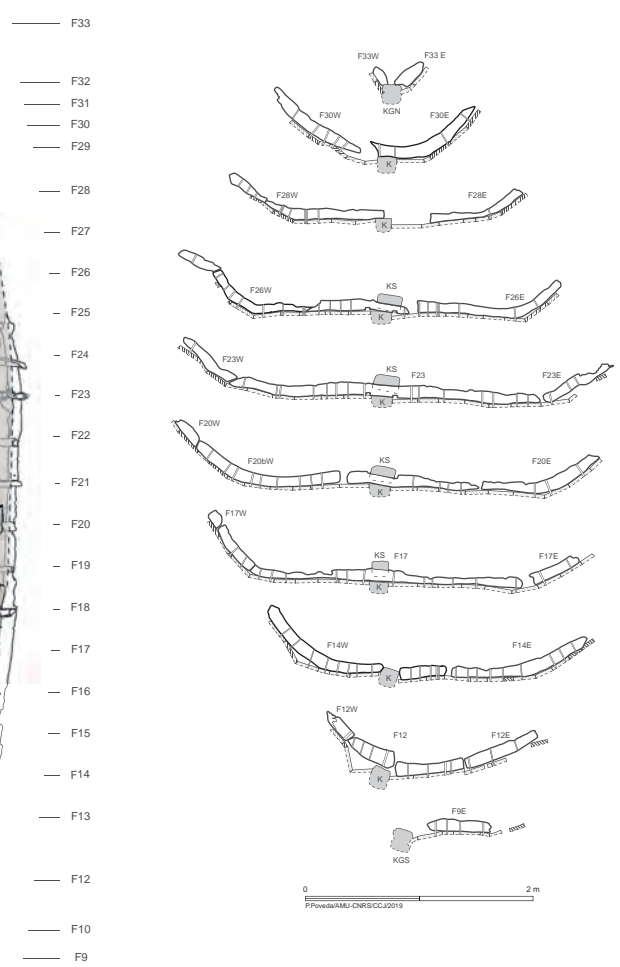


Fig. 44: Cross-sections of Caska 2 (drawing P. Poveda, AMU, CNRS, CCJ).

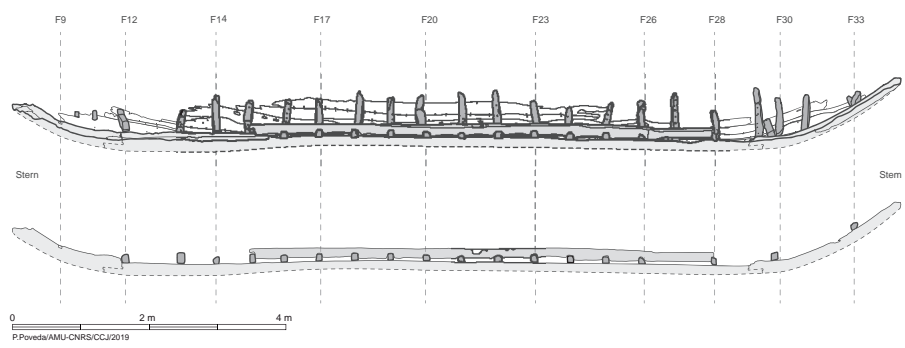


Fig. 45: Longitudinal sections of Caska 2 (drawing P. Poveda, AMU, CNRS, CCJ).



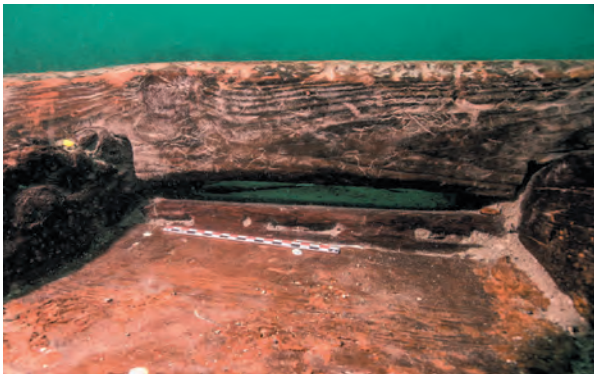


Fig. 46 The upper part of the keel without chamfer. The keelson/mast step is carved to accommodate on the frames and worked to allow the bilge water to circulate (photo T. Seguin).



Fig. 47: Recess on the upper surface of the stern transitional timber (photo T. Seguin).



Fig. 48: Scarf between the keel (right) and the stem transitional timber (left). Note the yellow pitch covering the hull (photo T. Seguin).



Fig. 49: Orthophoto of the shipwreck Caska 2 (photo T. Seguin, photogrammetry V. Dumas, AMU, CNRS, CCJ).

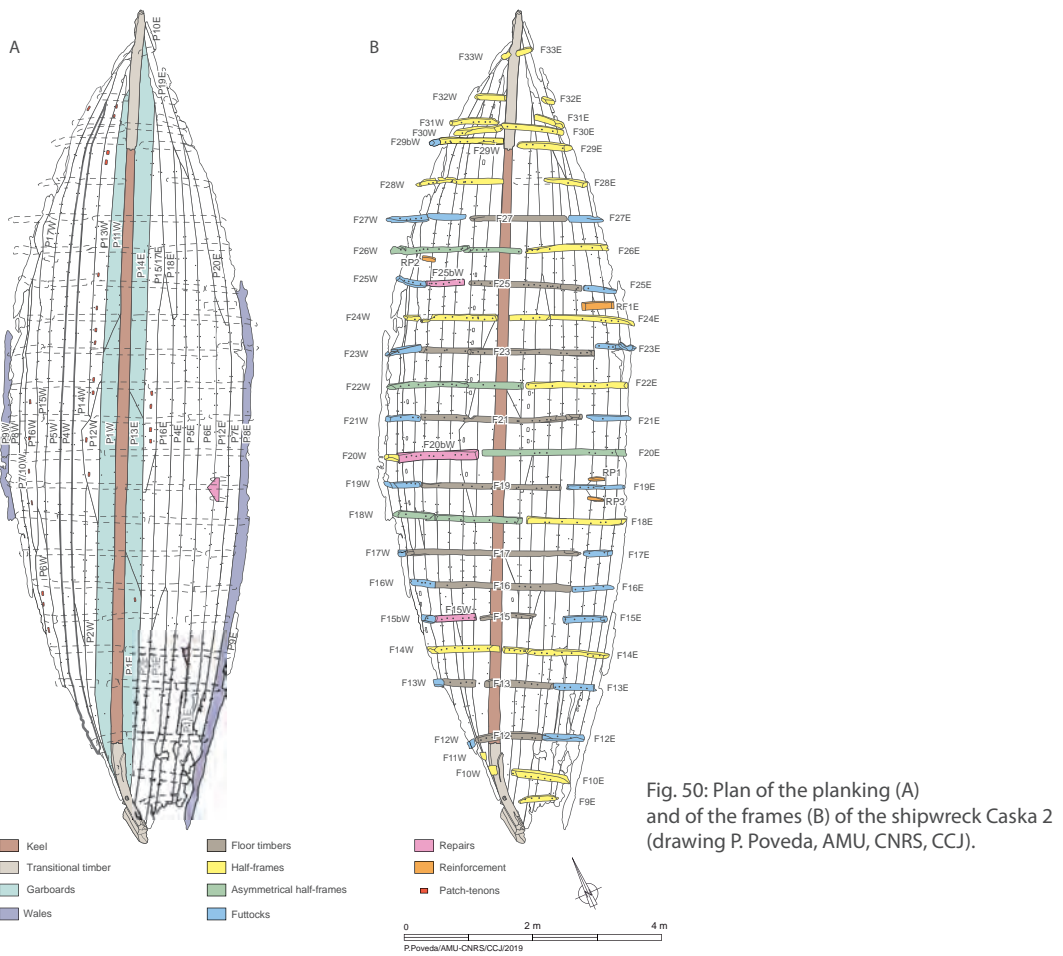


Fig. 50: Plan of the planking (A) and of the frames (B) of the shipwreck Caska 2 (drawing P. Poveda, AMU, CNRS, CCJ).



Fig. 51: Tackles on the port side (photo T. Seguin).



Fig. 52: Limber-hole on a half-frame. The white wire indicates the position of a patch-tenon on the garboard (photo T. Seguin).

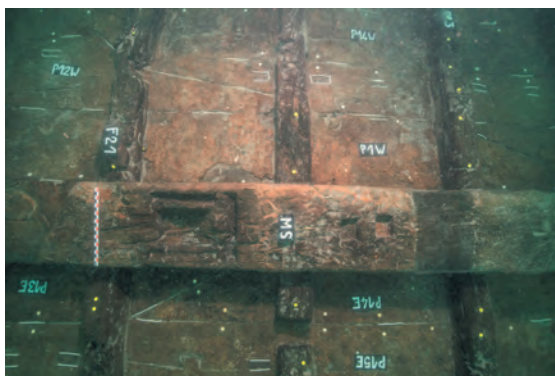


Fig. 53: The mast step and the others recesses for stanchions on the keelson/mast step (photo T. Seguin).



Fig. 55: Views of the hearth: a. from the South-West, b. from the East, c. from the North (photos T. Seguin).

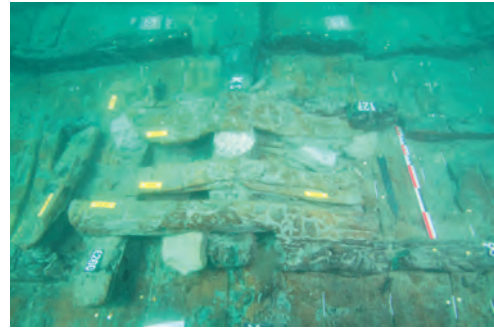
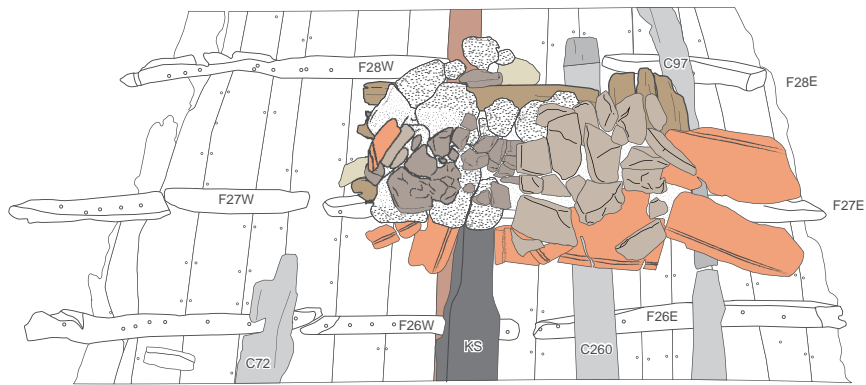


Fig. 57: The layer of planks supporting the hearth from the North (foto S. Govorčin, University of Zadar).



- Keel
- Keelson / mast-step
- Ceiling
- Stones
- Hearth floor
- Mortar
- Tiles
- Bricks
- Burned bricks

0 1 m  
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Fig. 56: The heart (drawing P. Poveda, AMU, CNRS, CCJ).



Fig. 58: The two deadeyes, RG1 on the left and RG2 on the right (photos T. Seguin).