



Denge Quarry Shipwreck Timbers: Recording and Assessment Stage

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Portway House
Old Sarum Park
Salisbury
Wiltshire
SP4 6EB

www.wessexarch.co.uk

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Non-technical Summary

The Denge quarry shipwreck, also referred to as Dungeness wreck, was found and recovered in spring 2022 by staff at Cemex's Denge quarry while excavating in the quarry lake for aggregate. The remains were recorded and re-deposited in the quarry by a team of archaeologists during a four-week period between July and August 2022. This phase of the project aimed to create a comprehensive record of all components that were recovered at the Cemex quarry.

The study of the timbers suggests that the ship could have been built in England as early as the mid-1530s with wood sourced from East and South-East England. However, the presence of timber from two different phases introduces some complexity to dating the ship, and it could either extend the earliest plausible construction date to post-1561 or imply that the ship underwent alterations at that time.

The ship's construction details show striking resemblance to the Gresham wreck (c. 1574), indicating a similarity of approach to the challenges of the adoption of carvel construction. This might well imply a shared origin or adherence to a regional tradition of shipbuilding.

Due to the lack of detailed archaeological surveys of English-built ships from this foundational period for English shipbuilding, this work hopes to provide a valuable contribution to an otherwise limited corpus of archaeological data.

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This report was written by Paolo Croce, and the project was managed for KCC by Casper Johnson and for Wessex Archaeology by Andrea Hamel.

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Denge quarry shipwreck timbers

Recording and assessment stage

1 INTRODUCTION

1.1 Project background

1.1.1 On 14 April 2022, four sections of a wooden shipwreck, as well as several loose timbers, were unearthed during dredging operations at Cemex's Denge Quarry in Lydd, Kent (Figure 1). The discovery of these timbers was promptly reported through the Marine Aggregate Industry Archaeological Protocol by the staff of the quarry, and the finds were given the ID Cemex_1029. Although the find wasn't directly related to marine activities, it initiated discussions with Archaeological Curators.

1.1.2 Later in April, Wessex Archaeology conducted an initial assessment of the timbers (Wessex Archaeology 2022a) to ascertain their historical significance and plan the next steps. Subsequently, in May 2022, additional emergency recording and dendrochronology sampling took place over a span of two days (Wessex Archaeology 2022b). These initial assessments suggested that the remains might have been those of an early carvel-built vessel from the 16th or 17th century. The timbers were temporarily stored in water within a trench dug next to the quarry, awaiting a decision on funding for their comprehensive recording.

1.1.3 Between July and August 2022, a team of archaeologists recorded the recovered timbers, thanks to funding provided by Historic England, following an emergency funding application led by Kent County Council (KCC). As the conservation cost of the material was deemed prohibitive, and no repository could be found in the limited time available, after the recording the timbers were re-submerged within the quarry in a nominated area, which had been assessed as suitable for long term storage, and buried in re-deposited aggregate.

1.2 Planning background

1.2.1 The shingle quarry located at Denge, operated by Cemex, is a landlocked quarry on Dungeness Foreland. It has been in operation since the 1940s and it is filled with water. Initially, the site was excavated to depths ranging from 3 m to 5 m. Subsequently, it underwent further extraction, deepening the quarry to its present state. Importantly, there are no specific archaeological conditions associated with the relevant planning permission nor are there any relevant obligations outlined in the associated S106 Agreement that would mandate archaeological activities or reporting within the quarry's operation. It is worth noting that despite this absence of formal obligations, Cemex, as the quarry operator, has been commendable in its efforts to facilitate the documentation and safekeeping of the archaeological remains discussed in this report.

1.3 Aims

1.3.1 The primary objective of the project was to undertake comprehensive recording and produce a description of the remains detailing the timbers recovered, including all components of the vessel framework and any ancillary finds obtained from the Cemex quarry. The aim was to achieve a standard of documentation that supports a thorough

interpretation of the remains and their context of deposition and that can be usefully interrogated to inform reliable reconstructions hypotheses.

Scope of the project

- 1.3.2 The documentation approach outlined for this project aligned with or surpassed the requirements outlined in Level 3 of the Chartered Institute for Archaeologists (CIfA's) "Standard and guidance for nautical archaeological recording and reconstruction" (CIfA 2014). This is described as:

A complete scaled survey including hull-form and photographic record of the remains of the whole vessel, recording all significant features, fittings and ancillary components. This record should contain data on the size, shape, material and condition of all elements of the vessels structure, fittings and ancillary components including a record of constructional features, all fastenings (size and type), tool marks (type and size), shipwrights marks, carpentry features (joints, bevels, chamfers), wood features, (grain, sapwood, knots, pins, bark), wear and compression marks, means of propulsion and steering, fittings (internal and external) and outer and internal coatings (paint, paying, caulking).

- 1.3.3 This report includes the following elements:

- A non-technical summary;
- The aims of the work;
- Methodology;
- A summary of the historical and archaeological context;
- A record of the timbers, containing a description of the preserved parts and interpretation of each individual element including a proposed building-sequence of the vessel;
- The presentation of the outcome of the timber assessment, including finds and environmental remains;
- A statement of the significance of the remains;
- Recommendation for further work;
- Appendices;
- Illustrations; and
- References.

- 1.3.4 This report is built upon the foundation of specialist reports, which collectively contribute to a wider understanding of the remains and their environment. The following reports are included in the appendices:

- A geoarchaeological assessment with reference to wider landscape and site development; based on the geotechnical investigation (GI) data obtained from Cemex. It also includes a review of previous research about the geomorphological history of the part of Dungeness (Appendix 1 - Wessex Archaeology 2023).
- An assessment of environmental samples retrieved from the bilge of the wreck (Appendix 2 - Wessex Archaeology 2025);
- Various identification analyses on samples of waterproofing material and coatings on the timbers (Appendix 3- Microtext 2023; Appendix 4 - Historic England 2023; Appendix 13 - Wren, Michael, Kuhnle, Luke 2024);
- The results of the dendrochronological analyses (Appendix 5 – Historic England 2025);
- A research report summarising the results of archive and documentary research (Appendix 6 - Draper 2023);
- A report presenting the outcomes of the initial research conducted using the National Record of the Historic Environment (NRHE) data (Appendix 7 – Historic England 2023);
- An assessment focused on the state of the wood of a selection of samples to determine the preservation condition of the wooden remains (Appendix 8 - Wessex Archaeology 2023);
- Macroscopic analyses on a granite boulder recovered from the discovery location (Appendix 9 - Parry 2024);
- Specialist assessment of the finds (Appendix 10 – Wessex Archaeology 2023)

1.3.5 Finally, Appendix 11 is a timber catalogue containing scaled drawings of all the timbers in 1:10 and 1:20 scale and scaled views (1:20 and 1:25) and Appendix 12 contains scaled drawings of the main pieces of wreck that are discussed in the text.

1.4 Copyright

1.4.1 The full copyright of the written/illustrative/digital archive relating to the project will be retained by Wessex Archaeology under the Copyright, Designs and Patents Act 1988 with all rights reserved. The client will be licenced to use each report for the purposes that it was produced in relation to the project as described in the specification. Information relating to the project will be deposited with the Historic Environment Record and Archaeological Data Service, where it can be freely accessed for the purposes of archaeological research, or development control within the planning process.

2 METHODOLOGY

2.1 Recording methods

2.1.1 The selected method for recording ship timbers was the 3D annotated scanning technique, as outlined in Van Damme *et al.* (2020). This method encompassed a two-phase approach: firstly, a 3D scan was performed to capture the timbers' detailed geometry, followed by a subsequent interpretation phase. During interpretation, a nautical specialist meticulously traced diagnostic features, such as fasteners and toolmarks,

directly onto the digital model of the timber. This approach ensured the comprehensive documentation of the timbers' complex geometries while adhering to project timelines. The Artec Leo scanner was utilised for the first phase whilst the annotation phase, which started immediately after the fieldwork, was conducted in Rhino3D.

- 2.1.2 The disassembly of the larger portions of the hull occurred in three sequential stages: the ceilings, followed by the frames, and finally, the outer planking. Each layer underwent photogrammetry recording, with the generated drawings subsequently digitized to produce 1:10 or 1:20 scale drawings. Every timber underwent tagging, measurement, photography, sketching, and laser scanning for detailed documentation.
- 2.1.3 The smaller sections were carefully rotated with the help of the machine made available by Cemex, allowing for the creation of a comprehensive 3D record. In consideration of health and safety protocols and with concerns for potential deformation and preservation of the timbers' integrity, the decision was made to not attempt the photogrammetric recording of the outside of the larger section while it remained attached.
- 2.1.4 The resulting digital records were then annotated and scaled drawings at 1:10 and 1:20 were generated for each timber. The frame and planking plans and cross-sectional representations were derived from a mixture of data from the photogrammetric models and the 3D scan of the timbers.
- 2.1.5 The dismantling process involved the use of plastic wedges and hand saws, complemented by the occasional use of battery-powered tools such as reciprocating saws to expedite disassembly.

2.2 Collection of samples

- 2.2.1 Various samples were collected to inform the investigation and were subject to specialist assessment. The methods of the analyses are described in each specific report (see appendices) which also provide detailed insight into the investigative procedures employed.

Dendrochronology

- 2.2.2 Timber samples were selected for dendrochronological assessment, with a specific focus on sections containing multiple articulated timbers. The selection of samples for dendrochronological analysis was a collaborative process involving consultation with the Scientific Dating team from Historic England (Appendix 5).
- 2.2.3 The sampling strategy aimed to maximise the likelihood of obtaining meaningful dates on each of construction elements. Therefore, sampling of a substantial number of frame elements was conducted to narrow the construction date of the vessel but also to analytically differentiate between the original construction phase and potential later additions. Other objectives were the confirmation that the various sections originated from the same wreck and likewise establishing connections with disarticulated timbers.
- 2.2.4 A total of 50 samples from 49 timbers were collected, with seven of these samples being elm, while the remaining were oak. Successful dating results were obtained for 25 of the oak samples. Six wood samples (three elm and three oak) were therefore submitted for tree ring dating using oxygen isotope analyses and five yielded dates.

Environmental

- 2.2.5 Five bulk sediment samples were acquired from areas exhibiting sediment accumulation, such as the bilge and beneath the ceiling planks (Appendix 2). One control sample was taken from natural deposits surrounding the shipwreck. This was done to facilitate comparative analysis with the broader environmental context and to potentially gain insights into the vessel's historical use.

Waterproofing & coating material sampling

- 2.2.6 Twelve samples of waterproofing material and other coatings were retrieved for subsequent analysis and specialized assessment including the identification of the fibres (Appendix 3), FITR (Appendix 4), isotopic analyses and GC/MS (Gas Chromatography-Mass Spectrometry) for the characterisation of the binding compound and coatings (Appendix 13). An attempt to carry out palynological analyses of potential pollens embedded within the pitch compounds was also attempted but was unsuccessful.

Petrographic analyses

- 2.2.7 A granite boulder that was reported as recovered with an unspecified number of several others from the area nearby the discovery location. The boulder was analysed by Stephen Parry of the British Geological Survey (Appendix 9). However, it is currently unclear whether the rocks were part of the archaeological context associated with the wreck site, for example as cargo or ballast.

2.3 Redeposition

- 2.3.1 In light of the financial constraints associated with preserving the wreck, after the recording phase, all timbers were placed within large containers (hippo bags) and subsequently redeposited within the quarry.
- 2.3.2 At the time of writing, Cemex's long-term plan is to continue quarrying operations until approximately 2024/2025. As part of the quarry's restoration process, the waste silt and sand resulting from the remaining dredging operations will be reintroduced into the quarry. This will ultimately result in the creation of a shallow lake, approximately 1 to 2 m in depth, with an approximate sediment layer of 3 to 4 m covering the redeposited timbers. This infilling process commenced in September 2022, coinciding with the redeposition of the remains. This action is expected to create an environment conducive to preservation of the timbers and completely bury the material under fine silt.
- 2.3.3 The exact position of the re-buried remains was added to the Kent HER.
- 2.3.4 Furthermore, there are ongoing discussions, though not yet formally agreed upon, for the RSPB (Royal Society for the Protection of Birds) to assume control of the site post-restoration. Regardless of the entity overseeing the site, it will be obligated to adhere to the relevant environmental regulations pertaining to the Dungeness area. These regulations will ensure the maintenance of a waterlogged and undisturbed burial environment for the archaeological remains.
- 2.3.5 To form a baseline for any future monitoring of the timbers, the physicochemical properties of a selection of wood samples were assessed by Wessex Archaeology in-house conservator to determine the preservation levels at the time of deposition (Appendix 8).

3 SITE LOCATION AND CONTEXT

3.1 Site location

- 3.1.1 Cemex's Denge Quarry is situated to the east of Dungeness Foreland, approximately equidistant between Greatstone and Dungeness. The quarry is landlocked, approximately 500 m away from the shore, behind the line of coastal houses of Coast Drive road and the Dungeness shingle beach.
- 3.1.2 The quarry is filled with water. Sand and gravel within the lake are extracted with a long arm excavator on a floating pontoon and then moved to a berth at the southern end of the lake. From there, sediments are taken to the conveyors and then processed in the plant.
- 3.1.3 The reported discovery position of the material is at 50° 56.213' N, 0°57.957' E (WGS84), c. 70 m from the south-west corner of the lake, at a reported depth of around 4 to 5 m below the water level of the quarry, which is about 2 to 3 m below the former ground level.
- 3.1.4 As the timbers were only recognised as significant once they were recovered, and had not been identified through previous surveys, very little is known about the status of the remains as they were at the bottom of the quarry. The orientation of the wreck *in situ* and the extent of the site are not known. The short videos made by the staff present during the recovery indicate that very little material fell off the hull whilst it was raised above the surface. However, the nature of these deposits that encased part of the wreck, and whether they contained finds or other significant material, is uncertain. Apart from certain limited areas between the frames under the ceiling planks, all the sections of the hull were empty of loose material when they were inspected after the recovery.

3.2 Geoarchaeological background

- 3.2.1 Dungeness Foreland constitutes a vast coastal barrier primarily made up of sand and gravel. Beyond this barrier, expansive low-lying areas unfold, encompassing former tidal flats and saltmarshes that have been successfully reclaimed from the sea.
- 3.2.2 This region is marked by significant periods of instability and swift alterations in the shoreline, exemplified by the storms and coastal flooding events of the 12th and 13th centuries. By the 14th century, substantial portions of the Walland and Denge Marshes had undergone reclamation using a network of embankments and drainage ditches. This trend persisted over subsequent centuries until the Marshes resembled their current state. The eastward expansion of Dungeness foreland occurred during the late-Holocene through the deposition of successive shingle ridges, contributing to a more stable barrier.
- 3.2.3 The geoarchaeological assessment (Appendix 1) has shown that the shipwreck was likely positioned either on the shoreline sands or within the gravels in a seaward-facing location, and it was subsequently preserved beneath or within the deposits of an advancing gravel barrier that extended eastward/northward. This is broadly consistent with the work of other authors (ie: Long *et al.* 2006), that indicates that the coastline in around AD 1400 was situated approximately 100 m west of the current coastline, in a location quite similar to that of the wreck. This aligns with the hypothesis that the wreck may have run aground or beached against on the shoreline.
- 3.2.4 However, it should be noted that the suggestion that the hull was located on an exposed shoreline or within gravel seems to be at odds with the excellent condition of most of the timbers, where fine details like tool marks and some surface treatments have been preserved. This level of preservation seems more consistent with a gentle environment

with rapid silt accumulation, such as a sheltered creek or lagoon, rather than the harsh conditions of a high-energy environment like a shingle shore.

- 3.2.5 A report detailing the wider geomorphological landscape and discuss the evidence provided by the bore holes made available by Cemex can be found in Appendix 1.

3.3 Historical background

- 3.3.1 This section draws upon the research conducted by Gill Draper and Serena Cant, which is included in full as Appendices 6 and 7. For a wider discussion of the historical and archaeological background of the nearby Cinque Ports towns of New Romney and Winchelsea, the works of Draper (2009) and Dhoop (2016) have been referred to.
- 3.3.2 Denge Marsh and Denge Nesse are the historical terms for the area now quarried (Figure 2). These areas were annexed to the small but important coastal market town of Lydd, Kent. Lydd was a member or 'limb' of New Romney, one of the five Head Ports of the Cinque Ports confederation. The Ancient Towns of Rye and Winchelsea situated to the west of Lydd and Dungeness were also part of the Cinque Ports confederation.
- 3.3.3 The Cinque Ports played a crucial role in England's defence and maritime trade during the Middle Ages; in exchange for their military and naval services, they received various privileges and exemptions together with other members of the confederation (Draper 2016).
- 3.3.4 The primary harbour connected to Lydd via the Wainway was the Camber, located between New Romney and Rye on the west side of Dungeness. Camber was actively used by Cinque Ports fleets in the 15th century and was an anchorage point for large English fleets in times of war. However, it began to silt up in the early 16th century, although large ships could anchor in parts of a channel, still called the Camber, in c.1572 and sail towards Rye, passing the end of the Wainway (Draper 2009).
- 3.3.5 Denge Marsh, which had been under the ownership of Battle Abbey starting from the late 11th century, constituted a unique manor stretching from the Denge Marsh sewer in the north to the shingle foreland of Dungeness in the south and south-west, an area of early accretion and continuous extension up to the present time. This territory maintained a somewhat distinct identity from Lydd, primarily owing to its unique lordship status under Battle Abbey.
- 3.3.6 The importance of wrecks in the region is documented in The Chronicle of Battle Abbey which contains numerous disputes with regards to their ownerships. By the 14th century, the right to wrecked goods had generally been granted to towns like the Cinque Ports or manorial lords. In the 16th century, agreements were made between the Portsmen and the Lord Warden of the Cinque Ports regarding the distribution of wrecked goods. Piracy and shipwrecking were common occurrences in the southern Cinque Ports, especially during times of war.
- 3.3.7 It is noteworthy that the majority of wrecking incidents occurred on the eastern side of Dungeness Headland (Dhoop 2016). Given this distribution pattern and the prevalence of south-westerly winds in this location, it seems that ships attempting to approach from the north-east, tacking against the wind to enter the Camber Estuary, often seemed to miscalculate the coastline and fail to round the tip of Dungeness, resulting in stranding on the headland's eastern coast. Even if they successfully rounded the tip, they remained susceptible to being blown toward Dungeness's southern beach, which becomes the leeward shore at that point.

- 3.3.8 This area, called the Nesse, served as a site for seasonal fishing settlements, known as cabins, which were utilized by the residents of Lydd. Notably, historical records from the 15th century from Lydd shed light on the presence of West Country fishermen, referred to as 'Westernmen', who frequented the Nesse for fishing and the drying of their catches. Both communities were involved in instances of piracy.
- 3.3.9 In 1571 the owners of the cabins at the Ness are mentioned when Lydd established a company of fishermen. A map by Matthew Pomeroy that dates to 1617 shows Lydd and Dungeness as well as the fishing cabins (Cock 1914).
- 3.3.10 The shoreline at Ness served not only as a fishing encampment but also as a lookout point to guard against foreign invasions. This practice can be traced back to the later years of the Hundred Years War and persisted throughout the 15th century. Detailed discussions regarding the necessities of watch duty and beacons for safeguarding Denge Marsh were meticulously recorded in documents from 1585 (Appendix 6, Lightfoot 1897). Notably, disputes regarding watch duty responsibilities at Dungeness emerged around 1587. In 1599, in response to the perceived threat of a substantial Spanish fleet invasion, the Lord Warden issued explicit directives for the continuous maintenance of watch duty at Denge Marsh (Appendix 6, Ly 4/4/8).
- 3.3.11 During the reigns of Henry VIII, Mary I, Elizabeth I, and James I, the Cinque Ports, including Lydd and New Romney, continued to provide shipping services across the English Channel for various types of passengers, such as pilgrims, merchants, craftsmen from various European countries, soldiers, and their horses. These ports played a significant role in facilitating travel during this period, with records indicating the presence of alien craftsmen from Germany, Italy, France, Spain, and the Low Countries in towns like Sandwich, Appledore, Romney Marsh, Rye, and Winchelsea.
- 3.3.12 The vessels used for transportation were typically owned by townsmen of the Cinque Ports or local fishermen. The nature and types of vessels used for these journeys are well-documented, ranging from fishing boats to carvels.
- 3.3.13 The Lord Warden recognized the potential for unloading goods in creeks without inspection, prompting orders for official inspections within the main part of the port (Appendix 6). Additionally, during both wartime and peacetime, the Privy Council and the Lord Warden wrote to New Romney and Lydd, directing them not to provide passage to individuals deemed undesirable for reasons related to crime, politics, or religion.
- 3.3.14 Contemporary references exist regarding the Dungeness lighthouse, which is said to have been initially established in 1615, with discussions concerning the fees associated with it and the individuals who were responsible for its construction and collection of those fees (Carpenter 1996, Appendix 6). This lighthouse appears to be a possible factor contributing to the diminished number of recorded losses in the Dungeness region during the 1620-1640 period.
- 3.3.15 In the second half of the 16th century, Rye emerged as a major port in the south-east, surpassing Lydd in importance. The nature of shipping and the import trade seems to change in the late 16th century, particularly during the Anglo-Spanish war of 1585-1604, with a focus on long distance commodity trade.

3.4 Ship building, ship finds around Dungeness

- 3.4.1 A review of the main archaeological findings, combined with historical records, was undertaken to offer insights into the maritime archaeological evidence of the period in the

area, and to provide a more comprehensive understanding of the archaeological context of the find.

- 3.4.2 By the early 14th century, records indicate the practice of boat breaking, which involved careful dismantling for the reuse of materials, at New Romney. Finds from the Southlands School site, particularly iron rovenails, supported the notion of construction, breaking, and repair of clinker vessels (Draper & Meddens 2009).
- 3.4.3 Evidence of shipbuilding, repair, and breaking sites in the broader region was also uncovered. At Smallhythe, iron fastenings and part of a clinker-built vessel were discovered, indicating ship-related activities dating from 1400 to 1545 (Draper & Meddens 2009). Smallhythe thrived primarily during the late Middle Ages and witnessed the construction of large vessels, including those intended for royalty, such as the Great Gallyion and Lesse Galleon, built for Henry VIII, with tonnages ranging from 200 to 300 tons (James *et al.* 2005).
- 3.4.4 Part of the broader maritime industry, a hemp-retting pit was identified on the Dungeness Foreland near Lydd, dated to between AD 1000–1400 and located c. 2.5 miles (4 km) south-southwest of New Romney (Schofield and Waller 2005). Hemp was apparently still grown in Lydd in the 16th century, and a ropemaker and ropewalk, where rope was laid out, also existed there in that period.
- 3.4.5 Several ship-finds have been made within the region, confirming the presence of a thriving maritime industry and a significant volume of seafaring activities. A side and sternpost rudders were trawled from Rye Bay, dating to around 1150–1250 and 1315–1405, respectively. The side rudder's size and configuration suggested it came from a Nordic vessel of at least 120 tons, while the sternpost rudder featured wrought iron pintles and was associated with a large ship (Marsden 1992, 1997).
- 3.4.6 In 2012, during an excavation at the Bridge Inn in Winchelsea, fragments of archaeological wood from a ship were unearthed. This discovery was interpreted as components of a clinker-built boat, potentially utilized for river transport. The assemblage included a frame fragment, and several planks constructed with overlapping techniques using iron rivets and caulked with animal hair and tar. Dendrochronology established a terminus post-*quem* of 1276, with a potential date range comprised between the 15th and 17th centuries (Russel 2013).
- 3.4.7 In 1987, a collection of timbers was unearthed in the Rye-Camber gravel pit, comprising planks and frame elements. These remains were interpreted as parts of a large carvel-built boat or a small ship, potentially dating back to 1450 (Goodburn 1990).
- 3.4.8 A shipwreck consisting mainly of oak, with some elm and fir components, was discovered at the Warren near New Romney, possibly in an old water channel. The ship's dimensions were recorded as 7.32 m wide by 15.85 m long, with a 2.44 m hold depth, but these proportions were likely inaccurate, or parts of the ship were missing. The vessel was clinker-built and fastened with treenails, and various artifacts including animal bones, possible human bones, and "copper coins" were recovered. It is believed to date from the post-medieval period, around the 16th century (Draper & Meddens 2009).
- 3.4.9 Another similar ship was found further in land near Maytham Wharf in Kent, measuring 19.1 m in length and 4.57 m wide, also built of oak. Artifacts recovered from this ship included pottery, a sword hilt, iron locks, and various other items. This vessel too was thought to date back to the 16th century (Draper & Meddens 2009). Both ships are

believed to have been sea-going coastal trading vessels of northern European origin, one possibly from the Low countries, and were associated with storm events.

- 3.4.10 In 1963, while installing a drainage system in Rye, two wooden vessels were unexpectedly encountered (Lovegrove 1964). The first vessel, labelled as Rye A, was identified as a carvel-built ship based on the remnants of a keelson, ribs, and outer planking. Although it was described as being 'of some size', with dimensions of only few elements presented in detail. The scarf of one of the frames (recorded in figure 2 of the article) is apparently similar to those found in the Denge quarry site.
- 3.4.11 The second vessel, known as Rye B, was reconstructed primarily from descriptions provided by a labourer involved in the excavation. It was characterised as clinker-built with an unusual configuration featuring two skins. However, this configuration was deemed improbable, raising the possibility that the workman's observations may have been a composite of two distinct vessels or the result of a shipbreaking process that led to the amalgamation of parts. It was suggested that these vessels could be associated with a shipbreaking yard and the proposed dating for this yard was no later than the end of the 16th century.

4 RESULTS

4.1 Introduction

- 4.1.1 In this section the single timbers are referred to by their number which is expressed within brackets, for example [083], and larger sections of coherent portions of the hull are numbered according to the 5000 sequence that was attributed during the first visit to the site, for example (5001).
- 4.1.2 The timbers and the larger sections of the hull are illustrated in timber catalogue in Appendix 11 and 12.

4.2 Description of the material

State of preservation of the timbers as found

- 4.2.1 Altogether, four substantial pieces of the hull were preserved with a good degree of integrity so that the relationship between the different elements could be observed (Plates 1 to 13). These were made by several multiple timbers and have been interpreted as a fragment of the bow section of the wreck, two sections of the starboard side of lower hull, and a fragment of the sternpost assembly.
- 4.2.2 The majority of the remaining timbers were loose and exhibited various degrees of damage. Most of them were split, truncated, frayed, and forcefully bent, with only few intact and undamaged.
- 4.2.3 Overall, the wood of the assemblage was structurally sound and very well preserved. It retained much of its mechanical strength and shape although it suffered from shrinkages and checks and deformations. This was mainly due to the fact that it was left out in the open and partially dried when it was first recovered. Part of this damage was mitigated after the initial visit as it was agreed with the Cemex managers that timbers were to be stored in an appositely excavated water tank until the recording phase could start.
- 4.2.4 Almost all of the wood used in the construction is oak with the exclusion of a few outer planks and shims that were made of elm. The overall shape of the hull was retained by

oak treenails and there was very limited use of iron for fasteners, and apart from a handful of bolts, most of the iron nails have rusted away.

- 4.2.5 During the recording stage, which happened to take place during the unprecedented extreme heatwave of July 2022, the timbers were kept wet with water hoses and buckets and covered with tarp and geotextile overnight. During the recording the largest preserved section of the hull (5004) visibly started hogging under its own weight. The efforts to keep the original shape by propping its ends with sandbags and shores had only partial success.
- 4.2.6 The analyses of the different components showed that the timber did have very limited erosion-related damage, with the original surfaces and edges generally well preserved. Negligible biofouling was observed, and wood-boring organisms' damage were almost completely absent, being noticeable in only limited areas of few outer planks. These included traces of an infestation of wood borers with several 1-2 mm in diameter round holes (poss. gribble or furniture beetles) in one plank [112] and two larger holes (poss. teredo, 6 mm in diameter) in the section of another plank [079]. The iron elements exhibited concretion deposits or rust stains and only a few of the smaller ferrous fasteners still retain their shape.
- 4.2.7 Obviously, in the larger sections 'fresh' damage consistent with the way that the timbers were recovered was observed. Timbers were visibly disarticulated, bent out of their original position. For example, the top ends of the frames and those of the planking had been forcefully pulled upward (Figure 5). Several of the timbers were frayed and ceiling planks on the main section (5004) were clearly scored by the teeth of the bucket.

Extent of survival

- 4.2.8 The dredger recovered over 140 ship timbers. Most of these timbers were brought up together in in four large coherent sections of wreckage (5004, 5005, 5006, 5007). These were said to have been scooped up by the machine on the same day and from the same location (Figure 6). Numerous small, disarticulated and often damaged timbers were found later when the gravel was processed. Whether these fragments were also recovered from the same location or from the wider area is unclear as the material that had been processed over a number of days was not distinguished by batch.
- 4.2.9 The possibility that the articulated sections came from more than one wreck was discounted on the basis of the absence of repeated elements within the assemblage, the internal consistency in terms of use of material, dimensions, and workmanship, in addition to the reported single location of recovery. These factors seem to indicate that the remains are likely to be those of only one vessel. Dendrochronological analyses seem to be consistent with this interpretation.
- 4.2.10 However, amongst the remaining disarticulated material, it is suggested that loose timbers [022] and [028] and possibly [026] and [027], might not be part of the same wreck, likely implying the existence in the area of more than a wreck. These are discussed more in details below.
- 4.2.11 Despite the accidental recovery, the extent of survival and the range of the components is notable as aligning all the larger sections, without accounting for the missing parts, would amount to a fore-and-aft run of over 12 m in length, which is probably a significant portion of the original length.

- 4.2.12 The two larger fragments of the wreck have been identified as the two portions of the lower starboard hull, from the centreline to approximately the turn of the bilge and just forward amidships, likely comprising the area where the maximum breadth of the vessel would be expected (5004, 5006).
- 4.2.13 The forward end of the ship at the turn of the bow is represented by a small section with outer planks and V-shaped frames (5005). A large, slightly curved bevelled timber was probably associated with this section at the stem of the ship, and it has been interpreted as an apron [080].
- 4.2.14 The last coherent fragment of note is a small strongly built vertical section (5007) that was once part of the stern assembly. It comprises centreline timbers that were part of the aft post and deadwood. These are above a timber that has been interpreted as a fragment of the aft section of the keel and skeg, and double outer planking with the stern hood end planks extending aft covering the post. This structure appears rather unusual because the aft end of the timber interpreted as keel extends beyond the post and distinctly curves upwards.
- 4.2.15 Within the articulated sections, the range of components or timber types preserved comprise the three layers of the lower hull sandwich – outer planking, frames and ceiling – part of the stern assembly and part of the centreline structure such as the massive apron/inner stempost [080]. Within the frame timbers category, floor timbers, first futtocks and filling timbers can be differentiated.
- 4.2.16 In terms of extent of survival, the keel is missing, except for a possible rather small and truncated segment that survives in the stern section. None of the floor timber spans for their complete breadth as most of them have at least one end that is truncated or eroded but at least one complete futtock survives with both ends preserved and some of the filling frames are complete. Similarly, only a limited number of planks are preserved for their whole extent.
- 4.2.17 The lack of the keel for the larger sections towards the middle of the hull (5004) could suggest that some of the centre line, and potentially a little of the port side of the bottom of the vessel may still lie buried at the find spot as the breaks seemed recent.

Description of the remains

- 4.2.18 This section provides a brief description of the timber remains. The construction components are subsequently discussed in more detail in Section 4.3.

Section (5005)

- 4.2.19 Section (5005) is one of the smaller sections, but it is significant as it is the forward most section that is preserved (Plates 1 to 3). It is part of the bow on the starboard side at the turn of the stem. It is 2.3 m long and 1.6 m wide and it is made of just eight timbers, four outer planks and four athwartship timbers. Its original location at the fore end of the vessel is indicated by the hood ends and twist visible in the outer planking and the accentuated rise and increasing forward angle of the two crotches [029][031]. Like all the other fragments described below, it is carvel planked. It retains four surviving strakes of outer planking, with two planks that still preserve the hood end to fit on the post. The planks narrow in width and reduce in thickness towards the bow end as they accommodate for the curve of the bow (Figure 7).
- 4.2.20 Waterproofing material was applied between the planks' seams probably applied in a way similar to luting or setwork rather than be driven in as with traditional caulking. Strands of

tarred hairs were placed in a distinctive carefully V shaped groove that is cut on the lower seam of the planks. The hood-ends chamfer to presumably fit in the stem rabbet where they were held in place with square shanked iron nails that are recessed within the planks (Figure 8). Other than these and the bolts used for the crotches; the whole structure is fastened with oak treenails.

- 4.2.21 The structure is held together by two substantial V-shaped floors / crotches timbers and extended by two additional half straight frames that are butted against but not fastened to the crotches. These narrow and rise substantially and shape into an almost straight profile. The treenails' holes at the fore end of the planking show that at least another timber was fitted athwartship further forward continuing the framing aft. The crotches' port arm is truncated but they span across the centreline and still retain part of the rectangular recess that presumably received the keel or other longitudinal timber to which they were fastened with an iron bolt. A square limber hole is visible immediately on top of this pocket, cut slightly to the starboard side. Marking the upper inboard faces, recesses and lines hacked roughly with an axe suggests the position where the ceiling plank were lined against the transversal pieces.

Timber [080]

- 4.2.22 A separate wide slab of bevelled timber (2.67 m in length, 0.39 m width and 0.15 m thickness) is very likely to be associated with this fragment and provides an indication of the sweep of the profile of the bow (Plate 4, Figure 9). This piece [080] has been interpreted as an apron which is a longitudinal timber that was used along the centreline vertically inside the stem assembly to support the bow plank ends and reinforce the transition between the stem and the keel.
- 4.2.23 This slab of oak is trapezoidal in section, with sides that flare out, taper and gently curves along its length. One of the ends of this piece is broken and could have had a scarf, although this is not clear. A large number of treenails are driven at an angle on its sides and many of these are not through or cut flush on the side of the concave face. The opposite (inner) face, which is convex in shape, has the remains of one ferrous fastener at its centre and few treenails at its ends.

Section (5006)

- 4.2.24 Fragment (5006) is 2.4 m long and 2.3 m wide and has been tentatively interpreted as a portion of the starboard side of the lower hull towards the bow aft of (5005) (Plate 5 and 6, Figure 10). It comprises four strakes of outer planking and four frame stations (four floor timbers, three first futtocks, four filling frames) covered by one board of the first run of the ceiling planking.
- 4.2.25 As with the other fragments, the floor timbers are truncated at different lengths along the centreline and three still retain a stump of the arm that extend across the centreline. They are curved in shape developing a full arm with little flat. At the centreline they present a well-developed foot that pronouncedly narrows towards the bow in the last three timbers [086, 088, 091]. They have two triangular notches to form limber holes and a ferrous bolt fastened some of the floor timbers to the keel.
- 4.2.26 The futtocks are placed aft of the floors and are, with the one exception of floor timber [088], all joined together laterally with diagonal hooks and simple butts, always secured with two treenails driven across, often at an angle. The rise and narrowing of the floors are very evident in this section with the base of the foot decreasing in siding from 240 mm to 120 mm, a sharpening deadrise and the arms of the frames leaning slightly forward.

- 4.2.27 The three filling frames sweep distinctly upwards from the transition of the arm of the floor timber to the bilge, and one, spanning 2.27 m in length, 210 mm sided and 180 mm moulded, is complete [087]. The heels of filling timbers start approximately at the same height, in correspondence of the start of the arm of the floor timber, just inboard of the inner edge of the only surviving ceiling plank. The filling frames are well squared and extend beyond the floors, strengthening the area of the scarf and providing a shoulder to the futtocks. They tightly seat between the consecutive frame stations, and some presents simple rebates to fit against the futtocks. The filling frames are fastened vertically to the planks with treenails and overall, the framing system creates a continuous sequence of solid wood with no voids in between.
- 4.2.28 There are four runs of outer planks that survive, and these all are broken towards amidships. Three scarfs are placed in the first three strakes towards the forward side of the structure. They are all vertical stop splayed scarfs and feathers in the same direction. The scarf on the second strake is short in length [093] measuring only 180 mm in length and it is unusually placed almost adjacent and with very little shift to a scarf on the third strake. The strakes of the outer planking are similar in width with the second surviving one being only just narrower. Unusually, the two planks that forms the first strake [092, 130], which are joined by a scarf, are of different width (respective max width 310 mm and 350 mm). It is not fully understood why this planking layout was used and whether this expanded plank was a stealer used to accommodate a change in shape of the hull at the bow, a repair or part of a possible more substantial alteration to the original hull.

Section (5004)

- 4.2.29 The largest section (5004) is preserved over a maximum length of 6.8 by 2.8 m and it is a portion of the lower hull of starboard side of a carvel planked vessel (Plates 7 to 9, Figure 11). The profile of this section from the keel to the turn of the bilge is rounded with the floors flat slightly widening towards the stern.
- 4.2.30 The section is truncated amidship in correspondence to where the keel would have been. This damage appears to be recent as some of the timbers are evidently frayed rather than simply eroded. At the other end the heads of the floor timbers were sealed under the inner planks, so they are in good state of preservation. The same cannot be said for the heads of the first futtocks which are worn and eroded.
- 4.2.31 In this section, the damage associated with the accidental recovery is most evident. Fore and aft end of this portion of hull looks freshly broken with some of the outer planks bent forcefully upwards by the excavator. Regularly spaced teeth marks of the excavator bucket score surface of the ceiling planks.
- 4.2.32 The structure consists of 57 individual ship timbers joined together. It spans across six consecutive strakes of outer planking, from the one immediately after the garboard to the turn of the bilge, and it extends for 12 frame stations, 11 of which retain both floor timber and first futtock. The futtocks are joined to the floor timbers with dove tail mortices which are laterally secured with two treenails. At the 7th surviving station from aft is the master frame [051][078] which is in correspondence of the change of the pattern of framing. The centre of symmetry of the framing pattern can ideally be traced in the room between the master frame and the preceding frame [050][072] aft of it. Filling frames, some of which are complete and extends for whole breath this portion of hull, are placed in the spaces between the floors where is possible, providing strength to the whole assembly (Figure 12). Above the frames, four strakes of ceiling planks survive.

- 4.2.33 The six strakes of outer planks have two or three planks in each strake and four planks that are preserved for the whole length (Figure 13). The width of the planks is rather regular although the second and fifth surviving strake are slightly narrower. The layout of the planking seems to show an alignment of the ends of planks every four strakes although shift of the aft two scarf at the fourth and fifth surviving strake [064, 065] is rather small. Three planks show small repairs that were fixed mostly with iron nails. The alignment of the feathers of the splayed vertical scarfs is the same indicating that this section was originally part of the starboard side of the vessel. The sny (upward curving) evident in the bottom planking is substantial, potentially suggesting that the maximum beam of the vessel (presumably located just ahead of midships) might have been approximately at the centre of the section 5004, aligning with the master frame.
- 4.2.34 The ceiling strakes are longitudinally assembled with vertical stop splayed scarfs with the exposed feather edges pointing to both directions. The width of the planks is rather regular and the ends of the planks of the first and third surviving strake are placed at the same height. All the ceiling planks were fastened to the hull with treenail and some repairs were made by inserting small dutchmen (matching insets cut within a larger timber).

Section (5007)

- 4.2.35 The aft end of the vessel is attested by the fragment (5007) which is identified as the lower section of the sternpost assembly (Plates 10 to 12, Figure 14). Probably part of a modified stern, it includes elements of the sternpost, keel, extended deadwood and the first three strakes of outer planking. The size of the section is relatively modest (1.66 m length, 1.12 m height, 0.29 m width) and it is eroded and partial. The structure is strongly built fastened with numerous treenails that run through, from one side to the other.

Section (5013)

- 4.2.36 Another small fragment (5013) consisting of three frames and two strakes, represents the last remaining portion of hull containing articulated timbers. It is 1.17 m fore and aft by 1.30 m across (Plate 13). The timbers are frayed at one end and the inboard face is rather worn. Two of the frames, presumably the end of filling timber and a first futtock, show the mostly intact squared wrong head at the other end. The outer planks are waterproofed in a similar way to the other sections.

Loose timbers

- 4.2.37 Within the disarticulated timbers, most were identified as either frames or planks. Significantly, one of the frames [028], identified as floor timber, is complete (Figure 15). It is 2.55 m wide, 230 mm moulded, and 160 mm sided. It is made of oak, well squared, symmetrical and accurately shaped. It is flat (floor-flat is c. 1.58 m) with little deadrise and a late almost straight sweep that leads the futtocks. Almost in the exact middle a rectangular limber hole was made with a saw. Only treenails were used, 20 of which run vertically and six on each end, which were driven across to join it to the futtock. From the position and dimension of the surviving treenails, the futtocks were similarly sided (160 mm) and must have been seated flush to the side face of the floor with an overlap of an estimated 700 mm. Fragments of other similar frames were found [026, 027, 132, 133] and with three samples taken for dendrochronology, one was dated consistently with the assemblage, although no felling date could be verified. Timber [028] comes from a carvel-built vessel with dead flat central bottom which seems rather different from the shape of the main wreck section. This observation together with the pattern and use of multiple treenails to fasten its sides to the first futtock, which differs to those used in the main wreck, could suggest that [028], and probably [026, 027], were possibly part of another carvel vessel, probably a very large boat or small ship.

- 4.2.38 Two of the disarticulated timbers could not be identified with certainty. These include a long timber [022] (2.8 m length, 180 mm width, 150 depth) with two joggles on one side and a lap for further one at the opposite end. This timber has survived exhibits an almost straight profile, featuring a flat bottom edge and a rounded top. It survived less well preserved than the other timbers and appears somewhat unrefined, displaying signs of erosion and the loss of its original surface, revealing numerous knots and resembling almost to a natural branch. It has eleven treenails in line, going through the side that has rebates and one slightly off the axis. Square shafted nails were driven in the joggles which are 295 and 394 mm long and 25-30 mm deep. Due to the presence of the joggles, the timber could find parallel with the floors of many clinker vessels of England and other parts of Northwestern Europe and therefore be part of another potentially even earlier vessel. The proportions suggest a large boat or a small ship, substantially smaller than the main wreck. Alternatively it has been suggested that this could have been associated with the possible upper work and be a standard but this hypothesis is very tentative and subject to further investigation.
- 4.2.39 A further piece that could not be identified is timber [012] which is a flat sub-triangular shaped piece. The timber is partial, its thickness is 90 mm for most of it but it has a diagonal rebate at the fragmented end where it increases to a thickness of 119 mm. The surviving partial arms of the triangle are 592 mm, 375 mm and 385 mm. Three treenails are driven vertically across the rectangular base and two more through the triangular faces where the square holes of four iron nails, also going through the wood side to side, can be seen in the concretion stain. One plausible interpretation of this piece is that it represents the end of a frame with remnants of a side-to-side joint. However, it is worth noting that the presence of nails at the joint between two frame timbers has not been observed in other sections of the wreck and therefore this interpretation remains tentative.

Objects found in the hull

- 4.2.40 The only finds that have a clear association with the timbers come from the bilge, where they became lodged between the frames of the largest hull section (5004), section (5013) and (5005) where they were found during the dismantling phase. The finds include a fragment small bone, a fragment of leather, a shoe fragment, an almost complete wooden dish and a ceramic fragment. These are discussed in more detail in Section 4.4.
- 4.2.41 A round smooth granite stone was also recorded as it was said to have been recovered from the same area of the timbers. An imprecise number of 'several' other similar boulders were allegedly previously recovered from the same rough location, but they were subsequently dispersed or disposed of and therefore could not be inspected.
- 4.2.42 While examining the processed aggregate material from the wider area, a handful of leather items including a shoe were found. However, a subsequent assessment indicated that these were likely to be of later period (19th century) so they are unlikely to be associated with the site.

4.3 Construction components

Wood

- 4.3.1 The predominant wood used in the construction of the vessel was oak, with elm being selectively employed for some certain elements.
- 4.3.2 The use of compass timbers is prevalent in the curved timbers. The floor timbers, crotches, futtocks and filler frames are generally made of naturally grown timbers and some of them are of substantial dimensions [029, 088]. The wood appears to be of very

good quality although not much care seems to be placed in the conversion as a few of the floor timbers and the futtocks are left with sapwood and bark on the surface [076]. Similarly, a few timbers have several knots which are ultimately the source of rot, although in very few cases knots were drilled out and plugged in.

4.3.3 Whilst there is a certain variety of choice in the shape and dimensions of the floors and futtocks, the filling frames appear to be uniformly halved and quartered to regular dimensions and appear to be more consistently made with similarly sized timber, with less branches and the right curvature to cover the bilge arc.

4.3.4 Elm was mainly used for the outer planks along the hull (5004) [067, 097, 112], and it was also utilized at the stern (5007), both in the inner and outer layers of the planking [102, 103, 121].

Fasteners

4.3.5 The majority of fasteners observed were treenails made of cleft oak heartwood shaved to approximately 16 sided cylinders. These were well rounded and with no noticeable flats, underscoring the proficiency of the makers but also likely higher production costs.

4.3.6 Treenails were driven for almost all fastenings and the majority of them go through the whole thickness of outer planking, frames and ceiling planks, although a few do not extend to the ceiling planks and are made flush on the frames (Figure 16). In a few places a new treenail had been bored through another. The average diameter of the treenail was between 25 mm and 35 mm and it is estimated that over 350 treenails were used to fasten the outer planks of the larger hull fragment (5004).

4.3.7 The positions where to start auguring the hole were often marked on the inboard face on the frames with a depression generally made by three or four chisel cuts which probably eased the start of the boring by holding the auger in place and possibly marked the intended boring position for the less experienced shipwrights. A few mistakes were made as a handful of the positions were marked and not drilled and a couple of treenails holes were started and not completed (for example [059]) (Figure 17). Although occasional intercutting treenails is to be expected, treenails appear at times distributed in a seemingly random or even chaotic pattern with several closely driven and doubling over each other.

4.3.8 The inboard ends of the treenail holes were very expanded, probably with a gouge or by rocking the auger allowing the ends to shape onto a much larger head and wedging (Figure 18). Other treenails were driven at an angle, so they head appears elliptical. In many cases the outboard end was, sometimes hastily, scored with two blows to form a 'V', 'II' or an 'X' and caulked with a yellow vegetable fibre which the microscope analyses identified as hemp (Figure 19-20) (Appendix 3). Wedges were driven in both ends.

4.3.9 In addition to treenails, various wooden plugs were employed at the scarf ends of outer planks. These included short, truncated conical bungs (115 mm long and 35 mm in diameter) and shorter four-sided conical wooden nails crafted from hard wood (115 mm long and 15-20 mm side) (for example [098]) (Figure 21). Blind treenails or plugs of varying diameters were utilized to compensate for knots [113]. Additionally, small triangular wooden pieces (measuring 32 mm by 15 mm by 5 mm) were inserted to fill the holes left by temporary fasteners (squared shafted) on the underside of the frames (Figure 22).

4.3.10 Iron bolts were observed as a method of fastening the larger structural components. They connected some of the frames to the keel [088, 091], used in the apron and to reinforce

the connection between the keel and sternpost [104]. The diameter of the iron bolts was 25-35 mm for a length of c. 315-380 mm. Due to significant corrosion, discerning the shape of their heads is challenging. However, in one case, it appears that it was round and clenched over a round rove.

- 4.3.11 Square-shafted nails (5-8 mm side) were regularly employed to fasten the hood-ends of the outer planks and scarf joints between planks (Figure 23). They also appear in association with the garboards [101, 105], some of the few repairs and seem to have been used as temporary fasteners of hull components. At least some of the nails were countersunk and left a quasi-square and roughly circular impression (20 mm in diameter) around the square hole. Only the impression remains, making it challenging to determine their initial appearance.

Waterproofing

- 4.3.12 The seams of the outer planks are 'caulked' with animal hair and tar. Calves or cattle is attested for all the samples taken, possibly with a limited use of goat hair. The fibres were combed in tufts and dipped in an organic binder that consisted of a mixture of pine tar (distilled from resinous pinewood) and most probably a pine resin (such as colophony) (Appendix 4). Generally, three strands of tarred hair were then pressed within the lower edge of the outer planks which had a shallow V shaped groove cut along it to a depth of 10-15 mm (Figure 24). The three strands were sometimes twisted or just pushed against each other (Figure 25). The bevels of the groove changed angle depending on the position of the plank and was realigned at the scarf following the feathering lip. After the waterproofing material was laid, the planks were likely clamped and wedged to tighten them in place and draw the edges together, enclosing the tarred hair within. This process flattened the strands and sometimes squeezed some the tarred hair out inboard. Overall, the quality of the work observed in the precision of the alignment and the tightness of the seams give the impression that this is the result of confident craftsmanship rather than an improvised solution.
- 4.3.13 The scarfs and landings at the bow were bedded using the same material but shaped as an irregular mass of felted bands (Figure 26). The same bedding was amply paid at the various connections at the stern, for example in the sandwich between the two layers of planks and between the first layer and the post, between the garboard and the keel heel, and at the various joints.
- 4.3.14 A protective layer of a dark brown-yellow coloured resinous material was generously applied to both the interior and exterior surfaces of the hull. This coating consisted of pitch most probably mixed with a pine resin (Figure 27).
- 4.3.15 In certain well-preserved outer planks, traces of a grey surface coating speckled with white were detected (Figure 28). The origin of this substance remains uncertain, raising questions about whether it is a result of seabed contaminants or part of an original treatment.
- 4.3.16 Although not strictly a waterproofing it is worth mentioning that one of the half frames at the bow end [032] has, along its inboard fore edge, remnants of a substance identified as rabbit skin glue on the inboard fore edge (Appendix 3). Rabbit skin glue is a traditional wood glue and its presence here is not directly explained given the absence of joints or repairs. Perhaps it was used for temporary fastening or evidence of a process of repurposing.

The Keel

- 4.3.17 Only a single fragmentary piece of the keel at the stern survives [104]. It is a naturally curved timber made of oak, straight in the fore part and then unusually curving upward aft beyond the surviving timbers of the sternpost. It is sub-rectangular in section with a sided dimension of 120 mm tapering to 80 mm forward across the scarf and has a maximum moulded dimension of 300 mm aft. The forward end has a scarf which is broken at the lower edge and fastened the timber to the vertical post [109]. On the upper surface a small shoulder was cut, presumably to help ease the vertical post in position for scarfing the two timbers together. A large vertical iron bolt attached the aft section of keel to the skeg [117], which is a fragmented wedge like-timber that notches against the underside of it. A water stopper is run horizontally between the two. There is no rabbet at the extremity of the keel and the garboards [101] [105] lie flush against the port and starboard faces. The strength of the keel sternpost joint is mainly provided by the treenails that pierce through the pack of timbers across the garboard and the first strake.

Apron

- 4.3.18 The apron [080] is made of a large, curved slab of oak shaped from a half log section. It is a substantial timber and near complete. It measures 2670 mm in length, 390 mm width and 150 mm thickness. It is trapezoidal in section, with sides that flare out (to a maximum of c. 60 degrees to the horizontal) and widens in thickness as it gently curves upwards, presumably matching the shape of the stem's inner curve. One of the ends is broken and could have had a scarf, although this is not clear. The other end has a straight cut.
- 4.3.19 A total of 32 treenails are driven at an angle on its sides (15 on the starboard side and 16 on the portside) and many of these are not through or cut flush on the side of the inner hollowed face. The outboard face, which is convex in shape, has the remains of one bolt run at its centre and one at the bottom alongside a treenail. The multiple treenails for the hull planking are still intact. Some are wedged and some protrudes 70 and 80 mm from the sides of the apron.
- 4.3.20 Two parallel lines carved horizontally across the inboard face probably indicates the location of transversal elements such as rising frames or crotches.

Outer planking

- 4.3.21 As mentioned above, the majority of the outer planking was made of oak although a limited number of elm planks are also present. Elm seems to be considered equivalent of oak for the underwater works, with more importance probably given to the shape of the sawn planks and presumably availability.
- 4.3.22 The planks were tangentially converted from heartwood using pit-saws, which left bold saw marks, and then dubbed with an adze (Figure 29). The charcoaled aspect of some of the planks indicated that where needed they were bent using charring on an open fire (Figure 30). There is generally no sapwood left, knots are relatively rare and it seems that there were no obvious weaknesses in the wood chosen.
- 4.3.23 The length of the few planks that survive with both ends varies from 2.9 m to 5.1 m, the thickness ranges between c. 70 mm at the stern and amidships to c. 50 mm at the bow end. The width varies along the length of the planks between 230 mm and 480 mm and generally tapering towards the bow. Except for one plank, [130], in the first strake of section (5006), the majority of the strakes are composed of planks that have similar and consistent dimensions with regular transitions.

- 4.3.24 The strakes are assembled in carvel fashion and fastened to the frames with treenails. In every case where the scarf is preserved, this is a vertical splayed scarf or simple flat scarf, typical of northern European lapstrake construction and unusual in carvel shipbuilding (Figure 31). The scarfs are all aligned in the same direction and the scarf halves end in feathered edges that terminate with either a flat or in some cases a lipped end, diagonal or square, to avoid fragility at the tip.
- 4.3.25 The toolmarks indicate that after the ends of the scarfs were scribed, these were hollowed with adzes [096] and luted with animal hair and tar. The joints are secured with treenails, usually a minimum of two, as well as square shafted iron nails, generally arranged in a line of three near the edge. The addition of the treenails that secured the frames made the joints stronger. The length of the scarfs ranges between 395 mm and 580 mm. In almost all cases the scarfs are staggered but sometimes the shift is surprisingly little being as close as 0.7 m apart in neighbouring strakes.
- 4.3.26 The exception to this are the scarfs of the first three strakes [129][093][130] in section (5006) which are placed side to side and are of a shorter length compared to the one observed amidships. The presence of a plank that is wider than its preceding one in the first strake also raises questions whether this is likely to represent a repair or a modification. Interestingly, the lower edge of this plank is square, distinguishing it from the preceding one which present a groove similarly to all the other planks; and fastened with an extra nail.
- 4.3.27 At the bow, the hood ends are chamfered into a landing that is c.100 mm wide which tapers onto and was fastened to the stempost with three nails after being covered with waterproofing material. As said above, V-shaped recesses were carved into the lower edges of all outer hull planks, and these recesses were inlaid with strands of tarred animal hair. The upper edges were square.
- 4.3.28 The impression is that the outside of the hull was well faired as appears without observable kinks and too many flats that could have resulted from sawing conversion.
- 4.3.29 Occasional indications of misplaced fastenings in the hull planking were observed. An example of this is found in one of the oak hull plank scarfs [098, 096], where nail holes were filled with a tapered oak plug, and two treenails were substituted with sizable, tapered oak bungs.
- 4.3.30 The garboard strakes at the stern are made of two short, fragmented planks at either side of the sternpost. Both are made of oak, 380-400 mm wide, 50-60 mm thick and are sub-rectangular in section with the lower outer edge bevelled to flow smoothly against the keel.
- 4.3.31 At the stern, the ends of the garboards and of the strakes next to the garboard (broad) turn to the vertical. The garboards are let through the aft face of the sternpost instead of terminating with hood ends in the rabbet. To prevent the stern from becoming too thick, the sternpost is tapered accordingly. However, to improve the fit a thin slice of timber [119] was wedged underneath the starboard garboard plank to add thickness to the post.
- 4.3.32 The garboards are fastened to the keel with square shaft iron nails evenly spaced (160-300 mm) and treenails in an alternating pattern along the lower edge. Few additional nails are driven in correspondence of the fore and aft edges and more treenails driven across the outer face. It is possible that an iron strap ran upwards from the aft end of the

garboard reinforcing the connection between the keel and the stern as suggested from a faint square impression on the upper aft corner of the outer face of the plank [101].

- 4.3.33 The planking at the stern seems to be doubled, and a more detailed discussion follows below in the paragraphs that examine of the sternpost timbers.

The framing system

- 4.3.34 The framing system consisted of floor timbers, futtocks and filling timbers which are mostly made by a mixture of whole curved oak logs, axe hewn to shape and smoothed with adzes, or pit-sawn in half or quarters (Figure 32). They were all fastened through to the planking and ceiling strakes using treenails, with a minority of treenails (estimated to four or five per timber) not going through the ceiling planks.
- 4.3.35 The lower part of the hull had dense but not too regular framing, with floor timbers securely joined side by side to the first futtocks and forming a continuous timber band with the filling frames fitted in between the frame stations.
- 4.3.36 The floor timbers were interconnected to the futtocks with a variety of joints (Figure 33), including single or double trapezoidal dovetail mortises (long base of 300 mm), hooked diagonal locks [047] or in one case butted side by side [054]. In the vast majority of cases two lateral treenails secured the connection, often one driven in the mortise and a second at the heel of the futtock (Figure 34). They were driven either from aft or fore, often at an angle and, in a handful of cases, they were left blind [047]. Sometimes, the angle at which the treenail is drive is so sharp that it comes through the underside of frame [072]. No ferrous fasteners were used. Generally, other than the observation that dove tail joints were most commonly used in section 5004, that the floor timber had the mortise cut, and that hook scarf were predominant in section 5006, no specific distribution pattern clearly emerges. The difference in the style of the mortises raises the question as to whether these were chosen on the basis of the characteristics of the timber, location within the hull, or whether they reflect allocation of the job to distinct workers.
- 4.3.37 Rather than a side connection to the futtock, the floor of the probable master frame head is joined to the futtock heel with a simple flat diagonal scarf [078, 051], 400 mm long, secured with at least two treenails driven vertically through (Figure 35).
- 4.3.38 The spacing between the floor timbers is fairly regular (spacing between centre floor timbers between 400 mm and 530 mm) and the pattern of floor - futtock - filling timber is repeated regularly across the hull, with the exception of the stations around the master frame where the relative position between the floor and the futtock changes. Aft of the master frame, the futtock is fastened to the fore face of the floor whilst fore of the master frame, the futtock is fastened to the aft face of the floor. The line of symmetry for the pattern floor lies between floors [050] and [051]. These two frames are bounded by filling frames and after those the sequence is clearly symmetrical and mirrored fore and aft. An extra frame (futtock – floor) ([071] [048] and [053] [073]) is added at the start. Therefore, if the two central frames are included, the sequence repeats itself fore and aft from the line of symmetry between [050] and [051] as: frame + filling timber, frame, frame + filling timber, frame + filling timber, frame + filling timber and so on.
- 4.3.39 The style of assembly means that the overlap is not necessarily at the same height in each frame and the filling timbers reinforce the joint spanning the length of the floor flat, but without crossing the keel, and the entire bilge arc.

- 4.3.40 Noticeably, in the area around the master frame location (before and after filling timbers [052] and [049]), where two frame stations are consecutive and not followed by a filler timber, there are few spaces that appears somehow 'odd' in an otherwise continuous and solid framing pattern.
- 4.3.41 Overall, it appears that the frames were pre-assembled before being raised or at least assembled in sequence [045] (Figure 36). The filling frames were added afterwards and dry-fitted as tightly as possible in between, fastened only vertically to the planking and not to other framing components fore and aft.
- 4.3.42 Some of the frames' upper faces were marked with lines that indicated the position of the ceiling planks and in some cases further trimmed [75,56].
- 4.3.43 Some of the floor timbers and futtocks exhibit corrosion stains and square shafted nail holes (3 to 5 mm sided) on their undersides. These are likely the impression of the iron fasteners used in securing the plank ends or facilitating their placement. As there is no clear alignment between the nails from different frame stations, there is no obvious indication that these could have functioned as temporary fasteners for ribbands. Seated after the bottom was planked, the filling frames lack any evidence of such fasteners. Similar impressions were also found on the upper face of the frames although more sparingly.
- 4.3.44 Rather than exhibiting a smooth curve, a few of the outboard faces of the lower hull framing present a few slight angular kinks or flats. These were dubbed so that the flat faced sawn hull planks could fit tightly with the curve of the frames without hollowing them in the inside to take it. If extra thickness was needed, wedge-shaped filling piece of oak were driven and underneath the frames [088] (Figure 37). This approach is a process that might be reminiscent of later medieval clinker shipbuilding in which the outer faces of the frames were cut to fit the outer planking of the hull. These kinks or flats are not so obviously visible in the filler frames as they are on the floors and futtocks. In fact, as it is explained below, in the case of the filler frames the reverse process was carried out, with the inner faces of the outer planking being adze dubbed to fit them within the hull.

Floors

- 4.3.45 The floor timbers were made of large oaks and shaped with saw and axe and dubbed with an adze. Their scantlings are reasonably regular (250-300 mm sided and 190-230 mm moulded), their section is rectangular or sub-rectangular with some of the edges rounded off, and generally slightly taper outboard. The length is variable and difficult to estimate as most of the floors are missing one end, but it appears that the wrongheads is generally cut between the third and fourth strake of outer planking. This results in an overlap with the futtock of up to 920 mm. The floor of the possible master frame [051] is 190 mm moulded and 250 mm sided and survives for a length of 1.60 m.
- 4.3.46 A potential symmetry in the extension of floors across the centreline is suggested by the intact floor [028] and the two crotches, although the evidence in this sense is clearly limited. The preserved partial length of the longest floor amidship is 1780 mm from end to tip.
- 4.3.47 The floors are relatively flat amidship with the flat of the floor extending outboard with little deadrise to approximately 900 mm from presumed centreline. Their heads present a little curve that leads the sweep of the futtocks. Towards the bow, the floors become more angled and develop a substantial foot [086, 088, 091] which increase their moulded dimension at the centreline from 200 mm to 280 mm and sharpen the angle of deadrise.

These floors are fastened to the keel with a bolt that goes through the centre. The two crotches [029, 031] at the bow are large natural curved timbers and offer a pocket that bites onto the keel or other longitudinal timber.

- 4.3.48 The floors have single square limber holes sawn in the underside for to a depth of 50 mm and 50 mm wide or two triangular notches cut to up to a depth up to 90 mm at the transition between the foot and the arm on either side of the base [086].
- 4.3.49 Generally, the floors are connected to the futtock with two treenails with the exception of the two crotches [029, 031] at the forward end of the hull that were not connected to the straight half frames and three of disarticulated frames [026, 027, 028] which had six treenails driven horizontally across the ends.

Futtocks

- 4.3.50 The first futtocks are generally compass timbers and converted in the same way as the floors. Often, they still retain sapwood and bark [076] and they are not well and regularly sided, as the natural shape of the wood is accommodated [072] (Figure 38).
- 4.3.51 Almost all of them are incomplete with only the lower ends preserved, which is cut off square or at an angle with the notable exception of the futtock of the master frame [078] which survives in its entirety. This is 1.45 m long, and 210 mm maximum sided, and 180 mm moulded gently tapering in both dimensions outboard. With a rectangular section, its heel is scarfed to the floor timber and the head is diagonally cut and the inboard slope fastened with a treenail to the outer hull.
- 4.3.52 Amidships they define a rounded transition at the turn of the bilge which in some cases appears almost formed by a portion of the circumference of a circle [070, 074] whilst forward they are almost straight, reflecting the change in the hull shape at the ends of the vessel.
- 4.3.53 The extent of longest preserved futtock spans from below the joint with floor timbers (between the first and second strake) up to at least the 6th or 7th strake of outer planking. The maximum preserved length is 2.1 m between the extremities. The maximum sided dimension varies between 186 mm and 270 mm and maximum moulded between 160 mm and 180 mm. As said above they were fastened across to the floors with typically two treenails and vertically to the outer and inner planking where the trenails are distributed in a seemingly random or even chaotic way.

Filling timbers

- 4.3.54 The filling timbers are all naturally grown curved oak timbers made to regular dimensions mainly from halved and quartered log and dubbed with axes. Several of them were left with the sapwood and bark attached and have cluster of small knots spread on the sides.
- 4.3.55 A total of 12 filler timbers survives between the different sections, almost all of them are complete and they appear carefully shaped and distributed. Generally, the lower end is vertically cut, and they all start at the same height just after the centreline at the centre line. They span across all the six surviving strakes of outer planking ending on the last strake where their heads align approximately two strakes above the floor wrongheads. They generally terminate with a square cut. The longest filling frames are around 2.1 m long.
- 4.3.56 The siding of the filling timbers is rather regular and is governed by the space between frame pair. Timber dimensions range between 150 mm sided by 170 mm moulded to 240

mm sided by 170 mm moulded for the largest filler frame that is next to the master frame station [052].

- 4.3.57 These timbers are not attached to the other elements of the framing assembly but were tightly inserted between the joined pairs of floor timbers and first futtocks, reinforcing the turn of the bilge and the area of the joint between floors and futtocks. Even though some of the filling frames are joggled onto the floors or futtocks they are never secured to them (Figure 16).
- 4.3.58 The treenails that fasten the filler frames to the planking are carefully driven in a methodical manner showing a similar number of fasteners (around 12) per timber with typically one to three treenails per strake along a single line. In a few cases, the auger was placed in the wrong place and the hole restarted nearby. Nonetheless, the patterns of the treenails driven in the filling timbers appears to be more regular and systematic than those of the floors and futtocks.
- 4.3.59 Before fitting the filling frames, the interior of the outer planking was scraped and smoothed to facilitate their placement (Figure 39). This process resulted in the removal of the tar coating, which served as a bedding, or at least was spread underneath the other frames. For some reason, the tar coating was not applied afterward.
- 4.3.60 Although this might reflect poor practice in terms of durability, it is likely that it would have saved money on the purchase of imported pine tar, and for those funding the work, this deficiency would have been concealed once the filler frames were added, potentially raising the question about the presence of malpractices, corruption or other socio-economic pressures in the shipyard.

The ceiling planking

- 4.3.61 Three adjacent strakes of inner planking were preserved, for a total of six planks amongst the different sections. The three surviving strakes are the first three closest to the centreline on the starboard side and there is no indication that a further strake existed towards the centreline as showed by the fact that most of the treenails driven to the upper face of the frames seems to have been cut flush there.
- 4.3.62 The ceiling planks are shaped in the same way as the outer hull planks, tangentially converted with a pit saw and with no bark or sap. At least two were bent with charring as evidenced by the traces of burning in their underside [37,40] (Figure 40).
- 4.3.63 Two are virtually complete, and the longest has a length of 6.20 m and a width of 380 mm whilst the other one is shorter by reach 460 mm across [37,40]. They are approximately 50-60 mm thick. All the ceiling planks were fastened to the hull with treenails and up to 50 treenails were nailed through the longer ones, each one made flush on the upper face and the majority wedged.
- 4.3.64 They are shaped to have a gentle camber and sheer. It is likely that the sawyers and carpenters employed by the shipwrights were clearly tasked with preparing the flitches with slight longitudinal curves. These curved planks would have been ideal for accommodating the natural 'sny and hang' of vessel hull planking, differing from the straight planks typically required by carpenters for constructing floors and similar structures. This approach would save materials and reduce costs for the shipbuilders by minimizing wastage when using planks with a slight curve along their length.

- 4.3.65 The strakes were joined lengthwise using simple vertical scarfs, resembling those used for the outer planking (Figure 41). The only difference is that the feathered edges of a ceiling plank point in opposite directions – one towards fore and the other towards aft, so they are both under (or both above) the next plank [37,40]. The scarfs were c. 400 mm in length and secured with few treenails.
- 4.3.66 The ceiling planks extended to the bow and their position was marked on the upper surface of the frames / crotches either with recesses or with straight lines scribed across the framing longitudinally.
- 4.3.67 Two square dutchmen (70 mm by 85 mm) were used to repair possible shakes or other defects from the surface of one of the timbers [038] and were cut through the whole thickness of the planks. The possibility that these blocks cover the mortices that might have otherwise been used for the ends of light vertical internal fitting timbers that were removed, is also worth considering. Such struts or light stanchions were sometimes used to support structures to hold cargo or ballast in place, or in the fitting of internal temporary cabins etc.

Toolmarks and intentional marks

- 4.3.68 Toolmarks observed include the lines of pit-saw marks which are characteristic on several planks and sides of the frame. For example, on one side of filler frame [046] the pit saw marks are clear, leading to a triangular split off section at the very end of the saw cut, where the wedges holding open the saw cut, split the last section of unsawn timber.
- 4.3.69 Also visible are the markings of curved blades of adzes for smoothing out the surface of planks. These blades appear to be up to 80 mm wide. The practice of adze dubbing was rarely employed in carpentry work, and the up to 80 mm wide, slightly curved adze marks found on the wreck timbers are characteristic of the tools used by early English carvel shipwrights. Evidence from the *Mary Rose* and 16th-century London tool assemblages indicates that these early adzes were a type of relatively light 'stirrup adze' of ancient Mediterranean design, clearly depicted as complete tools in 16th-century Italian paintings. They are notably different from the heavier shipwright's adzes used in 17th-century England and later periods.
- 4.3.70 Axe hewing is evident on select framing elements with axe stop marks of up to 100 mm width driven against the grain along the flat sides of frames [052].
- 4.3.71 Small blades such as chisels or gauges were used to mark the treenail position on the top of the frames and ease the tip of the auger for boring [087]. The concave wall of some blind treenail holes that were started and then not completed could be suggestive of the use of a spoon auger.
- 4.3.72 Very few deliberate marks were found. These include a series of arrow-based forms cut with a race knife on the aft moulded face of a filler frame [046], potentially indicating shipwrights' or more likely sawyers' marks. Additionally, there are potential markings for which there is less certainty that they were made intentionally, such as Roman numeral IX cut into a plank [039] with a race knife, as well as four parallel horizontal rather faint indentations on the moulded surface of a futtock [068] (Figure 42).

Repairs

- 4.3.73 Overall, the low number of minor repairs and errors indicate the use of good planking stock and seem to suggest that the construction was confidently assembled.

- 4.3.74 To address larger knots and defects like shakes and splits, a rectangular portion of the affected wood was cut and replaced with a small wooden patch. These patches extended either through the entire or partial thickness of the plank and were fastened using iron nails, generally two at the opposite corners.
- 4.3.75 In the construction of new vessels, Dutchmen were frequently utilized to conceal imperfections in the timber, extending beyond mere repair applications. Two small square Dutchmen (75 mm by 89 mm and possibly 44 mm by 55 mm), penetrating the entire thickness of the timber, were graved to the upper face of the ceiling plank [038] and fixed with iron nails to the frames. The grain of these Dutchmen was oriented at a 90-degree angle to that of the plank. As said above, the possibility that the mortices blocked by the two insets might have been used for light stanchions or other support cannot be excluded.
- 4.3.76 The outer planking presents few repairs and the tightness of these might suggest that the planks were seasoned or at least semi-seasoned when they were dressed for the vessel. Ample matted tar with animal hair was paid in the recesses before placing the patch when the area was exposed to the water as in the case of outer planking.
- 4.3.77 Most of the graving pieces were rather ordinary work. In the inboard face of outer plank [96] a small patch 15 mm thick and with a side of 110 mm [114] was inserted. It was probably used to cut out a knot. It was fixed with two iron nails and then treenailed through at a later stage.
- 4.3.78 A small trapezoidal graving piece was carefully inserted into the lower edge of the outer plank [097] and then nailed in place, carved with the groove line that fitted against the neighbouring strake and covered with waterproofing material. This piece was let for 44 mm into the plank and had a slight taper from the centre to the edge of the plank increasing its length from 115 mm to 125 mm (Figure 43).
- 4.3.79 A slightly more extensive and relatively more intricate repair is evidenced in the treatment of the outer plank [094], situated on the inner face of the plank in the forward section of the scarf joint beneath floor timber [060]. This repair involves the application of two overlapping patches (Figure 44). The outboard patch [116] covers a small square segment (110 mm by 110 mm) cut on the outboard side, penetrating through the whole thickness of the plank. This section is carefully shaped to leave only a slender sliver of wood along the starboard edge. The patch thickness is just 20 mm and it is attached with a nail to a larger rectangular inboard patch [115] (250 mm by 138 mm), which covers it. This rectangular graving piece, with a thickness of 30 mm, snugly fits into a recess carved into the plank and it is fastened to both the frame and outer hull with a treenail. Waterproofing material is placed between the patches and on top. Above this repair, a wedge has been driven and treenailed to augment thickness, serving to tighten the fit of frame [060] and potentially further secure the outer patch.
- 4.3.80 Thin carved 'shims' have been positioned beneath other joining surfaces where a perfect fit is not achieved, providing slight adjustments. These are generally made of elm, and some are very thin sculpted, tapering fragments.

The sternpost assembly

- 4.3.81 The sternpost assembly features a rabbeted sternpost with an extended aft deadwood [109], a fragment of keel [104] and its skeg [107]. Vertical planks line out the lower stern, which composed predominantly of oak for its larger vertical and longitudinal components, and by elm for the outer cladding [103][102], excluding the garboards [101][105] and the thinner planking within the rabbet [120] [121] (Figure 45).

- 4.3.82 The main components of this section are two large finely tapered vertical oak timbers assembled together in one piece [109] (Figure 47). This assembly has a trapezoidal cross-section which narrows upwards and tapers aft with the face forward measuring 132 mm sided at the outer heel just above the horizontal score for the outer planking and a min. of 152 mm sided on the inner face of the deadwood. The port and starboard faces of the assembly are maximum 1085 mm high along the vertical and extend for a maximum 645 mm in the fore and aft direction.
- 4.3.83 Most of the aft part of the post is missing, as it was damaged when it was recovered by the quarry excavator. However, fasteners indicate that at least another vertical timber was raised aft. The top part is broken and eroded in places. Along the aft upper edge, the post/deadwood [109] exhibits some deeply incised roughly driven axe marks, possibly hinting at the fact that the timber might have been re-used or partly salvaged (Figure 46).
- 4.3.84 The starboard side appears to be better preserved than the port side as it retains elements of the outer planking and the garboards and keel at the bottom of the assembly show evident tear and wear. The keel ends are both broken and most of the aft ends of the planks are frayed. The starboard garboard [101], despite its heavily eroded outer surface, appears to be preserved at both ends, which are butt ends, resulting in a surprisingly short plank (1.35 m length, 38 mm width, 60 mm thickness).
- 4.3.85 The timber [109] is part of a rabbeted sternpost and extended deadwood, presumably joined together with a lap joint that is bedded with the waterproofing compound as this is visible through an angled seam just forward of the rabbet.
- 4.3.86 A layer of the thinner ('original') planking is rabbeted and fayed into the sternpost [120] [121], and this was covered by a doubling layer of thicker planks [103][102] which extended past the rabbet line, to the aft end of the outer post.
- 4.3.87 The whole structure is held together to the planking by over 20 treenails of 30-35 mm in diameter that pierce it across its whole length and square shafted iron nails. A bolt and an iron nail were driven horizontally across the fore face. The assembly is raked aft and offer a rabbet on both sides for receiving the original planking. A rake of 64 degrees was measured along the rabbet from the horizontal. The preserved part of the fore face of the assembly raises at a similar angle whilst the aft one seems to follow a more vertical line.
- 4.3.88 The bottom has a tapering rebate to seat onto an unusually curved longitudinal timber, sub-rectangular in section, which is interpreted as the aftermost heel of the keel [104] (Figure 48). The joint is given additional adherence as the lower aft face of the post locks into a small step on the upward face of the keel, just fore of the rebate.
- 4.3.89 The rabbet is straight, and its depth increases along the height of the post from 20 mm to 35 mm. The two lowest outer strakes [103] [102] and the garboards [105][101] extended further aft over the line of the rabbet, presumably to the aftermost face of the sternpost.
- 4.3.90 The 'original' planking [120, 121] (maximum 35 mm thickness, maximum 470 mm width) that fits in the rabbet of the bipartite post is nailed along the rabbet and tarred with setworks on both sides (Figure 49). As said above, these thin planks are cladded by two thicker planks (broad) [102, 103] (maximum thickness 70 mm, maximum width 360 mm) that flow beyond the aft edge of the posts over the rabbet line. Under these two planks and under the vertical rabbet, the post is scored on both the portside and starboard face to accept the garboards so that the siding of the whole assembly is flush and regular. Thin

shims of wood [119] were packed between the garboard and the post and nail to fill the gap between the garboard and the post.

- 4.3.91 The underneath of the keel timber is scarfed and bolted to a possible reinforcing skeg [117] that seamlessly extends its base. It is shaped to accommodate the upward line that the keel forms as it curves beyond the aft end of the post. The presence of bolts and treenails that pierce them vertically suggests that there were other centreline timbers above them possibly extending the post further aft (Figure 50). The keel and the skeg are covered in tar and hair to bed the port and starboard garboard planks which are attached to the keel with a line of square shaft countersunk iron nail and treenails driven along the lower edge of the planks.
- 4.3.92 The morphological parallel for this sternpost assembly can probably be found in the extended sternposts of the slender sterns of the Low Countries. These often feature an extended web of timbers aft, a recessed surface at the bottom of the sternpost to accommodate the first three lower strakes, and an iron strap ties the outer planks to the post.
- 4.3.93 Examination of the aft heel of the sternpost, remaining undamaged, reveals a subtle concave impression, suggesting potential alterations (Figure 51). This concavity, possibly the original aft edge, hints at a groove for a possible pintle. The presence of iron staining and a diagonal line of nails on the port face tentatively supports this hypothesis.
- 4.3.94 If that is the case, the inner planks, lightly affixed with nails over tarred hair set work, along with the shims of wood used between these and the thicker outer planks could be part of an alteration that widened the stern's form, enabling the lower, full-thickness stern hull planks to seamlessly extend over the original post assembly.

4.4 Finds

- 4.4.1 The hull was devoid of finds apart from a fragment of a pottery, an animal bone, an off-cut of leather, an element of a shoe and a wooden dish which were all found trapped within the bilge stuck under or between the frames.
- 4.4.2 The quarry personnel also uncovered a limited number of artifacts during the sorting process of the gravel. These findings were examined since they might have originated from the layers in which the wreck was embedded. The assessment of the finds was undertaken in-house by Wessex Archaeology's finds specialists.

Leather (Obj No 7009 a/b, 7002, 7000)

- 4.4.3 Two pieces of thick cattle hide consist of a small triangular scarfed piece (SF 7009a) and a larger irregular shaped off-cut (7009b - 1029-5002). They were found between frames [052] and [053]. Off-cuts of leather as the by-product of leather working and would have been retained to be re-used or for re-purposing. The concave shape of the fragment (7009b - 1029-5002), may have been an off-cut from sole preparation or from the creation of a leather washer (Trott, 2020, 555).
- 4.4.4 A welt (SF 7002) from a turn-welt constructed shoe (Evans 2005, 68-70, Type 2/3) was found within section (5005). A single knife-cut butt is situated within the internal seat area, the curvature following the line of the internal waist where it is torn at the internal tread. No evidence for any stitching is evident within the hand-made stitch holes, although at least nine double stitches occur on the outer internal tread area suggesting a past repair.

- 4.4.5 A further shoe fragment was recovered from the processed material but it does not appear to be directly associated with the wreck remains, although it was dredged from the same general area. This is very worn near-complete left welted bottom unit from a male shoe (7000), that exhibits a worn rounded toe, with excessive wear on the internal toe area and tread. Significant wear is also evident along the outer tread and distal waist area, where the outer waist edge and around the seat/former heel stack has been torn away following the line of the original machine stitching. A further tear is evident across the waist towards the inner stitching margins. Two or three small wear patches are present mid-tread, indicative of repetitive pressure wear. The upper tread exhibits mid-sole edging impressions, that with the reintroduction of right and left-footed shoes from the 1830s (Swann 1982, 32) indicates later post-medieval or more likely a modern (post 1890) date (Mould 1997, 127).

Animal bone (Obj No 7003)

- 4.4.6 A single fragment of sheep/goat or pig rib, most probably from a cutlet, was recovered in between frames [46] and [70] close to a wooden dish. The rib had been roughly broken at both ends, with possible signs of rodent gnawing along one edge. The meat may have been procured fresh or possibly as cured meat for longer-term storage. Evidence for both was found onboard the Tudor warship, *Mary Rose*, including several casks of salted beef and pork were recovered (Coy and Hamilton-Dyer 2005).

Wooden dish (Obj No 7007)

- 4.4.7 Approximately two-thirds of a shallow wooden dish or saucer (diameter 175 mm), with the rim slightly cracked and distorted. It has a simple concave profile with no ornamentation to the rim; the base is slightly flattened but there is no basal angle. The simple profile, together with some slight irregularities in the surface, suggests that the vessel is not turned but handmade (Figure 52).
- 4.4.8 Such a simply made vessel is almost impossible to date. It cannot be directly paralleled, for example, amongst the large assemblage from the *Mary Rose* (sunk in 1545), where the wooden dishes are almost all larger and would be classified as mess or serving dishes; these vessels were invariably turned, with more clearly defined rims and bases (Weinstein 2005, 445–7). This example has the appearance rather of an individual eating vessel. Nevertheless, it certainly would not have been out of place on a late 16th-century wreck. It was found under frame [072].

Pottery vessel (Obj No 7010)

- 4.4.9 This is a body sherd from the neck/shoulder of a Raeren stoneware mug or jug (Figure 53). The sharp neck/shoulder angle indicates that this was a globular vessel with a cylindrical neck, a type current in the second half of the 16th century (eg Hurst *et al* 1986, fig 106, 332–3; Gaimster 1997, cat no 54). It was found between timber [122] and [123] in section (5013).

Granite boulder

- 4.4.10 A granite boulder that was reported as recovered from nearby the discovery location was recorded. The stone is ovoidal shaped with rounded edges and measures 390 mm by 300 mm by 250 mm. It is unclear whether this was part of the depositional context layers of the wreck site.
- 4.4.11 Examination by the British Geological Survey (BGS) has revealed that the ballast boulder comprises a pinkish pale grey, inequigranular, two-mica, tourmaline-bearing granite that contains sporadic tabular K-feldspar phenocrysts of up to 20 mm in length. The general

petrographic characteristics of this granitic rock are consistent with the boulder having been derived from a part of the early Permian Cornubian Batholith of South-West England. Comparison with reference specimens forming part of the BGS Petrological Collections highlights similarities with the so-called 'coarse granite' of the Scilly Isles, and this area is provisionally identified as the source of the boulder. It is noted, however, that granitic rocks of broadly similar character occur in Brittany, for example, and an alternative origin to the Scilly Isles cannot be discounted.

4.5 Environmental analyses

- 4.5.1 Five bulk sediment samples were taken from deposits preserved in the bilge of section (5004) and these were processed by Wessex Archaeology's Environment Team for the recovery and assessment of plant macro-remains (seeds, fruits, achenes etc.) and wood. One control sample was taken from natural deposits surrounding the shipwreck.
- 4.5.2 All of the samples contain remains which have been preserved in waterlogged (anoxic) preservation conditions, and these include varying quantities of wood fragments, mosses, seeds, and insects/invertebrates such as beetles (Coleoptera), fly puparia and water-flea (*Daphnia* sp.) egg cases and mites. Wood charcoal is present in small quantities, although no charred plant remains were observed. There are abundant foraminifera and ostracod shells in some of the samples. Other material recorded in most of the samples include fish bone, animal/bird bone, and marine shell.
- 4.5.3 Many of the plant remains recovered appear to reflect materials which could have been used as dunnage (or packaging) on board the vessel, including cereal straw, chaff, bracken and other plant stems. A number of plant and insect remains were probably unintentionally brought on board the vessel in other products such as dunnage (e.g., arable weeds, grain weevils).
- 4.5.4 On both the Newport Ship and the *Mary Rose*, many of the plant remains recorded reflected materials used as dunnage or packaging, paralleling the evidence from the Denge Quarry wreck (cf. Smith and Green 2005; Carruthers 2013). However, it is worth noting that straw, chaff or bracken may have had other uses on a ship. All of these materials could have been used to soak-up liquids, stuff mattresses or to provide animal bedding/fodder for livestock. The common occurrence of rye chaff in the Denge Quarry wreck is of particular note since this was also observed in both the Newport Ship and the *Mary Rose* (*ibid.*). This may relate to the specific selection of rye for its high-quality straw.
- 4.5.5 Other plant remains recorded could derive from spilled cargo, food waste and sewage or a combination of the three, and these include broomcorn millet, flax, hemp, hops, walnuts, hazelnuts, plums (or prunes), figs, grapes (or currants/raisins), pomegranates, dill, celery and mustard.
- 4.5.6 Therefore, many of the items recorded in the vessel could have been acquired from ports in England, however, there are also those suggestive of foreign imports in the assemblage in particular Broomcorn millet, figs and pomegranates.
- 4.5.7 Finds of broomcorn millet from archaeological sites in England are very rare, with only a handful of records known for the late medieval and post-medieval periods (Murphy 1994; Williams 1977; see also Brudenell et al. 2022 and Wilcox 1977). Two records of broomcorn millet for this period both come from cities – Norfolk and Hull – with well-known maritime trade connections (Murphy 1994; Williams 1977). It is therefore likely that the crop was either deliberately imported from abroad, or it was an unintentional contaminant of other products (e.g., cargo, dunnage). Broomcorn millet was also recorded in the

Newport Ship, a vessel which was used on trade routes between Britain and the Iberian Peninsula, probably somewhere in northern Spain or Portugal (Carruthers 2013).

- 4.5.8 Pomegranates are rarely recorded in archaeobotanical assemblages in northern Europe, although they were present in the Newport Ship (Carruthers 2013). Figs, prunes, currants (or raisins), pomegranates, walnuts and hazelnuts (or filberts) may all be foreign imports from France, the Iberian Peninsula or elsewhere in the Mediterranean. However, walnuts and hazelnuts are well-known to have been cultivated in southern England in the 16th century.
- 4.5.9 Overall, the evidence seems to indicate that the vessel was potentially used in coasting trade, visiting various ports around southern and eastern England. However, there are also a number of foreign imports in the assemblage, notably dried fruits.
- 4.5.10 Remains of exotic spices such as cloves, pepper, nutmeg, mace, ginger, cinnamon and others are absent and the small number of spices recorded included dill, celery and possibly mustards which all could have been grown in gardens in England (Moffett 2018).
- 4.5.11 In addition to that, some of the plant macroremains may reflect later contamination and they could be unrelated to the shipwreck. In particular, as shown by the control sample, a wide range of wetland species were present in the local environment and some of these are likely to have become incorporated into samples taken from the shipwreck (i.e., from re-worked sediment).

5 DISCUSSION

5.1 Number of wreck(s)

- 5.1.1 The likelihood of the five sections originating from multiple wrecks was ruled out due to the apparent absence of repetition of elements in the assemblage, internal consistency in material usage, dimensions, and workmanship. Additionally, the reported single recovery location supports the inference that the remains likely belong to a single vessel. The dating evidence broadly aligns with this interpretation.
- 5.1.2 However, within the material recovered there are at least two disarticulated timbers that can be ascribed to two further vessels: a clinker-built large boat (or small ship), possibly the earliest of the group and of medieval or post-medieval date; and a flat-bottom carvel-built vessel, possibly a large boat (or small ship). Both these vessels were likely to be considerably smaller than the main wreck and it is unclear whether they are from the same context and if they were associated with it. In addition to these, a further section of a carvel-built vessel was discovered north of the main wreck recovery location, however it was not possible for quarry staff to recover it. Therefore, there might have been at least four wrecks within the quarry area.

5.2 Dating

Dendrochronological dating

- 5.2.1 Several dendrochronological samples were taken from the different parts of the wreck sections in order to establish a date for the vessel. The dendrochronological analyses were carried out by the Historic England dating team (Appendix 5).
- 5.2.2 A total of 50 samples from 49 timbers were analysed with 43 being oak (*Quercus* sp.) and seven elm (*Ulmus* sp.). The analyses resulted in the successful dating of 25 of the oak timbers, 11 of which retained some sapwood or at least the heartwood/sapwood boundary

ring, and a further four with the outermost ring being the possible heartwood/sapwood boundary. The sample of one of the filler frames of section 5004 [061] contained bark edge to provide a narrow date of spring 1561. Six of the undated samples were subsequently analysed with oxygen isotopes dendrochronology and resulted in the successful dating of five additional samples (two oak and three elm).

- 5.2.3 The majority of dated samples were retrieved from section 5004, although two samples from section 5005, lacking sapwood rings, were dated with last measured ring dates of 1491 and 1496 with estimated felling date of after 1506 and after 1512. Additionally, one sample from section 5006 was dated to 1483 (estimated felling date of after 1498), while the rest were obtained from disarticulated timbers.
- 5.2.4 The oxygen isotopes dendrochronological analyses helped to gain dating of timbers from the stern section (5007) yielding results for the outer planks [103] and [102] (estimated felling date after 1536 and after 1530 respectively) and the inner plank [121] (felling date of after 1481).
- 5.2.5 The 31 dated timbers from the Denge Quarry wreck fall into two broad felling ranges, an earlier phase dated 1534-47 and a later phase of 1556-81 with a timber closely dated to spring 1561. Another two timbers [040][048] fall in between these two primary ranges so could feasibly be associated with either of the two main episodes of felling identified or could represent another felling episode.
- 5.2.6 The presence of timber from at least two different phases introduces some complexity to dating the ship, but despite the limited available data, the evidence is consistent in pointing towards the floors and futtocks originating from the earlier phase, while the wood for filler frames appears to have been harvested at later stage.
- 5.2.7 This seems to suggest that the years around mid-1530s to mid-1540s may represent the earliest date for the construction of the ship with later modifications within around 1561.
- 5.2.8 However, as evidenced in the case of the Gresham ship, the practice of timber stocking can complicate the dating of vessels from this period. In the absence of major rebuilding activity within the framing and planking assemblage, it remains a possibility—albeit a tentative one—that the frames and futtocks were constructed from re-used or long-stockpiled timber, potentially stored for more than a decade. If this were the case, the earliest feasible date for the vessel's construction could be shifted to sometime after the spring of 1561.
- 5.2.9 From this alternative and more speculative perspective, the spread of felling dates for the frame elements could therefore be explained with stockpiling rather than two construction phases separated by several years. In order to store timbers for such a long period a specific method of stockpiling – storage in ponds, likely containing salt or brackish water – would have been necessary. This is because oak timbers with significant amounts of sapwood, when stored above ground in southern England, are vulnerable to insect attack, which can leave noticeable traces in the sapwood within just two to three years. The practice of pond storage for shipbuilding timber is both archaeologically and historically documented from the late 15th century in Southeast England, at both large and small sites. For example, oak and elm timbers suitable for boat building were found at Poole, and the use of 'timber ponds' at Deptford Royal Yard from the 16th to 19th centuries were used for large ship construction.

- 5.2.10 The initial analyses of the construction sequence and carpentry details (**see below 5.4**) seem to indicate that the filling frames were not fitted during the very initial framing up and planking of the first planks of lower hull. Nonetheless, it is suggested that they might have been added shortly afterwards as the hull began to take shape (between few months to c. two years) as leaving the floors exposed could have resulted in some significant level of decay in the earlier framing. This timeline appears to be supported by the absence of any clear evidence for major rebuilding within the framing and planking.
- 5.2.11 Within this alternative interpretation, the dating and timber record evidence seem to point to the hull being reshaped within a few months to around two years after the initial build and also indicates the long-term water storage of the oak timbers, therefore, placing the date range of the main phase of the vessel construction around the mid-1560s and early 1570s, considering that the tightness of fit of the sawn oak hull planking is strongly suggestive of some degree of seasoning.

Artefactual evidence

- 5.2.12 The dating evidence is limited to the pottery fragment (Object number 7010), discovered within the small section of hull (5013) and possibly the turn-welt shoe (7002) found within section (5005) that has parallels with shoes attested on the *Mary Rose* (Evans 2005, 68–70, Type 2/3). The finds indicate that the utilisation of the ship dates to as early as the latter half of the 16th century.

5.3 Origin of the timbers

- 5.3.1 Overall, a diverse set of woodland sources rather than a single discrete origin has been suggested by analyses of the samples (Appendix 5).
- 5.3.2 Most of the oak seems to have been sourced from woodlands from the wider vicinity of the shipwreck's eventual location and exhibits links with reference chronologies made up of timbers from South East England and East Anglia. Notably, sites in Kent, London, and Essex stand out as particularly significant in this context.
- 5.3.3 The filling timbers seem to have a slightly more varied cross-matching comprising not only the locations mentioned above but also the Midlands, suggesting the possibility of different regional sources for some of these elements.
- 5.3.4 In general, it appears that the oak timbers analysed were mostly derived from trees in the order of 100–150 years old when felled. However, there are exceptions with [124] being derived from a tree over 200 years old, and notably the oak timbers associated with the later of the two main felling periods identified which appear to be derived from somewhat younger, around 70–100 years old and faster grown trees.

5.4 Analyses of the building sequence

Possible building concept and sequence

- 5.4.1 The sequence of building the hull is likely to have used pre-assembled frames that were composed of floors and first futtocks, pre-joined with lateral mortices and secured with two oak treenails. This applied to all the inspected frames with the exception of the master frame which has a different type of joint, and the two crotches at the bow as these are not fastened to the futtocks.
- 5.4.2 The narrow space between the frames and consequent lack of room to drive the treenails in the fore-aft direction, shows that floor timbers and futtocks were likely to have been assembled before being erected or at least built in sequence. This seems to be confirmed

by the angle with which some of the lateral treenails are driven. In addition to that, the fact that some of the treenails that secure the floors to the futtocks are cut by treenails driven from the outer planking would further corroborate that at least some of the planks were added only at a second stage when the futtocks were already fastened (for example a lateral treenail driven with a sharp angle between [043] and [068] was cut by a vertical treenail drive from plank [066]).

- 5.4.3 Considering the cultural context in which the ship was built it is possible that the master frame and possibly the adjacent frame were erected first to control the shape of the hull, followed by several other construction frames which were raised and attached to the keel, at least some with a ferrous bolt. The frame's shapes seem to have been predetermined with reasonable, but not perfect, accuracy as some later trimming and addition of wedges demonstrate.
- 5.4.4 The evidence of the use of temporary nail fastenings on the outboard faces of framing elements may reflect a number of practices documented in various traditional and historic systems of carvel building in Europe; such as locating blocks to wedge planks down against those already fastened, securing short struts of scrap timber to hold the pre-assembled frames up, or for securing vertical struts helping to shore up the framing initially before much hull planking was added.
- 5.4.5 After the outer sided faces of the pre-erected frames were adzed to the desired shape and shored into position, some of the outer planking could have been put in place. The spiled planks were probably offered up, clamped tight, close scribed to their neighbours and then unclamped. Now the joint could be made and the plank could be trimmed for a perfect fit. The lower edge of each plank was hollowed out in order to make space for the waterproofing material. During the final hanging process, three strands of rolled and tarred animal hair were laid between strake planks and the planks were fastened with trenails, which were caulked on the outside and secured with wedges on the inside. Joints and hood ends were additionally secured with countersunk iron nails. The planking could have been assembled from stern towards bow with the upper square edge possibly offered for clamping, hammering or shoring.
- 5.4.6 Prior to hanging, smaller defects in the planks were addressed. Some of the graving pieces and patches are located in areas which would have been inaccessible after hanging.
- 5.4.7 At some point later, once the outer planking was already in place, the extra filler frame timbers were fitted between the main frames and sometimes the planking was smoothed to ease their final fitting, removing the tar coat which was not replaced. The roughly hacked line on the inboard face of the outer planking might have been part of this process. The heels of the filling frames do not extend across the keel, and it is hard to establish exactly whether they were fitted during the initial construction of the ship or at a later stage as the dendrochronological analyses seem to indicate. The presence of the impressions of the nails used for the scarfs of the outer planking on the floors and futtocks and not on the filler pieces seem to provide a strong argument to further support this sequence.
- 5.4.8 It is possible that the insertion of the filling frames occurred relatively soon after the assembly of the frames and lower hull—within a period ranging from a few months up to two years. The surfaces of both the earlier and later framing show very little evidence of insect or fungal damage, which would typically be visible on the remaining sapwood in many areas. Additionally, there is no clear indication of any significant rebuilding that would have altered the frames or inner planking of the wreck. For instance, later framing

elements like the filling frame timber [61] would have required the removal and refitting of the ceiling planking for installation, and yet there is no indication that this took place.

- 5.4.9 At some point, presumably after fastening the filler pieces, the top of the frames would have been trimmed, and parts of the sides of a few of the linking treenails are revealed as a consequence. The ceiling plank positions were then marked with regular lines on top of all frames and fastened through.
- 5.4.10 Overall, the impression is that the vessel aligns with a frame-led approach although given that so much attention was given to the structure of the planking, one might question to what extent this is influenced by the longitudinal lines of the planking and whether a more stepwise sequence could be formulated for this wreck. The distinct scarf joint on the floor of the master frame supports this view, suggesting that the floor timber [051] was likely fastened first, followed by the initial strakes of planking, then the first futtock [078], with at least some of the other frames bolted onto the keel either concurrently or shortly thereafter to guide the planking around the bilge and upwards.

Design of the master frame

- 5.4.11 Given the presumed frame-led construction, it remains to be determined how a presumed mould of the master frame was designed, how the floor timbers shapes were determined and ultimately according to which method these were designed. However, a detailed study that aims to extract the potential geometries of the curves of the vessel is beyond the scope of the current study.
- 5.4.12 The master frame of the Denge Quarry wreck has been identified as that of frame [051][079] as this is morphologically different from the rest. However, frames [050][072] could also be considered. Their shape was not geometrically assessed but a quick comparison superimposing the moulded side of the frames to the midship section of the *Foresite*, as shown in the in the 'Fragments of Ancient English Shipwrigthry' seem to indicate rather close similarities of the curve as illustrated by Mathew Baker (Barker 1986). However, it also seems possible that the curve of futtock [072] might have served as a template for some of the other frames.
- 5.4.13 The first recorded midship sections from Mathew Baker's 'Fragments of Ancient English Shipwrigthry' are only from the 1570-80s (though they include a late record of four ships of 1546) and used a system of tangent arcs as theoretical construct for design of frames or cross-section (Barker 1986, Adams 2013). In this sense it might be significant that the first frames used in the Denge Quarry wreck could have been erected as early as the mid-1530s-40s.
- 5.4.14 It has been suggested that these methods were used during the construction of the *Mary Rose*, therefore anticipating the use of the methods of design traditionally attributed to Mathew Baker and his contemporaries (Marsden 2009, Adams 2013). However, whether the adoption of this method, which will become dominant in the 17th and 18th century, can be traced back to the early stages of carvel construction in England or even to the later part of the 16th century, has recently been contested (Pevny 2019).

5.5 Size

- 5.5.1 Although informed analyses of the tonnage and dimensions of the ship necessitate detailed 3D reconstructions of the possible original shape of the ship, which is outside the scope of this work, broader considerations can still offer valuable insights into the vessel's overall characteristics.

- 5.5.2 Despite the accidental recovery, aligning all the larger sections, without considering the missing parts, would result in a fore-and-aft run of over 12 m in length, likely representing a significant portion of the original length with both fragments of the bow and the stern represented within the assemblage.
- 5.5.3 The length of the longest plank could provide some evidence in terms of dimensions of the vessel. If we assumed that each strake might have been made of at least three plank sections up to c. 6 m long then we may imply that the length of the lower hull was in the region of a minimum 18-20 m, with the upper hull extending well beyond that and the maximum breadth very tentatively estimated around the 7-8 m mark.
- 5.5.4 When comparing it to the Gresham ship, which shares a similar construction (and is discussed in more detail below), the Denge Quarry wreck exhibits slightly larger scantlings. This suggests the possibility that the Denge Quarry wreck might have been slightly larger from the initial build of the Gresham ship, which before furring was estimated to have a tonnage of just over 200 (Auer *et al.* 2014). However, it is important to note that the comparison is not straightforward due to alterations made to the Gresham ship and by the fact that the relationship between scantling and size is not an immediate and direct one.
- 5.5.5 The English merchant vessels depicted in the Matthew Baker manuscript, whose content is generally attributed to the 1570-80s but also illustrates earlier ships (Barker 1986), could be tentatively used as a representation of the original appearance of the Denge quarry ship. In particular, ships such as the *Emmanual* and the *Foresite* seem to be fitting examples (Auer *et al.* 2014). Judging from contemporary illustrations, the vessel was three-masted, although no material relating to the upper works or elements of rigging have been found.

5.6 Ship construction

- 5.6.1 The Denge Quarry wreck is a relatively early carvel ship and it is possible that it was built as early as the mid 1530s-1540s, when the first generation of English Master Shipwrights was being officially recognised and appointed by Patent by Henry VIII of England, and then possibly rebuilt after the 1560s in a period when the second generation of those families were actively carrying out their trade.
- 5.6.2 In this timeframe (and even earlier), the transition from clinker to carvel planking was actively occurring, possibly in hand with the development of concepts and practices that are described in Mathew Baker's manuscript (Barker 1986, Auer *et al.* 2014, Adams 2013).
- 5.6.3 The vessel was in all likelihood built in England, using oak harvested from the eastern part of the country. The substantial curved oak logs employed for framing, given their considerable weight and unwieldiness, likely serve as a key indicator of the geographical area where the vessel was built.
- 5.6.4 Similarly to other English ships of the period, the Denge Quarry wreck is predominantly built using oak and principally fastened with treenails expanded with oakum (Auer 2004, Adams 2013). English elm is used sporadically, and this is reserved for certain elements for its durability under water. This is a phenomenon well documented for the 16th century in England when the use of elm becomes more common (Marsden 1996).
- 5.6.5 The Denge Quarry ship was likely built following a concept of a pre-determined design, possibly mediated from some sort of English tradition. Although the constructional

features found on the wreck such as the pre-assembled frames with dove tail and hook scarves are generally associated with the foreign (Ibero-Atlantic and Mediterranean) influence, it is interesting to note that solutions such as the flat scarfs of the outer planks are more reminiscent of the clinker building techniques and appear to constitute an anomaly in the traditionally carvel technique. Apart from the Gresham ship, only a handful of other carvel vessels present this deviation, but they all appear to have been constructed using a plank-orientated method. Namely, OE34, which was found in Flevoland and built in the Dutch-flush method, and the *Veje Hafnia* wreck which was dated to 1574 and built with wood from the Netherlands (Cattrysse 2013).

- 5.6.6 As this way to assemble planking was a more time and resource consuming technique, it has been suggested that this adoption might be due to the input of shipbuilders with expertise in clinker shipbuilding that might have been actively involved in the construction of carvel ships, possibly under the guidance of a master shipwright that had some knowledge in the carvel building method. This would not have been unusual for the period as, for example, it is known Augustino Levello, a Venetian shipwright, worked in the Deptford shipyard from 1543 to 1578, a time that coincided with Mathew Baker's time there. It is also known that Mathew Baker travelled to the Mediterranean (Barker 1986; Loewen 2007; Marsden 2009).
- 5.6.7 Importantly, as vessels like the *Mary Rose* do not have vertical outer hull plank scarfs, just butted caulked ends set on frames, this feature would currently seem to be distinctive of a possible regional early carvel construction tradition style. It is also similar to those used in the 16th century flat bottomed river barges of the Thames region (sometimes called 'western barges' as they came down the Thames from the west) and the older medieval style clinker barges of the lower Thames and river Lea that were called 'showts' (Goodburn 2016).
- 5.6.8 Similarly, the distinctive method employed for waterproofing the outer hull does not seem to have been identified in any other early carvel ships other than the Gresham ship. It is possible, therefore, that this method, found only in the Denge Quarry wreck and Gresham ship, could be a regional feature independently developed within the south-east England. While acknowledging that this period demonstrated marked experimentation in finding solutions for waterproofing carvel-laid planks on the outer hull, it has been proposed that this method could have drawn inspiration from the principle of luting used in clinker planking, where a compound, often animal hair and tar, is paid and not driven into the overlapping plank edges. Speculatively, an intriguing parallel for this waterproofing system has been found in the bottom planking of flat-bottomed barges of the Swale where it was used until the 20th century (Sattin 1990; D.Goodburn pers. comm.). In the barges the outer planks were rabbeted together (for example with half laps or dowels) and then bedded with tar and cow hair, known as setwork, and then clamped. There is also locally a version of this approach documented historically for the edge butting seams of flat-bottomed river barges of the Thames, Medway and Lea in the 19th century. The tarred hair was placed in slightly hollowed butting edges of the seams. This approach of using 'setwork' in barge bottom waterproofing is also archaeologically documented in barge remains from much earlier, of 16th to 18th century date, from the same region (Goodburn 2009). It must be said that there is no evidence of continuity between the Gresham and Denge Quarry site and the barges just mentioned so the hypothesis of an enduring regional tradition remains a tantalising parallel.
- 5.6.9 As mentioned above, the construction details of the Denge Quarry wreck exhibit remarkable similarities to those of the Gresham ship. The Gresham (or Princes Channel) ship was documented by Wessex Archaeology in 2004 and then further discussed in a

monograph published by BAR (Auer and Firth 2007; Auer *et al.* 2014). The ship, identified as a small to medium-sized armed merchant vessel, was built shortly after 1574. Presumably built in East England, it was discovered in the Princes Channel within the Thames Estuary. Shared characteristics include the framing pattern and the incorporation of filler frames. The construction also features specific elements such as the type of mortices connecting futtocks laterally to floor timbers, the use of vertical scarfs in the outer planking, the conversion of the timbers, some constructional features of the bow and the distinctive method for shaping and waterproofing the seams of the outer planks.

- 5.6.10 In spite of uncertainties and possible differences in the dating of the construction of the two ships, and the apparent absence of furring in the Denge Quarry wreck, the overarching similarities are remarkable and likely evidence of a common approach in the design, material procurement, direction and execution of the work for these two vessels.
- 5.6.11 As indicated by Auer (Auer *et al.* 2014), the characteristics of these (now two) ships present a challenge to our understanding of early modern shipbuilding in England because there is minimal resemblance between these and the other English wrecks of the period.

Evidence of possible modifications

- 5.6.12 As said above, the presence of timber from two different phases introduces complexity to dating the ship. The fact that the second phase of felling can be associated with the filler timbers raises questions as to whether these could have been added at a later stage(s), during a possible modification(s) of the ship, or if these were already included in the original build, thus dating the construction of the ship to after 1561. Therefore, understanding whether further evidence support the hypothesis of later modifications of the ship is critical.
- 5.6.13 As mentioned earlier, the concavity at the lower aft edge of the post [106] of section (5007), might suggest an alteration from the original shape of the stern. Similarly, it seems that the layer of 'original' planking might have been deliberately dubbed back and packed with setwork to fill out the surface to allow the extension of the lowest hull planking beyond what was originally intended.
- 5.6.14 Therefore, the addition of an extra, unusually curved, keel section could be part of a modification or re-adaptation of parts that changed the original shape of the sternpost assembly and altered the length of the vessel of 1.5 m or 2 m.
- 5.6.15 This could be consistent with the gaps in the original framing pattern observed in the larger section amidships and possibly the area of weakness in the outer planking, along with the use of a larger board for plank [130] in section (5006).
- 5.6.16 It is interesting to note that both the Denge Quarry wreck and the Gresham ship may have been rebuilt at some point during their life, perhaps to correct flaws in the original design.
- 5.6.17 The lengthening and modification for ships in this period, particularly English ships, is well-documented from written and, to a lesser extent, archaeological sources and appears to have been a rather common practice in the second half of the 16th century. It is relevant to note that, Sir Henry Manwaring, in his work "The Sea-man's Dictionary", written in 1623 while he was Lieutenant of Dover Castle, explains that when ships encountered difficulties in steering effectively, they were often either lengthened aft or had a false post added.

5.7 Loss and wreck formation process

- 5.7.1 The exact cause of loss is unknown and there are no signs of significant unseaworthiness or damage to the outer hull in the recovered sections of the wreck. Unfortunately, the wider surroundings of the wreck site could not be examined.
- 5.7.2 The wreck formation process is not clear. The reported location and the geomorphological studies seem to indicate that it was a beach front of a shingle beach. However, the quick burial in soft, protective silt within a small creek or lagoon would best explain the excellent preservation of timbers.
- 5.7.3 The wreck could have sunk accidentally, for instance during a storm, left to decay over a period of time with the starboard side collapsing and then covered in the following years by the progression of the shingle beach.
- 5.7.4 The extremely limited number of finds seems to point towards an abandonment of the wreck, possibly left to decay as a hulk, but the evidence is too scarce to draw any firm conclusions at this stage and presence of further archaeological material on the quarry lakebed cannot be excluded. Additionally, the wreck could have been salvaged after being wrecked, as possibly evidenced by the hacked upper extremity of the stern post, meaning that it was stripped of all fittings and possibly used as a source of wood.
- 5.7.5 The loss or abandonment of the wreck cannot be related to a specific date, although the wrecking occurred in the years after 1561 at the earliest.
- 5.7.6 Limited information is available regarding the duration of the ship's service before its eventual wreck. Although the amount of deterioration is difficult to quantify and its correlation with time is not straightforward, it is noted that the outer planks exhibit some signs of wear, with some bioturbation on small areas (e.g., plank [065] and garboards) but these appear to be localised and not extensive. Notably, the amount of damage that can be associated with teredo is negligible. This does not necessarily indicate a lack of seagoing activity, as little is known about teredo's origins, spread, and infestation of early modern ships in Northern European waters. However, it could be argued that it is unlikely that the ship frequently travelled to warm tropical seas where teredo infestation could have been more prevalent. Repairs are present albeit rather limited in number, and some of them could only have been applied before the insertion of the filling frames.
- 5.7.7 The tightness of the seams between the planks and the use of setwork (with no evidence of replacement with battens, driven caulking or sheathing) could suggest that the wreck had been in use only for a limited time when it was abandoned. The very limited wear and decay recorded would support this hypothesis. Therefore, a loss long after the late 1560s or 1570s, assuming a building date or refitting in the early 1560s, might be unlikely.
- 5.7.8 Speculatively, on the basis of the very tentative estimate of the size of the tonnage of the ship and the probable shipyard of origin of the ship, it is possible that the vessel might have been based in London or one of the other larger ports in East England where the large majority of merchant ships with a tonnage between 150 and 200 seem to have been based in the 1570s, as illustrated by the Colshill survey on shipping of 1572 (Calendar of State Papers, Domestic Series, Queen Elizabeth, addenda, Volume 22: Undated 1572).
- 5.7.9 There is no particular evidence of the type of cargo that this vessel might have been transporting or whether it was armed or not. Speculatively, if the vessel was built in the area around the Thames Estuary, it would have been lost or left to decay in an area close to where it was built and perhaps near its home port.

- 5.7.10 The environmental evidence seems to suggest that the vessel could have been used in both local and foreign trade. Vessels involved in coasting trade were largely used to transport coal, agricultural products (grain, dairy produce), fish, iron, timber and other naval products such as pitch and tar (Williams 1988). Some of these products can be identified within the Denge Quarry wreck (e.g., cereals), although there are also items which clearly point more towards foreign trade potentially as far as the Iberian Peninsula and the Mediterranean Sea (e.g., figs, pomegranates). Dried fruits and nuts regularly feature in customs records for the 15th and 16th centuries, and some of the major imports included prunes, raisins, currants, figs, dates and almonds amongst others (Stone 1949; Wilan 1959; Williams 1988). Trade in other fruits was more limited, although pomegranates are known to have been imported from Spain in this period, sometimes being referred to as 'pound-garnets' because of their jewel-like appearance (Gras 1918; Soden 2024). Pomegranates are rarely recorded in archaeobotanical assemblages in northern Europe, although they were present in the Newport Ship (Carruthers 2013). Currants, raisins and figs from Spain were also particularly prized in England in this period (Stone 1949; Soden 2014). Some dried fruits, nuts and spices were acquired from ports along the Atlantic or Mediterranean coasts, although they were also obtained through trade with secondary ports. In particular, Antwerp was a major entrepôt of world trade in the middle of the 16th century, and many vessels trading with ports in southern England would stop at Antwerp on their outbound or return journeys (Stone 1949). Some of the fruits and nuts recorded in the Denge Quarry wreck were not necessarily acquired through foreign trade. Orchards had become well-established in southern England by the 16th century, and these contained plums, damsons, walnuts, hazelnuts and other fruits which were not recorded in the Denge Quarry wreck such as pears and apples (Barnes and Williamson 2022; Mate 2006). The absence of exotic spices such as cloves, pepper, nutmeg, mace, ginger, cinnamon and others that are well-known to have been regularly imported into England throughout the 15th and 16th centuries is notable.
- 5.7.11 Overall, the hypothesis that the wreck might represent the remains of a salvaged ship, left to deteriorate seems plausible. And there is some limited evidence to support this as suggested by the possible hacked upper extremity of the sternpost. The presence of active wreckers would not be unusual for the area as hinted by the documentary sources. For example, this was the destiny in 1589 of a ship called the *Threasurer of Aalborg*, which went ashore at Dungeness and was plundered by wreckers: 'the inhabitants there coming aboard the said ship under colour to yield assistance fell a-spoiling and hewing the ship.' (Acts of the Privy Council 1589-90, 15 September 1589). Finally, the proximity of the shipwreck to the fishing cabins depicted in 16th-century charts lends support the possibility of accidental or deliberate grounding followed by salvage efforts following the loss.
- 5.7.12 Overall, given the excellent state of preservation of the timbers, as detailed in the wood conservation assessment (Appendix 8), it seems likely that the wreck might have been quickly buried and encased after deposition, allowing for minimal deterioration while still permitting some access before full burial, as evidenced by the sternpost being hacked, presumably *in situ*, in antiquity.
- 5.7.13 The initial lighthouse at Dungeness, reported to have been constructed in August 1615, might have diminished the number of shipwrecks but it was clearly not enough because, as the shingle banks expanded, the lighthouse found itself too distant from the coast. Consequently, a second lighthouse, constructed from brick, was erected around 1635 (Carpenter 1996).

5.8 Identification and documentary record

- 5.8.1 The research into the possible candidates for the identification of the wreck and into the available documentary sources was principally conducted by Serena Cant and Dr. Gillian Draper. For a full list of the sources consulted and a wider discussion of the candidates their work in Appendices 6 and 7 should be consulted.
- 5.8.2 Despite the inability to conclusively identify the remains of the wreck, research in documentary sources revealed some potential candidates.
- 5.8.3 The research was helped in some way by the fact that, due to its prominence as shipping hazard, the identity of Dungeness as distinct geographical feature was established early, along with those of the individual Cinque Ports. Therefore, it appears that there is a strong sense of location confidence in reporting wrecks in the documentary records.
- 5.8.4 The *Greyhound*, lost on the Bar of Rye in April 1563, during its return journey from Le Havre, emerges as a potential candidate for identification. The vessel played a role in the Newhaven Expedition of 1562-3, with victualling records hinting at its involvement in provisioning Le Havre (TNA E 351/2360).
- 5.8.5 An early depiction of the ship is illustrated in the Anthony Roll (Roll, no. 32) and the midship mould is depicted in Mathew Baker's *Fragments* in folio 13, which is also attributed to the *Hart*, *Bull*, and *Tiger* (Barker 1985).
- 5.8.6 The *Greyhound* was built as a galleass of around 180 tons, built for Henry VIII with other three other galleasses, the similarly sized *Bull* and *Tiger* and the slightly larger *Hart*. The date of their construction is around 1545-1546, probably at the Royal Dockyard of Deptford, along the Thames, and then rebuilt around 1558.
- 5.8.7 During its active service, the *Greyhound* was involved in several significant events. Notably, it participated in an engagement with the French off Shoreham-by-Sea on the Channel coast in August 1545, shortly after the loss of the *Mary Rose* the previous July. The ship also played a role in the 'Rough Wooing' during the Anglo-Scottish Wars from 1543 to 1551. In July 1553, it took part in the blockade of Yarmouth amid the political struggle between the supporters of Lady Jane Grey and Mary I. Additionally, the *Greyhound* contributed to the Kirkwall campaign in Orkney in 1557. Following a rebuild around 1558, the vessel participated in the Leith campaign in 1560 and then was lost off the coast of Rye, along with most of her 120-man crew and the captain John Malyn (Bodl. MS Rawlinson A.200, ff.330v, 334, 340 (1 January 1562-31 December 1563)).
- 5.8.8 After the loss of the vessel, extensive salvage efforts are mentioned in a contemporary account, focusing on saving the ordinance, ammunition, tackle, and apparel. This suggests that the ship might have been lost reasonably close to the shoreline and although the *Greyhound* vanishes from historical records afterward, it aligns with the type of vessel that might have been subject to attempts at hull salvage in this zone (TNA E 351/2199). However, it is more plausible that the efforts would have been directed towards bringing it ashore locally in Rye, rather than navigating it to the Denge Quarry area across Dungeness.
- 5.8.9 The *Greyhound*'s characteristics are somewhat consistent with those recorded with the Denge Quarry site. The suggested place of build at Deptford is consistent with timbers sourced from Essex, Kent and London and the build details also fit fairly closely with the dendrochronological results but are not a perfect match. The date of initial construction fits very well with the initial chronological match for the timbers, 1534-47 but the later

chronology of rebuild fits more loosely with the dendrochronological evidence: as the ship involvement in action in 1560 and loss in 1562/3 seems to be difficult to reconcile with a timber sourced in the spring of 1561, unless the timber was used in haste while still green.

- 5.8.10 Despite the alignment of its size, construction date, and potential place of origin with the dendrochronological results and other ship construction details that push it forward as a tantalizing candidate, no conclusive evidence was established. Furthermore, the reference to Rye Bar in 1563 seemingly excludes the *Greyhound* as a viable candidate as, considering the backdrop of the general location confidence in relation to the Cinque Ports, this is more likely to be reference to a location just outside Rye.
- 5.8.11 Another possibility is listed in the entry of the Calendar of State Papers for the year 1563. On 30 June, a ship of London, laden with beer, is mentioned as run shore near the Camber, probably as result of a recent storm (Calendar of State Papers Domestic: Edward VI, Mary and Elizabeth, 1547-80).
- 5.8.12 Another wreck is hinted by short letter dated 4 November 1570 from Lord Cobham, Warden of Cinque Ports, to the Jurats of Lydd, that reports that bearers had arrived to claim part of the goods wrecked at the Nesse. This aligns well with the available evidence in terms of location and date. However, there are no further details of the ship itself. The bearers were carrying bills of lading, which were likely used as evidence of ownership in deciding rights in relation to salvaged goods (Murray 1935, 126). There are several records of the Lord Warden making agreements with the jurats of Lydd that he would receive one-third of wrecked goods. For example, it was noted at a Brotherhood (Cinque Port confederation court) in 1560 that '*the Lord Warden shall enjoy the third part of all wrecks and findals saving that 'Wee shalbe free of Wreck of oure owne Goodes*' (Hull 1905, 281-82). Thus, the Portsmen were clear that this one-third entitlement applied only to the wrecks of ships which did not belong to men of the Ports. If Lord Warden Cobham was claiming right of wreck of 1570 as Warden or on behalf of the owner of the consigned goods, the ship must have belonged to non-Portsmen and possibly the Warden himself.
- 5.8.13 For the last quarter of the 16th century, there are three more recorded losses that could be potential candidates: one of a Dutch cargo vessel with an unknown, but considerable, cargo lost 'near Romney' in 1578, and a Danish cargo vessel which stranded at Dungeness in 1589. Both of comparable date, they can be excluded as candidates on the grounds of nationality, but well illustrate how locations of loss are cited in contemporary accounts. The third one is sailing ship ('*a wrack of sugar*') that was apparently wrecked at Broomhill in c.1590. However, Broomhill appears to be too far west for an identification with the Denge quarry shipwreck.
- 5.8.14 The *Red Lion*, wrecked 1592, has been suggested as a possible contender. Although recorded as lost on the Goodwin Sands, some distance away, reference was made to the goods which were held by the savers of Lydd, Romney. Additionally, the wreck was noted to 'belong' to London. However overall, the evidence is rather limited at the current stage of the research, and should be approached with caution.
- 5.8.15 In the early 17th century, at least two wrecks are recorded in the area: a 'bark' laden with Caen stone that sunk '*between Lydd and Rye*' in 1616, and a Dutch ship carrying silver, lost '*near the new lighthouse*' at Dungeness in November 1619, near Lydd. There are only brief details of this, mainly entailed with a question over the right of wreck: '*whether the right to some bars of silver, taken up from a wreck*' ... *that if the Judges think it unlawful, the counsel of the town of Lydd may be heard* (Calendar of State Papers Domestic: James I, 1619-23, volume 111). The Dutch ship can probably be excluded on the

grounds of nationality. The lack of recorded nationality for the bark transporting Caen stone suggests that there may not have been a perceived necessity to document it at the time, potentially defaulting the vessel to English. This interpretation gains partial support from the consistent export of Caen stone to England and its frequent use in the English built environment, implying the likely involvement of English ships in some aspects of this trade. Unfortunately, no evidence of Caen stone (a light, creamy yellow Jurassic limestone quarried in north-western France) was recovered from Denge Quarry, and the stone that was recovered was a granite, however it is possible that the cargo was salvaged at the time of wrecking.

5.9 Conclusion

- 5.9.1 This phase of the project has created a comprehensive record of all components that were recovered at Cemex's Denge Quarry, and the study of the timbers suggests that the ship was built not earlier than the mid-1530s, potentially modified as late as after 1561/2, with wood from East and South-East England.
- 5.9.2 However, in light of the dating evidence and certain carpentry details, it remains uncertain whether the hull was originally constructed using at least some stockpiled timbers and subsequently reshaped a short time later—possibly within a few months to about two years—during the late 1560s or 1570s.
- 5.9.3 The ship's construction details show striking resemblance to the Gresham wreck, indicating that they might have been built in the same area by similarly trained shipwrights and hinting that the solutions found in the Gresham ship were not unique but potentially indicative of a regional tradition of shipbuilding which existed alongside and adopted the increasingly dominant foreign paradigm of carvel shipbuilding possibly mediated through the lessons of the English Master shipwrights.
- 5.9.4 In fact, at the net of the current evidence, the so called '*English*' method of ship construction cannot be strictly defined from the archaeological record, probably because it was not homogeneous, but also because of lack of archaeological data. Therefore, this work is significant in contributing to the limited corpus of detailed archaeological studies from this foundational period for English shipbuilding, and it is hoped that it will form the basis for further work.

Statement of significance

- 5.9.5 The Denge Quarry wreck holds significance in the study of ship design and construction during a historical period where little documentary and archaeological evidence has survived.
- 5.9.6 Although not the sole English shipwreck from this era, it contributes to an expanding corpus of wrecks, including the Gresham ship (c. 1574), the Alderney wreck (16th century), *Sea Venture* (lost 1609), *Warwick* (lost 1619) (Adams 2013). What sets the Denge Quarry wreck apart is its inclusion in a small group of English ship finds whose extent survives to a meaningful extent and that have been meticulously documented using accurate 3D methods.
- 5.9.7 Within the period from the early to late 16th century found in England, the preserved remains of the Denge Quarry wreck holds a significance that can be broadly grouped with other notable nationally important wrecks, such as the *Mary Rose* (lost 1545), Gresham Ship (c. 1574), wrecks likely from the Mediterranean such as the Catterwater Wreck (early

16th century) and Yarmouth Roads Wreck (late 16th to early 17th century), the likely Iberian Studland Bay wreck (lost c. 1525), and the later Tankerton Bay wreck (c. 1590).

Limitation and challenges: discovery of additional wreck material

- 5.9.8 Significantly, while working on site, Cemex staff reported that an additional substantial portion of the outer hull of a wreck had been found at a different location, reportedly c. 350 m north from the position where the material discussed in this report was recovered. A video that was made available to the archaeologist on site shows a large portion of outer hull slipping off the dredger bucket falling back in the water as it was being brought out on the pontoon. It is unclear whether this is part of the same wreck or not, although there are similarities in the type of construction and size. This approximately 2 by 3 m section of hull is carvel-built, with an internal lining of four thick ceiling planks, ten frame timbers and at least one outer plank. The ceiling planks show vertical scarfs and are fastened with treenails to the regularly and closely spaced frame timbers. At least two of the frame timbers, possibly the first and second futtock, sit side by side and are connected across with treenails that run in the fore and aft direction. The coordinates obtained from the staff for the location where this section was found and dropped are 50° 56.402' N 0° 57.950' E.
- 5.9.9 Due to budget constraints and the operational schedule of the wharf, it was not feasible to arrange a geophysical survey or a diving operation to locate potential additional remains left *in situ* and those additional dropped during the recovery. A one-day ROV (Remotely Operated Vehicle) survey was attempted, but the results were regrettably compromised by the poor visibility that followed the commencement of the quarry infilling. Therefore, the presence and extent of the material and whether there are more wrecks that are still potentially at the bottom of the quarry is not known.
- 5.9.10 In terms of number of vessels whose remains might be still at the bottom of the quarry, it could be argued these might include a section comprising remnants of the keel and possibly part of the port side of the wreck covered in this assessment (Denge wreck 1), the second largely undocumented carvel-built vessel just discussed above (Denge wreck 2), a wreck of a clinker vessel represented by the joggled floor [022] (Denge wreck 3), and another carvel vessel with a dead flat floor midships from which timber [028] was derived (Denge wreck 4). Although it is possible that timber [028] could have been part of heavily built section dropped back in the water without recording (Denge wreck 2).
- 5.9.11 Although the objectives of the investigation were achieved, it must be pointed out that due to the limited budget and timescale of the operation, the thorough cleaning of timbers and the comprehensive recording of subtle features such as impressions, tool marks and nail holes directions and depths as well as the quality assurance of some aspect of post-recording individual timbers, were more time-restricted than preferred.

5.10 Recommendations for further work

Further analyses

- 5.10.1 A thorough study of the fasteners would complete the documentation of the wreck, helping to clarify the construction sequence and potentially offering additional evidence of modifications made to the hull shape over time. It could also assist in identifying the placement of possible elements used for longitudinal control.
- 5.10.2 An attempt to reconstruct the variety of parent trees used to build the vessel, similarly to the approach taken for the Mary Rose (Marsden, 2009), could be undertaken, to gain insight into how woodland resource management evolved during the late Tudor period.

- 5.10.3 Another potential area of investigation could be the logistics of the construction process, focusing on determining the minimum size of the building team required and estimating the labour investment involved. Experimental work and practical historical sources can provide insights into this, at least for the lower hull of the main Denge Quarry vessel.

Digital reconstructions

- 5.10.4 With the timbers duly reburied and recorded, the digital 3D data can now enable detailed accurate reassembly of the surviving elements, as well as to digitally model missing elements to aid in hypothetical reconstructions and develop line plans.
- 5.10.5 This would provide empirical support for validating and illustrate the proposed construction sequence and the proposed spatial arrangement of the structural components as a way to use 3D data to explore and verify the hypothesis presented in this report.
- 5.10.6 The digital reconstruction should be analysed and interpreted in the context of contemporary shipbuilding treaties in an attempt to identify the architectural concepts and geometrical approaches that might underlie the design of the ship. The concluding stage of the digital reconstruction phase would entail utilising naval architecture software for precise calculations of factors such as the centre of gravity and overall weight.
- 5.10.7 In the discussions of early modern European shipbuilding, the design of the master frame is recognized as a key topic. It has been suggested that the master frames of English vessels from this period might have been based on an arc-based concept. Given the precise geometric data obtained from this wreck, once a reliable model is developed, it would be valuable to investigate the master frame design further by identifying potential geometric techniques and deriving the arcs and construction principles that may have been employed to shape the hull.

Comparison with the Gresham ship

- 5.10.8 A more rigorous comparison with the Gresham ship, taking into account carpentry details, shape, and modifications, should be undertaken—particularly to investigate the possibility that these two vessels represent a new local shipbuilding tradition.
- 5.10.9 Conducting a comparative study of the dendrochronological data from both the Denge Quarry wreck and the Gresham ship would be valuable, particularly given the accessibility of this data. This analysis could seek to identify potential similarities in the parent trees, shedding light on shared practices in sourcing and managing woodland resources for ship construction, as well as examining how these practices compare to timber procurement within Royal shipyards.
- 5.10.10 In the process of establishing a baseline dataset through the analyses of the waterproofing material, the long-term goal would be to eventually retrieve samples from the timbers of the Gresham ship, currently situated in a private lake, and conduct comparative analysis between the two datasets in the hope that the indicators present in the caulking could help either establishing or ruling out shared practices between the two wrecks.

5.11 Archive

- 5.11.1 The digital archive will be deposited with the Archaeology Data Service (ADS), which is a Trusted Digital Repository with Core Trust Seal. In order to create a high quality, sustainable, concise and easily intelligible archive, all data has gone a process of selection prior to deposition.

5.11.2 The site digital archive includes the following:

PROJECT NAME:	Denge Quarry Shipwreck Timbers Post-Excavation		
Description:	Photogrammetric recording and 3D modelling of timbers from the Denge Quarry Shipwreck recording project at Lydd, Kent.		
Project Identifiers:			
Primary Depositor Contact:	Thomas Burt, Archives Officer, Wessex Archaeology t.burt@wessexarch.co.uk		
Estimated Deposition	2025		
Indicative File Estimates:			
File	Estimated Count	File	Approx. File Size (Estimate)
DOCUMENTS - pdf	20		500 MB
DOCUMENTS - docx	2		0.02MB
PHOTOGRAMMETRY – component raster images jpg	1670		12.5 GB
PHOTOGRAMMETRY – photogrammetry models obj + mtl + texture jpg	12		1.0 GB
PHOTOGRAMMETRY – photogrammetry model processing reports pdf	12		25 MB
3D scanner models – models obj + mtl + texture jpg	150		2 GB
RASTER IMAGES – site photographs and report images	1500		12 GB
	TOTAL		28 GB (Approx.)

5.11.3 Wessex Archaeology will hold the complete digital archive including all the raw scans, the 3D data obtained by scanning and postprocessing.

5.11.4 The physical archive will be transferred to Rye Castle Museum. Copies of files forming part of the digital archive will also be transferred to the Museum on request.

5.11.5 The physical archive comprises the following as minimum:

Obj No	Material	Object type
7002	Leather	Shoe trim
7003	Bone	Animal rib
7007	Wood	Plate
7009	Leather	Small strand
7010	Pottery	Raeren stoneware fragment

5.11.6 The grey literature report was made available via OASIS and supplied directly to the Kent Historic Environment Record (HER).

5.11.7 The KCC HER has created the following records as results of this project.

Name	HER Number
Denge Wreck 1	TR 01 NE 260
Denge Wreck 2	TR 01 NE 261
Reburial site	TR 01 NE 262



5.12 Dissemination

- 5.12.1 The project results have been disseminated through this grey literature report which will be uploaded to OASIS for deposition with the Archaeological Data Service (ADS). This will ensure that the work undertaken so far is readily accessible to researchers, specialists and the general public.
- 5.12.2 The shipwreck received media coverage on BBC Two's Digging for Britain, Season 10, Episode 1, which aired in 2023.
- 5.12.3 Preliminary findings were shared at the 2024 ISBSA conference, with an article accepted for the conference proceedings and currently awaiting publication. A popular article was published in the Kent Archaeological Society magazine (Croce 2025), and a peer-reviewed journal article is forthcoming, supported by funding from Historic England.

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6 APPENDICES

Appendix 1

1 GEOARCHAEOLOGICAL CONTEXT

1.1 Introduction

1.1.1 The following section provides a summary of the known geoarchaeological record for the Site of the Denge Quarry Shipwreck and its surrounding landscape.

1.1.2 Where age estimates are available for deposits, these are expressed in millions of years (Ma), thousands of years (Ka) and within the Holocene epoch as years Before Present (BP) with the corresponding Anno Domini (AD) date for historic periods. Where radiocarbon dates are included, the uncalibrated date (BP) is quoted followed by the calibrated date (cal. BP or cal. AD following the above format) date. These dates are supplemented where relevant with the comparable Marine Isotope Stage (MIS) where odd numbers indicate an interglacial period and even numbers a glacial period.

1.2 Solid Geology

1.2.1 The underlying bedrock is mapped by the British Geological Survey (BGS) as sandstones, siltstones and mudstones of the Hastings Beds, formed 134 –145 Ma during the Cretaceous Period.

1.3 Superficial Geology

1.3.1 The Site is located on the Dungeness Foreland along the southern and south-eastern shores of Romney Marsh. The BGS map the superficial deposits here as Storm Beach Deposits – Gravel, forming an area of exposed shingle.

1.3.2 In this part of the Dungeness Foreland, the sedimentary sequence often comprises nearshore sands overlain by gravels of the prograding shingle barrier of the Foreland. In places the barrier is interrupted by a series of natural depressions infilled with fine-grained and locally organic sediment representing tidal inlets and brackish lagoons.

1.3.3 The area of the Site has been well studied as part of the Holocene evolution of Romney Marsh and the Dungeness Foreland, including an Aggregate Levy Sustainability Fund (ALSF) study focusing on barrier dynamics and marshland evolution (Long *et al.* 2007). The barrier complex also forms the basis of extensive research by Long *et al.* (2006), Roberts and Plater (2007) and Plater *et al.* (2009).

1.3.4 The results of this research provide an important geomorphological context for the Site. The current shingle barrier of the Dungeness Foreland overlies a series of older beach ridges that formed part of a more extensive coastal barrier extending from Fairlight Head in the west (c. 20 km to the southwest) to Hythe in the east (c. 16 km to the northeast).

Pre-barrier development

1.3.5 The gravel barrier of the Dungeness Foreland is underlain by a sequence of nearshore sands that are >10 m thick at Jury's Gap and with a surface elevation of around -2 m OD (Long *et al.* 2006). Optically Stimulated Luminescence (OSL) dating of these nearshore sands demonstrates that they are of a progressively more recent date from west to east as the barrier developed under the influence of eastward longshore drift.

1.3.6 Between Jury's Gap and the Wicks the nearshore sands have been dated to between approximately 4650 ± 200 BP to 3580 ± 180 BP, compared to Dungeness Power Station

(c. 2.5 km to the south of the Site) where the sands date to 650 ± 40 BP and 560 ± 30 BP (Long *et al.* 2007).

Gravel barrier development

- 1.3.7 Plater *et al.* (2009) describe the origin of Dungeness Foreland as arising from emergence of the shoreface as a consequence of nearshore sediment accretion, potentially coupled with a fall in relative sea-level and/or a reduction in accommodation space, this emergent substrate then enabling the establishment of an early bay-barrier. OSL dates place the early formation of the barrier to approximately 5000 BP (Long *et al.* 2007). The development of the shingle gravel barrier continued through the longshore movement of offshore derived gravels and erosion of the Cretaceous chalk cliffs and associated Pleistocene deposits (Long *et al.* 1995).
- 1.3.8 The development of the foreland follows an evolutionary sequence of shoreface emergence followed by eastward barrier extension and back-barrier infilling, with the chronology of this emergence and progradation now well-constrained by OSL and ^{14}C age data to between about 5000 and 1000 years ago (Roberts and Plater 2005; Plater *et al.* 2009).
- 1.3.9 Early Holocene sea-level rise also resulted in the drowning, breakdown and retreat of the former barrier systems, with the sediment recycled into the subsequent barrier systems including the Dungeness Foreland (Mellett *et al.* 2012). The barrier currently has a surface relief of +3 m to +4 m between Jury's Gap and South Brooks, with a depth of gravels of up to 6 m+.
- 1.3.10 The gravel barrier gradually prograded eastward, creating a huge tidal lagoon landward and leading to the establishment of tidal mudflats and saltmarsh across Romney Marsh; these were subsequently replaced by freshwater peats which had begun to form within the adjacent river valleys from c. 6800 cal. BP. The eastward progradation of the foreland during the mid- to late Holocene is evident in the present morphology of the area, characterised by a series of up to 700 gravel beach ridges (Plater *et al.* 2009).
- 1.3.11 Marine influence gradually increased from 3000 cal. BP with the development of large tidal inlets at Rye, Romney and Hyde, with freshwater peats succeeded by marine-dominated tidal flats and saltmarsh across Romney Marsh, punctuated by localised survival of raised mire (e.g. Walland Mire) into the medieval period.
- 1.3.12 Plater *et al.* (2009) demonstrate evidence for two periods of enhanced growth of the foreland in response to storm-driven barrier breaching, the earlier of which spans the period 2000-1300 years ago with a second phase of extension around 1300-500 years ago, the latter forming the present ness and an adjacent back-barrier embayment.

Inter-ridge depressions

- 1.3.13 The last two thousand years are marked by a close interaction between the barrier development and back barrier environment within Romney Marsh. The opening of a series of tidal inlets through the barrier led to phases of increased flooding and sediment supply into the marsh, followed by subsequent narrowing and closure of these inlets.
- 1.3.14 These former inlets through the barrier are apparent today as a series of inter-ridge depressions. The connection between these depressions (gravel lows) and the sea is still open to debate, as it is unclear whether marshes were located behind the gravel foreland, were open to the east, or were infilling inter-ridge lows open directly to tidal ingress from the south.

- 1.3.15 The chronology of these post-gravel deposits is unclear due to a lack of radiocarbon dating, although palaeomagnetic dating (Plater *et al.* 2006) suggests that these deposits accumulated between 1050-550 BP (AD 900–1400).
- 1.3.16 The deposits encountered at South Brooks are likely to be later than those to the west, reflecting the rapid eastward progradation of the gravel barrier from 2000 years ago. Palaeomagnetic dating of deposits from South Brooks suggests sediment deposition around 925–575 BP (AD 1025–1375), with foraminiferal analysis showing a sequence of tidal and brackish environments (Plater *et al.* 2006).

1.4 Sequence and age of deposits in the area of the wreck

- 1.4.1 The Denge Quarry shipwreck is located towards the east of Dungeness Foreland, broadly equidistant between Greatstone and Dungeness. Palaeogeographic modelling by Long *et al.* (2006) shows the contemporary coastline in AD 1400 approximately 100 m west of the present-day coastline, at a location broadly similar to that of the wreck.
- 1.4.2 Roberts and Plater (2007) undertook OSL dating of a borehole (BH9) located approximately 150 m west of the Site, the OSL dating here demonstrating that the shoreface sands (underlying the gravels) at a depth of 4.85 m below ground level (bgl) were dated to AD 950 $\pm$ 50 (1050 $\pm$ 50 years before AD 2000).
- 1.4.3 Approximately 100 m north of here in BH10, the sands were dated to AD 1020 $\pm$ 40, demonstrating the trend to younger ages northwards from Dungeness towards Greatstone (Plater *et al.* 2009). On the basis of these dates and the subsequent modelling of the development of the foreland, Plater *et al.* (2009) emphasise that their observations are consistent with the model proposed by Lewis (1932) of enhanced easterly growth of the gravel barrier during the post-Roman era, and a switch to more northerly accretion from Saxon times.
- 1.4.4 Plater *et al.* (2009) undertook palaeomagnetic secular variation (PSV) dating on fine-grained deposits in a borehole at Boulderwall Farm, located on the eastern edge of Denge Marsh c. 250 m west of the Site. These sediments, largely comprising sandy clays and silts, are considered to have formed within a sheltered back-barrier environment following foreland progradation, initially as a result of tidal deposition in deep water (with tidal ingress from the south shore of Dungeness) followed by marshland sedimentation (Plater *et al.* 2009). At Boulderwall Farm these deposits were dated to AD 1400 $\pm$ 25 to AD 1500 $\pm$ 25, occurring during a broader period of rapid marsh sedimentation between 1100 and 500 years ago (Plater *et al.* 2009).
- 1.4.5 Ground Investigation (GI) was undertaken by CEMEX UK in the area of Denge Quarry, including 10 boreholes located in the general area the wreck (**Table 1**). These boreholes demonstrate a consistent sequence of sands overlain by sandy gravel and gravel, with the surface of the sub-gravel sands falling from c. -2 m OD in the north to c. -5 m OD in the south (**Figure 1**).
- 1.4.6 The sub-gravel sands, in places shell-rich, clayey and in one sequence (W20) described as 'organic' (containing fine roots and seeds) are interpreted as shoreface sands and equivalent to those OSL dated by Plater *et al.* (2009) in BH9. There is no evidence in the GI logs for back-barrier deposits such as those identified at Boulderwall Farm by Plater *et al.* (2009).

- 1.4.7 The gravels here are recorded to depths of between c. 7.5 and 10.0 m bgl. On the basis that the wreck was recorded at an approximate depth of 5 m below the water level of the quarry, it is possible that the wreck was preserved either towards the base of the gravels or on the shoreface sands.
- 1.4.8 These deposits, and the likely age of the vessel (16th century), are consistent with the wreck having been beached on either the shoreface sands or the gravels in a seaward-facing setting, and subsequently preserved within or below the deposits of an eastward/northward prograding gravel barrier.
- 1.4.9 Although a specific elevation for the wreck and date for the deposits in which it was preserved are not available, on the basis of the age of the vessel and palaeolandscape modelling, it seems more likely that the wreck was beached on the gravels during a storm prior to eastward/northward progradation of the gravel barrier over the wreck.

Table 1 GI boreholes undertaken by CEMEX UK

Name	Easting	Northing	Elevation (m OD)	Total depth (m)
W15	608320.30	120362.43	5.43	9.50
W16	608115.93	120322.70	5.43	10.00
W17	608107.29	120086.05	5.42	9.00
W18	608203.14	119894.50	5.55	9.25
W19	608295.71	119709.11	5.55	11.00
W20	608385.88	119534.59	5.46	11.15
W21	608468.94	119307.06	5.22	13.00
W23	608662.58	119581.58	5.76	11.00
W24	608529.86	120006.82	5.34	9.60
W25	608481.41	120211.77	6.81	9.60

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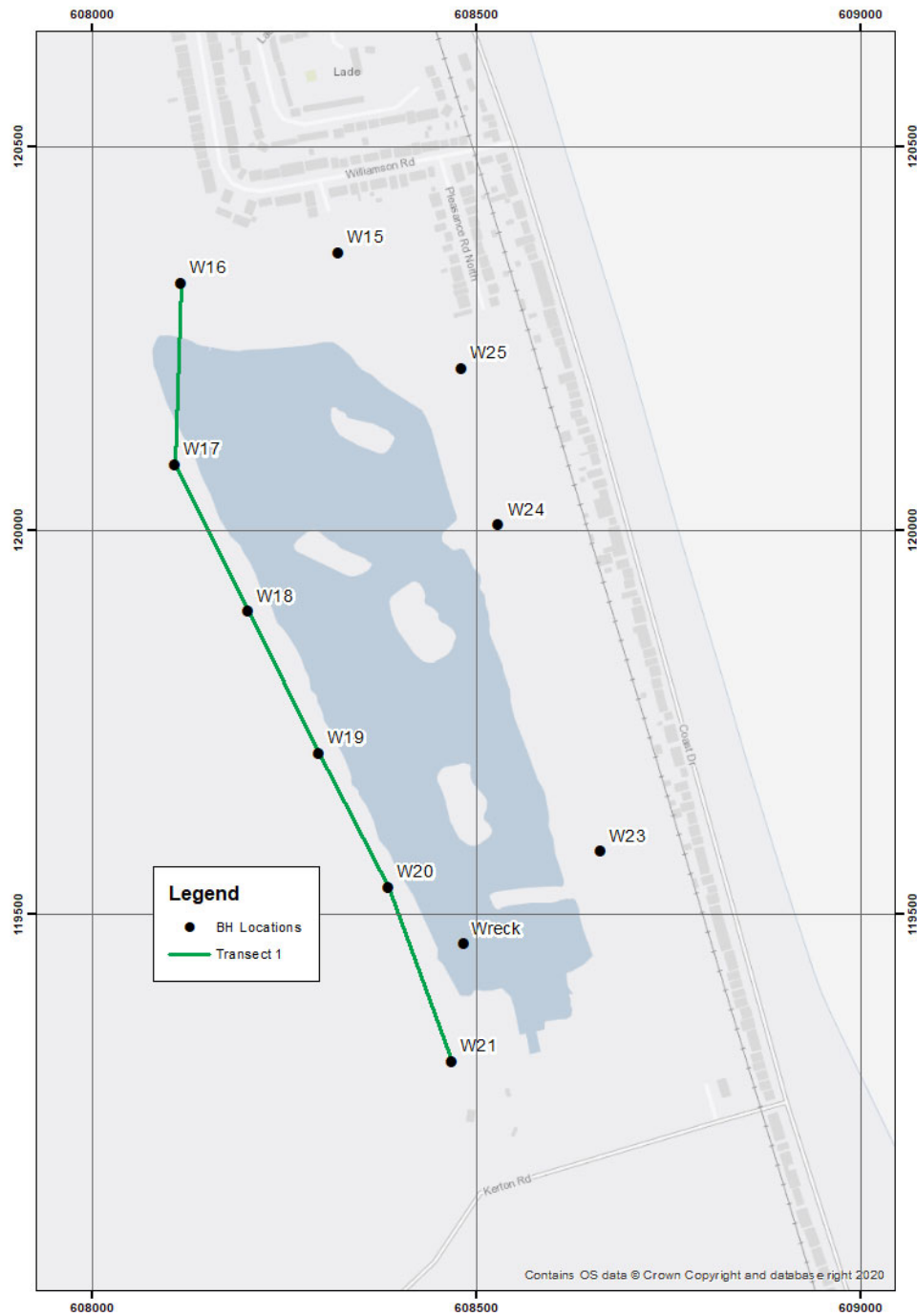


Figure 1 Location plan showing GI boreholes and location of the wreck

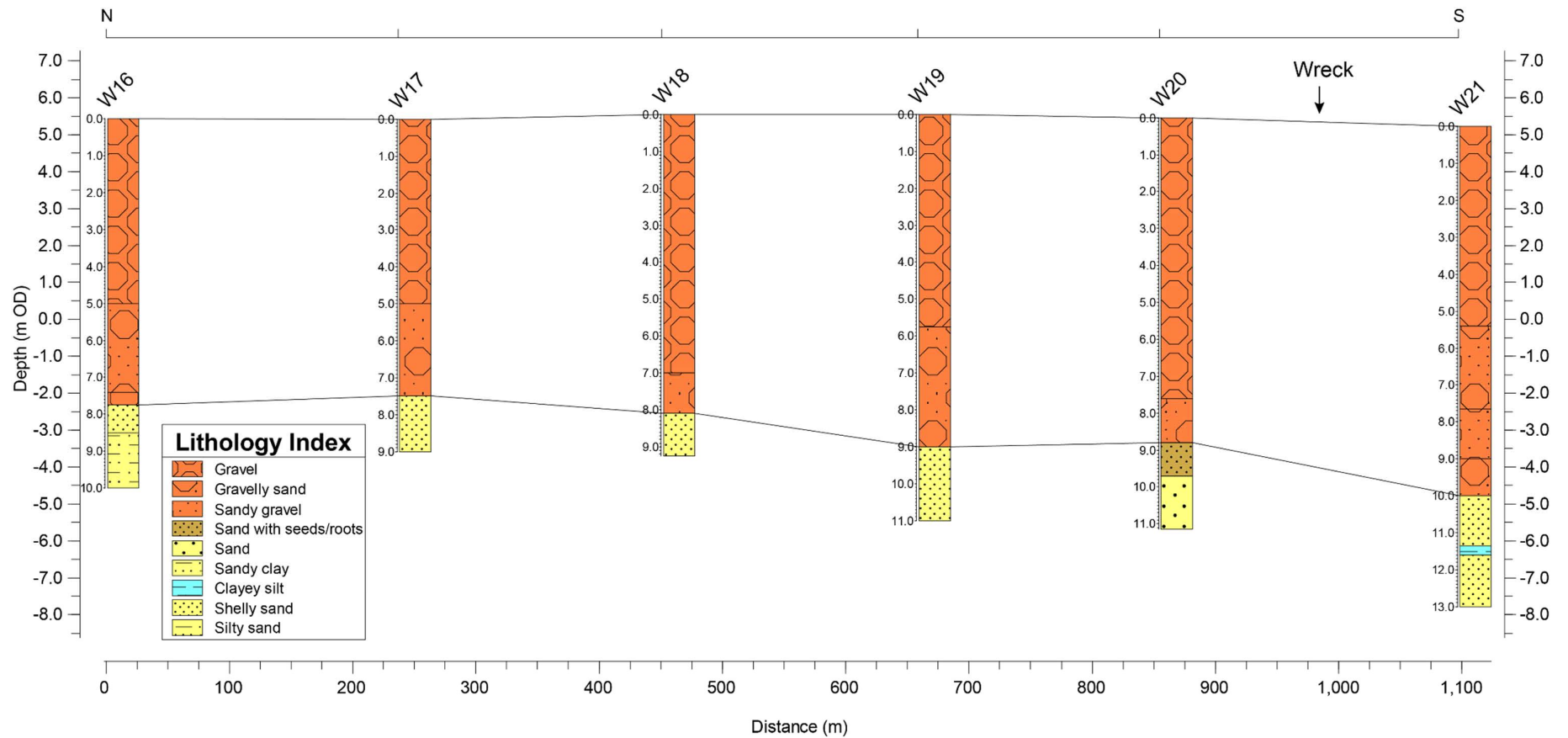


Figure 2 Transect of GI boreholes in the area of the wreck



Appendix 2

1 ENVIRONMENTAL EVIDENCE FROM THE DENGES QUARRY WRECK: WOOD, PLANT MACROFOSSILS AND INSECTS

This report was written by Dr Ed Treasure, with contributions from Sander Aerts. The wood and plant macrofossil assessment and analysis were undertaken by Dr Ed Treasure. The insect analysis was undertaken by Sander Aerts. The samples were processed by Samantha Rogerson.

Ruth Pelling (Historic England) is thanked for helping to identify some of the plant remains, notably the pomegranate seeds, and for providing access to the Keyence VHX7000 3-D digital microscope (AHRC Award AH/V011758/1) which used to photograph some of the remains.

Wessex Archaeology Project Code 264781

Summary

The analysis of waterlogged plant macrofossils and insects from the Denge Quarry wreck has provided valuable information on the vessel's history. Living conditions on board the vessel appear to have been unsanitary, and the lower sections of the hull probably contained accumulations of saline, organic-rich refuse. In particular, the bilge is likely to have contained sewage, food waste and spilled cargo, as well as the remnants of dunnage (or packaging materials). Analysis of the plant remains has revealed evidence for a diverse range of cultivated species, including cereals (rye, oats, broomcorn millet), fibre crops (flax, hemp), fruits/nuts (walnut, hazelnut, plum, fig, grape, pomegranate) and spices/flavourings (hops, dill, celery, mustard). Some of the cultivated species recorded can be clearly identified as imports (e.g., pomegranate), indicating that the vessel contains material which was acquired through trade with areas in Continental Europe.

1.1 Introduction

- 1.1.1 Five bulk samples were collected from the bilge and below the ceiling timbers of the vessel to determine if the deposits contained material associated with the historical use of the vessel (e.g., spilled cargo, dunnage or packaging materials, caulking, faecal waste etc.). In addition, a control sample was taken from the natural sediments surrounding the shipwreck for comparison. The samples collected are summarised in **Table 1**.

Table 1 Sample provenance summary

Context	Sample number	Sample vol. (l)	Comments
5004	101	10.5	ON 7003, sediment within hull
5004	102	5	ON 60, wood chips under timber
5004	108	0.5	ON 52 & ON 53, sample between planks
5004	109	0.5	ON 52 & ON 53, sample between planks
-	115	4	Sample of 'natural' sediment from quarry
5004	6001	0.5	Sediment within lower main section of hull

- 1.1.2 An initial assessment established that two of the samples (101, 102) contained well-preserved insect remains, wood fragments and plant macrofossils including cereal straw, chaff, imported fruits/nuts and other economic species which were associated with the historical use of the vessel. There were no remains of economic species in three other

samples from the vessel (108, 109, 6001), although these did contain large numbers of seeds from wild plants, probably reflecting the environment where the ship was wrecked.

1.2 Materials and methods

Plant macrofossils and wood

- 1.2.1 Two samples (101, 102) were fully analysed and quantified. An assessment was undertaken on the other samples to provide a broad characterisation of the assemblage as a whole.
- 1.2.2 The samples were processed manually using the wash-over method as outlined by Kenward *et al.* (1980), with the flot retained on a 0.25 mm mesh. Once processed, the residue was washed through a nested stack of sieves (5.6 mm, 0.25 mm). The coarse fractions of the residues (>5.6 mm) were dried and then sorted by eye to extract any artefactual and environmental remains. The flots and fine residue fractions were stored in glass vials containing water and they were kept wet during all phases of work, including subsampling, sorting and storage. All extracted remains were placed into cold storage to minimise deterioration of the remains, and to prevent fungal growth.
- 1.2.3 A stereomicroscope was used to examine the flots (40x magnification) for uncharred and charred plant macrofossils, vegetative remains, wood and other environmental remains (e.g., fish bone, insects etc.). Samples 101 and 102 produced very large flots which contained abundant fragments of wood. To assist with sorting, the flots were gently re-washed through a nested stack of sieves (9.5 mm, 5.6 mm, 4 mm, 2 mm, 1 mm, 0.5 mm and 0.25 mm sieves). Each sieve fraction was then sorted individually in a glass petri dish containing a small quantity of water, and all extracted remains were placed onto damp tissue paper for examination. A subsample (12.5%) of the 0.25 mm sieve fraction was examined from both samples. All of the remaining sieve fractions were sorted in their entirety (0.5–9.5 mm). The fine residue fractions were scanned alongside the flots. Following sorting, the residues were discarded.
- 1.2.4 The plant macrofossils were identified through comparison with modern reference material held by Wessex Archaeology and relevant literature (Cappers *et al.* 2006; Jacomet 2006). The remains were fully quantified where appropriate by counting the 'Minimum Number of Individuals' (MNI) through the use of diagnostic anatomical regions. All remains in the assessed samples were recorded semi-quantitatively on an abundance scale (**Table 2**). Selected wood fragments were identified through examination of the transverse, tangential longitudinal, and radial longitudinal sections at up to 400x magnification. Wood identifications were undertaken through comparison with Wessex Archaeology's reference collection and relevant literature (Gale and Cutler 2000; Hather 2000; Schweingruber 1990). Nomenclature follows Stace (2019) for wild taxa and Zohary *et al.* (2012) for cultivated taxa. Habitat information has been taken from Hill *et al.* (2004) and Stroh *et al.* (2023).

Table 2 Abundance scale

Symbol	Number range
(+)	<5
+	5–10
++	10–30
+++	30–100
++++	100–500
+++++	>500

Insects

- 1.2.5 Insect remains were extracted from the flots (samples 101 and 102) during the plant macrofossil analysis. A stereomicroscope (40x magnification) was used to assess the insect remains. Selected insect sclerites were extracted for identification, predominately dorsal beetle (Coleoptera) sclerites. The assessment aimed to establish the preservation condition of the remains, their concentration in the deposits, and to provide identifications on the range of taxa present. Identifications were aided by modern insect reference material and relevant literature where appropriate (e.g., Harde *et al.* 2021; Drost *et al.* 1992). Coleopteran nomenclature follows Duff (2018). The abundance scale used is outlined in **Table 2**.

1.3 Results

- 1.3.1 All of the samples contained environmental material which had been preserved in waterlogged burial conditions, including wood, plant macrofossils and insects. Other material noted in the samples includes animal hair, foraminifera, ostracods, small/abraded fragments of marine shell, charcoal fragments and fish bones/scales. There are some large fragments (>10 mm) of coal in samples 101 and 102, as well as a few fragments of clinker/cinder. Other samples contain small quantities of fragmented (<4 mm) coal and clinker/cinder.

Plant macrofossils

Sample from the 'natural' quarry sediments

- 1.3.2 The sample from the 'natural' quarry sediments produced a small flot which contains wood fragments (mainly twigs and roundwood), herbaceous epidermal tissues, mosses and a diverse range of wild plant macrofossils (**Table 3**). Many of the wild taxa recorded could have grown in a freshwater wetland environment, although some tolerate brackish conditions. These include pondweeds (*Potamogeton* sp.), rushes (*Juncus* sp.), birches (*Betula* sp.), sedges (*Carex* sp.), water-milfoils (*Myriophyllum* sp.), celery-leaved buttercup (*Ranunculus sceleratus*), horned pondweed (*Zannichellia palustris*), crowfoots (*Ranunculus* subg. *Batrachium*) and meadowsweet (*Filipendula ulmaria*). There are also some remains of insects/invertebrates which are commonly associated with wetland habitats (including those in coastal areas), such as foraminifera, ostracods and water-fleas (*Daphnia* sp.). Notably, this sample did not contain any puparia of the seaweed fly (*Thoracochaeta zosterae*) which are present in the samples from the wreck (see below). Fragments of wood charcoal, coal and clinker/cinder occur in very low concentrations.

Table 3 Assessment of plant macrofossils and wood from the 'natural' quarry sediments

Sample	Sample vol. (l)	Flot vol. (ml)	Flot matrix	Plant macrofossils and wood (waterlogged)	Other
115	4	15	Mainly wood fragments (inc. twigs); Herbaceous epidermal tissues	Moss stems & leaflets (inc. <i>Sphagnum</i> sp.); Plant macrofossils ++, inc. <i>Ranunculus</i> subg. <i>Ranunculus</i> , <i>R. sceleratus</i> , <i>R.</i> subg. <i>Batrachium</i> , Chenopodiaceae, <i>Persicaria</i> sp., <i>Potentilla/Fragaria</i> sp., <i>Potamogeton</i> sp., <i>Carduus/Cirsium</i> , Chenopodiaceae, <i>Juncus</i> sp., <i>Rubus</i> sp. (and thorn), <i>Betula</i> sp., <i>Filipendula ulmaria</i> , <i>Zannichellia palustris</i> , <i>Carex</i> sp., tree budscapes, <i>Cenococcum geophilum</i>	Foraminifera and ostracods ++++; Moll-m/f, mainly small fragments, some whole shells ++++; <i>Daphnia</i> egg cases +; Beetles + fragmented coal and clinker/cinder, Fish bone (+); Fragmented coal and clinker/cinder

Samples from the wreck

Samples 101 and 102

- 1.3.3 The analysis results are presented in **Table 4**. Both of the samples produced very large flots (2000–3000 ml) which are almost entirely composed of oak (*Quercus* sp. – deciduous) wood fragments. Most of these fragments (<10 mm) have square/sharp edges and clearly visible tool marks, indicating that they are woodchips. There are also a few larger fragments of oak heartwood, as well as a piece of a broken treenail.
- 1.3.4 Waterlogged plant macrofossils are well-preserved in the samples and include remains of both cultivated and wild/weed taxa. Photographs of selected plant remains from the wreck are presented in **Appendix 1**.
- 1.3.5 There are frequent fragments of cereal straw, as well as occasional fragments of rye (*Secale cereale*) and oat (*Avena sativa*) chaff. Cereal grains are very rare, and most are crumpled and unidentifiable. One of the better-preserved cereal grains derives from rye. Other cultivated species recorded include broomcorn millet (*Panicum miliaceum*), hemp (*Cannabis sativa*), hops (*Humulus lupulus*), flax (*Linum usitatissimum*), fig (*Ficus carica*), grape (*Vitis vinifera*), plum (*Prunus domestica*), walnut (*Juglans regia*) and pomegranate (*Punica granatum*). In addition, there are occasional remains of other food plants which were probably either cultivated or collected, such as hazelnuts (*Corylus avellana*), as well as seeds of dill (*Anethum graveolens*), wild celery (*Apium graveolens*) and mustards (*Brassica/Sinapis* sp.). The mustard seeds are possibly from a cultivated species based on their large-size, although they are fragmentary.
- 1.3.6 Remains of wild taxa are particularly common, and many of these could be attributed to a range of different habitat types. Taxa which are commonly associated with waste ground, arable fields or fallow areas are particularly well-represented, with evidence for corncockle (*Agrostemma githago*), stinking chamomile (*Anthemis cotula*), corn marigold (*Glebionis segetum*), fat-hen (*Chenopodium album*), knotgrass (*Polygonum aviculare*), redshank/pale persicaria (*Persicaria maculosa/lapathifolia*), thistles (*Cirsium/Carduus* sp.) and sow-thistles (*Sonchus* sp.). There are some probable grassland taxa, including buttercups (*Ranunculus* subg. *Ranunculus*) and sheep's sorrel (*Rumex acetosella*). Bracken (*Pteridium aquilinum*) leaflets are present in low numbers in sample 102. Both of the trace quantities of pine (*Pinus* sp.) needles.

1.3.7 Many of the other wild taxa recorded probably reflect the local vegetation around the site of the shipwreck, and it is likely that some of the remains washed into the vessel after it was abandoned. The taxa recorded include trees such as poplars (*Populus* sp.) and alders (*Alnus* sp.), as well as a diverse range of herbaceous taxa including pondweeds, celery-leaved buttercup, crowfoots, great fen-sedge (*Cladium mariscus*), sedges, rushes, probable sea-blite (cf. *Suaeda maritima*), oraches (*Atriplex* sp.), wild barley (*Hordeum* sp.), sweet-grasses (*Glyceria* sp.), toothed medick (*Medicago* cf. *polymorpha*) and sea clover (*Trifolium subterraneum*). Fragments of peat mosses (*Sphagnum* sp.) occur in both samples. All of these taxa could have occurred within a coastal environment, growing in areas such as shingle banks, sand dunes, sea cliffs, grazing marshes, saltmarshes and other wetland habitats (e.g., fens, bogs, river margins, brackish lagoons, drainage ditches). Notably some of the taxa recorded are present in the control sample which was taken from the 'natural' quarry sediments, suggesting that they reflect the environment where the ship was wrecked. However, some of these remains could have been inclusions in materials which were used for caulking (discussed further below).

Table 4 Analysed plant macrofossils and wood from the vessel

Context		5004	5004
Sample		101	102
Bulk volume (ml)		10.5	5
Net volume (ml)		3000	2000
Cereals			
<i>Avena sativa</i> (Common oat)	floret	1	-
<i>Avena</i> sp. (Oats)	glume frags	(+)	+
<i>Avena</i> sp. (Oats)	lemma frags	(+)	(+)
<i>Panicum miliaceum</i> (Broomcorn millet)	floret	-	1
<i>Secale cereale</i> (Rye)	grain	1	-
<i>Secale cereale</i> (Rye)	rachis	-	4
Triticeae (Indet cereal)	grain	2	-
Triticeae (Indet. cereal)	grain frag.	+	-
Triticeae (Indet. cereal-sized)	culms/culm nodes	+	++
Fruits and nuts			
<i>Punica granatum</i> (Pomegranate)	seed	-	8
<i>Corylus avellana</i> (Hazel)	nutshell	-	2
<i>Ficus carica</i> (Fig)	fruit	10	18
<i>Juglans regia</i> (Walnut)	pericarp	-	1
<i>Prunus domestica</i> (Plum)	fruitstone (frag.)	-	1
<i>Vitis vinifera</i> (Grape)	pedicle	1	1
<i>Vitis vinifera</i> (Grape)	seed	-	5
Other cultivated or collected species			
<i>Anethum graveolens</i> (Dill)	seed	1	1
<i>Apium</i> cf. <i>graveolens</i> (Wild celery)	fruitlet	1	-
<i>Brassica/Sinapis</i> sp. (Cabbages/Charlock)	seed	-	1
<i>Cannabis sativa</i> (Hemp)	fruit	1	2
<i>Humulus lupulus</i> (Hop)	fruit	2	2
<i>Linum usitatissimum</i> (Flax)	seed	1	-
Waste ground, arable fields and fallow ground			
<i>Arctium</i> sp. (Burdocks)	fruit	1	-
<i>Agrostemma githago</i> (Corncockle)	seed	1	-
<i>Agrostemma githago</i> (Corncockle)	seed frags.	+	(+)
<i>Anthemis cotula</i> (Stinking chamomile)	fruit	1	-
<i>Chenopodium album</i> (Fat-hen)	fruit	1	-
<i>Cirsium/Carduus</i> sp. (Thistles)	fruit	-	2
<i>Glebionis segetum</i> (Corn marigold)	fruit	1	1



Context		5004	5004
Sample		101	102
Bulk volume (ml)		10.5	5
Net volume (ml)		3000	2000
<i>Persicaria maculosa/lapathifolia</i> (Redshank/Pale persicaria)	fruit	1	4
<i>Polygonum aviculare</i> (Knotgrass)	fruit	-	1
<i>Sonchus</i> sp. (Sow-thistles)	fruit	1	-
<i>Stellaria</i> cf. <i>media</i> (Common chickweed)	seed	1	-
<i>Urtica dioica</i> (Common nettle)	fruit	1	-
Freshwater wetlands, saltmarshes and other coastal areas			
Amaranthaceae (Amaranth)	fruit	2	3
<i>Atriplex</i> sp. (Oraches)	fruit	2	-
<i>Glyceria</i> sp. (Sweet-grasses)	Fruit	(+)	(+)
<i>Hordeum</i> sp. (Wild barley)	rachis	1	-
<i>Medicago</i> cf. <i>polymorpha</i> (Toothed medick)	fruit	-	1
Poaceae (Grass family)	fruit (<2 mm)	+	+
<i>Ranunculus</i> subg. <i>Ranunculus</i> (Buttercups)	fruitlet	3	2
<i>Ranunculus sardous</i> (Hairy buttercup)	fruitlet	1	-
<i>Ranunculus scleratus</i> (Celery-leaved Buttercup)	fruitlet	-	1
<i>Rumex acetosella</i> (Sheep's sorrel)	fruit	1	-
cf. <i>Suaeda maritima</i> (Annual Sea-blite)	fruit	-	8
<i>Trifolium subterraneum</i> (Sea clover)	compound fruit	-	1
Wetlands (freshwater)			
<i>Carex</i> spp. (Sedges)	fruit	3	2
<i>Cladium mariscus</i> (Great Fen-sedge)	fruit	1	-
Cyperaceae undiff. (Sedge family)	fruit	1	1
<i>Juncus</i> sp. (Rushes)	seed	+	-
<i>Potamogeton</i> sp. (Pondweeds)	fruitlet	1	-
<i>Potentilla</i> sp. (Cinquefoils)	fruitlet	1	-
<i>Ranunculus</i> subgenus <i>Batrachium</i> (Crowfoots)	fruitlet	2	-
<i>Sphagnum</i> sp.	leaflets	+	+
Woodland, scrub and heath			
<i>Alnus</i> sp. (Alders)	bract	-	1
<i>Pinus</i> sp. (Pines)	needle frags.	(+)	(+)
<i>Populus</i> sp. (Poplars)	buds/budscale	+	-
<i>Pteridium aquilinum</i> (Bracken)	leaf	-	+
<i>Rubus fruticosus</i> agg. (Bramble)	fruitlet	5	2
<i>Rubus</i> sp. (Brambles)	fruitlet	1	-
<i>Quercus</i> sp. (Oak)	wood frags.	+++++	+++++
<i>Sambucus nigra</i> (Elder)	fruit (endocarp)	1	-
cf. <i>Prunus spinosa</i> (Blackthorn)	thorn	1	-
Indet.	budscale	+	-
Uncertain ecological grouping			
Asteraceae (Daisy family)	fruit	-	1
Monocot./Herbaceous	culms	-	+
Musci (Mosses)	stems	+	+
Indet.	seed capsule?	-	1
Other material			
Indeterminate	twigs	+	+
Indeterminate	charcoal	++	++
Coal	fragments	++	++
Clinker/cinder	fragments	(+)	(+)
Ostracods	shells	++	-
Foraminifera	tests	-	+
Fly puparia	-	++++	++++
Insects/beetles	-	+++	++

Context		5004	5004
Sample		101	102
Bulk volume (ml)		10.5	5
Net volume (ml)		3000	2000
Snails	-	+	+
Animal hair	-	+	++
Fish bone	-	-	(+)

Samples 108, 109 and 6001

- 1.3.8 Three other samples from the shipwreck contain low concentrations of wood fragments (twigs, roundwood), degraded vegetative material, moss stems and wild plant macrofossils (**Table 5**). There are no remains of economic species (e.g., cereals, fruits, nuts etc.) and the wood fragments recovered are not from worked timbers. Most of the plant taxa recorded could have grown in the local environment around the shipwreck, although some could have been inclusions within caulking materials (discussed further below). The taxa recorded include alder, birch, peat mosses, pondweeds, sedges and water-milfoils. Other environmental remains comprise Bryozoa (aquatic invertebrates) statoblasts, fly puparia, beetles, foraminifera, ostracods, small/abraded fragments of marine shell and charcoal. There are also some fragments of animal hair, coal and clinker/cinder.

Table 5 Assessed plant macrofossils and wood from the vessel

Sample	Sample vol. (l)	Flot vol. (ml)	Flot matrix	Plant macrofossils and wood (waterlogged)	Other
108	0.5	12	Wood fragments, inc. twigs ++	Plant macrofossils +, inc. moss stems & leaflets (inc. <i>Sphagnum</i> sp.), Chenopodiaceae, <i>Carduus/Cirsium</i> , <i>Betula</i> sp., <i>Potamogeton</i> sp., <i>Ranunculus</i> subg. <i>Ranunculus</i> , <i>Carex</i> spp., Apiaceae (prob. wild), indet seed	Charcoal (+); Foraminifera + ostracods +++; Moll-m/f (mainly small fragments, some whole shells +++; Fly puparia ++; Beetles ++ and other insect parts, Fish bone ++; Fragmented coal and clinker/cinder
109	0.5	10	Mainly highly degraded wood fragments, some twigs/small branch frags; Monocotyledon stems rare	Plant macrofossils +, inc. moss leaflets (inc. <i>Sphagnum</i> sp.), <i>Rubus</i> sp., <i>Ranunculus</i> subg. <i>Ranunculus</i> , <i>Myriophyllum</i> sp., <i>Alnus glutinosa</i> fruit and cf. cone fragment, deciduous tree leaves, Bryozoa statoblasts, <i>Sonchus asper</i>	Charcoal (+); Foraminifera + ostracods +++; Moll-m/f small fragments +++; Fish bone (+); Fragmented coal
6001	0.5	10	Mainly degraded wood fragments, some twigs/small branch frags; Animal hair; Monocotyledon stems rare	Plant macrofossils +, inc. moss leaflets (inc. <i>Sphagnum</i> sp.); Chenopodiaceae, <i>Potamogeton</i> sp., <i>Carex</i> spp., deciduous tree leaf fragments	Charcoal (+); Foraminifera + ostracods +++; Moll-m/f small fragments +++; Fly puparia ++; Beetles +, Fish bone ++; Fragmented coal

Insect remains from the wreck

Samples 101 and 102

- 1.3.9 Both of the samples produced moderate quantities of well-preserved insect remains (**Table 6**), including beetles (Coleoptera), fly pupae (Diptera), and mites (Acari). The beetle assemblages are primarily synanthropic. Notably, the grain weevil (*Sitophilus granarius*) and the saw-toothed grain beetle (*Oryzaephilus surinamensis*) are present. These are both common pests of stored cereal crops, and they became common in the medieval and later medieval periods, largely due to the trade in cereal grain (Smith and Kenward 2011; King *et al.* 2014). The grain weevil is a primary pest of cereal grains, whilst the saw-toothed grain beetle is a secondary pest since it commonly infests damaged cereal grain. Any cereal grain which has been damaged is also more susceptible to mould growth. The handsome fungus beetle (*Mycetaea subterranea*) is known to occasionally infest mouldy grain, alongside other taxa, including minute fungus beetles (Latridiidae). Other potential synanthropes include various minute brown scavenger beetles (including *Corticaria/Corticarina* species). A few possible fragments of the drugstore or biscuit beetle (cf. *Stegobium paniceum*) may reflect the presence of cereal-based foods on the vessel.

Table 6 Insect remains from the vessel

Sample	Coleoptera (beetles)	Diptera (flies)	Other
101	<i>Cercyon depressus</i> (4), <i>Cercyon</i> sp. (2), <i>Oryzaephilus surinamensis</i> (1), cf <i>Stegobium paniceum</i> (1), <i>Sitophilus granarius</i> (1), <i>Lyctus brunneus</i> (1), <i>Anobium punctatum</i> (1), <i>Mycetaea subterranea</i> (5), <i>Corticaria/Corticarina</i> sp. (6), <i>Latridiidae</i> sp. (1)	<i>Thoracochaeta zosteriae</i> + + + +, <i>Sphaeroceridae</i> +, <i>Musca/Muscina</i> sp. (+)	Oribatidae +
102	<i>Bembidion</i> sp. (1), <i>Amara</i> sp. (1), <i>Hydroporus</i> sp. (1), <i>Cercyon depressus</i> (5), cf <i>Cercyon</i> sp. (1), <i>Mycetaea subterranea</i> (4), <i>Corticaria/Corticarina</i> sp. (2), <i>Latridius</i> sp. (1), cf <i>Stegobium paniceum</i> (1), <i>Oryzaephilus surinamensis</i> (2), <i>Sitophilus granarius</i> (3)	<i>Thoracochaeta zosteriae</i> + + + +, <i>Sphaeroceridae</i> +	-

Coleoptera remains given as MNI; Diptera and other remains recorded on an abundance scale

- 1.3.10 There are abundant water scavenger beetles (*Cercyon* sp.) in both samples, notably *Cercyon depressus*. This species is commonly associated with decaying organic matter, although it is also frequently observed on seaweed. Sample 102 also produced fragments of ground beetles (*Bembidion* sp., *Amara* sp.), alongside an elytron of an aquatic diving beetle (*Hydroporus* sp.), probably reflecting the natural background fauna.
- 1.3.11 Wood-boring beetles are present in sample 101, including the powderpost beetle (*Lyctus brunneus*) and the common furniture beetle (*Anobium punctatum*). They are likely to have infested the ship's timbers (or other timber on the vessel). The powderpost beetle prefers hardwoods, particularly oak, whilst the common furniture beetle feeds on both softwoods and hardwoods.
- 1.3.12 Fly pupae are abundant in both samples, particularly the seaweed fly (*Thoracochaeta zosteriae*). This species often occurs in cesspits and other deposits of sewage, but it is also found in coastal environments, particularly on seaweed (Smith 2013a). The fly pupae of other taxa are also present (*Sphaeroceridae*, *Musca/Muscina*). *Musca* and *Muscina* species are typically found in and around settlements, especially in decaying and fouling organic matter. A single moss mite (Oribatida) was also recorded.

1.4 Discussion

1.4.1 A well-preserved assemblage of wood, plant macrofossils and insects has been recovered from the Denge Quarry wreck, providing an insight into the vessel's history. In particular, the dataset provides information on the depositional environment of the wreck, materials used as dunnage (or packaging), foods consumed during voyages, living conditions on board the vessel and trade routes.

1.4.2 Archaeobotanical assemblages have only been studied from a small number of other later medieval and post-medieval wrecks across northern Europe (e.g., Carruthers 2013; Larsson and Foley 2023; Manders and Kuijper 2015; Robinson and Aaby 1994; Ruas 1989; Smith and Green 2005; Wessex Archaeology 2021). Consequently, the evidence from the Denge Quarry wreck is significant. In the sections below, detailed comparison is made with the evidence from the mid-15th century *Newport Ship*, which sank on the banks of the River Usk, South Wales, and the early to mid-16th century *Mary Rose* which sank in the Solent, southern England (Carruthers 2013; Smith 2013b; Smith and Green 2005; Robinson 2005).

Interpreting the evidence

1.4.3 The interpretation of the evidence from the Denge Quarry wreck is not straightforward. It is difficult to establish the specific use (or uses) of some of the plant material which was brought on board the vessel. In addition, some of the remains recorded are likely to reflect contamination from the burial environment (i.e., once the vessel was abandoned).

1.4.4 The following categories of material can be identified in the samples from the Denge Quarry wreck:

- fragments of wood from the ship's timbers and woodworking debris, possibly left over from the shipbuilding phase or they may be related to salvage or repair of the timbers (wood chips, wood-boring beetles);
- dunnage or packaging materials (e.g., cereal straw, chaff, bracken);
- caulking materials, tar/pitch or unintentional inclusions in caulking materials (e.g., pine needles, moss, seeds of wetland plants etc.);
- waste, sewage and spilled cargo (e.g., figs, grapes, hops, walnuts, pomegranate, broomcorn millet, other cereal grain, grain weevils, coal, charcoal);
- wild plants (or weeds) and insects which were unintentionally brought into the ship in other materials (e.g., arable weeds in dunnage, grain weevils in cereal-based foods);
- seeds and other material in the local environment which washed into the vessel after it was abandoned (e.g., plants and insects which could have existed in an intertidal environment).

Sources of material on board the vessel

Wood fragments

1.4.5 Samples 101 and 102 contained abundant oak wood fragments, mainly consisting of woodchips but with some larger fragments from timbers. There were also fragments of oak treenails. These wood fragments may reflect debris left over from the shipbuilding phase, although they could also be associated with repairs or salvage of the timber from the vessel. Salvaging timbers from wrecks is known to have occurred in the mid- to late 16th century

around the coastline of southern England, and there is a possibility that the vessel was drawn up onto the edge of a watercourse for repair, before being abandoned following a change in circumstances (e.g., difficulty of reaching timbers, changes in watercourses). Some accounts of timber salvage in the area around Lydd are outlined by Draper in the documentary study of the Denge Quarry wreck (Appendix 6: Draper 2023).

- 1.4.6 Notably, no wood fragments from non-native species (e.g., spruces, firs) were observed. It is unlikely that the vessel was used to transport timber.

Dunnage or packaging materials

- 1.4.7 Most of the remains recorded probably reflect materials which were used as either dunnage or packaging on board the ship, such as cereal straw, chaff and other stems or leaves (e.g., bracken). It is likely that some of the wild taxa recorded were contaminants of the cereal straw, such as corncockle, corn marigold, fat hen, knotgrass, redshank/pale persicaria and thistles. These were characteristic cornfield weeds (or arable weeds) in the later medieval period, and they were probably harvested alongside the straw (*cf.* de Moulins 2007). Some of the insects could have been stray contaminants of cereal straw or crop-processing debris (e.g., grain weevil, saw-toothed grain weevil).
- 1.4.8 Dunnage was used on ships to keep the cargo in position during transport, and a wide range of materials could have been used for this, depending on local availability and the type of cargo. For example, a House of Commons report for 1826, notes that straw mats made of rye were used to prevent cereal grain from spoiling (Parliament, House of Commons 1826). Straw bundles were also used to protect a cargo of bread wheat grain on the 16th century Dutch merchant vessel, the *Scheurrak SO 1* (Manders and Kuijper 2015). Cereal grain was vulnerable to damage during transport, and it was remarked that some imports of rye from the Baltic in the late 16th century were ‘very musty’ (Williams 1988, 155). Mouldy grain or straw would have provided a suitable habitat for the handsome fungus beetle to thrive in the Denge Quarry wreck, and it is possible that straw matting was used on the vessel to protect transported grain. Other crop-processing by-products (e.g., oat chaff) may have been used to protect more fragile cargos, such as pottery or tobacco pipes. The husks of buckwheat (*Fagopyrum esculentum*) are known to have been used for this purpose in the late medieval and post-medieval periods (Tomlinson and Hall 1996). Similarly, bracken has traditionally been used as a packaging material, with the young green fronds being used to protect items such as soft fruit or fish (Campbell and Pelling 2013).
- 1.4.9 On both the *Newport Ship* and the *Mary Rose*, many of the plant remains recorded reflected materials used as dunnage or packaging, paralleling the evidence from the Denge Quarry wreck (*cf.* Smith and Green 2005; Carruthers 2013). However, it is worth noting that straw, chaff or bracken may have had other uses on a ship. All of these materials could have been used to soak-up liquids, stuff mattresses or to provide animal bedding/fodder for livestock. The common occurrence of rye chaff in the Denge Quarry wreck is of particular note since this was also observed in both the *Newport Ship* and the *Mary Rose* (*ibid.*). This may relate to the specific selection of rye for its high-quality straw. Rye produces a particularly tall and strong straw, and it has traditionally been used for weaving, thatching, tying cereal sheaths and as a stuffing material (Halstead 2014).

Spilled cargo, food waste and sewage

- 1.4.10 The original cargo the Denge Quarry wreck is unknown, possibly because it was salvaged shortly after the vessel was abandoned. However, some of the cargo may have also disappeared due to poor preservation in the depositional conditions. For example, cereal grains often preserve poorly in waterlogged deposits, even when associated evidence can be well-preserved, such as insect pests, cereal bran or arable weeds (Smith 2013a).

- 1.4.11 The plant remains which potentially reflect spilled cargo – or unintentional contaminants within cargo – include cereal grains, flax seeds, hemp seeds, hop seeds, nutshells (walnut, hazelnut), fruits (e.g., prunes, raisins/currants, figs, blackberry, pomegranate) and spices or flavourings (e.g., mustard, wild celery, dill). Several of these plants feature in custom records for the late medieval and post-medieval periods, and they were widely traded through ports around the English coastline (Stone 1949; Williams 1988; Soden 2024). Spilled cargo could have become spread across the hull, either during sailing or once the vessel was wrecked. However, it is difficult to securely identify which (if any) of the plant remains recorded in the Denge Quarry wreck reflect spilled cargo. In addition, any cargo may have become mixed with other detritus within the hull, including food waste and sewage.
- 1.4.12 It is well-known that conditions on board vessels in the late medieval and post-medieval periods were unsanitary. Sewage and food waste recorded in both the *Newport Ship* (Carruthers 2013; Smith 2013b) and the *Mary Rose* (Smith and Green 2005). Similarly, the 15/16th century *Aber Wrac'h*, near Brest, contained numerous remains which probably reflect mixtures of food waste and sewage, including coprolites, cereal bran, walnuts, hazelnuts chestnuts, plums and grapes (L'Hour 1989; Ruas 1989). Some of the plant remains recorded in the Denge Quarry wreck are commonly associated with deposits of sewage or food waste in towns and cities across Europe (Greig 1996; Hondelink and Schepers 2020; Smith 2013a; Speleers and van der Valk 2017; Badura *et al.* 2015; Peña-Chocarro *et al.* 2019; Świąta-Musznicka *et al.* 2021). In particular, the small seeds of some fruits (figs, grapes), flavourings (mustards, wild celery) and weeds (corncockle) are often considered to reflect the presence of sewage in archaeological deposits (Smith 2013a).
- 1.4.13 Some of the insect remains in the Denge Quarry wreck are also common indicators of sewage. Grain weevils could have been consumed within pottage or coarse bread, whilst the few probable fragments of the drugstore beetle or biscuit beetle may have been contaminants of ship's biscuits (*cf.* Spalding 2015; Smith 2013a). The seaweed fly is also a common indicator of sewage in archaeological deposits, and other taxa recorded may reflect decaying and fouling organic matter such as the water scavenger beetle, *Cercyon depressus*. In the *Newport Ship*, it was suggested that the presence of the seaweed fly and *Cercyon depressus* reflected the accumulation of a saline-rich blend of organic waste or sewage (Smith 2013b). The seaweed fly was also present in the *Mary Rose*, probably also indicating the presence of foul organic matter (Robinson 2005). The same may be true of the Denge Quarry wreck, highlighting the challenging conditions for those living on board the vessel. However, it should be emphasised that both *Cercyon depressus* and the seaweed fly could have thrived on spreads of seaweed once the vessel was wrecked.
- 1.4.14 A notable absence in the Denge Quarry wreck is cereal bran which is a very common indicator of sewage in archaeological deposits (Smith 2013a). Documentary records indicate that sailors would have consumed either fresh bread or ships' biscuits (a type of hard dry bread) in the 16th century, and therefore the absence of cereal bran is surprising (Coy and Hamilton-Dyer 2005). Cereal bran was also absent in both the *Mary Rose* and the *Newport Ship*, perhaps indicating that any cereals consumed on these vessels had already been fully processed (Carruthers 2013; Smith and Green 2005). The absence of cereal bran is unlikely to reflect a preservation bias, especially considering that other plant remains in the Denge Quarry wreck were well-preserved. Cereal bran has, however, been recovered in small quantities from other shipwrecks, such as the 15th/16th century *Aber Wrac'h* (Ruas 1989). Whilst there were a few cereal grain fragments in the Denge Quarry fragments, these were not cereal bran *per se* (i.e., they are broken whole grains). The presence or absence of cereal bran in shipwrecks probably relates to the types of cereal-based foods consumed during voyages.

- 1.4.15 Taken together, the plant macrofossils could reflect a combination of spilled cargo, food waste or sewage. Given that the vessel appears to have been used over a period of decades, there would have been ample opportunity for spilled cargo to become mixed with other sources of debris within the hull.

Caulking materials, pitch and tar

- 1.4.16 Hemp fibres and tarred animal hairs appear to have been the main materials which were used as caulking between the planks in the Denge Quarry wreck (see Appendix 3: Microtext 2023 and Appendix 4: Historic England 2023). The samples contained some remains of these caulking materials, notably clumps of animal hair fragments, whilst the small number of pine needles recovered could have been contaminants of pitch, tar or pine resin. Some of the other plant macrofossils recorded in the samples potentially also reflect materials used for caulking (perhaps to repair the vessel). This point is well-illustrated by Deforce *et al.* (2014) who examined caulking materials from two 14th century cogs from Doel, northern Belgium.
- 1.4.17 In the cogs at Doel, Deforce *et al.* (2014) recorded a wide range of plant macrofossils in the caulking materials, including pine needles, birch fruits, mosses (particularly *Sphagnum* sp.), possible arable weeds, small quantities of rye chaff and the seeds of various wetland species (e.g., bogbeans, sedges, tasselweeds, pondweeds, rushes etc.). The analysis by Deforce *et al.* (2014) clearly indicates that some of the seeds of wetland plants in the Denge Quarry wreck could have been unintentional contaminants of caulking materials. This scenario is certainly plausible for samples 108 and 109 which were collected from between wooden planks. However, there is also a possibility that some of the remains washed into the vessel after it was wrecked, as is discussed below.

The depositional environment: plant macrofossils and insects in the local area

- 1.4.18 All of the samples from the Denge Quarry wreck contained varying quantities of material which probably washed into the vessel shortly after it was abandoned, notably the remains of wild plants which can grow in riverine, estuarine and coastal environments. Several of the wild plant taxa recovered from the vessel were present in the natural sediments around the wreck, supporting the interpretation that some of these remains are later contaminants (e.g., birch, alder, sedges, pondweeds, water-milfoil, mosses etc.). Similarly, other material recorded in the samples from the vessel probably reflects later contamination (e.g., foraminifera, ostracods, fish bone/scale, marine shell). It is very difficult to reconstruct the depositional environment of the vessel from this fragmentary evidence, although it is notable that the assemblage contains taxa which are associated with freshwater and brackish habitats, as well as other coastal habitats (e.g., sand dunes).

Coasting trade and foreign trade

- 1.4.19 The Denge Quarry wreck is thought to reflect the remains of an English vessel, and it could have been abandoned near to its main operational area. It was potentially used as a coasting vessel to transport products from the *Cinque Ports* to other ports around the English coastline. Vessels involved in coasting trade were largely used to transport coal, agricultural products (grain, dairy produce), fish, iron, timber and other naval products such as pitch and tar (Williams 1988). Some of these products can be identified within the Denge Quarry wreck (e.g., cereals), although there are also items which point towards foreign trade (e.g., figs, pomegranates).
- 1.4.20 In the sections below, notes are provided on some of the key economic species recorded in the Denge Quarry wreck, and potential trade routes are outlined.

Staple cereal crops: rye, oats, barley and wheat

- 1.4.21 The main cereal species cultivated in the late medieval and post-medieval periods in England were bread wheat, rivet wheat, hulled barley, rye and oats (Moffett 2018). Two of these species – rye and oats – were recorded in the assemblage from the Denge Quarry wreck, probably due to the use of straw and chaff as dunnage. It is possible that other cereal species are present amongst the unidentifiable grains. Rye and oats could have been sourced from around Lydd since they are both known to have been cultivated in the local area in the later medieval period (Hinton 2008; Sweetinburgh 2008). Similarly, many of the arable weed species recorded could have grown in cereal fields around Lydd, or elsewhere in south-east England (Stevens and Fuller 2018). Grain is known to have been exported from Kent in this period, primarily to London (Hipkin 2008). This could support the view that the cereal remains in the Denge Quarry wreck reflect local produce, although this interpretation is uncertain.
- 1.4.22 Rye and oats were widely cultivated across Continental Europe in the 16th century, and they could have been acquired from any number of ports situated in the Baltic, the Low Countries, France or the Iberian Peninsula (Peña-Chocarro *et al.* 2019; Rösch *et al.* 1992; Rottoli 2014; Ruas 2005). In addition, weeds such as corncockle, corn marigold and stinking chamomile are also well-known to have infested arable fields on the Continent (*ibid.*). A further complicating factor is that cereal grain was imported into England throughout the 16th century, particularly when there were poor harvests. For example, during the famine of 1596, English importers handled huge shipments of rye from the Baltic (Stone 1949). Imports of cereals – particularly rye – from Baltic ports are a common feature of customs records for this period (Mączak 1968; Williams 1988).

Broomcorn millet

- 1.4.23 A single example of broomcorn millet was recovered from the Denge Quarry wreck. This small-seeded cereal species was cultivated on a minor scale in the south-east of England in the post-medieval period, although it never became widely established as a crop (Greig 1996; Thirsk and Sanconie 1999). In contrast, broomcorn millet was widely cultivated across Europe in the late medieval and post-medieval periods, particularly in northern Spain and Portugal (Peña-Chocarro *et al.* 2019; Rösch *et al.* 1992; Rottoli 2014; Ruas 2005).
- 1.4.24 Finds of broomcorn millet from archaeological sites in England are very rare, with only a handful of records known for the late medieval and post-medieval periods (Murphy 1994; Williams 1977; see also Brudenell *et al.* 2022 and Wilcox 1977). Two records of broomcorn millet for this period both come from cities – Norfolk and Hull – with well-known maritime trade connections (Murphy 1994; Williams 1977). It is therefore likely that the crop was either deliberately imported from abroad, or it was an unintentional contaminant of other products (e.g., cargo, dunnage). Broomcorn millet was also recorded in the *Newport Ship*, a vessel which was used on trade routes between Britain and the Iberian Peninsula, probably somewhere in northern Spain or Portugal (Carruthers 2013). It is possible that the Denge Quarry wreck was also involved in trade routes with the Iberian Peninsula.

Hemp and flax

- 1.4.25 Hemp and flax were widely cultivated in the late medieval and post-medieval periods across Britain, primarily for the production of fibre (Moffett 2018). Both of these crops were closely connected with the maritime industry since they were used to produce rope, cordage, canvas and other textiles (Smith 1990). Flax seeds were also used to produce linseed oil; this oil has a wide range of industrial uses, and it could have been used to preserve wood, as a fuel in oil lamps and in the production of varnishes, paints, dyes and inks (Ertuğ 2000).

- 1.4.26 The cultivation of hemp around Lydd is well-documented from the medieval period onwards, and it appears to have been a particularly important crop in the local area (Sweetinburgh 2008). Hemp fibres are known to have been produced on the Dungeness foreland in the later medieval period (Schofield and Waller 2005), and elsewhere around the southern and eastern coasts of England (Bradshaw *et al.* 1981). In the mid-16th century, the government encouraged the cultivation of hemp and flax for fibre production, and they became regionally important crops in areas such as Norfolk, Suffolk and Somerset (Thirsk 1997). However, there was great demand for hemp and flax fibres in this period, and they had to be imported into England to meet demand (Stone 1949; Thirsk 1997). Linseed oil is also known to have been imported on a small-scale in this period (Stone 1949). It is plausible therefore that the hemp and flax seeds reflect unintentional contaminants of imported fibre or other products (e.g., oil).

Hops

- 1.4.27 The cultivation of hops had become well-established in England by the mid-16th century since the plant was increasingly being used to brew hopped beer (Verberg 2020). In particular, hop cultivation flourished in counties along the south-eastern coast of England during this period, namely in Norfolk, Suffolk, Essex and Kent (Thirsk 1997). We know that hops were already cultivated in the area around Lydd at the beginning of the 16th century since a farmer on Romney Marsh left “a howe of hops” in his will to his wife in 1506 (Sweetinburgh 2008). The small number of hop seeds recovered from the Denge Quarry wreck could be related to this expansion in the brewing of hopped beer, with the seeds being sourced from somewhere in south-eastern England. There was no evidence for the hop flower (or cone) – the part of the plant which is used to brew beer – although this could reflect a preservation bias. Low numbers of hop seeds were recorded in the *Newport Ship* (Carruthers 2013) and the *Mary Rose* (Smith and Green 2005); in both of these cases, there was also no evidence for the hop flower. Hop seeds have also been recovered from a number of other late medieval shipwrecks across Europe, but evidence for the flowers is very rare (e.g., Robinson and Aaby 1994; Manders and Kuijper 2015; Larsson and Foley 2023). The hop seeds could have been unintentional contaminants of beer rations issued on vessels, or they could have had other medicinal uses (Smith and Green 2005). Alternatively, hop seeds may have been traded in this period to expand the cultivation range of this crop, and to aid the spread of new varieties.

- 1.4.28 Whilst hops were cultivated across south-eastern England by the mid-16th century, they continued to be imported on a large-scale from the Low Countries and France to keep up with demand (Stone 1949; Williams 1988). Beer brewed using hops had gained great popularity in England in the mid- to late 16th century. The English poet Gervase Markham remarked that there was almost daily traffic with France and Holland in the mid-16th century to acquire hops (Thirsk 1997). The widespread cultivation of hops for brewing beer had begun earlier on the Continent, and consequently farmers in these areas were more experienced at producing this crop, which can be difficult to cultivate (Badura *et al.* 2015; Hondelink and Schepers 2020; Speleers and van der Valk 2017; Verberg 2020; Święta-Musznicka *et al.* 2021). It is not unlikely therefore that hop seeds in the Denge Quarry wreck were acquired from abroad, most likely from a port in the Low Countries.

Fruits and nuts

- 1.4.29 The Denge Quarry wreck contained a number of nut and fruit species including grapes (probably raisins or currants), figs, plums (probably prunes), walnuts, hazelnuts and pomegranates. Whilst some of these plants could have been grown in southern England, most of them would have been acquired through foreign trade.

- 1.4.30 Dried fruits and nuts regularly feature in customs records for the 15th and 16th centuries, and some of the major imports included prunes, raisins, currants, figs, dates and almonds amongst others (Stone 1949; Wilan 1959; Williams 1988). Trade in other fruits was more limited, although pomegranates are known to have been imported from Spain in this period, sometimes being referred to as 'pound-garnets' because of their jewel-like appearance (Gras 1918; Soden 2024). This fruit has long been imbued with symbolic significance, a point which is clearly highlighted by the numerous artistic depictions of pomegranate in the 15th and 16th centuries (Stone 2017). Pomegranates are rarely recorded in archaeobotanical assemblages in northern Europe, although they were present in the *Newport Ship* (Carruthers 2013). Currants, raisins and figs from Spain were also particularly prized in England in this period, whilst walnuts and prunes were often imported from France (Stone 1949; Soden 2014). The importance of walnut cultivation in France is highlighted by their labelling as 'French nuts' in some later medieval documentary sources (Studer 1911). Similarly, hazelnuts also feature in later medieval customs records (Gras 1918). Some dried fruits, nuts and spices were acquired from ports along the Atlantic or Mediterranean coasts, although they were also obtained through trade with secondary ports. In particular, Antwerp was a major entrepôt of world trade in the middle of the 16th century, and many vessels trading with ports in southern England would stop at Antwerp on their outbound or return journeys (Stone 1949).
- 1.4.31 Some of the fruits and nuts recorded in the Denge Quarry wreck were not necessarily acquired through foreign trade. Orchards had become well-established in southern England by the 16th century, and these contained plums, damsons, walnuts, hazelnuts and other fruits which not recorded in the Denge Quarry wreck such as pears and apples (Barnes and Williamson 2022; Mate 2006). It is assumed that the hazelnuts recovered from the Denge Quarry wreck derive from the native species (*C. avellana*), although, they could be from filberts (*C. maxima*) which was probably introduced into cultivation in England in the later medieval period (Greig 1996). Whilst it is likely that most – if not all – of the fruits and nuts in the Denge Quarry wreck reflect imported produce, the possibility that some were locally cultivated should not be discounted.

Spices and other flavourings

- 1.4.32 Exotic spices such as cloves, pepper, nutmeg, mace, ginger, cinnamon and others are well-known to have been regularly imported into England throughout the 15th and 16th centuries, often from Antwerp (e.g., Stone 1949; Williams 1988; Soden 2024). Their absence in the Denge Quarry wreck is notable, especially considering that the vessel contained the remains of other exotic plants (e.g., figs, pomegranates). The small number of spices recorded included dill, celery and possibly mustards. All of these could have been grown in gardens in England (Moffett 2018).

Coal and charcoal

- 1.4.33 Fragments of charcoal and coal were common in the samples, and there were also a small number of fragments of clinker or cinder (the by-products of burning coal). This material probably reflects fuel (or fuel waste) from ovens on board the vessel, although a small proportion of the charcoal fragments may be associated with charring of the planks in the construction of the vessel. In addition, it is worth noting that charcoal and coal were transported by sea in this period. Coal was beginning to be widely used as a fuel source by the mid-16th century in England (Warde 2011). The domestic coal trade expanded significantly towards the end of the 16th century, with coasting vessels being used to transport the product from Newcastle to numerous ports along the eastern and southern coast of England (Williams 1988). Charcoal was also exported from Kent in the late 16th century, in part due to the abundance of woodland in the region (Wilkinson 2006).

Conclusions

1.4.34 The analysis of waterlogged plant macrofossils and insects from the Denge Quarry wreck has provided valuable information on the vessel's history. Most of the plant remains appear to reflect materials which were used as dunnage (or packaging) on board the vessel, including cereal straw, chaff, bracken and other plant stems. Other plant remains probably reflect spilled cargo, food waste and sewage (or a combination of all three). Many of the items recorded in the vessel could have been acquired from ports in England, however, there are also clearly several foreign imports in the assemblage:

- **Rye and oats:** both crops were cultivated around Lydd, and they are known to have been traded by coasting vessels. However, rye was also imported on a large-scale from the Baltic. Other products in the vessel were probably also sourced from the Baltic (e.g., pitch, tar).
- **Broomcorn millet:** unlikely to have been cultivated in England. Possible areas of origin include the Low Countries, France or the Iberian Peninsula. It may have been an unintentional contaminant of other materials brought on board the vessel.
- **Hemp and flax:** both crops were cultivated around Lydd, and they are known to have been traded by coasting vessels. However, they could also be foreign imports.
- **Hops:** cultivated around Lydd, and hop cultivation was becoming well-established in England by the mid- to late 16th century. However, hops were a major crop in the Low Countries, and the seeds are potentially foreign imports.
- **Fruits and nuts:** figs, prunes, currants (or raisins), pomegranates, walnuts and hazelnuts (or filberts) may all be foreign imports from France, the Iberian Peninsula or elsewhere in the Mediterranean. However, walnuts and hazelnuts are well-known to have been cultivated in southern England in the 16th century.
- **Spices:** remains of spices (or other flavourings) were very rare. Dill, celery and mustard could have been grown in England, or they may have been imported from abroad.

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Appendix 1: Photographs of selected plant remains from the Denge Quarry Shipwreck

Top left: rye (*Secale cereale*) rachis; Top right: broomcorn millet (*Panicum miliaceum*) grain with lemma and palea; Bottom left: pomegranate (*Punica granatum*) seed; Bottom right: hemp (*Cannabis sativa*) seed. All photographs were taken using a Keyence VHX7000 3-D digital microscope (AHRC Award AH/V011758/1) at Fort Cumberland, Historic England.



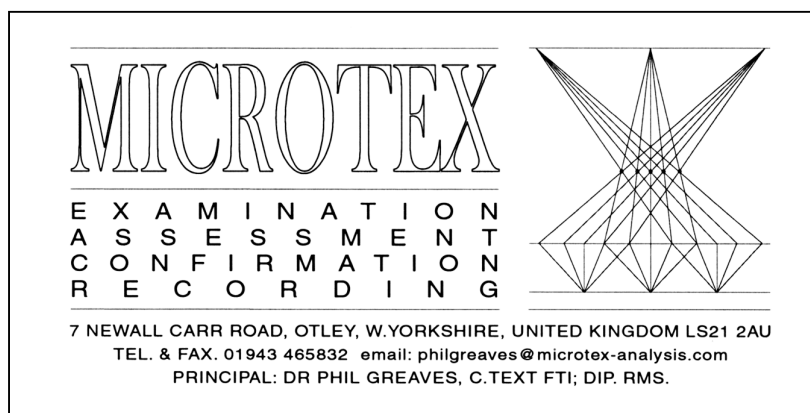
Appendix 1 (continued): Photographs of selected plant remains from the Denge Quarry Shipwreck

Fig (*Ficus carica*) seeds





Appendix 3



Wessex Archaeology
Unit R6
Sheaf Bank Business Park
Prospect Road
Sheffield
S2 3EN

Ref. 4245
21st February 2023

TEST REPORT

Analysis of Animal Fibres from Caulking: Shipwreck Ref. 264870

The animal fibres in the above samples have been identified microscopically by detailed examination and comparison with authentic reference samples according to **ISO TR 11827 (2012)**. The following diagnostic features and likely species type were recorded:

(NB The degrees of degradation vary both within and between these samples. Identifications must therefore be regarded as tentative).

113 Timber 009

Fine Fibres

Irregular mosaic scaling, with near to close margins. Fine lattice medullae, some fragmental. Varying pigment density. Some fibres have more prominent margins and near to distant margins.

Coarse Fibres

Irregular mosaic scaling, scales protrude slightly. Fine lattice medullae. Generally dense pigment. Some fibres with rippled crenate patterning and close to near margins.

These features are most consistent with **calf** (cattle) fibres, though there are also smaller numbers more similar to black/brown English **goat** fibres.

103 5004 096

As Timber 009 – The features are most consistent with **calf** (cattle) fibres, though there are also smaller numbers more similar to black/brown English **goat** fibres.

These fibres are very severely degraded.

116 5001 loose recovery

As Timber 009 – The features are most consistent with **calf** (cattle) fibres.

117 5005 033

As Timber 009 – The features are most consistent with **calf** (cattle) fibres, though there are also smaller numbers more similar to black/brown English **goat** fibres.

110 5005 between 034 and 035

As Timber 009 – The features are most consistent with **calf** (cattle) fibres, though there are also smaller numbers more similar to black/brown English **goat** fibres.

Occasional fibres have the appearance of **horse mane hair**.

118 5003 1029 loose

As Timber 009 – The features are most consistent with **calf** (cattle) fibres.

104 5005 T034

As Timber 009 – The features are most consistent with **calf** (cattle) and adult **cattle** fibres

These fibres are very severely degraded.

114 – 5006 - T129

As Timber 009 – The features are most consistent with **calf** (cattle) fibres, though there are also smaller numbers more similar to black/brown English **goat** fibres.

These fibres are very severely degraded.

122 5005 T032 Glue ?

These are animal **fur** fibres:

Fine Fibres

Chevron to waved mosaic scaling with near margins. Uniserial ladder medullae with some double or multiseriate. Scale margins prominent.

The coarse fibres are largely absent. Only isolated examples can be found:

Coarse Fibres (Guard Hairs)

Chevron to waved mosaic scaling with near margins. Irregular mosaic at base. Some shallow petal. Smooth. Multiseriate ladder medullae.

These features are most consistent with **rabbit**.

112 5004 - T079 Plank – T078 Frame

These are vegetable stem (bast) fibres. Their ultimates, cell structures, dislocation marks and dimensions are most consistent with **hemp**.

PH Greaves

Dr PH Greaves



Appendix 4



Analysis by Fourier-transform infrared (FTIR) spectroscopy of caulking materials and coatings on timbers from the Denge Quarry shipwreck

Francesca Gherardi, Investigative Science Team, Fort Cumberland Laboratories, Historic England

1. Introduction

The investigation of the timbers recovered from the Denge Quarry shipwreck (probable 16th century wooden vessel) is part of the project “Denge Quarry Shipwreck Timbers: Updated Project Design (Post-Excavation Stage)” (HE Project Number: 9095) by Kent County Council and Wessex Archaeology.

One of the aims of the project is to study the caulking materials and the yellow coating on the timbers recovered from the site and identify the type of hairs and the organic binder.

To characterise the chemical composition of the organic binder in the caulking materials and the coatings on the timbers, gas chromatography mass spectrometry (GC/MS) was proposed to be used.

However, due to unavailability of GC/MC, a selection of the small finds was sent by Wessex Archaeology to Historic England Fort Cumberland laboratories, where they were studied by Fourier transform infrared (FTIR) spectroscopy to provide a preliminary characterisation of the organic binder in the caulking materials and the coatings on the timbers. GC/MS could not be used as not available in the laboratory.

2. Materials and methods

Small samples were collected from a selection of small finds (SF) from the caulking materials (SF032, SF103, SF110, SF113, SF114, SF117 and SF118) and the coatings on the timbers (SF103, SF120 and SF121). The samples were observed by 3D digital microscopy, using the Keyence VHX7000 3-D digital microscope at different magnifications (AHRC Award AH/V011758/1).

Then, they were analysed by FTIR spectroscopy to obtain qualitative chemical information. The FTIR spectra were acquired by a Spectrum 100 spectrometer (Perkin Elmer) equipped with a DTGS detector, fitted with Attenuated Total Reflection (ATR) diamond-ZnSe crystal accessory. Spectra were recorded over the range 650-4000 cm^{-1} , with a resolution of 4.00 cm^{-1} , and were averaged over 32 accumulations.



3. Results and discussion

3.1 3D digital microscopy

The samples from the caulking materials contain hairs from animal fibres embedded in an organic binder. In some cases, a thin black crust is visible (Figure 1, top row). Some samples are covered by a shiny dark patina, which compacts the animal fibres (Figure 1, middle row). In other samples, the hairs are embedded in a brown and powdery material (Figure 1, bottom row).

The fibres in the caulking SF032 are embedded in a resinous/gluey binder and a thin brown crust is present (Figure 2).

The samples collected from the coating on the timber are few millimetres thick, they are yellow/light brown on the recto and glassy and dark brown on the verso (Figure 3).



Figure 1. 3D digital microscopy images of samples collected from SF110 (top row), SF114 (middle row) and SF118 (bottom row) at different magnifications.



Figure 2. 3D digital microscopy images of a sample collected from SF032 at different magnifications.

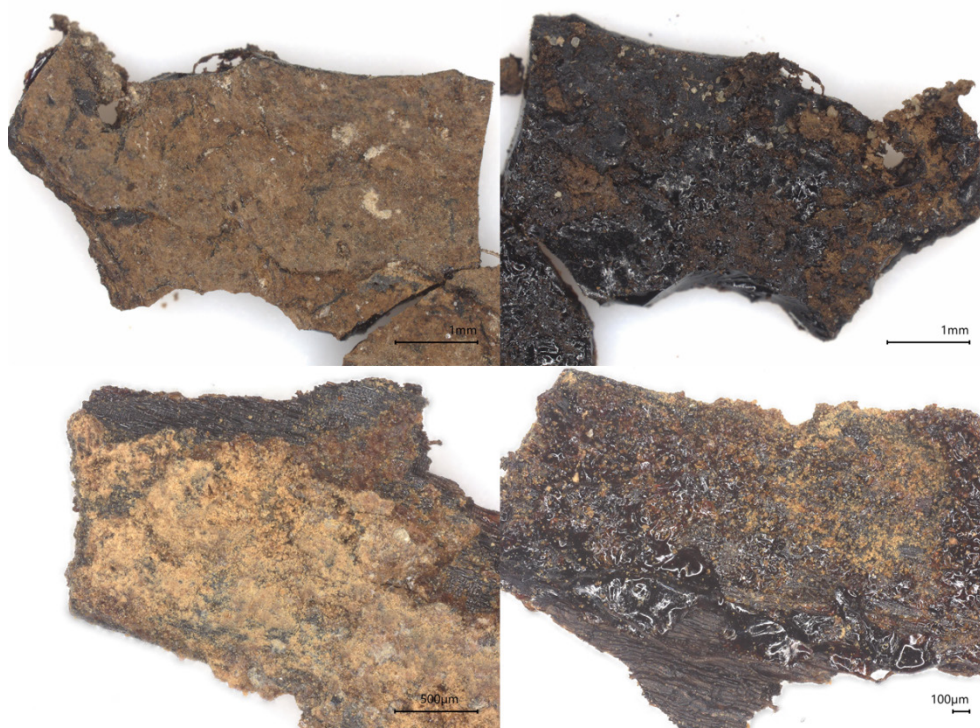


Figure 3. 3D digital microscopy images of samples collected from SF103 (top row) and SF121 (bottom row), recto (left side) and verso (right side), at different magnifications.

3.2 ATR-FTIR spectroscopy

FTIR spectroscopy was used to gain preliminary qualitative chemical information about the samples. In the analysis of organic materials from archaeological sites, it is important to highlight that the chemical composition of the materials may have been changed by treatment before use and due to ageing.

All the caulking materials gave similar FTIR spectra (Figure 4), which are characterised by peaks at about 3378 (OH stretching), 2955, 2926, 2861 (C-H stretching in CH₃ and CH₂), 1731 (C=O stretching of ester), 1686 (C=O stretching of acid), 1638 (OH stretching), 1502 (aromatic C-C bending), 1458 (CH₂ and CH₃ bending), 1383 (CH₃ bending), 1277 (OH bending) and



1170 (C-O stretching of ester) cm^{-1} . The spectra are matching the reference spectra collected from pitch (also known as pine tar or archangel tar) and a pine resin (colophony) (Figure 4). The presence of the aromatic bands in the spectra proves the presence of a pitch, as aromatisation of terpenoids occurs during its production from a conifer resin [1, 2].

Some of the samples display a high peak at about 1038 cm^{-1} (Si-O bond), which is associated to the presence of silicates/clay materials. It is difficult to determine if silicates were added intentionally as fillers to the organic binder or if they are contaminants from the seabed.

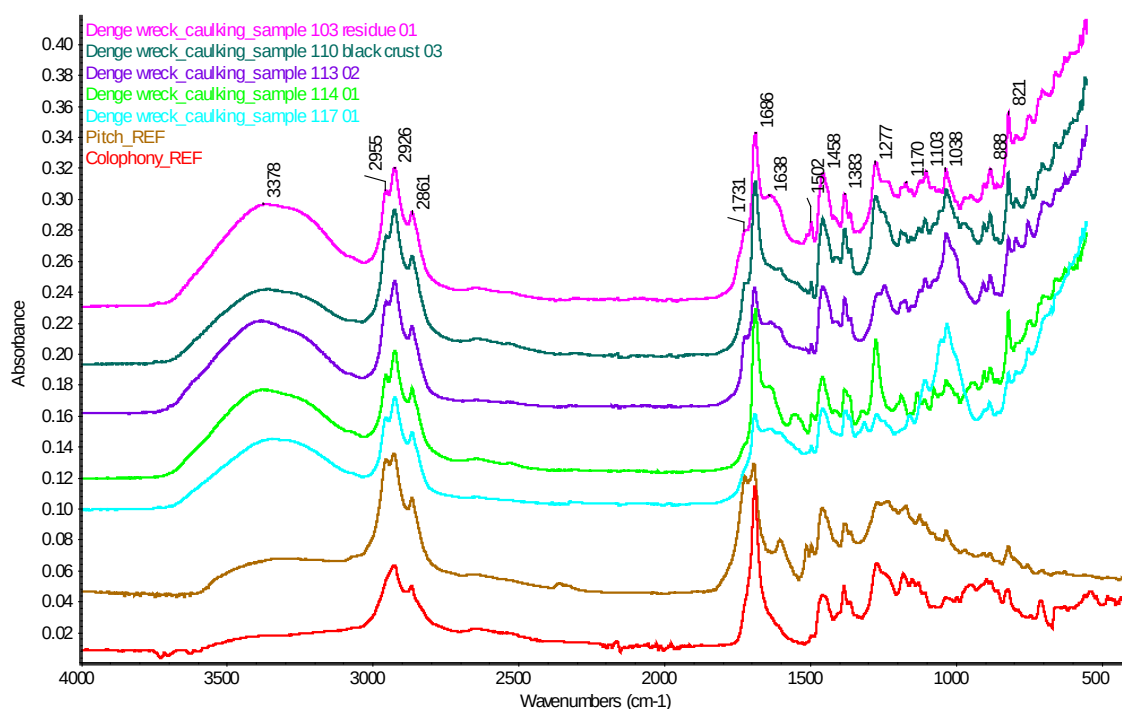


Figure 4. FTIR spectra of samples collected from SF103 (pink spectrum), SF110 (dark green spectrum), SF113 (purple spectrum), SF114 (light green spectrum) and SF117 (light blue spectrum) and the FTIR spectra of reference samples of a pitch (brown spectrum) and colophony (red spectrum).

The FTIR spectra from the resinous/gluey binder in the sample collected from SF032 display peaks that are related to the presence of a pitch. The round shape of the peak at about 1600 cm^{-1} might suggest the presence of small amounts of a proteinaceous glue (such as rabbit skin glue). This cannot be fully determined as the main peaks related to proteins in the glue overlap with the absorption bands of the pitch. Chemical extractions using different solvents can further clarify this. In addition, a high peak at about 1033 cm^{-1} due to silicates can be observed (Figure 5).

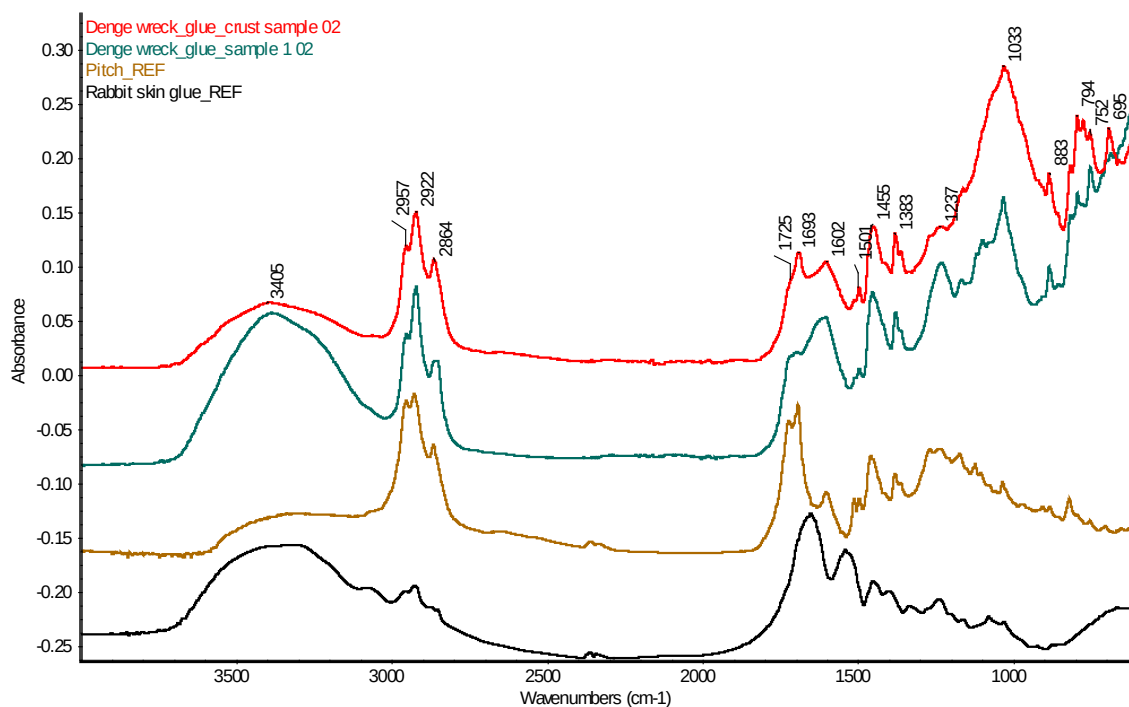


Figure 5. FTIR spectra of samples collected from SF032 (red and dark green spectra) and the FTIR spectra of reference samples of a pitch (brown spectrum) and rabbit skin glue (black sample).

The samples from the coatings covering the timbers provide similar FTIR spectra (Figure 6). They show similarities with the spectra from the caulking materials, but they display higher bands at about 1597 cm⁻¹ (aromatic C-C stretching). The spectra can be associated to the presence of a pitch (or pine tar) and a conifer resin (such as colophony).

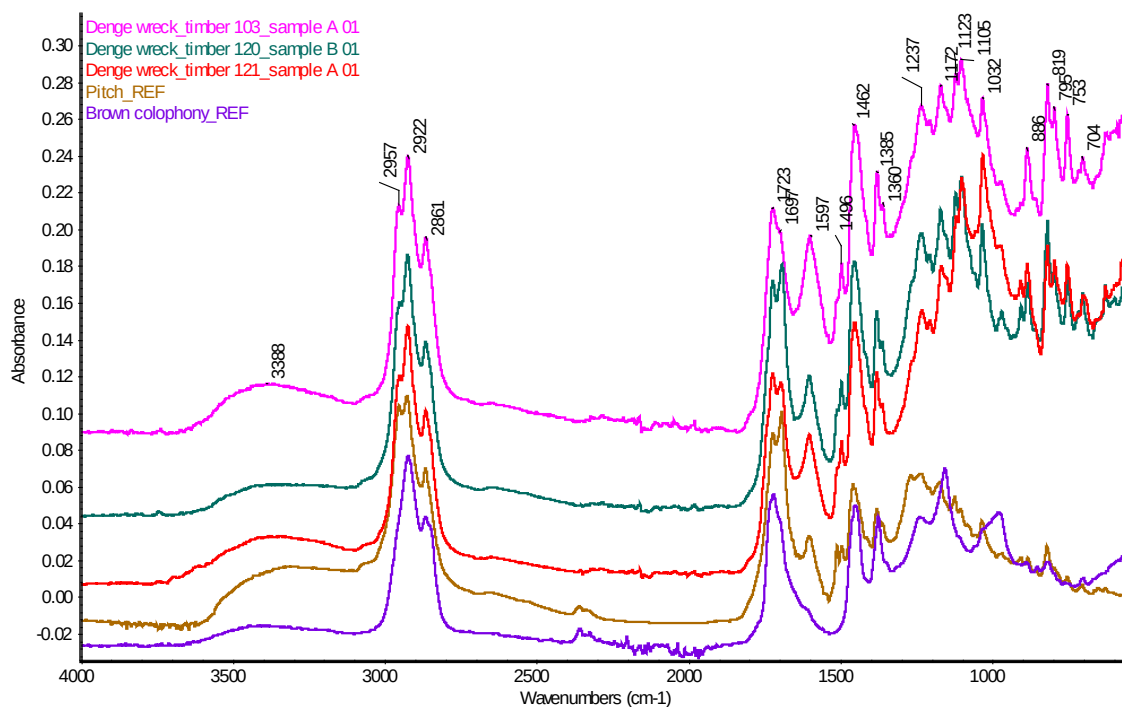


Figure 6. FTIR spectra of samples collected from SF103 (pink spectrum), SF120 (dark green spectrum) and SF121 (red spectrum) and the FTIR spectra of reference samples of a pitch (brown spectrum) and a brown colophony (purple spectrum).

The results obtained from the analysis of these organic materials by FTIR spectroscopy are consistent with other studies in the literature, which prove the use of pine tar and resin as organic binder in caulking materials and as coatings to protect timbers in ships [1-3].

4. Conclusions

FTIR spectroscopy was used to provide a preliminary characterisation of the organic binder in the caulking materials and the coatings on the timbers from the Denge Quarry shipwreck. The spectra obtained from the organic binder in the caulking materials indicate that a pine tar (distilled from resinous pinewood) was used most probably together with a pine resin (such as colophony).

A proteinaceous glue (such as rabbit skin glue) was probably added to pine tar in the resinous/gluey binder in the caulking material SF032.

The coatings on the timbers consist of a pitch most probably mixed with a pine resin.

To better distinguish complex pine tar and identify molecular biomarkers indicative of specific pine species, GC/MS analysis should be carried out.



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Appendix 5

Denge Quarry Shipwreck, Kerton Road, Lydd, Kent

Ring-width and Oxygen Isotope Dendrochronology

Alison Arnold, Robert Howard, Neil J. Loader, Darren Davies,
Danny McCarroll and Cathy Tyers



Denge Quarry Shipwreck, Kerton Road, Lydd, Kent

Ring-width and Oxygen Isotope Dendrochronology

Alison Arnold, Robert Howard, Neil J. Loader, Darren Davies, Danny McCarroll and Cathy Tyers

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Summary

Dendrochronological analysis was undertaken on 50 samples from 49 timbers, or timber fragments, from a wooden vessel of carvel construction uncovered during dredging operations at the Denge Quarry site on the Kent coast. Seven of these samples were elm, whilst the remaining 43 were oak. Analysis by ring-width dendrochronology resulted in the successful dating of 25 of the oak timbers. A further five timbers, two oak and three elm, were dated by oxygen isotope dendrochronology. A likely construction date for the vessel in the mid-AD 1530s to mid-AD 1540s is indicated, with subsequent repairs being undertaken, with at least one of the later repair timbers being derived from a tree felled in the spring of AD 1561. This date indicates that this is a relatively early example of this type of vessel.

Contributors

Alison Arnold, Robert Howard, Neil J. Loader, Darren Davies, Danny McCarroll and Cathy Tyers

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Andrea Hamel and Paolo Croce, both of Wessex Archaeology, are thanked for their considerable help and input into this programme of tree-ring analysis. Casper Johnson (Kent County Council Senior Archaeological Officer), Stuart Churchley (Historic England Marine Planning Officer), and Hefin Meara (Historic England National Listing Adviser, Marine) are thanked for their support and input. Finally, we would like to thank Shahina Farid (Historic England Scientific Dating Coordinator) for commissioning this programme of dendrochronology and for her input into this report.

Front cover image

Shipwreck fragments uncovered during dredging operations at Denge Quarry on the Kent coast. [Photograph Wessex Archaeology]

Archive location

The Historic England Archive, The Engine House, Fire Fly Avenue, Swindon SN2 2EH

Historic Environment Record

Kent Historic Environment Record, Heritage Conservation, Kent County Council, Invicta House, County Hall, Maidstone, Kent ME14 1XX

Date of investigation

The wreck fragments were uncovered during dredging operations in April 2022. An interim report on the dendrochronological analysis was produced in August 2022, followed by

oxygen isotope dendrochronology commissioned in September 2023. This final report was submitted in July 2025.

Contact details

Historic England, Cannon Bridge House, 25 Dowgate Hill, London, EC4R 2YA. ☎ 020 7973 3700. ✉ customers@HistoricEngland.org.uk

Alison Arnold and Robert Howard, Nottingham Tree-ring Dating Laboratory, Mayfield Cottage, Tattle Hill, Dale Abbey, Ilkeston, DE7 4RR. ✉ alisonarnold@tree-ringdating.co.uk; ✉ roberthoward@tree-ringdating.co.uk

Neil J Loader, Darren Davies, Danny McCarroll, Department of Geography, Swansea University Wales, SA2 8PP ✉ n.j.loader@swansea.ac.uk ✉ d.mccarroll@swansea.ac.uk, ✉ d.davies@swansea.ac.uk

Cathy Tyers, Historic England, Cannon Bridge House, 25 Dowgate Hill, London, EC4R 2YA, ✉ cathy.tyers@historicengland.org.uk.

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Introduction

During dredging operations in April 2022 at CEMEX's Denge Quarry on the Romney Marshes, in Kent (Figs 1 and 2), the remains of a wooden vessel were revealed (Fig 3). CEMEX facilitated recovery, temporary storage, and access to these remains for recording, and subsequent reburial. The preliminary archaeological assessment report produced in May 2022 (Wessex Archaeology 2022) concluded that the remains, including articulated sections of the hull, disarticulated timbers and timber fragments, were those of a carvel-built wooden vessel, although it remained a possibility that some of the disarticulated timbers/timber fragments could be from a different vessel. Close parallels in construction detail with previously analysed vessels suggested a sixteenth, or early-seventeenth century date, for this vessel indicating the remains were potentially of national significance. Further details can be found in the Project Design produced for Historic England by Kent County Council and Wessex Archaeology in July 2022 (Kent County Council 2022a) and in the Updated Project Design prepared for Historic England in November 2022 (Kent County Council 2022b), in advance of a formal publication.

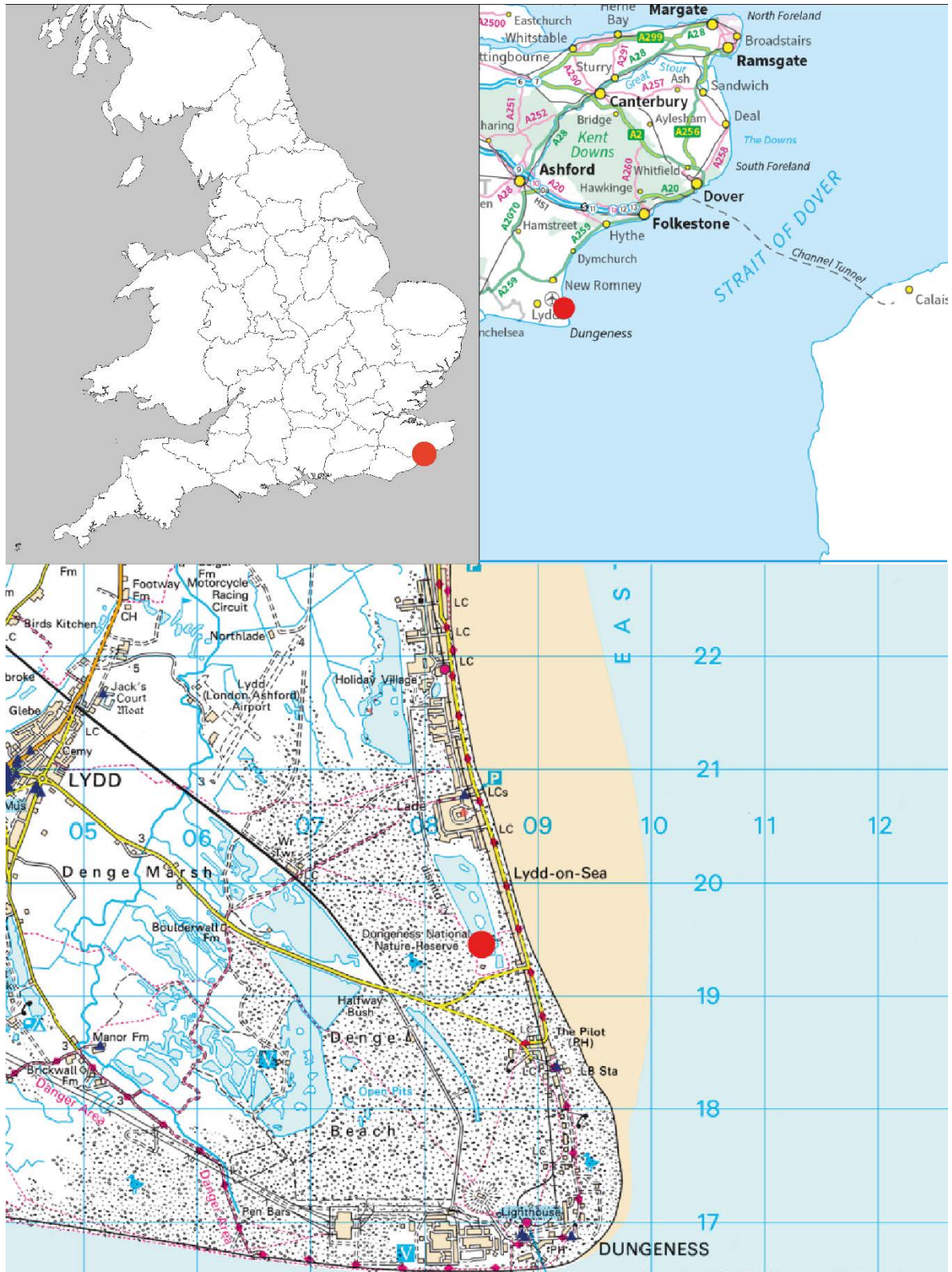


Figure 1: Maps to show the location of Denge Quarry dredging operation in Lydd, Kent. Top right: Scale: 1:615,000. Bottom: Scale 1:38,500. [© Crown Copyright and database right 2025. All rights reserved. Ordnance Survey Licence number 100024900]



Figure 2: Detailed location of the Denge Quarry wreck. [photograph Wessex Archaeology]



Figure 3: One of the articulated sections of the vessel at the quarry site. [photograph Wessex Archaeology]

Ring-width dendrochronology

Sampling

Ring-width dendrochronological analysis was commissioned to provide independent dating evidence and hence inform understanding and significance of the vessel remains.

Following the preliminary assessment of the remains by Wessex Archaeology, cross-sectional slice samples (e.g. Figs 4a–d) from 15 timbers were submitted for dendrochronological analysis in June 2022 and a further 35 samples were sent in October 2022.

Each sample in the initial batch was initially designated a laboratory code, DEN-G (for 'Denge'), and numbered 01–15, these being cross-referenced to the initial identifiers allocated by Wessex Archaeology, based on the number of the articulated section or disarticulated timber and, where appropriate, the number of samples taken from timbers of an articulated section (e.g. section 5004, sample 1), in Table 1. These samples were subsequently, mostly given Unique ID numbers by Wessex Archaeology. The second batch of 35 samples, including a duplicate sample from a timber previously sampled (037 / DEN-G02), had been allocated Unique ID numbers by Wessex Archaeology prior to submission of the samples to the laboratory. Details of these samples are also given in Table 1. Further information pertaining to most of the samples can be found in Wessex Archaeology documents Dendrochronology samples summary (264780.02) and Dendrochronology sample summary II (264780.05).

Analysis and results

During sample preparation using standard techniques, it was noted that seven of the 50 samples were not oak. These were subsequently identified as elm (*Ulmus* sp.). All remaining samples were oak (*Quercus* sp.) but three (095, 110, 114) with less than 30 rings were deemed unsuitable for secure dating purposes. All seven elm samples and the remaining 40 oak samples (representing 39 oak timbers) were measured, the raw ring-width data being given in Appendix 1. The outermost rings on some samples were unmeasurable. This was due to a combination of distortion and degradation of the outer surface, and in some instances these outermost rings were also very narrow, precluding reliable measurement. Such rings were counted, where possible, or an estimate of the number of rings present was made.

The data series of the duplicate oak samples from timber 037 (037 / DEN-G02) matched with a value of $t = 15.4$ and were thus combined to produce a single timber series, 037m.



Figure 4a: Oak outer plank sample 079 (vessel section 5004, sample 3) as supplied to the Nottingham Tree-Ring Dating Laboratory. [photograph Wessex Archaeology]



Figure 4b: Oak frame, possible filling frame, sample 061 (vessel section 5004, sample 4) as supplied to the Nottingham Tree-Ring Dating Laboratory. [photograph Wessex Archaeology]



Figure 4c: Elm outer plank, possibly of sternpost, sample 102 (vessel section 5007) as supplied to the Nottingham Tree-Ring Dating Laboratory. [photograph Wessex Archaeology]



Figure 4d: Oak frame sample 025 (vessel section 5026) as supplied to the Nottingham Tree-Ring Dating Laboratory. [photograph Wessex Archaeology]

Table 1: Details of tree-ring samples from the CEMEX Denge Quarry Shipwreck, Lydd-on-Sea, Kent. Samples are oak unless stated otherwise, with elm timbers being highlighted in grey

UID / lab code	Part of section and description	Total rings	Sapwood rings	First measured ring date AD	Last heartwood ring date AD	Last measured ring date AD
- / DEN-G09	5010 Outer plank with hood	61	no h/s	1437	-----	1497
- / DEN-G11	5014 Outer plank, elm	73	no h/s	-----	-----	-----
- / DEN-G12	5015 Plank, possibly outer plank	51	no h/s	-----	-----	-----
- / DEN-G13	5025 Frame	111+1nm	(+h/s)	1400	----- (1511)	1510
- / DEN-G15	5027 Frame	112+3nm	(+h/s?)	1392	1503?	1503
006	5024 Disarticulated unknown plank	134+2nm	no h/s	1380	-----	1513
025 / DEN-G14	5026 possible filling frame	11nm+ 45	5	(1490) 1501	1540	1545
026	Disarticulated frame, possibly from different wreck	95	10	-----	-----	-----
028	Disarticulated frame, possibly from different wreck	60+	18 +3nm	-----	-----	-----
030 / DEN-G06	5005/1 Filling frame	85+3nm	no h/s	1407	-----	1491
034 / DEN-G07	5005/2 Outer plank	124	no h/s	1374	-----	1497
037m	5004 Ceiling plank	74	no h/s	1443	-----	1516
037 / DEN-G02	ditto/2, primary sample	71+1nm	no h/s	1443	-----	1513
037	ditto, duplicate sample	69	no h/s	1448	-----	1516
040	5004 Ceiling plank	100	h/s?	1427	1526?	1526
041	5004 Ceiling plank	67	no h/s	-----	-----	-----
044	5004 Filling frame	54+	16 +2nm	1504	1541	1557
047	5004 Floor	67	4	1442 _l	1506 _l	1510 _l
048	5004 Floor	47	5	1481 _l	1523 _l	1527 _l
053	5004 Floor	69	13	1457	1512	1525
056	5004 Floor	103	3	1410	1509	1512
057 / DEN-G05	5004/5 Frame, filling frame	44+2nm	(+h/s)	1503	----- (1548)	1546

059	5004 Filling frame	50	h/s	1487	1536	1536
061 / <i>DEN-G04</i>	5004/4 Filling frame	59+	19 +1¼nm C	1501	1540	1559
064	5004 Outer plank	61	no h/s	1444	-----	1504
065	5004 Outer plank	103	no h/s	1388	-----	1490
067 / <i>DEN-G01</i>	5004/1 Outer plank, elm	78	no h/s	-----	-----	-----
068	5004 Futtock	91	h/s	1419	1509	1509
069	5004 Futtock	101	h/s	-----	-----	-----
074	5004 Futtock	112	h/s?	1389	1500?	1500
075	5004 Futtock	98+	h/s +15-20nm	1401	1498	1498
076	5004 Futtock	79+	h/s +25-35nm	-----	-----	-----
079 / <i>DEN-G03</i>	5004/3 Outer plank	99	no h/s	1380	-----	1478
088	5006 Floor	75	no h/s	1409	-----	1483
095	5004 Tingle	nm	---	-----	-----	-----
096	5004 Outer plank	89	h/s?	1423	1511?	1511
097	5004 Outer plank, elm	44	no h/s	-----	-----	-----
099	5004 Tingle	89	no h/s	-----	-----	-----
101	5007 Gardboard	88	no h/s	-----	-----	-----
102 / <i>DEN-G08</i>	5007 Outer plank, possibly of sternpost, elm	79	no h/s	1452 _l	-----	1530 _l
103	5007 Outer plank, elm	67	no h/s	1470 _l	-----	1536 _l
110	Wedge found between 050/092	nm	---	-----	-----	-----
112	5004 Outer plank, elm	68	no h/s	-----	-----	-----
113	5004 Outer plank	79	no h/s	-----	-----	-----
114	5004 Dutchman or repair (broken)	nm	---	-----	-----	-----
115	5004 Repair	80	no h/s	-----	-----	-----
116	5004 Dutchman or repair	54	no h/s	-----	-----	-----
121	5007 Inner plank, elm	68+1nm	no h/s	1413 _l	-----	1480 _l
124 / <i>DEN-G10</i>	5013 possible futtock or filling frame	180+	5 +20-25nm	1335	1509	1514
132	Disarticulated frame, possibly from different wreck	69	no h/s	1420	-----	1488

133	Disarticulated, frame possibly from different wreck	41	5	-----	-----	-----
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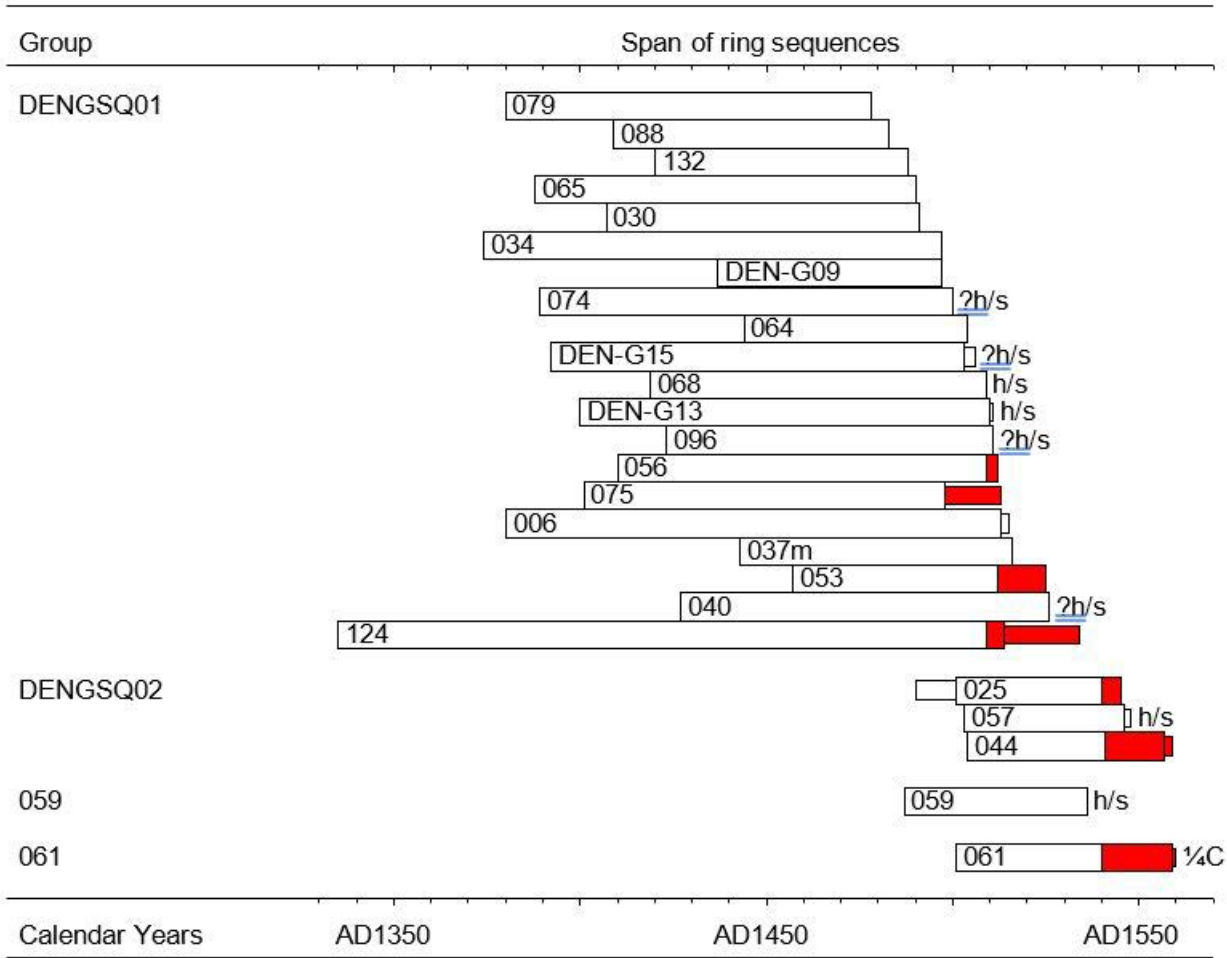
h/s = the heartwood/sapwood ring is the last ring on the sample; h/s? = the possible heartwood/sapwood ring is the last ring on the sample; nm = sample not measured; *nnm* = rings present that could not be reliably measured; ¼C = complete sapwood, felled the following spring; _i = oxygen isotope date (all other dates have been derived through standard ring-width dendrochronology);

The data series of this and the remaining 38 measured oak samples were then compared with each other by the Litton/Zainodin grouping procedure (see Appendix 2). This comparative process resulted in the identification of a group comprising samples from 20 timbers, these grouping at a minimum value of $t = 3.0$, and cross-matching with each other at the positions illustrated in Figure 5. These 20 series were combined at their indicated offset positions to form DENGSQL01, a site chronology with an overall length of 192 rings. Site chronology DENGSQL01 was then compared with an extensive corpus of oak reference chronologies, this indicating a repeated series of strong cross-matches when the first ring of the site chronology dates to AD 1335 and the date of its latest ring is AD 1526 (Table 2).

Cross-matching was also identified between three other samples at a minimum value of $t = 4.1$. The cross-matching positions are illustrated in Figure 5. These three series were combined at their indicated offset positions to form DENGSQL02, a site chronology with an overall length of 57 rings. Site chronology DENGSQL02 was then also compared with oak reference chronologies, this indicating a repeated series of strong cross-matches when the first ring of the site chronology dates to AD 1501 and the date of its latest ring is AD 1557 (Table 3). In view of the relatively short overlaps between the three individual component series, these were also compared to the oak reference chronologies (Tables 4a–c), as well as being analysed using a variant of the Belfast CROS program (Baillie and Pilcher 1973; Tyers 2004).

Site chronologies DENGSQL01 and DENGSQL02 were compared with the 16 remaining, measured but ungrouped, oak samples, but there was no satisfactory cross-matching. These 16 samples were, therefore, compared individually with the full corpus of reference material for oaks. Secure cross-matching was obtained for two samples, 059 and 061 (Fig. 5; Tables 5 and 6), but there was no satisfactory cross-matching for the remaining 14 oak samples which therefore remain undated by ring-width dendrochronology.

The data of the seven measured elm series were also compared with each other, but perhaps not unexpectedly, bearing in mind the challenging nature of ring-width dendrochronological analysis of elm (Bridge 2020), there was no secure cross-matching identified between any of the samples. All were compared to the oak data from this site, as well as the oak reference chronologies, but to no avail. The elm samples therefore remain undated by ring-width dendrochronology.



White bars = heartwood rings; red bars = sapwood rings; narrow bars = unmeasured rings; h/s = the heartwood/sapwood ring is the last ring on the sample; h/s? = the possible heartwood/sapwood ring is the last ring on the sample; 1/4C = complete sapwood, felled the following spring

Figure 5: Bar diagram showing the relative positions of overlap of the samples from the 25 oak timbers dated by ring-width dendrochronology arranged by group and last ring date

Table 2: Results of the cross-matching of site sequence DENG SQ01 and relevant reference chronologies when the first-ring date is AD 1335 and the last-ring date is AD 1526

Reference chronology	Span of chronology	t-value	Reference
Abbot's Lodging, Coggeshall Abbey, Essex	AD 1372–1567	10.9	Arnold and Howard 2015a
Chilton Manor, Sittingbourne, Kent	AD 1368–1520	9.2	Howard et al. 1988
Walmer Castle, Walmer, Kent	AD 1396–1523	9.2	Arnold and Howard 2015b
Otley Hall, Suffolk	AD 1415–1587	9.2	Bridge 2001
Windsor Castle, Berkshire	AD 1192–1613	8.6	Tyers et al. 1997
Manningtree, Essex	AD 1384–1534	8.5	Loader unpubl 1996
Chenies Manor, Chenies, Buckinghamshire	AD 1370–1551	8.4	Miles et al. 2004
Crows Hall, Debenham, Suffolk	AD 1406–1559	8.3	Miles et al. 2007
Queen Elizabeth Hunting Lodge, Chingford, London	AD 1398–1541	8.2	Tyers and Hibberd 1993
Hays Wharf, Southwark, London	AD 1248–1647	8.1	Tyers 1996a; Tyers 1996b

Table 3: Results of the cross-matching of site sequence DENG SQ02 and relevant reference chronologies when the first-ring date is AD 1501 and the last-ring date is AD 1557

Reference chronology	Span of chronology	t-value	Reference
Otley Hall, Suffolk	AD 1415–1587	8.8	Bridge 2001
Woodbarns Farm, Belchamp St Paul, Essex	AD 1482–1544	7.0	Bridge et al. 2021
Bramcote Church, Nottinghamshire	AD 1393–1586	6.6	Howard et al. 1995
55-63 Stoneham Street, Coggeshall, Essex	AD 1338–1554	6.5	Miles and Bridge 2013
Polesworth Abbey gatehouse, Warwickshire	AD 1446–1582	6.5	Arnold and Howard 2007
Model Farm, Linstead Magna, Suffolk	AD 1497–1614	6.3	Bridge 2002
Oracle site, Reading, Berkshire	AD 1468–1611	6.2	Miles 2013
New Buckingham, Norfolk	AD 1509–1683	6.1	Cooper et al. 2012
Weston Hall, Weston upon Trent, Derbyshire	AD 1480–1628	6.0	Arnold et al. 2020
Crows Hall, Debenham, Suffolk	AD 1406–1559	6.0	Miles et al. 2007

Table 4a: Results of the cross-matching of 025, one of the three individual component series of site sequence DENGSEQ02, and relevant reference chronologies when the first-ring date is AD 1501 and the last-ring date is AD 1545

Reference chronology	Span of chronology	t-value	Reference
Otley Hall, Suffolk	AD 1415–1587	6.0	Bridge 2001
Osterley House stables, London	AD 1379–1567	5.9	Tyers 2009a
Convoys Wharf, London	AD 1371–1756	5.6	Tyers 2013
Powcher's Hall east roof, Ely, Cambridgeshire	AD 1457–1609	5.4	Arnold et al. 2004
Coggeshall Abbey, Essex	AD 1372–1567	5.4	Arnold and Howard 2015a
Letheringham Lodge, Suffolk	AD 1490–1608	5.1	Miles and Bridge 2014
23 East Street, Coggeshall, Essex	AD 1472–1599	4.9	Tyers 2011
Paycockes, Coggeshall, Essex	AD 1346–1587	4.7	Tyers 2006
Boyes Croft Maltings, Great Dunmow, Essex	AD 1470–1553	4.6	Bridge 1999
Weston Hall, Weston upon Trent, Derbyshire	AD 1480–1628	4.6	Arnold et al. 2020
Church of St Peter and St Thomas, Stambourne, Essex	AD 1435–1570	4.5	Tyers 2000a

Table 4b: Results of the cross-matching of 044, one of the three individual component series of site sequence DENGSEQ02, and relevant reference chronologies when the first-ring date is AD 1504 and the last-ring date is AD 1557

Reference chronology	Span of chronology	t-value	Reference
Polesworth Abbey gatehouse, Warwickshire	AD 1446–1582	5.8	Arnold and Howard 2007
Chantry, Fenny Stratford, Buckinghamshire	AD 1468–1591	5.7	Bridge 1993
Broadway House, Debenham, Suffolk	AD 1497–1600	5.6	Miles et al. 2009
Osterley House stables, London	AD 1379–1567	5.2	Tyers 2009a
Oracle site, Reading, Berkshire	AD 1468–1611	5.1	Miles 2013
Otley Hall, Suffolk	AD 1415–1587	5.1	Bridge 2001
Bodleian Library, Oxford	AD 1385–1610	5.1	Miles and Worthington 1999
St Clair's Farm, Droxford, Hampshire	AD 1468–1610	5.1	Bridge et al. 2016
Langley Abbey, Norfolk	AD 1436–1611	5.0	Arnold et al. 2014
St Marys' Church, Cratfield, Suffolk	AD 1503–1640	5.0	Bridge 2008

Table 4c: Results of the cross-matching of 057, one of the three individual component series of site sequence DENGSEQ02, and relevant reference chronologies when the first-ring date is AD 1503 and the last-ring date is AD 1546

Reference chronology	Span of chronology	t-value	Reference
Ballingdon Bridge, Sudbury, Suffolk	AD 1484–1790	6.5	Tyers 2002
Powcher's Hall, Ely, Cambridgeshire	AD 1457–1609	6.4	Arnold et al. 2004
Oracle site, Reading, Berkshire	AD 1468–1611	6.2	Miles 2013
Paycockes, Coggeshall, Essex	AD 1346–1587	6.0	Tyers 2006
Gosfield Hall, nr Halstead, Essex	AD 1449–1537	5.9	Bridge 1998
Hampton Court Palace, Richmond upon Thames, London	AD 1498–1633	5.5	Miles et al. 2007
Letheringham Lodge, Suffolk	AD 1490–1608	5.3	Miles and Bridge 2014
St Nicholas' Church, Brighthelm, Leicestershire	AD 1502–1687	5.2	Arnold et al. 2005
23 East Street, Coggeshall, Essex	AD 1472–1599	5.2	Tyers 2011
Coggeshall Abbey, Essex	AD 1372–1567	5.1	Arnold and Howard 2015a
Model Farm, Linstead Magna, Suffolk	AD 1497–1614	5.0	Bridge 2002

Table 5: Results of the cross-matching of site sequence 059 and relevant reference chronologies when the first-ring date is AD 1487 and the last-ring date is AD 1536

Reference chronology	Span of chronology	t-value	Reference
Bridgewater Cottage, Wribbenhall, Worcestershire	AD 1400–1619	7.2	Tyers 2007
2 Wyre Hill, Bewdley, Worcestershire	AD 1354–1590	6.5	Tyers 2015
Mere Hall, Hanbury, Worcestershire	AD 1408–1610	6.5	Miles et al. 2005
Stokesay Castle, Shropshire	AD 1449–1640	6.4	Miles et al. 1997
26 Westgate Street, Gloucester, Gloucestershire	AD 1399–1622	6.2	Howard et al. 1998
Pyke Barn Cottage, Chalgrove, Oxfordshire	AD 1419–1555	6.0	Miles and Bridge 2015
The Readers House, Ludlow, Shropshire	AD 1406–1622	5.9	Bridge and Miles 2011
Lower Brockhampton gatehouse, Bromyard, Herefordshire	AD 1368–1543	5.7	Nayling 2001
Plowstall Farmhouse, Bayton, Worcestershire	AD 1410–1570	5.6	Miles et al. 2008
St John the Baptist Church, Myndtown, Shropshire	AD 1420–1568	5.5	Arnold et al. 2022

Table 6: Results of the cross-matching of site sequence 061 and relevant reference chronologies when the first-ring date is AD 1501 and the last-ring date is AD 1559

Reference chronology	Span of chronology	t-value	Reference
Otley Hall panelling, Suffolk	AD 1380–1555	6.6	Tyers 2000b
Boyes Croft Maltings, Dunmow, Essex	AD 1470–1553	6.4	Bridge 1999
Old Manor Farm, Tacolneston, Norfolk	AD 1497–1594	5.8	Tyers 2009b
Manor Cottage, Prees, Shropshire	AD 1421–1553	5.6	Miles et al. 1995
Upper Lake, Westbury, Shropshire	AD 1418–1546	5.5	Worthington and Miles 2001
Hyde Farm, Middleton Priors, Shropshire	AD 1442–1547	5.3	Miles et al. 2004
Walton House, Stafford Road, Stone, Staffordshire	AD 1451–1613	5.3	Arnold and Howard unpubl 2018
Bramhall Hall, Stockport, Cheshire	AD 1359–1590	5.3	Arnold and Howard unpubl 2013
The Dower House, Bayham Abbey, East Sussex	AD 1469–1550	5.4	Arnold and Howard 2006
Chambers Wharf, London	AD 1421–1703	5.2	Tyers 2019

Oxygen isotope dendrochronology

Following the completion of the ring-width dendrochronological analysis, those samples that remained undated were reviewed with respect to their significance in informing understanding of the wreck and their potential suitability for oxygen isotope dendrochronology. This review led to six samples being selected and submitted for oxygen isotope dendrochronology. These were given a laboratory code of DENG in front of their Unique ID numbers.

Methodology

Oxygen isotope dendrochronology relies upon the same fundamental principles, limitations, and assumptions as conventional (ring-width-based) dendrochronology. However, rather than using ring-width measurements, it uses the ratio of heavy to light oxygen isotopes (McCarroll and Loader 2004) in the latewood cellulose ($\delta^{18}\text{O}$). The isotopes can have a higher signal to noise ratio than ring-width measurements and strong signals do not require the trees to be growing under any environmental stress (Young et al. 2015).

The method relies on a regional master chronology (Loader et al. 2019) constructed using oak timbers previously dated by ring-width dendrochronology sourced from across approximately 45,200km² (20,000 mile²) region centred on Oxfordshire, in south-central England. The chronology was developed as part of a Leverhulme Trust funded project (RPG-2014-327) and currently covers a period from AD 1200–2000 with annual replication (sample depth) of 10 trees throughout the chronology period.

Ring sampling

The six samples provided for isotope dendrochronology were three oak (028, 047 and 048) and three elm (102, 103, 121). A thin slice (4mm) is removed from the base of the samples selected for isotopic analysis. This initial sub-sampling ensures that the original measured surface from which the reported ring-width measurements were derived is physically preserved and archived for future scientific analysis, as is the case for all samples obtained during Historic England funded investigations on historic buildings.

Several physiological studies of oak trees have shown that the earlywood is partially formed from carbohydrates fixed in previous years (Richardson et al. 2013; McCarroll et al. 2017). To avoid this chemical carry-over effect in oak, only the latewood of each tree-ring is prepared for chemical analysis and dating. Elm, chestnut, ash, and other ring-porous species probably also exhibit a similar carry-over of carbohydrate from latewood to earlywood (Loader et al. 2021). For consistency of approach, latewood only was analysed

isotopically. Each latewood ring is carefully removed as thin slivers (approximately 40µm thick) using a scalpel and dissecting microscope.

Laboratory methods

Wood samples are converted to α -cellulose using an acidified sodium chlorite solution with removal of hemicelluloses by sodium hydroxide (after Loader et al. 1997). Samples are homogenised using an ultrasonic probe and vacuum-dried at -50°C for 48 hours, and then 0.30–0.35mg of dry α -cellulose are weighed into individual silver foil capsules for pyrolysis to carbon monoxide (CO) at 1400°C (Woodley et al. 2012). The resulting carbon monoxide is analysed using a Delta V isotope-ratio mass spectrometer. Data are expressed as per mille (‰) deviations relative to the Vienna Standard Mean Ocean Water (VSMOW) international standard. Analytical precision is typically 0.30‰ (σ_{n-1} , $n=10$) (Loader et al. 2015). The master chronology was prepared as two independent pools of five trees to ensure quality control and the resulting data combined to form the ten-tree master chronology. Individual samples for dating are prepared and analysed separately, using identical preparation protocols. The resulting stable isotopic data are presented as chronologies (time series).

Statistical analysis and dating

Tree-ring oxygen isotope data have statistical properties that are quite different from ring-widths, requiring different pre-treatment. The Baillie-Pilcher filter that works well for ring width dating (Baillie and Pilcher 1973) is not appropriate for isotope data and would result in unrealistically high t -values (Loader et al. 2019). The isotope data are filtered using a simple nine-year rectangular filter, with indices derived by subtraction. Degrees of freedom are corrected for autocorrelation and filtering, resulting in t -values that conform to a Student's t -distribution and can be used to calculate one-tail probabilities of error. The probabilities are corrected for multiple testing by dividing them by the number of possible matches against the master chronology (a 'Bonferroni' correction) (Dunn 1959; 1961). The ratio of probabilities for the first and second highest t -values provides an 'isolation factor'. Potential dates are only considered for acceptance when the corrected probability of error is less than one in a hundred and the probability for the best match is more than an order of magnitude less likely to be in error than the next best match. All t -values pertaining to isotope data in this report are Student's t -values.

Cross-matching between isotope samples is achieved using the same approach, with the number of possible matches determined by setting a minimum size of overlap. Student's t -values are reported as well as the highest correlation coefficient, offset in ring number, and size of overlap.

In oxygen isotope dendrochronology it is not always necessary or possible to obtain isotopic measurements on each tree-ring, in which case the last ring measured isotopically

must be placed within the context of the entire sample. This may require addition of years identifiable in the sample, but not measured isotopically. Once a date for the last ring has been calculated, a felling date or sapwood estimate may be assigned using identical methods to those in ring-width dendrochronology (see below; Appendix 2).

Results

Sixty-one isotope measurements were conducted on oak sample DENG028 which correspond to rings 1 to 60 of the measured ring width series; an additional ring (equivalent to ring 61) was observed and measured at the outer edge of the sample prepared for isotope analysis.

Forty-nine isotope measurements were conducted on oak sample DENG047 which correspond to rings 0 to 45 and 52 to 54 of the measured ring width series. An additional partial ring was observed at the start of the isotope sample (ring 0). It was not possible to extract latewood cellulose for the narrow rings 46-51.

Forty-five isotope measurements were conducted on oak sample DENG048 which correspond to rings 1 to 45 of the measured ring width series.

Seventy-two isotope measurements were conducted on the elm sample DENG102 which correspond to rings 6 to 77 of the measured ring width series.

Sixty-six isotope measurements were conducted on the elm sample DENG103 which correspond to rings 1 to 66 of the measured ring width series.

Fifty-three isotope measurements were conducted on the elm sample DENG121 which correspond to rings 15-52, 54-58 and 60-68 of the measured ring width series; an additional ring was observed at the outer edge of the isotope sample (equivalent to ring 69). It was not possible to extract latewood cellulose for the rings 53 and 59.

The individual series were compared against the Loader et al. (2019) reference chronology. DENG028 does not pass the statistical thresholds for consideration and is currently considered undated (Table 7). The other series DENG047, DENG048, DENG102, DENG103, DENG121 all pass the statistical thresholds for consideration of a date, although two (DENG047 and DENG048) with relatively low match statistics (Table 7). The relative dating (cross matching) of the individual series agrees with the dates obtained against the reference chronology. A 109-year isotope composite series (Fig 6), deng_elm_all, was developed from the three isotopically-dated overlapping elm series; this dates securely against the Loader et al. (2019) reference chronology. Whilst both the oak series DENG047 and DENG048 dated independently against the reference chronology, given the short series overlap (<15 datapoints) a composite series was not developed.

To provide additional confidence in these results the six series were also compared against a Central England and West Chronology currently in development. This chronology is derived from samples sourced across a larger geographical region and has enhanced sample replication relative to the Loader et al. (2019) reference chronology. This comparison confirms the results obtained against the published reference curve, with all five previously dated series confirmed with significantly enhanced match statistics (Table 8).

Sample DENG047 returns a date of AD1497 for ring 54 which relates to a date of AD1510 for the last full ring-width measurement (ring 67).

Sample DENG048 returns a date of AD1525 for ring 45 which relates to a date of AD1527 for the last full ring-width measurement (ring 47).

Sample DENG102 returns a date of AD1528 for ring 77 which relates to a date of AD1530 for the last full ring-width measurement (ring 79).

Sample DENG103 returns a date of AD1535 for ring 66 which relates to a date of AD1536 for the last full ring-width measurement (ring 67).

Sample DENG121 returns a date of AD1481 for ring 69 which relates to a date of AD1480 for the last full ring-width measurement (ring 68).

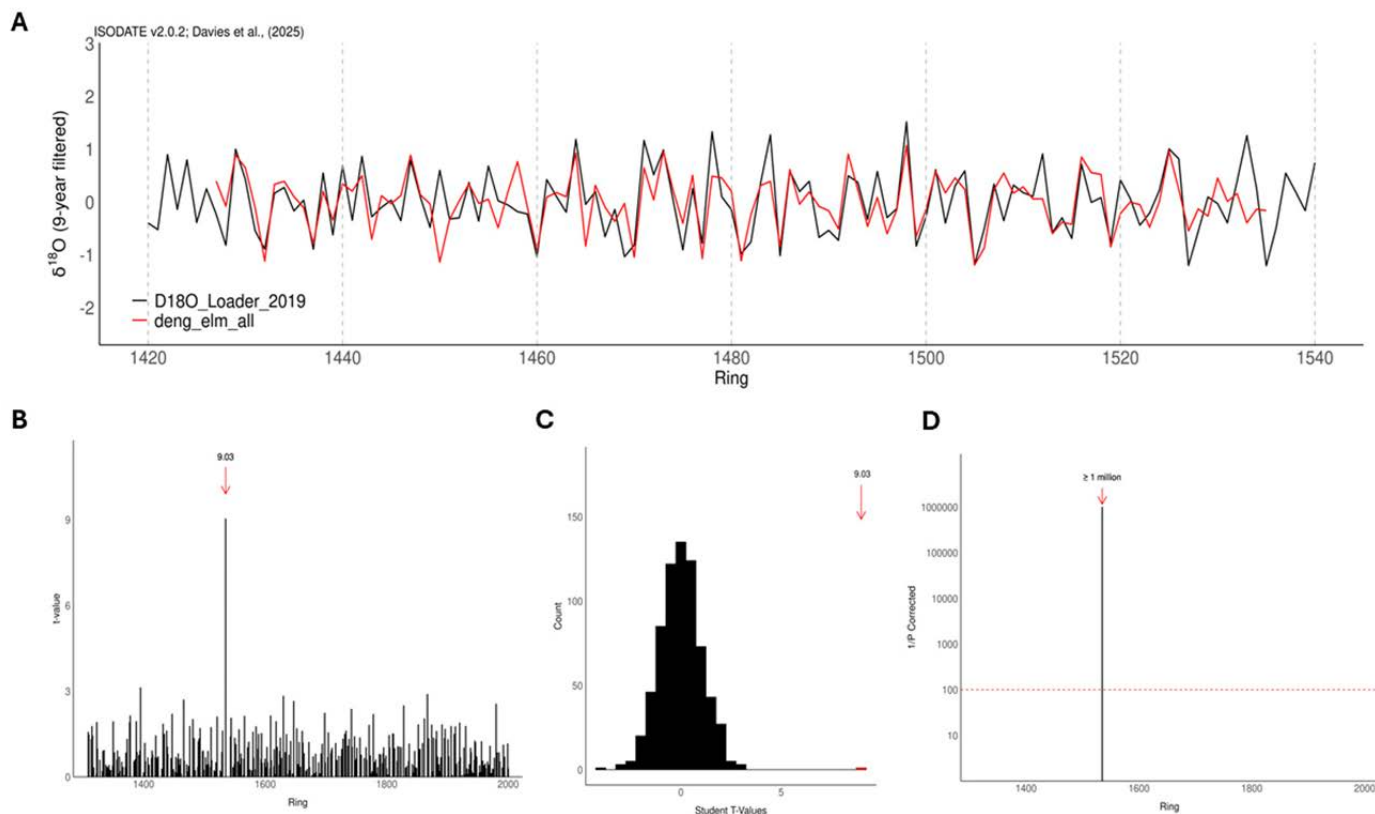


Figure 6: Dating results for the 109-year isotope composite series *deng_elm_all* developed from the isotopically-dated overlapping elm series (DENG102, DENG103, DENG121) A: Time series of the site isotopic mean plotted against the master chronology B: Student's *t*-values for all possible end dates with full overlap against the master chronology. C: Distribution of Student's *t*-values for all possible matches. D: End dates with corrected probabilities ($1/p$) of more than one. Those below the dashed line ($1/p = 20$) are not statistically significant. Note: Whilst both the oak series DENG047 and DENG048 dated independently against the reference chronology, given the short series overlap (<15 datapoints) a composite series was not developed for presentation.

Table 7: Stable oxygen isotope dating of the individual samples from Denge Wreck against the south-central England master chronology (Loader et al. 2019) over the period AD 1200–AD 2000. Number of whole rings present in core sample (N), number of rings on which $\delta^{18}\text{O}$ measurements were undertaken (Ni), Pearson's correlation coefficient (r), degrees of freedom (adjusted for autocorrelation and multiple sampling), Student's *t*-value, probability (1/p), isolation factor (IF), and date for last isotope measurement.

Reference chronology	N	Ni	R	df	T	1/p	IF	Date
DENGE028	60+	61	0.54	49	4.51	FAIL	FAIL	Does not date
DENGE047	67	49	0.67	39	5.59	1395	213	1497
DENGE048	47	45	0.66	35	5.19	291	589	1525
DENGE102	79	72	0.67	58	8.72	> 1 Million	>1000	1528
DENGE103	67	66	0.67	56	6.68	> 200k	>1000	1535
DENGE121	68	53	0.65	45	5.73	3375	>1000	1481

Table 8: Stable oxygen isotope dating of the individual samples from Denge Wreck against the Central England and West chronology (unpublished) over the period AD 1200–AD 2000. Number of whole rings present in core sample (N), number of rings on which $\delta^{18}\text{O}$ measurements were undertaken (Ni), Pearson's correlation coefficient (r), degrees of freedom (adjusted for autocorrelation and multiple sampling), Student's *t*-value, probability (1/p), isolation factor (IF), and date for last isotope measurement.

Reference chronology	N	Ni	R	df	T	1/p	IF	Date
DENGE028	60+	61	0.55	51	4.64	FAIL	FAIL	Does not date
DENGE047	67	49	0.73	39	6.73	> 53k	>1000	1497
DENGE048	47	45	0.75	35	6.76	> 33k	>1000	1525
DENGE102	79	72	0.77	59	9.35	> 1 Million	>1000	1528
DENGE103	67	66	0.72	56	7.67	> 1 Million	>1000	1535
DENGE121	68	53	0.7	45	6.50	> 48k	>1000	1481

Interpretation

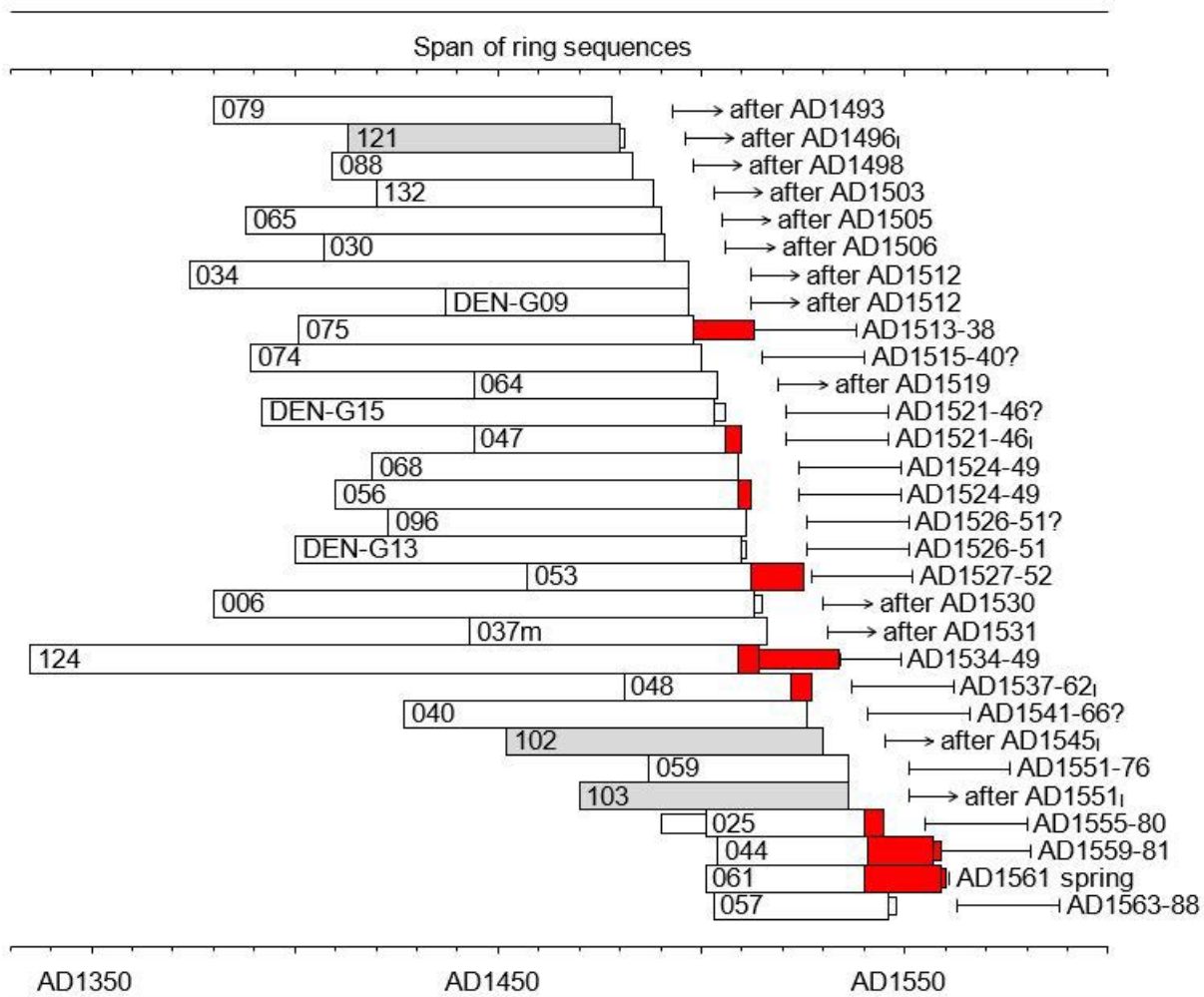
Ring-width dendrochronology has resulted in the successful dating of 25 oak timbers (26 samples), with a further five timbers (three elm; two oak) being dated using oxygen isotope dendrochronology, the subscript _i being used to indicate that a sample has been dated by oxygen isotope dendrochronology (Table 1; Fig 7). All felling date ranges and *terminus post quem* dates for felling have been calculated using the estimate that 95% of mature oak trees from this area have between 15 and 40 sapwood rings. The equivalent values for elm are as yet unknown. One problem that has been encountered in considering elm is that it has often proved very difficult to determine the position of the heartwood/sapwood boundary, even when it is known that the complete sapwood is present on a timber. Out of 129 measured series considered by Bridge (2020), 19 had complete sapwood where the number of sapwood rings could not be determined, but in 18 cases where sapwood numbers were counted the mean number of rings was 24, with a range of 9 to 51. With relatively few examples, it is probably wise not to make generalisations about elm sapwood numbers at this stage and so the 15–40 sapwood estimate used by the Nottingham Tree-ring Dating Laboratory for oak trees has also been used for elm timbers in this report.

Oak

Of the 27 dated oak timbers, 13 retain some sapwood or at least the heartwood/sapwood boundary ring, whilst the outermost ring on a further four samples is noted as possible heartwood/sapwood boundary (Table 1). The presence of the heartwood/sapwood boundary means that although a sample may have lost all of its sapwood rings, it is *only* the sapwood that is missing, these being potentially trimmed off during conversion from the parent tree or lost through degradation, thus allowing felling date ranges to be obtained for the timbers represented or, in one case where the sapwood was complete, a precise felling date (Fig 7). The dates of the heartwood/sapwood boundary rings vary by 50 years (AD 1498 on sample 075; AD 1548 on sample 057), indicating that the dated timbers represent more than one episode of felling. The dates of the heartwood/sapwood boundary rings on those 17 dated oak samples that have it, or potentially have it, suggest that there are at least two main periods of felling (Fig 7).

The earliest of these felling periods, represented by 10 samples, has heartwood/sapwood boundary dates ranging from AD 1498 (075) to AD 1512 (053), a variation of only 14 years suggesting that these oak timbers were felled at the same, or similar, time as part of a single felling episode, albeit in the absence of bark edge, potentially spread over a small number of years. The average heartwood/sapwood boundary for this early group is AD 1508 but, if the three relevant samples with possible heartwood/sapwood boundary are included, it becomes AD 1507. Allowing for a minimum of 15 sapwood rings, and a

maximum of 40 sapwood rings (the 95% confidence interval for the number of sapwood rings on oak trees), gives these timbers an estimated felling date at some point between AD 1522 at the earliest and AD 1547 at the latest. However, this felling date range can be further refined when allowing for the 20–25 unmeasured sapwood rings on sample 124 which, assuming that these timbers were all felled at the same time, or within a small number of years of each other, pushes the earliest possible felling date into the mid/late AD 1530s.



White bars = oak heartwood rings; red bars = oak sapwood rings; grey bars = elm heartwood rings, but note issues (see above) with recognition of elm sapwood rings; narrow bars = unmeasured rings; subscript _i indicates dated by oxygen isotope dendrochronology

Figure 7: Bar diagram showing the relative positions of overlap of the samples from the 30 dated timbers arranged by their individual felling date or felling date range.

The second of the two main periods of felling suggested is represented by five oak samples with heartwood/sapwood boundary ring dates ranging from AD 1536 (059) to AD 1548 (057). Again, this is suggestive of the timbers represented being derived from trees felled at the same, or similar, time. The average heartwood/sapwood boundary date of AD 1541 produces an estimated felling date range of AD 1556–81 which encompasses the known felling date of one of the samples, 061, in the spring of AD 1561. In view of the nature of repairs to working vessels and the lack of clear evidence from the dendrochronological analysis (the lack of very high levels of similarity between the individual series) to indicate that these represent a single coherent group of timbers, the felling date range given should be viewed as simply providing an indication as to a period of time over which repairs may have been undertaken using those timbers without complete sapwood.

The two remaining oak samples with felling date ranges (048 with an estimated felling date range of AD 1537–62_i and 040 with an estimated possible felling date range of AD 1541–66) are clearly broadly coeval. However, these two timbers could be associated with either of the two main periods of felling identified or could represent a separate felling episode.

All other oak samples comprise heartwood only and thus, have lost not only their sapwood rings but an unknown number of heartwood rings as well. The dates of the outermost rings present on these samples from 10 timbers range from AD 1478 on 079 to AD 1516 on 037. Based on the assumption that the loss of heartwood would be minimised during conversion from tree to timber element it would appear that most of the timbers represented by these samples are more likely to be associated with the earlier of the two main felling periods identified. However, the level of similarity between 037m and 040 ($t = 9.3$) suggests that both of these ceiling planks may be derived from trees growing close to each other, and even potentially from a single tree, and thus, likely to have been felled at the same time in the mid-sixteenth century.

Elm

The three elm timbers dated, all by oxygen isotope dendrochronology, had outermost measured (ring-width) ring dates of AD 1480_i (121), AD 1530_i (102), and AD 1536_i (103). None of these three planks had any trace of identifiable sapwood so only *terminus post quem* dates for their felling can be obtained using, as explained above, the minimum number of sapwood rings expected for oak timbers (Fig 7). This means it is not possible to be certain which of the felling episodes identified from the oak timbers that these elm timbers may be associated with or whether they again represent additional felling episodes. Outermost ring dates in the AD 1530s could be suggestive of at least two of them, both outer planks, not being associated with the earlier of the two main felling

periods but with the known issues relating to the identification of sapwood (Bridge 2020) this is far from certain.

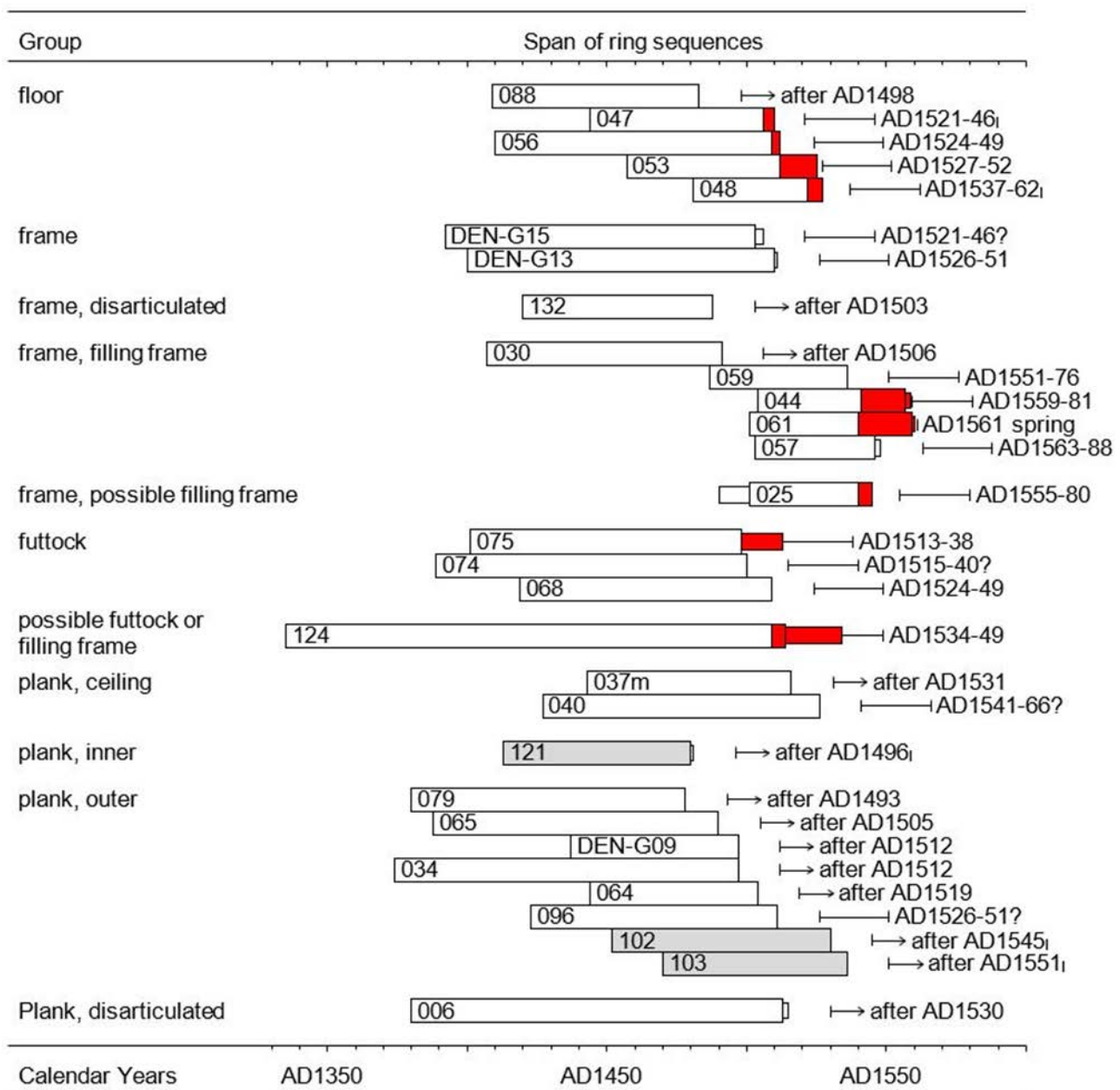
Discussion and conclusion

Analysis by ring-width dendrochronology and oxygen isotope dendrochronology of timbers from this site has successfully dated samples from 27 oak and three elm timbers (Table 1; Fig 7). Interpretation of the sapwood and the dates of the heartwood/sapwood boundaries on those samples which retain it suggests that many of the timbers are likely to be associated with a felling period in the mid-AD 1530s to mid-AD 1540s. This may indicate the date of the initial construction of the vessel, which would make this vessel a relatively early example of carvel construction. A small number of timbers are later and hence may represent repairs with at least one timber having been felled in the spring of AD 1561. In the absence of more than one precise felling date, however, it is not possible to determine whether those clearly later timbers were *ad hoc* minor repairs or part of a more major programme of repairs some two or three decades after the initial construction of the vessel. In addition, it is possible that some of the dated timbers were not associated with either of these two identifiable main felling periods, although they are clearly broadly coeval. This interpretation does, however, not take into account the possibility of stockpiling of timber, which could therefore place the construction of the vessel later in the sixteenth century. There is also no discernible difference with respect to date or growth characteristics between the two dated disarticulated timbers (006 and 132) and the rest of the assemblage. Detailed recording of the recovered sections of the vessel may further inform the interpretation of the dendrochronological results.

It is of note that the clearly later timbers associated with the second main felling period in the mid-AD 1550s to early AD 1580s are all filling frame timbers, or in one instance a possible filling frame timber (Fig. 8), although four of these are associated with section 5004, whilst the other, the possible filling frame, is associated with section 5026 (Fig 9). The majority of dated timbers are associated with section 5004, with all other sections mostly having only one dated timber associated with them (Fig. 9).

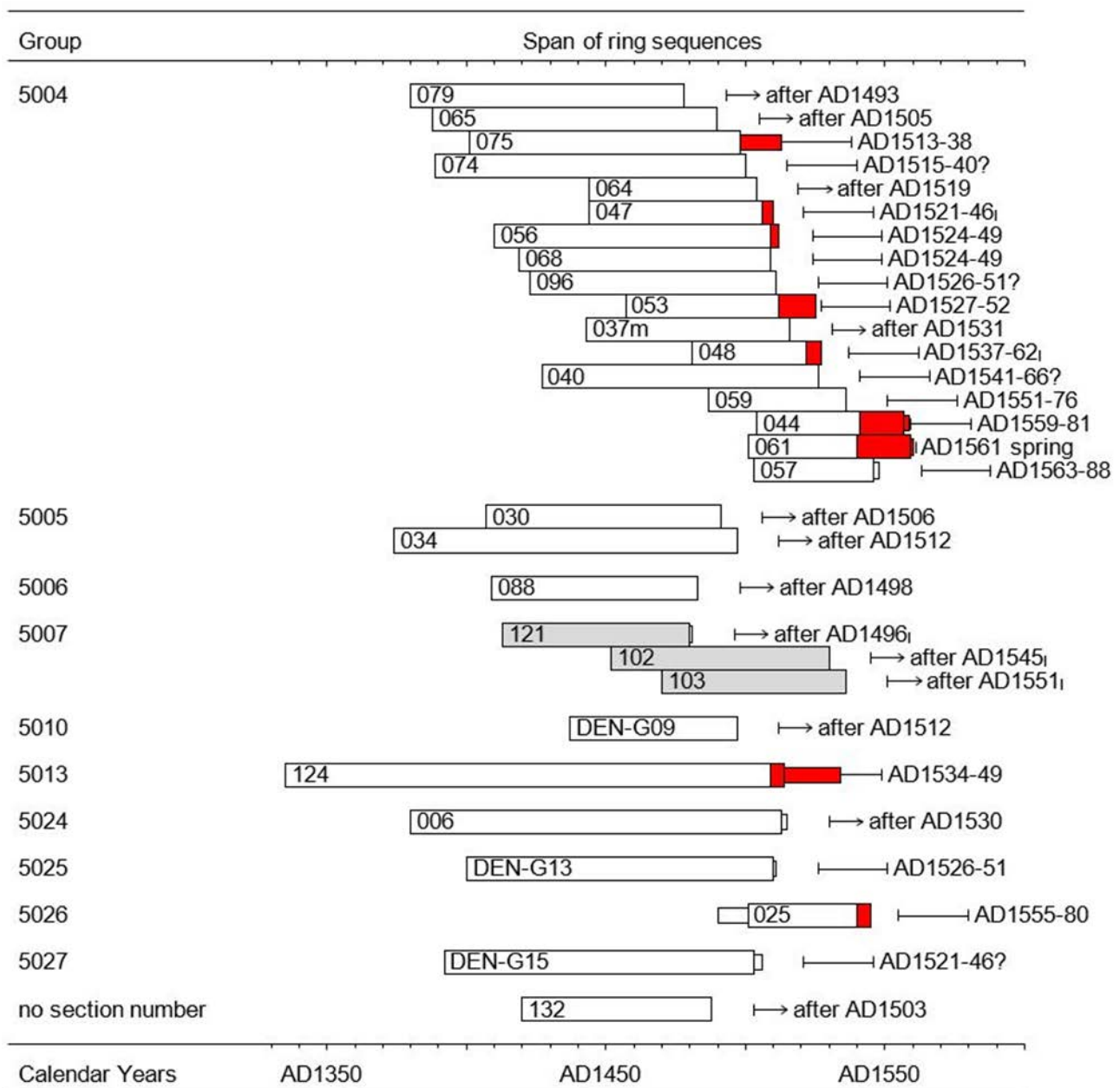
All ring-width dendrochronological dated material appears to be of English origin. As may be seen from Table 2, although site chronology DENG SQ01 has been compared with reference material from across the British Isles, it would appear that there is a distinct trend for it to show the strongest similarity with reference chronologies made up of timbers from sites in south-east England and East Anglia. While the source of the timbers used at these particular reference sites is itself unknown, such cross-matching might normally suggest that the dated trees used for this vessel are from a similar source and hence relatively local to the final resting place of this vessel. Site sequence DENG SQ02, however, whilst showing strong similarities with some reference chronologies in the same regional area as DENG SQ01 does show more varied cross-matching into the Midlands suggesting the possibility of a different regional source for these three timbers (Table 3).

The two individually dated timbers, 059 and 061, both tend to show stronger similarities with reference chronologies from the Midlands (Tables 5 and 6).



White bars = oak heartwood rings; red bars = oak sapwood rings; grey bars = elm heartwood rings, but note issues (see above) with recognition of elm sapwood rings; narrow bars = unmeasured rings; subscript _i indicates dated by oxygen isotope dendrochronology

Figure 8: Bar diagram showing the relative positions of overlap of the samples from the 30 dated timbers arranged by timber element type and their individual felling date or felling date range.



White bars = oak heartwood rings; red bars = oak sapwood rings; grey bars = elm heartwood rings, but note issues (see above) with recognition of elm sapwood rings; narrow bars = unmeasured rings; subscript _i indicates dated by oxygen isotope dendrochronology

Figure 9: Bar diagram showing the relative positions of overlap of the samples from the 30 dated timbers arranged by section number their individual felling date or felling date range.

Overall the level of cross-matching across the ring-width grouped/dated samples is very variable suggesting a disparate set of woodland sources rather than a single discrete woodland source. Apart from the high match mentioned above between 037m and 040, there is only one other similarly strong match between individual series, this being between DEN-G13, a frame timber, and 074, a futtock, which cross-match with a value of $t = 11.8$, again suggesting the possibility that these two timbers are derived from trees growing close to each other, and even potentially from a single tree.

The successful dating of the two oak and three elm timbers by oxygen isotope dendrochronology also suggests that these timbers are of likely English origin and hence could also be from similar woodland sources to those dated by ring-width dendrochronology.

In general, it appears that the oak timbers analysed were mostly derived from trees in the order of 100–150 years old when felled. However, there are exceptions with 124 being derived from a tree over 200 years old, and notably the oak timbers associated with the later of the two main felling periods identified which appear to be derived from somewhat younger, around 70–100 years old, and faster grown trees. The elm timbers show more similarities in growth characteristics to the younger oak trees used but this cannot be used as an indication that these two groups of timbers are in anyway coeval.

Whilst, as indicated above, it was no surprising that the elm samples could not be dated by ring-width dendrochronology, the oak timbers that remained undated by ring-width dendrochronology were generally considered suitable for secure dating purposes, although some did show distortion or compression to the rings which might hamper successful cross-matching during ring-width dendrochronological analysis. The inability to date these samples, in one instance by both ring-width and oxygen isotope dendrochronology, should not be taken to indicate that they are not broadly coeval with the successfully dated material as it is a common, if inexplicable, feature of dendrochronological analysis to find that some samples cannot be dated.

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Appendix 1: Data of measured samples

Ring-width data

Measurements in 0.01mm units

DEN-G09

134	142	170	143	135	183	159	119	116	144
153	125	142	110	106	99	132	202	153	210
170	143	136	164	188	164	152	134	171	171
159	210	257	293	198	205	177	223	287	183
142	146	224	246	252	250	231	251	206	228
290	248	227	229	183	170	195	179	133	229
249									

DEN-G11

308	278	324	284	304	247	228	286	308	280
230	238	201	281	277	280	201	260	236	206
170	161	206	182	165	173	174	150	140	131
121	147	104	114	143	126	106	141	127	119
140	91	63	71	71	104	150	154	95	108
111	118	137	109	98	224	268	298	260	207
140	170	239	197	209	211	222	224	175	162
158	193	197							

DEN-G12

179	313	464	452	426	389	417	290	254	327
349	322	336	315	443	440	363	351	258	326
322	323	197	241	204	234	182	220	280	312
355	301	372	287	253	296	291	383	307	404
399	303	323	458	560	441	394	329	243	299
298									

DEN-G13

400	310	269	231	238	251	226	190	264	290
191	140	175	209	199	190	183	200	178	157
180	149	133	168	202	196	108	81	201	219
190	244	265	164	174	168	138	175	142	118
113	160	188	225	174	169	132	135	148	177
150	142	175	168	175	173	289	220	228	192
174	146	149	145	116	133	151	177	165	193
196	163	174	153	193	241	101	63	66	114
95	137	104	112	107	76	118	147	122	163
124	103	105	106	114	120	162	133	82	101
110	84	87	82	83	98	96	114	91	134
122									

DEN-G15

104	72	89	114	98	100	135	147	105	111
55	86	103	110	99	81	96	83	101	123
70	95	103	82	106	128	165	89	108	110
60	85	84	149	213	137	145	145	96	117
115	97	95	131	108	126	205	101	122	109

151	223	201	154	153	149	105	128	97	102
135	139	155	160	195	169	192	94	113	85
95	106	88	117	75	71	83	89	88	91
93	97	99	118	120	112	136	107	98	131
82	130	130	100	102	147	139	116	109	129
104	102	114	117	195	132	88	85	124	94
104	133								

006

236	392	234	192	198	273	287	205	250	221
258	215	175	216	228	262	321	287	316	246
193	205	161	145	235	151	191	166	188	145
136	159	179	133	121	144	145	159	158	150
146	199	149	201	189	158	121	127	182	157
129	160	157	189	149	172	119	148	190	181
217	130	133	174	145	112	120	132	111	132
93	98	113	123	178	135	168	154	138	106
124	151	159	146	114	114	107	148	173	156
160	126	162	119	152	199	131	137	127	152
159	214	175	158	174	147	211	220	166	185
199	192	142	204	196	172	209	211	121	162
173	155	217	174	184	219	186	142	144	195
135	123	145	175						

025/DEN-G14

160	175	133	139	171	173	172	195	177	320
289	281	220	222	258	272	218	340	327	278
196	235	248	240	202	186	163	178	195	109
187	198	154	170	319	223	206	211	247	261
177	141	217	240	241					

026

206	264	192	496	545	486	354	497	416	373
236	357	434	407	490	494	428	381	279	185
405	235	307	281	125	105	134	123	156	197
173	141	214	242	193	156	202	190	105	167
280	209	189	160	157	125	167	267	145	148
178	118	112	134	214	134	160	142	140	182
171	195	180	139	248	300	128	166	242	200
348	265	257	551	413	387	212	181	174	167
201	218	156	145	164	235	250	223	255	240
141	241	301	335	331					

028

108	182	83	151	162	138	327	333	493	350
289	254	223	179	174	258	324	247	277	366
276	243	202	286	269	254	299	212	231	245
202	244	259	202	264	263	282	199	200	225
150	166	212	196	187	247	289	275	235	274
226	225	280	315	247	175	205	268	196	190

030/DEN-G06

73	72	85	79	35	77	66	70	61	81
76	90	85	85	83	78	111	117	132	117
78	147	186	174	240	220	147	148	137	186

161	189	139	183	178	181	196	126	120	121
123	110	133	136	104	109	105	115	86	109
108	139	91	77	91	94	113	94	96	116
81	100	101	109	134	117	123	142	130	107
76	91	89	112	171	138	118	79	57	52
50	58	46	63	90					

034/DEN-G07

136	113	107	117	98	83	93	68	77	76
78	109	149	112	106	76	75	100	89	94
108	88	107	102	164	88	128	188	124	160
193	141	169	139	173	147	164	149	144	147
147	130	96	153	155	100	120	132	77	144
128	100	102	99	114	103	130	94	148	87
101	153	271	200	218	100	170	197	241	314
223	263	177	235	164	328	179	160	154	176
148	159	238	185	249	170	253	234	253	250
137	132	87	60	85	145	153	121	199	167
248	193	193	165	190	234	226	328	214	230
277	246	244	291	249	224	193	239	164	182
245	236	268	266						

037/DEN-G02

362	345	292	177	193	330	329	248	245	328
243	316	333	207	250	243	184	230	301	221
221	178	213	241	192	356	396	376	264	187
149	189	258	220	117	191	242	267	200	166
180	250	184	239	349	278	337	203	120	169
210	306	222	287	251	167	156	121	128	132
151	234	208	385	307	197	210	170	170	193
371									

037

287	278	218	195	240	272	355	329	215	228
294	224	259	330	268	236	209	228	298	268
300	384	370	293	186	146	202	270	191	125
173	252	305	228	208	152	237	176	206	320
281	344	229	115	184	220	295	213	266	252
164	155	128	137	128	168	214	207	351	323
204	232	157	191	206	362	342	299	389	

040

201	320	143	111	132	87	41	51	61	178
137	174	209	362	480	500	478	422	379	380
347	462	585	300	373	369	323	359	323	346
356	413	396	380	477	399	385	324	329	401
320	329	354	381	282	258	218	242	285	265
176	247	292	279	229	219	221	254	186	235
269	230	246	189	115	172	209	220	203	247
176	149	142	107	120	130	116	175	157	272
183	171	242	154	220	256	283	313	242	200
141	221	198	118	188	349	263	354	241	297

041

143	149	188	167	132	160	79	38	186	309
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250	147	191	219	264	339	435	411	382	331
276	326	349	375	267	280	219	173	217	204
202	203	260	247	209	288	181	176	163	155
173	176	203	265	239	187	151	156	139	149
108	87	122	246	173	160	139	127	198	140
215	192	219	150	96	163	230			

044

245	180	139	191	174	201	172	209	266	342
327	564	654	441	665	545	416	373	346	447
447	449	477	481	338	310	268	452	379	326
407	471	342	274	292	283	346	245	182	190
158	133	117	92	110	143	144	137	110	116
97	118	130	184						

047

317	259	249	157	219	335	366	317	221	453
511	366	429	362	311	308	364	297	594	785
581	287	477	501	365	546	509	375	588	419
422	559	456	324	400	592	508	463	472	482
439	490	351	403	343	109	62	62	55	48
53	73	80	72	59	73	75	100	91	92
133	85	109	113	129	125	159			

048

277	478	706	625	498	389	661	679	720	510
273	273	391	489	569	455	277	258	330	529
445	563	270	495	409	406	269	243	231	292
240	249	295	217	304	277	262	382	236	208
206	250	338	204	240	272	267			

053

294	176	184	163	120	190	214	114	114	163
227	273	257	216	139	239	193	321	235	232
177	153	253	245	212	186	202	182	236	179
268	241	257	268	171	161	133	183	340	384
287	180	255	301	257	302	213	294	258	218
99	81	91	104	132	151	150	114	119	154
114	201	187	131	111	113	117	135	197	

056

101	111	133	115	111	106	131	116	115	119
142	155	162	163	217	261	256	254	266	144
113	131	116	115	120	109	226	221	161	145
144	148	282	227	174	146	166	176	136	163
152	146	148	124	159	151	183	209	169	167
173	209	160	203	121	187	197	124	159	190
218	158	128	186	187	216	153	166	271	285
238	296	186	216	209	175	168	158	122	127
107	117	107	92	116	128	141	100	85	95
100	118	106	104	104	90	121	81	86	172
92	88	119							

057/DEN-G05

344	391	366	341	332	378	418	314	456	453
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446	317	417	396	181	367	337	292	223	203
263	284	318	398	356	369	337	320	335	245
202	333	447	361	430	449	448	400	207	166
256	282	336	289						

059

405	278	243	231	147	137	130	155	166	265
179	156	200	239	184	218	189	192	247	259
208	261	285	251	314	335	210	169	264	240
272	184	222	178	179	261	144	159	145	158
200	201	194	173	290	143	147	198	213	212

061/DEN-G04

470	527	346	476	467	442	369	374	531	523
440	361	400	393	449	413	298	476	435	358
317	377	280	414	263	364	340	318	270	188
337	219	329	281	394	274	391	332	359	376
327	185	218	217	265	150	189	135	136	129
115	142	141	134	129	116	148	128	176	

064

416	286	283	402	429	340	314	279	225	241
323	377	448	472	340	309	325	360	359	437
289	380	363	240	304	367	480	328	310	293
291	339	279	306	284	367	314	452	246	250
312	255	347	356	320	266	238	203	153	196
209	201	289	142	130	151	161	166	170	155
285									

065

415	359	349	214	175	275	203	298	376	423
453	464	327	414	415	281	375	339	497	390
427	127	49	47	74	98	116	171	151	176
223	171	226	333	181	301	290	173	103	168
165	160	137	172	221	176	121	145	93	154
201	196	124	114	111	133	89	67	100	144
94	129	98	99	80	115	169	146	203	149
156	100	162	117	153	136	106	149	132	107
164	180	212	125	121	93	132	173	86	93
91	143	144	201	199	187	150	177	181	210
160	196	257							

067/DEN-G01

267	250	215	203	179	299	218	572	460	475
530	488	440	375	383	251	215	182	215	215
138	141	176	102	147	224	204	216	179	178
175	210	164	153	155	135	109	134	154	136
130	200	208	185	185	129	116	171	86	109
98	93	101	96	96	97	140	153	176	145
91	222	273	339	374	250	173	179	199	270
218	301	363	324	275	215	128	204		

068

131	215	226	162	249	146	158	184	60	96
111	176	144	154	140	83	89	153	119	228

143	119	94	80	105	76	74	122	72	69
104	82	115	110	139	142	123	186	98	133
51	130	79	134	88	104	127	117	118	128
150	101	114	102	121	142	180	97	84	133
109	111	156	191	169	159	109	110	194	151
179	164	120	100	79	92	178	194	115	80
83	113	67	60	73	92	57	100	55	75
74									
069									
166	222	296	264	284	203	193	283	271	164
203	157	157	257	229	118	90	118	107	122
81	82	80	68	113	184	137	118	87	96
87	65	65	61	65	53	49	46	52	66
58	54	50	60	56	48	41	31	38	61
57	47	71	93	78	81	92	88	86	49
46	49	87	60	50	85	99	97	107	118
78	54	24	37	51	53	70	66	44	55
52	145	130	125	107	90	120	109	117	119
88	100	124	118	112	103	154	119	119	145
153									
074									
399	552	658	350	322	381	362	506	362	348
380	282	221	167	134	208	208	230	169	190
174	124	90	150	163	177	159	165	181	156
136	193	193	174	225	186	160	95	76	123
143	118	151	150	111	136	119	98	142	126
90	92	102	140	141	112	121	105	82	89
87	93	68	75	89	89	84	111	76	76
46	53	62	91	77	65	74	72	71	66
63	76	63	65	56	66	71	47	45	59
82	81	79	63	65	62	41	55	67	66
76	63	57	52	50	56	75	99	62	60
56	84								
075									
130	88	101	114	135	177	168	239	216	157
99	132	194	155	144	181	157	265	195	258
314	204	211	217	221	256	188	248	234	240
230	240	176	143	153	246	281	239	146	154
144	156	177	176	177	118	166	168	144	137
128	135	124	138	144	211	156	165	94	100
109	121	119	99	111	117	105	144	140	167
130	110	122	98	139	150	141	116	109	116
156	135	121	129	93	85	97	73	101	74
84	63	72	95	54	79	69	75		
076									
191	118	125	127	148	114	113	112	80	111
148	133	127	110	91	89	91	106	106	94
46	49	63	60	68	64	59	64	89	72
54	55	53	63	36	69	44	48	38	46
43	48	57	42	47	42	42	34	44	51
47	49	49	42	52	48	51	48	67	63

59	63	62	58	56	72	73	104	56	406
203	98	111	77	110	74	73	53	91	

079/DEN-G03

266	217	241	247	167	186	167	198	154	133
127	211	115	155	118	124	146	169	189	160
198	160	137	122	122	94	143	129	157	123
79	78	122	200	165	215	129	134	139	85
95	99	88	131	137	101	100	71	193	121
80	121	106	101	169	150	111	205	191	176
173	152	176	187	120	76	100	132	60	114
84	75	66	86	142	144	155	132	97	73
95	91	108	78	85	62	89	75	99	138
151	109	129	108	124	194	143	126	239	

088

393	179	115	136	233	320	383	333	408	356
154	257	444	271	360	467	495	323	207	306
340	234	435	653	339	288	348	408	224	370
262	158	165	225	209	205	204	175	118	138
85	126	102	66	65	86	88	267	296	201
118	211	97	102	89	86	55	70	82	100
146	254	197	169	176	136	291	141	95	150
146	118	162	157	218					

096

154	120	89	84	136	136	144	153	125	194
169	141	152	110	134	124	121	86	99	123
112	114	63	78	82	92	88	92	68	80
73	72	104	98	99	102	76	112	125	149
183	118	119	133	148	172	193	242	179	183
192	181	273	226	157	176	262	264	342	264
190	175	182	186	314	227	205	280	210	173
214	206	181	238	245	127	145	171	199	241
185	197	216	228	162	131	163	154	184	

097

121	199	268	230	250	287	202	189	269	209
147	197	135	140	125	123	148	234	410	396
376	296	273	289	375	291	343	273	240	313
196	143	114	228	226	291	217	152	167	221
196	306	209	279						

099

107	86	118	96	108	97	90	78	108	112
129	82	90	82	85	88	94	104	82	69
106	100	137	96	75	74	100	89	118	93
82	119	91	74	94	125	157	105	95	103
96	105	115	121	90	114	90	105	91	103
98	67	75	86	82	78	108	84	88	121
97	120	81	75	90	93	96	79	102	96
128	64	85	74	116	122	97	124	152	110
87	92	92	133	154	113	98	137	169	

101

334	245	339	254	362	375	427	581	390	200
290	380	388	397	366	482	89	103	193	211
324	350	509	420	510	457	473	373	538	355
338	353	284	65	57	117	136	167	114	280
509	432	369	241	129	168	206	246	355	346
220	207	261	255	303	138	149	206	250	210
184	225	256	253	196	305	340	87	53	46
59	75	92	101	151	257	138	153	145	220
223	251	95	55	55	72	110	183		

102/DEN-G08

264	251	363	288	430	390	385	392	284	273
342	353	293	188	334	336	273	408	279	283
225	435	322	366	286	314	217	204	196	138
198	177	216	291	337	444	270	253	193	317
267	377	388	224	282	250	261	163	146	229
150	136	209	305	309	216	175	246	253	177
199	253	229	269	210	235	248	232	212	204
347	151	116	89	164	101	122	89	111	

103

344	394	458	447	396	380	425	399	215	356
286	388	357	205	291	321	314	169	322	173
167	260	146	203	215	280	305	275	322	218
278	347	403	330	299	354	313	336	250	234
247	237	149	320	268	248	247	169	208	231
165	76	94	122	148	116	118	192	222	110
116	158	132	119	163	200	209			

112

330	705	497	548	390	289	277	231	266	288
231	289	264	226	226	185	205	191	170	210
173	171	137	161	89	127	159	115	171	172
126	166	139	151	135	137	143	135	105	97
103	87	135	108	96	104	130	152	131	142
159	148	294	425	317	207	137	130	180	212
267	278	282	306	321	304	218	262		

113

117	132	169	187	269	170	109	82	109	126
194	185	202	139	133	167	176	165	196	213
147	137	110	127	185	123	73	81	82	106
111	82	60	86	77	103	146	149	167	148
116	98	74	96	98	80	150	129	126	129
88	84	95	97	100	146	138	131	115	103
105	141	120	133	97	120	127	157	188	193
161	138	132	108	131	137	115	83	139	

115

206	222	174	265	200	184	135	175	161	214
154	168	239	206	156	132	159	231	232	131
176	188	249	265	182	200	165	187	188	257
200	180	176	166	105	83	99	72	117	96
86	87	98	99	73	110	83	102	102	167
204	176	105	127	150	137	147	156	121	169

147	164	113	133	176	135	98	115	117	126
69	96	80	81	88	124	142	98	83	157

116

165	153	141	155	122	127	131	139	142	149
115	147	163	133	123	138	151	114	127	102
115	131	188	181	219	165	163	183	195	186
199	233	199	173	147	195	196	269	210	209
146	152	204	187	210	184	217	198	241	175
157	280	236	138						

121

404	356	375	364	435	440	382	466	475	318
553	279	338	460	337	255	399	433	327	345
262	286	238	264	278	265	178	248	222	259
259	276	283	256	239	180	190	110	108	139
108	166	131	155	186	244	196	231	141	198
140	137	107	103	128	203	154	135	115	197
147	131	195	164	162	287	512	630		

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66	56	34	65	80	76	109	69	55	60
97	80	76	60	72	73	59	64	73	80
96	114	115	50	35	60	41	117	108	90
46	49	47	52	98	69	73	77	78	49
51	55	51	77	70	105	68	95	45	40
57	72	95	76	76	77	60	38	32	55
92	76	50	69	88	66	81	84	71	130
74	111	56	91	61	60	54	65	81	78
68	89	68	72	65	71	89	79	96	85
117	101	73	98	126	116	103	122	97	73
60	49	76	59	63	75	76	112	138	52
67	92	75	53	71	46	68	83	88	88
79	116	109	75	56	52	69	65	73	74
89	117	103	107	131	99	95	101	74	79
96	79	50	56	80	94	122	131	123	83
90	84	136	116	132	119	125	85	61	85
115	151	90	85	94	106	129	137	144	158
105	104	83	65	98	91	88	90	80	69

132

160	136	144	132	143	102	102	140	152	134
140	133	167	137	134	151	124	133	130	125
121	107	110	116	94	80	89	91	100	123
86	78	73	97	105	93	136	105	108	99
115	121	164	153	122	120	116	141	163	158
151	145	184	144	154	189	150	129	135	149
140	235	143	182	190	134	150	181	136	

133

160	159	181	116	294	562	673	628	651	561
455	262	397	309	182	191	227	205	145	211
154	216	229	241	167	108	130	163	212	344
163	103	126	143	151	141	273	286	265	325
333									

Oxygen isotope data

Oxygen isotope ratios ($\delta^{18}\text{O}$) for the measured tree-ring series. Data are reported as per mille (‰) deviations relative to the VSMOW standard (Coplen 1995).

Year (AD)	DENGE047	DENGE048	DENGE102	DENGE103	DENGE121
1535				29.78	
1534				29.83	
1533				29.52	
1532				30.02	
1531				29.81	
1530				30.28	
1529				29.68	
1528			29.68	29.67	
1527			28.73	29.63	
1526			29.90	30.03	
1525		30.35	30.45	30.88	
1524		29.63	29.76	29.64	
1523		29.05	28.85	29.38	
1522		29.54	29.90	29.42	
1521		29.57	30.03	29.44	
1520		28.83	29.10	29.90	
1519		28.11	28.34	29.29	
1518		28.70	29.79	30.66	
1517		29.40	30.02	30.37	
1516		30.15	30.01	30.99	
1515		28.29	29.01	29.49	
1514		29.35	28.84	29.98	
1513		27.93	28.74	29.52	
1512		29.23	29.83	29.75	
1511		29.08	29.48	29.95	
1510		29.17	29.53	30.25	
1509		28.81	29.17	30.19	
1508		29.80	29.55	30.76	
1507		29.23	29.67	30.08	
1506		28.96	28.29	29.31	
1505		28.42	28.29	28.79	
1504		29.39	29.68	30.30	
1503		29.58	30.22	30.01	
1502		28.67	29.48	30.43	
1501		29.17	30.34	30.61	
1500		28.85	29.24	30.44	
1499		29.29	28.83	29.83	
1498		29.66	31.06	30.91	
1497	28.24	28.32	29.32	30.24	

1496	28.13	28.54	28.79	29.93	
1495	29.31	29.44	29.90	30.10	
1494		28.72	29.43	29.58	
1493		29.39	29.99	30.15	
1492		30.31	30.41	31.15	
1491		28.23	29.01	29.80	
1490		28.89	29.25	30.36	
1489		28.49	29.61	30.02	
1488	28.82	28.94	29.38	30.80	
1487	29.42	28.95	29.27	30.28	
1486	29.59	29.24	30.04	30.86	
1485	27.97	27.76	28.34	29.38	
1484	29.66	29.19	29.89	30.33	
1483	29.28	29.51	29.50	30.60	
1482	28.25	28.71	29.07	30.06	
1481	28.48	28.72	28.25	29.06	27.96
1480	28.81		29.42	30.40	29.87
1479	28.88		29.84	30.57	29.97
1478	28.77		29.97	30.85	29.75
1477	27.89		28.44	29.63	28.24
1476	28.98		30.52	31.36	29.67
1475	28.61		29.60	30.16	29.21
1474	28.70		30.30	30.76	29.36
1473	30.64		30.85	31.04	30.56
1472	29.12		29.22	31.38	29.31
1471	30.03		30.13	31.38	
1470	28.73		28.35	29.75	28.38
1469	28.75		29.79		29.12
1468	28.50		29.20		28.99
1467	29.09		29.58		29.27
1466	30.96		30.23		29.48
1465	28.44		29.12		
1464	30.31		31.22		29.90
1463	29.25		29.82		29.75
1462	30.36		30.50		29.43
1461	29.73		30.13		29.60
1460	28.28		29.14		28.54
1459	28.24		29.75		29.32
1458	29.25		30.54		30.14
1457	29.72		30.07		29.34
1456	29.11				28.72
1455	29.94				29.30
1454	28.80				29.08
1453	29.93				29.36
1452	29.71				29.06
1451	29.44				28.87

1450	30.76				28.11
1449	29.27				29.28
1448	28.91				29.52
1447	28.72				30.28
1446	29.12				29.67
1445	28.87				29.71
1444	29.28				29.95
1443	28.62				29.10
1442					30.27
1441					29.91
1440					30.03
1439					29.33
1438					30.00
1437					29.01
1436					29.58
1435					29.79
1434					30.24
1433					30.29
1432					28.93
1431					30.04
1430					30.76
1429					30.92
1428					29.86
1427					30.41

Ring	DENGE028
61	30.20
60	29.60
59	31.21
58	29.62
57	29.79
56	30.44
55	30.32
54	29.94
53	30.05
52	31.01
51	30.26
50	30.75
49	29.74
48	30.79
47	30.55
46	30.06
45	30.23
44	29.85
43	29.69
42	30.41

41	29.94
40	32.04
39	30.67
38	30.41
37	31.13
36	29.57
35	29.49
34	32.34
33	29.69
32	29.97
31	30.37
30	30.99
29	29.99
28	30.12
27	30.05
26	30.06
25	29.82
24	30.68
23	29.44
22	29.50
21	29.62
20	29.69
19	29.31
18	29.53
17	29.46
16	29.17
15	29.99
14	30.75
13	29.99
12	30.00
11	29.29
10	31.87
9	29.87
8	30.44
7	29.61
6	30.52
5	30.05
4	30.96
3	31.92
2	29.88
1	29.79

Appendix 2: Tree-ring dating

The Principles of Tree-Ring Dating

Tree-ring dating, or dendrochronology as it is known, is discussed in some detail in the Nottingham Tree-ring Dating Laboratory's Monograph, *An East Midlands Master Tree-Ring Chronology and its uses for dating Vernacular Buildings* (Laxton and Litton 1988) and *Dendrochronology: Guidelines on Producing and Interpreting Dendrochronological Dates* (English Heritage 1998). Here we will give the bare outlines. Each year an oak tree grows an extra ring on the outside of its trunk and all its branches just inside its bark. The width of this annual ring depends largely on the weather during the growing season, about April to October, and possibly also on the weather during the previous year. Good growing seasons give rise to relatively wide rings, poor ones to very narrow rings and average ones to relatively average ring widths. Since the climate is so variable from year to year, almost random-like, the widths of these rings will also appear random-like in sequence, reflecting the seasons. This is illustrated in Figure A1 where, for example, the widest rings appear at irregular intervals. This is the key to dating by tree rings, or rather, by their widths. Records of the average ring widths for oaks, one for each year for the last 1000 years or more, are available for different areas. These are called master chronologies. Because of the random-like nature of these sequences of widths, there is usually only one position at which a sequence of ring widths from a sample of oak timber with at least 70 rings will match a master. This will date the timber and in particular, the last ring.

If the bark is still on the sample, as in Figure A1, then the date of the last ring will be the date of felling of the oak from which it was cut. There is much evidence that in medieval times oaks cut down for building purposes were used almost immediately, usually within the year or so (Rackham 1976). Hence if bark is present on several main timbers in a building, none of which appear reused or are later insertions, and if they all have the same date for their last ring, then we can be quite confident that this is the date of construction or soon after. If there is no bark on the sample, then we have to make an estimate of the felling date; how this is done is explained below.

The Practice of Tree-Ring Dating at the Nottingham Tree-Ring Dating Laboratory

Inspecting the Building and Sampling the Timbers

Together with a building historian the timbers in a building are inspected to try to ensure that those sampled are not reused or later insertions. Sampling is almost always done by coring into the timber, which has the great advantage that we can sample in situ timbers and those judged best to give the date of construction, or phase of construction if there is more than one in the building. The timbers to be sampled are also inspected to see how

many rings they have. We normally look for timbers with at least 70 rings, and preferably more. With fewer rings than this, 50 for example, sequences of widths become difficult to match to a unique position within a master sequence of ring widths and so are difficult to date (Litton and Zainodin 1991). The cross-section of the rafter shown in Figure A2 has about 120 rings; about 20 of which are sapwood rings – the lighter rings on the outside. Similarly, the core has just over 100 rings with a few sapwood rings.

To ensure that we are getting the date of the building as a whole, or the whole of a phase of construction if there is more than one, about 8–10 samples per phase are usually taken. Sometimes we take many more, especially if the construction is complicated. One reason for taking so many samples is that, in general, some will fail to give a date. There may be many reasons why a particular sequence of ring widths from a sample of timber fails to give a date even though others from the same building do. For example, a particular tree may have grown in an odd ecological niche, so odd indeed that the widths of its rings were determined by factors other than the local climate! In such circumstances it will be impossible to date a timber from this tree using the master sequence whose widths, we can assume, were predominantly determined by the local climate at the time.

Sampling is done by coring into the timber with a hollow corer attached to an electric drill and usually from its outer rings inwards towards where the centre of the tree, the pith, is judged to be. An illustration of a core is shown in Figure A2; it is about 150mm long and 10mm diameter. Great care has to be taken to ensure that as few as possible of the outer rings are lost in coring. This can be difficult as these outer rings are often very soft (see below on sapwood). Each sample is given a code which identifies uniquely which timber it comes from, which building it is from and where the building is located. For example, CRO-A06 is the sixth core taken from the first building (A) sampled by the Laboratory in Cropwell Bishop. Where it came from in that building will be shown in the sampling records and drawings. No structural damage is done to any timbers by coring, nor does it weaken them.

During the initial inspection of the building and its timbers the dendrochronologist may come to the conclusion that, as far as can be judged, none of the timbers have sufficient rings in them for dating purposes and may advise against sampling to save further unwarranted expense.

All sampling by the Laboratory is undertaken according to current Health and Safety Standards. The Laboratory's dendrochronologists are insured.



Figure A1: A wedge of oak from a tree felled in 1976. It shows the annual growth rings, one for each year from the innermost ring to the last ring on the outside just inside the bark. The year of each ring can be determined by counting back.



Figure A2: Cross-section of a rafter, showing sapwood rings in the left-hand corner, the arrow points to the heartwood/sapwood boundary (H/S); and a core with sapwood; again, the arrow is pointing to the H/S. The core is about the size of a pencil.



Figure A3: Measuring ring widths under a microscope. The microscope is fixed while the sample is on a moving platform. The total sequence of widths is measured twice to ensure that an error has not been made. This type of apparatus is needed to process a large number of samples on a regular basis.



Figure A4: Three cores from timbers in a building. They come from trees growing at the same time. Notice that, although the sequences of widths look similar, they are not identical. This is typical.

Measuring Ring Widths

Each core is sanded down with a belt sander using medium-grit paper and then finished by hand with flourgrade-grit paper. The rings are then clearly visible and differentiated from each other with a result very much like that shown in Figure A2. The core is then mounted on a movable table below a microscope and the ring-widths measured individually from the innermost ring to the outermost. The widths are automatically recorded in a computer file as they are measured (see Fig. A3).

Cross-Matching and Dating the Samples

Because of the factors besides the local climate which may determine the annual widths of a tree's rings, no two sequences of ring widths from different oaks growing at the same time are exactly alike (Fig. A4). Indeed, the sequences may not be exactly alike even when the trees are growing near to each other. Consequently, in the Laboratory we do not attempt to match two sequences of ring widths by eye, or graphically, or by any other subjective method. Instead, it is done objectively (i.e. statistically) on a computer by a process called cross-matching. The output from the computer tells us the extent of correlation between two sample sequences of widths or, if we are dating, between a sample sequence of widths and the master, at each relative position of one to the other (offsets). The extent of the correlation at an offset is determined by the t-value (defined in almost any introductory book on statistics). That offset with the maximum t-value among the t-values at all the offsets will be the best candidate for dating one sequence relative to the other. If one of these is a master chronology, then this will date the other. Experiments carried out in the past with sequences from oaks of known date suggest that a t-value of at least 4.5, and preferably at least 5.0, is usually adequate for the dating to be accepted with reasonable confidence (Laxton and Litton 1988; Laxton et al. 1988).

This is illustrated in Figure A5 with timbers from one of the roofs of Lincoln Cathedral. Here four sequences of ring widths, LIN-C04, 05, 08 and 45, have been cross-matched with each other. The ring widths themselves have been omitted in the bar diagram, as is usual, but the offsets at which they best cross-match each other are shown; e.g. the sequence of ring widths of C08 matches the sequence of ring widths of C45 best when it is at a position starting 20 rings after the first ring of C45, and similarly for the others. The actual t-values between the four at these offsets of best correlations are in the matrix. Thus, at the offset of +20 rings, the t-value between C45 and C08 is 5.6 and is the maximum found between these two among all the positions of one sequence relative to the other.

It is standard practice in our Laboratory first to cross-match as many as possible of the ring-width sequences of the samples in a building and then to form an average from them. This average is called a site sequence of the building being dated and is illustrated in Figure A5. The fifth bar at the bottom is a site sequence for a roof at Lincoln Cathedral and is constructed from the matching sequences of the four timbers. The site sequence width for each year is the average of the widths in each of the sample sequences which has a width for that year. Thus, in Figure A5 if the widths shown are 0.8mm for C45, 0.2mm for C08, 0.7mm for C05, and 0.3mm for C04, then the corresponding width of the site sequence is the average of these, 0.55mm. The actual sequence of widths of this site sequence is stored on the computer. The reason for creating site sequences is that it is usually easier to date an average sequence of ring widths with a master sequence than it is to date the individual component sample sequences separately.

The straightforward method of cross-matching several sample sequences with each other one at a time is called the 'maximal t-value' method. The actual method of cross-matching a group of sequences of ring-widths used in the Laboratory involves grouping and averaging the ring-width sequences and is called the 'Litton-Zainodin Grouping Procedure'. It is a modification of the straightforward method and was successfully developed and tested in the Laboratory and has been published (Litton and Zainodin 1991; Laxton et al. 1988).

Estimating the Felling Date

As mentioned above, if the bark is present on a sample, then the date of its last ring is the date of the felling of its tree (or the last full year before felling, if it was felled in the first three months of the following calendar year, before any new growth had started, but this is not too important a consideration in most cases). The actual bark may not be present on a timber in a building, though the dendrochronologist who is sampling can often see from its surface that only the bark is missing. In these cases, the date of the last ring is still the date of felling.

Quite often some, though not all, of the original outer rings are missing on a timber. The outer rings on an oak, called sapwood rings, are usually lighter than the inner rings, the heartwood, and so are relatively easy to identify. For example, sapwood can be seen in the corner of the rafter and at the outer end of the core in Figure A2, both indicated by arrows. More importantly for dendrochronology, the sapwood is relatively soft and so liable to insect attack and wear and tear. The builder, therefore, may remove some of the sapwood for precisely these reasons. Nevertheless, if at least some of the sapwood rings are left on a sample, we will know that not too many rings have been lost since felling so that the date of the last ring on the sample is only a few years before the date of the original last ring on the tree, and so to the date of felling.

Various estimates have been made and used for the average number of sapwood rings in mature oak trees (English Heritage 1998). A fairly conservative range is between 15 and 50 and that this holds for 95% of mature oaks. This means, of course, that in a small number of cases there could be fewer than 15 and more than 50 sapwood rings. For example, the core CRO-A06 has only 9 sapwood rings and some have obviously been lost over time — either they were removed originally by the carpenter, they rotted away in the building and/or they were lost in the coring. It is not known exactly how many sapwood rings are missing but using the above range the Laboratory would estimate between a minimum of 6 ($=15-9$) and a maximum of 41 ($=50-9$). If the last ring of CRO-A06 has been dated to 1500, say, then the estimated felling-date range for the tree from which it came originally would be between 1506 and 1541. The Laboratory uses this estimate for sapwood in areas of England where it has no prior information. It also uses it when dealing with samples with very many rings, about 120 to the last heartwood ring. But in other areas

of England where the Laboratory has accumulated a number of samples with complete sapwood, that is, no sapwood lost since felling, other estimates in place of the conservative range of 15 to 50 are used. In the East Midlands (Laxton et al. 2001) and the east to the south down to Kent (Pearson 1995) where it has sampled extensively in the past, the Laboratory uses the shorter estimate of 15 to 35 sapwood rings in 95% of mature oaks growing in these parts. Since the sample CRO-A06 comes from a house in Cropwell Bishop in the East Midlands, a better estimate of sapwood rings lost since felling is between a minimum of 6 (=15–9) and 26 (=35–9) and the felling would be estimated to have taken place between 1506 and 1526, a shorter period than before. Oak boards quite often come from the Baltic region and in these cases the 95% confidence limits for sapwood are 9 to 36 (Howard et al. 1992, 56).

Even more precise estimates of the felling date and range can often be obtained using knowledge of a particular case and information gathered at the time of sampling. For example, at the time of sampling the dendrochronologist may have noted that the timber from which the core of Figure A2 was taken still had complete sapwood but that some of the soft sapwood rings were lost in coring. By measuring into the timber, the depth of sapwood lost, say 20mm, a reasonable estimate can be made of the number of sapwood rings lost, say 12 to 15 rings in this case. By adding on 12 to 15 years to the date of the last ring on the sample a good tight estimate for the range of the felling date can be obtained, which is often better than the 15 to 35 years later we would have estimated without this observation. In the example, the felling is now estimated to have taken place between AD 1512 and 1515, which is much more precise than without this extra information.

Even if all the sapwood rings are missing on a sample, but none of the heartwood rings are, then an estimate of the felling-date range is possible by adding on the full complement of, say, 15 to 35 years to the date of the last heartwood ring (called the heartwood/sapwood boundary or transition ring and denoted H/S). Fortunately, it is often easy for a trained dendrochronologist to identify this boundary on a timber. If a timber does not have its heartwood/sapwood boundary, then only a post quem date for felling is possible.

Estimating the Date of Construction

There is a considerable body of evidence collected by dendrochronologists over the years that oak timbers used in buildings were not seasoned in medieval or early modern times (English Heritage 1998; Miles 1997, 50–5). Hence, provided that all the samples in a building have estimated felling-date ranges broadly in agreement with each other, so that they appear to have been felled as a group, then this should give an accurate estimate of the period when the structure was built, or soon after (Laxton et al 2001, fig 8; 34–5, where ‘associated groups of fellings’ are discussed in detail). However, if there is any evidence of

storage before use, or if there is evidence the oak came from abroad (e.g. Baltic boards), then some allowance has to be made for this.

Master Chronological Sequences

Ultimately, to date a sequence of ring widths, or a site sequence, we need a master sequence of dated ring widths with which to cross-match it, a Master Chronology. To construct such a sequence, we have to start with a sequence of widths whose dates are known, and this means beginning with a sequence from an oak tree whose date of felling is known. In Figure A6 such a sequence is SHE-T, which came from a tree in Sherwood Forest which was blown down in a recent gale. After this, other sequences which cross-match with it are added and gradually the sequence is 'pushed back in time' as far as the age of samples will allow. This process is illustrated in Figure A6. We have a master chronological sequence of widths for Nottinghamshire and East Midlands oak for each year from AD 882 to 1981. It is described in great detail in Laxton and Litton (1988), but the components it contains are shown here in the form of a bar diagram. As can be seen, it is well replicated in that for each year in this period there are several sample sequences having widths for that year. The master is the average of these. This master can now be used to date oak from this area and from the surrounding areas where the climate is very similar to that in the East Midlands. The Laboratory has also constructed a master for Kent (Laxton and Litton 1989). The method the Laboratory uses to construct a master sequence, such as the East Midlands and Kent, is completely objective and uses the Litton-Zainodin grouping procedure (Laxton et al. 1988). Other laboratories and individuals have constructed masters for other areas and have made them available. As well as these masters, local (dated) site chronologies can be used to date other buildings from nearby. The Laboratory has hundreds of these site sequences from many parts of England and Wales covering many short periods.

Ring-Width Indices

Tree-ring dating can be done by cross-matching the ring widths themselves, as described above. However, it is advantageous to modify the widths first. Because different trees grow at different rates and because a young oak grows in a different way from an older oak, irrespective of the climate, the widths are first standardized before any matching between them is attempted. These standard widths are known as ring-width indices and were first used in dendrochronology by Baillie and Pilcher (1973). The exact form they take is explained in this paper and in the appendix of Laxton and Litton (1988) and is illustrated in the graphs in Figure A7. Here ring-widths are plotted vertically, one for each year of growth. In the upper sequence of (a), the generally large early growth after AD 1810 is very apparent as is the smaller later growth from about AD 1900 onwards when the tree is maturing. A similar phenomenon can be observed in the lower sequence of (a) starting in AD 1835. In both the widths are also changing rapidly from year to year. The peaks are the wide rings and the troughs are the narrow rings corresponding to good and poor growing

seasons, respectively. The two-corresponding sequence of Baillie-Pilcher indices are plotted in (b) where the differences in the immature and mature growths have been removed and only the rapidly changing peaks and troughs remain, that are associated with the common climatic signal. This makes cross-matching easier.

t-value/offset Matrix

	C45	C08	C05	C04
C45		+20	+37	+47
C08	5.6		+17	+27
C05	5.2	10.4		+10
C04	5.9	3.7	5.1	

Bar Diagram

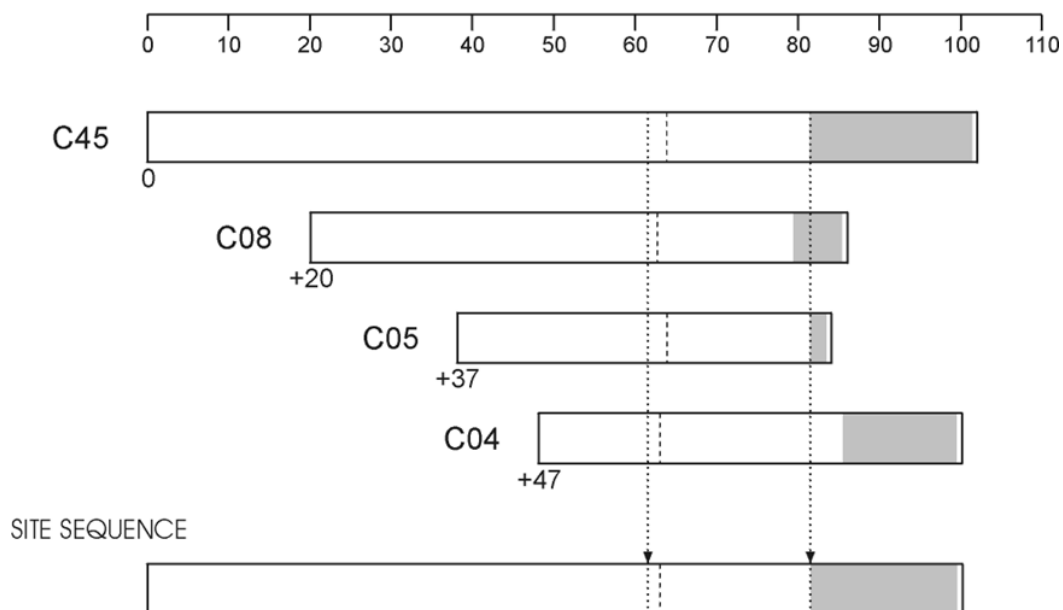


Figure A5: Cross-matching of four sequences from a Lincoln Cathedral roof and the formation of a site sequence from them. The bar diagram represents these sequences without the rings themselves. The length of the bar is proportional to the number of rings in the sequence. Here the four sequences are set at relative positions (offsets) to each other at which they have maximum correlation as measured by the *t*-values. The *t*-value/offset matrix contains the maximum *t*-values below the diagonal and the offsets above it. Thus, the maximum *t*-value between C08 and C45 occurs at the offset of +20 rings and the *t*-value is then 5.6. The site sequence is composed of the average of the corresponding widths, as illustrated with one width.

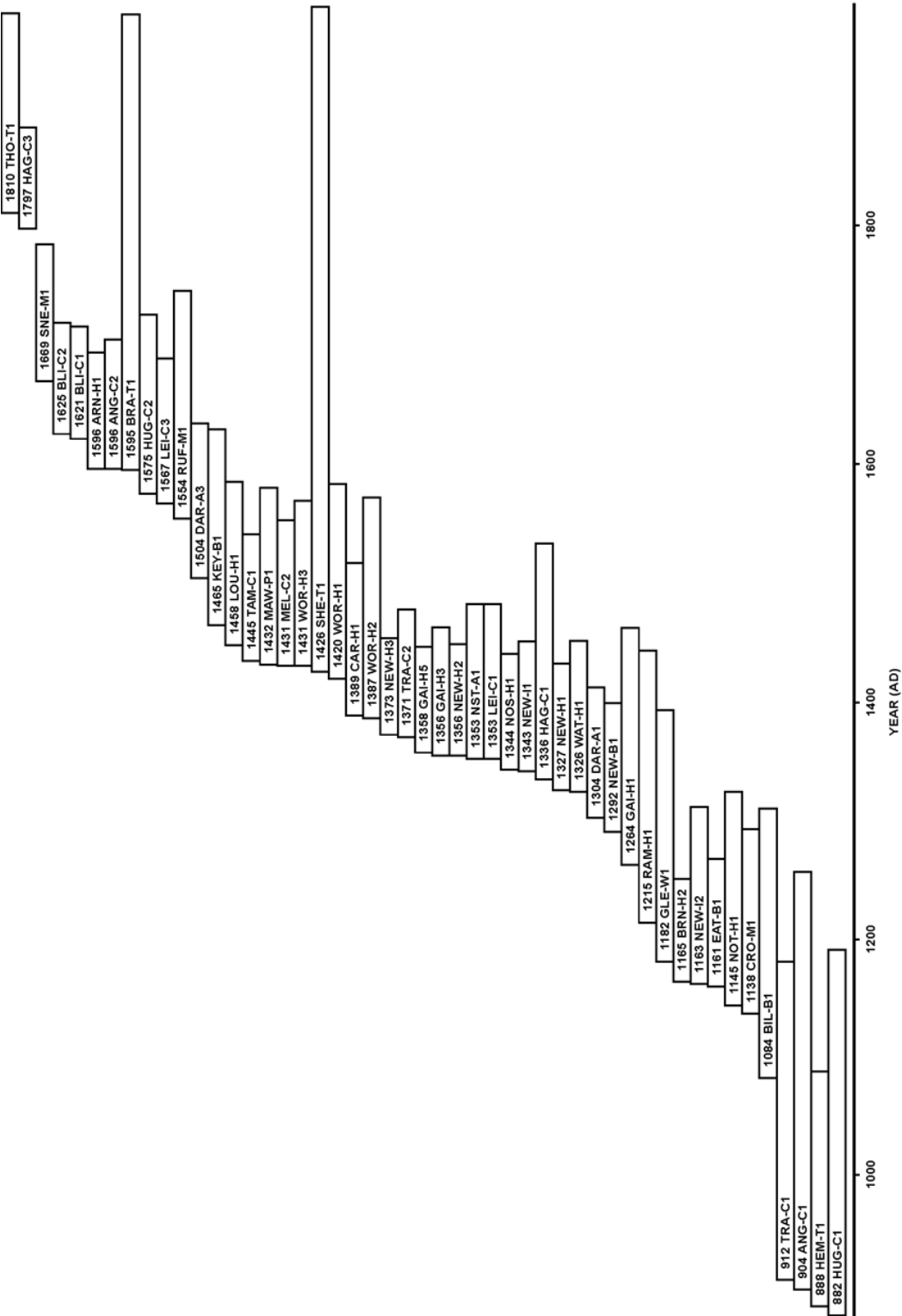
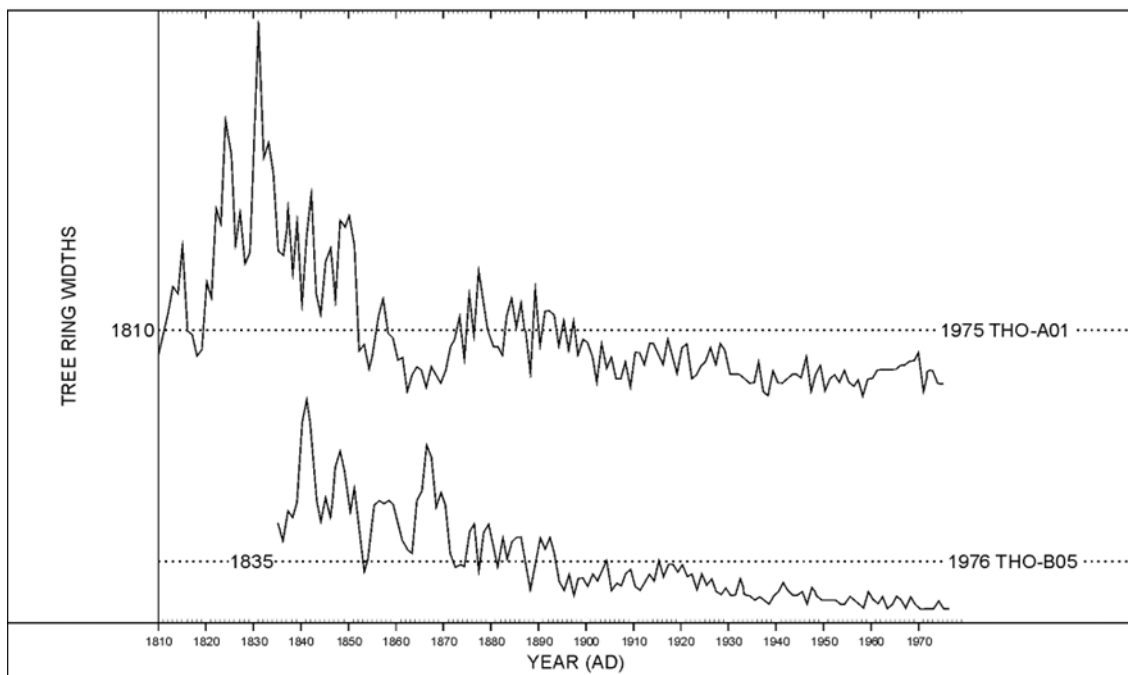


Figure A6: Bar diagram showing the relative positions and dates of the first rings of the component site sequences in the East Midlands Master Dendrochronological Sequence, EM08/87.

(a)



(b)

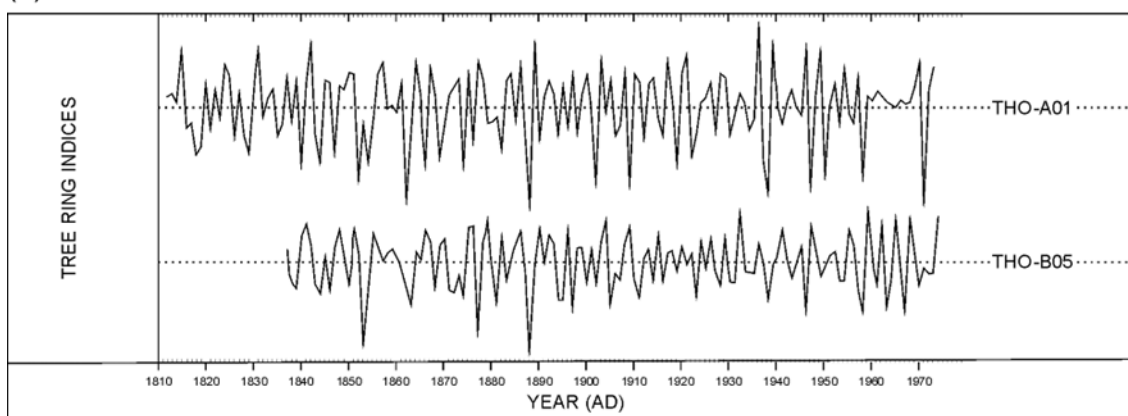


Figure A7 (a): The raw ring-widths of two samples, THO-A01 and THO-B05, whose felling dates are known. Here the ring widths are plotted vertically, one for each year, so that peaks represent wide rings and troughs narrow ones. Notice the growth-trends in each; on average the earlier rings of the young tree are wider than the later ones of the older tree in both sequences.

Figure A7 (b): The Baillie-Pilcher indices of the above widths

The growth trends have been removed completely.

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Appendix 6

Documentary research report on Tudor wrecked ship at Denge Quarry

Gillian Draper FSA FRHistS

Introduction

This report gives an overview of shipping in the locality and of the results of searches in documentary sources for the possible identity of the shipwreck found at Denge Quarry.

The most recent dendrochronology dates for the timbers were mostly between 1534-47 with some later ones (repairs or additions?) of or around 1561. The earlier timbers seem to be derived from trees growing in East Anglia or Southeast England, and some of the later ones possibly from further west. The eastern end of East Sussex, including Bodiam Park, and particularly the Wealden Forest, is well documented for supplying timber for shipbuilding particularly in the Hundred Years Wars [1337-1453], for royal shipbuilding at Small Hythe on the Rother in the fifteenth century, and also for the fortifications of Calais until its loss in 1558 (Draper 2009, 66-78, 226, 253). This and all works by me are available on <https://canterbury.academia.edu/GillianDraper> .

It is thought the Denge Quarry ship may have been over 20 years old when wrecked (or ran aground or was abandoned as was not uncommon in this locality (e.g. Draper and Meddens 2009, 40). The documentary search for wrecks concentrated on the sixteenth century continuing briefly into the early seventeenth where appropriate.

Denge Marsh and Denge Nesse, this historical terms for the area now quarried, were annexed to the small but important coastal market town of Lydd, Kent. Lydd was a member or 'limb' of New Romney, one of the five Head Ports of the Cinque Ports confederation. The Cinque Ports provided ship service for the monarch in return for early urban privileges, together with other members of the confederation, i.e., their limbs or members which were smaller ports usually nearby (Draper 2016, 69-72, 76-89). The Ancient Towns of Rye and Winchelsea which lay to the west of Lydd and Dungeness were also part of the Cinque Ports confederation (see map below from Draper and Meddens 2009).

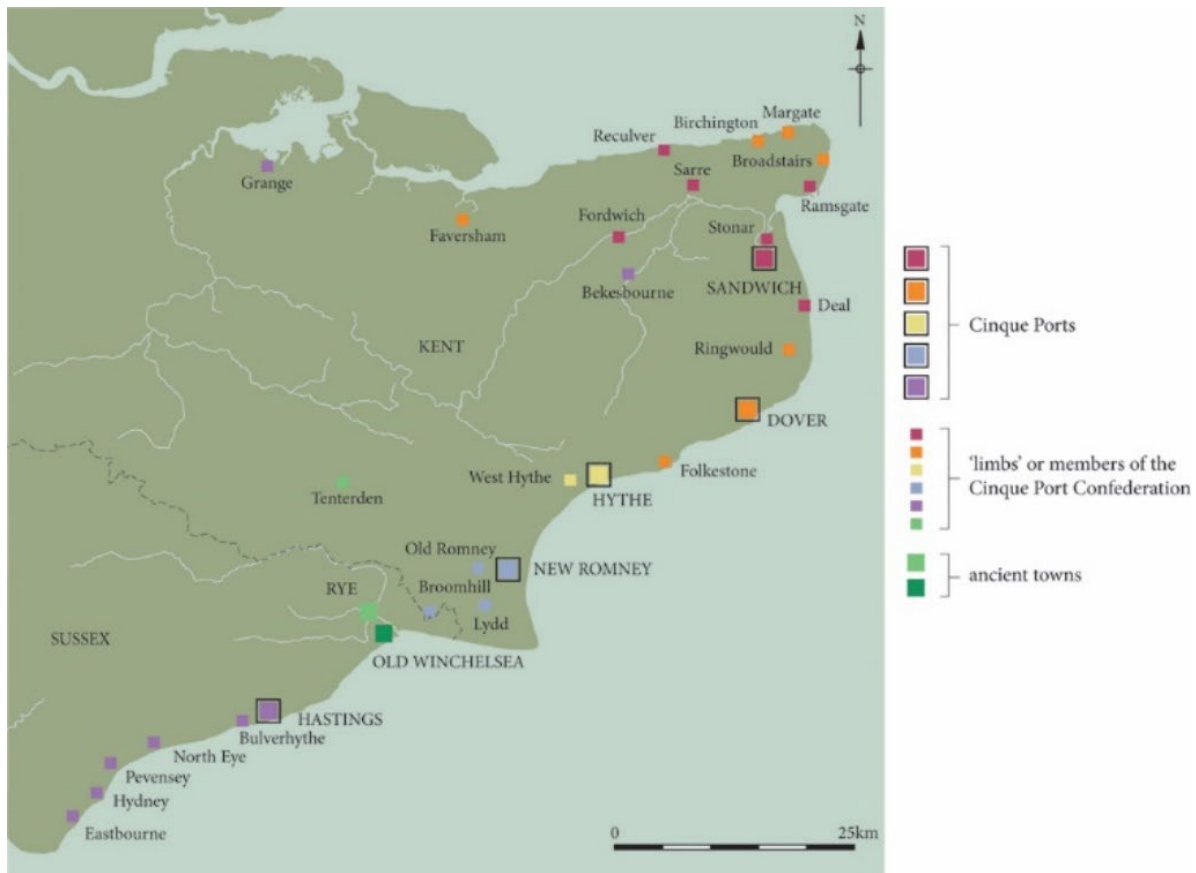


Figure 1 Caption : the Head Ports, Ancient Towns and limbs or members of the Cinque Ports confederation, by permission of Pre-Construct Archaeology (from Draper and Meddens 2009).

Sources

The documentary searches concentrated on the civic records of the Cinque Ports, with a short look at the Calendars of Patent Rolls and the Calendars of State Papers Domestic and Foreign [CSPD] in the earlier seventeenth century which were available online. The Patent Rolls were known to be especially revealing of details of wrecks in the fourteenth century but changed in their nature by the Tudor period hence the search also of the CSPD, which partly replaced the Patent Rolls. The online index of records of the Elizabethan Star Chamber court were checked but no useful references to wreck or piracy in the Lydd locality were found.ⁱ

All of the above have some availability online but it is important to note that by far the best and most detailed catalogue of the Cinque Ports records is in paper in the Appendix of their catalogues at the Kent History and Library Centre [KHLIC], Maidstone. The Appendix was searched, and then manuscripts read as appropriate. Search terms used were a wide range of variants of names particularly Denge Marsh/Nesse, and also the term wreck, ship and piracy/pirates. Wrecking and piracy were closely connected in this area, and the treatment of a captured vessel by pirates, such as cutting into little pieces or burning is discussed in Draper (2009, 52).

Those documents identified as possibly useful were:

The chamberlains' account books from 1428. The first one printed by Finn (1911) covered 1428-84 and is, as he regarded, the most varied and interesting in content particularly regarding shipping in the later years of the Hundred Years War. The next covers 1513 x 1542, and then they are largely continuous although increasingly concerned only with financial matters.ⁱⁱ

assorted papers from 1572ⁱⁱⁱ;

miscellaneous documents from 1550 onwards^{iv};

coroner's inquisitions from 1434 onwards but none related to deaths in connection with shipping/wrecks^v;

muster lists with details of equipment arranged (sometimes) by districts of the town of Lydd with separate lists of bailiffs and jurats (cf. aldermen), young men and servants and able men ready to serve, as certified to the Lord Warden of the Cinque Ports (1547-1635);^{vi}

all the other medieval and early modern Cinque Port documents including correspondence (from 1550), Brotherhoods and Guestling [Cinque Port] courts (1567 onwards), correspondence with Cinque Ports courts (1570 onwards);

From all of these only a few items of specifically related to wrecks were found (below), although many give a clear view of shipping from the fifteenth to the seventeenth centuries and around Lydd.

A sample of the chamberlains' accounts was reviewed from the manuscripts, some of which are microfilmed, in case any references to wrecks could be identified which had not been catalogued. None was found although there was an extensive detailed record of a ship supplied by Lydd for the monarch in 1589-90 as part of Cinque Ports service, but not wrecked.^{vii} This would have been part of the so-called English Armada [see Wikipedia].

It is also important to note that Denge Marsh and Denge Nesse where the ship was found was part of the Cinque Port confederation as a part of the town of Lydd. All members of the confederation, and all manors in the locality, jealously guarded the right of wreck within their jurisdictions or liberties. These jurisdictions were well known by the thirteenth century by oral tradition, by charters, by perambulations and in the case of New Romney by a map of 1683 (Draper and Meddens 2009, 4, fig. 22, 34).^{viii} **It is therefore in the documents of Lydd and Denge Marsh that records a local wreck must be sought**, with a brief comparison which was made via the paper catalogues with those of New Romney, Lydd's Head Port. Lydd regarded any wreck on the coast of Denge Marsh i.e. Dungeness as falling within the jurisdiction and liberty of Lydd and the customary right of its inhabitants by the Ports' charter of 1278, although on occasion this valuable right was granted to manorial lords.

It is important to note that the Lydd records (and indeed others) do not contain formal records of wrecks but rather incidental scattered mentions. The catalogue of New Romney records does not mention any wrecks. There is a note among the Lydd records of a (rare)

dispute in 1561 on trade between William Weston of New Romney and William Sebrand of Lydd concerning trespass and theft of Spanish cassats (silk).^{ix}

There is a statement of account among the Cinque Ports records for money spent by Lydd for goods handed to the captain of the 'Dacee' in April-June 1596. I have not found out anything more about this ship but could try to do so if wished.^x There is no suggestion however that it was wrecked. There are minutes of a meeting of the West Ports, Lydd and Romney at Rye on 10 Sept 1596 with detailed accounts, running to eight pages, which could be checked.^{xi}

There are a letter, depositions and other documents concerning the Pelican of Pomra wrecked in the bay of Romney in 1600 and discussed below.

Denge Marsh records

The Cinque ports and their limbs were in the manors of various lords as well as having much independence as early towns and ports on whose ship service (below) the monarch depended. The lord of Lydd was the archbishop of Canterbury, and the lord of Denge Marsh was primarily the abbot of Battle, but Canterbury Cathedral Priory and the Castle of Rochester also had lands there. This split lordship was another factor in ensuring bounds and customs such as rights concerning wrecks were known and recorded. There are manorial records for Denge Marsh, mainly sergeants' accounts for the fourteenth century, at the National Archives but such records largely deal with agricultural matters, in particular the cultivation of the lord's demesne lands. They are highly unlikely to be related to wrecks or shipping and are not of the relevant period. There are later Dengemarsh rentals but these do not deal with wrecks. Finn (1911, xxii) noted that here were two parish clerks one for Lydd, one for Denge Nesse in the fifteenth century. It was an exceptionally literate locality (Draper 2020, 188-89).

In contrast to such manorial records the civic records of Lydd also cover Denge Marsh and what was known as (Denge) Nesse because they were annexed to the town, and for the reasons given above, it is these civic records which dealt with wrecks in this locality.

The value of salvage of wrecks made it especially important to know in whose jurisdiction the wreck had occurred, and civic records make this clear. For example, the first book of chamberlains' accounts (1428-84) of Lydd recorded 'Itm [Item] paid in expenses of John Grynford being here in the Gange days, 12d' (Finn 1911, 1970).^{xii} ('Gange' or Going or perambulation of bounds at Lydd was held on Rogation Day).

In 1462 a major and aggressive lessee of Denge Marsh, Andrew Bate, whose actions also appear in the chamberlains' accounts, caused bounds to be recorded. Bate tried to encroach on Town lands from the lands he leased on Dungeness, i.e. the Ripe between Lydd and the sea shore, and thus caused the definition of the bounds to be made in 1462. The town 'paid for our bounds upon the Ripe, 10s', a large amount (Finn 1911, 35, also 275, 279, 283). Bate also put heavy tolls of the Westernmen who came to fish at Dungeness (Finn 1911, xx-xxi). In 1467-68 one William Rolfe offered Battle Abbey more for the lease of Denge Marsh than Andrew Bate had done. Also Rolfe offered 'all manner of franchises and liberties to be reserved to the lord, as in wrecks, fishings, waifs, strays and the profits of the Cabons,

[fishing cabins] etc' (Finn 1911, 323). It is notable that the right to wrecks appears first, and therefore most important, in this list of manorial rights, and was to remain the property of the lord.

The disputes and negotiations over the boundaries and nature of the liberty evident in the 1460s continued in the sixteenth and seventeenth centuries, for example Lydd recorded that early in Elizabeth I's reign (1558- 1603) 'The Bourough [sic] of Lydd is a circuit, known by bounds and marks', and the location and bounds of Denge Marsh were given too.^{xiii} In there was a dispute in the early seventeenth century as to whether a place called Orlestone formed part of New Romney or lay within Lydd's liberties.^{xiv} In 1664, a perambulation and recording of the metes and bounds of marshes called Denge Marsh, marsh lands called Jenes Gutt alias Jurie Gutt, in Walland Marsh and White Kempe (Kent), and the parish of Bruckland [Brookland, Kent] was made in a tithe dispute.^{xv}

The conflicts caused by the division of powers and rights between the townsmen of Lydd and their manorial lords, as in the other Cinque Port towns, was also a significant factor in ensuring that boundaries were known and recorded.

The Great White Book and of The Black Book of the Cinque Ports c.1465-1955 (printed by Hull 1966) were searched for the term wreck and relevant place name variants.^{xvi} These books are 'registers' of the proceedings so the Cinque ports confederation courts, particularly the Brotherhood court.

The Cinque Ports and ship service

The ship service of the Cinque Ports confederation can be summarised as a total of fifty-seven ships for a fortnight a year. The ships had twenty mariners and a steersman. These were too small to be warships, and may have been used for scouting in the Channel or to transport perhaps sixty soldiers and their horses (Murray 1935, 12-13, appendix I; Rodger 1998, 25, 124; Rodger 1996, 644] There is fuller detail for New Romney's ship service particularly in relation to wrecking, piracy and merchants, and the nature of the town's vessels in Draper and Meddens (2009, 13-14, 37-40). Together with Denge Marsh, Lydd provided one ship towards the Cinque Port ship service of New Romney's five ships. It also paid one penny out of every five pence which New Romney spent on its Cinque Port obligation to pay the wages/expenses of sending its MP to Parliament. Accounts show this was a substantial amount in the fifteenth century, for example £5 6s 5d in one year (Finn 1911, xvii, 260) and £3 6s 8d 'for our part of the navy' in another (Finn 1911, 160).

Lydd was summoned to provide its ship service when a large English force of 10, 000 men was raised in 1436 to relieve the siege of the castle of Guînes, Pas-de-Calais. Lydd received a letter from the common clerk of New Romney 'for the rescue of the castle' and it paid '9d. for a dinner for one man crossing the Ness to proclaim that letter to the fishermen there'. In view of the large force, with many needing to be transported, it is likely more than one vessel from Lydd was required. However Lydd paid 5s to one of its townsmen to ride to the Lieutenant of Dover, the deputy of the Lord Warden of the Cinque Ports, 'to excuse the town of Lydd from that voyage' (Finn 1911, 69-70).

The location of The Tudor ship on Dungeness Foreland

The Tudor ship was found on the east of Dungeness Foreland, broadly equidistant between Greatstone and Dungeness. As the Denge Quarry Shipwreck Timbers assessment Archaeological Context (1.4.1) showed from the work of Long et al 2006, the contemporary coastline in AD 1400 lay approximately 100 m west of the present-day coastline, at a location broadly similar to that of the wreck. This is consistent with the wreck having been beached on either the shoreface sands or the gravels in a seaward-facing setting, and subsequently preserved within or below the deposits of an eastward/northward prograding gravel barrier (1.4.8). The detailed findings of the earth scientists accorded with the rather different historical evidence for the development of the area in the medieval period examined in Draper 2009 (figs 1.3, 1.4, 2.4, 6, 7, 39).

From this various evidence three reconstructions of this changing locality and the settlements thereon are given in figures below:

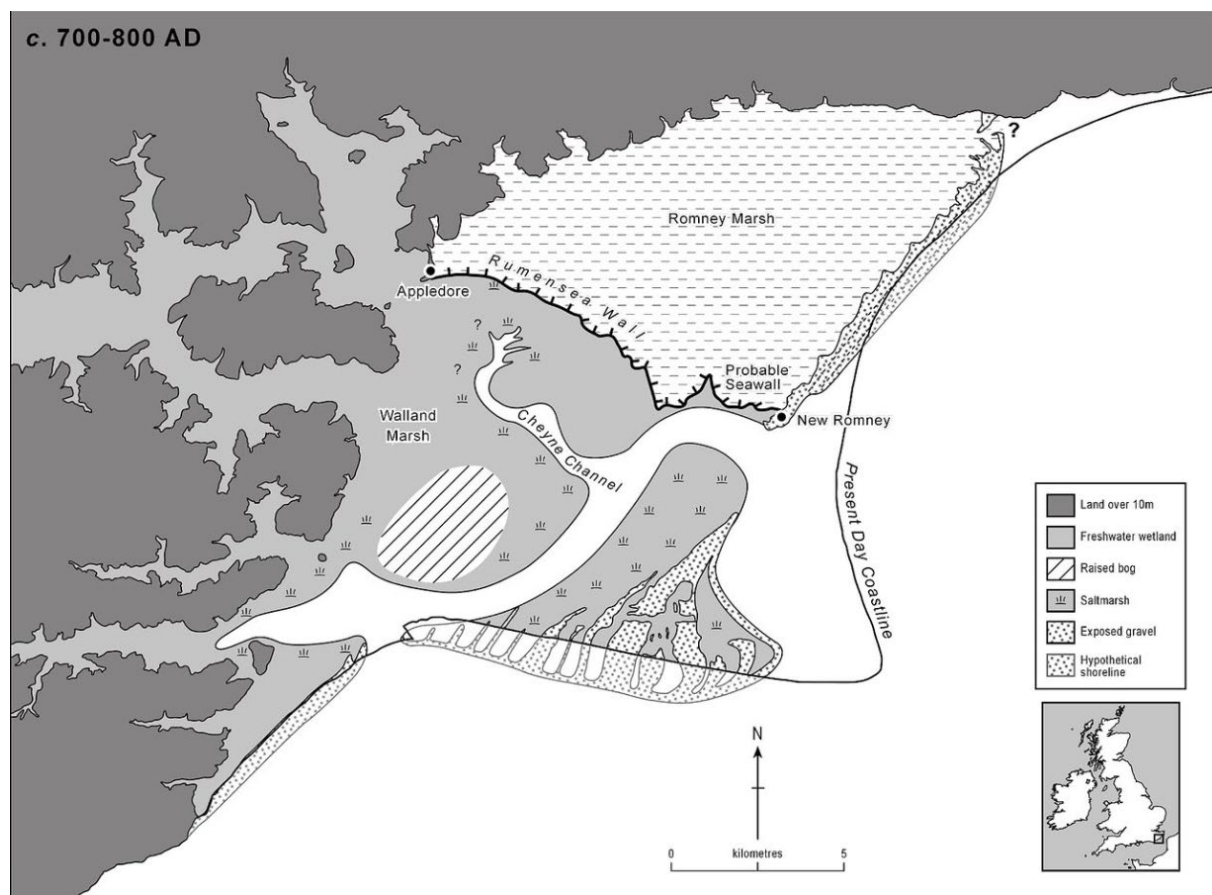


Figure 2 A palaeogeographic reconstruction of Romney Marsh and [the later] Dungeness Foreland c. 700-800 AD (after Long et al. 2007) = Draper Gill copyright

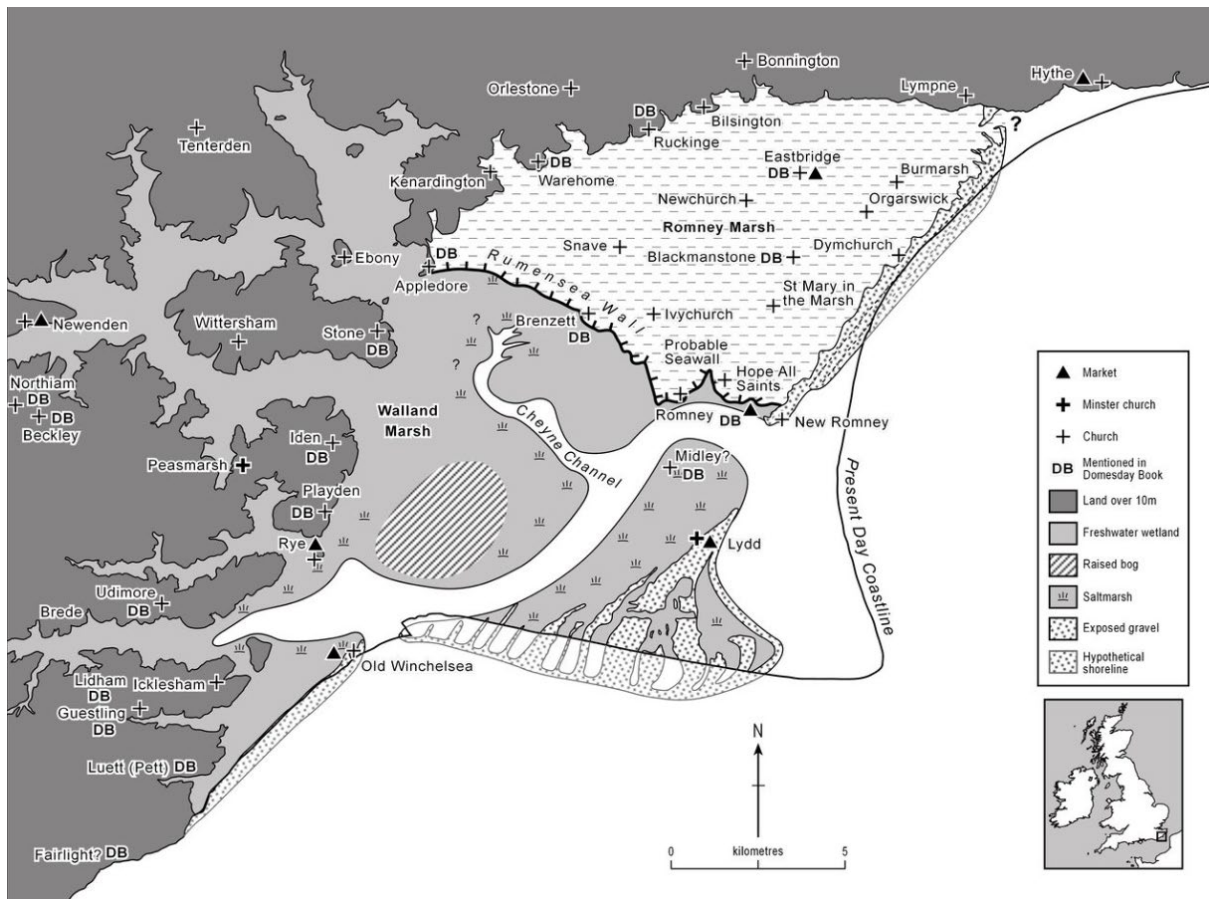


Figure 3 The same with addition of settlements of the eleventh century (after Long et al. 2007) - Draper Gill copyright

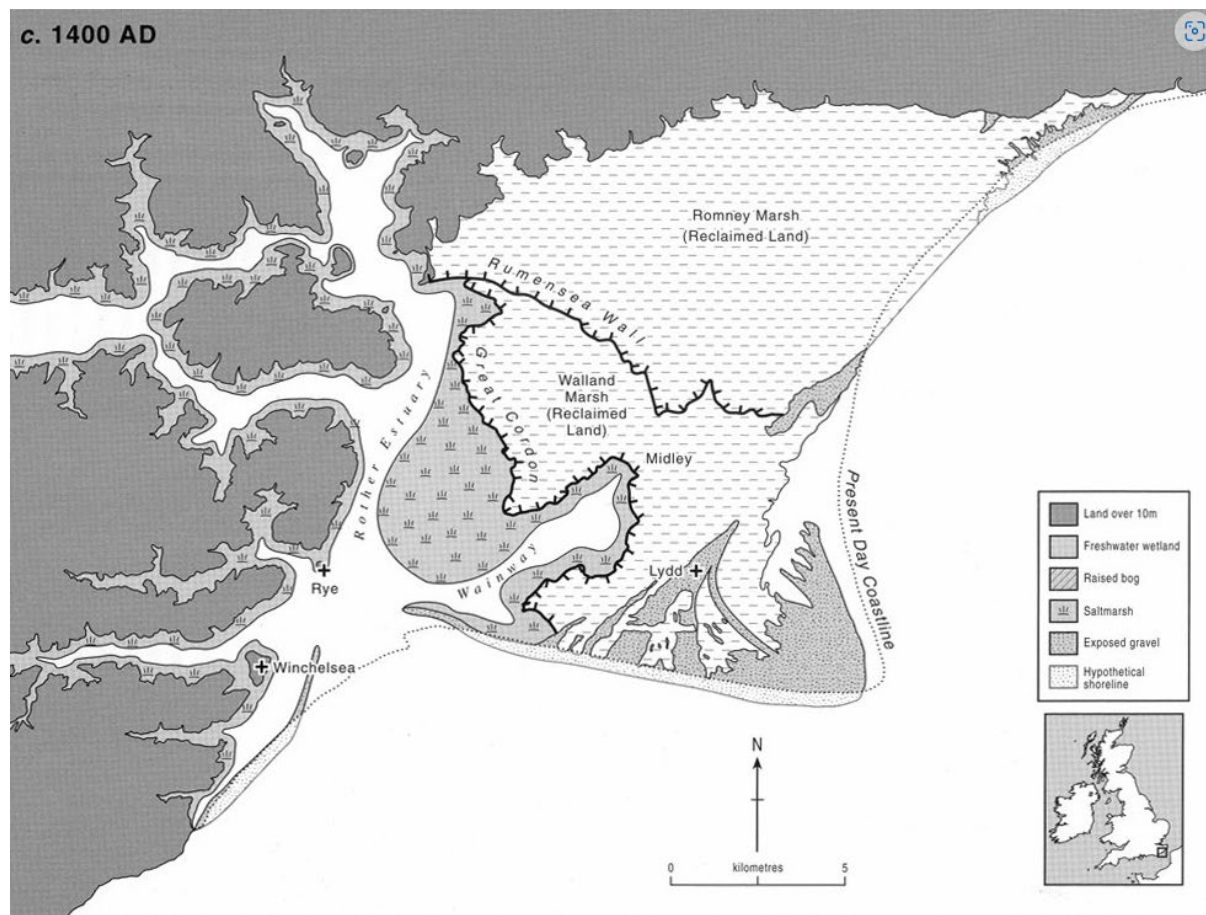


Figure 4 The development of the Dungeness foreland by the late Middle Ages with the shared anchorage of Rye and New Winchelsea, the Camber, lying between them (after Long et al. 2007)- Draper Gill copyright

The history of Denge Marsh and Dungeness

Denge Marsh manor was the shore-based manor of Battle Abbey from the late eleventh century. It comprised (unusually for Kent) a single large block of land in Lydd parish with a few small blocks to its west in Broomhill parish. It ran from Denge Marsh sewer on its north 'as far as [what became] the shingle foreland of Dungeness to the south and south west' (Barber et al 2008, 9).

Denge Marsh was semi-separate from Lydd not least because it was under different lordship, that of Battle Abbey. The Nesse to the north-east of Denge Marsh was the location of seasonal fishing settlements (cabins) of men of Lydd (Gardiner 1996, 18-20). The chamberlains' accounts claimed that in the 1460s Andrew Bate (below) 'wasted and put away from Dengemarsch seventy households and [there were] not eight men left to defend against the King's enemies'. Andrew Bate was a butcher and this was likely part of the conversion from arable cultivation (where possible) to pasture which took place at this time in this area (Finn 1911, xvi, xxx-xxi, 323; Dimmock 2001; Draper 1998).

Fifteenth-century Lydd records contain many references to 'Westrenmen' i.e. fishermen from the West Country, coming to fish and dry their fish at the Nesse, revealing the types and relative values of the fish. Fishermen from both localities were familiar with each other as they all followed the shoals around the coast, and also through acts of piracy committed

together by some (Draper and Meddens 2009; Draper 2009). The Western men were firmly treated by the Dungeness fishers and Lydd town with regard to giving an account of what fish they had dried; in an example from 1465-66 they were 'dystreynned by[t]here bodyis' (distraigned by their bodies) to do so. They had to pay 4d for every thousand of whiting dried, and 2d for every hundred of ling, cod and conger. The Westrenmen also had to make a contribution of 4d out of every 20s worth of fish they sold 'to the town's common profit'.^{xvii} In 1571 the bailiff and jurats established by ordinance a company or fellowship of fishermen, the owners of 'cabons' at the Ness or Masters of the Stade there, doing so in accordance with the Ports' royal charters and custom. They laid down 29 rules for the company.^{xviii} A map of 1617 by Matthew Poken shows the physical and artificial features of the landscape between Hythe, Appledore and Rye, thus including Lydd and Dungeness and the fishing cabins there.^{xix}

The history of Lydd and its havens

Lydd was a growing town from the early thirteenth century with an economy based on both farming and fishing. It flourished until the later sixteenth century, when depopulation and the effects of a capitalist conversion from mixed farming to livestock for export had serious effects (Sweetinburgh 2009, 155-58; Draper 1998, 116-22). It is possible that any wrecked vessel at Denge Marsh/Nesse belonged to fishers or coastal traders there, or might have been sailing to Lydd's haven. The fifteenth-century chamberlains' accounts cover a period of serious change at New Romney and Lydd. New Romney's harbour continued to silt up, as it had done since the great storm of 1287-88, and Lydd may have become relatively more important in this period. Yet Lydd town was not on the coast although it was a large parish with a long coastline. The Wainway channel was Lydd's late medieval harbour and probably extended to near the northern side of the town. Access to the sea for local supplies and sailing was via the Wainway (Wagon Way), for example shingles (wooden tiles) for the repair of the church were brought in several times in the fifteenth century and again in 1524-5 (Finn 1911, 335 339 340, 367, 409).

Later the Wainway channel was reduced in length through silting or the deposit of shingle and used for shipping goods up the channel only as far as a place called Wainway gate. The goods were then transported overland to Lydd by cart, but this was no longer possible by later sixteenth century (Barber et al 2008, 27, n. 40). An earlier 'harbour' facility was at The Brooks on the western side of the town. A 'port' near Denge Marsh is said to have possibly existed before The Brooks, i.e. in the twelfth to fourteenth centuries, which was later replaced by trade and fishing based at Dungeness or 'the Nesse' (Coatts 2005, 15-20).

The major harbour where vessels connected with Lydd via the Wainway was the Camber, the sheltered anchorage between New Winchelsea and Rye on the west side of Dungeness. Camber is known in 1303 and was shown on a chart by Andrew Bianco in 1436. Camber, along with Sandwich, were the places where Cinque Ports fleets gathered in the fifteenth century when ordered to do so by the monarch as part of large English fleets. The anchorage was actively in use in wartime in 1423 when vessels of between twenty and two hundred tons from Southampton, Dorset, Devon and Cornwall were ordered to be

assembled there. It became increasingly silted in the early sixteenth century with fresh and salt marsh in parts of it, although large ships could anchor in parts of a channel, still called the Camber, in c.1572 and sail towards Rye, passing the end of the Wainway. A defensive tower built on a spit of shingle in the Camber in c.1500 became the site of Henry VIII's Camber castle (details in Draper 2009, 37-40).

Rights, customs and profits of wreck from the eleventh to the sixteenth centuries

Rights, customs and profits of wreck were created early and were especially important when establishing and maintaining rule over the kingdom after the Conquest. Denge Marsh and its hinterland were a very significant locality at this time, surrounded by the sites of the battle of Hastings, the earliest post-Conquest Abbey (Battle Abbey, established 1067), and some of the earliest ports/towns in England including Romney and Old Winchelsea. Fishing from the long stretch of coastline which was part of Denge Marsh manor (and all the coast around) helped maintain a vital food supply. Vessels carrying monarchs, their men, their households and their valuable goods sailed from to and the ports particularly Romney, whose importance is measured by the fact that it was partly in the lordship of the Archbishop of Canterbury. Wrecks were valuable since the right to their cargoes could be given along with land. The significance of Denge Marsh is demonstrated by its royal associations. Denge Marsh was originally part of the royal manor of Wye and were given to the major abbey of Battle by William I, with the right of wreck (Searle 1980, 79). Disputes over wrecks, as follows, were therefore between the most important men of the kingdom and were significant in establishing common law.

The Chronicle of Battle Abbey demonstrates this happening in relation to Denge Marsh at an early period with the importance of the laws established remaining significant in the sixteenth century. The chronicle opens up the important and valuable aspects of wreck which underlay disputes and discussions of incidents over the next four centuries (at least), although some aspects were modified by royal decisions and legal cases: that there was a royal right to wreck which could be granted away; individual and institutions understood that there was local and maritime custom relating to wreck; time was allotted by custom to the owners of a wrecked vessel having it repaired if possible; a wreck could be perceived to come under different jurisdictions which affected actions taken in relation to it and its contents; the definition of a legal wreck became linked to life- even that of one surviving man or animal, and there were survivors' rights to a wreck; and lastly, and despite all this, force could be used to implement or overcome legal rights of wreck.

This is clear from the chronicle, royal action and the comments of a late sixteenth-century Kent lawyer. In c.1102 'There happened a wreck in Dengemarsch, a member of Wye... A ship laden with royal ornaments and works, and much shattered by the waves, was cast ashore at that place; and as it could not be repaired within the time allotted by custom, the king's collectors came to seize the vessel with its treasures for the crown. This Master Gausfrid [procurator of the Abbey] and his men opposed, upon which a complaint was laid before the king. But he, willing to observe the custom of the country, and cautious of doing anything that might injure his Abbey, waived his own claims, and commanded the shipwrecked commodities to be given up to the Abbey. Master Gausfrid, therefore,

disposed of them as he thought best, giving the royal vestments to the servants, while he applied the rest of the cargo to the use of the Abbey' (Lower 1851, 52-5).

Again, in c.1140 'a storm happened, and a vessel belonging to the port of Romney (within the jurisdiction of the archbishop of Canterbury) laden with various commodities, was wrecked upon the land of the Abbey of Battel in Dengemarsch, the crew with difficulty saving their lives... The tenants of Dengemarsch, therefore, according to maritime custom, and the royal privileges of Battel Abbey, made a forcible seizure of the wreck' (Lower 1851, 72-75).

The chronicle continues with account of court cases between kings, archbishop and abbot, and statements of law about the custom and profits of wreck, and reviews of edicts of Kings Stephen and Henry I (the latter's ruling confirmed by Edward I in 1274-5). Specifically, it became law that 'if any live thing, as a man or a dog, escape from the vessel, such vessel shall not be accounted a legal wreck' (Lower 1851, 72-5) This meant, in brief, that rather than the lord of the soil having the wreck, any survivors should have it. This remained relevant even in 1570 when the county historian William Lambarde noted approvingly that this remained the case.

Once it was established that a wreck had occurred, the issue was who had the right to such goods as the salvors rescued or which came ashore. By the fourteenth century the right had generally been granted away by the monarch to towns including the Cinque Ports or manorial lords or acquired by the Lord Warden of the Cinque Ports. Over the fourteenth and fifteenth centuries the Ports negotiated individual agreements with the Warden, who received either a third or half of wrecked goods. However in 1574 the Portsmen made an agreement with the Warden that if a vessel of the Portsmen was wrecked, the salvors and the town concerned had full rights. However, in the case of vessel of a non-Portsmen, the Warden took a half of the goods (Murray 1935, 125-6).

The Calendars of State Papers Domestic from the reigns of Edward VI to James I (1547-1625 altogether) contain numerous references to disputes over right of wreck, although two specifically related to Lydd are either too early or (presumably) too late for the Tudor shipwreck. The first of 1534 gives a 'Petition of Robt. Rocquelin and Henry Janson, factors of Robt. Du Mouchel, sen., and François Benoist, showing that on Sunday, 22nd Feb. 1533, a ship called "La barge de Croisset," Oliver Thuboye dict Chouart master, was wrecked near the Camber. She was of 100 or 120 tons burden, and was laden with corn, Rouen cloth, &c., belonging to Mouchel and Benoist. On Monday, the 23rd, the crew went to recover some of the cargo, but were prevented by Englishmen, who killed one and wounded others. On Thursday, the 25th (sic) Rocquelin, with two English and two Frenchmen, asked the bailiff of Lydd to return the goods, most of which he had in his house, but he replied that they were for the lord Warden, who would answer for what was done. Rocquelin then went to the bailiff of Winchelsea, who has part of the goods. He likewise replied that he was the lord Warden's servant, and had acted for him. Rocquelin then went to Rye and asked persons who had his goods to return them, but they refused. They beg the King to order the lord Warden to restore the merchandise on their paying a reasonable sum for salvage (Letters and Papers, Foreign and Domestic, Henry VIII, Volume 7, 1534).^{xx}

The second reference, from November 1619, asked 'whether the right to some bars of silver, taken up from a wreck ... that if the Judges think it unlawful, the counsel of the town of Lydd may be heard' (Calendar of State Papers Domestic: James I, 1619-23, volume 111).

Piracy and wrecking on coast of Denge Marsh

Piracy and deliberate wrecking of ships were a feature of the southern Cinque Ports, especially in wartime, and are well documented and published). One example is given here from the period of the hugely valuable import of Gascon wine to Winchelsea, because it specifically mentions the coast of Denge Marsh which is relatively unusual- usually the home ports of the pirates or wreckers are named. Laurence de Seynt Jak (Saint James), was master of the ship called the ship of Our Lady of Fount Arabye and made a petition to Edward II and his council in c.1315. Seynt Jak stated that he and his fellows, merchants of Gascony, on the way to Gascony carrying goods of the value of £2,200 encountered a storm and were wrecked upon the coast of Denge Marsh. Then men of Winchelsea, Rye and Romney came and by force and arms stole their goods. On this Bernard Franssa, attorney of the merchants purchased a writ of the king to Robert de Kendal (constable of Dover Castle and keeper of the Cinque Ports) to enquire of these things, but he was unable to do so as the men of the ports disputed his right to do so. The merchants request that the king and his council give evidence if the king and his ministers with a warrant have the authority to enquire of such malefactors or not, and order that the merchants have restitution of their goods, and remedy that the men of the Cinque Ports are not able to be inquisitors of the trespasses that they themselves have made. This was Seynt Jak's second attempt to get justice, and Robert de Kendal was ordered to see that it was rapidly done.^{xxi}

Piracy against Flemish shipping in the Channel continued to be rife until the end of the fourteenth century, with the pirates taking advantage of political and trade disputes between France, England and Flanders, and continued beyond (Barron 1995, 4-6, 20).

Watches in wartime

The first chamberlains' book documented watches against the French landing at Dungeness during the last years of the Hundred Years War and later in the fifteenth century. A strict watch was kept, not only at the Nesse e.g. in 1470, but also at Goryswall and Wayesend (below) (Finn 1911, 417). Ships were used too to keep the sea, and specifically against the French in the North Sea (Finn 1911, 169).

Lydd possessed a gun which was dragged on planks called 'hame slidys' to the Nesse or the Goote (gut, i.e. drainage outfall) in times of feared French invasion (Finn 1911, 170). The chamberlains paid 4d for the meat and drink of two carpenters who mended the guns on the Monday the French came on land at the Nesse in the autumn of 1429 (Finn 1911, 178). The gun was clearly fired from the shore not from a ship. The gun was a Serpentine, a common type of small cannon; gunstones and gunpowder were bought for it, for example in 1484-85, and also two bags of leather for the powder (Finn 1911, xvii, 175, 315).

Other Lydd records and late sixteenth-century quarter sessions records also record such watches. For example, there was a watch dispute at Dungeness in c. 1587 and on 16 August

1599, the Lord Warden wrote to the Seven Hundreds and Lydd commanding that watch be kept at Denge Marsh to guard against the threat of invasion by a large Spanish fleet ‘which is in readiness’.^{xxii} On 18 July 1597 there was a presentment of the Seven Hundreds (the civil administrative unit in which Denge Marsh lay) for failure to carry out beacon watch duties in Denge Marsh, and similarly around Easter 1600. It was recorded at that time that anciently (before/by 1403-04) men of the seven hundreds ‘have been accustomed to keep sea watch in time of war on the coast at Denge Marsh, with twelve men each day and night’.^{xxiii} There was also an extremely lengthy contemporary discussion of the requirements for watches and beacons from 1585 at Denge Marsh recorded in great detail in a document held in Hawkhurst church in 1897 and other documents (Lightfoot 1897, 299-310).

The nature of shipping around Lydd in the fifteenth century.

The Lydd chamberlains’ accounts give the best view of shipping in the area in the fifteenth century. This includes the types of vessels, their names, the number of men in them, and the number of sailors required to move vessels around e.g. to the Camber. There are also mentions of the loss of a ship and the salvage of tackle. There are also records of where a ship was obtained or hired from for Lydd’s ship’s service, the nature of that service, how the ship was provisioned and how those who sailed it were equipped. There are thus glimpses of Lydd’s role in political and military and royal activities. There is also an indication of the nature of a boat, as opposed to a ship, which came into Lydd, and of the fishing equipment which some fishing boats carried, and places with which Lydd ships traded. (Later accounts to do not contain such details, see Sources). Vessels are usually called ships (*naves*), occasionally boat/*navicula*.

The names of the vessels are tabulated here and discussed below.

Information about vessels at Lydd	Dates	References from Finn 1911
Ship with boats bound to it bought by Lydd	1429-31	26-31
Ship of Appledore	1429-30	30
Ship hired apparently from Winchelsea	1436	56-63
Stephen Howghe’s boat (<i>navicula</i>)	1443	85-6
Ship of Sir Thomas Kyryell (Kyriell)	1443-4	91, 93
The Trinity	Sep. 1444	97-8
The Ruge Cule of Brittany	1444-5	94-103
Ship of Hull, salvage of tackle	1444-5	xix, 101-2, 105
Ship of Portugal	1445	102-3, 170
A carrack	1448	125
Ship called the Nicholas	1449	134, 137
Ships of the Earl of Warwick to be arrested	1470	257
Ship of Sandwich hired	1475	292-4
The George brought from Romney	1479-80	303-4
The Hayne of Lydd	1491	325

Ship with boats bound to it bought by Lydd: in 1429-31, a ship bought by the town is first recorded in the accounts as at being at Redyng, a shipbuilding site on the banks of the Rother, near Small Hythe (below). The ship was then at Appledore, further down the Rother, and ultimately it went to the harbour at the Camber. Two large payments of 35s and 40s (and one of 15d) were paid to one Broker and the owners of the ship and his partners in full payment for the ship: possibly these were the shipbuilders or previous owners. A sum total of £6 6s 5d was also recorded for the ship. Another 13d was paid for the expenses of the owner of the ship when he went to Lydd 'to have warranty for the ship'. Another 7d was later paid to Thomas Buntynge for 'binding the boats to the ship' thus giving a picture of its nature. The ship was intended for the voyage of the king although this is only mentioned as an aside in the accounts when 3d was paid for bread and beer when the jurats met to choose the men for that voyage. It was provisioned with bread, candles, casks, flesh, fish and butter (Finn 1911, 29). The voyage was perhaps Lydd's part in the king's French coronation: 'in April 1430, the royal entourage, more than 300 strong, crossed the channel with a large army; the king [aged 10] was accompanied by senior nobles, and the cost was prodigious' (ODNB HVI, where this is further discussed).

'Reding', now Reading Street, was a major late medieval shipbuilding site on the Kent side of the River Rother near Small Hythe. On 1488 one of two large carracks which Henry VII commissioned was being built, probably staying with Adam Oxenbridge, the mayor of Rye (Small Hythe was a member of Rye). The carrack was then floated down the Rother later in 1488 to have its masts and rigging fitted (Draper 2021, 295).

Ship hired apparently from Winchelsea: In 1436, a journey was made to Rome for which Lydd hired a ship with a boat; provisions were bought, apparently sufficient for one man, although presumably he would sail with other people. The journey was being made on behalf of the town by the common clerk, William Leycroft, and might have been a pilgrimage or a visit to the papal court although there appears to be no reference to it in the Calendar of Papal Registers. Leycroft took his journey on Monday after the feast of the Epiphany of the Lord (6 January), apparently a rough time to sail. 13s 4d were paid to cover his salary for half a year. The ship hired and its boat went first to Romney then to the harbour, presumably the Wainway, 20d being paid to four men bring it from Romney to the harbour. With the agreement of all the jurats and commonality of the town, Leycroft made crossing to Rome in this ship. It was provisioned with meat, two barrels of beer, salt, bread and butter and cheese, a tablecloth and fish, dishes and a bowl.

Ship of Portugal: money was paid in relation to this from the seventh scot assessed on 14 Feb. 1445 and accounted for on 30 May 1445 (below). Later various men were 'paid to be at Lydd to make accords between the masters of botys [boats] of this town and the Portynгалens, 7s. 4d' (Finn 1911, 170). These were Portuguese, whom the Middle English Dictionary records with men of other places, Spain, Galicia and Brittany and Almaine [modern Germany], as carrying out much trade in vessels with the southwest and other parts of England, including grain, oil and wax in the fifteenth century

Ship called the Nicholas: an entry in the accounts clearly related to ship service and giving notice of the number of sailors required in a ship records 'Item paid William Groce for

carrying letter to the Lieutenant [of the Cinque Port Warden] of Dover for the excuse made by the Jurats for the fishermen whom he wanted to have had, 40 men, in the ship called the Nicholas, 10d’.

Stephen Howghe’s boat (*navicula*): In 1443 Lydd was paying for a boat for the transport of stones to repair the church, ‘Itm paid to Stephen Howghe’s boat (*navicula*) as far as Farley [Fairlight, on the coast to the west towards Hastings], and for his labour, 2s 6d. Item paid to Richard Hughelot mariner, for the same, 20d’. At this time (1443) stones were being obtained from various places for the repair of Lydd church, most presumably by cart, but as here some by boat, and presumably coming up the Wainway: ‘Itm paid to Lawrence Lante for his work about the stone coming from Fairlight, 8d’.

Ships called the Trinity and The Ruge Cule of Brittany: In autumn 1444 Lydd hired a ship called the Trinity from Sandwich, then the most flourishing Cinque Port with a valuable import and export trade, ‘for the voyage to bring over the Lady Margaret, who will be Queen of England, into England’ (Finn 1911, 97-8). Margaret was the daughter of René, Duke of Anjou and the marriage was an attempt to promote friendship with France (ODNB Henry VI). A proxy marriage between Margaret and the Duke of Suffolk took place on 24 May 1444, at Tours, and Suffolk returned to France in November 1444 with a substantial and protracted expedition to fetch Margaret, with a splendid pageant, costing more than £5573. The actual marriage took place on 22 May 1445 at Titchfield abbey and her coronation in Westminster Abbey on 30 May 1445 (ODNB Margaret of Anjou).

The jurats of Lydd apparently changed their minds and hired the Ruge Cule (below) instead of the Trinity. The payments relating to the Trinity and the Ruge Cule are not clearly separated or precisely dated in the accounts (Finn 1911, 94-101). In September 1444 a payment of 29s 4d of ‘old debt’ was made to one John Serlis at Sandwich for the Trinity which had been hired there and 36s 8d to Richard Hughelot, mariner and purser of the Trinity. However, seven other entries relating to the hiring of the Trinity were crossed through in the account, presumably because they were disallowed at audit or the chamberlains felt they could not justify paying them.

The Ruge Cule of Brittany In the summer of 1444, apparently, men went to Appledore for the ship called The Ruge Cule of Brittany, hired instead for the voyage of Lady Margaret.^{xxiv} 10d was paid for the men’s breakfast there. Appledore was a small market town on the River Rother in the 13th century. Appledore lay c. 7 miles (11km) inland from New Romney and had a jetty of the late twelfth or thirteenth century which is likely to have been used mainly for local Appledore river trade to and from the port of Romney, but could also have been used by sea-going coastal vessels (Burke 2004, 3). There were three payments to the owner of the Ruge Cule from the seventh scot of 1445 (below) for either buying or hiring the ship, and including cheese for it, totalling the very large amount of £24 14s 5d. Eight sailors and four rowers were recruited at 4d each, and later two more rowers at same cost. The ship was equipped with more food including fresh herrings, a bullock (roasted) and bread which had been impounded by the Sergeant of Dengemarsh, also three quarters of mutton, beer, flour, etc. A man was paid 14d for repairing one pipe i.e. a cask for ale, cider or wine, apparently equivalent to ‘two hogsheads’, or maybe a cask for food. He was also paid for

one day's journey to the Camber to repair the ship, and for the making of three barrel-heads for the ship, and for four hoops, 14d, presumably also for barrels. Obviously because of its intended purpose, this was an extremely smart and well-equipped ship, which cost the town a lot. To cover part of the cost of the ship the town raised six scots (local taxes on the townspeople) which raised a total of £17 9s 10d. They then raised a seventh scot on 30 May 1445 (Finn 1911, 95, 102). Scots were again raised in 1447-1449 which various men failed to pay, including William Eden. For this the jurats took and held fishing equipment, one shotnetryge [shotnet rig], in the common house of Lydd (Finn 1911, 137). Shot nets are mentioned as nets only in the many Lydd wills or 'with their apparatus' which as they were used as a line of nets, may be the rig. In terms of Denge finds, it is the lead weights that have survived, and these are what the archaeologists found (information from Dr Sheila Sweetinburgh).

Ship of Hull: in 1444-45 the tackle of a ship of Hull had been salvaged and all the salvors agreed to make a grant of 33s 4d to the lead of the roof of the new church tower. The tower was important to sailors since it was very tall and could therefore act as a sea-mark.

Ship of Sir Thomas Kyryell (Kyriell): this ship was to be hired by the town in 1443-4. It was lying at Winchelsea i.e. close to the Camber anchorage, and two men went to it. 13s 4d was paid to Thomas Kyriell for rigging it 'for part of the gear'. Although Kyriell was a career soldier he had earlier been appointed on 1 December 1436 'to go abroad on the king's business, presumably the relief of the castle of Guînes, above, to take up two ships and a vessel called 'passager' in the port of Wynchelse to convey him and his company, and to impress mariners to navigate them at the king's wages'.^{xxv} Kyriell was a career soldier and because of his military credentials had been appointed Lieutenant, i.e. captain, of Calais in 1439-42 (Grummitt 2008, 1, 10n, 67-8). Later in life Kyriell was MP for Kent, and also Lieutenant of Sir Humphrey Stafford, Duke of Buckingham, as Constable of Dover castle and Warden of the Cinque Ports, 1456-60. As such he held the Admiralty Court, for example, at Lydd, in summer 1455 when a man was paid 4d to make a proclamation 'at the sea-side' about this court (Finn 1911, 167). Kyriell was executed after the battle of St Albans of 17 February 1461 which the Yorkists lost.

'A carrack': a brief mention of a carrack in 1448 is as follows 'Itm paid for the like [i.e. carrying up to Dover castle for the return of a letter] of a letter coming [from the Archbishop] for a carrack...20d'. There is a brief mention of a proclamation for the goods of such a ship but no further details, 'Itm paid for a cry for the goods of the kareke, 1d'.

Ships of the Earl of Warwick to be arrested, 1470: the men of the Cinque Ports always aimed to be on the right side in political struggles because of their relationship to the monarchy and the fact that attempts to overthrow the monarch usually involved the entry of the contenders into southeast ports (Draper and Meddens 2009, 40; Mercer 2010, 252-58). The chamberlains' accounts have brief mentions of Lydd's 'weak diplomacy' in sending men to fight the Earl of Warwick, Richard Neville, the so-called Kingmaker, but then paying troops to help King Edward IV, whose overthrow Warwick was attempting and temporarily achieved (Finn 1911, xviii). The reference to the ships of the Earl being arrested is part of this.

Ship lost at Weyhisend [Wayesend]: In 1471-2 the following was recorded without more detail, 'Itm in expenses at my Lord Arundell his man bringing a letter for a ship lost at Weyhistend [Wayesend], 8d'. Arundell was William Fitz-Alan, Lord Warden of the Cinque Ports of 1471-78 (Finn 1911, 266, 269). Weyhistend [Wayesend], a location not now known, was mapped by Philip Symonson in 1596 as lying on the coast to the southeast of the Wainway Channel and Broomhill church, which is now ruined.

Bote called the Antony: in 1472 '6s 8d [was] paid to Edward Alweye for his bote'. 12d was paid to Gilbarde to speak with the Master of the Antony 12d. Also noted was 'Itm paid for one Cry [proclamation] to have men in the Antony 1d'. One William Gylbarde was one of two common collectors of the scot and also common sergeant (Finn 1911, 315, 317). This payment was clearly related to ship service in some way. What is of interest is that the vessel was called a boat not a ship and therefore smaller.

Ship of Sandwich hired in 1475. A ship was hired from Sandwich for a voyage of the King, that is as part of his fleet, and moneys were paid for equipment, including sail cloth at 6d, and food etc. Twenty-one men and a boy were chosen but only 19 men and youths were paid to serve in it by Lydd, each man 3s 5d, and the boy 2d for 15 days. This was the standard Cinque Ports service; if they had served more days the monarch would have paid. The materials bought were loaded either at 'the Nesse' or the Camber. As this was a voyage to transport the King, Lydd paid for clothing, presumably for the townsmen/sailors who might encounter the King: gowns for at least two men, and 'Jakettes' (jackets) for an unspecified number of men, costing 36s for the cloth and 3s 10d for the making'. Jakettes were stylish wear or associated with ceremony as when the Earl of Warwick came to London with 600 men in red jackets (Middle English Dictionary, from *The Brut*, c.1500). In July 1475 an English army crossed to France, but saw no significant military action' (ODNB Edward IV); Lydd must have hired this ship to take part in transporting the army. This was part of military activity which had been contemplated by Edward IV against France since 1468. He was eventually bought off by a substantial pension from Louis XI, and an agreement that Edward's daughter should marry the Dauphin Charles.

Ship called The George: this ship was brought back from Romney in 1479-80, with few details. 'Itm paid in the expenses to the men of the Town of Romney, and other men of the Marsh at Lydd, at the fetching home of The George, 4s 10d' suggesting it belonged to Lydd.

The Hayne of Lydd: this reference is in a memorandum apparently added later at the end of the accounts book: 'the Bailiffs and Jurats agree with Robert Cokeram and Robert Alewey who own The Hayne of Lydd that it should be thoroughly prepared for service of the King [Henry VII] and begin on Monday 3 September Henry VII (1491) viz. every week'. Clarke, Pearson et al (2008) index *Hayne* under ship types, but it does not appear as such in Middle English Dictionary. (Their study of another Cinque Port, Sandwich, in the medieval period and up to 1600 indexes only two wrecks).

Overview of shipping in 16th century

In Henry VIII's reign (1509-47), Lydd as well as New Romney and the other members of the Cinque Port confederation continued to provide shipping across the Channel for various

kinds of passengers including pilgrims, merchants, alien craftsmen, soldiers and their horses (Draper 2009, 32, 49, 70).^{xxvi} Alien craftsmen from modern Germany, Italy, France, Spain and the Low Countries were listed in tax and other records in Sandwich, Appledore, Romney Marsh, Rye and Winchelsea between 1436 and 1538 (Draper 2009, 82-3). Lydd chamberlains' accounts refer to 'our' aliens in an appreciative or protective manner several times in the fifteenth century.^{xxvii} Sir Richard Guldeforde was one of the later pre-Reformation pilgrims, crossing from Rye to Venice and onto Jerusalem in 1506 (Lutton 2009). Most of the vessels providing transport are known, or likely to have been, vessels owned by townsmen of the Ports or fishermen thereof. The size, nature and types of vessel using the southerly members of the confederation, particularly Rye, are known and published in detail. For example, in 1492 seven Rye vessels were listed, ranging from a fishing boat to a carvel (Draper 2009, 38-44). In the 1560s to 1580s there was strong local demand for the building of ships with, for instance, arrangements for the building or leasing of ships between Rye and London men particularly noticeable in the late 1570s and 1580s (Draper 2009, 104).

Providing shipping passages across the Channel continued in Mary 1's reign (1553-54), Philip and Mary's reign (1554-58), Elizabeth's reign (1558-1603) and James I's reign (1603-25). The several letters surviving from the Privy Council, Lord Warden of the Cinque Ports or his Lieutenant to New Romney ordering stays of shipping or the arrests of intended voyagers from Romney or Lydd demonstrate that it was likely that vessels from these ports were expected to be involved.^{xxviii} In times of political suspicion or war the Cinque Ports were ordered to stop all passages across the channel for a period of days, although efforts were made to keep passage open. Sometimes specific individuals were sought in the Ports such as one Francis Crayne, a young man from Plymouth, who had landed at the Nesse apparently in an attempt at secrecy.

The Lord Warden was aware that creeks might be used to unload goods without inspection, for example from ships returning with the army from Spain in August 1596, and ordered that instead the goods should undergo official inspection within the main part of the port. In both wartime and peacetime the Privy Council and other individuals, mainly the Lord Warden, wrote to New Romney and Lydd to order that ships should not provide passage to men considered undesirable for criminal, political or religious reasons. This was particularly the case early in the reign of James I (and VI of Scotland). For instance, a stay of passage of ten days was ordered on 16 July 1603 to prevent the escape of a priest, William Watson, charged with dangerous practice against the king's person, and also the escape of Sir Griffin Markham and his brothers with descriptions of them all. This was part of the Bye plot, 'a Catholic conspiracy to seize the king James at Greenwich and force him to grant a general toleration'.^{xxix} The Privy Council ordered the lifting of the stay of shipping by letter five days later on 21 July 1603. The priest Watson was arrested and executed at Winchester later in the year.

The focus of communications with the southerly members of the Cinque Ports confederation reflected the short channel crossings and the availability of vessels which could transport passengers. Religious 'strangers', i.e. Walloons and Huguenots, including

weaving and fishing households, arrived in Kent and Sussex Cinque Ports from 1562 from the Low Countries and France, often from Dieppe to Rye. They were probably fetched and carried in local vessels, including those used for fishing. Men from both communities were involved in piracy on Spanish vessels in the Channel in the early 1570s (Backhouse 1995, 36; Draper 2009, 163). Between the 1540s and 1590s Rye became the major southern-eastern port, far surpassing Lydd, and contributed vessels to general warfare and privateering with royal encouragement (Draper 2009 134-136, 168). However these vessels were probably relatively small in contrast to the ships of the 1590s onwards which were seized by English privateers including in the Channel. These ships were carrying Brazilian sugar produced by enslaved people, and particularly during the Anglo-Spanish war of 1585-1604 (Davies and Finnegan 2023).^{xxx} Various entries in the Calendar of State Papers confirm this change in the nature of shipping and the import trade early in Charles I's reign. The entries largely concern import of Brazilian sugar from Brazil or goods from the East Indies. Some, as below, refer to disputes over the right of wreck. There is a reference to a wreck off the coast of Sussex in 1636-37 as follows, but I take it that this is too late a date for the shipwreck of the Tudor ship:

'The like [petition] of John Duburdett, a merchant of France, and other English merchants adventurers thither, to the same [the Lords of the Admiralty]. Petitioners having divers ships freighted with wines from France to the port of London, eighteen sail of them about February last were wrecked on the coast of Sussex or that way. One ship having aboard 190 tuns of wine, about 60 tuns floated on the sea. These were dredged ashore by the inhabitants, and are claimed by the Earl of Abergavenny on pretence that he has the royalty of the soil. Petitioners are advised that these wines belong to his Majesty. Pray directions to the Attorney-General to sue for the same in his Majesty's name, and on their recovery that the Lords of the Admiralty will make a favourable composition with petitioners'.^{xxxi}

Specific wrecks:

Five possibilities for the identity of the Tudor shipwreck were identified among the records, but only the first is likely.

A short letter dated 4 November 1570 from Lord Cobham, Warden of Cinque Ports, to the Jurats of Lydd, has survived.^{xxxii} It has the message that the bearers have come to claim part of the goods wrecked at the Nesse. There are no further details of the ship itself. The bearers were carrying bills of lading, thus he would have known what goods the wrecked ship had carried, having consigned the goods to the vessel himself; else he knew who consigned the goods and was requiring their return as Admiral of the Ports. Even in the fifteenth century loading lists i.e. bills of lading had been used in Admiralty inquisitions and courts' in the Ports (held by the Warden) as evidence of ownership in deciding rights in relation to salvaged goods (Murray 1935, 126). (A bill of lading was an official detailed receipt given by the master of a merchant vessel to the person consigning the goods, by which he makes himself responsible for their safe delivery to the consignee, OED).

There are several records of the Lord Warden making agreements with the jurats of Lydd that he would receive one-third of wrecked goods. For example, it was noted at a Brotherhood (Cinque Port confederation court) in 1560 that 'the Lord Warden shall enjoy the third part of all wrecks and findals saving that 'Wee shalbe free of Wreck of oure owne Goodes' (Hull 1905, 281-82).^{xxxiii} Thus the Portsmen were clear that this one-third entitlement applied only to the wrecks of ships which did not belong to men of the Ports. If Lord Warden Cobham was claiming right of wreck of 1570 as Warden or on behalf of the owner of the consigned goods, the ship must have belonged to non-Portsmen and possibly the Warden himself.

The Romney Marsh Research Trust archaeological gazetteer ([GAZETTEER Archives » The Romney Marsh Research Trust \(rmrt.org.uk\)](http://rmrt.org.uk/category/publications/gazetteer/) <http://rmrt.org.uk/category/publications/gazetteer/>) has a reference of 1563 to a London-based sailing ship run ashore near the Camber. However this seems too early in date, although if the wreck is of this type of ship, the several secondary sources given could be checked. Also sailing ship ['a wrack of sugar'] was apparently wrecked at Broomhill in c.1590. Broomhill (above) is too far west for an identification with the Tudor shipwreck.

A wreck of 1619 with bars of silver taken up apparently near Lydd (details above). There are only these brief details of this. However as no date is known for the wrecking of the Denge Quarry ship, this may be an unlikely fit.

The ship Pelican of Pomra (the Pomeranian part of Mecklenburg-Vorpommern, Germany) looked like a possibility for the Tudor shipwreck, however further investigations showed it was wrecked not off Lydd but in the bay of Romney and furthermore that it 'is now mended' before its crew went home.^{xxxiv} There survives a letter from Lord Henry Cobham, Lord Warden, of 21 Oct. 1600 requiring a certificate of furniture and goods taken up from the Pelican of Stralsounde in Pomerlande which was cast upon the beach near Lydd on 14 October [1600], and a draft reply. There were also depositions concerning goods salvaged from the Pelican.^{xxxv}

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ⁱ From 17 Nov. 1587 to 16 Nov. 1588 there were references to piracy against Danish and French ships but not near Lydd, TNA [The National Archives] STAC 5/A30/20.

ⁱⁱ KHLC Ly 2/1/1/2-8. All documents cited are at KHLC unless otherwise stated.

ⁱⁱⁱ Ly 2/1/2.

^{iv} Ly 2/1/5.

^v Ly/6/2.

^{vi} Ly 4/8/1-15.

^{vii} Ly 2/1/2, ff.4-8.

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- viii The liberty of Winchelsea clearly defined its separation from that of Rye in a charter of 1247, Draper 2009, 25, fig.2.5, 41.
- ix Ly/4/11/2.
- x CP/Br/25, 4pp.
- xi CP/Br/15
- xii Ly 2/1/1.
- xiii Fifth Report of the Royal Commission on Historical Manuscripts Part I Report and Appendix (London 1876) [HMC Fifth Report], 531.
- xiv Ly 4/7/3/2,3 (1609x1620)
- xv TNA E 134/16Chas2/Mich39.
- xvi CP B/1 (1432-1571), CP B/2 (1572-1955).
- xvii HMC Fifth Report, 526.
- xviii Ly 15/3/5.
- xix The description of Romney Marsh Walland Marsh Denge Marsh & Guldeford Marsh ... By Math. Poker, 1617. Republished 1845 by James Cole. Copy in East Sussex and Brighton and Hove Record Office, RYE/132/13. Part of it is reproduced in Barber *et al* 2008, fig. 3, following 318.
- xxxx 'Henry VIII: February 1534, 21-25', in Letters and Papers, Foreign and Domestic, Henry VIII, Volume 7, 1534, ed. James Gairdner (London, 1883), pp. 85-91. British History Online <http://www.british-history.ac.uk/letters-papers-hen8/vol7/pp85-91> [accessed 23 July 2023].
- xxi TNA SC 8/2/99.
- xxii Ly 4/4/8.
- xxiii QM/SI/1597/12/3; Q/SR1 Easter 1600 No. 7.
- xxiv Q/SR/1/m.4d.
- xxv Calendar of Patent Rolls 1436-41, 15 HVI, 85.
- xxvi E.g., NR CPW/166.
- xxvii Ly 2/1/1.
- xxviii For the following, see the paper catalogue of NR CPW/167-!90.
- xxix <https://www.nationalarchives.gov.uk/education/resources/james-i/the-bye-plot/> [accessed 30.7.23]
- TNA SP 14/3, f.31.
- xxx <https://blog.nationalarchives.gov.uk/early-sugar-consumption-in-england/> [accessed 30.7.23]
- xxxi Calendar of State Papers Domestic: Charles I, 1636-7, ed. John Bruce (London, 1867), pp. 393-414. British History Online <http://www.british-history.ac.uk/cal-state-papers/domestic/chas1/1636-7/pp393-414> [accessed 2 January 2023].
- xxxii Ly/4/4/1. The Warden was William Brooke, 10th Baron Cobham 1558-97.
- xxxiii Findals were goods found in the liberty of each town whether on sea or land (Hull 1905, 194).
- xxxiv NR/ JW/ 123/ 2.
- xxxv NR/CPI/44/1, 2.

Addendum 1.

Review of Calendars of State Papers Domestic to 1640.

Gill Draper

The nineteenth-century published versions of these State Papers, the Calendars [CSPD], have largely been made available online by the Hathi trust and I have give both forms of reference. Some of the paper volumes were reprinted by Kraus in the 1960s.

CSPD 1623-25:ⁱ There are six references to Lydd of which two are relevant. They demonstrate the conflict over the Cinque Ports' liberty and particularly rights of wreck between the landholder Sir Nicholas Tufton who held Denge Marsh, Lydd and the Lord Warden.

On 13 July 1623 a letter from the 'Bailiff and Jurats of Lydd to Lord Zouch [Lord Warden, 1615-24]. Sir Nich. Tufton impeaches his Lordship's [Lord Warden's] jurisdiction, by summoning as jurors for the assizes at Maidstone two men of Dengemarsch, which has, time out of mind, been reputed to be within the liberty of the Cinque Ports'.

In 1624, 'Note that Sir Nich. Tufton, to whom the manor of Dangie- marsh [Denge] was granted by the King, claims the wrecks and royalties thereof, which belong of right to the Lord Warden of the Cinque Ports, and the beach land, which belongs to the town of Lydd. He has taken the cause into the Court of Exchequer, contrary to the liberties of the Cinque Ports, whereby it should be tried at the Chancery Court of Dover. Requests that his Grace [the Duke of Buckingham, George Villiers, Lord Warden 1624-28] will order the case to be transferred thither' (p.433).ⁱⁱ

There are three other references to Dungeness, as below.

24 December 1623. 'Commissioners of the Navy to Buckingham. Report in reference to the light at Dungeness; that it was erected by Hugh Bullock, at his own expense, and the patent thereof granted, on the proposition of Mr. Bing and Mr. Lamplugh, to Sir Edw. Howard on whose decease it devolved on his brother and executor, Sir Fras. Howard, with a tax of 1d. per ton on vessels homeward bound, for its support; that Lamplugh, who was to receive one-fourth of this tax, contrived to procure letters from the King, extending it to vessels outward bound, which derive no benefit from the light, and also giving him half the profit instead of the fourth, &c., and mean-time vessels are endangered by the light-house being ill kept. Advise that the petitioners be allowed the charge of it, on their proffered condition of levying the tax on homeward bound vessels only, and paying 100 /. a year to the patentees' (p.133).

9 January 1624 . 'Instructions for John Chudleigh, Captain of the Charles. He is to clear the coast of pirates between St. Helen's, Isle of Wight, and Dungeness; to repress the insolvencies of men-of-war in violently rescuing ships or prizes in the harbours or on the coasts; to prevent any traffic between the inhabitants of the coasts and pirates; to be careful of his own stores, &c.' (p.146).

18 August 1624. 'Instructions [by Lord Admiral Buckingham,] for Capt. Thos. Wilbraham, appointed to the command of the ship [Mary Rose], to scour the coasts of pirates, from Dungeness to Portland. Pirates are to be taken and imprisoned, their goods safely kept, all traffic between them and the coasts prevented, &c. There is to be no contest for precedency between him and Capt.Chudleigh' (who was appointed to 'scour the coast' from Portland to Land's End, commanding the Speedwell (p.328).

There are nine references to wrecks between Sandwich and Chichester, with goods such as sugar and cinnamon and wines specified, and the usual claims and counter-claims over the goods, but none relating to Dungeness.

The CSPD for 1625-26 contain numerous references to wrecks and their valuable goods but not near Dungeness, as below, e.g. a ship wrecked off Goodwin sands. 'Four large ships had arrived from the East Indies; one of 800 tons wrecked near Dover Castle (Sept .16 1625).ⁱⁱⁱ

Feb. 11 , 1626. Information of Peter Cannon. Thirty-six chests of Brazil sugar brought to Dover in a ship called the Jacob, recovered by a collusive claim in the Court of Admiralty. Sir Anthony Dering's interference with wrecked goods. Complaints against Peter Dibbs.^{iv}

March 26, 1626. Sir Edwd. Dering to Nicholas. Details the evidence of the right of his family to wreck of the sea, as the same was formerly enjoyed by the Maison Dieu, of Dover. ^v

August 2 1626. Sir John Hippisley and Sir Geo. Newman to Buckingham. At his request they certify what are his rights within the Cinque Ports with respect to things found jetsam, flotsam, and ligan [goods sunk at sea, with a float attached for recovery, Chambers dictionary], with an account of their proceedings in reference to a claim made by the States for anchors and cables lost in the Downs.^{vi}

August 7 1626 : Petition of Inhabitants of the Cinque Ports to the same [Duke of Buckingham presumably, as above]: Pray that the two ships to be furnished by the Ports may be employed in guarding their coast; also, that they may appoint the Captains and officers, and have letters of marque [so they can take prizes].^{vii}

The year 1626 (no precise date): a reference to five pages of discussion on the practical working of the law of wreck.^{viii} (The Hathi Trust does not appear to have made available the rest of the years 1626-27, which appear in the later Calendars which may be available with extra time via British History Online but I doubt they would reveal anything especially important).

CSPD 1628-29: the references in this volume are concerned with war: 9 April 1628, 'The Council to Buckingham. To dispose of the men now Whitehall ordered to be billeted at Hythe as follows:-30 at Hythe, 60 at Romney, and the rest at Lydd' (p.93).^{ix} There are two references to Dungeness: 5 March, 1629, 'Lords Commissioners of the Admiralty to Capt. John Mennes. Complaints being daily made that English ships were taken about Dungeness; by French men-of-war and Dunkirkers, he is to ply up and down with the Adventure between Gore End (near/on Dungeness, see first report) and the eastern part of the Isle of Wight, to preserve his Majesty's coasts, and capture ships of Spain, of the Archduchess, or of France (p.488).

On June 19 1629 Capt. John Pennington states to the 'Lords Commissioners of the Admiralty that he has sent the Whelps (although ill fitted and provided) to clear the coast as far as Dungeness' (p.580).

No wrecks were recorded in the locality of Dungeness or Lydd. 12 March 1629, one, a long ship, the St Peter, is recorded as run ashore in the context of war near Arundel with the Earl of Arundel claiming it (pp. 492-93).

CSPD 1629-31 has no references to Lydd, no relevant reference to wreck/s, and only one to Dungeness in the context of war, the nature of ships, and the operation of Calais merchants in the Channel: on 28 July 1629, 'The ships of war of Dunkirk Dreadnought and Ostend are all laid up in harbour, for want of money to set them out; only two or three small sloops of Gravelines pester the

narrow seas between Blackness and Dungeness, and take English and Hollanders daily. Calais merchants dare not pass their goods to Dover for fear of them'. ...The ships of war of Dunkirk Dreadnought. and Ostend are all laid up in harbour, for want of money to set them out; only two or three small sloops of Gravelines pester the narrow seas between Blackness [maybe Cap Blanc-Nez, Calais] and Dungeness; and take English and Hollanders daily. Calais merchants dare not pass their goods to Dover for fear of them. Suggests that one of the Whelps should be commanded to ride in Calais-road and ply between the forenamed places', p.22.^x

CSPD 1631-33: there are no references to Lydd, Dungeness or Denge. Once again the reference to wrecks do not concern the Dungeness locality but do concern rights of wreck; specifically on 17 January 1633 that the king is receiving 'very little' from wrecks but that 'The towns and private lords of manors have appropriated the greatest part of the sea-coasts within these Admiralties, and so take to themselves all wrecks; and other Admiralty droits' (pp. 514-15).^{xi}

CSPD 1633-34: no references to Lydd, Dungeness or Denge. No references here to wreck/s in this locality although there is similar concern to the above about the king's loss of revenue from wrecks in 1631-33 (p.125).^{xii}

CSPD 1635^{xiii}: there are no references to Lydd or Denge and none to wreck in this locality (one ship of Hamburg was wrecked near the Isle of Wight in December 1635, p. 611). There are four references to Dungeness and to the lighthouse and one to its role in war (in August 1635 it was said an urgent message 'has arrived from Dungeness with certain news of an engagement between the fleet and the Hollanders, before Calais' (p.122). In sum on the lighthouse, in spring and summer 1635 there was discussion about the Dungeness lighthouse, said to have been there for twenty years, focussing on the amount masters and owners were to pay. It had been settled at one penny a tun to be paid on the ship's return voyage. and one penny by the merchants. The Master, Warden and Assistants of Trinity House disliked the fact that 'private men' like William Bullock (below) had the right to collect this toll believing it should go to them, but it was counterclaimed that they 'never perform anything' (with regard to erecting or maintaining a lighthouse) (p.7). In addition on July 3 1635 there was a petition of the inhabitants of the Isle of Wight who stated that they rely on foreign shipping for their trade as they cannot easily get to markets on the mainland. 'During two years past there has been collected 2d. the ton of shipping for Dungeness Lights, which has been the means that much shipping have avoided that road and ridden at by-places out of the command of any castle, and now of late Sir John Meldrum has a deputy at Cowes who requires 4d. more for every ton of foreign shipping for lights at the Foreland [Thanet], so that now there being 6d. for every ton of foreign shipping required at Cowes strangers distaste the same, and some say they will hazard the sinking of their ships rather than endure so heavy a tax.' The inhabitants of the Isle of Wight feared the loss of their trade (p.292).

CSPD 1635-36; this has one reference to Lydd, £85 had been paid for ship money in October 1634 (p.74).^{xiv}

CSPD 1635-36 (Vol 10).^{xv} There are no references to Lydd, Denge or Dungeness. But there is one to Ness; 'The first westerly wind will bring more certain intelligence, for the Swallow and the two Whelps are in those parts, and will be in the Downs with the first slant of wind, and if he finds there be any of them in those seas, he doubts not soon to force them out, though he cannot say he will take them by reason of the foulness of his ships. He has lain to and again between Dover, Calais, and the Ness; all this week, and found work enough to recover back, not without damage (p.227). Five references to wreck do not relate to this locality.

CSPD 1636-37: this contains no refs to Dungeness, Denge, Lydd, nor do the six references to wrecks refer to this locality.

CSPD 1637: ^{xvi} In the year 1637 there is one mention of Lydd (as below), six of Dungeness or its lights (i.e. lighthouse) and many of wrecks, notably at Seaford, a (small) Cinque Port member of Hastings. A summary of these mentions follows: it is not always possible to distinguish between the wrecks mentioned. I suspect that the frequent mentions of wrecks near Seaford (not a feature of earlier documents) is for these reasons- the documents searched earlier largely related to Kent; once the Dungeness lighthouse was built, as below, wrecks may have occurred instead on the rocks near Seaford; there may have been an aristocratic landowner in the locality keen to pursue his right to wreck (p.349).

Description of a ship furnished with ordnance was wrecked [driven on ground] near Seaford in Sussex in the admiralty of the Cinque Ports. it was laden with oil and other goods, which were taken up. It was required that an inventory and appraisalment must be taken at Seaford, Pevensey, Hastings and Lydd, and this was done on 3-5th August of 1637. The total value of the inventory/appraisalment of Seaford was £1968 13s 4d, Pevensey £66, Hastings £132, Lydd £22, and presumably the salvors came from these places.

Mention of the ship run aground at Seaford and oil therefrom, some of which was sold in France (p.335).

Ship run aground near Newhaven but eight sailors escaped so not a wreck (p.344).

Another wreck at Seaford and many, mainly workmen, examined at Seaford and Hastings by commissioners appointed by the Lord Warden about the wreck and cargo (pp.321-22).

Several entries in this volume (e.g. p.320) are concerned with the balance between the right to the profits of wrecks between the admiralty court and landowners and indeed the King.^{xvii} The king claimed half the value of the wreck in many places including the Duchy of Cornwall, with landowners receiving the value of the other half of the goods, and salvors had to be content with what the king 'so nobly' gave them (p.357).

A man named Sackville Porter and one Thomas Elphick and others of Seaford petitioned the king about a ship had run onto rocks near Seaford after a battle and been broken to pieces. Petitioners had salvaged £2000- worth of goods at great danger to themselves and asked the Lieutenant of Dover Castle and a judge in the Cinque Ports admiralty court to be allowed half of their value 'according to former usage' (p.315).

Another wreck near Seaford carrying oil, silk and grogram, ordnance, anchors and cables, all of which had been saved at Seaford, Pevensey and Hastings. The earl of Suffolk, Lord Warden, Theophilus Howard, who was part of the company of adventurers and planters of the city of London for the first colony in Virginia, claimed them all. The salvors were to receive one fourth of value (p.376). Later there is a record that the Lord Warden's deputy i.e. the lieutenant of Dover Castle and the admiralty court held at Dover confirmed these goods belonged to Lord Warden (p.443).

Mention of 'another light at Dungeness' being made, in a dispute over collections of money from strangers arriving at the North and south Foreland, the Isle of Wight, Falmouth and Plymouth (p.387)

There was another dispute over this in November 1637 when William Bullock who held or owned the Dungeness light had been charging one penny for the maintenance of the light from the merchant owners and from master of the ship, and was only to charge that penny for the return voyage and

then half to be paid by the owner and half by the merchant. The same applied to the lights at North and South Foreland (Thanet) (pp.525-6).

It is said that the first lighthouse at Dungeness was erected in August 1615 and licenced to private ownership by King James I. It was just a wooden tower, probably 35ft high, with an open coal fire on top. Apparently, the sea receded and shingle banks grew and left the lighthouse too far from the coast, so a second was built, in brick, around 1635. This was about 110 feet high and lasted around 100 years.^{xviii} (In 1623 the Mayor and jurat of Rye wanted an act for restoring the town to its former prosperity, regaining its harbour and allowing ships to come in stormy weather 'by erecting a convenient fire light at the dangerous passages neer the mouth of the said harbour commonly called Dungeness which might direct the seamen in coming into the said harbour'.^{xix} The jurats disputed that Mr Bullock was 'first projector of the Light' and claimed a public not a private light was needed - this would be to Rye's benefit).^{xx}

Besides the record in the CSPD, Chancery documents show members of the Bullock family involved with the Dungeness lighthouse, perhaps both the first and second one, to judge by the dates. In the reign of James VI and I (1603-25) a Hugh Bullocke had had a dispute with one William Lamplugh over the profits of the lighthouse stated to have been erected by Sir Edward Howard at Dungeness.^{xxi}

William Bullock, presumably Hugh's relative, had a dispute over property in Dungeness in 1640 with two men, Thomas and John Winspear, presumably relating to the second lighthouse.^{xxii}

p.493 Of the few mentions of Dungeness there is on October 21 [1637] that in a communication from Sir John Penington (Admiral of the Narrow Seas) to the lords of the Admiralty that a small English bark had complained to him that a French picaroon had taken 'some bred and trifles' from it at the Nesse. Penington sent two ships to see if it could meet the bark (unsuccessfully.)

Around November 25 (the Thursday before) 1637 a very great ship supposed to be a Hollander was cast away at the Nesse and all the people on it drowned, as [Sir John] Penington communicated to Secretary Christopher Windebank and then to the lords of the Admiralty). 525-6.

CSPD 1637-38 ; there is a petition with the Cinque Ports' own description of the decayed state of the harbours including Lydd, apart from Dover, in the hope of paying less ship money. There are no reference to Dungeness or Denge. Neither of two references to wreck in this Calendar refer to this area (p.93).^{xxiii}

CSPD 1638-39;^{xxiv} There are no references to Lydd, Denge or Dungeness nor to a wreck of relevance. However there is a note about the Lord Admiral's versus the Lord Warden's right in the matter of wreck. 'In the beginning of the late business I put you in mind to have a care of preserving the Lord Admiral's right in the Downs, in case there should any wrecks; or other casualties happen there, and now my Lord has commanded me once more to refresh your memory therewith, and to tell you that he doubts not but that you very well know that the Lord Warden has no further pretension there, nor into any part of the sea than a horseman can reach with a lance. Whatsoever is further into the sea than that appertains to the Lord Admiral, and to no man else, and therefore if any man pretend to sweep for anchors or cables, or to take up any ordnance without the extent of that lance, encroaches upon my Lord Admiral's jurisdiction; and his Lordship's pleasure is that you, with the rest of the captains under you, do take order for prevention of his Lordship's prejudice in this kind and on this present occasion, and that the small vessels of the fleet which ride nearer the shore may have some particular instructions from you to this purpose (p.42).

ⁱ This volume contains some entries which are only possibly dated to 1624, Calendar of State Papers Domestic, James I, 1623-1625 (London, Longmans 1859).

<https://babel.hathitrust.org/cgi/pt?id=osu.32435018875476&seq=9&q1=Mary+Anne> [28.9.23]

ⁱⁱ CSPD 1623-25, p.433.

ⁱⁱⁱ CSPD 1625, 1626, vol.1 (London, Longman, 1858)

<https://babel.hathitrust.org/cgi/pt?id=msu.31293010904062&seq=7>

^{iv} CSPD Vol 21.

^v CSPD Vol 23.

^{vi} CSPD vol. 33.

^{vii} CSPD vol. 33.

^{viii} CSPD Addenda 1625-49, vol.23, p.188, <https://babel.hathitrust.org/cgi/pt?id=msu.31293010613002&seq=5>

^{ix} Calendar of State Papers Domestic 1628-1629, Charles I, v. 3 (London, Longman, 1859)

^x Calendar of State Papers Domestic 1629-1631, Charles I, v.4 (London, Longman, 1860)

<https://babel.hathitrust.org/cgi/pt?id=msu.31293010901878&seq=9&q1=1629-31>

^{xi} Calendar of State Papers, Domestic series, of the reign of Charles I, 1631-33 v.5 (London, Longman, 1862)

<https://babel.hathitrust.org/cgi/pt?id=coo1.ark:/13960/t2p565806&seq=5>

^{xii} Calendar of State Papers, Domestic series, Charles I, 1633-1634 vol 6 (London, Longman, 1863)

<https://babel.hathitrust.org/cgi/pt?id=hvd.hwyn2l&seq=7>

^{xiii} Calendar of State Papers, Domestic , Charles I, 1635, v.8 (London, Longman, 1865)

<https://babel.hathitrust.org/cgi/pt?id=msu.31293010610214&seq=7>

^{xiv} CSPD 1635-36 Charles I, vol.9 (1866)

<https://babel.hathitrust.org/cgi/pt?id=coo1.ark:/13960/t47p9kb4t&seq=9>

^{xv} Calendar of State Papers, Domestic Charles I, 1635-36 (vol.10)

^{xvi} Calendar of State papers, Domestic series, Charles I, 1637, v.11

https://babel.hathitrust.org/cgi/l?lmt=ft&a=srchls&adv=1&q1=state+papers+domestic&field1=ocr&anyall1=all&op1=AND&yop=between&pdate_start=1621&pdate_end=1640

^{xvii} The Cinque Ports had their own Admiralty court over which the Lord Warden presided, see my first report.

^{xviii} <https://dungenesslighthouse.com/history> [17.08.23]

^{xix} East Sussex and Brighton and Hove Record Office, RYE/47/98/15b.

^{xx} RYE/47/98/21

^{xxi} Court of Chancery pleadings, TNA C 2/Jasl/B9/13.

^{xxii} TNA C 8/75/143.

^{xxiii} Calendar of State Papers Domestic, Charles I, 1638-39 (HMSO 1869, Kraus reprint 1967)

<https://babel.hathitrust.org/cgi/pt?id=msu.31293010903106&seq=7&q1=1967> [7.10.2023]

^{xxiv} 1638-39. <https://babel.hathitrust.org/cgi/pt?id=msu.31293010612277&seq=7&q1=wreck>

Addendum 2

1570 wreck transcription of letter of Lord Warden authorising bearer to collect wrecked goods

KLHC Ly/4/4/1 [Cinque Port correspondence]

Note: The letter is badly faded and apparently hastily written but an enhanced photo has made it possible to read most of it.

The abbreviated words have been extended wherever this is clear. It does not affect the meaning. The right-hand margin appears to be missing or the paper has been torn and something else was written on that part of the paper. Again it does not affect the contents/meaning of the letter

Lines are numbered.

The Lyvete-naunt who is referred to in lines 5-6 is an early spelling for Lieutenant [Middle English Dictionary, Michigan]. He was the Lord Warden's deputy.

1 After my herthey commendations the

2 beareres hereof are come to claymes

3 parte of the goods, Lately wrecked

4 at the nesse, as appereth by the bylles

5 of Ladynge remaynge in my Lyvete

6 nauntes custodye. I praye yow

7 use them with cortesty and to shewe

them your Frendley helpe to see

8 the condition of their goods [8a, line inserted above: and to come to sum composition wyth them]
with

9 oure favour and so Fare you hertele

10 well W Cobham the 4 of No

11 vember 1570

12 Your loving frend

13[Signed] W Cobham

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Appendix 7

Denge Quarry Wreck

Profiling the Documentary Records against the Dendrochronological Data

1 Background

This paper refines the initial assessment of documentary data in the Historic England Research Records (HERR) database,¹ produced in April 2022 before the dendrochronological assessment.² This initial survey of documentary data profiled the wreck site – as then understood – against data for wrecks in the vicinity of Denge Quarry for 1200-1699, but since then the dendrochronological analysis has narrowed down the date range considerably.

The 26 dated timbers from the Denge Quarry Wreck fall into two broad felling ranges, the earlier phase for 1534-47 and a later phase circa 1561, with another timber falling in between these two primary ranges. In terms of querying documentary data, this suggests a service life of around 1540 (allowing for timber seasoning and construction) to 1600, with at least one period of repair either to extend life or following an incident. This would be consistent with typical service life profiles as seen in the (HERR) database and with the interpretation of the vessel from which they came having been well used.

Throughout the sailing era, a career of approximately 20-30 years before refit or loss was usual, with few ships remaining seaworthy beyond approximately 30 years without extensive investment in refit or repair,³ although there were several notable exceptions with an extended service life (for example, the near contemporary *Vanguard* was built as a galleon 1586, and as a Fourth Rate sunk as a blockship during the Raid on the Medway in 1667).

The wreck was discovered at Lydd-on-Sea, a largely 20th century settlement, distinct from Lydd itself. It is near two of the original five Cinque Ports, known as ‘head ports’, namely New Romney and Hythe, with Lydd as a later ‘corporate limb’ or sub-port of New Romney. The present location is behind a shingle bank and a road, i.e. in a location with no direct access to the sea. This may not always have been the case with the tidal watercourses and marshes in the local area and one of the hand-drawn Armada Maps of 1589, following the Armada events of 1588, shows a viable watercourse in the correct location between ‘Rumney’ and ‘Leede’. (See Fig. 1)

This is slightly at odds with the literature claiming that the late 16th century appears to have formed the chronological limit for the navigability of surviving tidal channels locally following both geological processes of siltation (shoreline deposit) and deliberate man-made land reclamation from the late 13th century onwards, both of which led to port decline and isolation of Cinque Port settlements from the sea.⁴ Nevertheless this date range seems likely to have been the general trend. For example, there was a petition for the repair of the ‘puddle and creek’ of Rye in 1573,

¹ Formerly National Record of the Historic Environment (NRHE).

² Cant, S 2022 *Cemex_1029 Data Briefing* (unpublished briefing note)

³ Based on observation of vessel histories in the HERR database.

⁴ See, for example: Eddison, J 1983 “The Reclamation of Romney Marsh: some aspects reconsidered”, *Archaeologia Cantiana* 1983:99 47-58; Long, A, Waller, M, and Plater, A, 2006 “Coastal resilience and late Holocene tidal inlet history: The evolution of Dungeness Foreland and the Romney Marsh depositional complex” (UK), *Geomorphology* 82:3-4 309-330

suggesting that it had been adversely affected, and further directions for the upkeep of Rye in 1595.⁵ The original settlement of Lydd (not Lydd-on-Sea) also reflects this change: it appears close to the watercourse in the Armada Map (Fig. 1) but now lies inland approximately 2.5 miles from Lydd-on-Sea to the east, 1.75 miles from the south coast (**Fig. 2**).



Fig. 1 Armada Map 8: The English and Spanish fleets between Dover and Calais NMRN 2020/43/8 © NMRN. Note how the land curves inward to the west between Romney and Lydd in a more pronounced fashion than it does today (see **Figs. 2** and **3**), suggesting that the modern coastline was still in the process of forming, although ‘artistic licence’ may also partially account for this view.

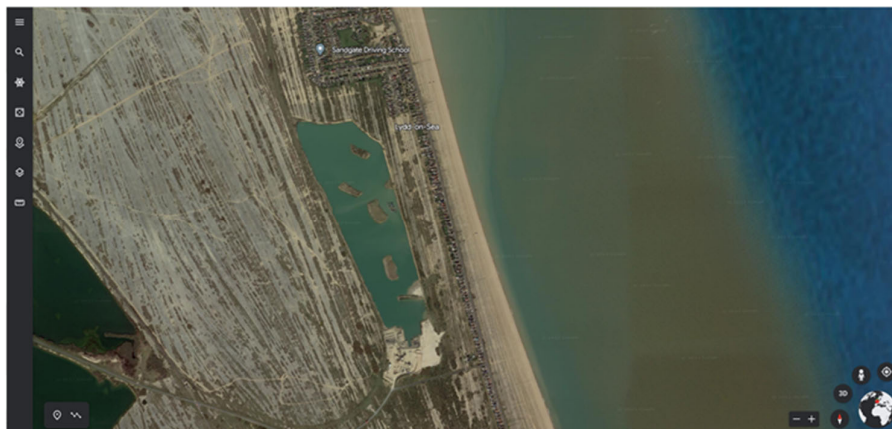


Fig. 2 Location Map of Cemex Denge Quarry at Lydd-on-Sea, with the quarry approximately 0.15 mile from the sea (Google Earth: 2021 data)

⁵ *Calendar of State Papers Domestic, Edward VI, Mary and Elizabeth, 1547-80*, Elizabeth, Vol. 93, No.22 (London: HMSO); CP/2/5/5, 31 December 1595, Kent History and Library Centre

The present location of the wreck at Lydd-on-Sea, without obvious outlet to the sea, suggests a few possibilities: **1.** that the remains are those of a vessel lost while navigating to or from the sea in a once viable channel, such as that depicted on the Armada Map, perhaps under extreme conditions (see **6**); **2.** a ship laid up beside such a channel, perhaps for repairs, and subsequently left to decay as siltation processes cut off access to the sea, the end date for which coincides with the vessel's projected life span; **3.** a vessel washed ashore in stormy weather when its present location was nearer the sea, because the shoreline had not built up to its present extent; or **4.** a ship washed ashore in an inundation event in this low-lying area, leaving it high and dry. A mixture of some or all of these scenarios is even possible.

There is ample archaeological evidence for sites 'wrecked through decay' as in possibility (2): for example, the 15th century *Holigost* and *Grace Dieu* at Bursledon, Hampshire, and the logboats and 20th century barges (at either end of the chronological spectrum) laid up and left to decay. These vessels are well recorded in the HERR database. Contemporary documentation for deliberate lay-ups is limited and confined to the laying up of major vessels, hence records for the *Holigost* and *Grace Dieu* exist, but not, for example, for the Newport ship or for many vessels so drawn up for which funds for repair never materialised.

Further, the timbers appear to derive from a context sourced from in and around the Thames Estuary (Essex/Kent/London), suggesting that the vessel was lost or left to decay close to its area both of build and operations. Its potential characterisation is as an English cargo vessel, perhaps of coasting type, perhaps lost close to one of its home ports, which would be an obvious lay-up location (e.g. brought in damaged from a voyage; death of master or owner, for example).

The HERR has therefore been interrogated for two sets of data: for records of losses in the vicinity of Denge Quarry around 1540 to 1600 (although acknowledging that an earlier loss date after c.1580 might be more feasible) to see if a match can be made; and for comparable English vessels of the period lost elsewhere, in an effort to provide a characterisation for the vessel.

2 Results of documentary interrogation: records near Denge Quarry

It is worth stating at the outset that few records for the period are very specific regarding location of loss – they may specify a place or simply state that the vessel has been lost *near* a particular location, but not the *direction* or *distance* from that place. Even at a later date, e.g. the mid-18th century, 'near' a place could be many miles away, even up to 30 miles.

Secondly, historical accounts of shipwrecks in English waters tend to focus on vessels lost on the open sea or within major estuaries, not within minor navigable channels, and are thus unlikely to match a vessel within this context.

The existing documentary data for shipwrecks reveals that few records match the area of loss (i.e. reported in the vicinity of Dungeness, Lydd and Romney) during the late 16th century and those that do contain details which exclude them from consideration as candidates for the identity of the wreck site. These wrecks are

discussed in further detail in this section. That said, there are three wrecks which are of interest, not necessarily as candidates but which have some bearing on a possible late 16th century characterisation (discussed in further detail in **Section 5**).

It is also worth noting that, until the late 18th century, reports for 'Lydd' reference the original settlement and in fact refer to the area around Jury's Gap, as suggested by at least one HERR record,⁶ some 2.75 miles away to the south-west. This overlaps with Jury's Gap being named in its own right from the 1630s onwards.⁷

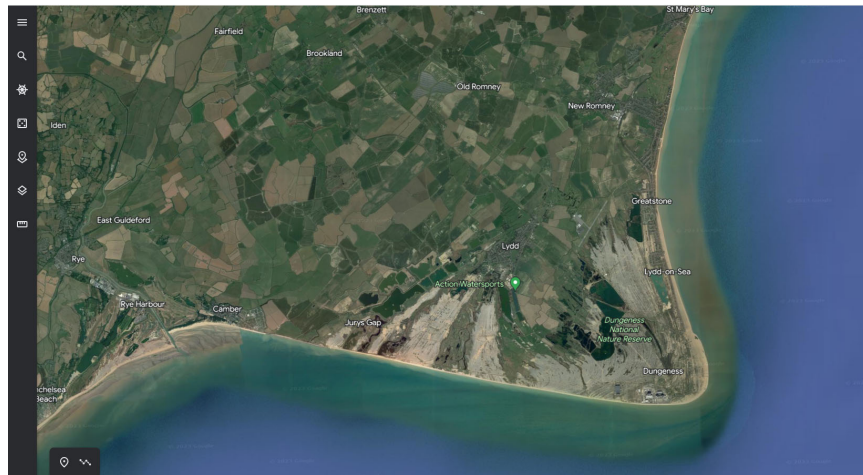


Fig. 3 Location map of Lydd, with Jury's Gap visible to the south-west, and the proximity of Dungeness and Romney to the east (Google Earth: 2021 data). Note the inward curvature of the coastline to the west is less pronounced than that of the 1589 chart

The potential for sources locating wrecks to or near Lydd to reference the Jury's Gap area in the medieval to early modern period suggests that in contemporary sources a likely catchment area for the vicinity of Denge Quarry may well reference '[near] Romney' or '[near] Dungeness', not 'near Lydd'.

Given the importance of the Cinque Ports as coastal towns with privileges in return for ship service, there is a strong sense of location confidence in reporting wrecks. Records for this area are unusually unambiguous and clear in both medieval and early modern records,⁸ attributable to each port's distinct identity in an area densely populated with its peers. There are 9 medieval records for Dungeness, beginning in 1286, 2 for Lydd, with 1279 the earlier, 13 for Romney (1102-1107), and 2 for Rye (1405). Thus we can be clear that Dungeness was established early as a hazard to shipping with its own distinct identity along with those of the individual Cinque Ports.

⁶ Wreck of the *Hope* West Indiaman, from Jamaica for London, 1789 (HERR UID 882691)

⁷ *Angel Gabriel*, 1637 (HERR UID 970647); unknown wreck with woollen goods, 1639 (HERR UID 1167651)

⁸ There are some comparable instances for the 16th century in the HERR dataset, for example for Cornwall, but these are the exceptions that prove the rule. It would take the establishment of a strong regional and national press in the latter half of the 18th century to permit both relative confidence in location and other details with universal coverage of vessel types of low socio-economic status (passage boats, fishing vessels) and greater precision in all details only achieved in the Victorian era.

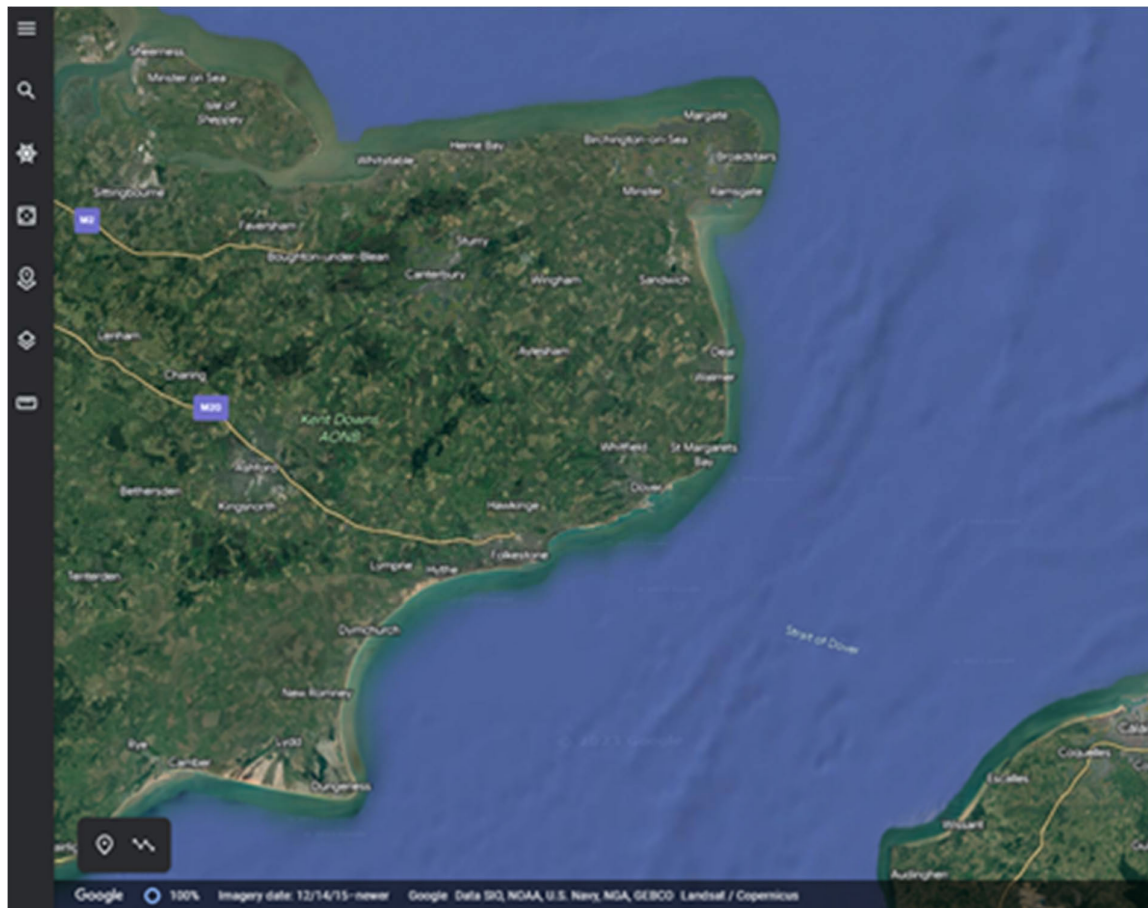


Fig. 4 Location map of the Cinque Ports (Google Earth: 2021 data)

For the post-medieval period 1540-1899, we see a subtle shift, with Dungeness by far the most populated wreck location, with 264 documented casualties (as distinct from sites). This may have something to do with the increasing prominence of Dungeness as a shipping hazard, due to the accumulation processes, and increasingly difficult to 'round the corner' in unfavourable winds. For Lydd 18 losses are reported (overlapping with Jury's Gap during the same period), 32 for Romney, and 101 for Rye.

For the last quarter of the 16th century, there are two recorded losses: one of a Dutch cargo vessel with an unknown, but considerable, cargo lost 'near Romney' in **1578**, and a Danish cargo vessel which stranded at Dungeness in **1589**.⁹ (See spreadsheet: **Annex A**, sheet 1.) Both of comparable date, they can be excluded as candidates on the grounds of nationality, but well illustrate how locations of loss are cited in contemporary accounts.

Two early 17th century wrecks are recorded in the area: a 'bark' laden with Caen stone 'between Lydd and Rye' in 1616, and a Dutch ship carrying silver, lost 'near the new lighthouse' at Dungeness in 1619-20.¹⁰ (**Annex A**, sheet 1)

⁹ Respectively HERR 1209345 and 1209352

¹⁰ Respectively HERR 1264171 and 1209147

The latter vessel can be excluded on the grounds of nationality, date, and location, since it is fairly certainly sited to a notable landmark, although it illustrates the issue discussed above that the distance or direction from the landmark is not specified.

In the case of the former (the bark with Caen stone), the catchment area for this wreck must also reference the coastline south of Lydd, being east of Rye, and therefore also close to Jury's Gap: as Dungeness is securely recorded in its own right as early as 1286, had the wreck come ashore near there that fact is likely to have been recorded, so this wreck event can also be excluded on those grounds as being a match for the Denge Quarry wreck.

In terms of nationality, however, it illustrates a key point arising out of the documentary evidence for this period. Documentation for this particular coastline is not only reliable in terms of location, it also tended to consistently record nationality from as early as the Middle Ages onwards. This is likely to have arisen out of the status of the Straits of Dover as a busy international shipping channel connecting northern and eastern Europe on the one hand and southern Europe and the Mediterranean on the other, and the consequent familiarity of local residents and seamen with vessels of all types.

As the nationality of the bark with Caen stone is not recorded, it is possible that at the time there was no perceived *need* to record the nationality and that the vessel was therefore by default English.

This interpretation is partially supported by the regular export of Caen stone to England, and its frequency in the English built environment, both presupposing the involvement of English ships for at least some of this trade. The three other wrecks recorded with Caen stone in HERR are all English, although of much later date,¹¹ suggesting this hypothesis is at least plausible.

Thus the 1616 Caen stone wreck is the only potential English vessel so far recorded in this area around the right time, though on location grounds it is likely to be excluded as a potential match for Denge Quarry, coming ashore on the Jury's Gap side, west of Dungeness (and consistent with the other three wrecks with Caen stone, incidentally, all appearing to have been driven ashore by a southerly wind).

Additionally, the decline of the Cinque Ports by Elizabeth's reign and the resemblance of the 1590 coastline to that of the present-day coastline, suggests that this vessel also falls outside a feasible chronological match for the Denge Quarry site. Thus none of the wrecks so far discovered for that period appear to be a potential match for the Denge Quarry site.

¹¹ Other than the 1616 wreck, there are three further losses recorded in HERR with Caen stone explicitly recorded as the cargo: all in the mid-19th century, all English, and all in Kent/Sussex: *Honoria*, 1852, at Brighton en route Caen for London; *John & Mary*, 1856, near her intended port of Hastings from Caen; and *Thomas Hubbuck*, 1870, Dungeness Bay, Caen for London. Given the prevalence of Caen stone in English building, there must be further wrecks not yet recorded or hidden in plain sight in the records.

3 Comparison with the wider wreck dataset in English waters

For comparison, for the period **1540-1600** there are currently **192 records**,¹² of which **12** are sites: **4 designated wrecks** (Cattewater, Church Rocks, Gull Rock, *Mary Rose*); **1 de-designated wreck** (Brighton Marina); an unidentified ship at Barrow; the Gresham Ship lost after 1574 in the Thames, now placed in a disused quarry at Stoney Cove; and **5 logboats** whose date span has been indicated as including the early post-medieval period, but which may be of earlier date.

Within these data nationalities are frequently missing and only **28 vessels can be identified as English** (spreadsheet: **Annex A**, sheet 2) but the true number is likely to be masked in the existing records.¹³ Nationality is inconsistently recorded, if at all, but as discussed above, the absence of a recorded nationality might by default suggest an English nationality: this may not be consistent throughout the dataset (e.g. the Cinque Ports, but not necessarily elsewhere).

The absence of nationality data for many contemporary (and later) records forms part of a wider documentation issue in which key data elements are missing (name, cargo, departure and destination, home port) or are vague or imprecise (location and mechanism of loss). A broad location and an approximate date are sufficient to create a record from documentary sources.

The partial nature of the record explains why it has not so far been possible to find a match and why finding an exact match for this vessel in the future may be very difficult. It is worth dwelling on this contextual background in more detail before further profiling the wreck site in the light of the few records which *do* exist, and which do, in their various ways, contribute to a characterisation of the vessel.

A key issue is the matter of record survival before approximately the mid-17th century, which plays out in the consequent biases in the data, further skewed not only by *what* has survived but *why* it has survived. Wreck records throughout the 16th century, as evidenced by the surviving material, tend very much to favour three main groups:

- well-documented ships of state (e.g. the *Mary Rose*, 1545)
- wreck events of major seagoing ships, especially of foreign nationality (lucrative cargoes and the possibility of diplomatic incidents arising therefrom, e.g. the designated *St Antony* at Loe Bar in 1527)
- wreck events resulting in contention and thus leaving traces in judicial and state records (for example, the loss of a Scottish cargo vessel at Runton in 1577 led to a petition to the Council of State for impartial judges since Sir Edward Clere was the petitioner's 'mortal enemy'). Legal wrangling could drag on for many years and the first surviving mention may significantly post-date the wreck or there are gaps in the record.¹⁴

¹² As a result of research for this paper, 12 further documented wrecks were discovered in the full 1607 Early English text cited below at section 6, and the records of Canterbury Cathedral, which will be added to the database following dissemination of this paper. They are, however, included in the total as the most up-to-date figure as at August 2023. None are in the Romney area.

¹³ The 12 newly discovered wrecks do not skew this total: one is 'of Marseilles' and the other 11 are not explicitly stated as English, although there is a strong likelihood that some at least probably were.

¹⁴ For example, in one case most of the material pertaining to the wreck dates from 1585; however, it took place in 1577.

If wreck events do not fulfil these primary criteria, they are unlikely even to have been recorded in the first place (e.g. small fishing vessels from coastal villages will rarely, if ever, be recorded due to low socio-economic status, yet these were among the most vulnerable of all vessels), and further geographical biases are apparent away from centres of population and power.

The attitudes of individual rulers and authorities towards wrecks varied significantly by personality and over time, in turn influencing investigations and consequent creation of records, reaching a peak never equalled thereafter during the reigns of Edward III (1327-77) and Richard II (1377-99).

For the Tudors, naval expenditure was relatively modest,¹⁵ and other than the catastrophic wreck of the *Mary Rose* during the reign of Henry VIII, the State Papers for Henry, Edward VI, Mary and Elizabeth demonstrate that wrecks were generally regarded as administrative or diplomatic matters, rather than as sources of income, so receive less emphasis within surviving correspondence. Further, during the reigns of all the Tudors, religious affairs and the consequent plots and counter-plots of the era were prioritised in the extensive documentary record that has come down to us.

Thus internal affairs also have a significant influence on survival of the documentary record: the period of initial felling, as noted in the dendrochronological analysis, coincides with the Dissolution of the Monasteries. In the first place, major domestic upheaval, seen both during this period and during the English Civil War and Interregnum of the mid-17th century, introduces a substantial inward-looking bias in the documentary record in which those affairs become more prominent while sidelining external events such as reports of shipping losses. Secondly, the Dissolution of the Monasteries in itself resulted in the removal of privileges and destruction of relevant records where monastic estates retained substantial rights to wreck as landowners.

The effect of all of the above is to render the surviving documentation partial in terms of **geographical coverage**, of **chronological coverage** (entire year spans may have no surviving wreck records at all, e.g. 1527, 1550-54, 1562, 1585-6) and in terms of **data content** (as previously stated, a location and a date would be sufficient for a mention in documentary sources to constitute a record of a wreck).

For several reasons, not least the law of averages; the reliance on domestic circulation of cargo by sea (e.g. wheat, coal); and the expansion of trade both domestically and internationally, at this period, it is simply implausible that there were years with no wrecks at all.

¹⁵ See, for example, Rodger, N A M 1998 *The Safeguard of the Sea: A Naval History of Great Britain, Vol.1 660-1649* p237 (London: HarperCollins Publishers)

4 Characterisation and potential of the existing records in HERR

The records in HERR draw very heavily on the various calendared papers of the period (*Letters and Papers, Foreign & Domestic*, Henry VIII; *Calendar of State Papers Domestic*, Edward VI, Mary and Elizabeth, *Calendar of State Papers Foreign*, Edward VI, Mary and Elizabeth).

These have been exhaustively mined, first by Richard Larn for the *Shipwreck Index of the British Isles*, being re-checked around 1997-2000 by physical examination of volumes by the present author and other Royal Commission staff, and subsequently receiving further checking through the digitisation of the Calendars on *British History Online* c2013-14.

For the purposes of finding a potential match for the Denge Quarry wreck these records have been rechecked once more by keyword in June 2023, e.g. 'storm', 'tempest', 'wreck', 'stranded' 'Goodwin', 'Scilly', 'Lydd', 'Denge', 'Dungeness', 'Romney', although it is not, of course, possible to interrogate every potential navigational hazard or place of loss. This most recent interrogation resulted in the creation of records for 3 new wrecks and improvement of the data for 3 more, a worthwhile exercise in itself for a period having such significant chronological gaps.

We are therefore confident that the *State Papers* have been exhausted as a potential source of information for wrecks of this period and it is to other sources that we must now turn for further documentary evidence for wrecks locally.

A dataset of 28 records of English nationality does not permit any firm conclusions, and is significantly subject to the various biases in the extant documentation outlined above, but it does point towards some comparators that may be used to profile the wreck, and it may lead us to potential candidates and sources.

5 From comparators to potential candidates: some key wrecks

There are some 'less obvious' wrecks that do not appear in the spreadsheet for the region at Annex A, and we turn now to these to shed light on potential characterisation of the wreck at Denge Quarry as comparable vessels recorded as lost in the nearby region, and whether in turn these vessels might be considered and scored as potential candidates. At the very least they open up the discussion.

5.1 A cargo vessel laden with wheat lost near Dover, 1544¹⁶ The timbers discovered at Denge Quarry suggest that the vessel was either lost or laid up to decay not far from its build and/or operational context, suggesting a coasting vessel, and an English cargo vessel laden with wheat suggests involvement in the coasting trade, as was typical for agricultural products.

However, it is too early to match with the later timbers from the Denge wreck, and we can have confidence that, as one of the Cinque Ports, 'near Dover' securely excludes other settlements in the vicinity, so that on location grounds, this particular vessel can be excluded from consideration as a candidate.

¹⁶ HERR 1450844

Nevertheless, it demonstrates that vessels involved in the circulation of cargoes for domestic consumption, i.e. coasting vessels, were operating locally. It is a close match as a vessel of comparable type, while we also know that coal was also carried from Newcastle-upon-Tyne for east coast ports and London as early as the 14th century, as attested on the north coast of Kent.¹⁷

5.2 Warship *Greyhound* on Rye Bar.¹⁸ We turn now to a warship within this dataset lost in the Kent/Sussex area. At this period the warship as a wholly distinct type, always purpose-built, had not fully evolved. There were certainly ‘king’s ships’, built for, and devoted to, the defence of the state, as the *Mary Rose*; however, at time of need private vessels normally used for cargo would be pressed into military service, as happened during the Anglo-French War 1542-46, the Newhaven Expedition (expedition to Le Havre) 1562-63, and the various conflicts with Spain (Cadiz 1587, Armada 1588, expeditions to Corunna, Lisbon and the Azores 1589).

In other words, employment in both cargo trade and naval service at a time of wars with other European powers is not mutually exclusive. This raises the possibility that naval service *might* have formed part of the Denge Quarry wreck’s career, and would be consistent with the observation that the wreck bears signs of being well-used. It would also be consistent with the Cinque Ports’ known *modus operandi* in time of war, in providing ship service. While the sample dataset for English-flagged vessels as wrecks is restricted, nevertheless naval vessels and cargo vessels in naval use comprise just over 20% of that dataset for English-flagged vessels (though two admittedly were not of English origin, from Bremen and Lübeck, 1544).

Among these naval vessels was the ***Greyhound***, lost on ‘on the Bar of Rye’ while returning to England from Le Havre in **April 1563**, thus a participant in the Newhaven Expedition 1562-3: an account of the beef lost in victualling records suggests that she might have been engaged in provisioning Le Havre.¹⁹

In its location context (very close by), the *Greyhound* is probably the closest comparator for the Denge Quarry site from among the recorded English-flagged vessels on this coastline. Her voyage (France to England) also suggests a potential context for an English coaster lost in this region, which might as plausibly have been involved in English cross-Channel trade with France as with domestic trade (mails, passengers, wine, wool and cloth, and, of course, Caen stone: see **2** above). English ties with Calais were particularly close until 1558, the Pale of Calais being a staple port, and, as the Newhaven Expedition demonstrates, English naval as well as commercial involvement with France remained strong after the loss of Calais.

Looking at the *Greyhound* in more detail, it is fairly close in profile to what we know about the Denge Quarry site. Whether this is sufficient to take her into the realms of a potential candidate is worth some consideration and her location is worth discussing further.

¹⁷ Information from the HERR dataset

¹⁸ HERR 902540

¹⁹ TNA [E 351/2360](#) *Records of the Exchequer: Pipe Office: Declared Accounts*, Navy: Victualling (Surveyors General &c.) also referenced as a Pipe Roll, Navy Victualling

Location: As discussed at **2** above, location details for shipwrecks could be quite nebulous, both generally through the centuries, and specifically in this particular area ('near Lydd' turning out to be at Jury's Gap, for instance). However, this vagueness of detail competes with a general confidence in the siting of wrecks close to any one of the Cinque Ports, given their administrative oversight of the local area and clear individual identities and well demarcated territories.

As it happens, the 'Bar of Rye' is recorded only twice in the documentary record out of 122 accounts indexed as being lost at, near, or off Rye: the *Greyhound*, 1563, and the *Josephine*, 1841.²⁰ The latter wreck is securely located at Rye with efforts to run for that harbour during a gale, and then striking upon the bar, with the coastguard at Rye attempting rescue.

This suggests that Rye Bar certainly referenced a location just outside Rye by 1841 and that mention of the Bar itself as early as the *Greyhound* record in 1563 may be potential evidence for the local accumulation processes that led to the decline of the Cinque Ports. By the same token, this very specific place, against the backdrop of the general location confidence in relation to Cinque Ports, seems to take the *Greyhound* out of further contention as a candidate for the wreck site, but it is worth discussing further below.

Service History: The service record for the *Greyhound* is reasonably detailed. She was built c1544, most likely at Deptford, participating in an action with the French off Shoreham-by-Sea on the Channel coast in August 1545 (following the loss of the *Mary Rose* the preceding July); taking part in the 'Rough Wooing' (Anglo-Scottish Wars, 1543-1551); in the blockade of Yarmouth, July 1553 (during the tussle between the supporters of Lady Jane Grey and Mary I), and the Kirkwall campaign in Orkney, 1557. She was then rebuilt around 1558 and took part in the Leith campaign in 1560, finally being lost 'upon the Bar of Rye by tempest of weather' in April 1563. Such a vessel fits very well with the interpretation of the Denge Quarry wreck having been worked hard during its career.

The build details also fit fairly closely with the dendrochronological results but are not a perfect match. The date of initial construction fits very well with the initial chronological match for the timbers, 1534-47, and is in line with the estimated date range for a vessel based on typical service careers discussed in **1: Background** above. The suggested (but not confirmed) place of build at Deptford is also consistent with timbers sourced from Essex, Kent and London.

The later chronology of rebuild fits more loosely with the dendrochronological evidence: her rebuilding in 1558 could account for the intermediate timber, but her involvement in action in 1560 and loss in 1562/3 is difficult to reconcile with a timber dated around 1561 (allowing for seasoning and use in building), a detail likely to also place the *Greyhound* out of contention for a match with the Denge Quarry wreck.

The reported position of loss suggests reasonable proximity to the Rye shoreline, as does the extensive salvage of the vessel noted in a contemporary account: 'the saving and recovering of the ordinance [sic], ammunition, tackle and apparel

²⁰ HERR, UID 1435524

belonging to Her Majesty's ship called the *Greyhound*'.²¹ This suggests that the vessel lay in the inter-tidal zone. The *Greyhound* thereafter disappears from the record, but fulfils the profile of the sort of vessel to which some attempt at hull salvage might also have been directed, and which seems likely or possible in this zone. However, effort would surely have been concentrated on bringing it ashore locally to Rye, rather than bringing the vessel round the shipping hazard of Dungeness to the Denge Quarry area, so on those grounds the *Greyhound* would seem to fizzle out as a candidate.

5.3 The *Red Lion* on the Goodwin Sands, 1592.²² The loss of the *Red Lion* of London would seem at first glance to be significantly outside the geographical scope for the Denge Quarry wreck, were it not for one particularly unusual feature not otherwise attested in the other 788 records in HERR which make up the recorded casualties known to have been lost on the Goodwin Sands. The *Red Lion* of London was one of three ships 'cast away' on the Goodwins in November and December 1592, together with the *Golden Lion* of Middelburg and the *St Peter* of Amsterdam.

All three vessels have left significant traces in the *Calendar of State Papers Domestic* and the ensuing enquiries and salvage activity took place under the direction of the Lord Warden of the Cinque Ports. In the papers for February 1593 pertaining to the *Red Lion* and *Golden Lion*, some goods were noted as found 'westward of Dover'.²³ Material from the Goodwin Sands was frequently widely dispersed, but not usually 'westward of Dover', mostly in the Downs, occasionally further afield to the north-east. Thus salvage of wrecks on the Goodwin Sands usually took place from other ports which lay much closer to the Sands, with locals attending in boats from the Downs ports of Ramsgate, Deal, Sandwich, and Walmer, occasionally from the Dover area.²⁴

Uniquely, however, for the Goodwin Sands, reference is made in March to 'the rest of the goods which the savers of Lydd, Romney, and other places have yet in their keeping'.²⁵ This corroborates 'westward of Dover'. It is unlikely that crews from further afield would have competed with the local crews salvaging the wrecks in the Downs, while typical dispersal patterns do not usually sweep materials from the Goodwins as far to the south-west as beyond Dover.

How then can we account for the presence of salvors from Lydd and Romney in this record? Because salvors from those places are not otherwise attested for wrecks on the Goodwin Sands (well recorded from the medieval period onwards as a distinct hazard) this suggests a possibility that one of those vessels might not actually have come to grief on the Goodwin Sands, but instead might have been driven ashore elsewhere in the vicinity and at the places named: i.e. that the manner of loss was

²¹ TNA [E 351/2199](#) Duplicament (copy) B Gonson, Treasurer of the Navy, in *Records of the Exchequer: Pipe Office: Declared Accounts*, also referenced as a Pipe Roll of the Navy Treasury.

²² HERR 1178532

²³ *Calendar of State Papers Domestic, Edward VI, Mary and Elizabeth*, 1591-94, Elizabeth I, Vol.CCXLIV, No.46, 20 February 1593

²⁴ Based on observation in the HERR database.

²⁵ *ibid.*, No.89, 22 March 1593

the same, stranding, but the location was different, yet easily conflated with the Goodwin as in Kent and within the same jurisdiction of the Cinque Ports.

Further, the presence of salvors from Romney as well as Lydd suggests the location as more likely to have been the east coast side, north of Dungeness, not the southern coast and Jury's Gap area suggested by Lydd alone (see **Section 2**). Thus a coastline facing east towards the Goodwin Sands appears likely to have contributed to any confusion. The vessel cannot have come ashore as far as Dungeness, as Dungeness was historically named as a distinct hazard in its own right from an early date, adding some weight to the supposition that one of the two vessels came ashore, rather than simply wreckage, in the Lydd/Romney area. That area accords well with the Denge Quarry wreck.

Either vessel therefore could have come ashore in or around Romney and Lydd, but it is uncertain which one. However, if it were the English vessel, it might emerge as a candidate for the wreck.

There are some consonances between the *Red Lion* of London and *Golden Lion* of Middelburg which appear suspicious, and which may suggest the conflation of detail observable elsewhere during multiple wreck events: not that they were driven at the same time in the same place, which is characteristic of storm events in general, and for the Goodwin Sands in particular, but that details from one may have been muddled with the other, and this may extend to location as well as to the other discernible areas of potential confusion. For example, the fact that both vessels' names incorporate *Lion* would be suggestive of a characteristic source of conflation (vessel names characteristically being muddled or reduplicated in multiple wreck events) and similarly locations were often swapped round as multiple, conflicting and partial written and oral reports came in.²⁶

The two vessels seem sufficiently distinct in port of registry at least, and in the associated merchants, to suggest that there were indeed two vessels, not two apparent vessels emerging out of conflicting details for the same vessel, as can sometimes be the case.

Further layers of confusion have arisen in secondary interpretation, with the standard reference work for shipwrecks in UK waters, the *United Kingdom Shipwreck Index*, suggesting that both were East Indiamen, perhaps early East Indiamen antedating the formation of the English East India Company in 1600 and the Dutch equivalent, the Vereenigde Oost-Indische Compagnie (VOC) in 1602. Such ships were certainly in existence and lost in English waters before the establishment of the respective companies, for example the Dutch *Maan* in 1598,²⁷ but it seems somewhat of a stretch to describe both vessels as East Indiamen coincidentally lost in the same area at the same time, particularly two ships with such similar names (even if these were names that were of popular types in both English and Dutch usage at the time.)

²⁶ Observation from HERR database. Although, as they say, 'stranger things happen at sea', and two ships named *Friends* were also genuinely recorded in collision with one another!

²⁷ HERR 1364518

There is no evidence in the respective calendared texts that the vessels were East Indiamen other than the silver on board, which was interpreted in the *Shipwreck Index* as evidence for that destination.

This lack of clarity of detail tends to support the supposition that other details for the *Red Lion* such as its location, could also be erroneous, resulting in part from confusion at the time (which would not be at all unusual, and was, indeed, common in multiple wrecks due to the same weather event).

In turn, this suggests that it would be worth examining the original, rather than calendared (summarised) State Papers, as well as the original correspondence of the Lords Warden of the Cinque Ports held by the Kent History and Library Centre, to establish whether or not the *Red Lion* might be a plausible candidate.

At the very least, regardless of whether the *Red Lion* ultimately proves to be a likely candidate for the wreck, or is a red herring, this research has the potential to improve our understanding not only of this wreck, but also of the other two lost in late 1592, and recover information that has been lost to successive transcription processes.

There is much going for the *Red Lion* as a candidate beyond these circumstantial hints. This vessel is definitively claimed as belonging to London: this does not necessarily confirm that the ship was built **at** London, but this seems very likely that a vessel belonging to London could have been built there: it is, after all, a location plausibly sourcing timber from the suggested area around the Thames, Essex and Kent.

Further, the loss date of 1592 falls within the date range suggested by the timbers: if we regard 1561 as a *terminus post quem* for any additions or alterations to the Denge Quarry wreck, then it would also fit well with a vessel lost well into a considerable service life in 1592. As discussed in **Section 1** above, a lifespan beyond the characteristic 25 to 30-year career would not be unusual, particularly if, at that point, the vessel was then rebuilt and refitted, allowing extension of her service life for a further 10-30 years or more.

We cannot say more at this stage pending further research than that one of two wrecks around that time would fit the criteria for the Denge Quarry wreck very well in date and location, particularly in terms of the salvors from Lydd and Romney, and nationality, if it were this English vessel which was so driven ashore (and not the Golden Lion of Middelburg). This remains a theory to be proven or disproven: the possible conflation with the *Golden Lion* and the unconfirmed possible conflation of the place of loss of both vessels may ultimately rule this vessel out.

6 Further possible characterisations not sourced from existing records

Aside from the existing wrecks currently recorded on the HERR database, all of which, as we have seen, are problematic as candidates in various ways, there may be other potential characterisations that could point to where we might need to look for further information.

6.1 Does the vessel represent the remains of a ship recovered for salvage or cannibalisation, and then potentially left to rot? For example, could part or all of the vessel have been recovered and drawn up locally on the banks of a (former) watercourse now infilled but represented partially by the waterlogged quarry area, awaiting further salvage, stripping, repair or even quiet decay? The potential for either the *Greyhound* or the *Red Lion* to have undergone these processes suggests that this might plausibly have happened to other vessels.

The location of the wreck created the risk of forming a nucleus for further silt accumulation that would have further jeopardised a coastline prone to these processes (cf the 19th and 20th activities of the Mersey Docks and Harbours Board, dispersing wrecks by blasting to prevent obstruction of the entrance to the Mersey).

Scenarios of vessels being drawn up awaiting their fate are reasonably well attested in HERR records: as noted in **1**, this was certainly the case with vessels of naval origin, from the 15th century *Grace Dieu* and *Holigost* at Bursledon on the River Hamble in Hampshire to the late 19th century remains of the former HMS *Beagle* in the River Roach, Essex and even the First World War U-boat on the Medway, which should have been destroyed under the terms of the Treaty of Versailles after being cannibalised for her engines and other parts.²⁸

These examples are all of vessels in naval use, some of which have passed quietly from the documentary record, that is, with no formal 'last entry' or striking from an official register, others reasonably well documented.

Elsewhere there is also considerable evidence for barges left to decay quietly in hulk assemblages around the country, while during the 18th and 19th centuries recovery of wrecked vessels - at least to the point where they could be drawn up on a beach and sold by auction for breaking and salvage of parts - was common and is well-evidenced in contemporary advertisements for sale (and is distinct from recovery of vessels for repair and reuse or sale as seaworthy, or potentially seaworthy, entities).

For the 16th century there is much less evidence for recovery operations, but this is unsurprising given the general paucity of surviving source material, discussed at **4** above. However, some contemporary evidence *does* survive, and various salvage activities are recorded in the HERR database:

- 1.** sophisticated diving operations on sunken vessels (*St Mary & St Edward*, 1546; a vessel with tin and lead, 1547, both Needles);
- 2.** recovery of cargo in the inter-tidal zone (*Mary Bonaventure*, 1581, Portishead Point); and
- 3.** recovery of wrecked vessels in the inter-tidal zone (two French fishing vessels blown off course into St. Ives Bay, 1545-6).²⁹

²⁸ *Grace Dieu & Holigost*, National Heritage List for England List Entry Number 1000061; CGWV No.7, formerly HMS *Beagle*, NHLE List Entry Number 1467785; ?UB-122, HERR UID 900735

²⁹ HERR, UIDs *St. Mary & St. Edward*, 1621067; tin & lead vessel, 1621068; *Mary Bonaventure*, 1411128; French fishing vessels, 1462062 and 1462074

There is also some precedent along these lines at an earlier date in this particular area, demonstrating that recovery activity was indeed undertaken along this coastline. In 1364 a Spanish cargo vessel named *Le Seint Marie* (evidently turned into the law French used at this period, but which in old Castilian is likely to have been *Santa Maria*) 'which by accident got on the sands at Dengenesse by Romeney . . . and there remained for two days high and dry in the marshes'.³⁰ This suggests a temporary situation followed by a refloating, and thus a different form of salvage activity, recovery of the vessel as an otherwise seaworthy entity.

Further, 'high and dry' suggests that some vessels could be driven beyond the reach of a local tidal range (or until such time as a spring tide, either fairly shortly afterwards, or some months later, depending on local conditions, would allow them to be refloated), and in this context suggests that it was a plausible process for a ship wrecked locally to undergo.

Records of vessels being left 'high and dry' beyond the normal tidal reach are relatively little documented in HERR, with 44 instances, including a near-contemporary vessel which stranded on marshy ground near Appledore during the 1607 Bristol Channel 'tsunami' which washed her so far inland that she could not be refloated.³¹ These 45 instances suggest that this phenomenon is not well understood and as a manner of loss may be masked in the paucity of detail characteristic of much of the record, and thereby under-representative of this particular manner of loss (there may be more instances than we are currently aware of).

This may lead to an alternative interpretation.

6.2 Loss in some form of inundation event or storm surge? Consideration of a vessel being left 'high and dry', beyond the reach of mean high water ranges, suggests the possibility that the Denge Quarry wreck might have been lost not in or beside a watercourse or the shoreline, but instead by being washed ashore in some form of inundation event, either because of an exceptional tide, or because of some form of flood event, or a combination of the two, as was certainly seen in the Bristol Channel event of 1607 and the storm which lashed the Essex coast and Canvey Island in 1953, both of which have been characterised as storm surges.

The present-day location of the site may suggest the potential for the Denge Quarry wreck to represent such a loss due to some form of inundation or storm surge event. As the Appledore event suggests, such events were perhaps made more likely along low-lying marshy stretches of coastline which were easily overwhelmed by large volumes of water. The lack of comparative data for such events in the dataset as a whole, and for records in the late Tudor period more specifically, make it difficult to establish how plausible such a possibility is. As an example, there was a known storm surge and tidal on 5 October 1570, which both left some slender traces in the record for shipwrecks along the east coast of England from the Humber to the Straits of Dover.³²

³⁰ HERR, UID 1447446; *Calendar of Patent Rolls*, Edward III, Vol. XII, 1361-64, membrane 29d

³¹ 1409638

³² 1607. *A true report of certaine wonderfull ouerflowings of waters, now lately in Summerset-shire, Norfolke, and other places of England, destroying many thousands of men, women and children, ouerthrowing and bearing down whole townes and*

For example, a vessel was stranded in the 'extreame flouds' at Great Yarmouth and other vessels cast ashore on the Lincolnshire coast. The Romney Marsh area was also affected in this event, as the 1570 narrative makes clear:

At Broom Hill [Broomhill, near Camber Sands], in Romney Marsh, four miles from Rye, the water came in so outrageously, that it brake down the marsh Wals, one master Bury, being owner thereof, who lost by the same a thousand one hundred threescore and two of his sheepe . . . ³³

The 1570 narrative may not be wholly reliable, as it is a retrospective account written nearly 40 years later after the 1607 events, but it is convincing in its detail of both place- and personal names, which suggests that it is at least dependent on an earlier written or printed source or collation of material. Such an event known both to have affected shipping and to have reached as far south as the south (English Channel) coast of Romney Marsh suggests that there is potential for a wreck to have occurred in the vicinity as a result of this weather event. Given the general dearth of surviving records, it would not be surprising for documentation for this wreck never to have been made, to have been made but not survived, or even to lie in archives awaiting discovery.

Such an event would fit well with a vessel of the suggested age with suggested repairs with timbers dating from the early 1560s, and would explain how a vessel came to rest as far inland as it has done, particularly if, around 1570, shoreline deposit processes were still in progress. Admittedly, it is a speculative supposition, unsupported at present by documentary evidence, but it is not without the realms of possibility.

7 Significance of the wreck site

The site in itself is a significant find for a period 1540-1600 for which **5.75%** of the known wreck dataset comprises the archaeological remains of vessels (see **Section 3**); the **four designated wrecks** for this period comprise **2%** of the combined total of documented wreck events and known archaeology and **36.36%** of the 11 sites that are, or have in the past been, attributed to this period.

The wreck is therefore a rare archaeological survival for this period.

In turn, the documentary evidence is partial at best and full of gaps, as described above. When set in the context of an 'ideal' (and unachievable) dataset of wrecks corresponding to all the documented wrecks, and others not documented, now lost to us, as discussed above - that figure of known archaeology is vanishingly small.

Out of the designated group, only one has a confirmed identification: the *Mary Rose*. The other non-designated sites likewise remain unidentified. The archaeological record therefore runs parallel to the documentary record, rather than overlapping.

villages, and drowning infinite numbers of sheepe and other cattle <http://name.umdl.umich.edu/A12596.0001.001> This document is our primary source for the Bristol 'tsunami' storm surge of 1607 and the Appledore wreck: the document goes on to elaborate the events of 1570 by way of comparison. See further detail on sources on the UK Web Archive for [weather events 1500-1599](http://www.ukwebarchive.org.uk/1500-1599).

³³ 1607. A true report of certaine wonderfull ouerflowings of waters . . .

Each, in its different ways, provides evidence for wreck events, but still the gaps remain.

However, the lack of identification for archaeological remains does, in a way, reflect the documentary record, which is vague and partial by comparison to later centuries in English waters. The wreck is significant *because* of lack of documentation.

We are unlikely to be able to identify, or at least to fully identify, the vessel, but this does not detract from its significance. It shares some characteristics with known wrecks, all of which are, in different ways, problematic, but which suggest some ways in which we can characterise known English vessels which came to grief on this coastline at this period.

The suggestion that the vessel is English is of great significance: out of the known wreck archaeology, only the *Mary Rose* and Gresham Ship are positively identified as English vessels, representing **1%** of the combined known dataset. In this, the archaeology reflects the documentation in the dataset as a whole: the 28 records which are known, because explicitly recorded, as English in some way, e.g. being 'of London', account for **14.5%** of the combined dataset and are likely to be under-represented in the existing dataset (e.g. where 'English' may be a reasonable supposition but cannot be confirmed on examination of surviving narratives).

The closest comparator for the Denge Quarry wreck is the Gresham Ship in terms of period and nationality: its location in a quarry is fortuitous and not a direct comparator, however (as a result of deliberate redeposit for preservation in a waterlogged context following archaeological excavation).

- the cargo vessel at Dover, 1544, confirms the potential for coasters to have been lost on this section of coastline;
- the *Greyhound* of 1563 is too early, but was 'hard-worked', suggests a strong trading link with France and the possibility of a ship having been laid up in some way awaiting potential recovery;
- the *Red Lion* of 1592 would fit well in date and fit other criteria if the recorded intervention of the men of Lydd and Romney can be corroborated from other records as involved in a wreck cast ashore in the vicinity, rather than on the Goodwin Sands;
- Further, there is a known inundation event at the right period in 1570 that would resolve all the issues of location and date, and would be very rare evidence of such an event, under-represented as it is within the records.

It may not be possible to uncover evidence for the last scenario, or even to provide a match for the wreck amongst any surviving documentary records, but it certainly appears to be an avenue worth exploring and documentary research appears to be the logical next step: it has already borne fruit in the wider national context with the 12 additional wrecks found. Documentary research is likely at the very least to provide more wrecks for the NMHR database, which means that the significance of the rare archaeological remains of the Denge Wreck is only likely to grow as the number of documented events increases.

It seems plausible to suggest that the number of documented wreck events for this coastline might increase as a result of the suggested research by something in the order of **5-10%**.

8 Suggested next steps

Research into the following documentation:

- Original, rather than calendared (summarised) State Papers, held at the National Archives and elsewhere (to establish whether or not the *Red Lion* is a plausible candidate, and to improve our recording of that vessel);
- Original correspondence of the Lords Warden of the Cinque Ports held by the Kent History and Library Centre (for the *Red Lion* and to build up a fuller picture of the wrecks on the Kent coastline as a whole, as an NMHR project). As a source, this correspondence appears to have been superficially mined on the foundation of the present NMHR database some 30 years ago, and is likely to repay re-examination.
- Research into the events of 1570 as they affected the Romney Marsh coastline (for any evidence of wreck events in this area)
- Research into the accounts of Canterbury Cathedral (one new wreck from the Isle of Sheppey has already been identified from The National Archives' catalogue entry for Canterbury: as at the time of reporting, not yet entered onto the system, but one of the 12 identified during research for this paper).

Serena Cant
Marine Information Officer
Historic England, 01.08.2023



Appendix 8

1 WOOD CONSERVATION ASSESSMENT

By Tom Wicks

1.1 Introduction

- 1.1.1 A selection of samples taken from timbers of a ship were analysed to determine the preservation condition of the wooden remains. Analysis focused on the loss of wood substance to determine the condition of the wood. A greater loss of wood substance would indicate higher degradation levels of the wood. For each sample, measurements were taken to determine the maximum water content (MWC), the shrinkage, and the basic density. The pin test was also done on each sample to cross-reference against the other results and provide an additional metric to measure condition.

1.2 Aims and methods

- 1.2.1 This assessment was undertaken to determine the preservation levels of the wooden timbers prior to redepositing the timbers *in-situ* in the quarry. This assessment will provide a baseline for any future monitoring of the timbers.

Samples

- 1.2.2 A total of 13 samples were taken from various locations on the ship. 10 of these samples were from larger timbers, the remaining 3 were taken from planks. Due to the size of the samples, a smaller piece was cut off from each one. These smaller pieces were cut to ensure they included material from the outside to the centre of each timber to account for the expected differences in preservation level between the outer and inner material.

Maximum Water Content (MWC) Analysis

- 1.2.3 MWC) is used to determine how much water is contained within a sample when it is completely waterlogged. This is used as an indication of the loss of wood substance, as water fills the gaps left by the loss of material.
- 1.2.4 Using a vacuum to ensure complete saturation of samples risks damaging the wood structure by collapsing cells, which can modify the outcome of the test (Macchioni *et al.* 2012). Samples had been stored in water since recovery, so were assumed to be completely waterlogged without the need to use a vacuum.
- 1.2.5 Samples were blotted with paper towels to remove excess water, then weighed while still waterlogged. They were then placed in the oven at approximately 100°C for three days to ensure they were fully dried. The oven was then turned off and the samples were allowed to cool in the oven, after which their dry mass was measured. MWC was then determined by the following equation:

$$\text{maximum water content} = 100 \times \frac{(\text{wet mass} - \text{dry mass})}{\text{dry mass}}$$

- 1.2.6 Higher percentages mean a higher water content in the wood, which indicates the wood is in a more degraded condition since there is less wood content. A classification is often given based on the MWC: Class I (>400%), Class II (185–400%), or Class III (<185%), with Class I being considered highly degraded and Class III considered undegraded (de Jong 1977). The actual degradation level varies by the wood species, with some species not considered degraded below 400% MWC, for example (McConnachie *et al.* 2008).

Shrinkage

- 1.2.7 Shrinkage is caused in wood by the collapse of the cellular structure on moisture loss. The surface tension of water evaporating out of the wood structure causes the collapse of cells which then presents itself as shrinkage of the wood. Loss of wood substance leads to greater shrinkage due to the larger pores inside the wood, causing greater areas of collapse within the wood structure.
- 1.2.8 Due to the sizes of the samples, it was considered shrinkage could be used as an additional measurement of preservation. Shrinkage is determined by the difference between the measurements of the three planes of wood before and after drying, it is given as a percentage.
- 1.2.9 Where possible the radial, tangential, and transverse measurements of each subsample were taken before drying as part of the MWC analysis. The measurements were retaken after drying to determine how much shrinkage was present in each plane.

Basic Density (Bd) and Residual Basic Density (RBd)

- 1.2.10 Basic Density (Bd) is another method of measuring loss of wood substance. The loss of material from wood decreases the density as more volume is taken up by gaps in the cellular structure. The volume of degraded waterlogged wood does not change significantly, as the loss is presumed to be primarily cellulose and the remaining lignin preserves the original volume and shape of the wood while waterlogged.
- 1.2.11 The density is measured as a relationship between the waterlogged volume and the dry mass. The volume of each subsample was determined by submerging it in water in a marked container. The level of the water was read before and after submerging each subsample and the difference in water level gave the volume of the subsample. The mass of each subsample was measured as part of the MWC analysis, this same measurement could be used to give the basic density along with the waterlogged volume.
- 1.2.12 Residual Basic Density (RBd) is the basic density of the sample compared against the normal density of the same species of wood. By comparing against normal wood of the same species, the loss of wood is indicated by a decrease in density.

Pin Test

- 1.2.13 The loss of material in the wood structure makes wood softer and easier to pierce. This degradation usually moves from the outer surface inwards, meaning the outer surface of waterlogged wood will be more degraded than the inner material and therefore softer. A steel pin is driven into the surface of the wood and the distance it can be pushed without resistance gives an indication of how deeply any degradation has progressed.
- 1.2.14 The pin test was done by pushing a pin into the outer surface of each sample in four locations. The pin was marked at the depth it pierced, then pulled out of the wood and the depth was measured. The pin test is a subjective measurement but does offer some indication as a comparative tool between samples.

1.3 Results

Maximum Water Content (MWC)

- 1.3.1 Results of the MWC analysis are shown in Table 1. Based on the results of the MWC test, all samples can be categorised in Class III, undegraded. The most highly degraded sample was 59B, which at 128.57% is still solidly within Class III indicating a good state of

preservation. This lines up with a visual inspection of the samples, which seemed to be in very good condition. Surfaces were not easily marked by handling and even on drying most samples still felt solid and did not crumble.

Table 1 Results from MWC analysis

Sample	Waterlogged mass (g)	Dry mass (g)	MWC (%)
44B	691	387	78.55
47B	756	421	79.57
48B	672	333	101.80
53B	865	453	90.95
56B	868	401	116.46
59B	688	301	128.57
69B	1294	692	86.99
74B	758	409	85.33
75B	484	230	110.43
76B	483	271	78.23
96B	961	511	88.06
97B	412	200	106.00
112B	889	428	107.71

Shrinkage

- 1.3.2 Shrinkage measurements and results are shown in Tables 2–4. All samples saw much less shrinkage in the transverse direction than in the tangential or radial directions, additionally, all but one of the samples (69B) shrunk more in the tangential than the radial directions, which is normal for wood in good condition.

Table 2 Measurements of the radial plane of each sample and the percentage shrinkage

Sample	Waterlogged Radial (mm)	Dry Radial (mm)	Radial shrinkage (%)
44B	114	103	9.65
47B	115	102.5	10.87
48B	133	114	14.29
53B	155	141.5	8.71
56B	163	151.5	7.06
59B	107	97	9.35
69B	135	118	12.59
74B	115	104	9.57
75B	97	89	8.25



76B	107	90	15.89
96B	-	-	-
97B	-	-	-
112B	-	-	-

Table 3 Measurements of the tangential plane of each sample and the percentage shrinkage

Sample	Waterlogged Tangential (mm)	Dry Tangential (mm)	Tangential shrinkage (%)
44B	99	87	12.12
47B	130	101.5	21.92
48B	152	122	19.74
53B	152	121.5	20.07
56B	169	153	9.47
59B	110	91	17.27
69B	138	126	8.70
74B	109	91.5	16.06
75B	106	87	17.92
76B	96	74	22.92
96B	-	-	-
97B	-	-	-
112B	-	-	-

Table 4 Measurements of the transverse plane of each sample and the percentage shrinkage

Sample	Waterlogged Transverse (mm)	Dry Transverse (mm)	Transverse shrinkage (%)
44B	73	71	2.74
47B	102	101	0.98
48B	65	64.5	0.77
53B	63	62	1.59
56B	64	63	1.56
59B	105	103	1.90
69B	120	118	1.67
74B	122	119.5	2.05
75B	86	84	2.33
76B	91	88	3.30

96B	102	100	1.96
97B	69	68	1.45
112B	85	84	1.18

- 1.3.3 While it was possible to determine the different planes of the wood in the samples, the orientation of the planes was not ideal. Measurements were attempted as accurately as possible, but for samples 96B, 97B and 112B it was not possible to get accurate readings of the radial or tangential measurements.

Basic Density (Bd)

Table 5 Measurements of the basic density

Sample	Waterlogged dimensions (mm)	Volume (cm ³)	Bd(g/cm ³)
44B	97 x 97 x 73	687	0.56
47B	87 x 92 x 100	800	0.53
48B	102 x 126 x 60	771	0.43
53B	107 x 115 x 63	775	0.58
56B	96 x 148 x 59	838	0.48
59B	85 x 83 x 105	741	0.41
69B	87 x 121 x 116	1221	0.57
74B	119 x 86 x 75	768	0.53
75B	77 x 80 x 87	536	0.43
76B	60 x 90 x 80	432	0.63
96B	50 x 100 x 188	940	0.54
97B	53 x 140 x 66	490	0.41
112B	55 x 85 x 186	870	0.49

- 1.3.4 The results for basic density readings are in Table 5. The basic density results obtained from using the volume measurements in water appeared anomalous, with seven of the samples having a higher basic density than either of the suspected species of wood. The measuring container used only had approximate readings every 200 ml, which likely wasn't accurate enough for this test.
- 1.3.5 All sides of the wood were also measured while waterlogged, so these measurements were used to calculate volume. Due to the irregular shape of the samples, these measurements are also only approximate. However, the basic density results obtained using these secondary volumes do appear to match up much more with normal wood.
- 1.3.6 At time of writing, the samples tested here have not been analysed to determine their species. An interim statement on the dendrochronology of 15 earlier samples determined 12 were oak (*Quercus* sp.) and 3 were elm (*Ulmus* sp.) (Howard *et al.* 2022).
- 1.3.7 Potential results for the residual basic density based on these two species have been drawn up for each sample and are shown in Table 6. These results are obviously subject to change

depending on the determination of the species of each sample, but it does offer some possible indication. The residual basic density was determined on the basis of a normal density of 0.56 and 0.43 g/cm³ for oak and elm respectively.

Table 6 Measurements of the basic density

Sample	RBd if Oak	RBd if Elm
44B	100.61	131.03
47B	93.93	122.32
48B	77.11	100.43
53B	104.35	135.90
56B	85.42	111.25
59B	72.56	94.50
69B	101.19	131.79
74B	95.15	123.92
75B	76.64	99.81
76B	112.02	145.89
96B	97.07	126.42
97B	72.93	94.98
112B	87.89	114.47

Pin test

- 1.3.8 Steel pins were driven into the surface of the wood until there was resistance and the depth the pin was pushed to was measured. The samples consisted of cross-sections of planks and timbers; a pin was tried in each of the four outer faces. Where resistance was felt immediately, or the pin could not be pushed into the surface at least past the point of the pin, a reading was not taken. The results of the pin test are in Table 7.
- 1.3.9 The samples were variable in their surface conditions, including variation between the four surfaces of each sample. This was also evident on visual inspection; the level of degradation was visibly uneven between the surfaces of each sample. The pins were able to be pushed furthest into samples 53B, 75B and 76B. While samples 96B, 97B and 112B were all in better condition based on the pin test.

Table 7 Results from the pin test

Sample	Pin Depth (mm)			
44B	19.5	-	-	-
47B	15	2.5	-	-
48B	15.5	-	-	-
53B	23.5	15	7.5	-
56B	12.5	11	9	-
59B	7.5	-	-	-
69B	6	4	-	-

74B	9	8	8	-
75B	25	12	-	-
76B	24	12	4	-
96B	5	4	-	-
97B	5.5	5.5	-	-
112B	6	6	-	-

1.4 Discussion

- 1.4.1 The wood from the 16th century shipwreck is in a good state of preservation. Maximum water content analysis showed all the samples tested were within Class III and this lines up with the other analyses performed, which also determined the wood was in good condition. The difficulties mentioned in getting accurate measurements on the subsamples means the results are likely more approximate than would be desired. However, based on the consistency between the tests paired with the visual analysis of the samples, the overall conclusion that the wood is in a good state of preservation does not seem to be inaccurate.
- 1.4.2 The results of the tests were quite consistent, with samples 47B and 76B being in the top three results of two of the tests, and sample 69B being in the top three results of all the tests except for MWC. Likewise, sample 75B performed poorly in all the tests and sample 56B was in the bottom three for both MWC and shrinkage (based on the ratio between the shrinkage of transverse and radial planes).
- 1.4.3 Despite performing well in the other tests, sample 76B did poorly in the pin test, as did sample 53B despite having a higher residual density. This could be a result of the subsampling. The pin test was done on the overall larger sample, so if the subsample which was taken for MWC, shrinkage and Bd analysis was not representative of the condition of the whole sample, it would lead to differences between those tests and the pin test. This shows the importance of visually inspecting the samples before taking subsamples to ensure the sample is as representative of the whole sample as possible.
- 1.4.4 When undertaking loss of wood substance tests such as these, it should be noted additional material in the cell structure of the wood, such as minerals and corrosion products, can make the wood appear in better condition than it is. Additional analysis such as Fourier transform infrared spectroscopy (FTIR) would be a complementary and non-destructive method for testing the condition of the wood by determining the lignin to cellulose ratios (High and Penkman 2019; High and Hazell 2021). Fourier transform infrared spectroscopy works by checking the signal peaks for cellulose and lignin, then comparing these with undegraded wood of the same species. A larger difference between the peaks indicates a more degraded sample due to a loss of cellulose. However, this technique is not also without its flaws and a variety of tests will provide the best indication of the condition of waterlogged wood.

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Appendix 9

Comments on the analysis of the possible ballast stone

Stephen F. Parry PhD, BSc (Hons), FGS, Petrologist | Building Stone Specialist, British Geological Survey (extracts from various correspondence from 22/01/2024 to 17/06/2024)

Examination by the British Geological Survey (BGS) has revealed that <the ballast boulder> comprises a pinkish pale grey, inequigranular, two-mica, tourmaline-bearing granite that contains sporadic tabular K-feldspar phenocrysts of up to 20 mm in length. The general petrographic characteristics of this granitic rock are consistent with the boulder having been derived from a part of the early Permian Cornubian Batholith of South-West England. Comparison with reference specimens forming part of the BGS Petrological Collections highlights similarities with the so-called 'coarse granite' of the Scilly Isles, and this area is provisionally identified as the source of the boulder. It is noted, however, that granitic rocks of broadly similar character occur in Brittany, for example, and an alternative origin to the Scilly Isles cannot be discounted at the time of writing. Analytical work, including radio-isotopic dating, is ongoing in an attempt to better constrain the source area.



The images below show the ballast boulder sitting alongside sample Econ. 13047 (from the Scilly Isles), with the polished surfaces in the same focal plane. One of the images shows the specimens dry and the other with them wet.





Appendix 10

1 NOTES ON FINDS

By Lorraine Mephram, Rachael Seager Smith

1.1 Wooden dish (Obj No 7007)

1.1.1 Approximately two-thirds of a shallow wooden dish or saucer (diameter 175 mm), with the rim slightly cracked and distorted. It has a simple concave profile with no ornamentation to the rim; the base is slightly flattened but there is no basal angle. The simple profile, together with some slight irregularities in the surface, suggests that the vessel is not turned but handmade.

1.1.2 Such a simply made vessel is almost impossible to date. It cannot be directly paralleled, for example, amongst the large assemblage from the *Mary Rose* (sunk in 1545), where the wooden dishes are almost all larger and would be classified as mess or serving dishes; these vessels were invariably turned, with more clearly defined rims and bases (Weinstein 2005, 445–7). This example has the appearance rather of an individual eating vessel. Nevertheless, it certainly would not have been out of place on a late 16th-century wreck.

1.2 Pottery vessel (Obj No 7010)

1.2.1 This is a body sherd from the neck/shoulder of a Raeren stoneware mug or jug. The sharp neck/shoulder angle indicates that this was a globular vessel with a cylindrical neck, a type current in the second half of the 16th century (eg Hurst *et al* 1986, fig 106, 332–3; Gaimster 1997, cat no 54).

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Weinstein, R 2005 'Messing' items, in J Gardiner (ed) *Before the Mast: Life and Death Aboard the Mary Rose*, The Archaeology of the Mary Rose Vol 4, 440–8

1.3 Animal bone (Obj No 7003)

1.3.1 A single fragment of sheep/goat or pig rib, most probably from a cutlet, was recovered close to a wooden dish and Raeren stoneware mug or jar. The rib had been roughly broken at both ends, with possible signs of rodent gnawing along one edge. The meat may have been procured fresh or possibly cured meat for longer-term storage. Evidence for both was found onboard the Tudor warship, *Mary Rose*, including several casks of salted beef and pork were recovered (Coy and Hamilton-Dyer 2005).

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2 LEATHER ARTEFACTS

By Kevin Trott

2.1 Leather shoe fragments

- 2.1.1 Two shoe fragments were recovered, one consists of a welt (SF 7002) from a turn-welt constructed shoe (Evans 2005, 68-70, Type 2/3). A single knife-cut butt is situated within the internal seat area, the curvature following the line of the internal waist where it is torn at the internal tread. No evidence for any stitching is evident within the hand-made stitch holes, although at least nine double stitches occur on the outer internal tread area suggesting a past repair.
- 2.1.2 A very worn near-complete left welted bottom unit from a male shoe (7000) exhibits a worn rounded toe, with excessive wear on the internal toe area and tread. Significant wear is also evident along the outer tread and distal waist area, where the outer waist edge and around the seat/former heel stack has been torn away following the line of the original machine stitching. A further tear is evident across the waist towards the inner stitching margins. Two or three small wear patches are present mid-tread, indicative of repetitive pressure wear. The upper tread exhibits mid-sole edging impressions, that with the reintroduction of right and left-footed shoes from the 1830s (Swann 1982, 32) indicates later post-medieval or more likely a modern (post 1890) date (Mould, 1997, 127).

2.2 Worked leather

- 2.2.1 Two pieces of thick cattle hide consist of a small triangular scarfed piece (SF 7009a) and a larger irregular shaped off-cut (7009b - 1029-5002). Off-cuts of leather as the by-product of leather working and would have been retained to be re-used or for re-purposing. The concave shape of the fragment from 1029-5002, may have been an off-cut from sole preparation or from the creation of a leather washer (Trott, 2020, 555).

2.3 Conservation

- 2.3.1 The four pieces of leather are currently kept in tap water, contained within individual airtight plastic containers. These are stored in a fridge.

3 STORAGE AND CURATION

3.1 Selection strategy

- 3.1.1 The four leather artefacts have been recorded to an appropriate archive level. The leather has limited potential for further analysis but any securely dated leather or items of intrinsic interest should be conserved for retention. The late post-medieval/modern continuous sole has no further research potential and should be considered for discarded.

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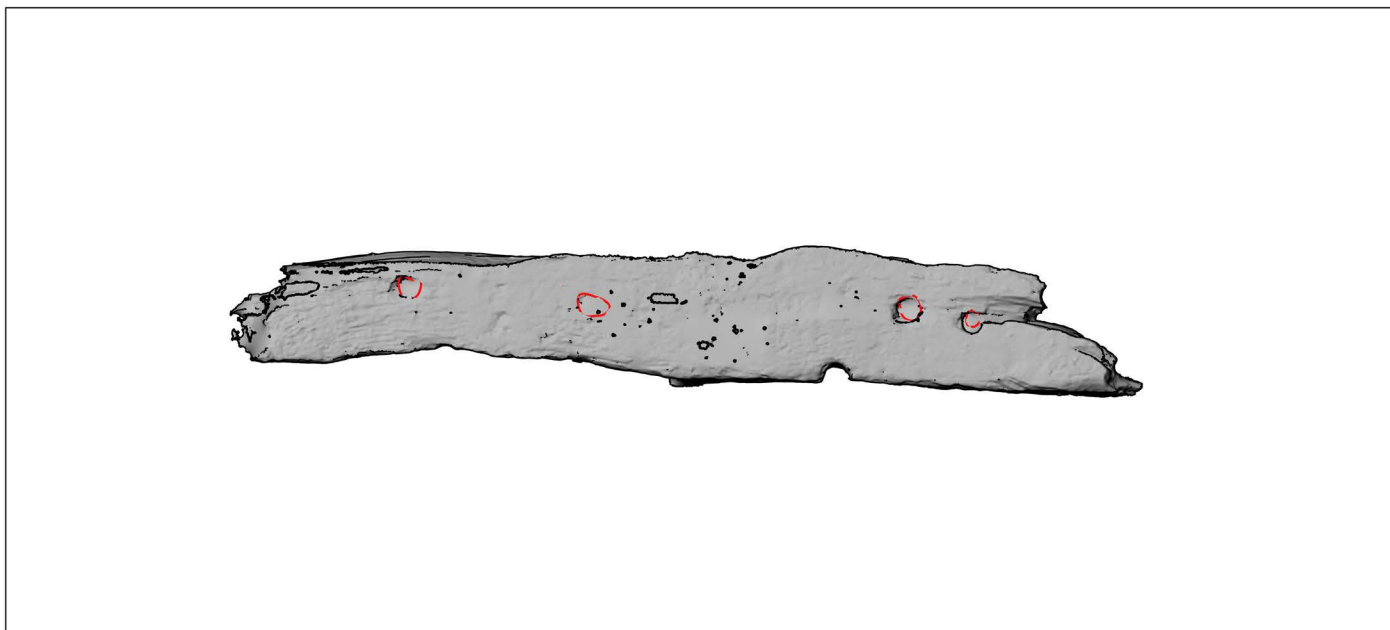


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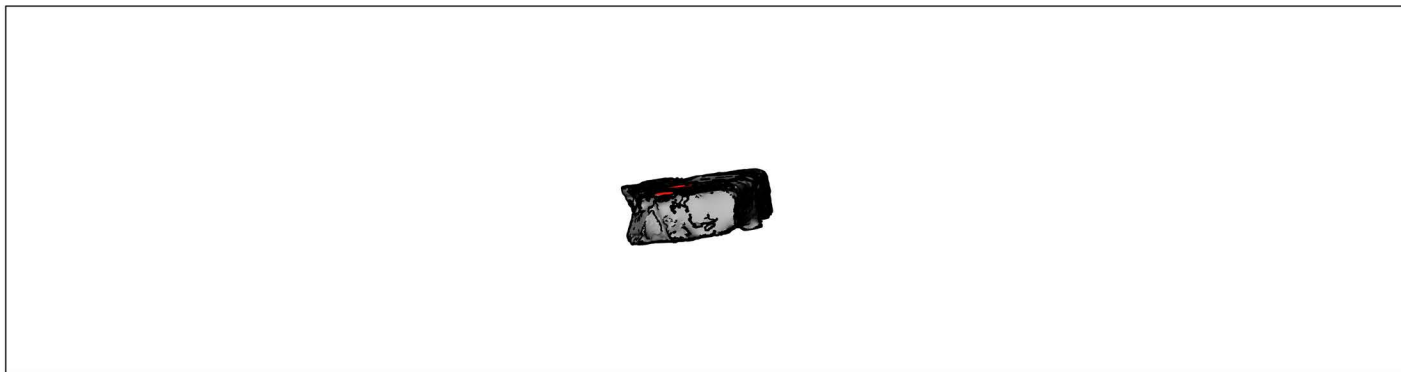


Appendix 11

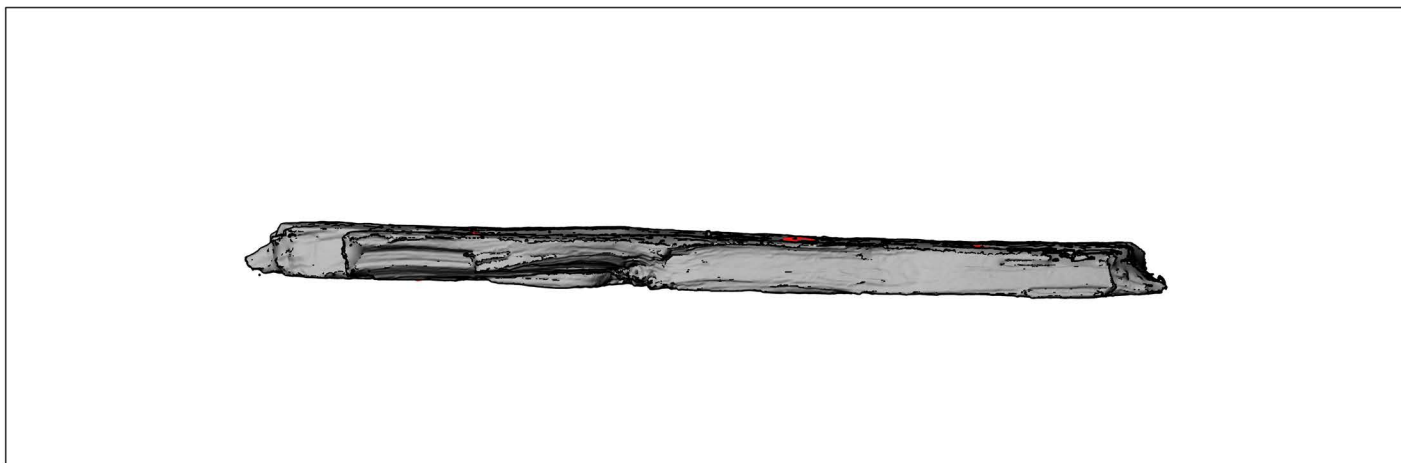
Top view



Front view



Side view



0 0.5 1m

Legend:

● Trenails and trenail holes / wedged trenails

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Status:	Final			Drawing No.:	001	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Top view



Front view



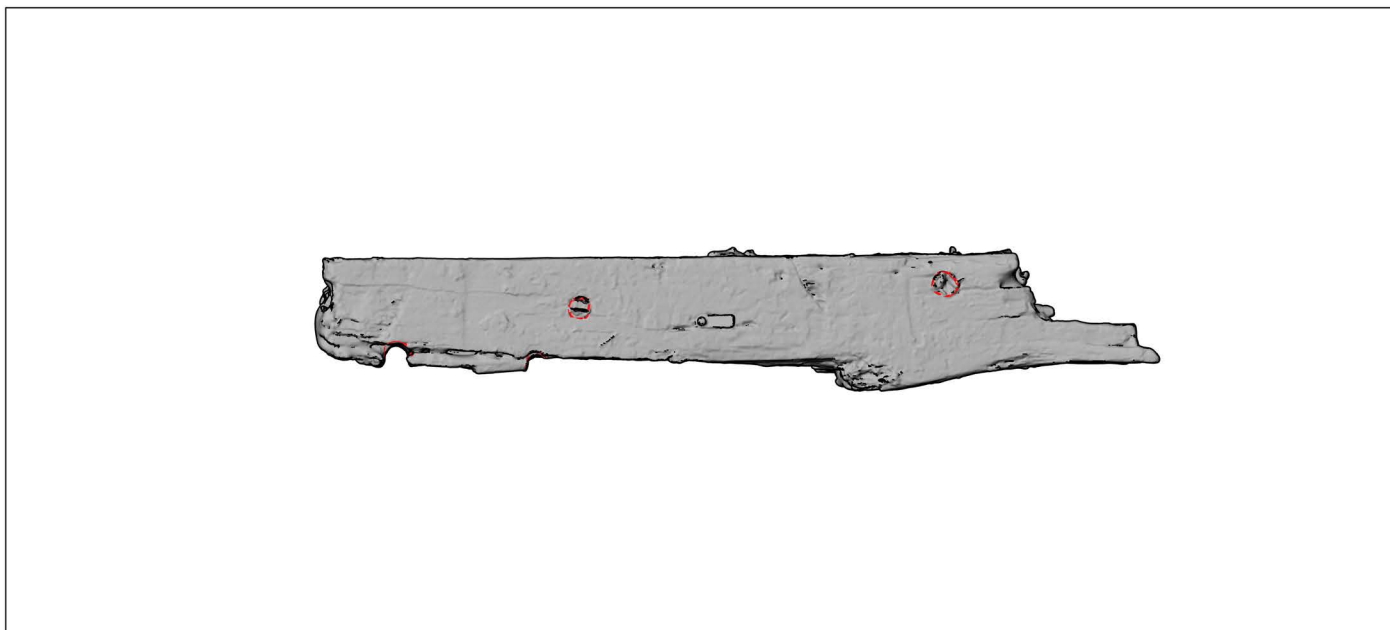
Side view



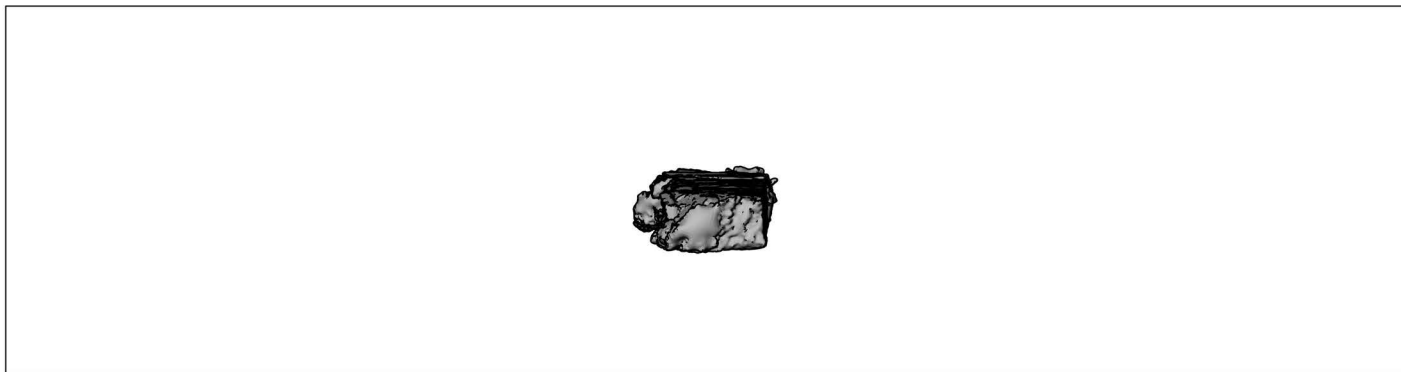
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Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Top view



Front view



Side view



0 0.5 1m

Legend:

⊙ Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:			Previous number:	-	Timber ID:	003
Timber type:	plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	003	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Top view



Front view



Side view



0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:			Previous number:	-	Timber ID:	004
Timber type:	plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	003	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Outboard view



Front view



Side view



0 0.5 1m

Legend:

●○ Treenails and trenail holes / wedged trenails ■○ Iron nail holes / heads

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Section:	-		Previous number:	-	Timber ID:	003
Timber type:	outer plank	Location:	Disarticulated timber			
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Outboard view



Front view



Side view



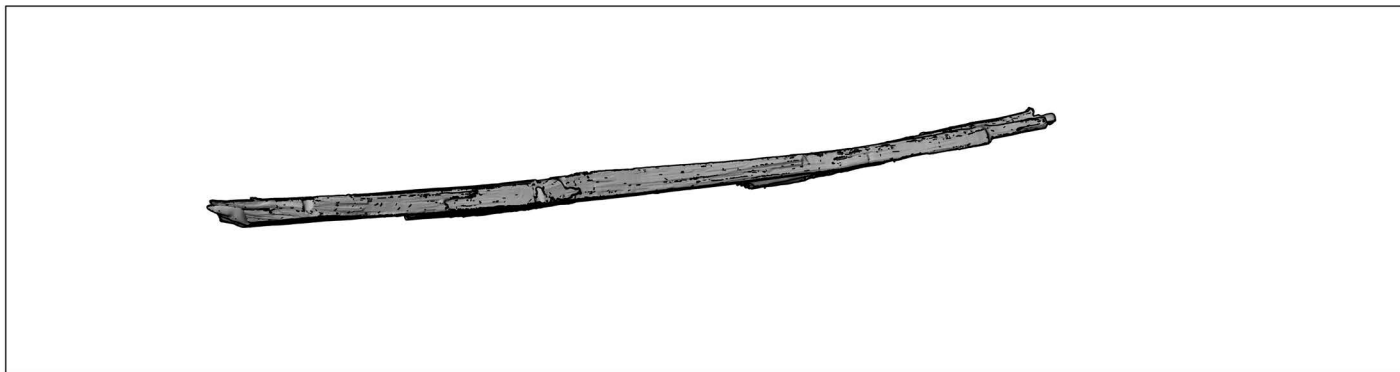
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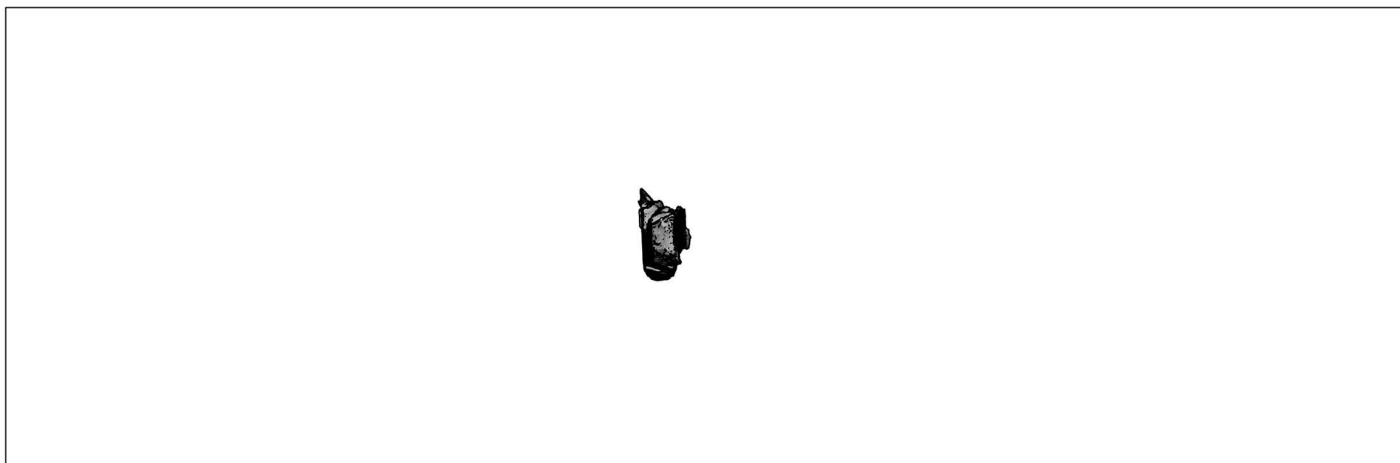
Inboard view



Side view



Front view



0 0.5m 1m

Legend:

● Trenails and trenail holes / wedged trenails

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Section:	-		Previous number:	5019	Timber ID:	004
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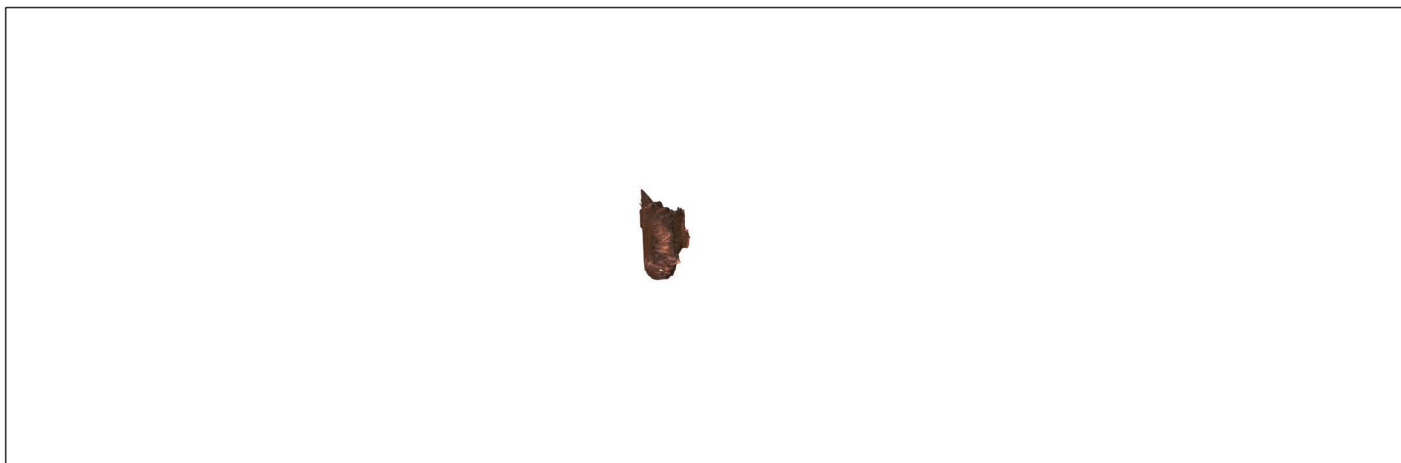
Inboard view



Side view



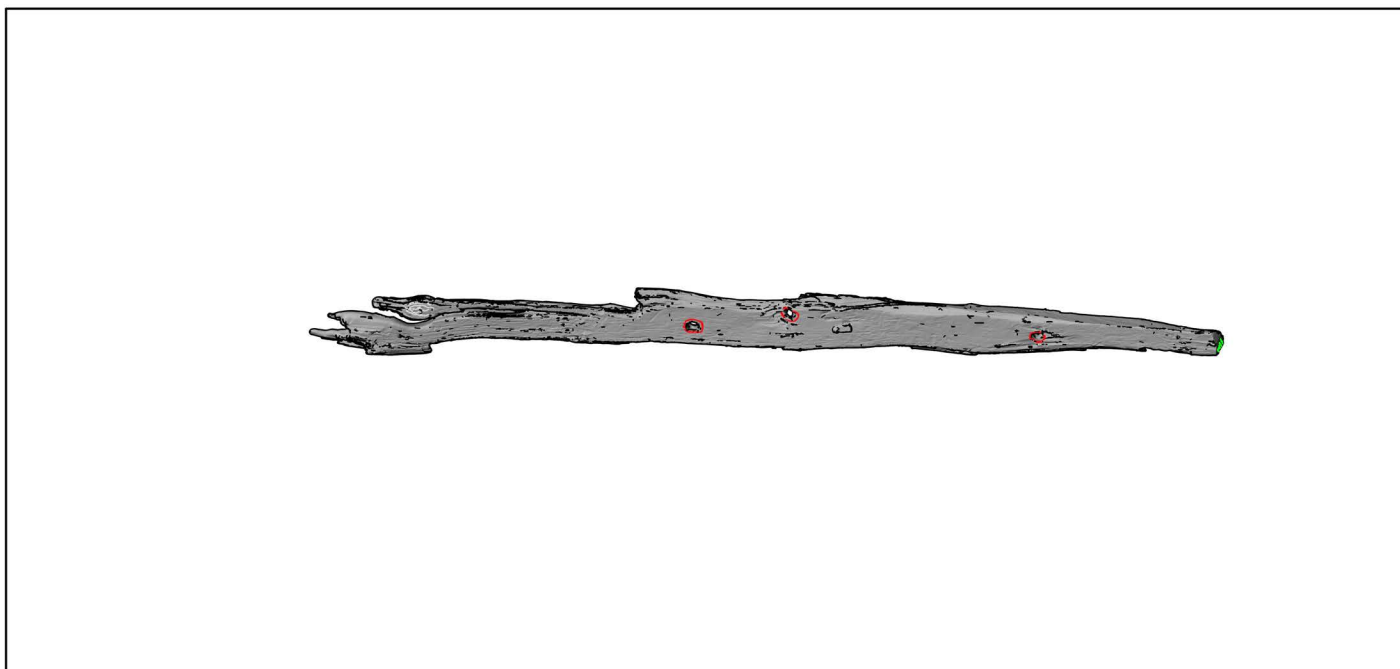
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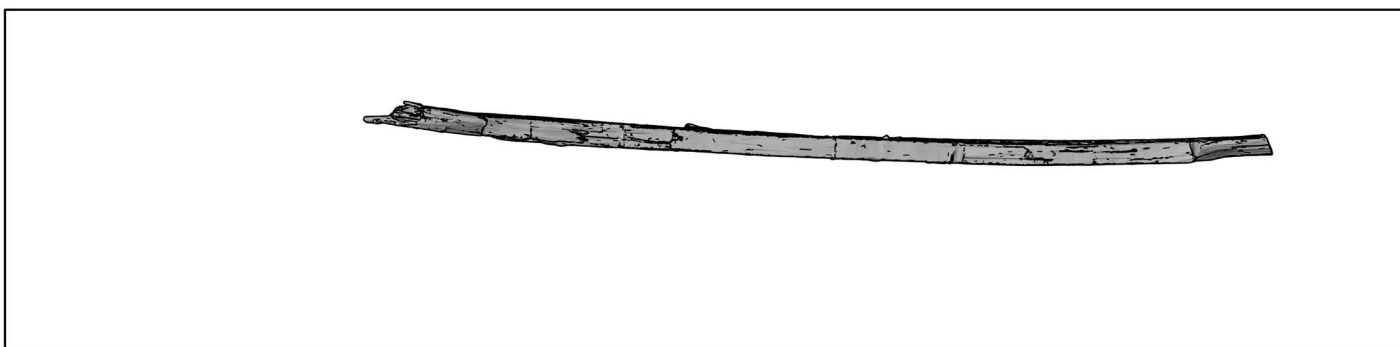
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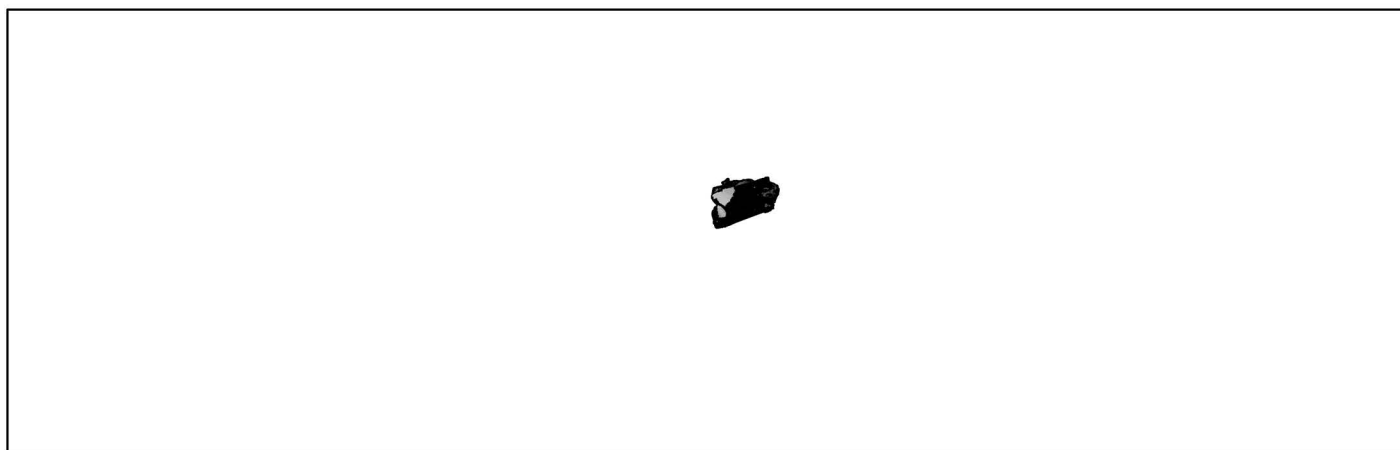
Inboard view



Side view



Front view



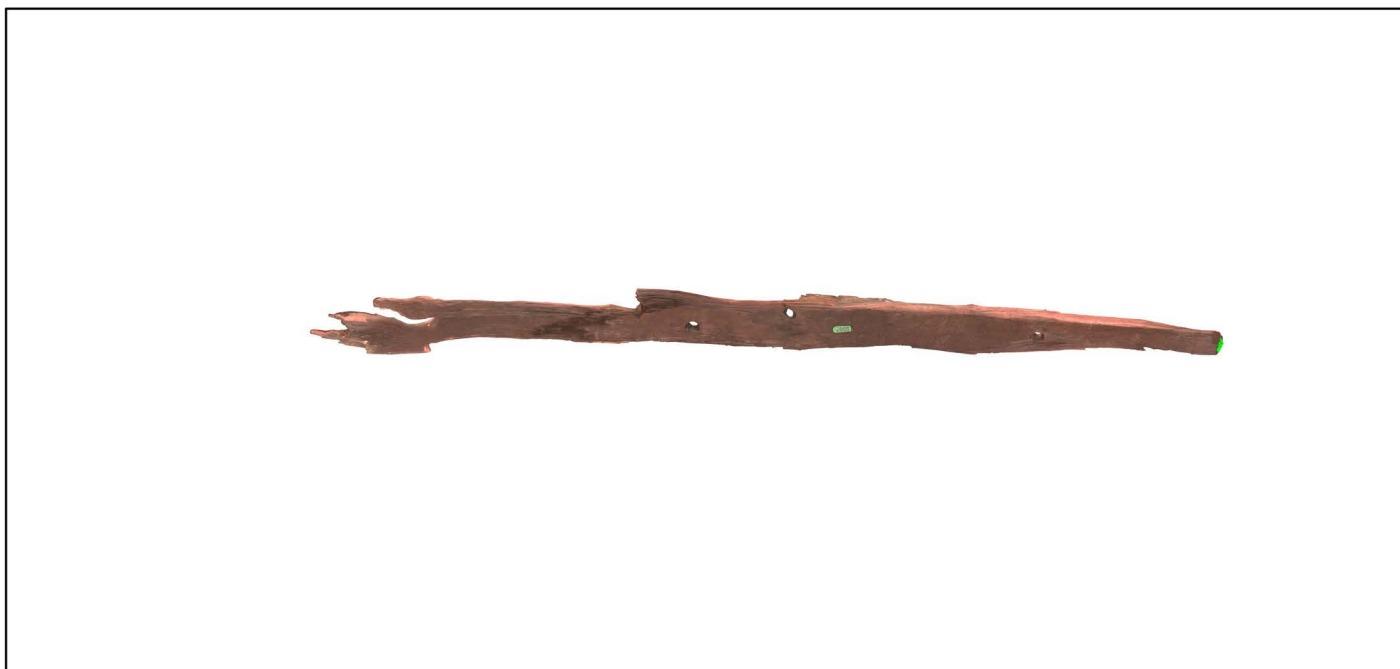
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Legend:

●○ Trenails and trenail holes / wedged trenails

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Section:	-		Previous number:	-	Timber ID:	005
Timber type:	plank	Location:	Disarticulated timber			
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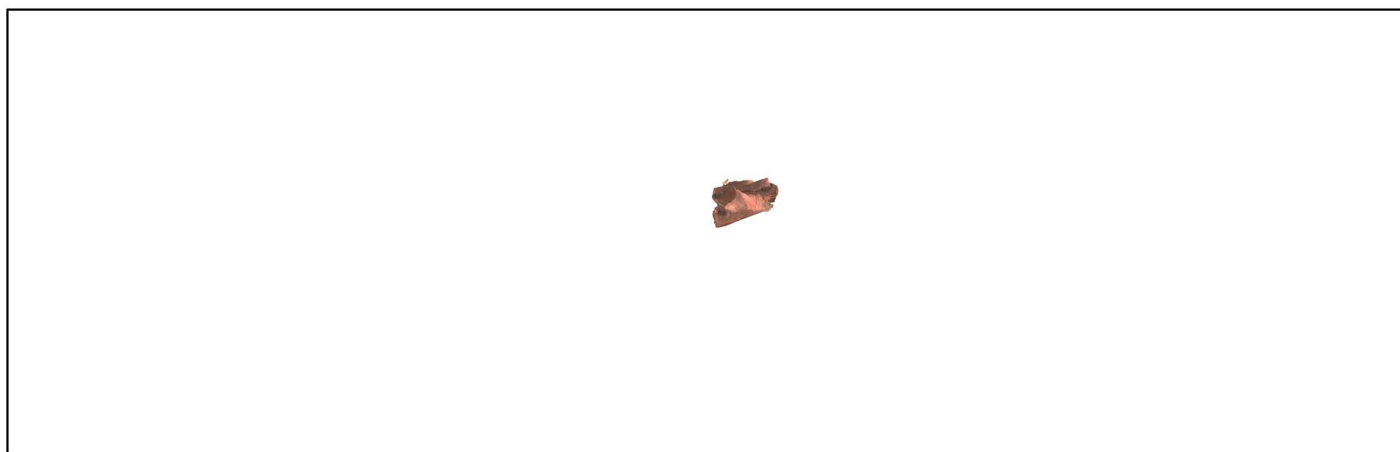
Inboard view



Side view



Front view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	005
Timber type:	plank	Location:	Disarticulated timber			
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Scale:	1:20	Date:	22/02/2022	Made by:	Paolo Croce	

Inboard view



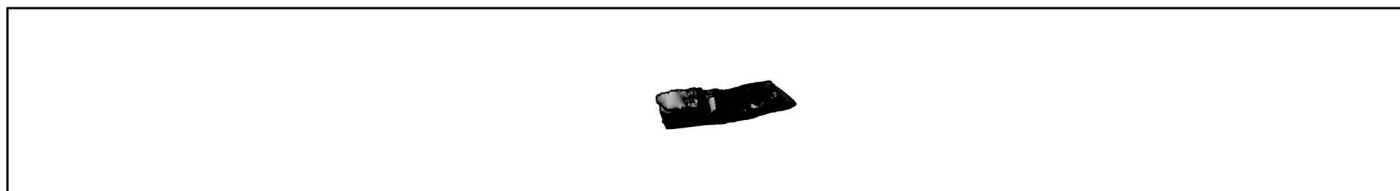
Side view



Outboard view



Front view



0 0.5m 1m

Legend:

○● Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:		Timber ID:	006
Timber type:	plank	Location:	Disarticulated timber			
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Inboard view



Side view



Outboard view



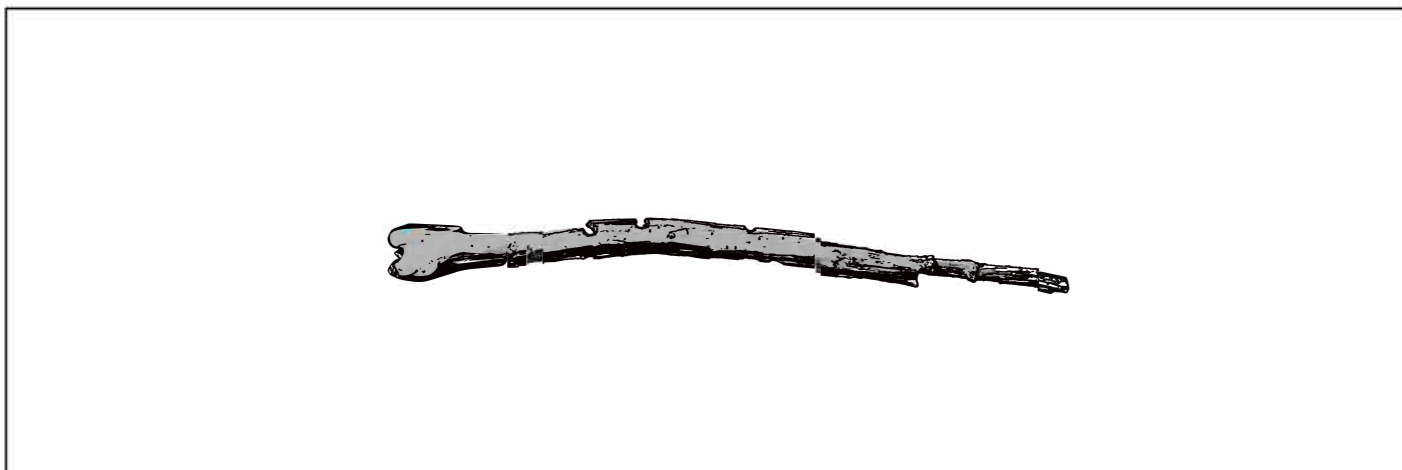
Front view



0 0.5m 1m

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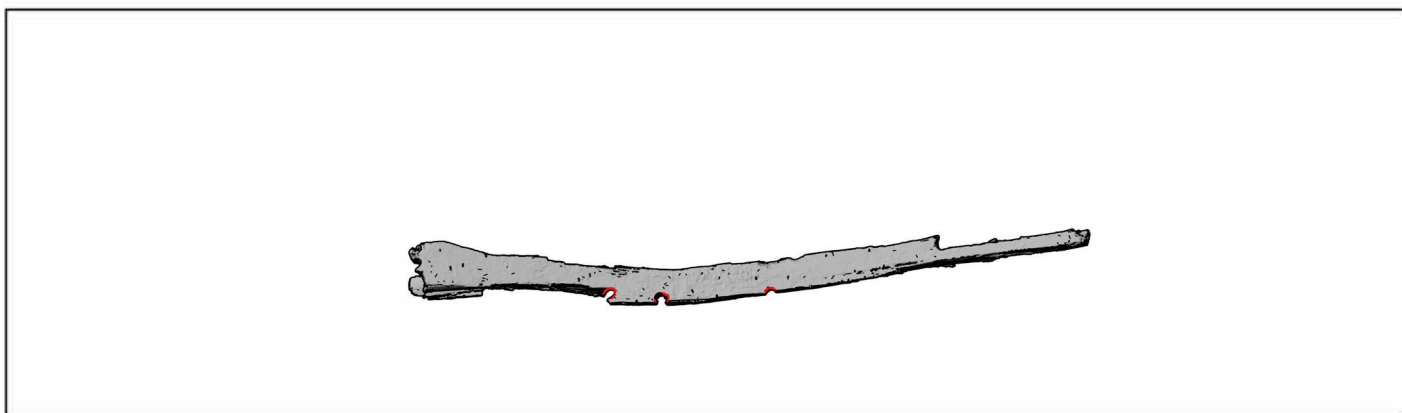
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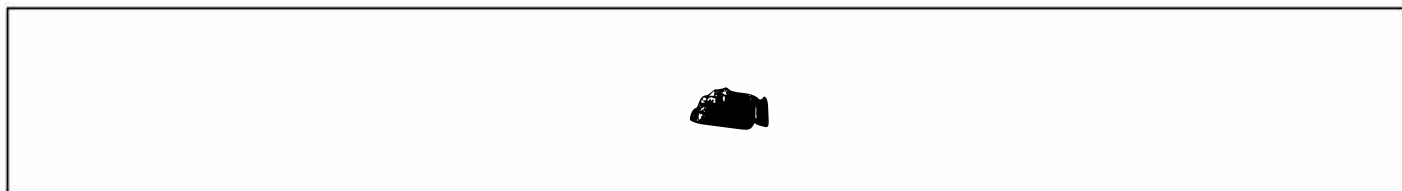
Side view



Inboard view



Front view



0 0.5m 1m

Legend:

●● Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	007
Timber type:	outer plank	Location:	Disarticulated timber			
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Outboard view



Side view



Inboard view



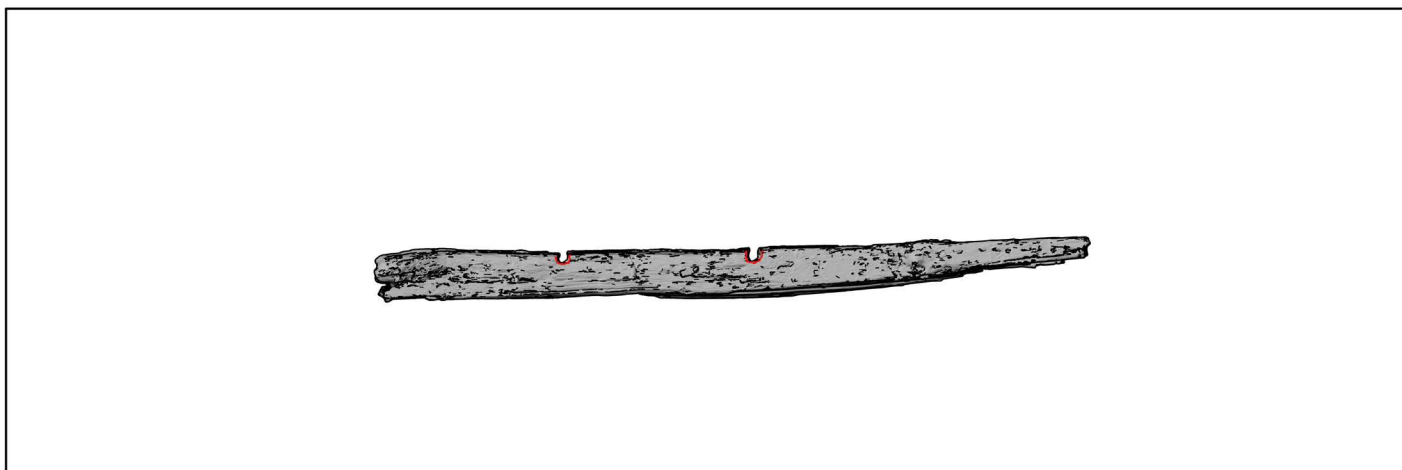
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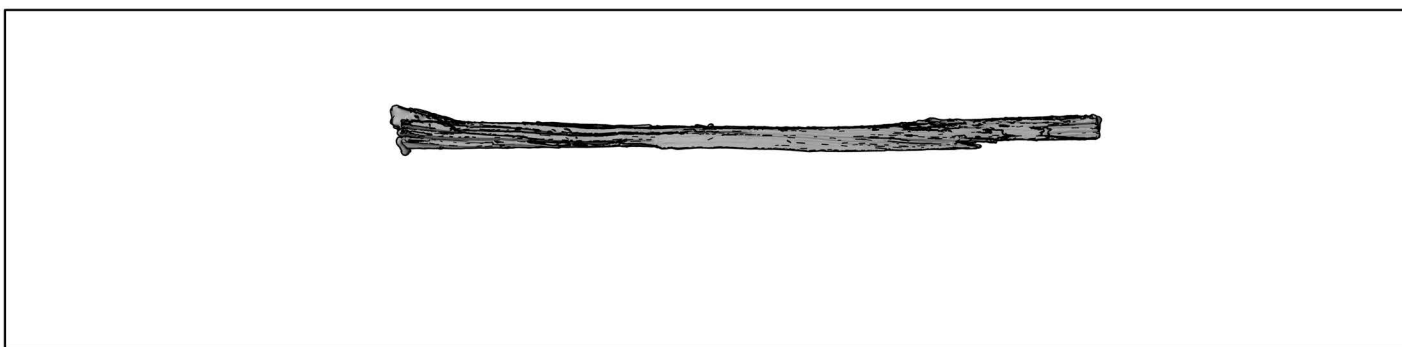
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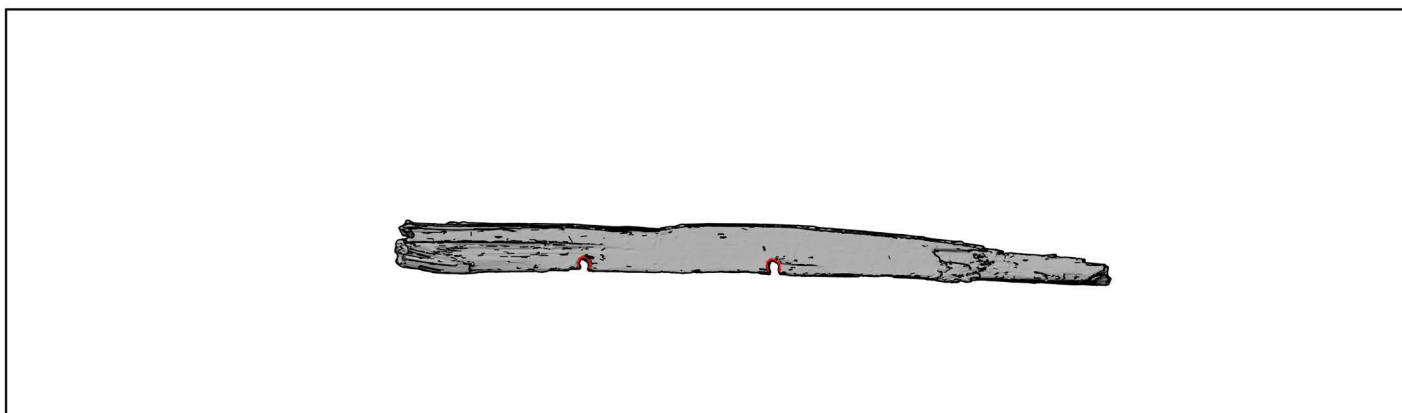
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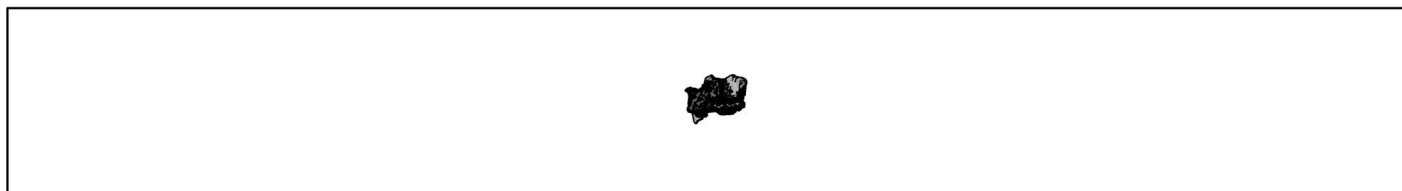
Side view



Inboard view



Front view



0 0.5m 1m

Legend:

● Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	008
Timber type:	plank	Location:	Disarticulated timber			
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Top view



Side view



Bottom view



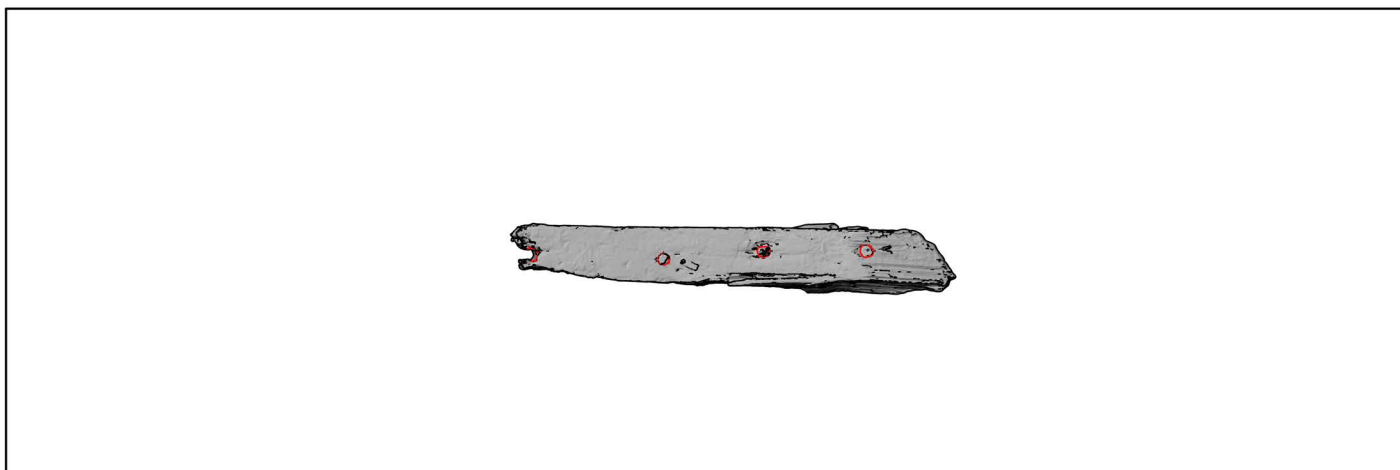
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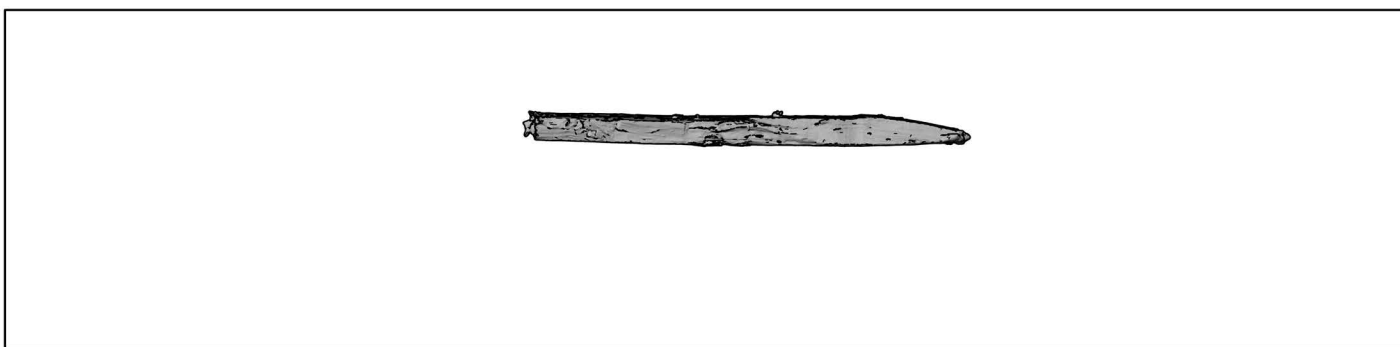
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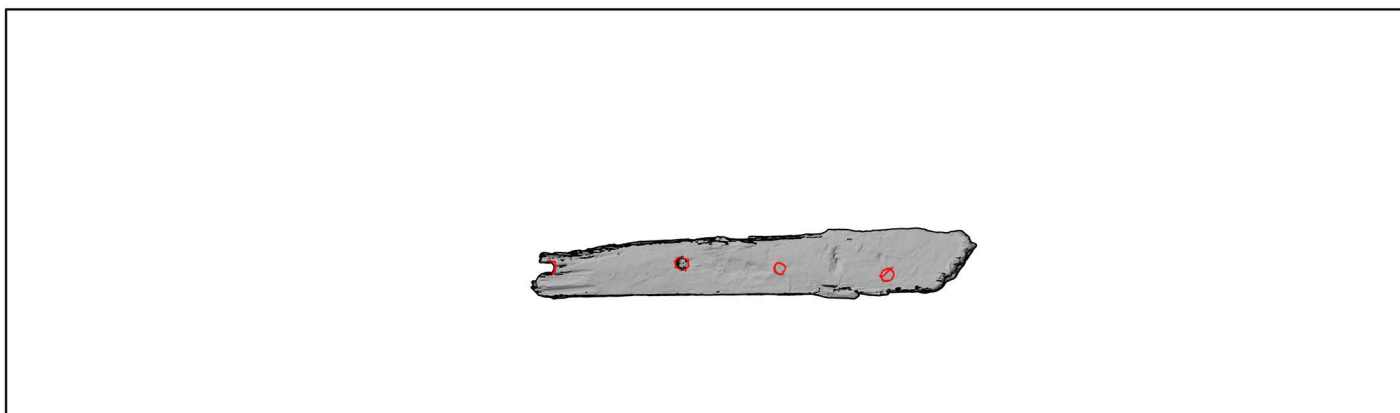
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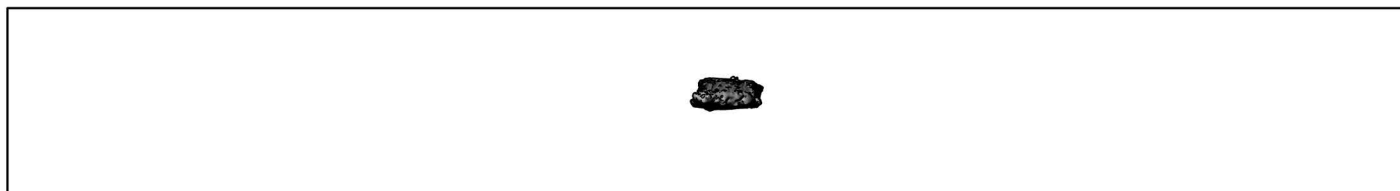
Side view



Outboard view



Front view



0 0.5m 1m

Legend:

⊙ Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	009
Timber type:	plank	Location:	Disarticulated timber			
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Inboard view



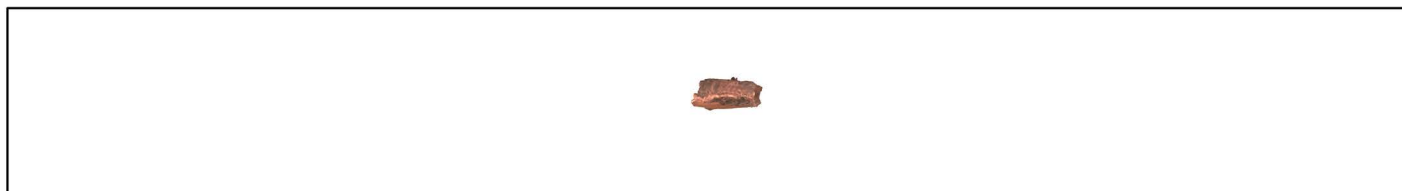
Side view



Outboard view



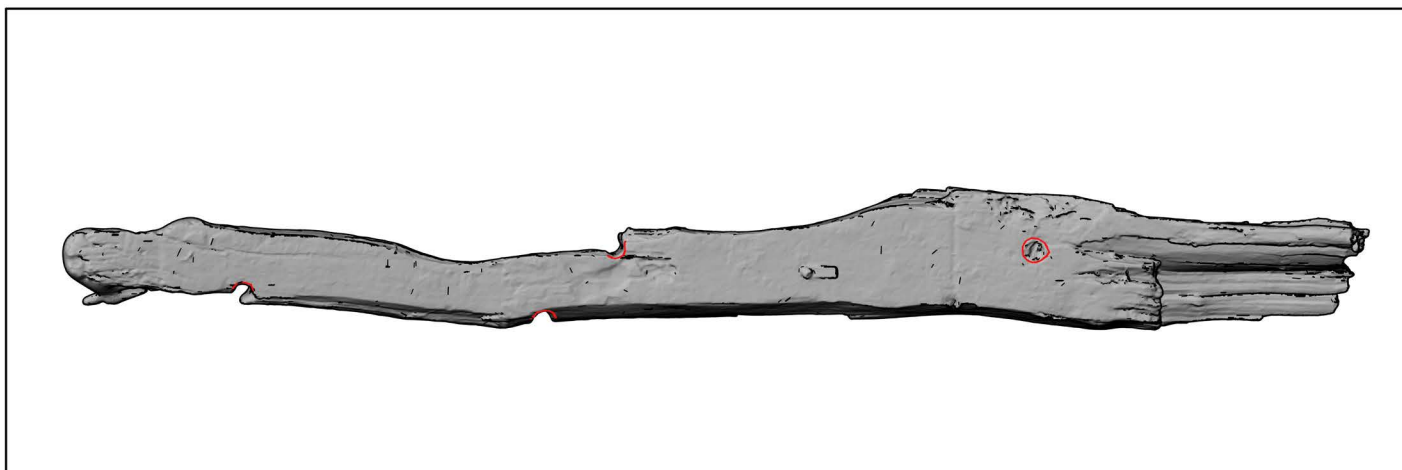
Front view



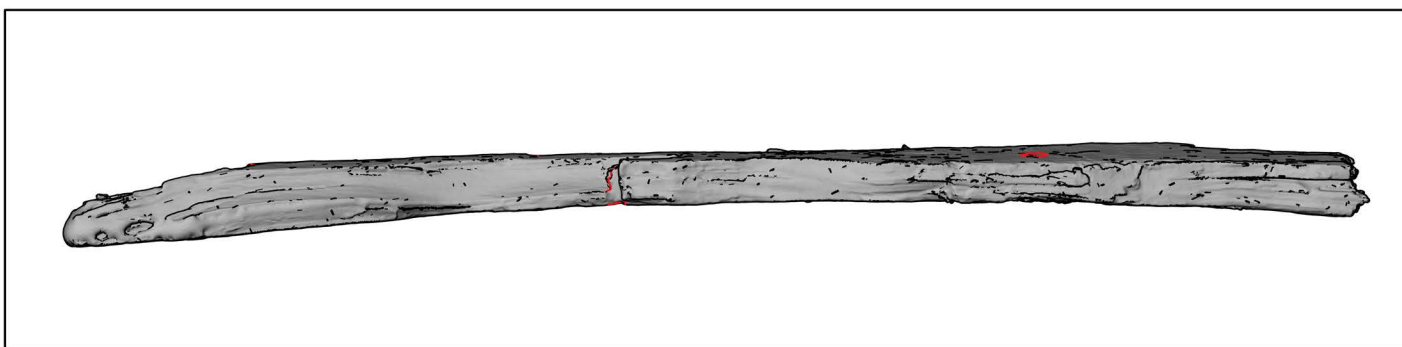
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	008
Timber type:	plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	018	
Scale:	1:20	Date:	22/02/2022	Made by:	Paolo Croce	

Top view



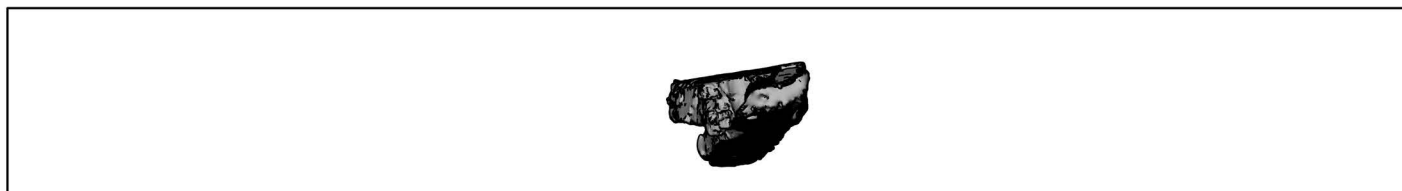
Side view



Bottom view



Front view



0 0.5 1m

Legend:

⊙ Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	010
Timber type:	plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	020	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Top view



Side view



Bottom view



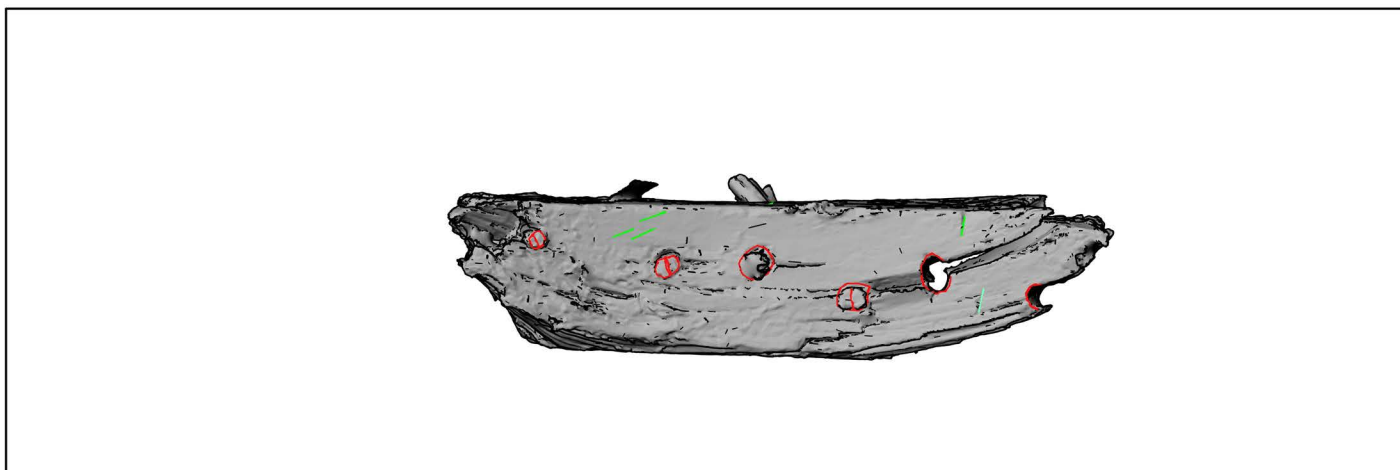
Front view



0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	010
Timber type:	plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	019	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

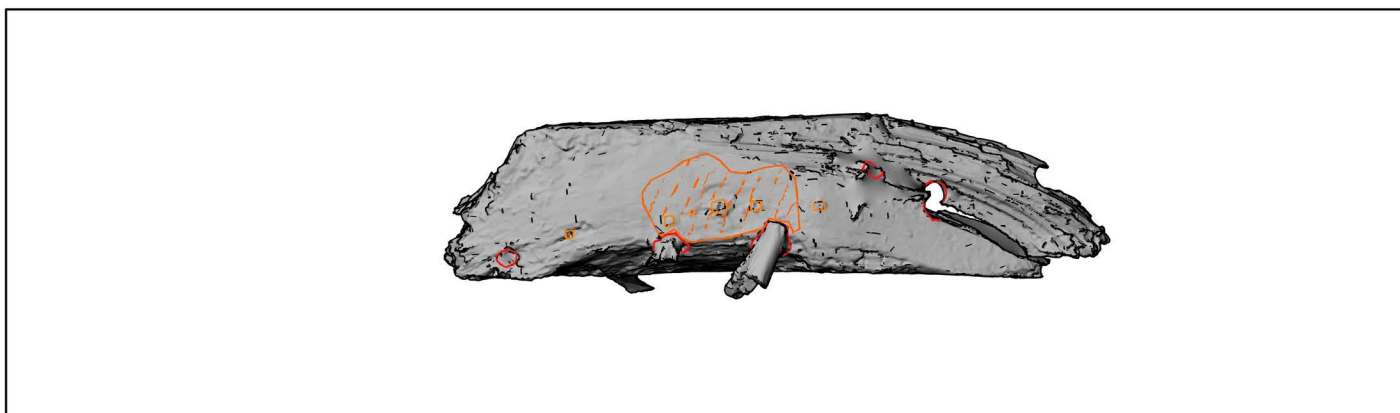
Inboard view



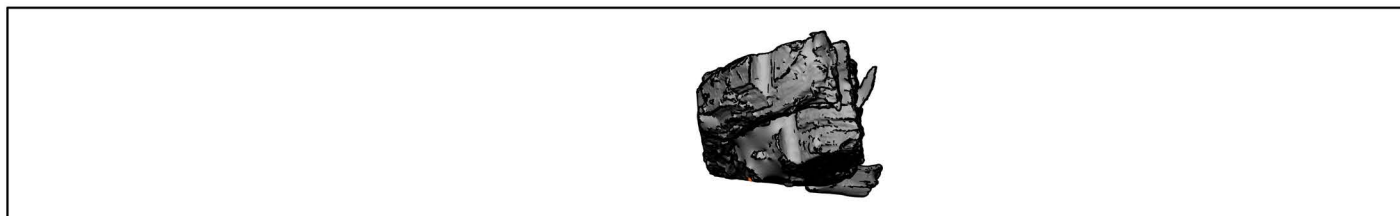
Side view



Outboard view



Front view



0 0.5 1m

Legend:

- ⊙ Trenails and trenail holes / wedged trenails
- Toolmarks
- ▨ Concretion
- Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5011	Timber ID:	011
Timber type:	frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	022	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



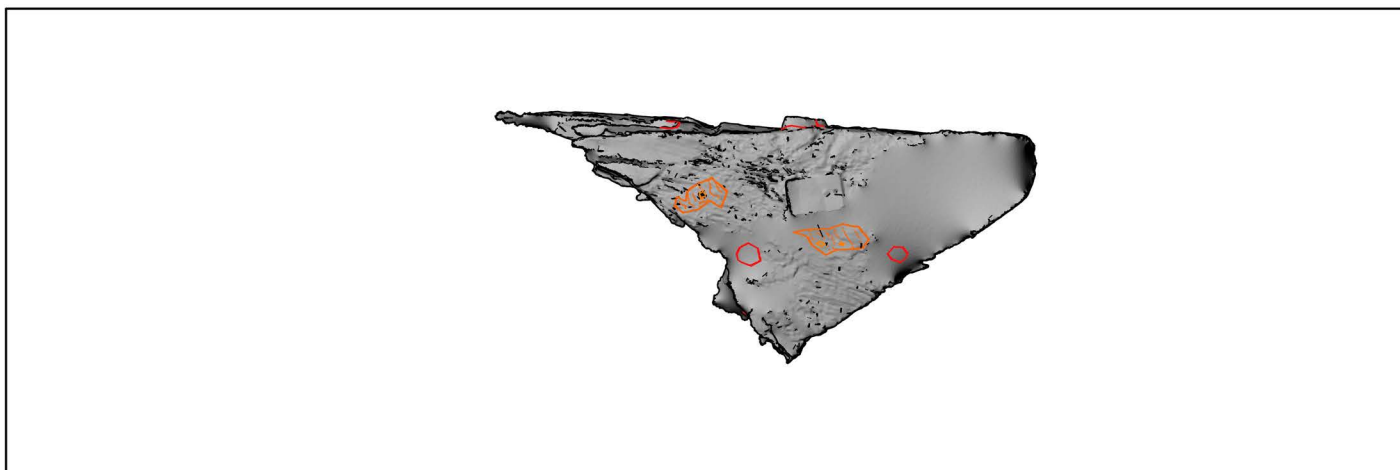
Front view



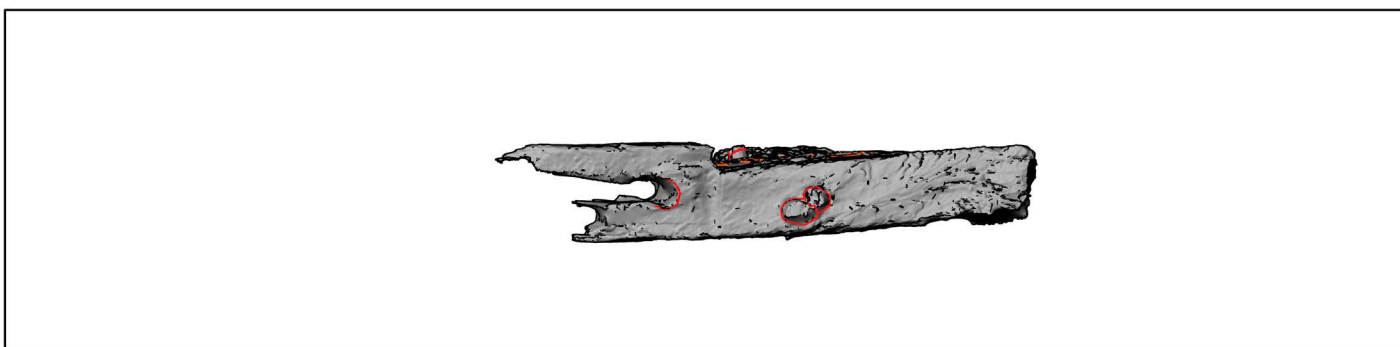
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5011	Timber ID:	011
Timber type:	frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	021	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

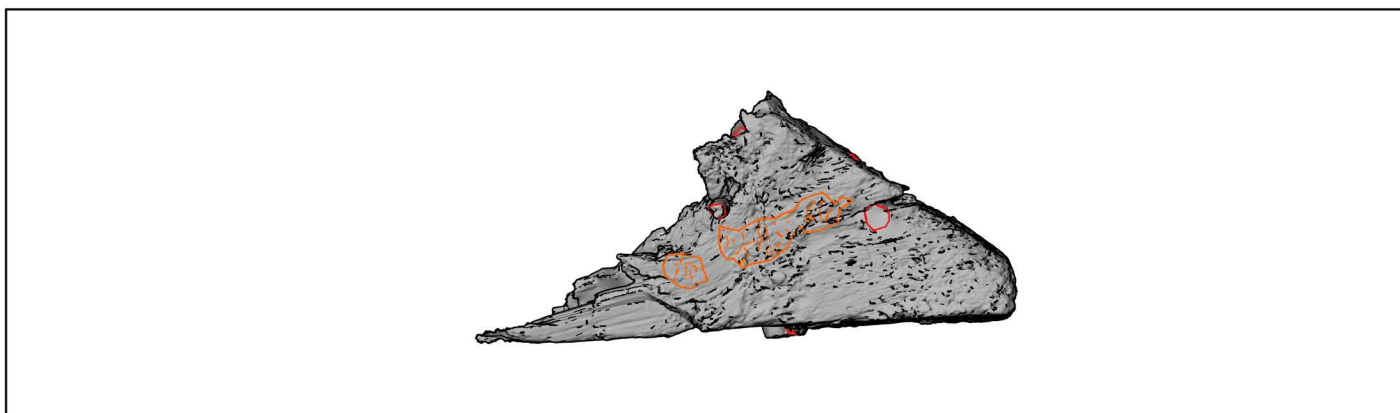
Top view



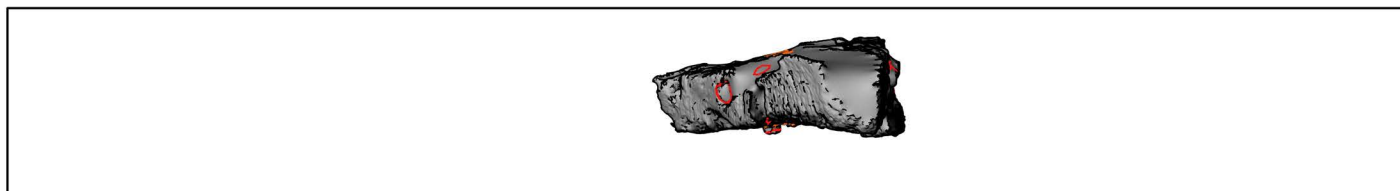
Side view



Bottom view



Front view



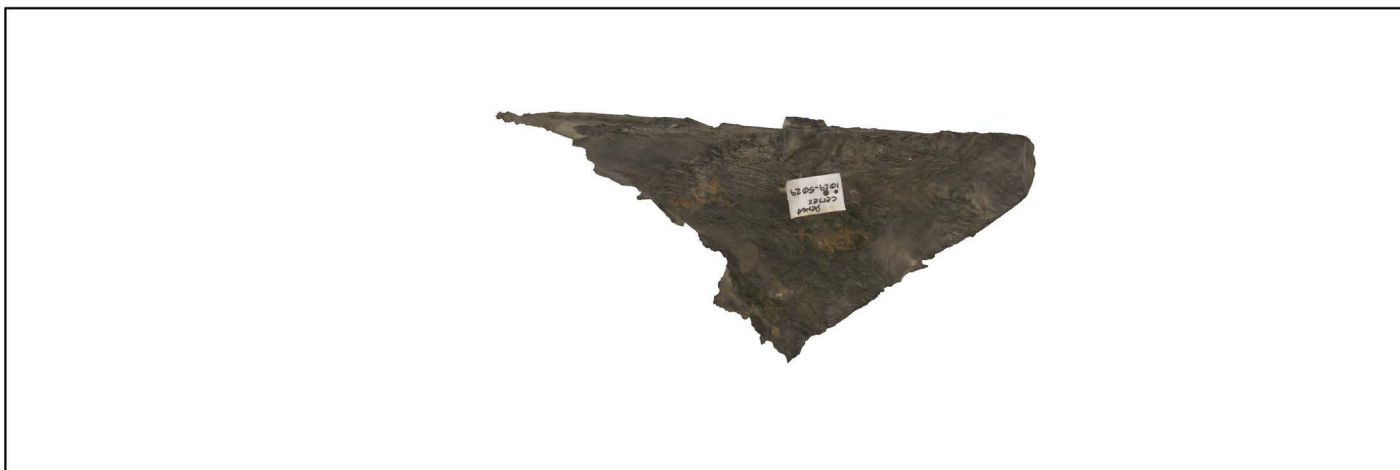
0 0.5 1m

Legend:

- Trenails and trenail holes / wedged trenails
- ▨ Concretion
- Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5029	Timber ID:	012
Timber type:	not identified	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	023	
Scale:	1:10	Date:	01/03/2022	Made by:	Paolo Croce	

Top view



Side view



Bottom view



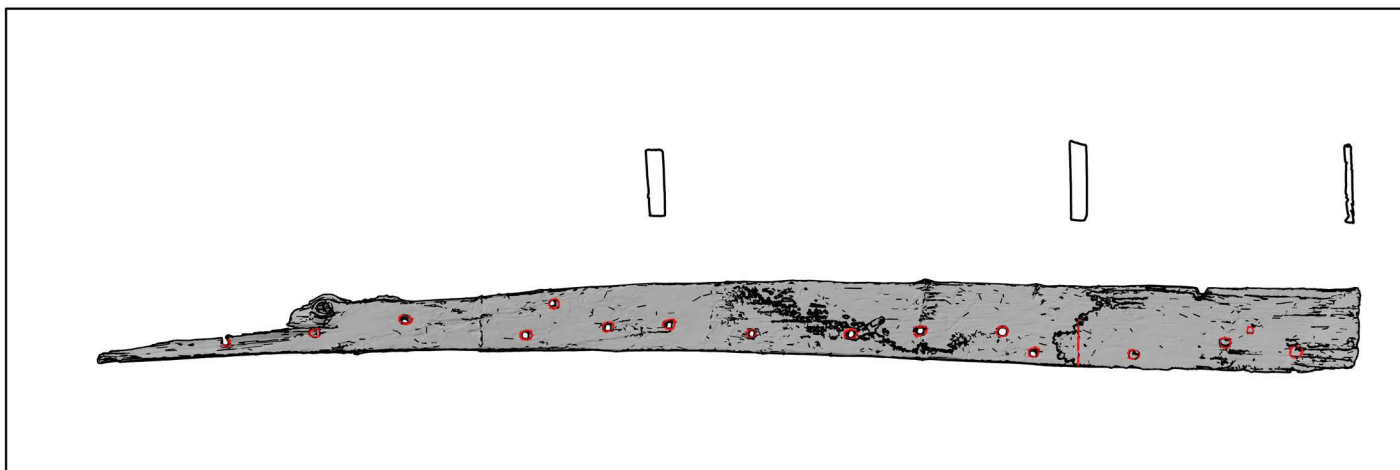
Front view



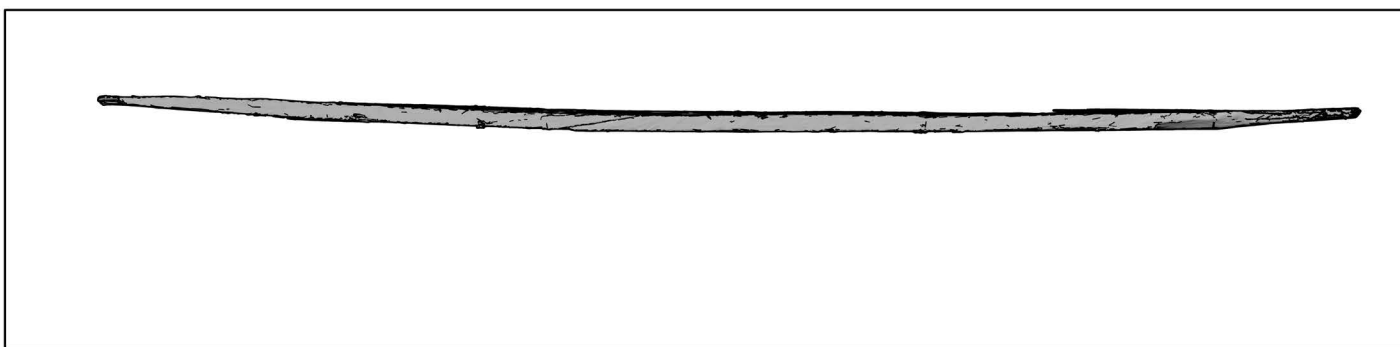
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5029	Timber ID:	012
Timber type:	not identified	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	024	
Scale:	1:10	Date:	01/03/2022	Made by:	Paolo Croce	

Top view



Side view



Bottom view



Front view



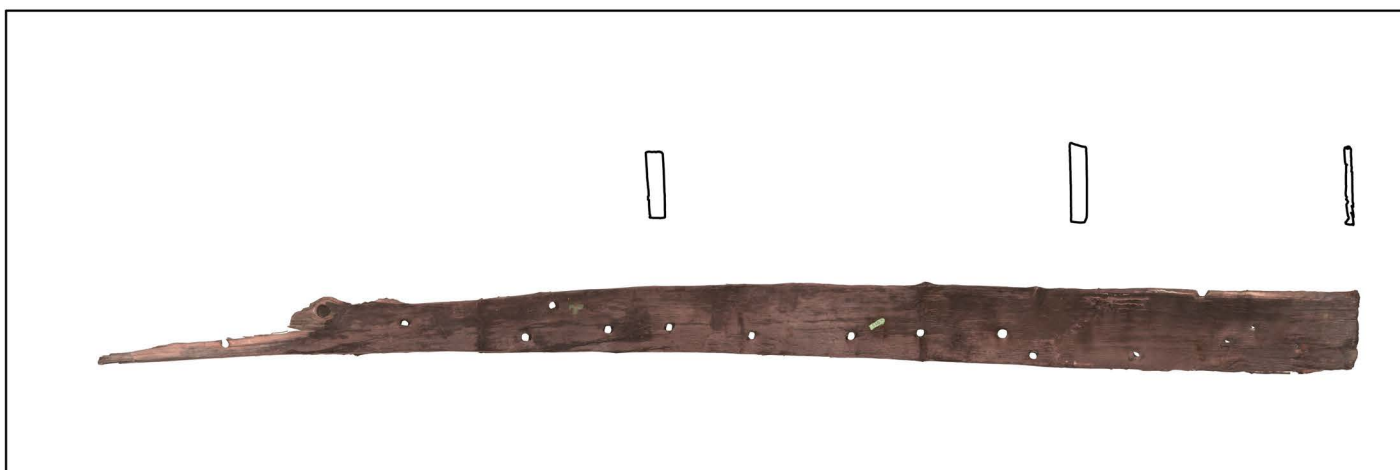
0 0.5m 1m

Legend:

●○ Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	013
Timber type:	ceiling plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	025	
Scale:	1:25	Date:	22/02/2022	Made by:	Paolo Croce	

Top view



Side view



Bottom view



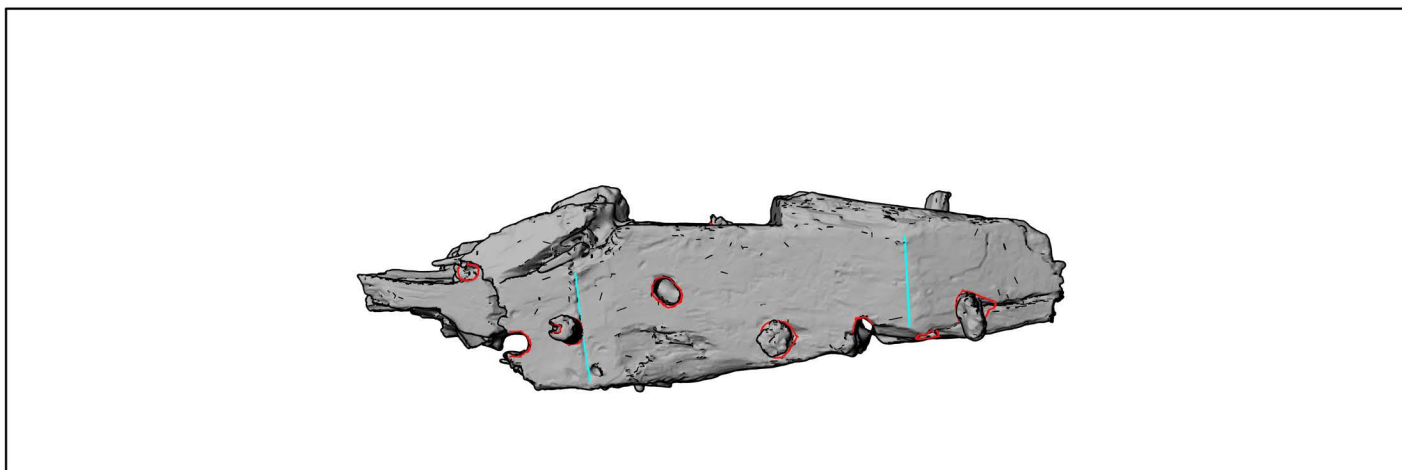
Front view



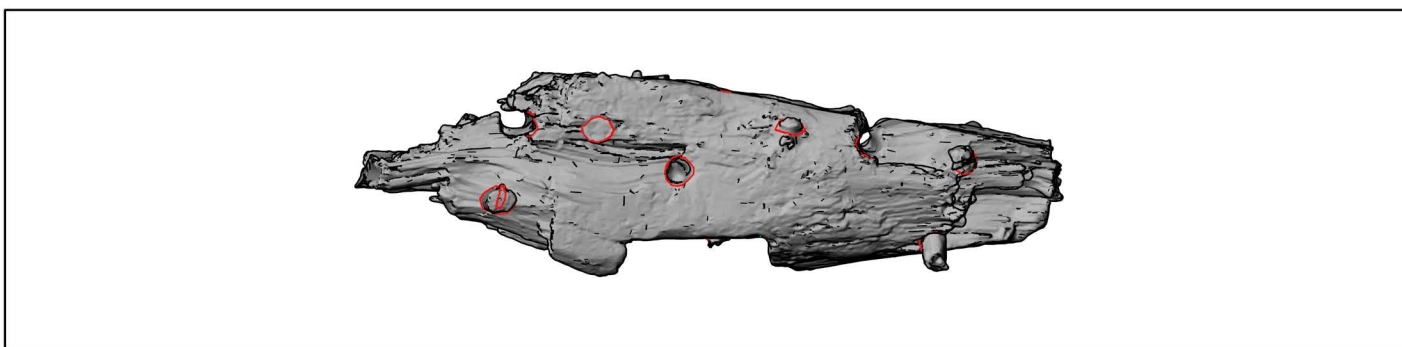
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	013
Timber type:	ceiling plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	026	
Scale:	1:25	Date:	22/02/2022	Made by:	Paolo Croce	

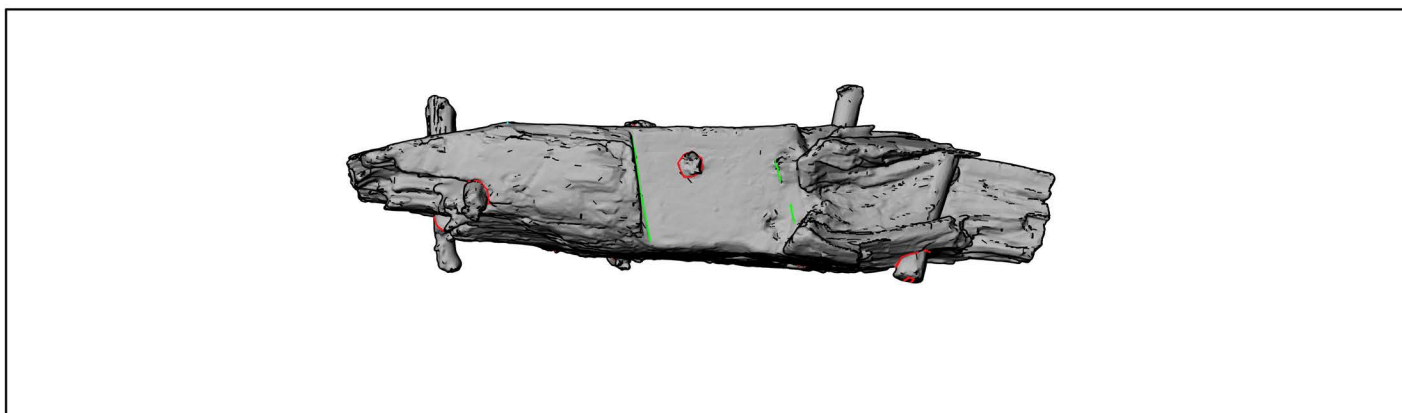
Inboard view



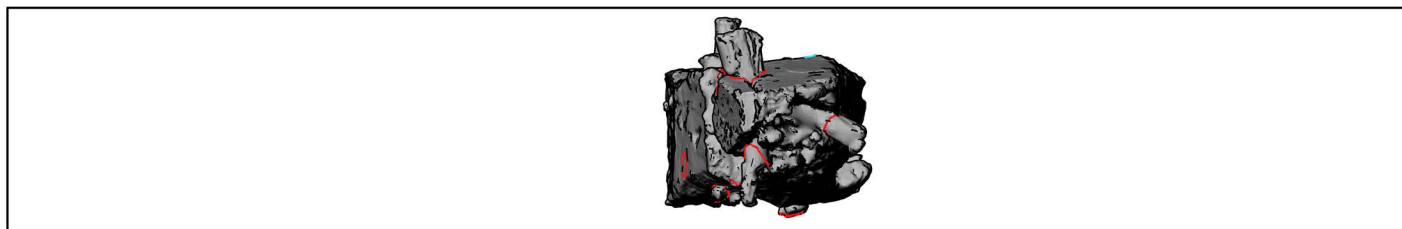
Outboard view



Fore/aft view



Side view



0 0.5 1m

Legend:

⊙ Trenails and trenail holes / wedged trenails

— Toolmarks

— Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	014
Timber type:	frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	027	
Scale:	1:10	Date:	01/07/2022	Made by:	Paolo Croce	

Inboard view



Outboard view



Fore/aft view



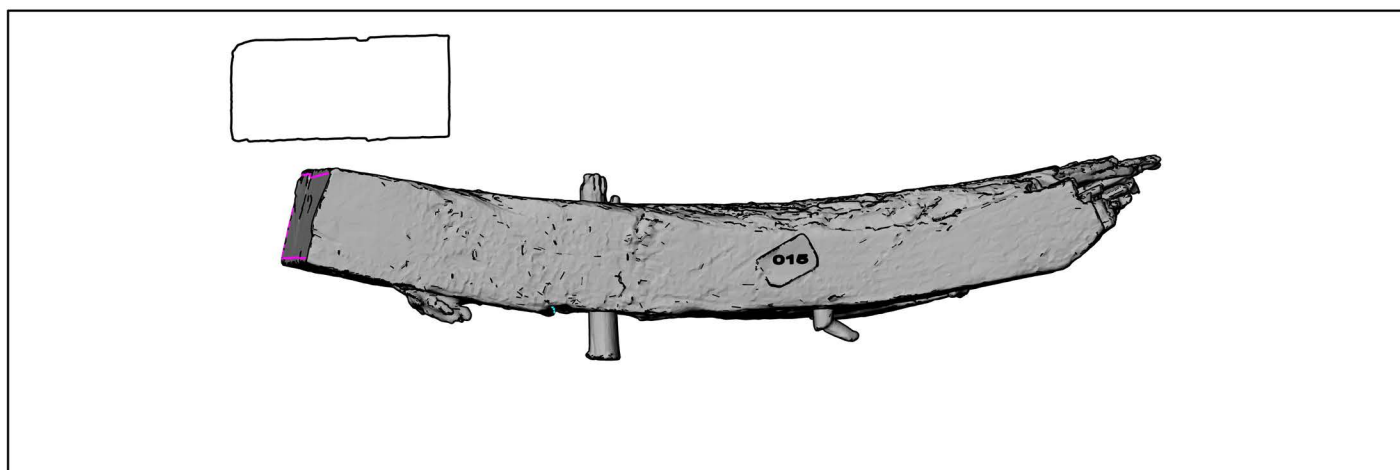
Side view



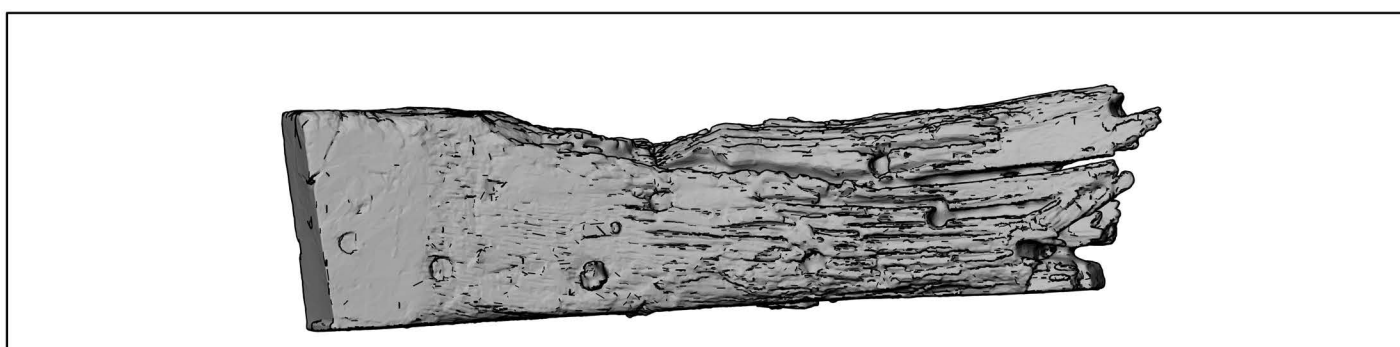
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	014
Timber type:	frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	028	
Scale:	1:10	Date:	01/07/2022	Made by:	Paolo Croce	

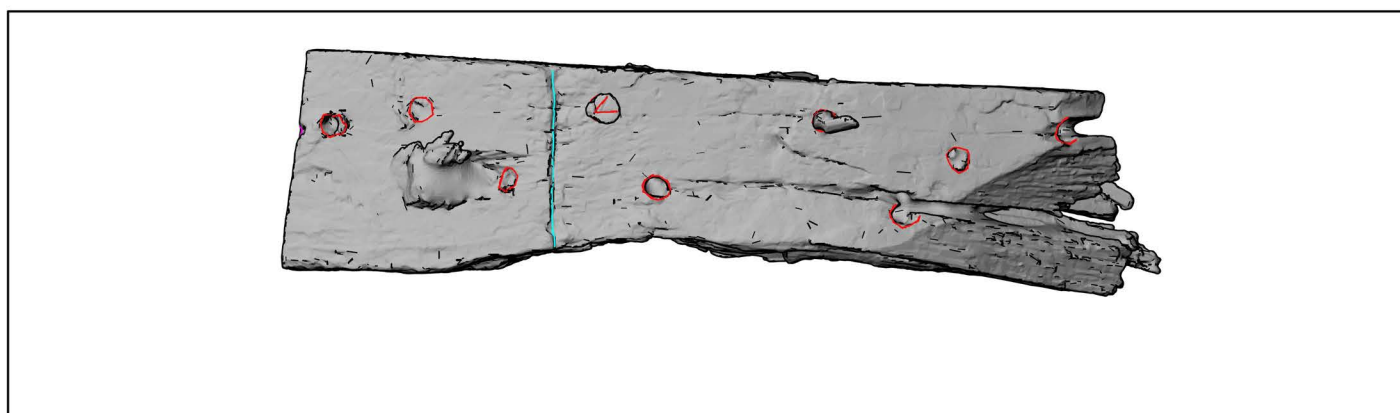
Fore and aft view



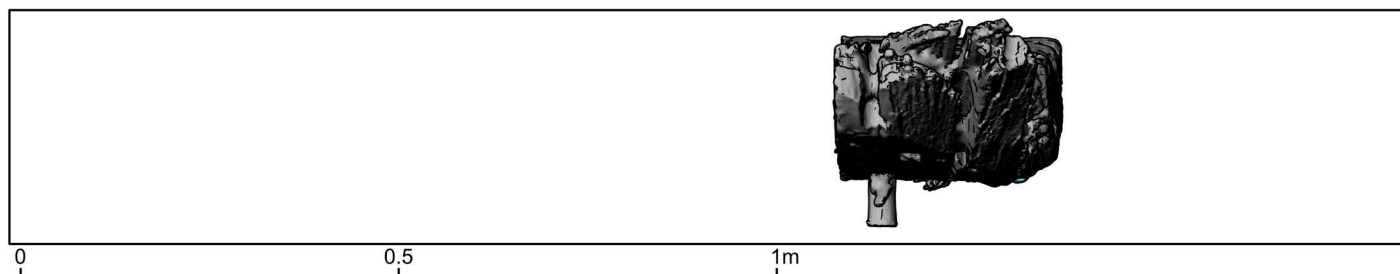
Inboard view



Outboard view



Side view



0 0.5 1m

Legend:

⊙ Trenails and trenail holes / wedged trenails

█ Dendrosample cut

— Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5009	Timber ID:	015
Timber type:	frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	030	
Scale:	1:10	Date:	01/03/2022	Made by:	Paolo Croce	

Fore and aft view



Inboard view



Outboard view



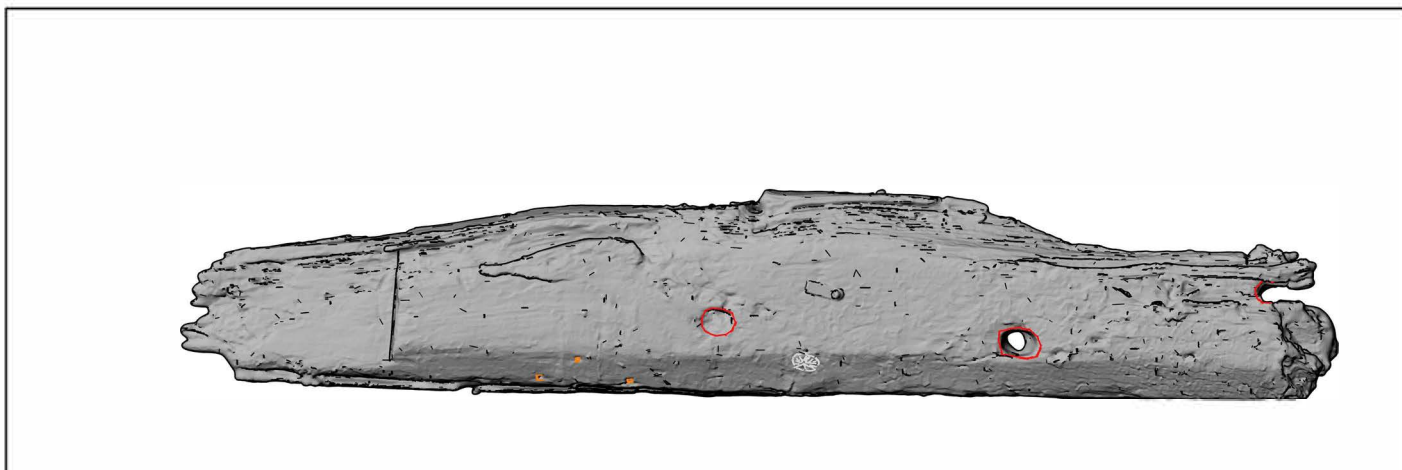
Side view



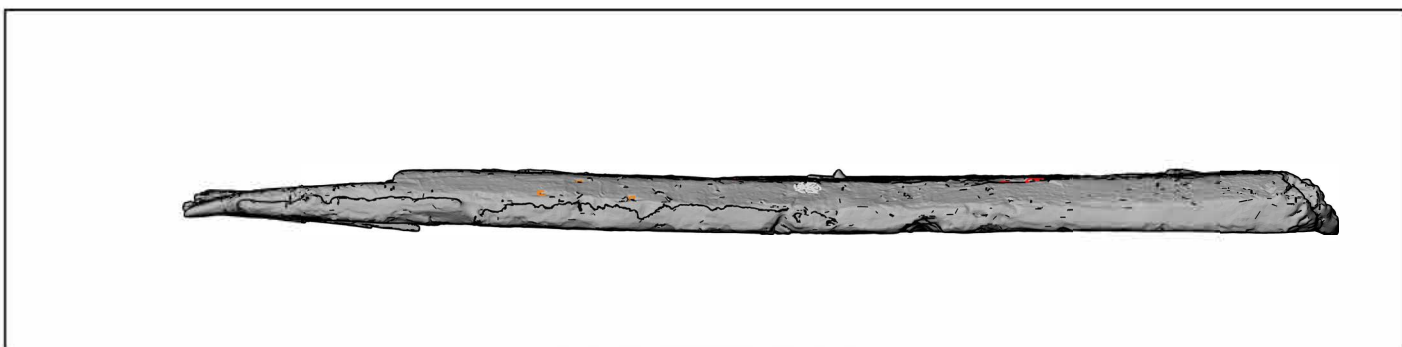
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5009	Timber ID:	015
Timber type:	frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	030	
Scale:	1:10	Date:	01/03/2022	Made by:	Paolo Croce	

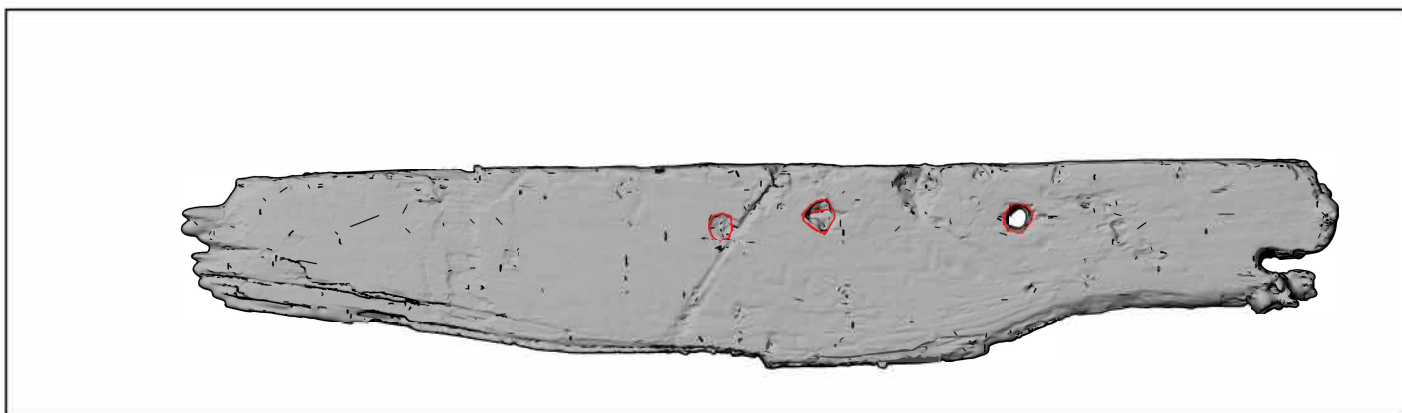
Top view



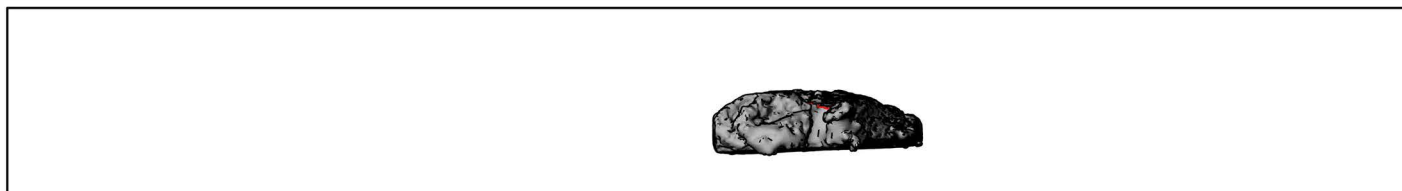
Side view



Bottom view



Front view



0 0.5 1m

Legend:

⊙ Trenails and trenail holes / wedged trenails

◻ Iron nail holes

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5022	Timber ID:	016
Timber type:	poss. outer plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	031	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Top view



Side view



Bottom view



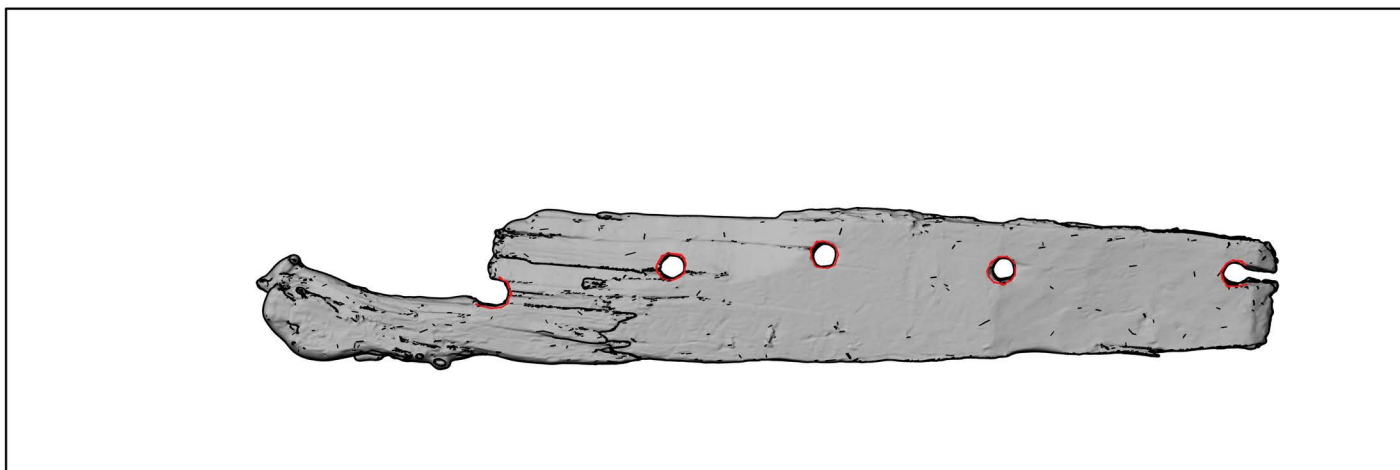
Front view



0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5022	Timber ID:	016
Timber type:	poss. outer plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	032	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

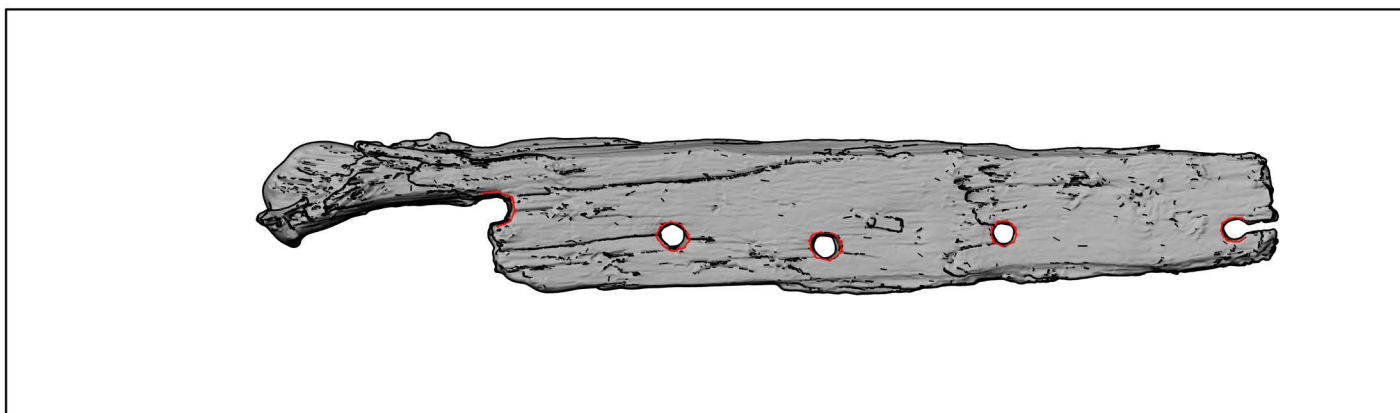
Inboard view



Side view



Outboard view



Front view



0 0.5 1m

Legend:

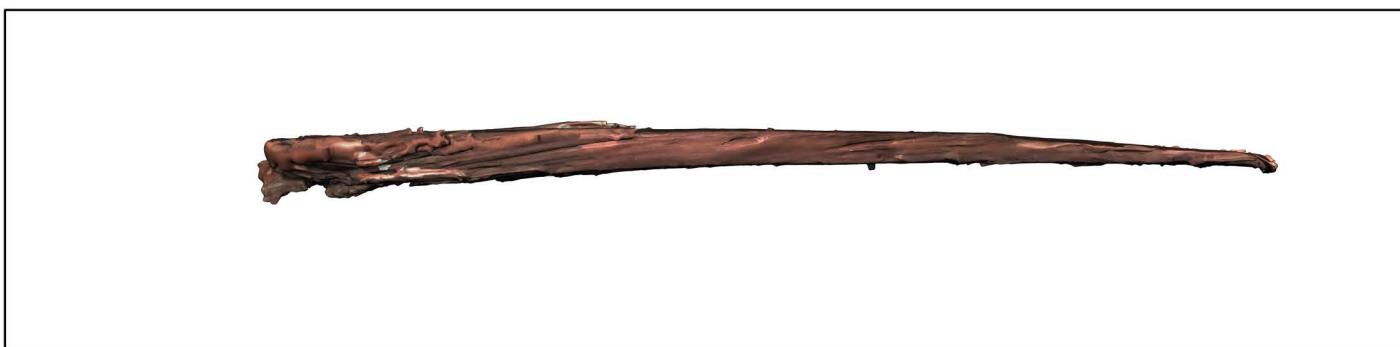
○● Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	017
Timber type:	poss. ceiling plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	033	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



Front view



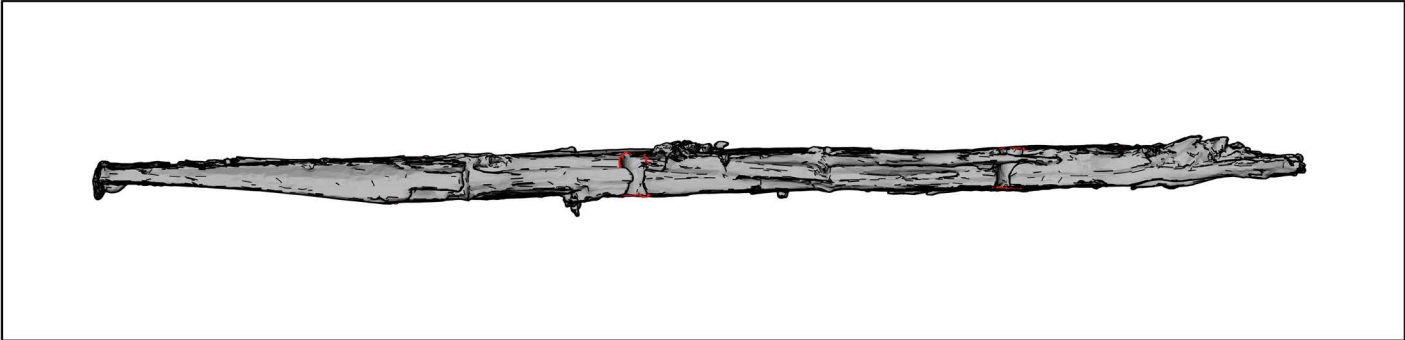
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	017
Timber type:	poss. ceiling plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	033	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

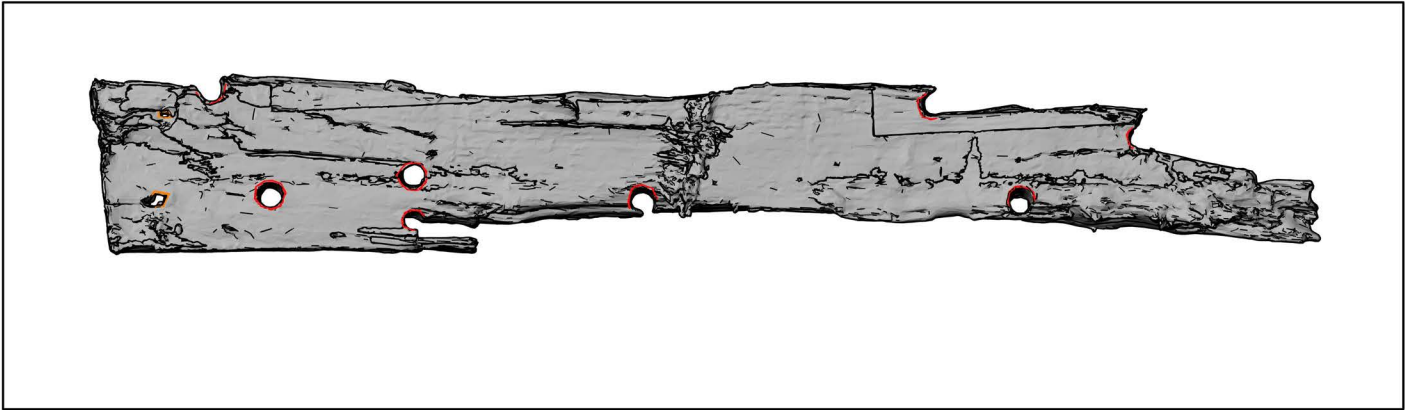
Inboard view



Side view



Outboard view



Front view



0 0.5 1m

Legend:

-  Trenails and trenail holes / wedged trenails
-  Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5021	Timber ID:	018
Timber type:	outer plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	035	
Scale:	1:10	Date:	02/03/203	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



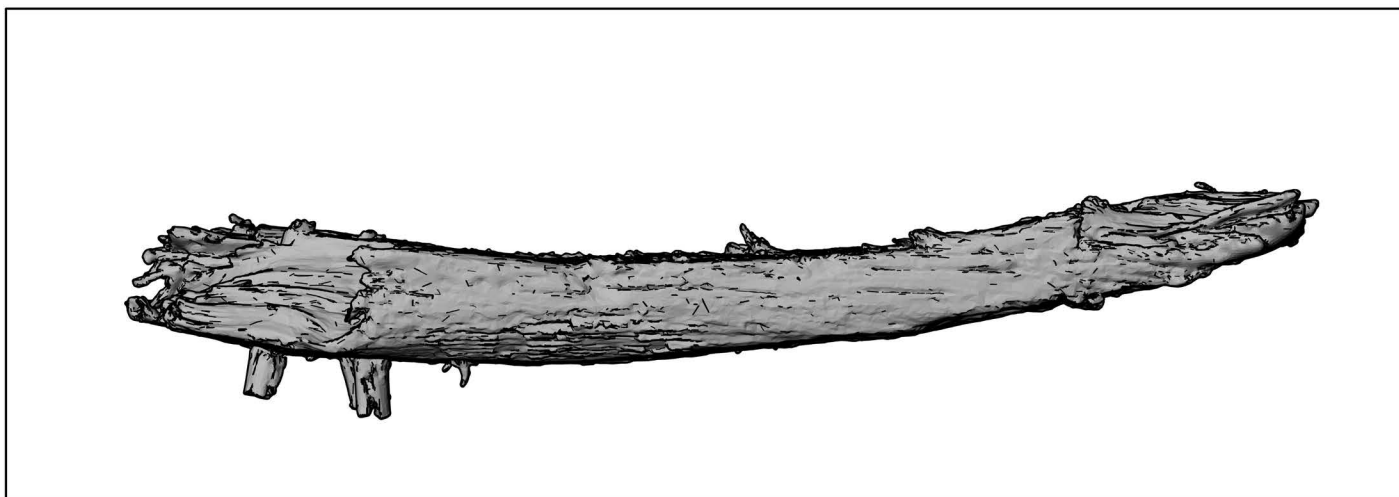
Front view



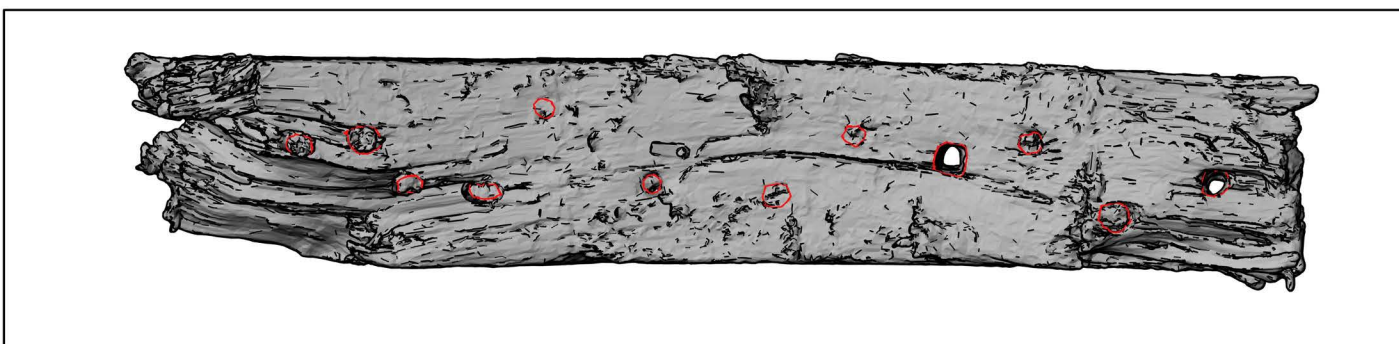
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5021	Timber ID:	018
Timber type:	outer plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	036	
Scale:	1:10	Date:	02/03/203	Made by:	Paolo Croce	

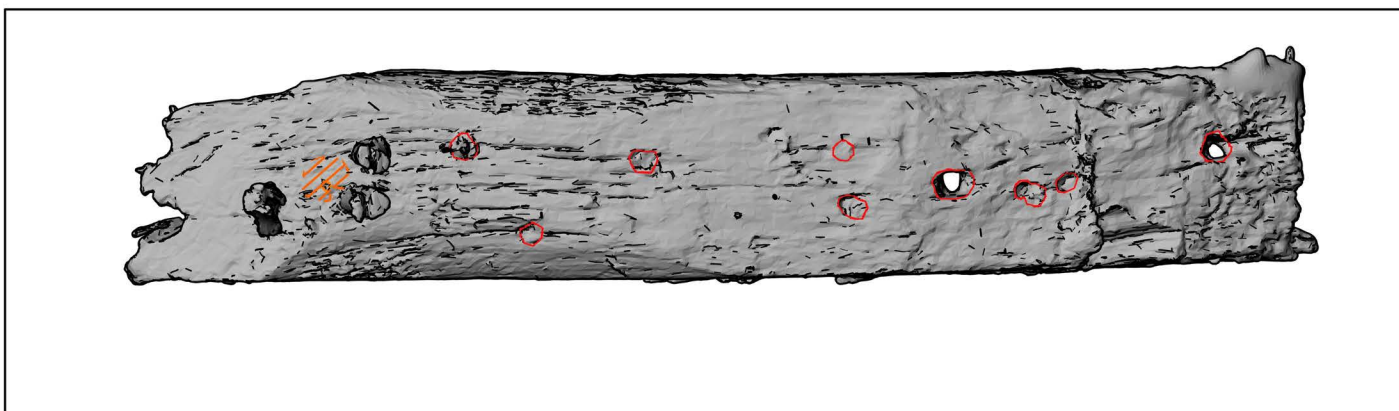
Fore/aft view



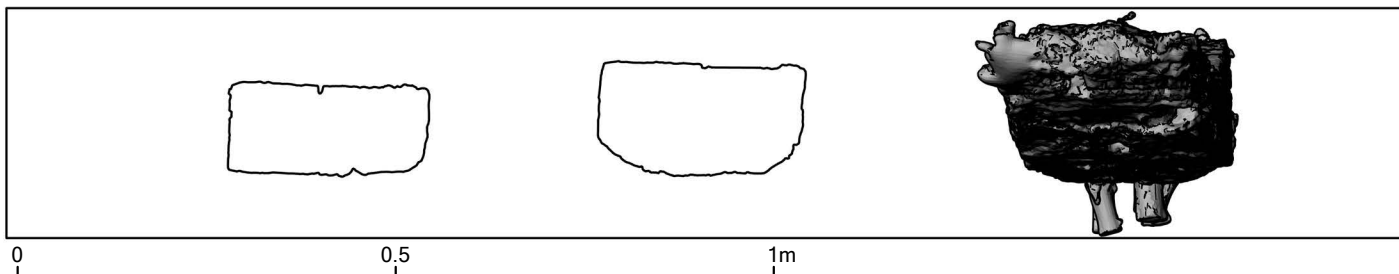
Inboard view



Outboard view



Front view

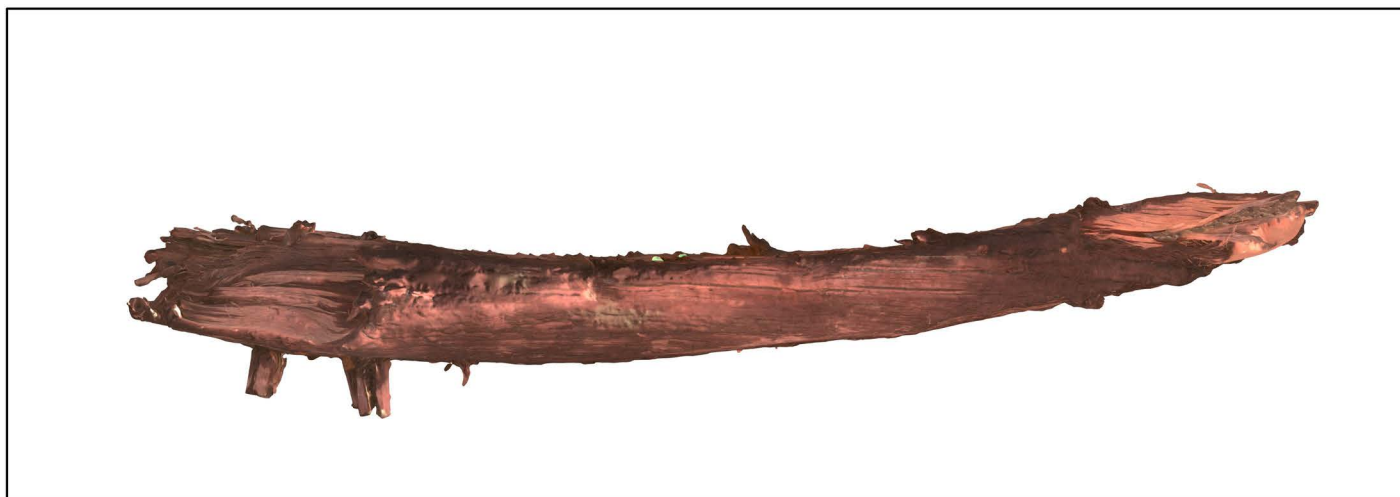


Legend:

- Trenails and trenail holes / wedged trenails
- ▨ Concretion
- Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5031	Timber ID:	019
Timber type:	Frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	037	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Fore/aft view



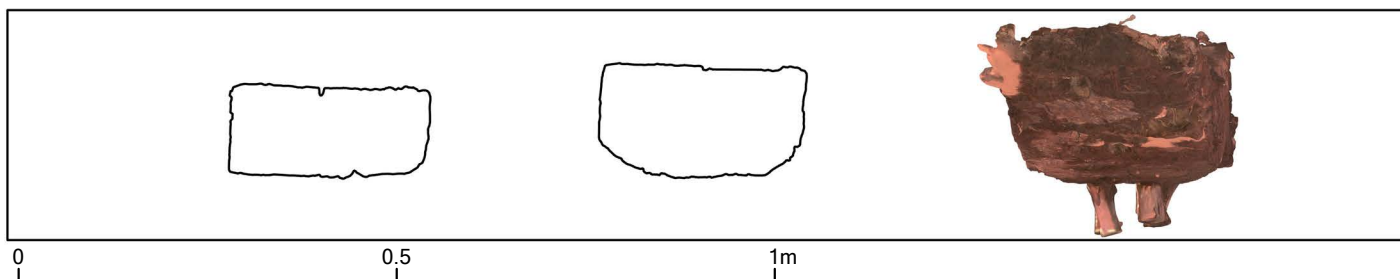
Inboard view



Outboard view

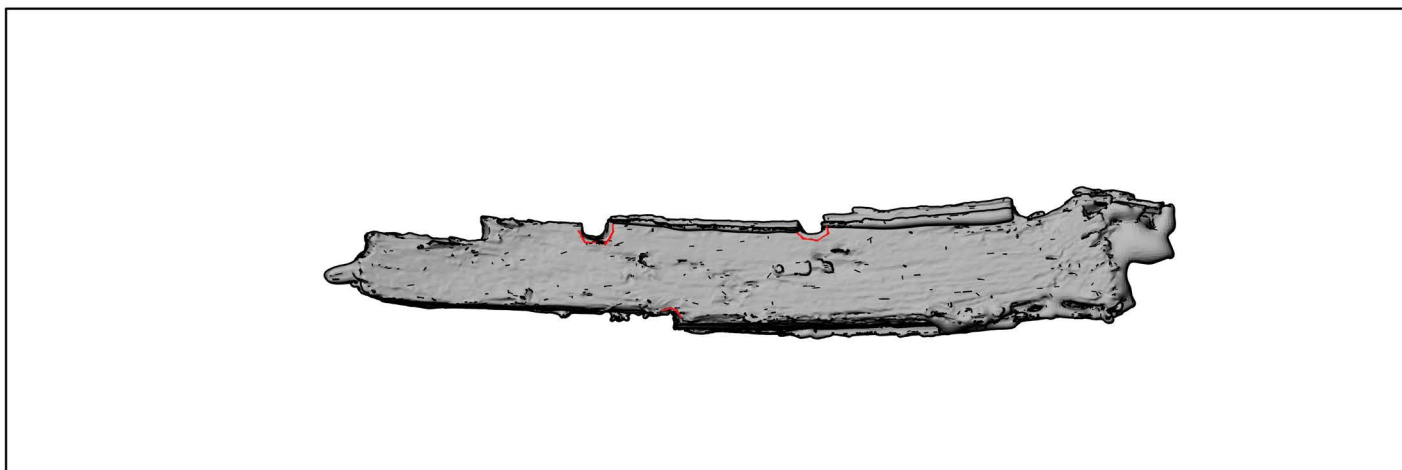


Front view

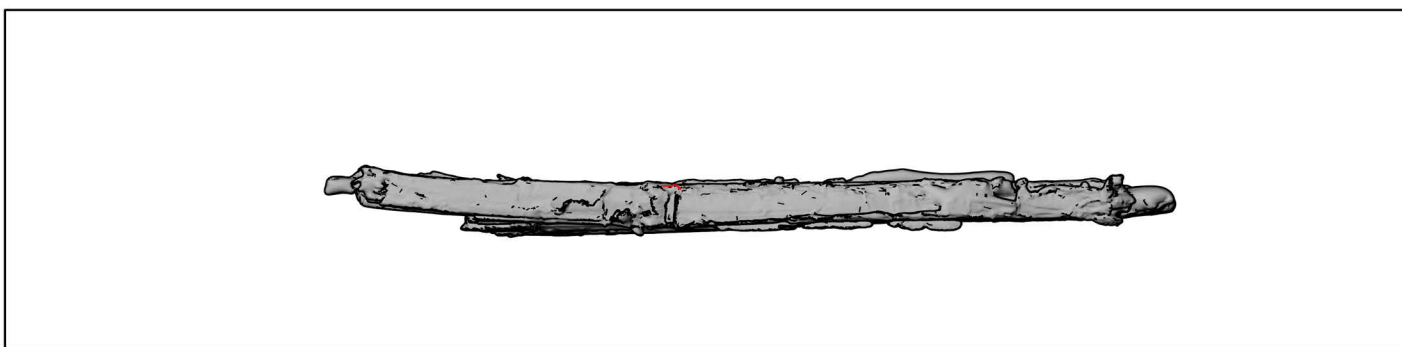


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5031	Timber ID:	019
Timber type:	Frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	040	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

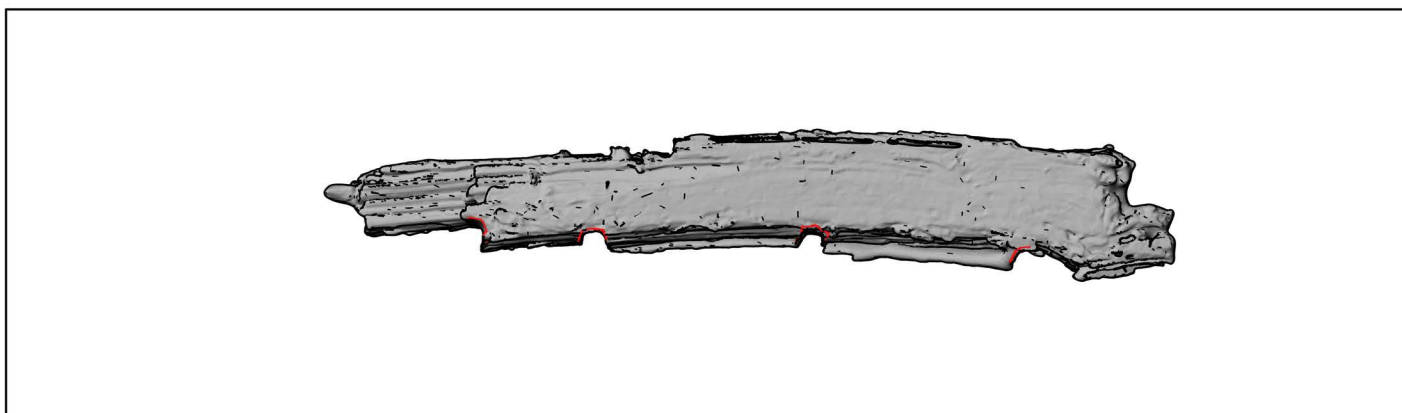
Top view



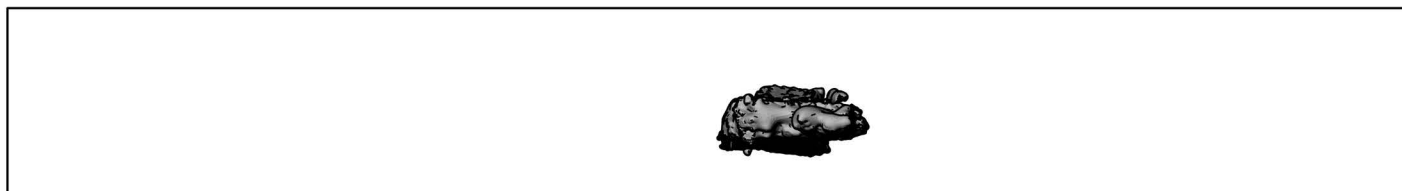
Side view



Bottom view



Front view



0 0.5 1m

Legend:

●○ Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	020
Timber type:	plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	040	
Scale:	1:10	Date:	02/03/2023	Made by:	Paolo Croce	

Top view



Side view



Bottom view



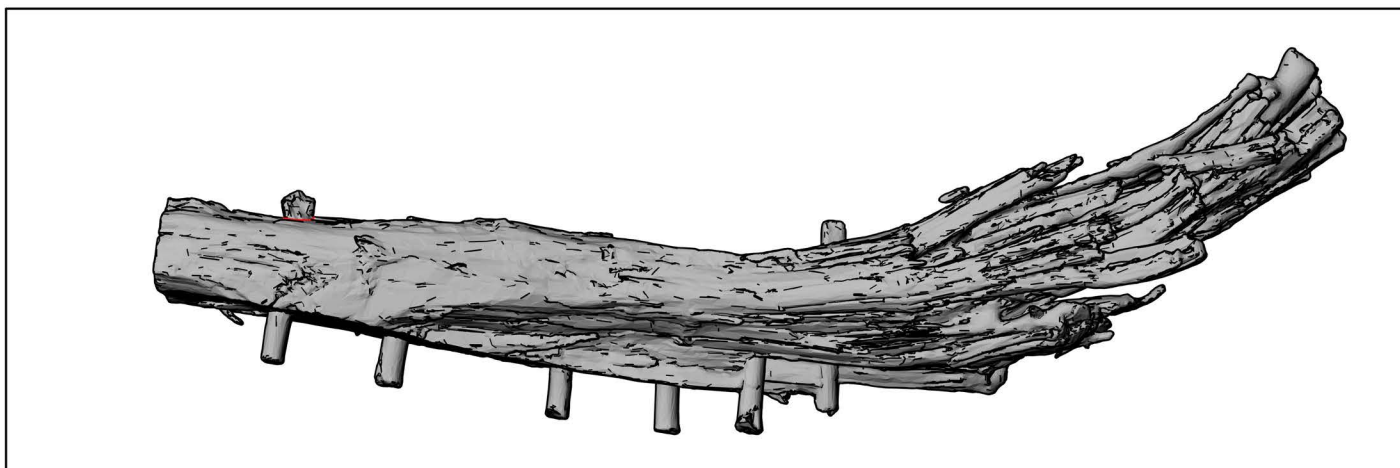
Front view



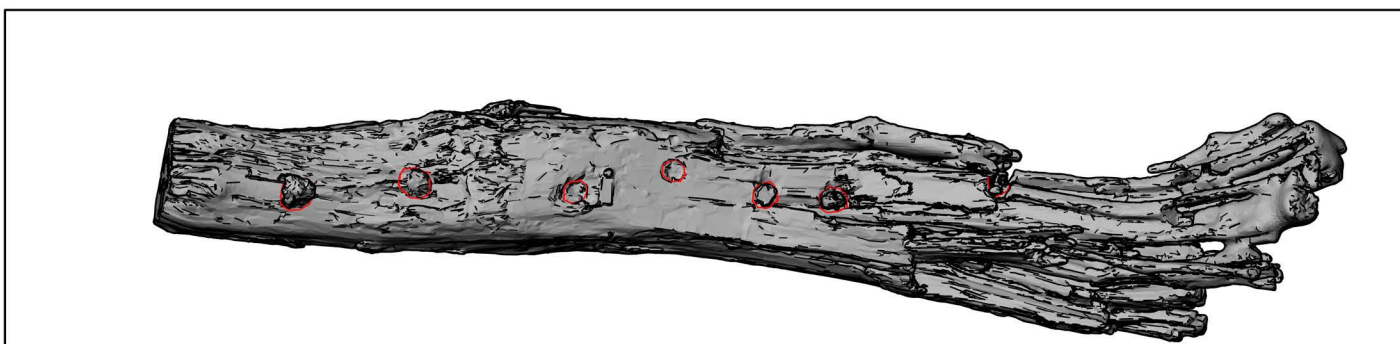
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	020
Timber type:	plank	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	041	
Scale:	1:10	Date:	02/03/2023	Made by:	Paolo Croce	

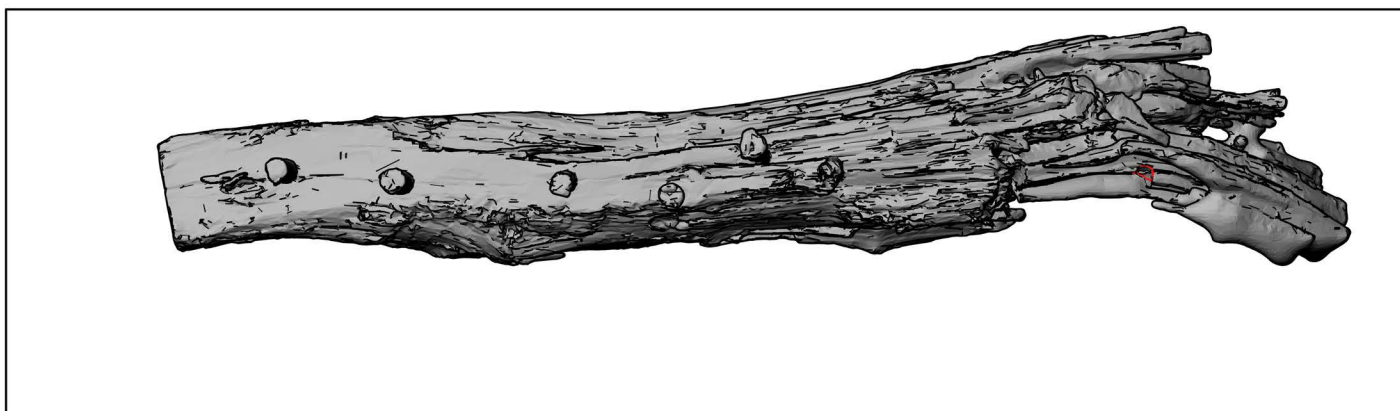
Fore/aft view



Inboard view



Outboard view



Side view



0 0.5 1m

Legend:

⊙ Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	021
Timber type:	poss. filling frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	042	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

Fore/aft view



Inboard view



Outboard view



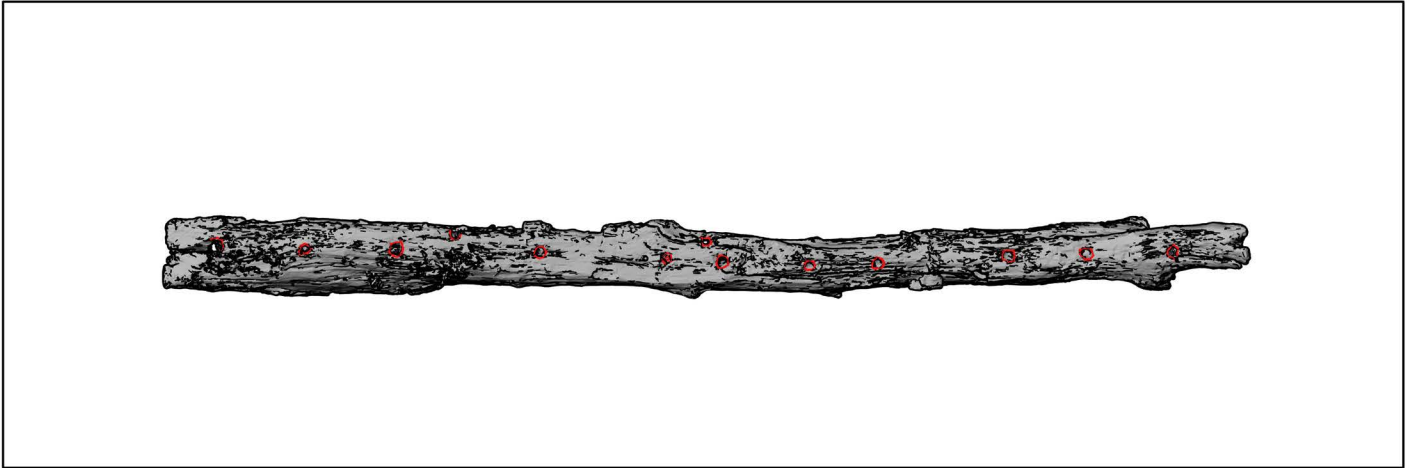
Side view



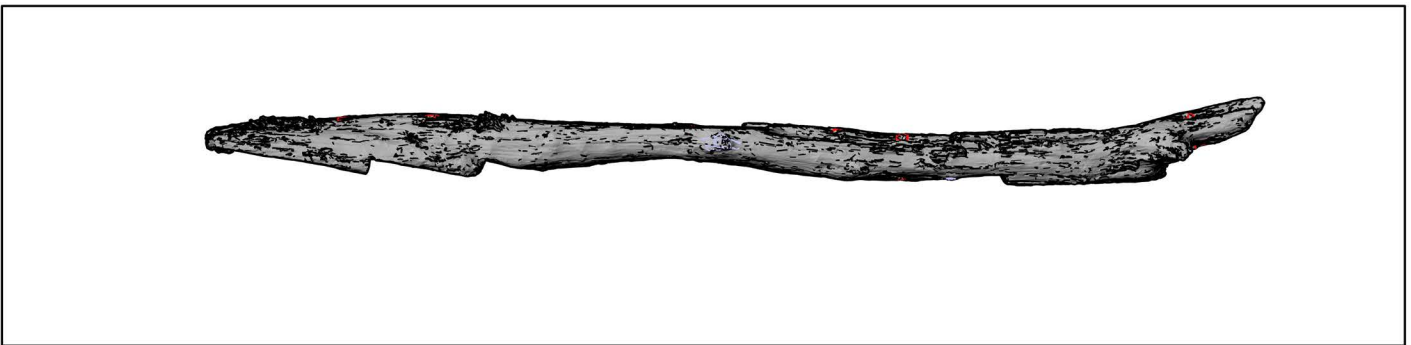
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	021
Timber type:	poss. filling frame	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	043	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

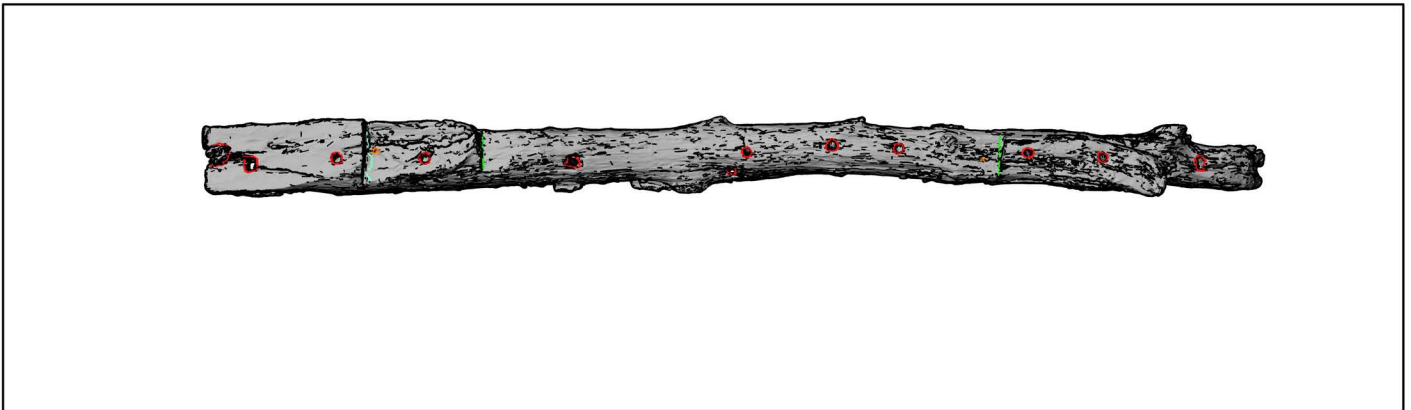
Top view



Side view



Bottom view



Top view



0 0.5m 1m

Legend:

● Trenails and trenail holes / wedged trenails

○ Iron nail holes / heads

— Axe marks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:		-		Previous number:		Timber ID:	022
Timber type:	unknown, poss. standard			Location:	Disarticulated timber		
Status:	Final				Drawing No.:	044	
Scale:	1:20	Date:	03/03/2023	Made by:	Paolo Croce		



Top view



Side view



Bottom view



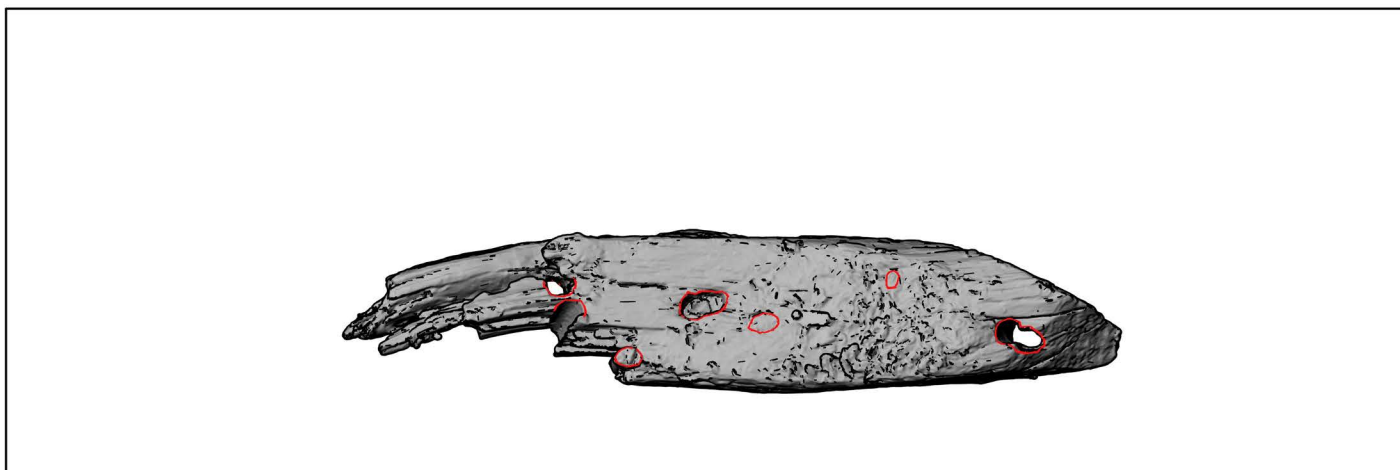
Top view



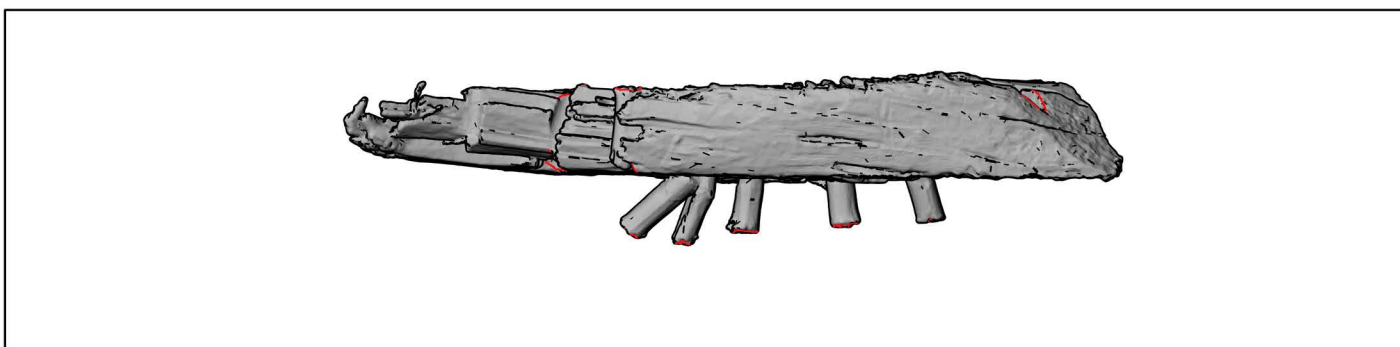
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:		Timber ID:	022
Timber type:	unknown, poss. standard		Location:	Disarticulated timber		
Status:	Final		Drawing No.:	045		
Scale:	1:20	Date:	03/03/2023	Made by:	Paolo Croce	

Inboard view



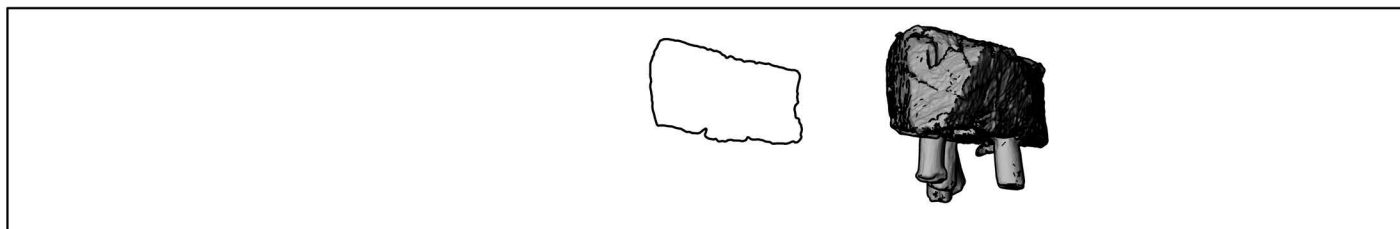
Side view



Outboard view



Front view



0 0.5 1m

Legend:

○● Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	023
Timber type:	poss. floor timber	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	046	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

Inboard view



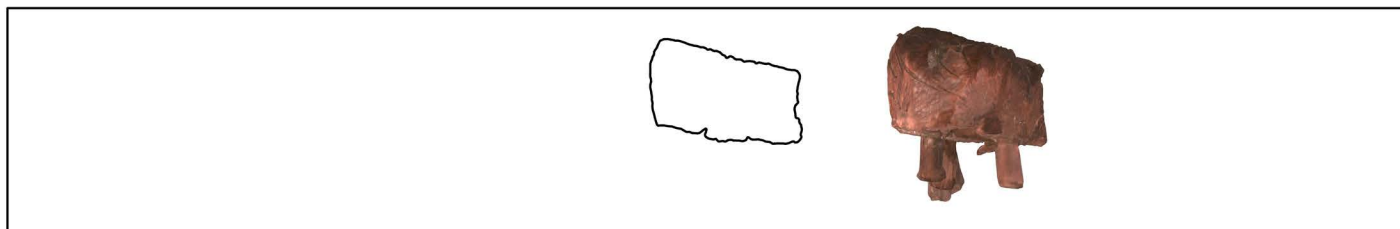
Side view



Outboard view



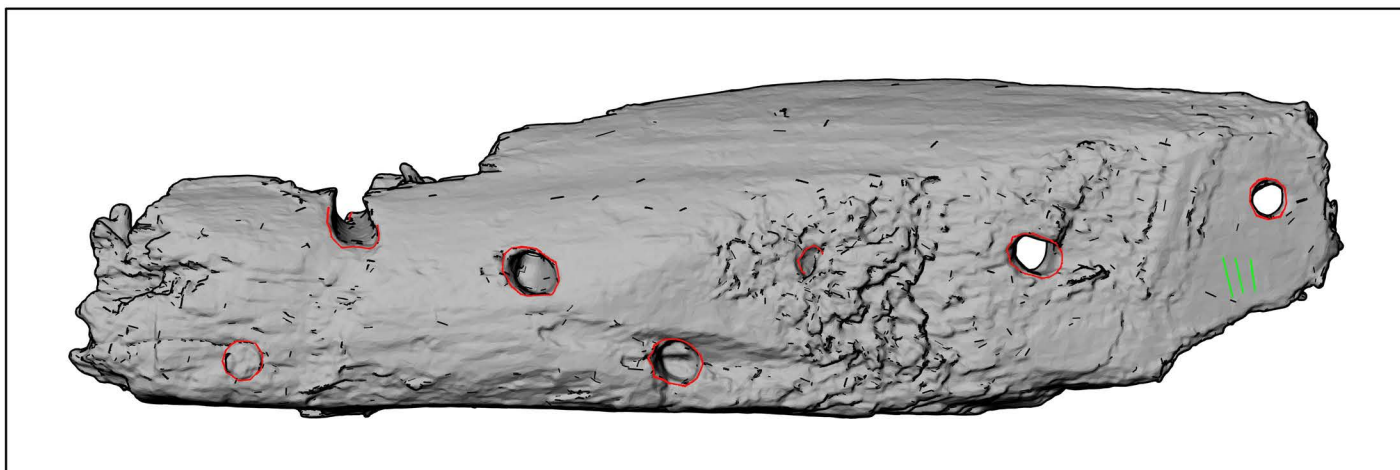
Front view



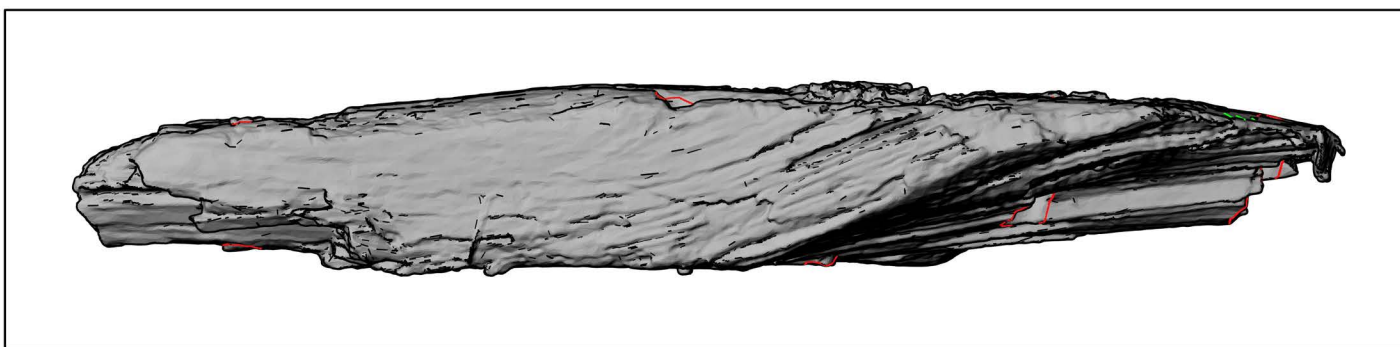
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	023
Timber type:	poss. floor timber	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	047	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

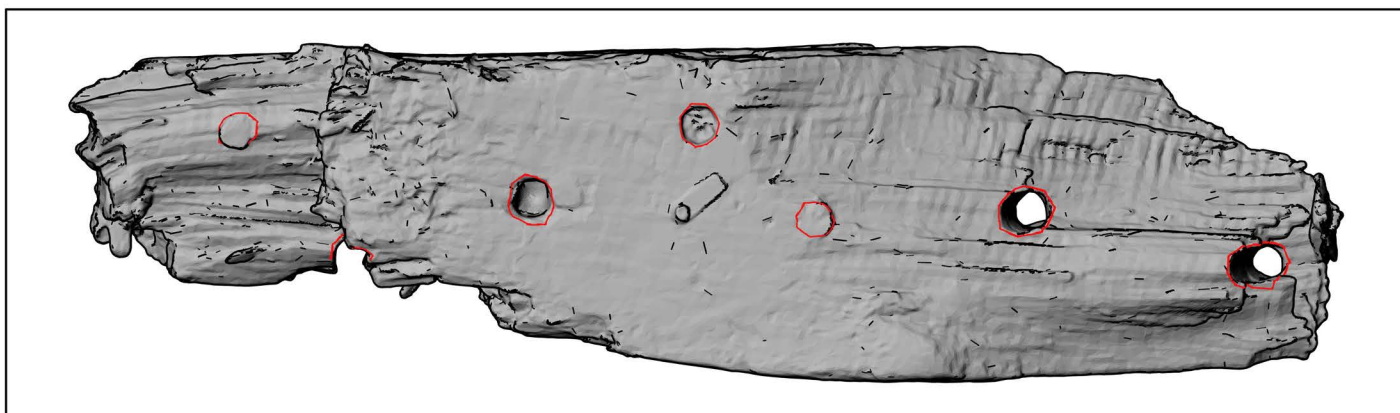
Inboard view



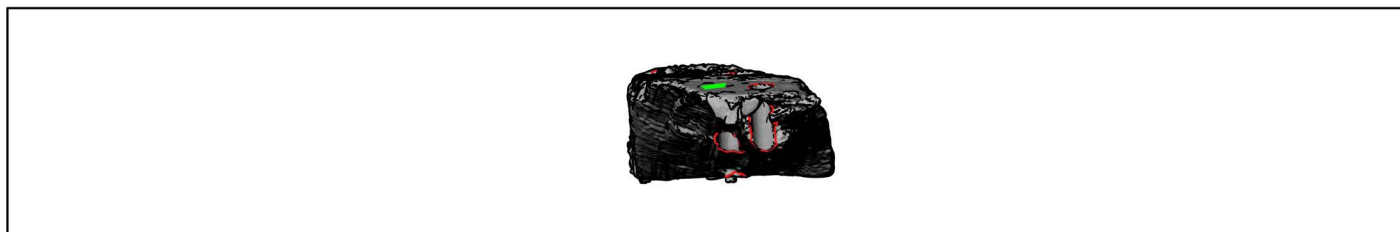
Fore/aft view



Outboard view



Front view



0 0.5 1m

Legend:

○● Trenails and trenail holes / wedged trenails

— Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	024
Timber type:	poss. frame timber	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	048	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

Inboard view



Fore/aft view



Outboard view



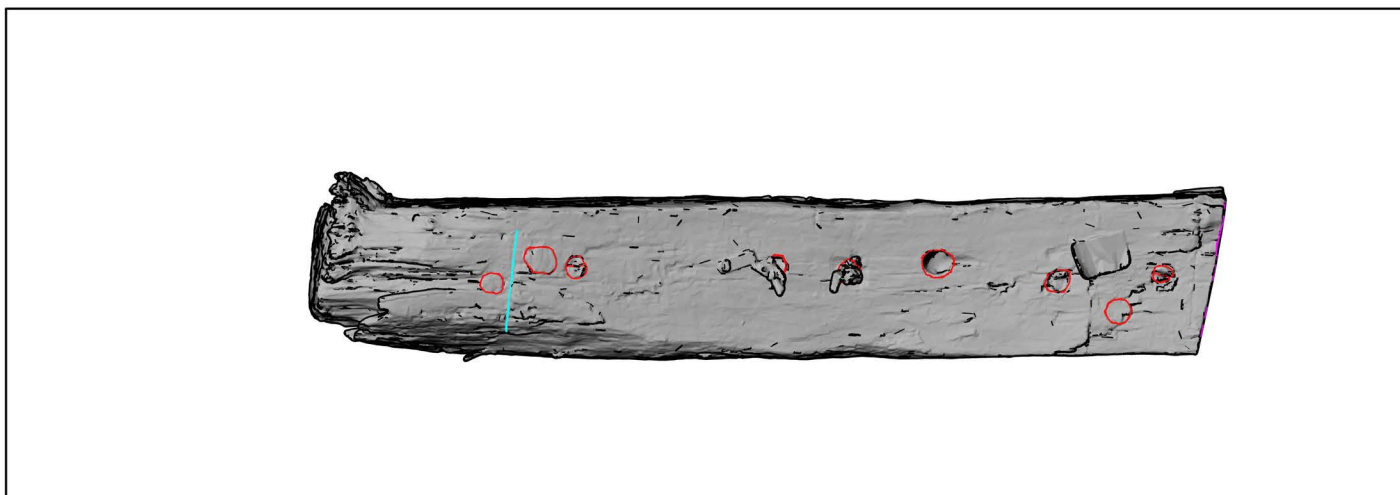
Front view



0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	024
Timber type:	poss. frame timber	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	049	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

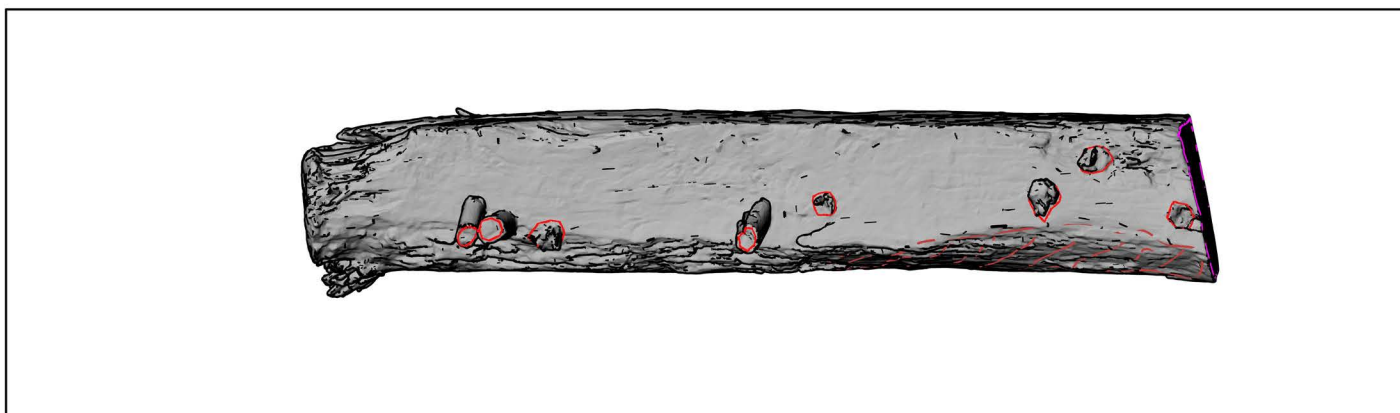
Inboard view



Fore/aft view



Outboard view



Front view



0 0.5 1m

Legend:

- Trenails and trenail holes / wedged trenails Sapwood / bark
- Dendrosample cut
- Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5026	Timber ID:	025
Timber type:	poss. frame timber	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	050	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

Inboard view



Fore/aft view



Outboard view



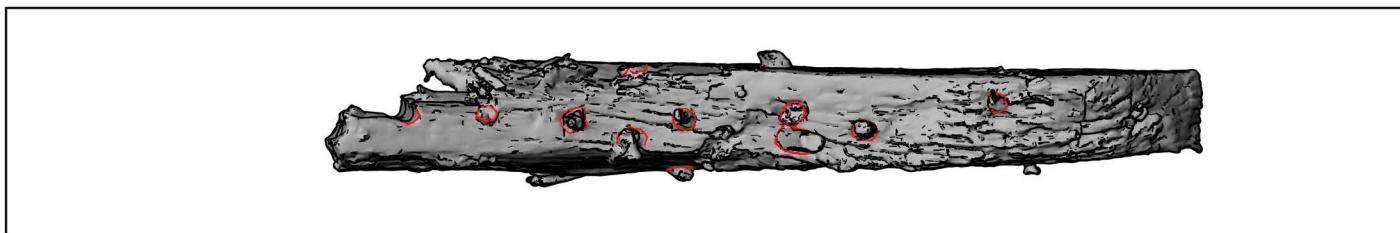
Front view



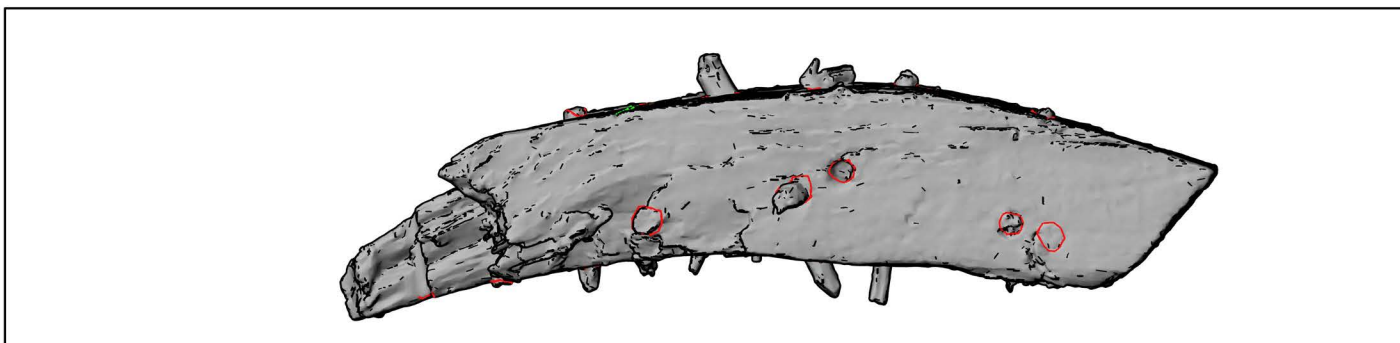
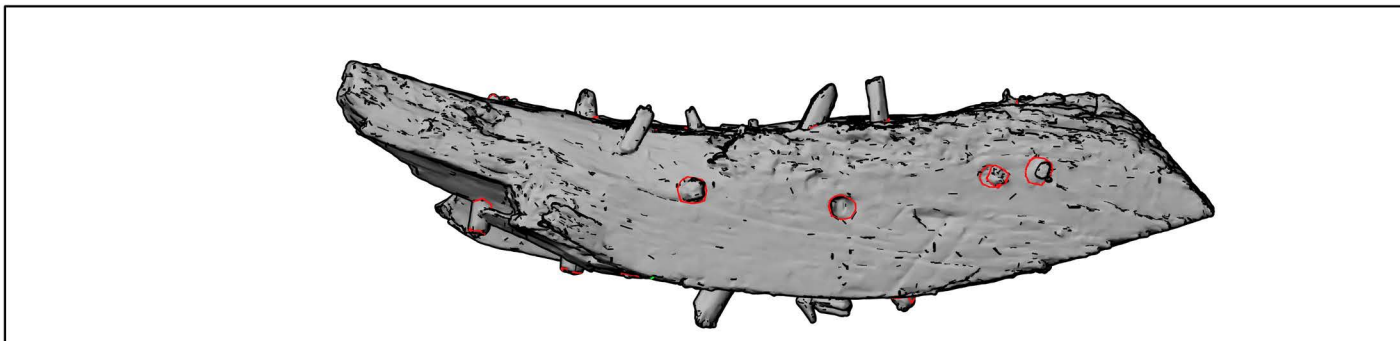
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5026	Timber ID:	025
Timber type:	poss. frame timber	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	051	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

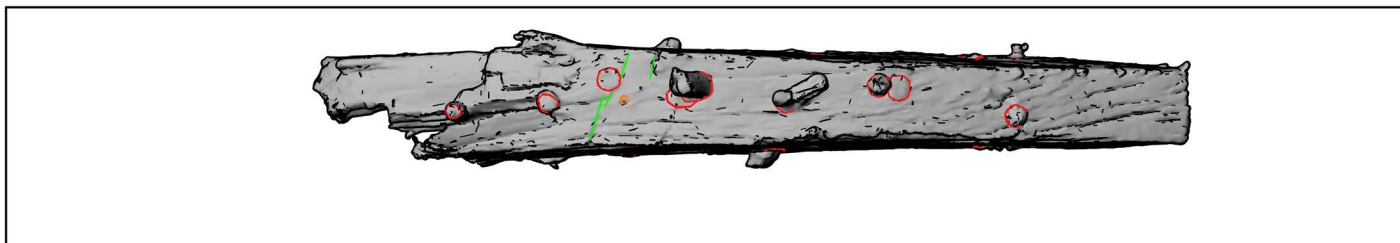
Inboard view



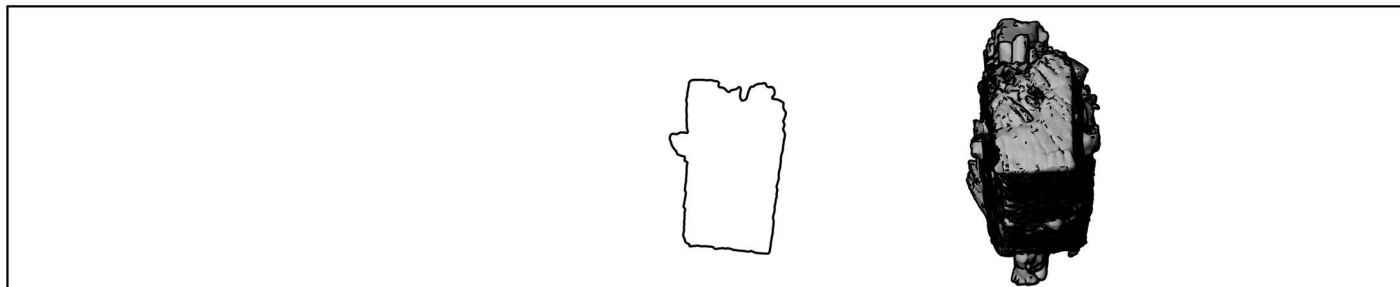
Moulded view



Outboard view



Side view



0 0.5 1m

Legend:

- Trenails and trenail holes / wedged trenails
- Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	026
Timber type:	poss. futtock	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	052	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

Inboard view



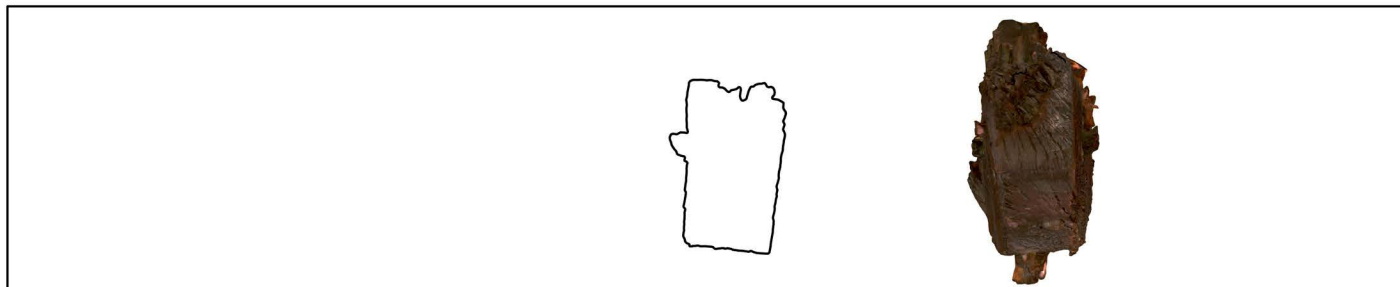
Moulded view



Outboard view



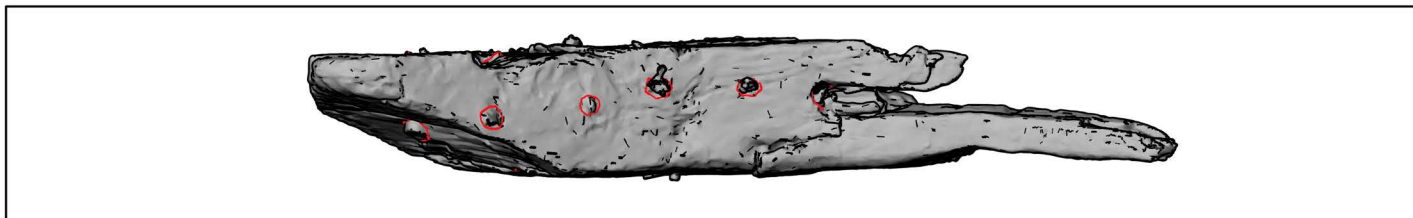
Side view



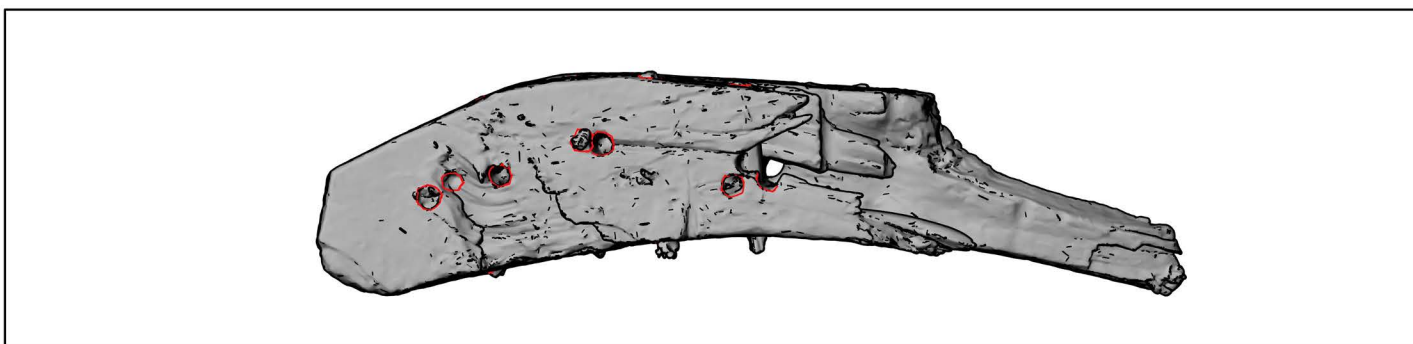
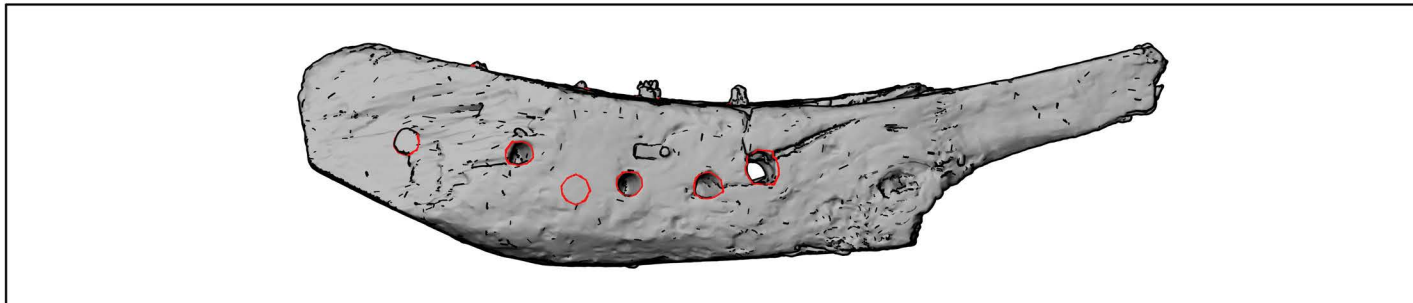
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	-	Timber ID:	026
Timber type:	poss. futtock	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	053	
Scale:	1:10	Date:	03/03/2023	Made by:	Paolo Croce	

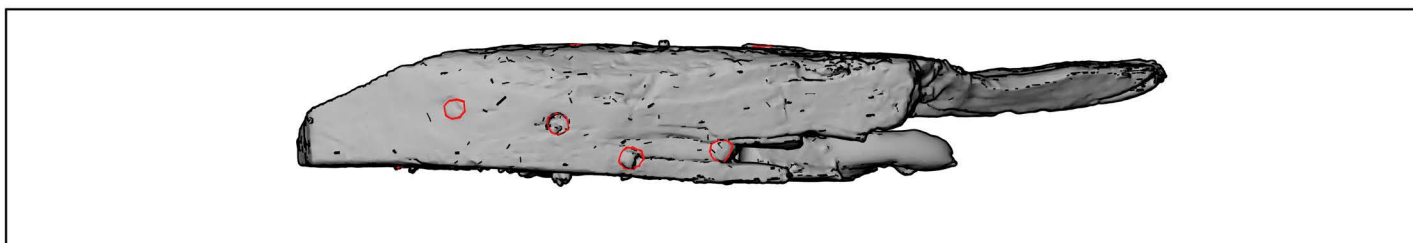
Inboard view



Moulded view



Outboard view



Side view



0 0.5 1m

Legend:

⊙ Treenails and treenail holes / wedged treenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-	Previous number:	-	Timber ID:	027	
Timber type:	frame timber	Location:	Disarticulated timber			
Status:	Final		Drawing No.:	055		
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Inboard view



Moulded view



Outboard view



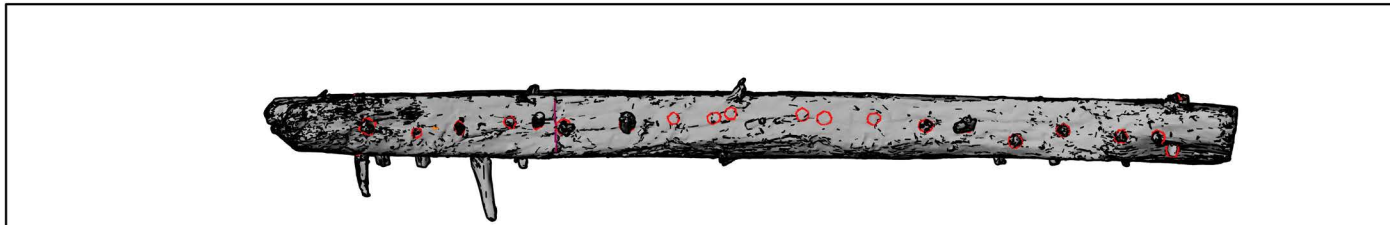
Side view



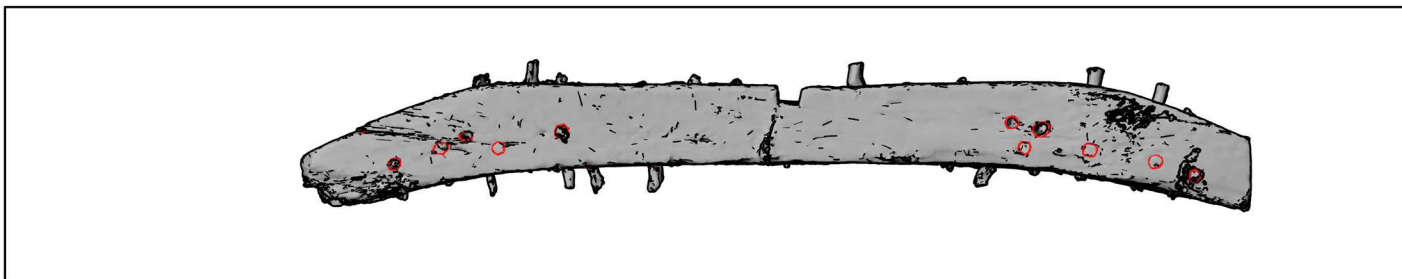
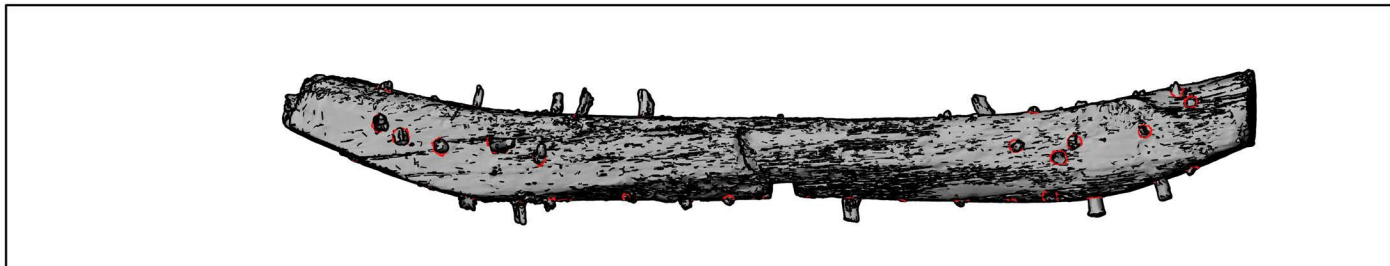
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck			Project No.:	280780
Section:	-	Previous number:	-	Timber ID:	027
Timber type:	frame timber	Location:	Disarticulated timber		
Status:	Final		Drawing No.:	055	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce

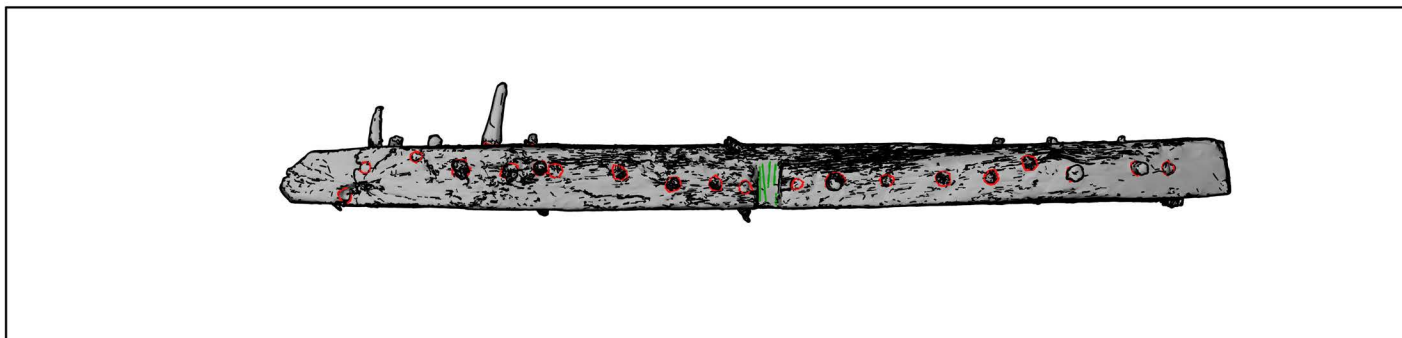
Inboard view



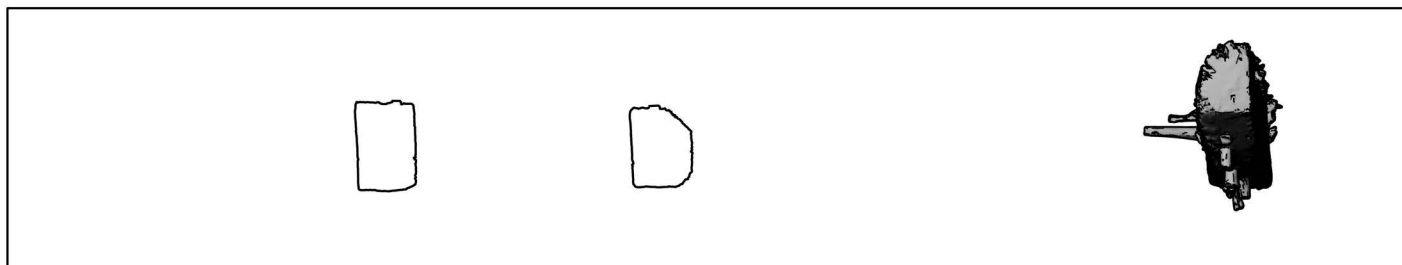
Moulded view



Outboard view



Side view



0 0.5m 1m

Legend:

●○ Trenails and trenail holes / wedged trenails

— Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-	Previous number:	-	Timber ID:	028	
Timber type:	poss. floor timber	Location:	Disarticulated timber			
Status:	Final			Drawing No.:	056	
Scale:	1:20	Date:	03/03/2023	Made by:	Paolo Croce	

Inboard view



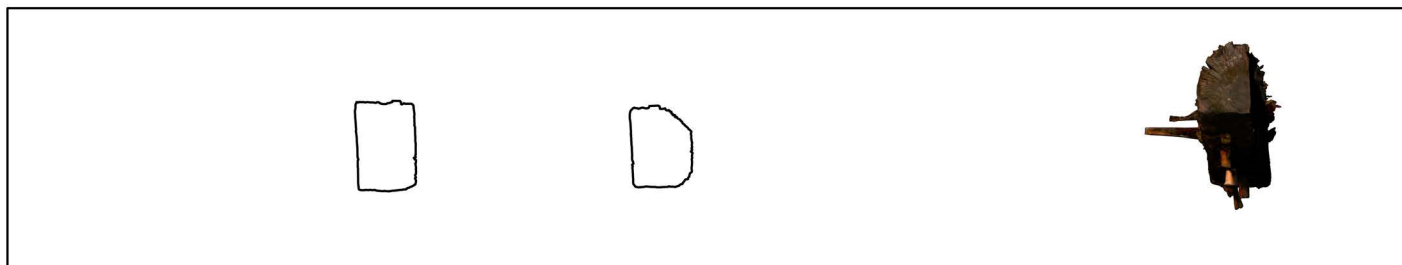
Moulded view



Outboard view



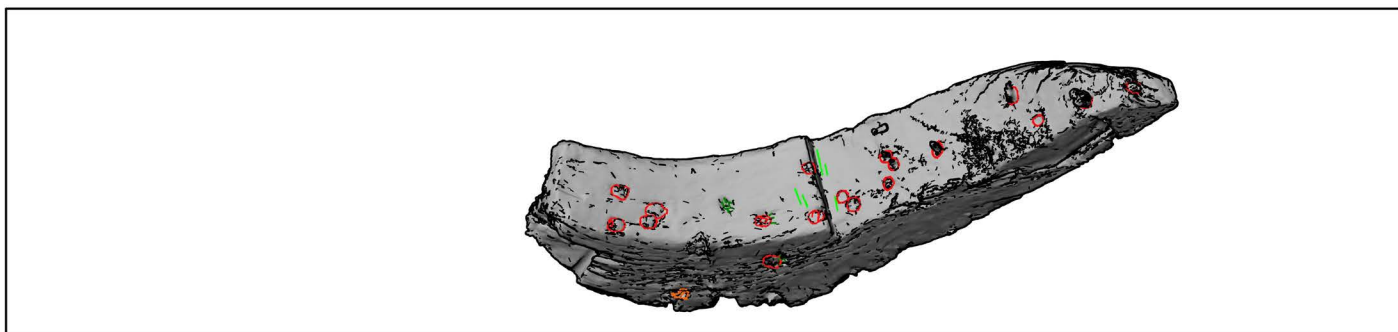
Side view



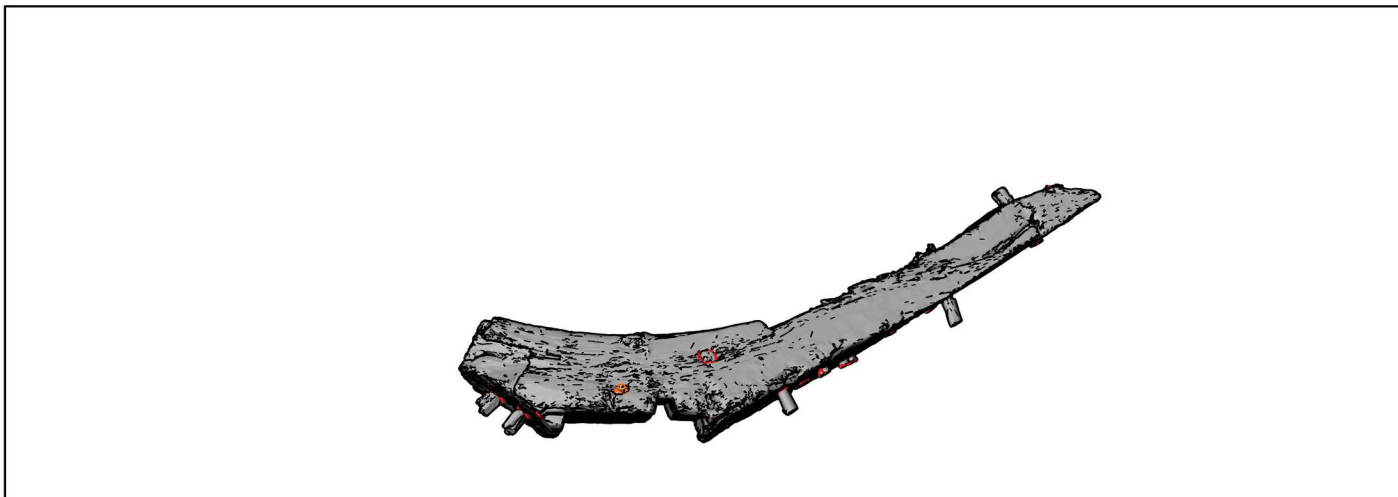
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-	Previous number:	-	Timber ID:	028	
Timber type:	poss. floor timber	Location:	Disarticulated timber			
Status:	Final		Drawing No.:	057		
Scale:	1:20	Date:	03/03/2023	Made by:	Paolo Croce	

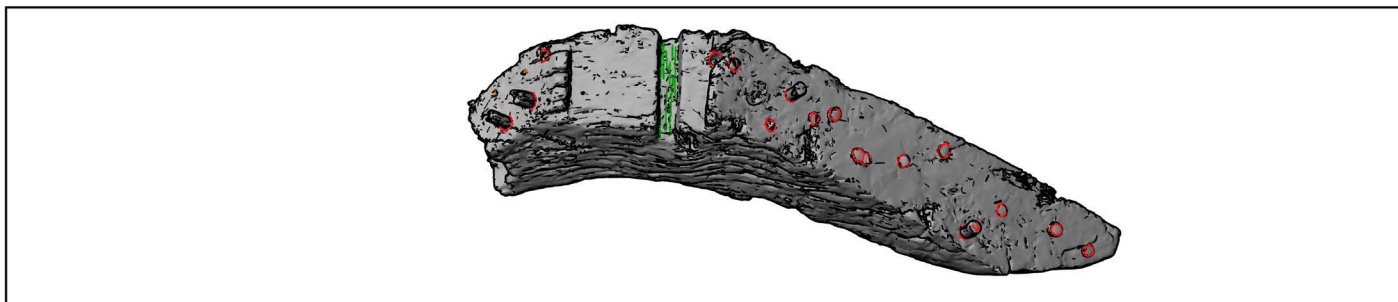
Inboard view



Aft view



Outboard view



Starboard view



0 0.5m 1m

Legend:

- ⊙ Trenails and trenail holes / wedged trenails
- ▨ Concretion
- ◻ Iron nail holes / heads
- Tool marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	029
Timber type:	floor timber	Location:	Floor 2 of section 5005 next to 030			
Status:	Final		Drawing No.:	058		
Scale:	1:20	Date:	22/02/2022	Made by:	Paolo Croce	

Inboard view



Aft view



Outboard view



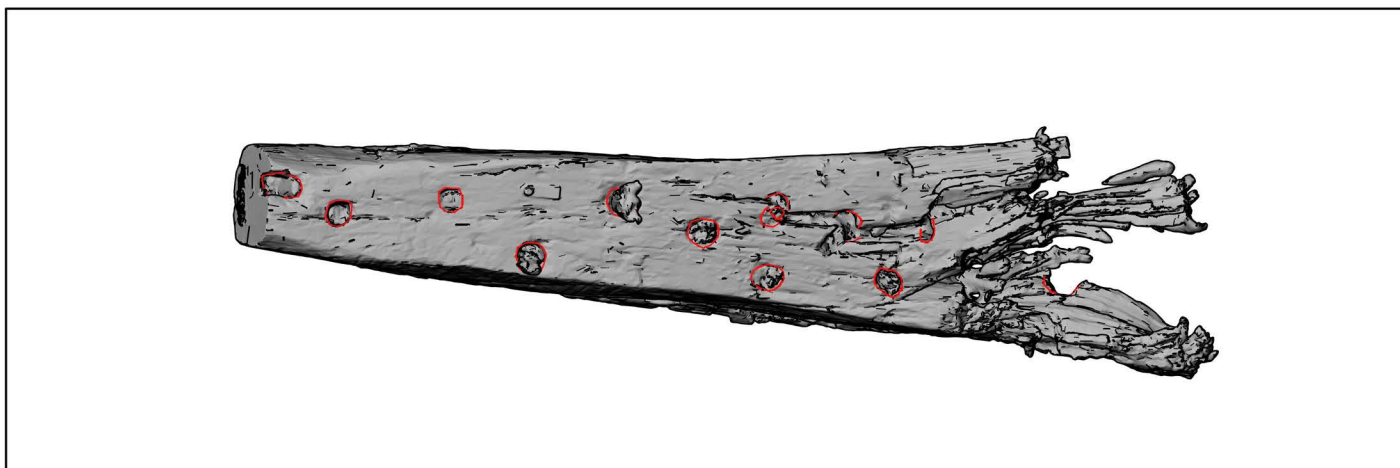
Starboard view



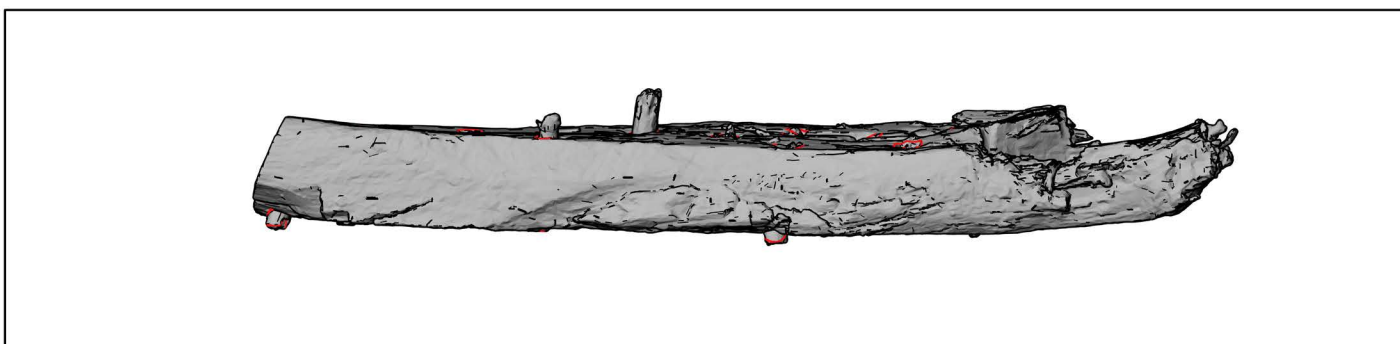
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	029
Timber type:	floor timber	Location:	Floor 2 of section 5005 next to 030			
Status:	Final			Drawing No.:	059	
Scale:	1:20	Date:	22/02/2022	Made by:	Paolo Croce	

Inboard view



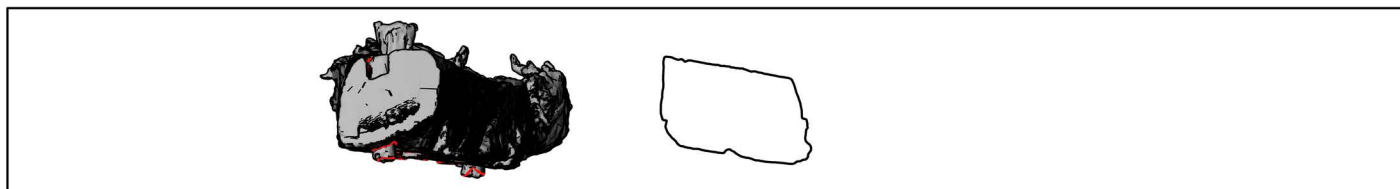
Aft view



Outboard view



Port view



0 0.5 1m

Legend:

○● Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:	-	Timber ID:	030
Timber type:	filling frame	Location:	Filling frame, abutts floor 029			
Status:	Final			Drawing No.:	060	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

Inboard view



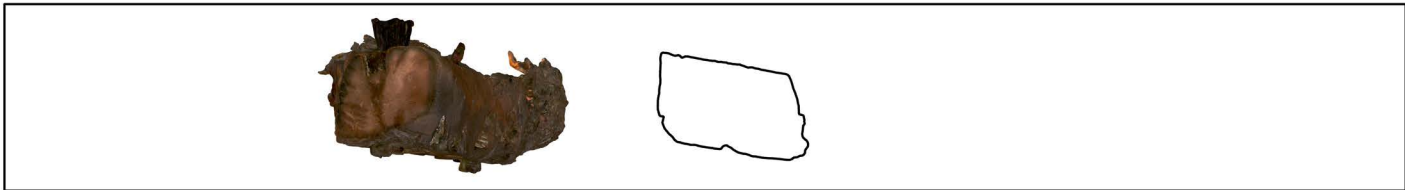
Aft view



Outboard view



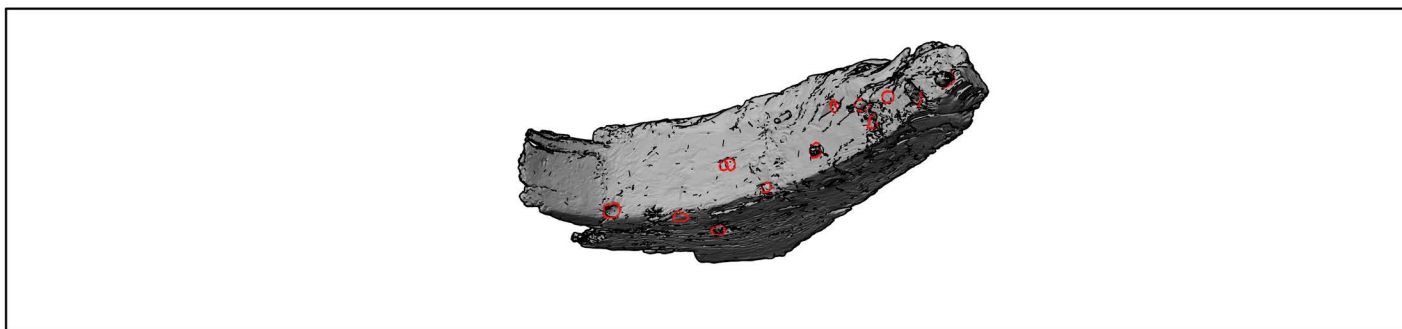
Port view



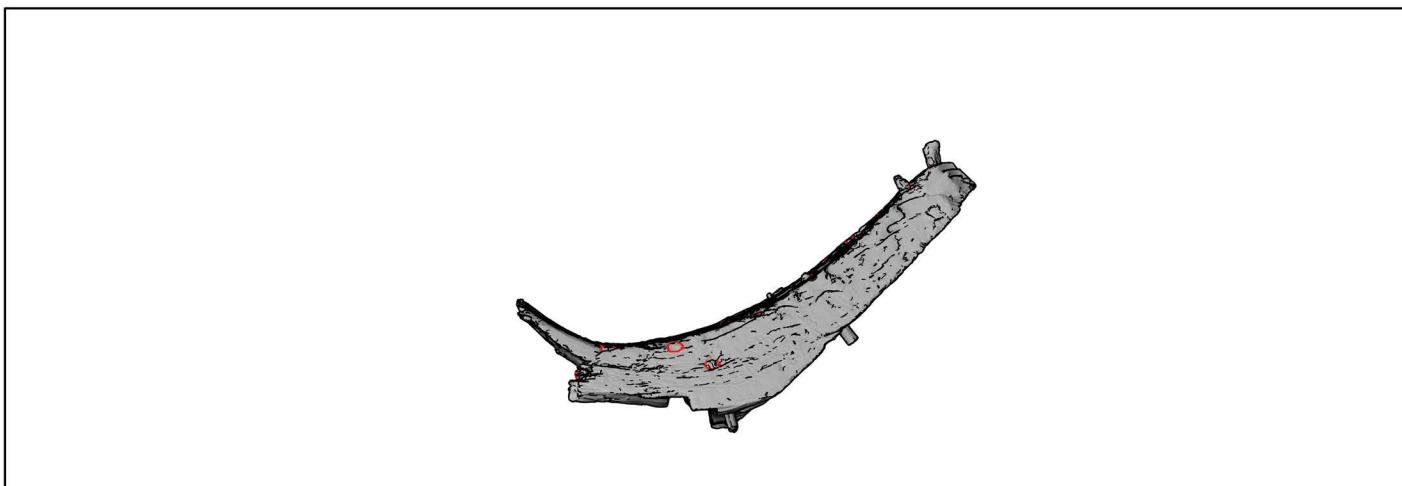
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:	-	Timber ID:	030
Timber type:	filling frame	Location:	Filling frame, abutts floor 029			
Status:	Final			Drawing No.:	061	
Scale:	1:10	Date:	20/07/2022	Made by:	Paolo Croce	

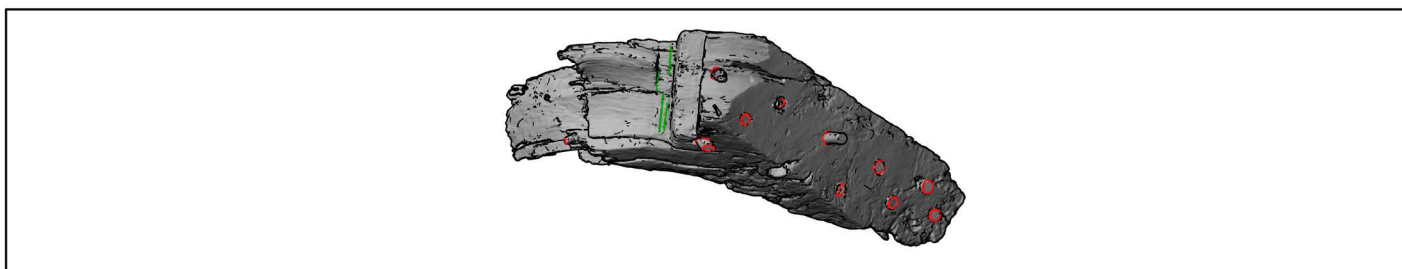
Inboard view



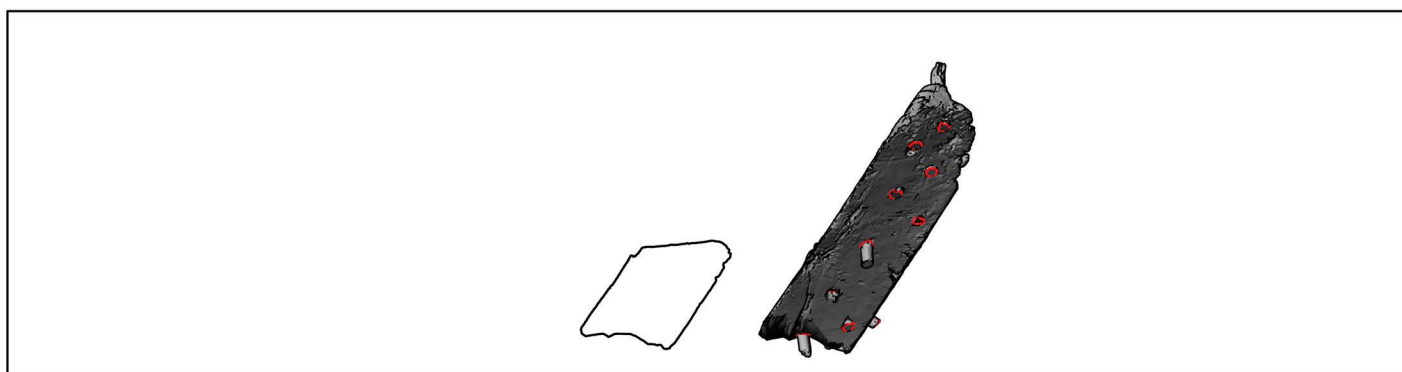
Aft view



Outboard view



Starboard view



0 0.5m 1m

Legend:

●○ Trenails and trenail holes / wedged trenails

— Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	031
Timber type:	Floor timber / crotch	Location:	Section 5005 (next to 032)			
Status:	Final			Drawing No.:	062	
Scale:	1:20	Date:	22/02/2022	Made by:	Paolo Croce	

Inboard view



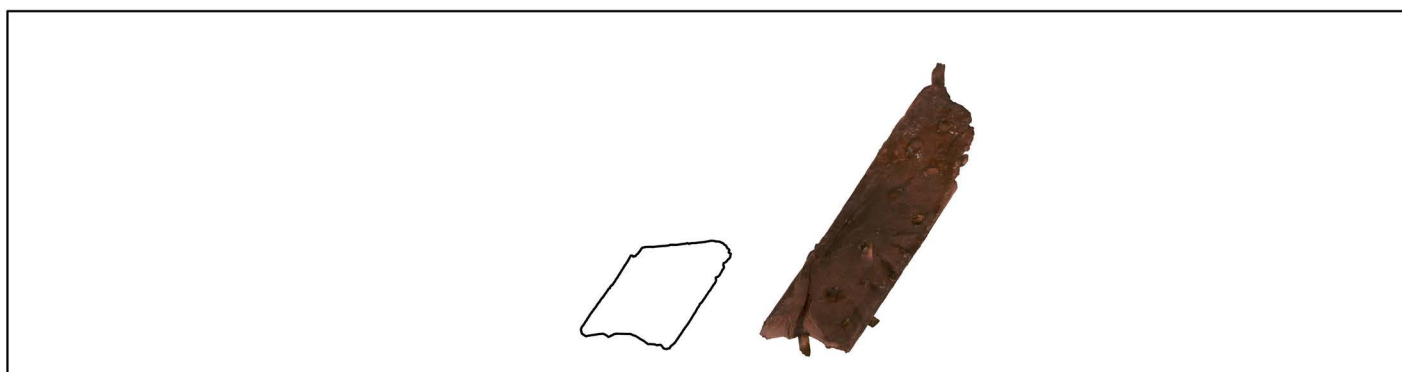
Aft view



Outboard view



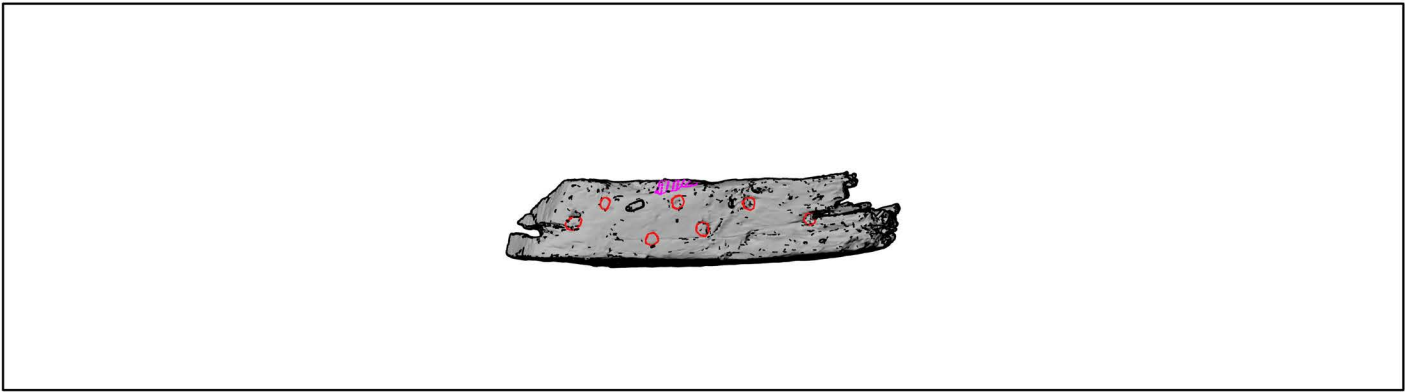
Starboard view



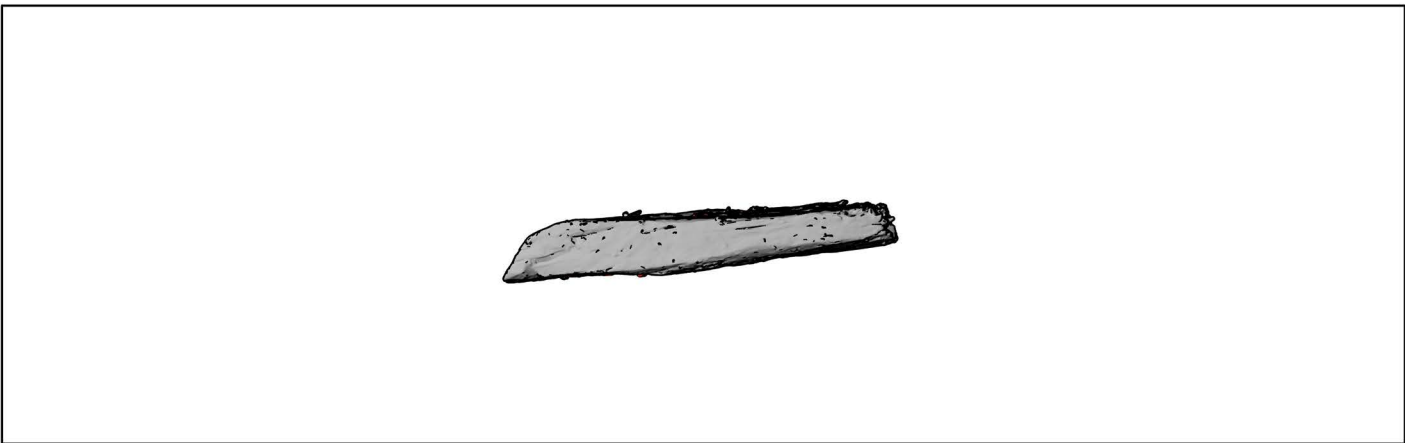
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	031
Timber type:	Floor timber / crotch	Location:	Section 5005 (next to 032)			
Status:	Final			Drawing No.:	063	
Scale:	1:20	Date:	22/02/2022	Made by:	Paolo Croce	

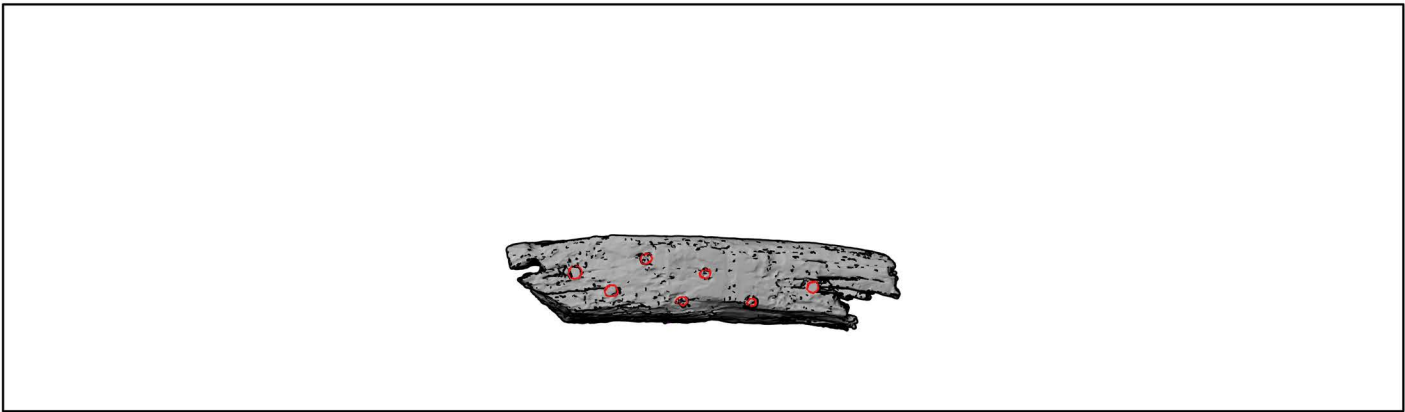
Inboard view



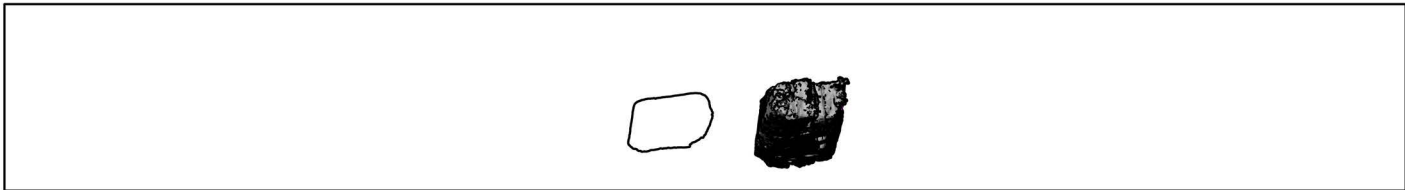
Aft view



Outboard view



Starboard view



0 0.5m 1m

Legend:
●○ Trenails and trenail holes / wedged trenails
— Poss. glue traces

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:	-	Timber ID:	
Timber type:	filling frame	Location:	section 5005, next to floor 031			
Status:	Final			Drawing No.:	064	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	



Inboard view



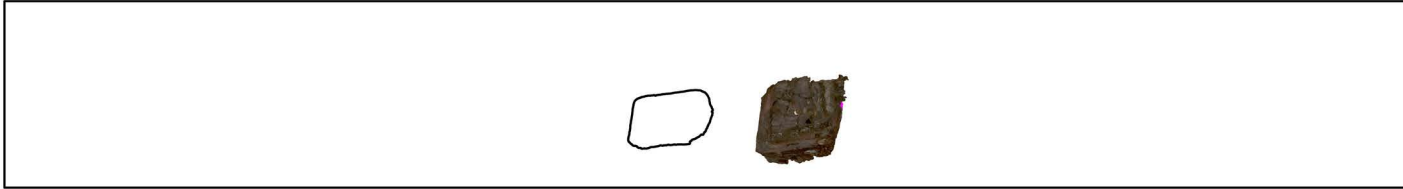
Aft view



Outboard view



Starboard view



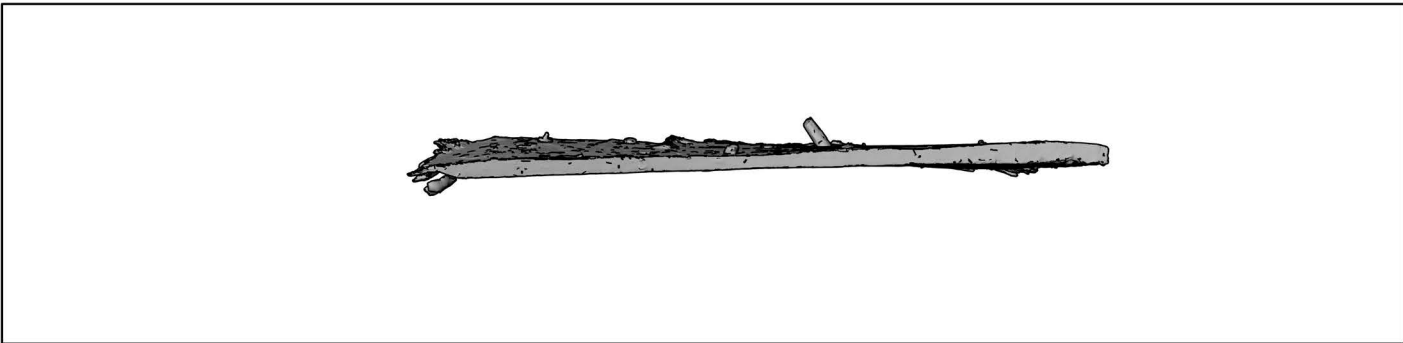
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:	-	Timber ID:	
Timber type:	filling frame	Location:	section 5005, next to floor 031			
Status:	Final			Drawing No.:	065	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

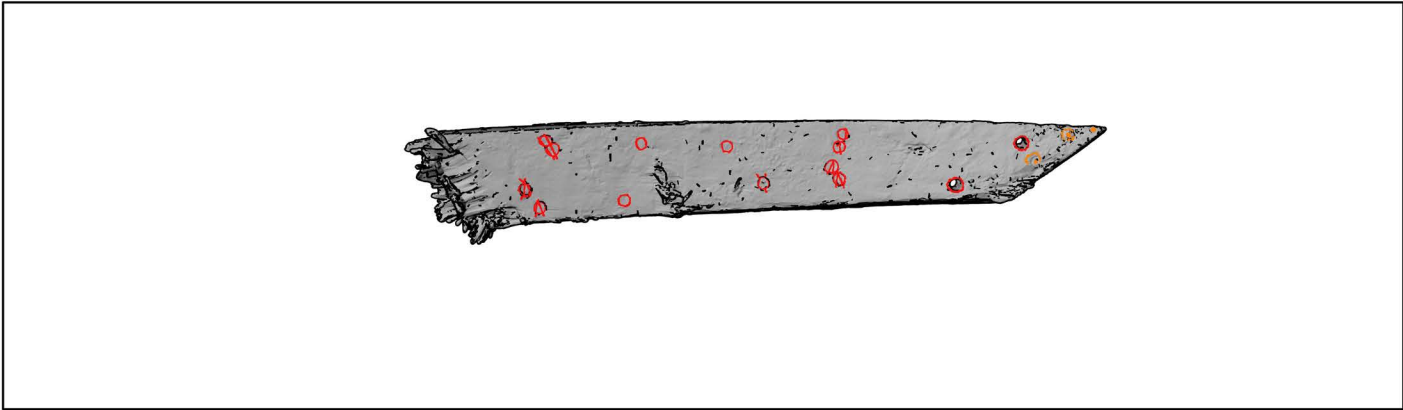
Inboard view



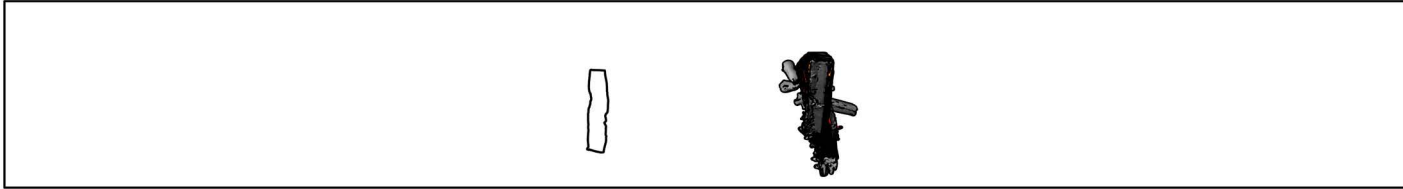
Side view



Outboard view



Fore view



0 0.5m 1m

- Legend:
- Treenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	033
Timber type:	outer plank	Location:	First strake			
Status:	Final			Drawing No.:	066	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



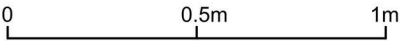
Side view



Outboard view

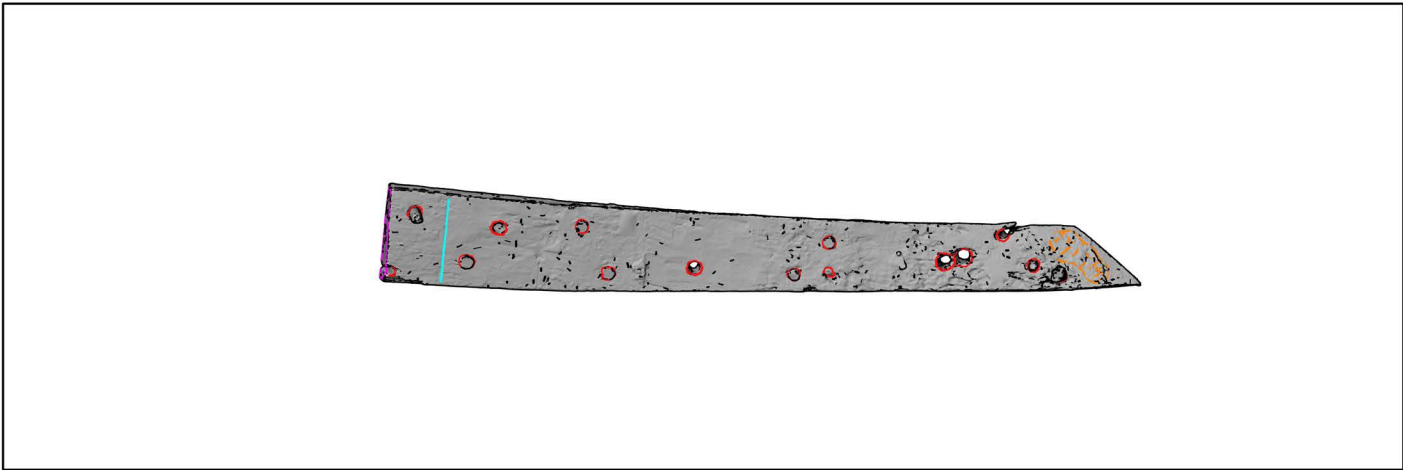


Fore view

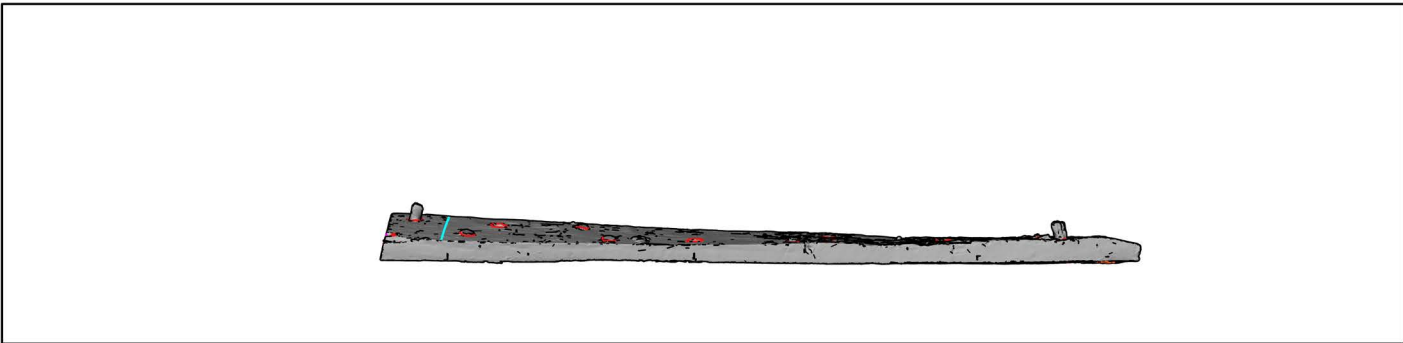


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	033
Timber type:	outer plank	Location:	First strake			
Status:	Final			Drawing No.:	067	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

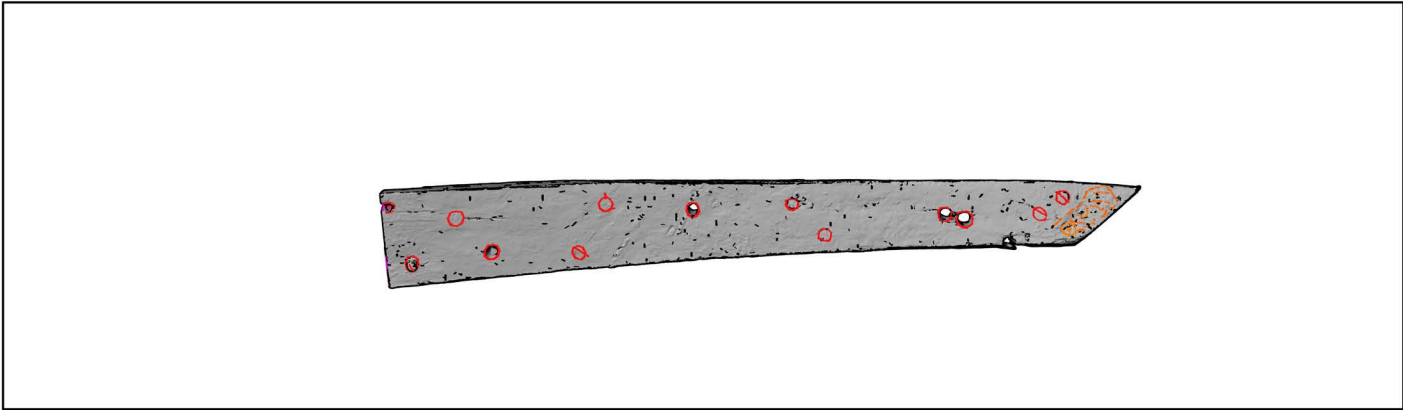
Inboard view



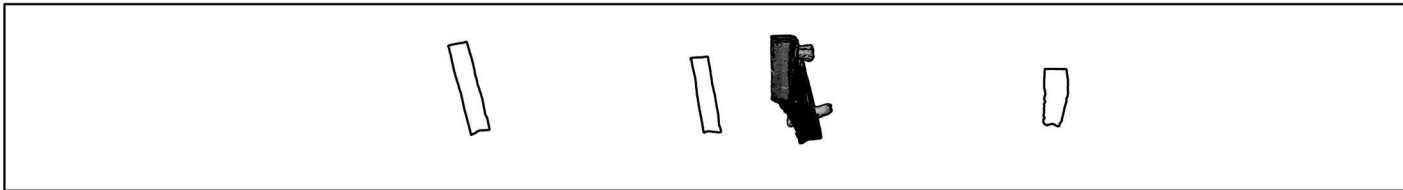
Side view



Outboard view



Fore view



00.5m1m

- Legend:
- Treenails and trenail holes / wedged trenails

Iron nail holes / heads

Dendrosample cut

Concretion

Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	034
Timber type:	outer plank	Location:	2nd strake			
Status:	Final			Drawing No.:	064	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



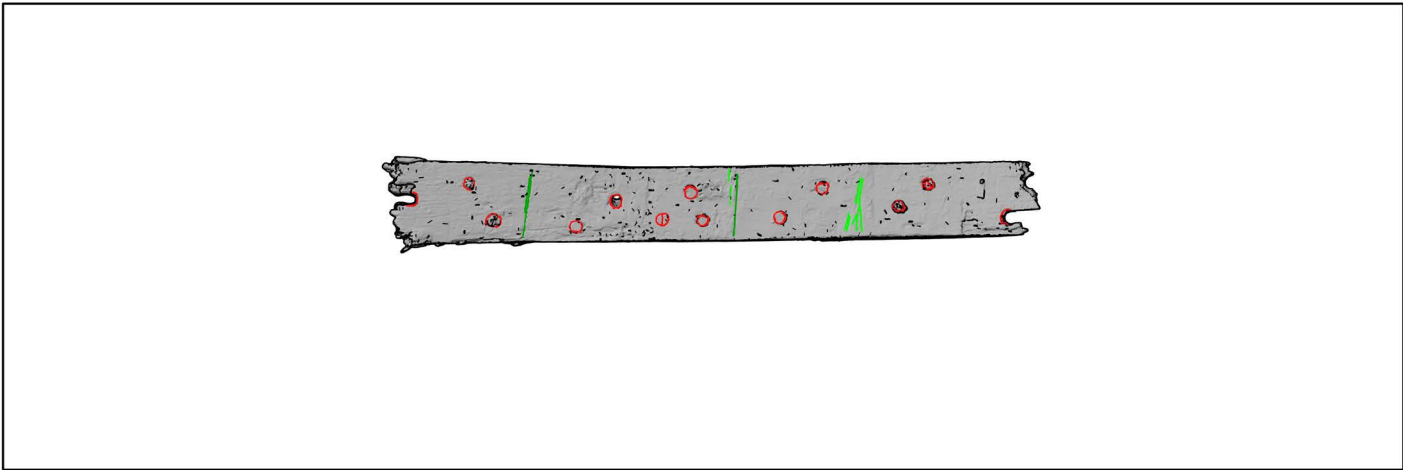
Fore view



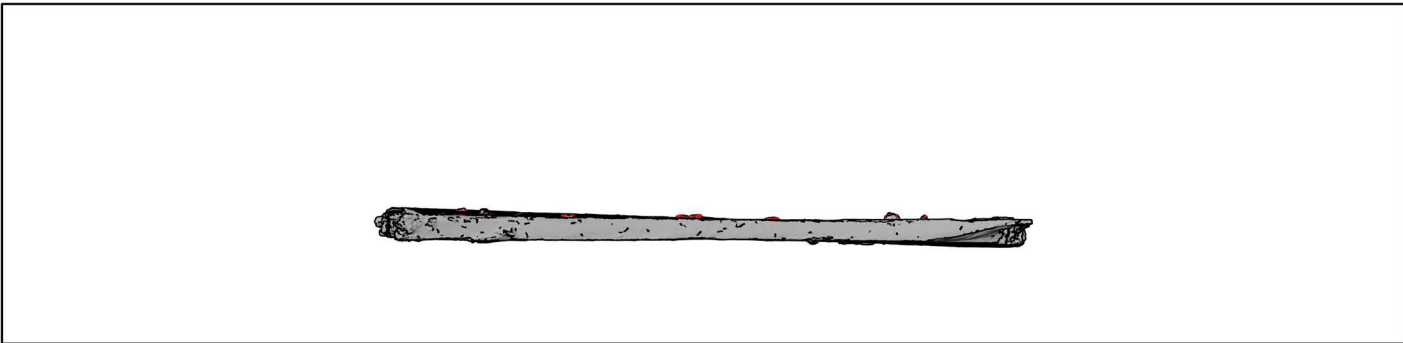
00.5m1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	034
Timber type:	outer plank	Location:	2nd strake			
Status:	Final			Drawing No.:	065	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

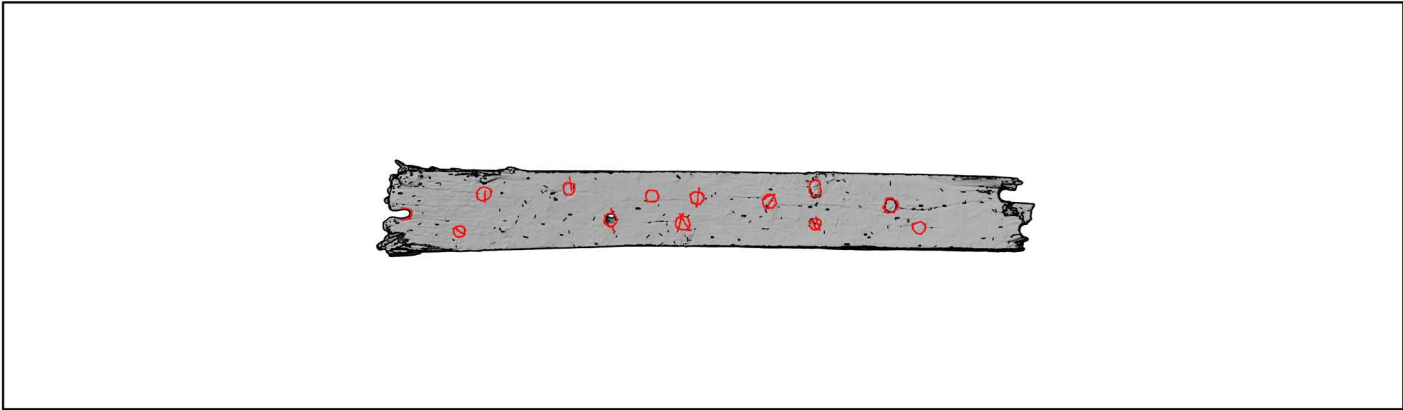
Inboard view



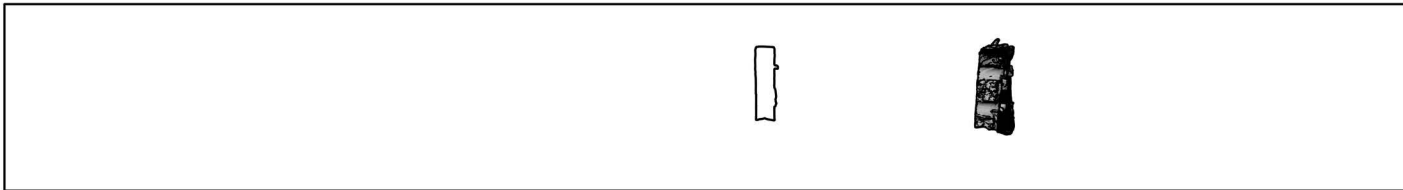
Side view



Outboard view



Fore view



0 0.5m 1m

- Legend:
-  Trenails and trenail holes / wedged trenails
 -  Axe Marks
 -  Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	035
Timber type:	outer plank	Location:	3rd strake			
Status:	Final			Drawing No.:	070	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



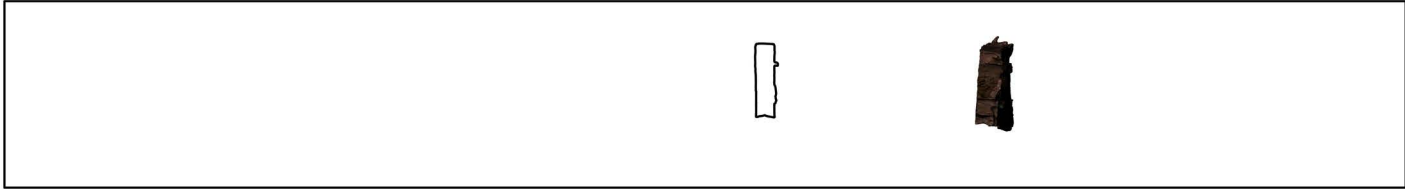
Side view



Outboard view



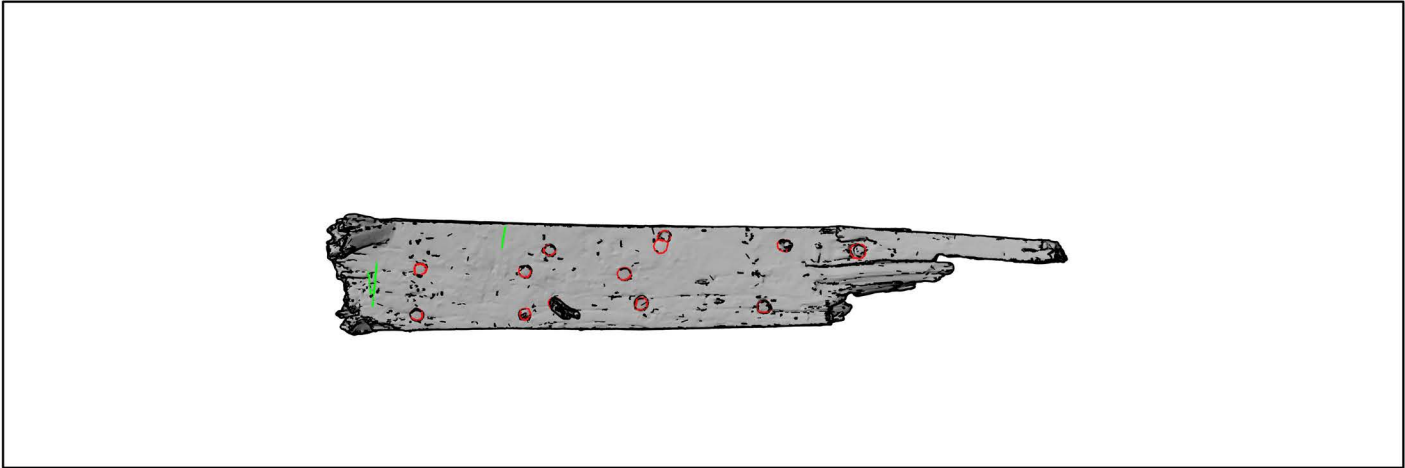
Fore view



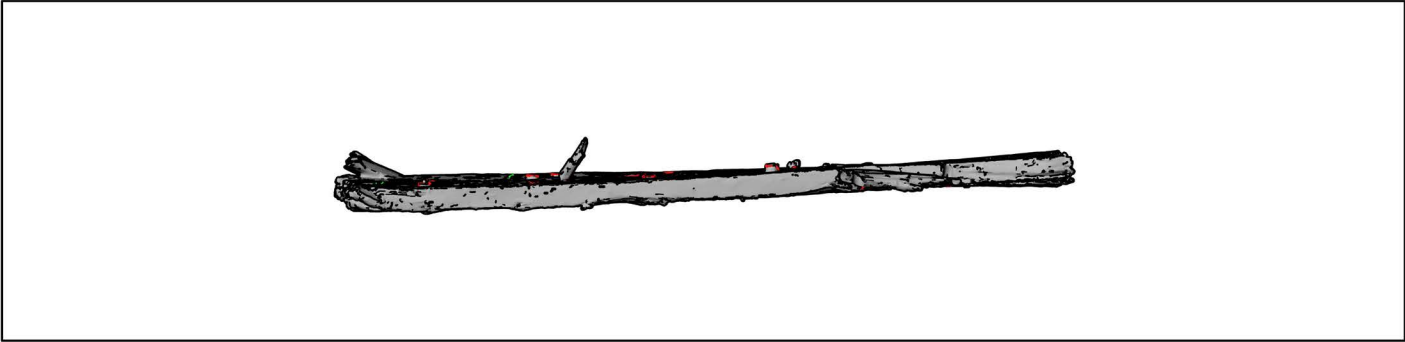
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	035
Timber type:	outer plank	Location:	3rd strake			
Status:	Final			Drawing No.:	071	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

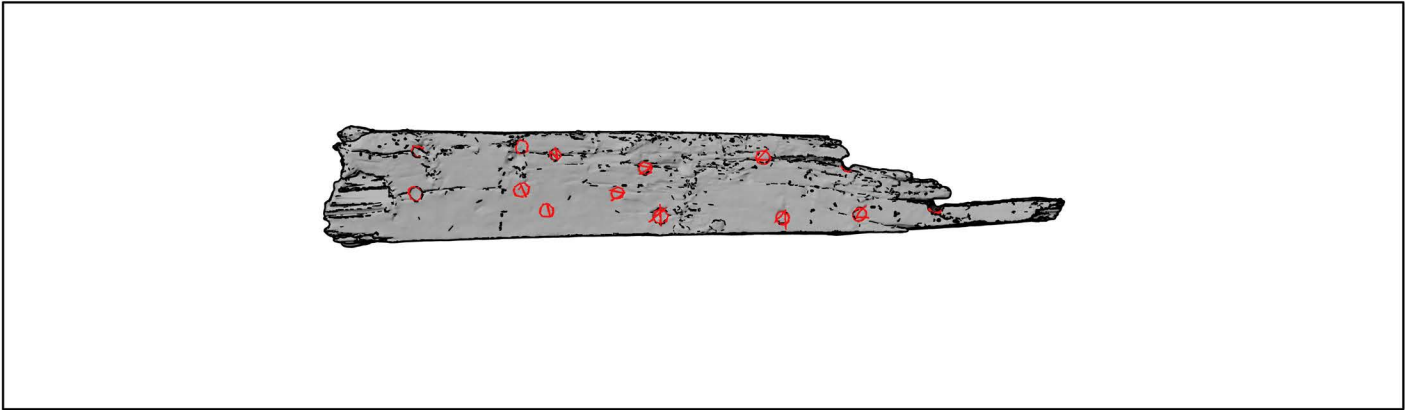
Inboard view



Side view



Outboard view



Fore view



0 0.5m 1m

- Legend:
-  Treenails and trenail holes / wedged trenails
 -  Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	036
Timber type:	outer plank	Location:	4th strake			
Status:	Final			Drawing No.:	072	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



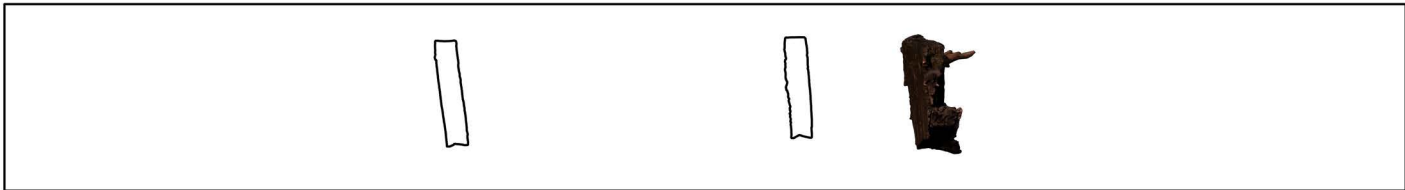
Side view



Outboard view



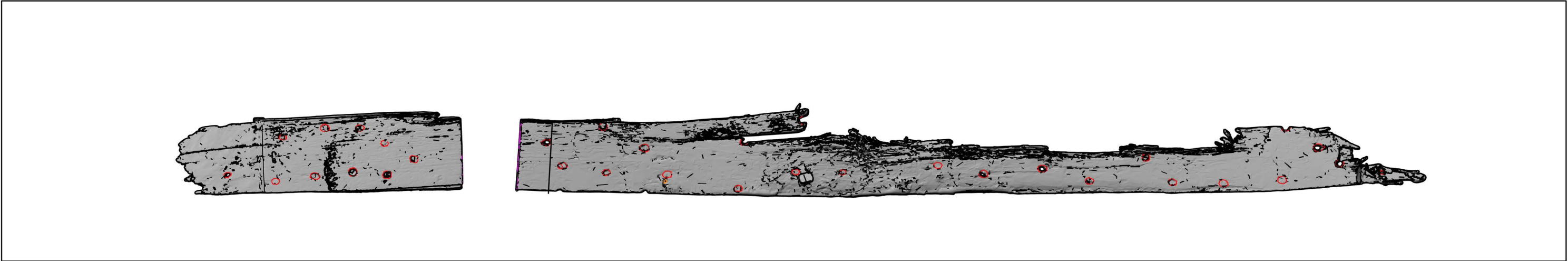
Fore view



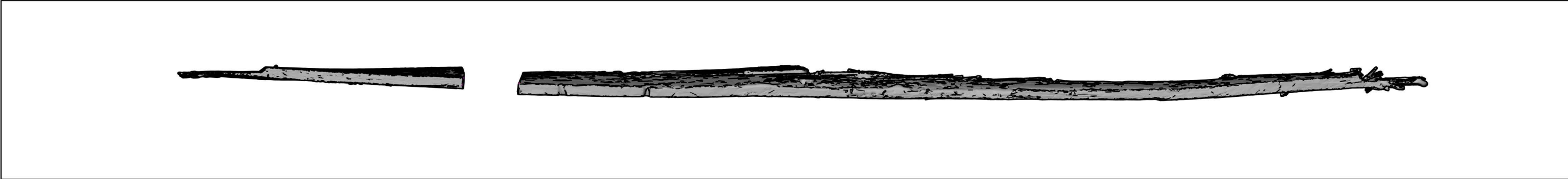
00.5m1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5005		Previous number:		Timber ID:	036
Timber type:	outer plank	Location:	4th strake			
Status:	Final			Drawing No.:	073	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

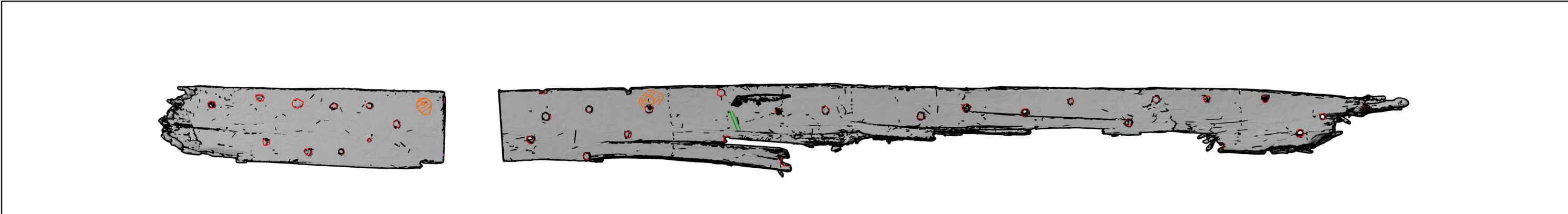
Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

- Trenails and trenail holes / wedged trenails
- Iron nail holes / heads
- Toolmarks
- Concretion
- Dendrosample cut

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:				Previous number:	-	Timber ID:	037 and 37b
Timber type:	ceiling plank		Location:	first surviving strake of section 5004, starboard side			
Status:	Final				Drawing No.:	074	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

Inboard view



Side view



Outboard view



Aft view



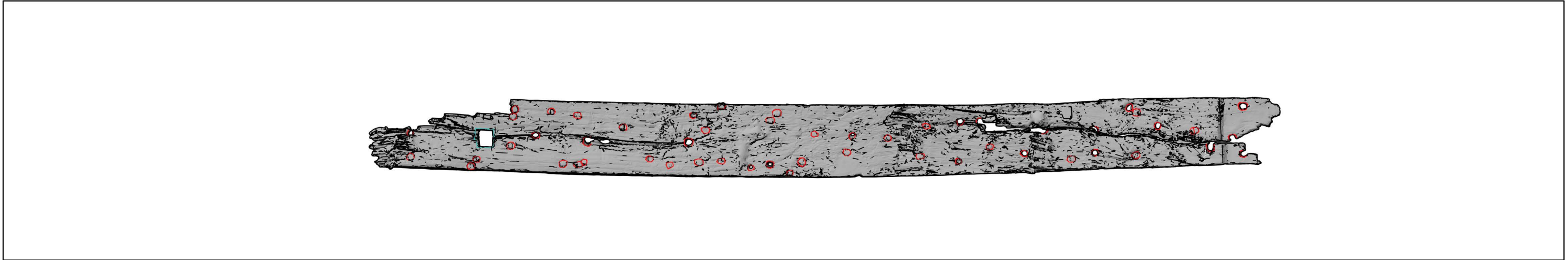
0 0.5m 1m

Legend:

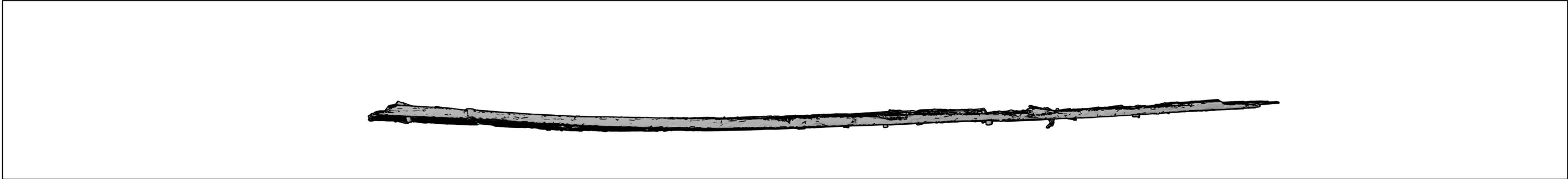
- Trenails and trenail holes / wedged trenails
- Iron nail holes / heads
- Toolmarks
- Concretion
- Dendrosample cut

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:				Previous number:	-	Timber ID:	037 and 37b
Timber type:	ceiling plank		Location:	first surviving strake of section 5004, starboard side			
Status:	Final				Drawing No.:	075	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

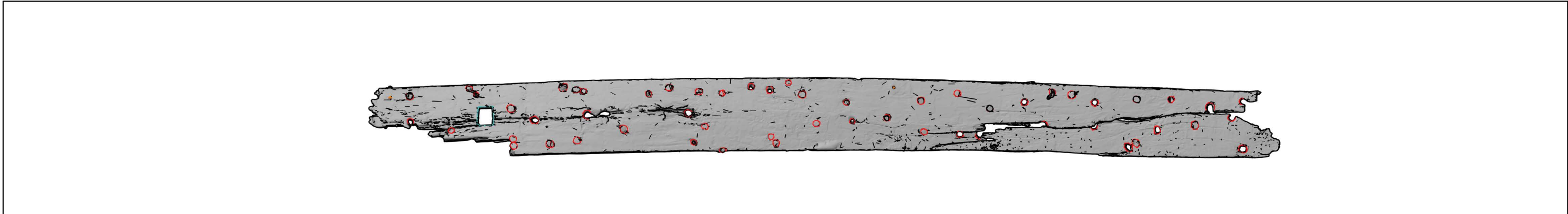
Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

- Treenails and trenail holes / wedged trenails
- Iron nail holes / heads
- Repairs

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:			Timber ID:	038 and 38b
Timber type:	ceiling plank	Location:	second surviving strake of section 5004, starboard side, 1 of 2 planks (aft)				
Status:	Final				Drawing No.:	076	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

Inboard view



Side view



Outboard view



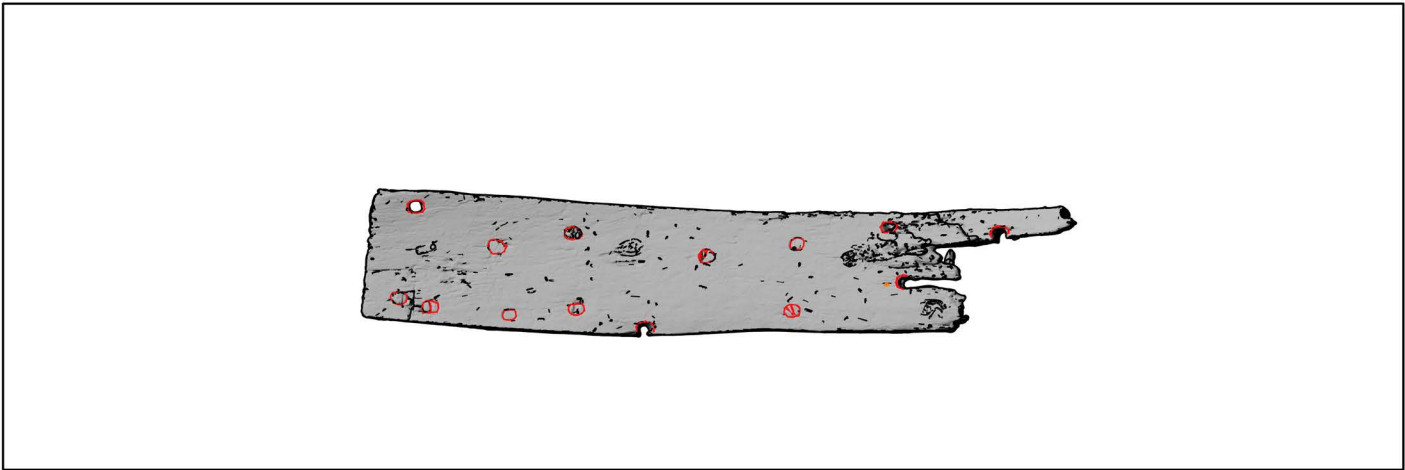
Aft view



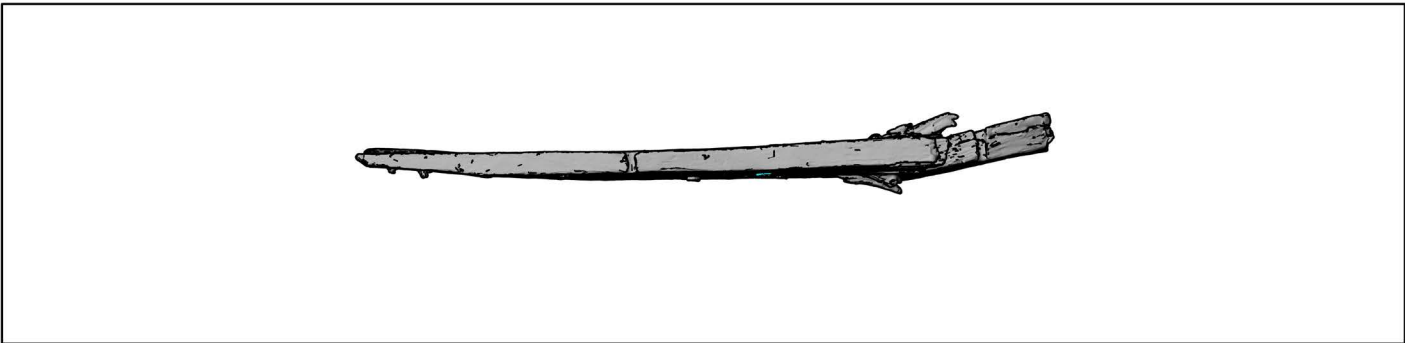
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004	Previous number:				Timber ID:	038 and 38b
Timber type:	ceiling plank	Location:	second surviving strake of section 5004, starboard side, 1 of 2 planks (aft)				
Status:	Final				Drawing No.:	077	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

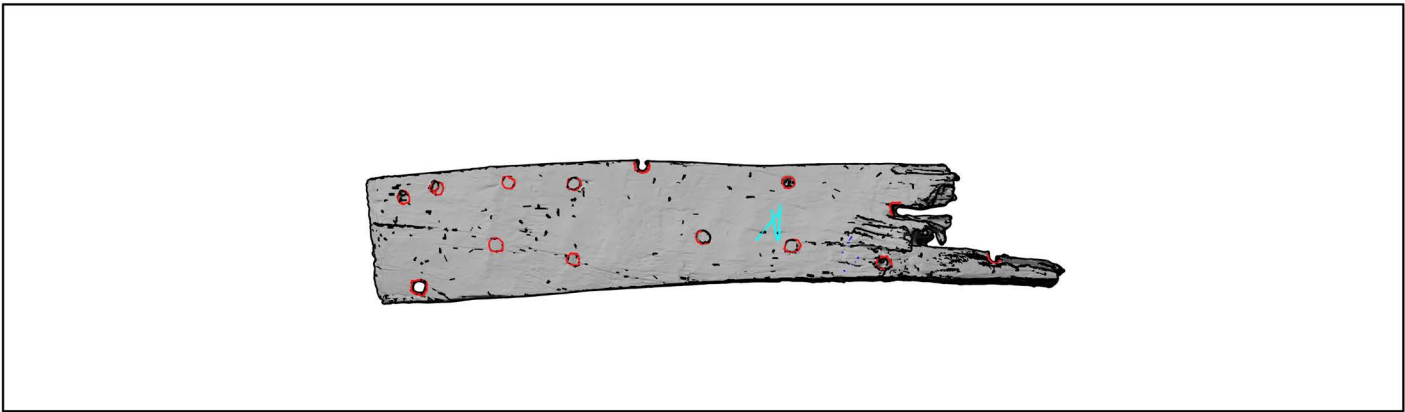
Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Intentional marks
 - Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004	Previous number:			Timber ID:	039
Timber type:	ceiling plank	Location:	second surviving strake of section 5004, starboard side, 2 of 2 planks (fore)			
Status:	Final			Drawing No.:	078	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



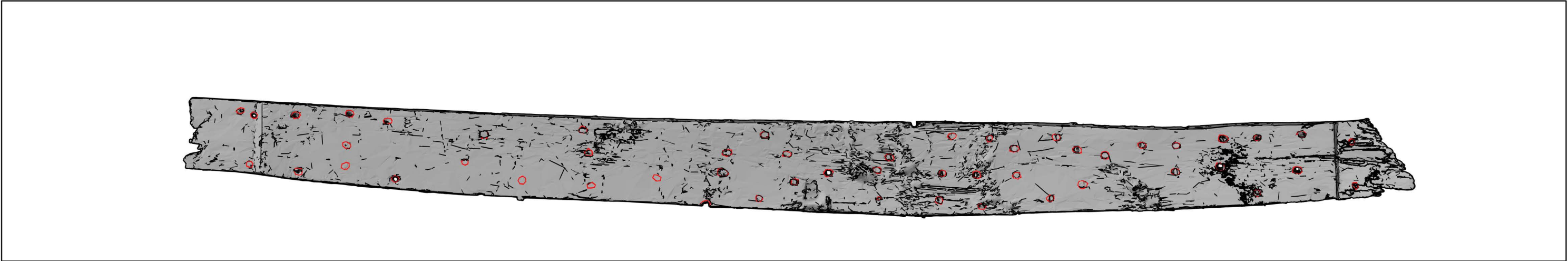
Aft view



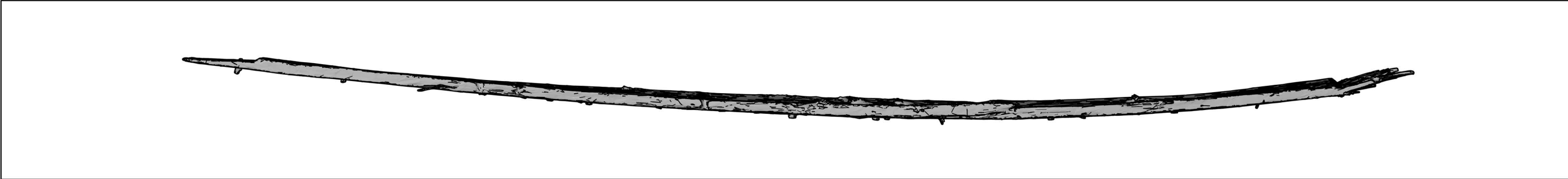
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	039
Timber type:	ceiling plank	Location:	second surviving strake of section 5004, starboard side, 2 of 2 planks (fore)			
Status:	Final			Drawing No.:	079	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

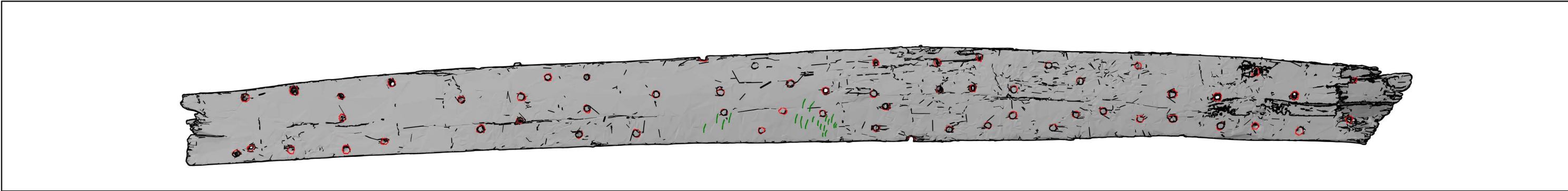
Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

- Treenails and trenail holes / wedged treenails ●○ Iron nail holes / heads
— Toolmarks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:			Timber ID:	40
Timber type:	ceiling plank	Location:	3rd surviving strake of section 5004, starboard side				
Status:	Final				Drawing No.:	080	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

Inboard view



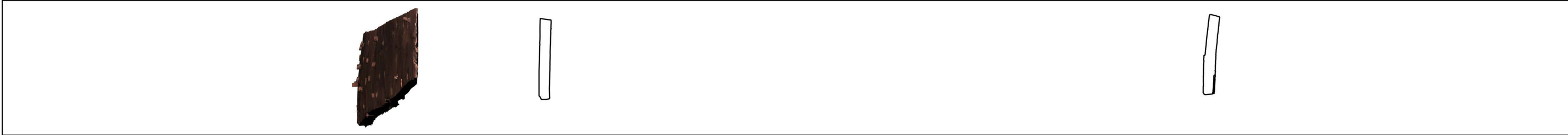
Side view



Outboard view



Aft view



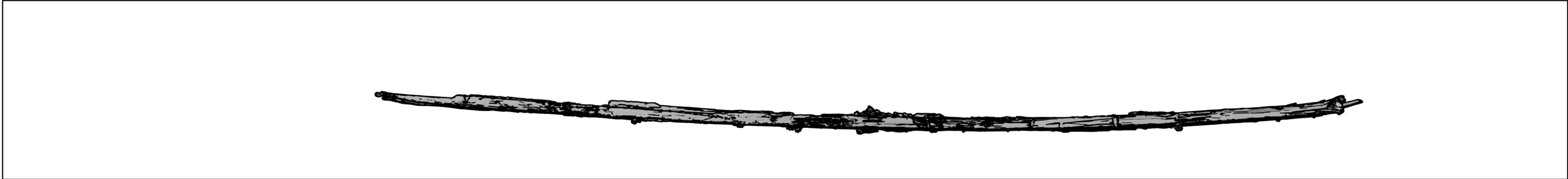
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:			Timber ID:	40
Timber type:	ceiling plank	Location:	3rd surviving strake of section 5004, starboard side				
Status:	Final				Drawing No.:	081	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

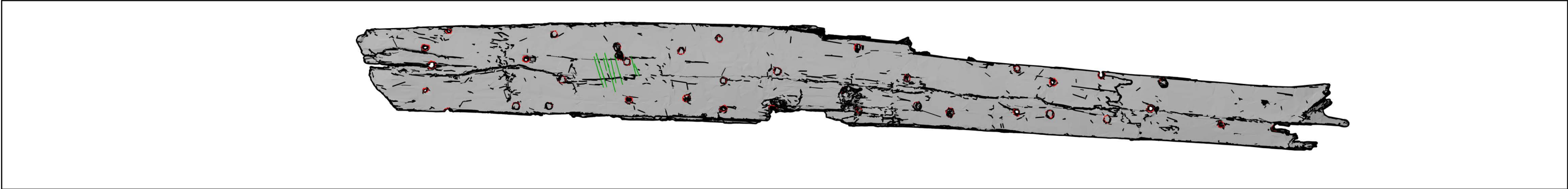
Inboard view



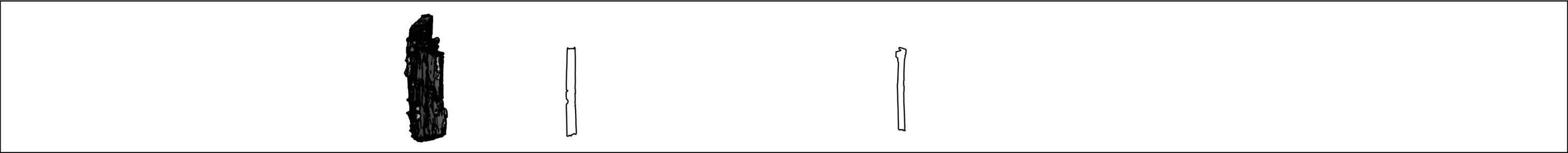
Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

-  Treenails and trenail holes / wedged trenails
-  Toolmarks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	41	
Timber type:	ceiling plank	Location:	4th surviving strake of section 5004, starboard side				
Status:	Final				Drawing No.:	082	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

Inboard view



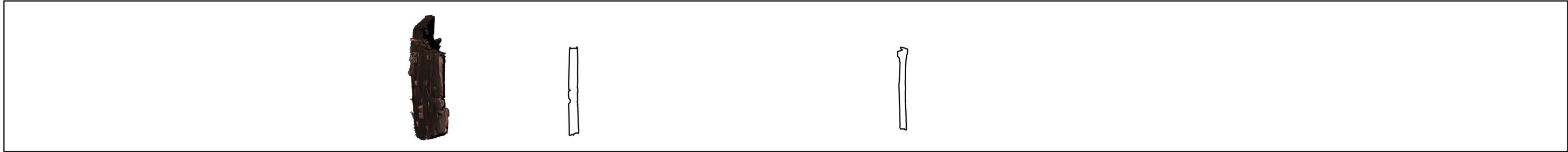
Side view



Outboard view



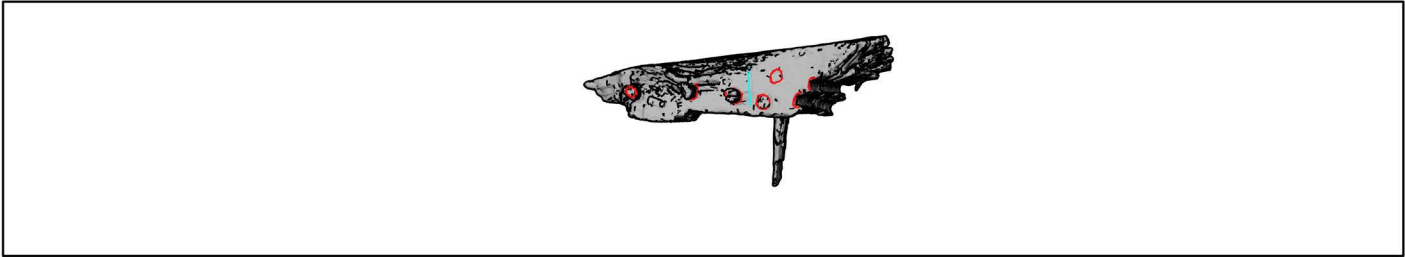
Aft view



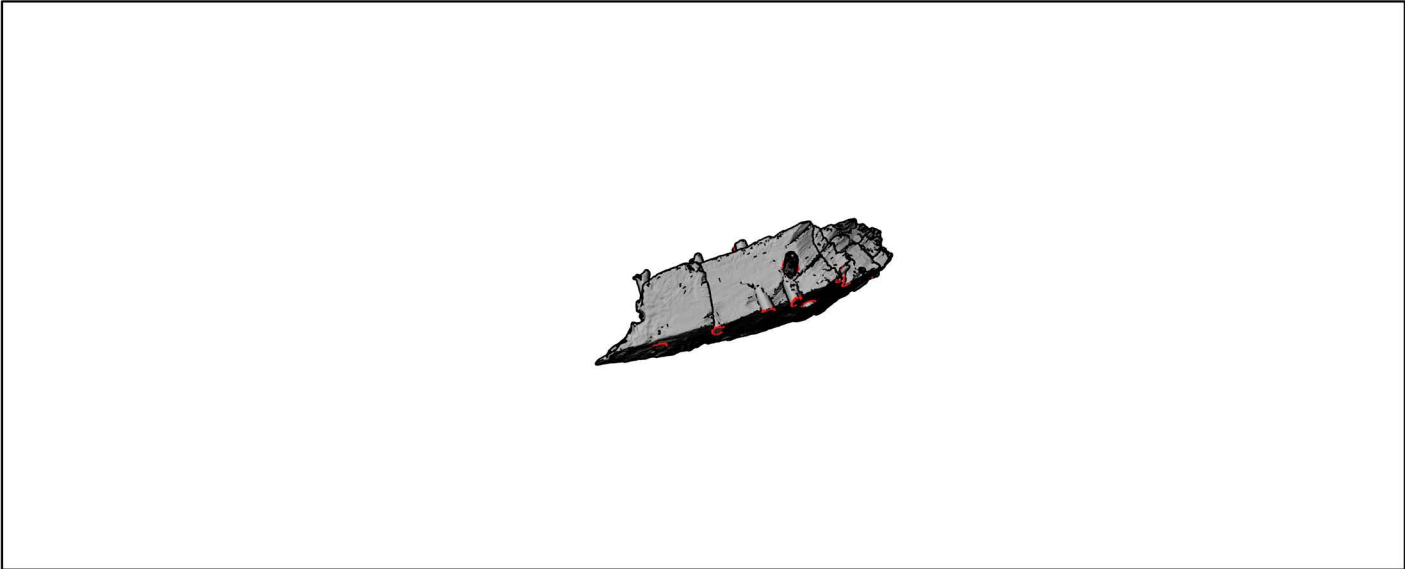
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	41	
Timber type:	ceiling plank	Location:	4th surviving strake of section 5004, starboard side				
Status:	Final				Drawing No.:	083	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

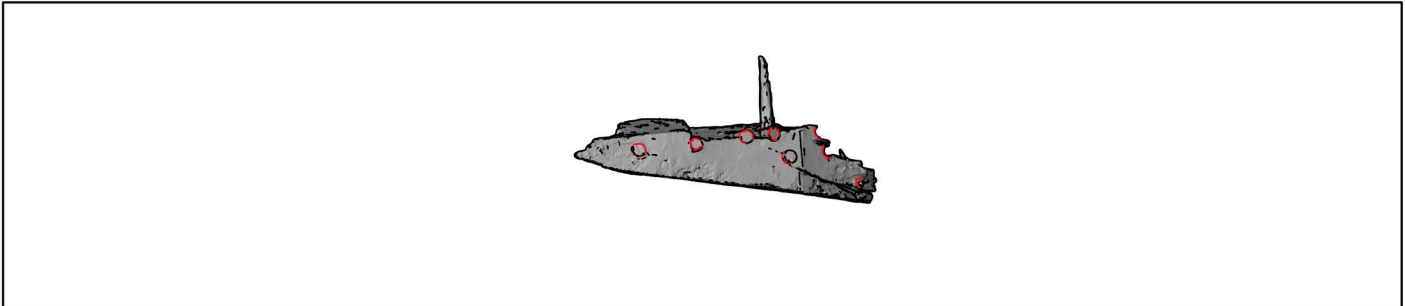
Inboard view



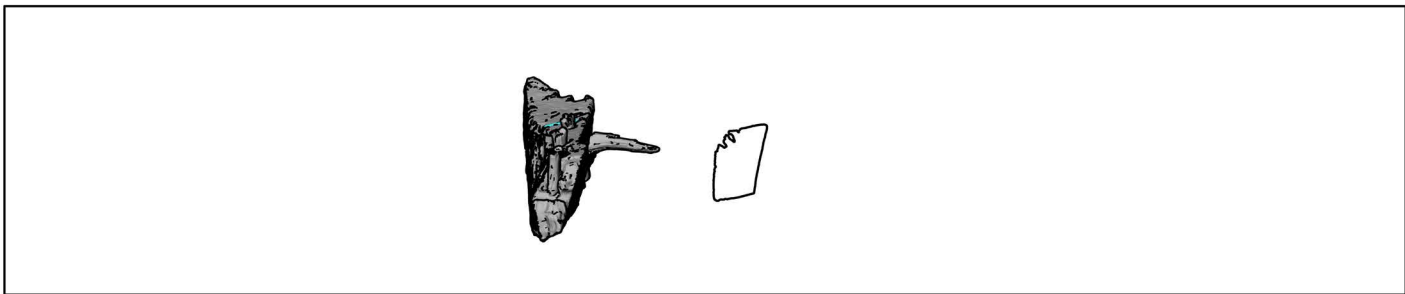
Aft view



Outboard view



Portside view



0 0.5m 1m

- Legend:
-  Treenails and treenail holes / wedged treenails
 -  Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	042
Timber type:	futtock	Location:	first surviving futtock aft, over outer plank 063 064 065			
Status:	Final			Drawing No.:	084	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



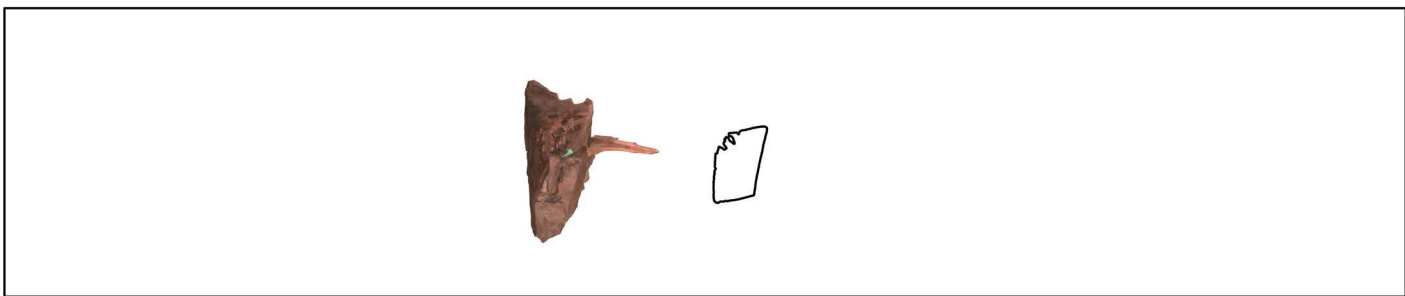
Aft view



Outboard view



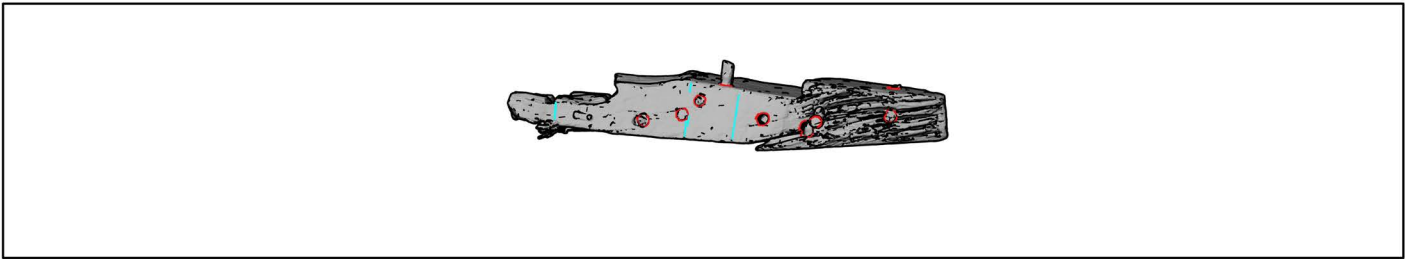
Portside view



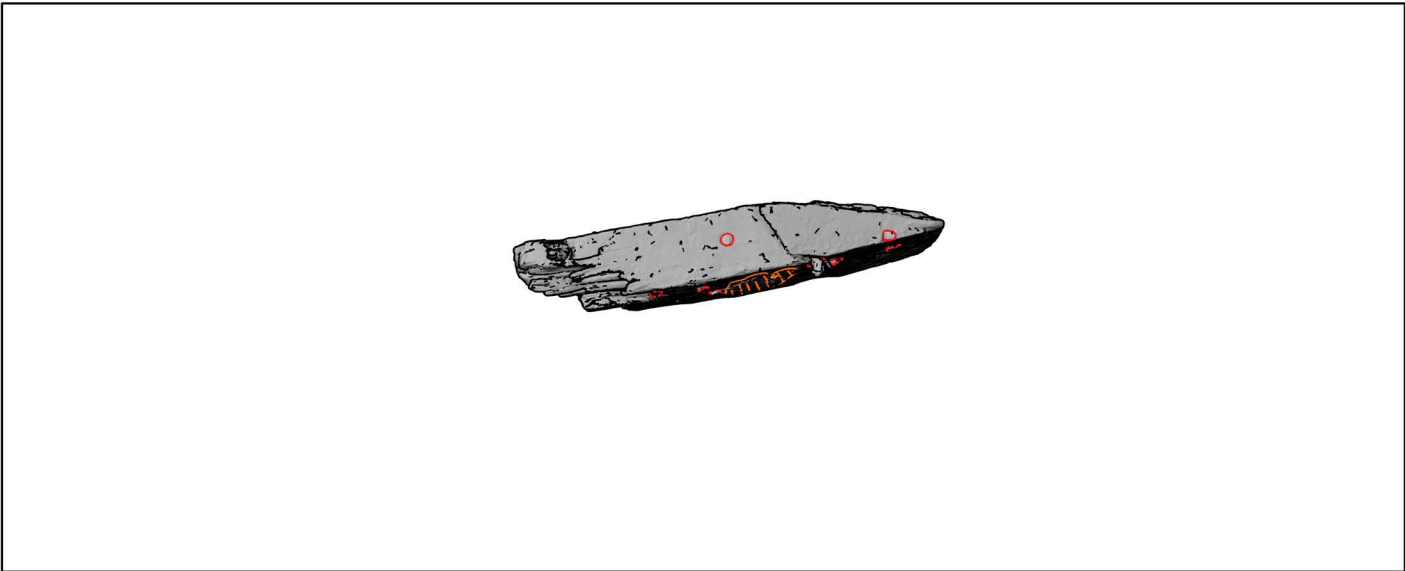
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	042
Timber type:	futtock	Location:	first surviving futtock aft, over outer plank 063 064 065			
Status:	Final			Drawing No.:	085	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

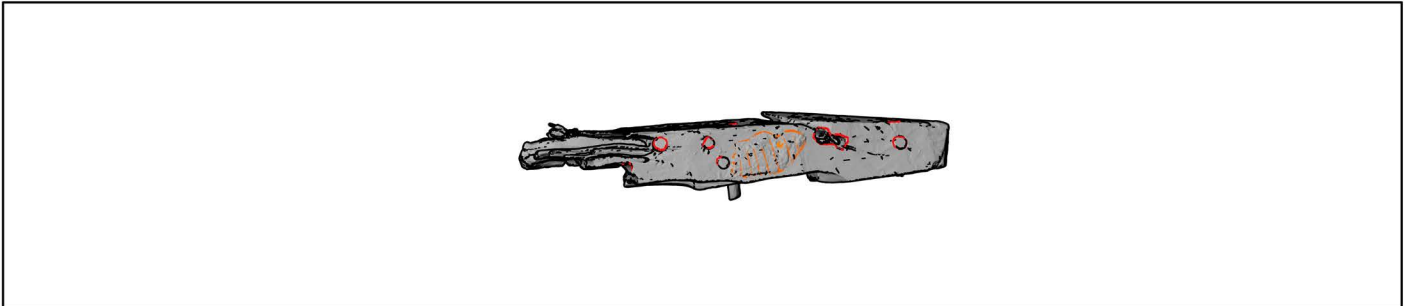
Inboard view



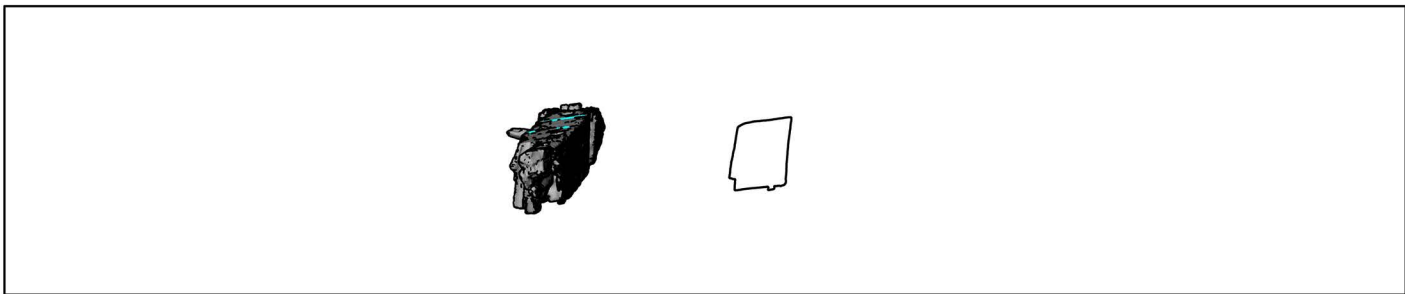
Aft view



Outboard view



View from portside

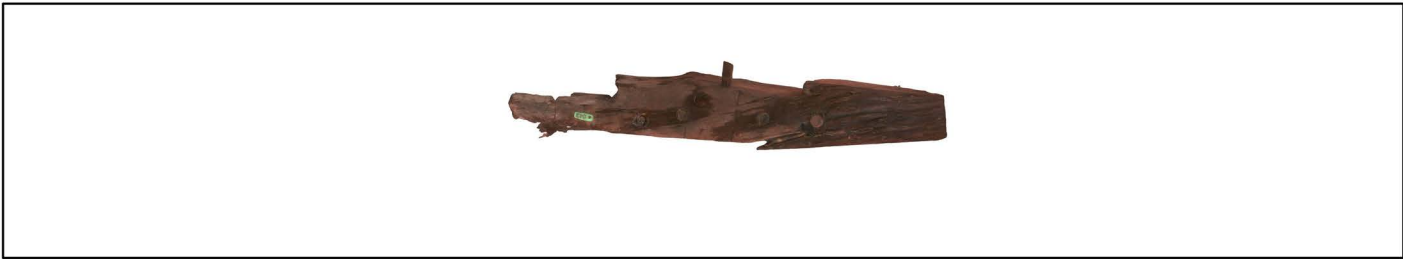


0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Concretion
 - Intentional marks
 - Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	043
Timber type:	floor	Location:	aftermost floor, jointed to futtock 068			
Status:	Final			Drawing No.:	086	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



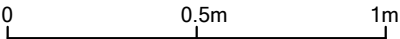
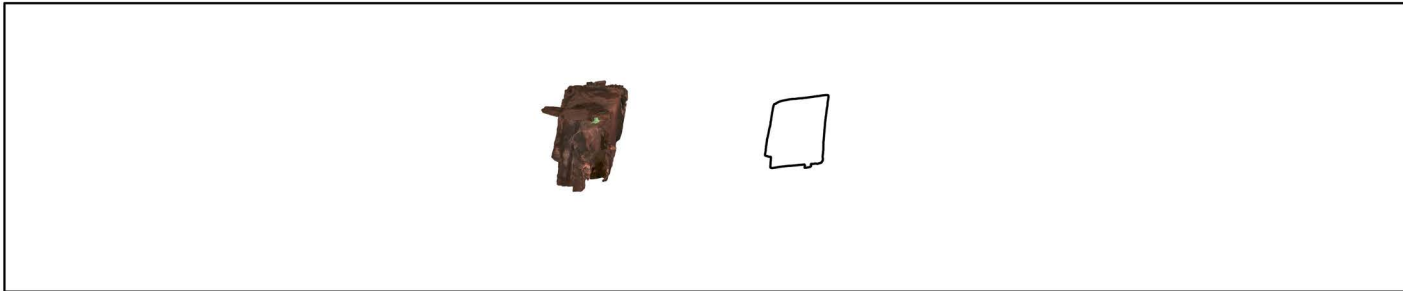
Aft view



Outboard view

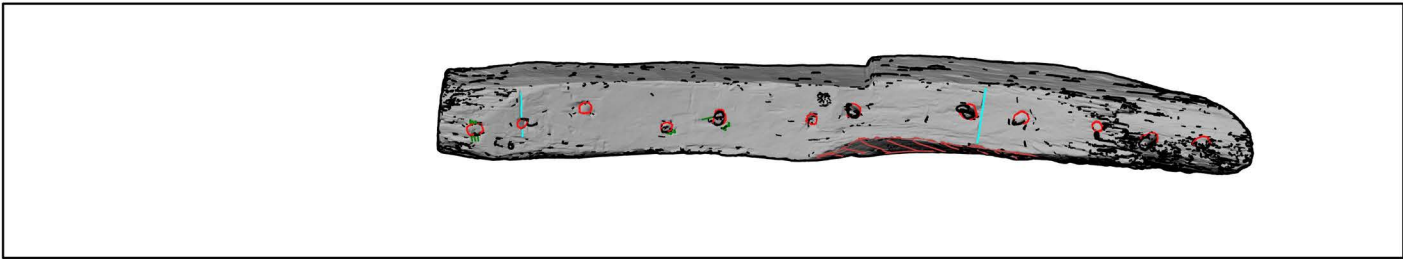


Portside view

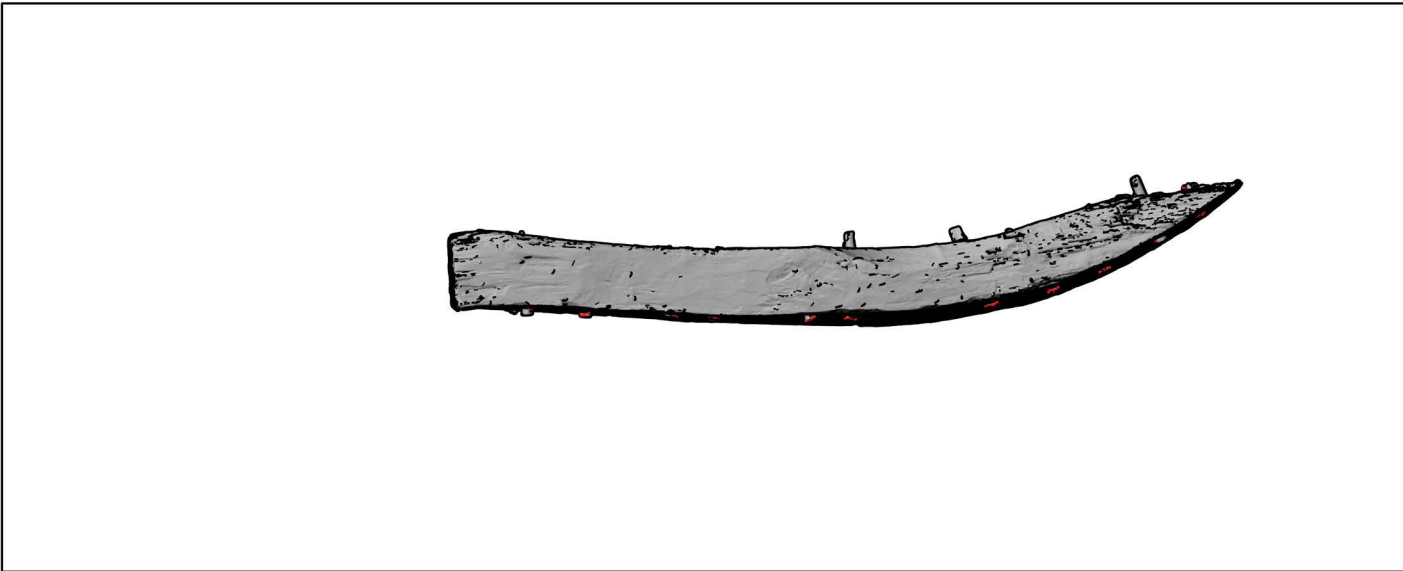


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	043
Timber type:	floor	Location:	aftermost floor, jointed to futtock 068			
Status:	Final			Drawing No.:	087	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

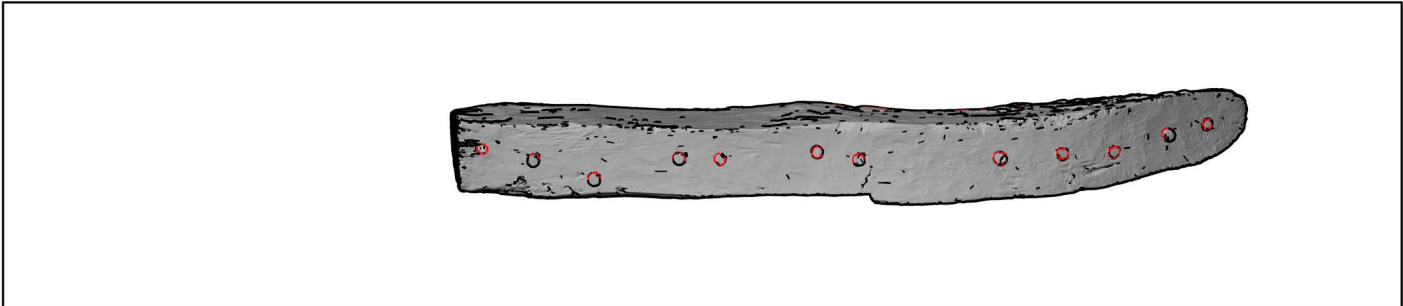
Inboard view



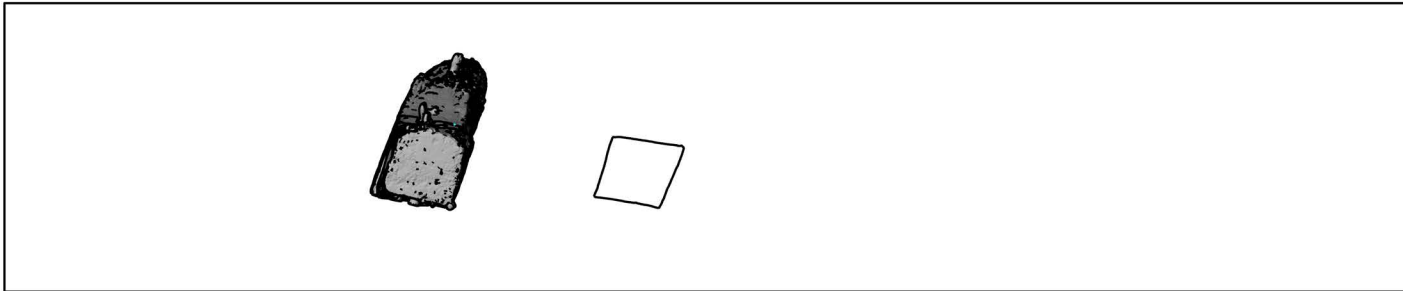
Aft view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Sapwood / bark
 - Toolmarks
 - Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	044
Timber type:	filling frame	Location:	filling frame, fore of 068 and aft of 45			
Status:	Final			Drawing No.:	088	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

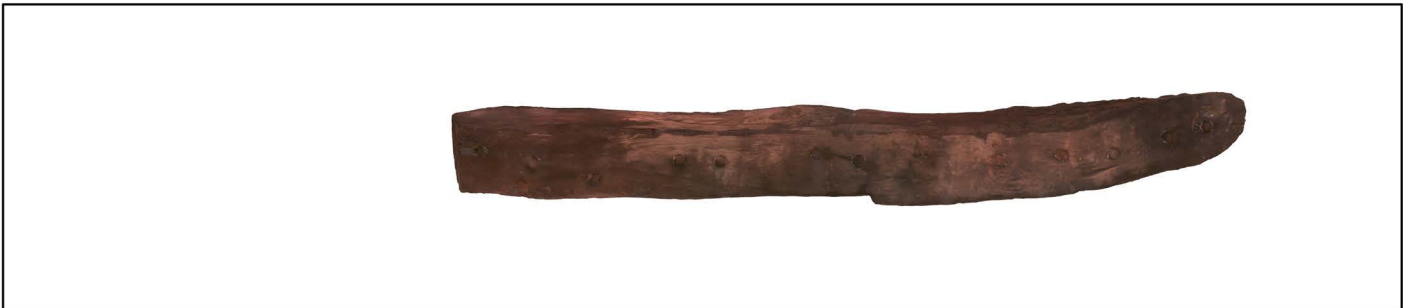
Inboard view



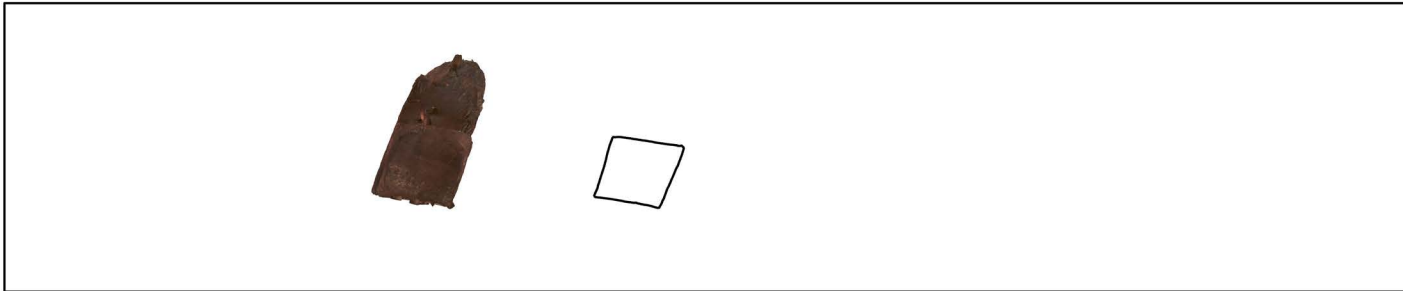
Aft view



Outboard view



Portside view

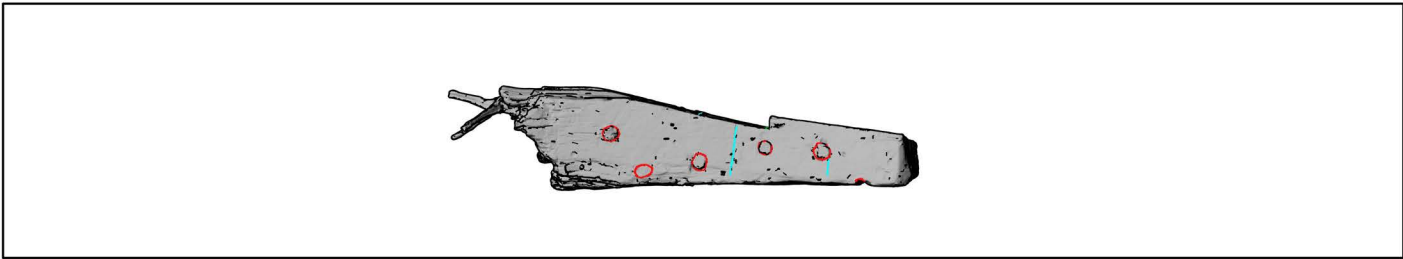


0 0.5m 1m

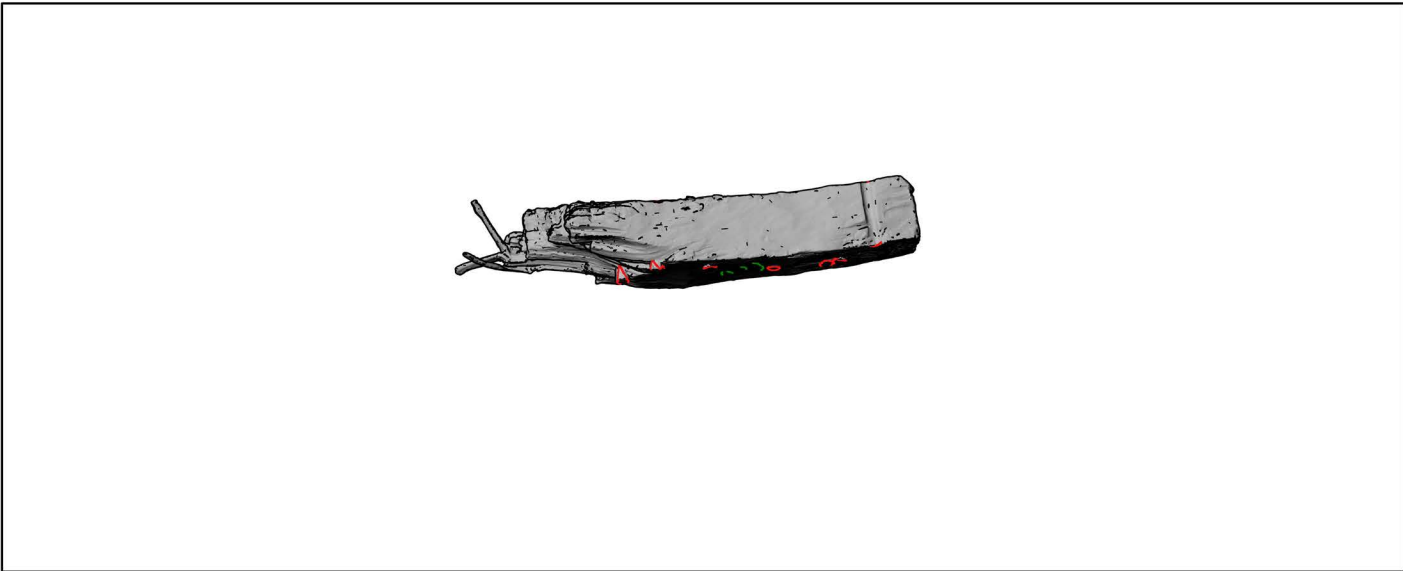
- Legend:
-  Trenails and trenail holes / wedged trenails
 -  Sapwood / bark
 -  Toolmarks
 -  Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	044
Timber type:	filling frame	Location:	filling frame, fore of 068 and aft of 45			
Status:	Final			Drawing No.:	089	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

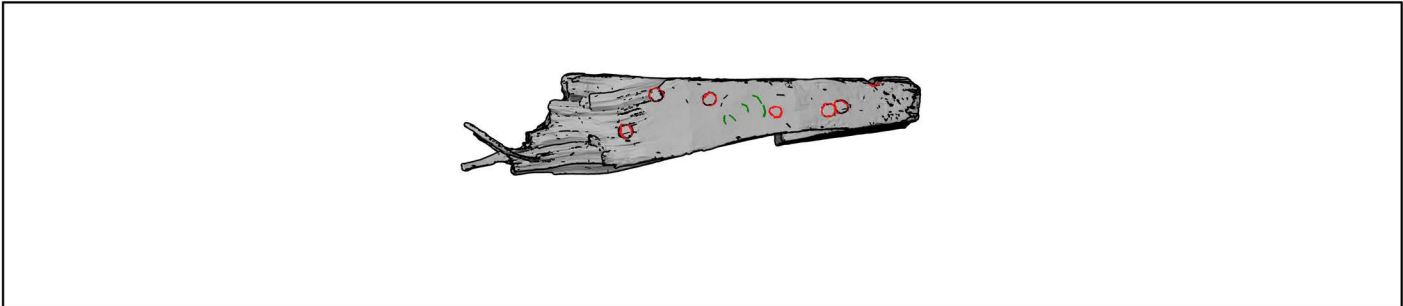
Inboard view



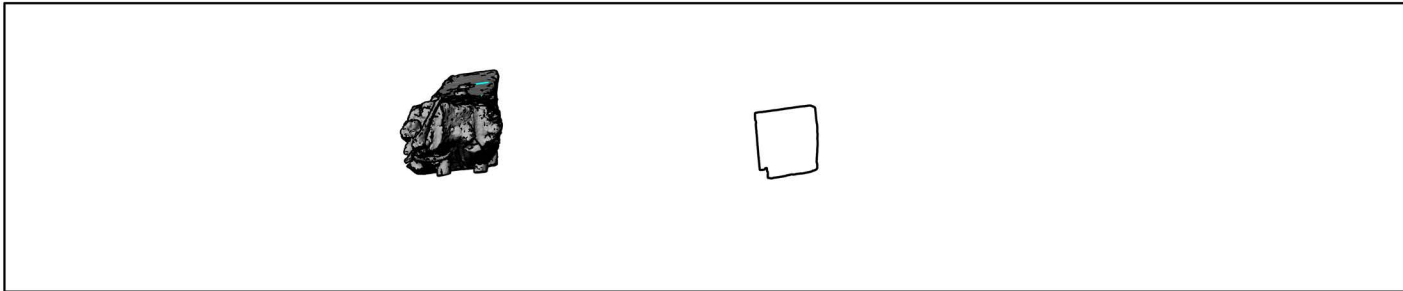
Aft view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Toolmarks
 - Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	045
Timber type:	floor	Location:	floor, scarf against futtock 69			
Status:	Final			Drawing No.:	090	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



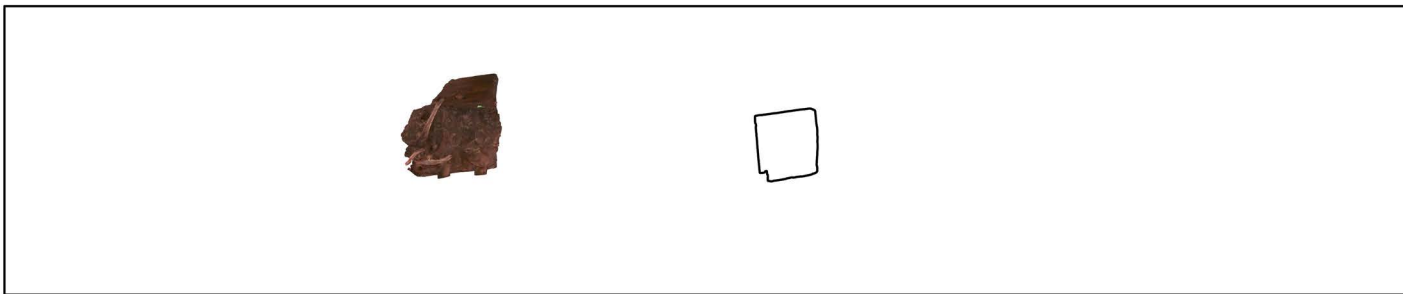
Aft view



Outboard view



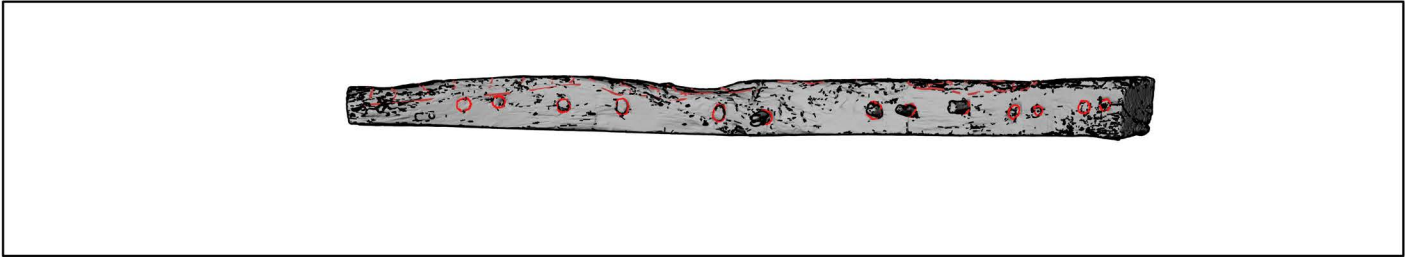
Portside view



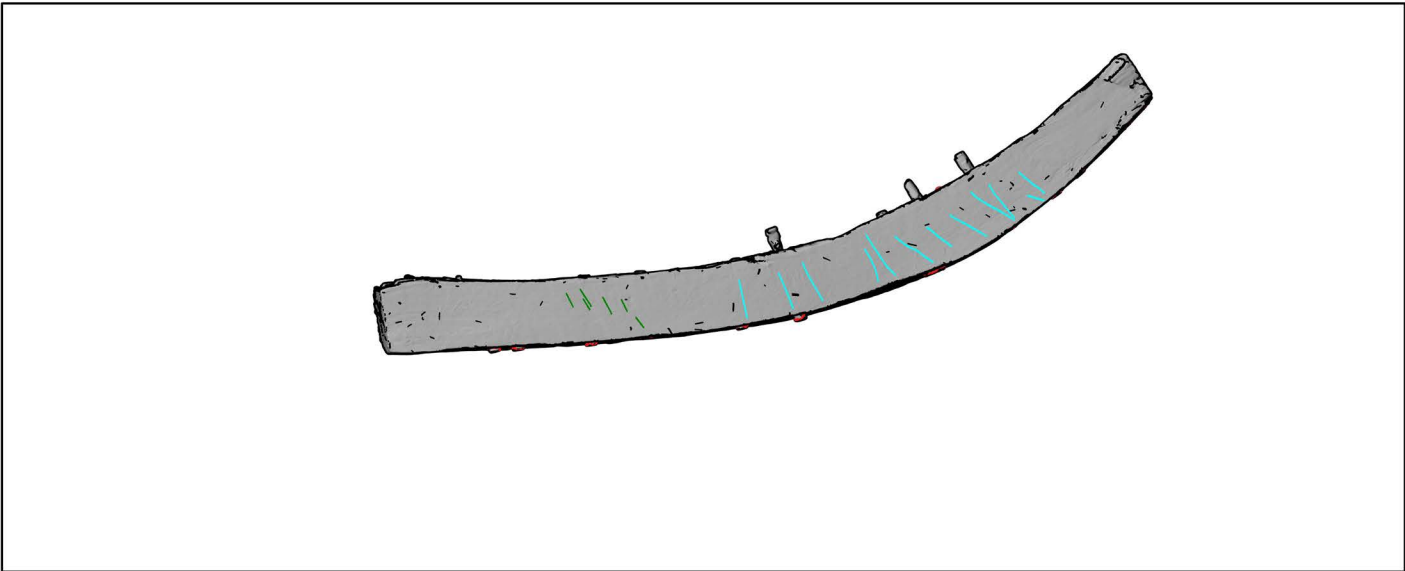
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	045
Timber type:	floor	Location:	floor, scarf against futtock 69			
Status:	Final			Drawing No.:	091	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

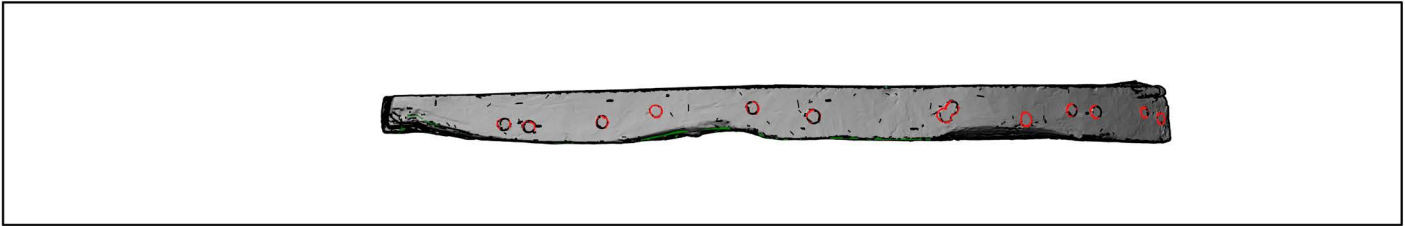
Inboard view



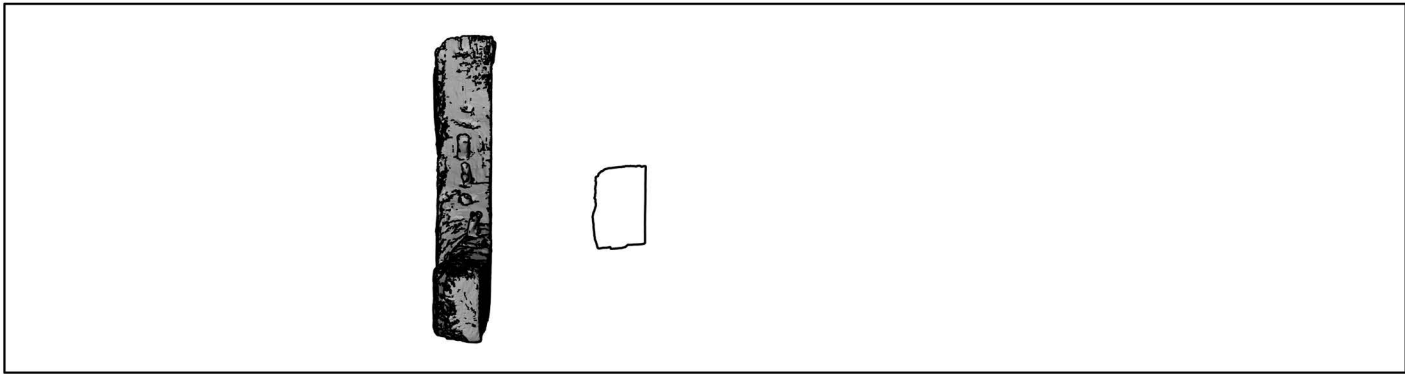
Fore/Aft view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Sapwood / bark
 - Toolmarks
 - Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	046
Timber type:	filling frame	Location:	next to futtock 69 and floor 47			
Status:	Final			Drawing No.:	092	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



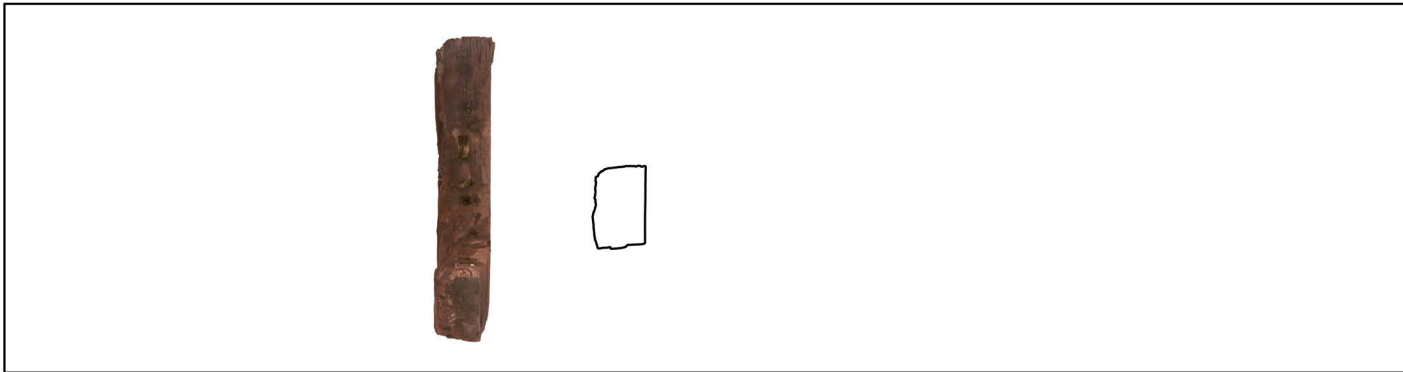
Aft view



Outboard view



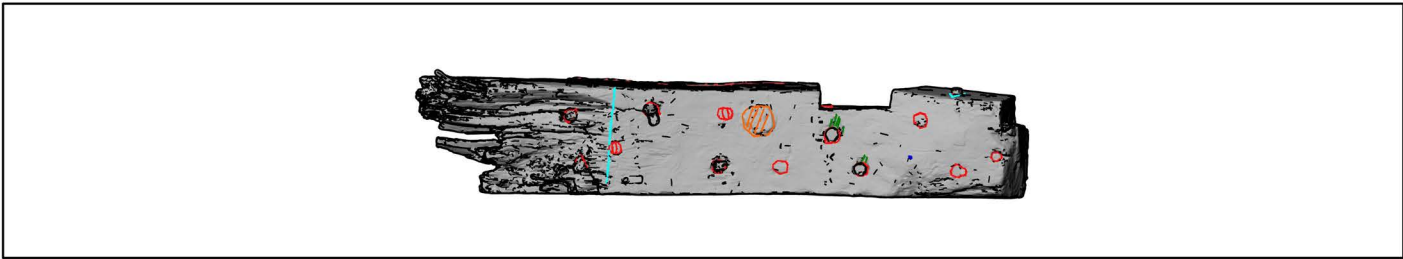
Portside view



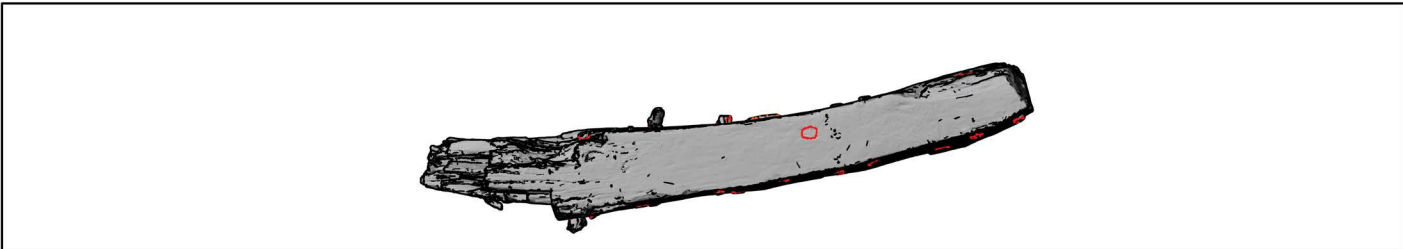
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	046
Timber type:	filling frame	Location:	next to futtock 69 and floor 47			
Status:	Final			Drawing No.:	093	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



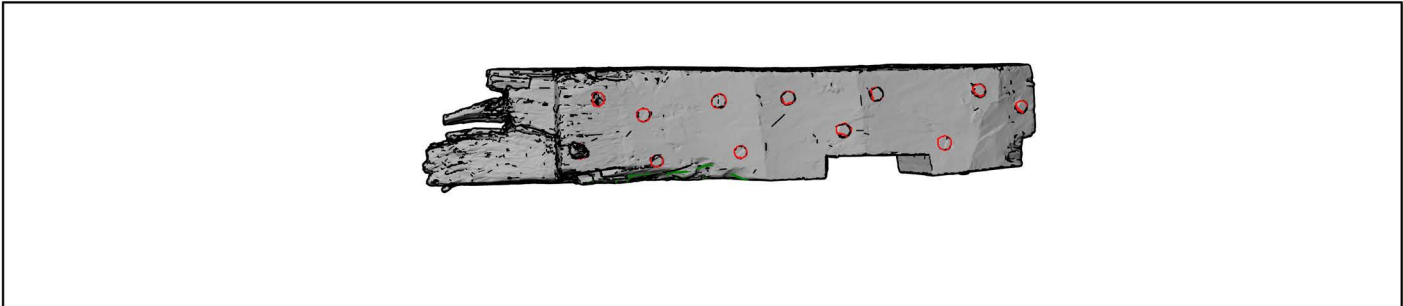
Aft view



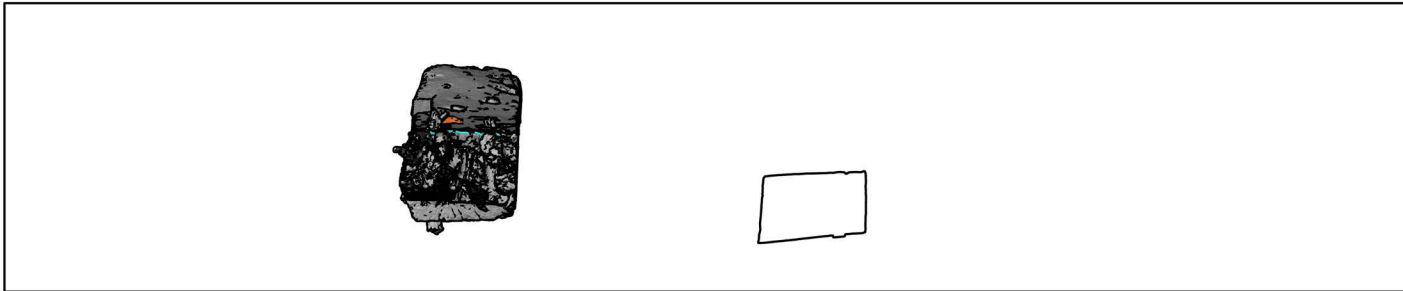
Fore view



Outboard view



Portside view



0 0.5m 1m

Legend:

-  Trenails and trenail holes / wedged trenails

 Sapwood / bark

 Wooden plugs / nails
-  Toolmarks

 Iron nail holes / heads

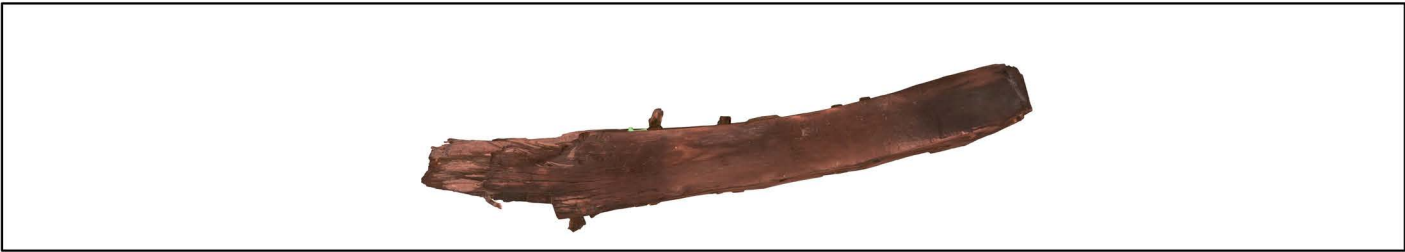
 Intentional marks
-  Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	047
Timber type:	floor timber	Location:	floor, scarf against futtock 70			
Status:	Final		Drawing No.:	094		
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



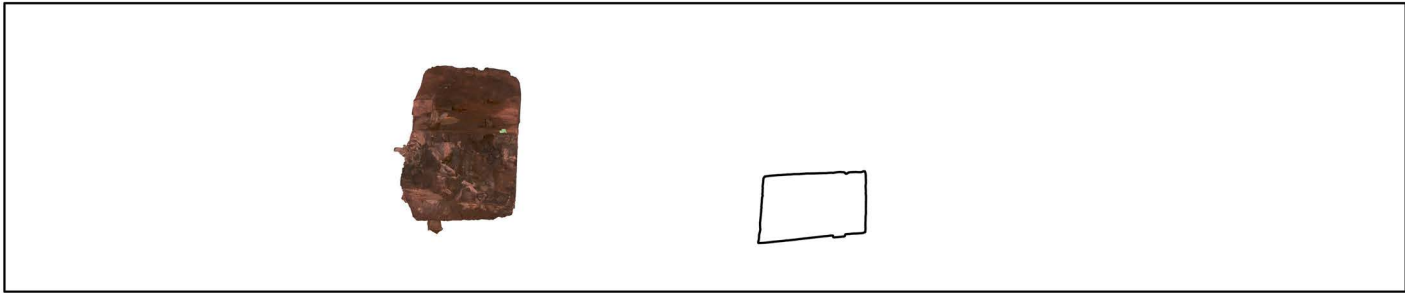
Fore view



Outboard view



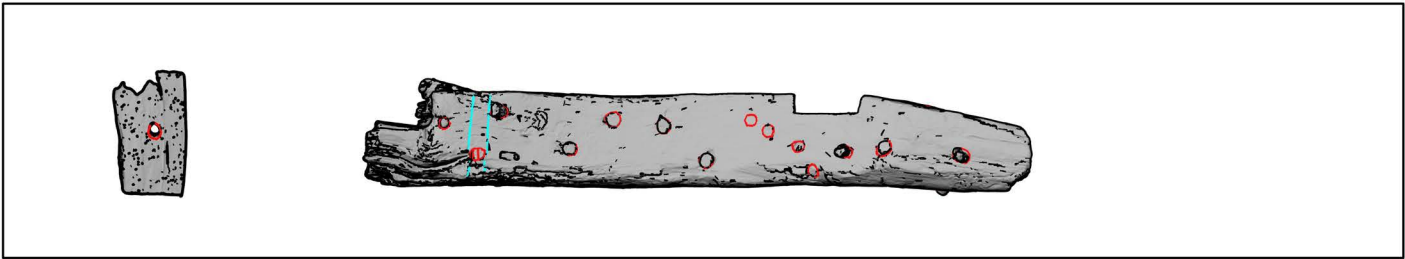
Portside view



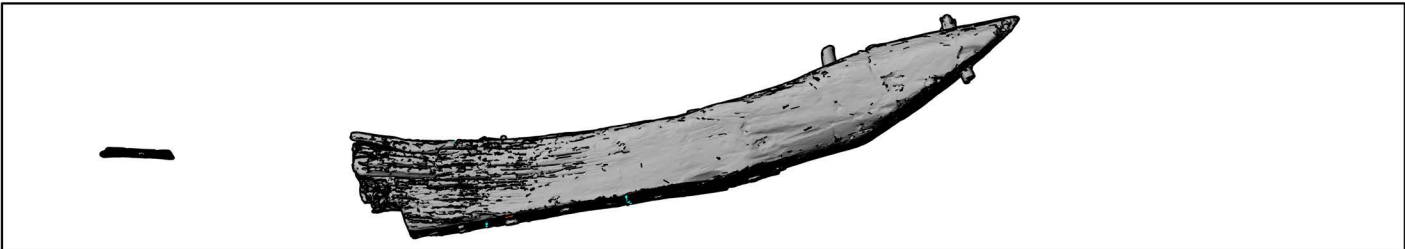
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	047
Timber type:	floor timber	Location:	floor, scarf against futtock 70			
Status:	Final			Drawing No.:	095	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

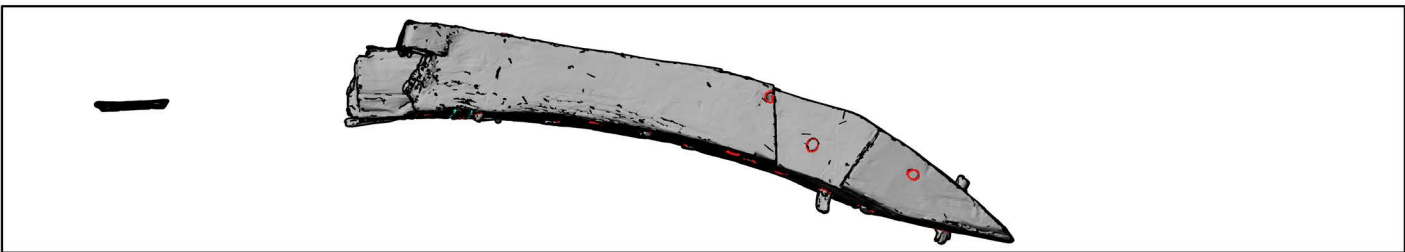
Inboard view



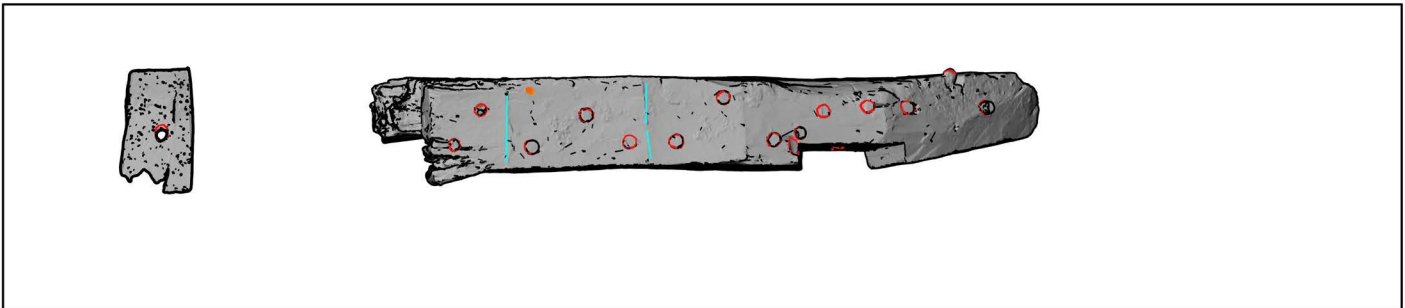
Aft view



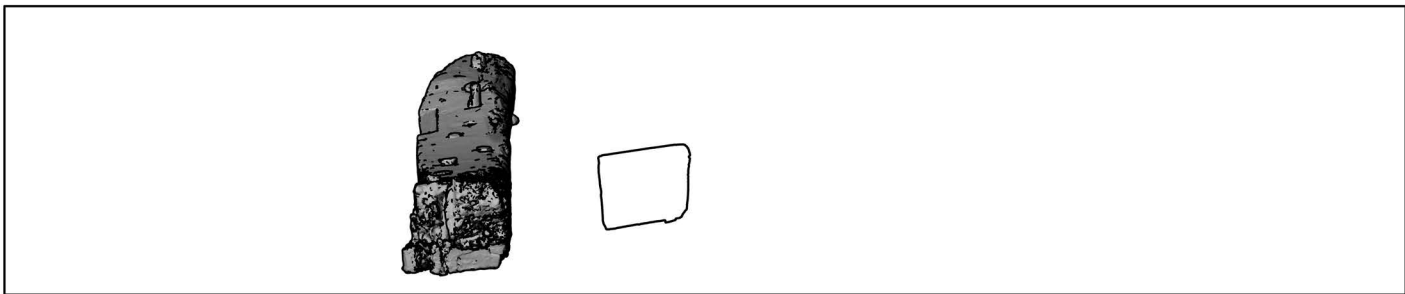
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Intentional marks
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	048 and 48b
Timber type:	floor, tingle	Location:	floor, scarf against futtock 71 / tingle under floor			
Status:	Final			Drawing No.:	096	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



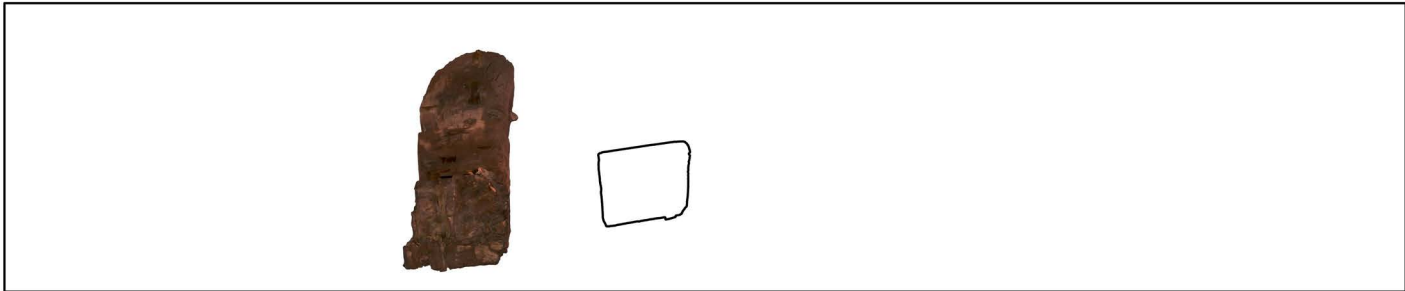
Fore view



Outboard view



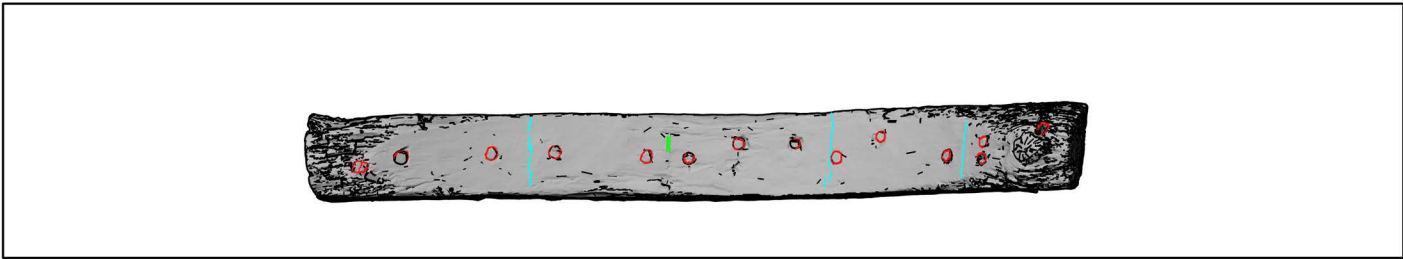
Portside view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	048 and 48b
Timber type:	floor, tingle	Location:	floor, scarf against futtock 71 / tingle under floor			
Status:	Final			Drawing No.:	097	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

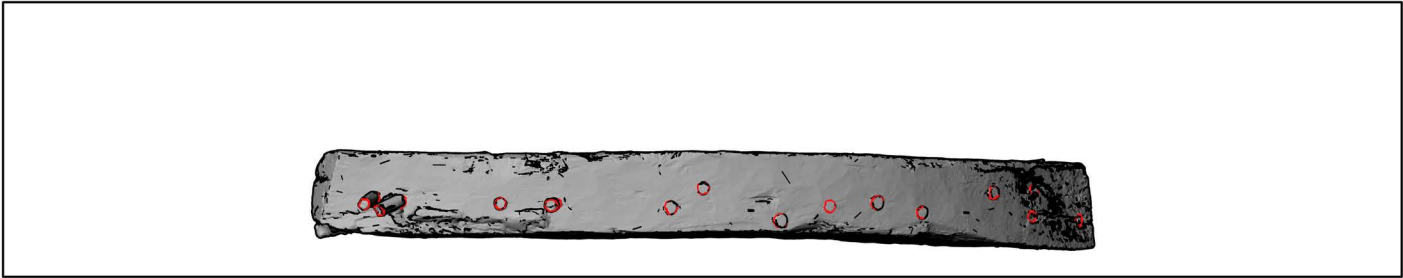
Inboard view



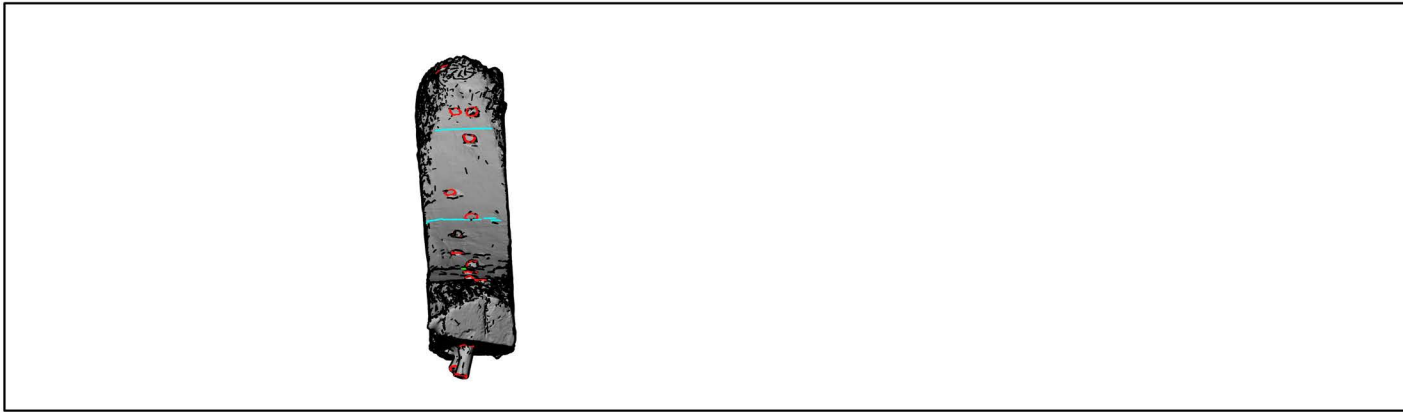
Aft view



Outboard view



Portside view



0 0.5m 1m

- Legend:
-  Trenails and trenail holes / wedged trenails
 -  Intentional marks
 -  Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	049
Timber type:	filling frame	Location:	between 48 and 50			
Status:	Final			Drawing No.:	098	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

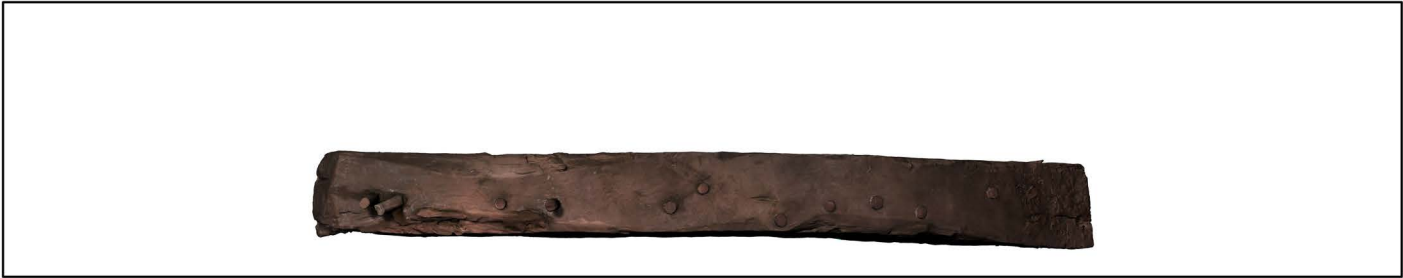
Inboard view



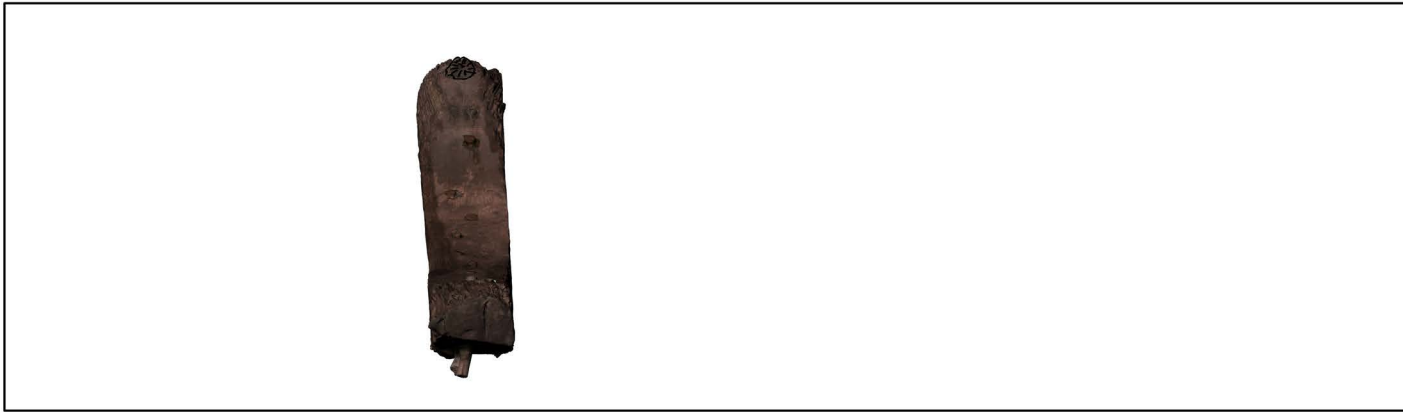
Aft view



Outboard view



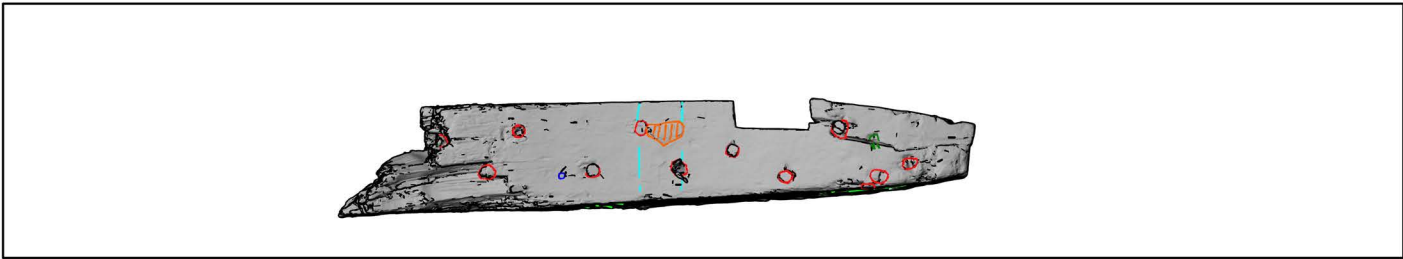
Portside view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	049
Timber type:	filling frame	Location:	between 48 and 50			
Status:	Final			Drawing No.:	099	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

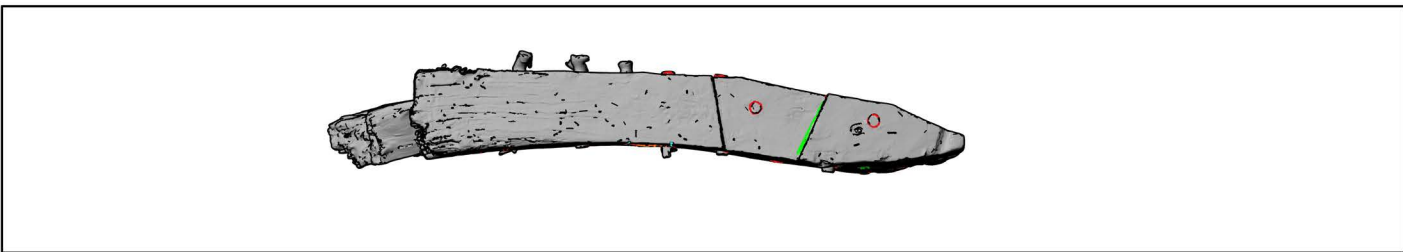
Inboard view



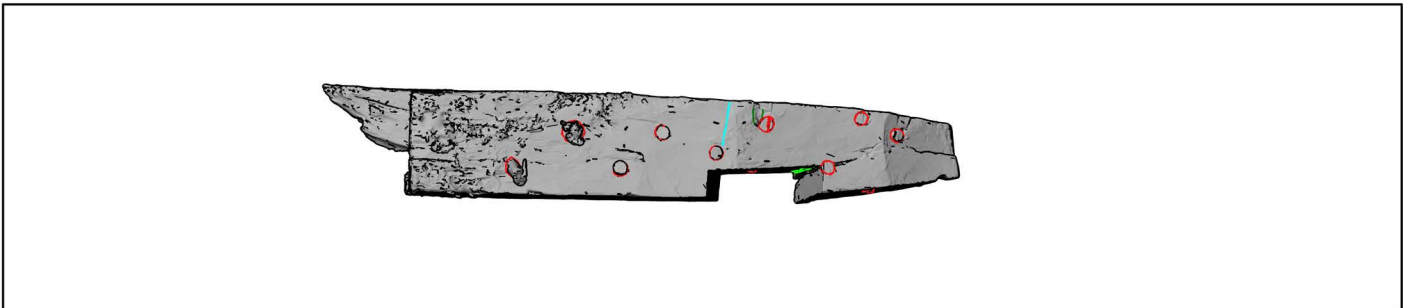
Aft view



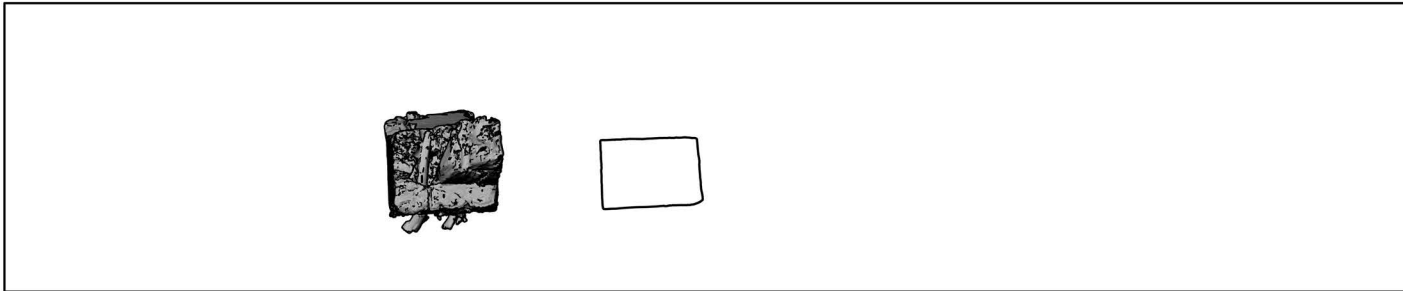
Fore view



Outboard view



Portside view



0 0.5m 1m

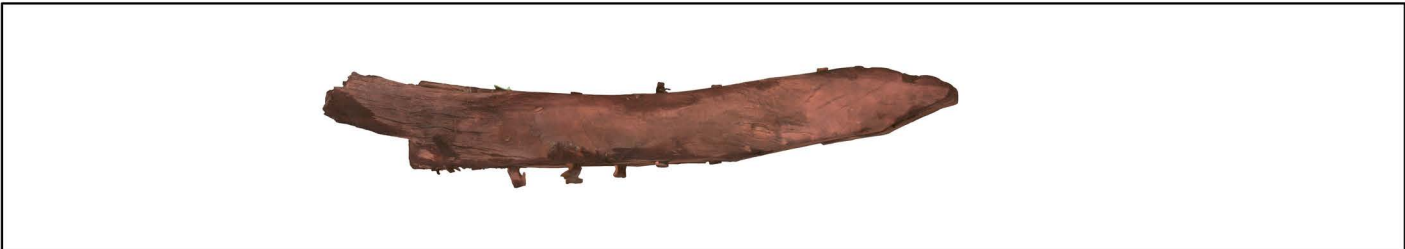
- Legend:
- Trenails and trenail holes / wedged trenails
 - Wooden plugs / nails
 - Toolmarks
 - Iron nail holes / heads
 - Concretion
 - Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	50
Timber type:	floor timber	Location:	floor, scarf against futtock 72			
Status:	Final			Drawing No.:	100	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



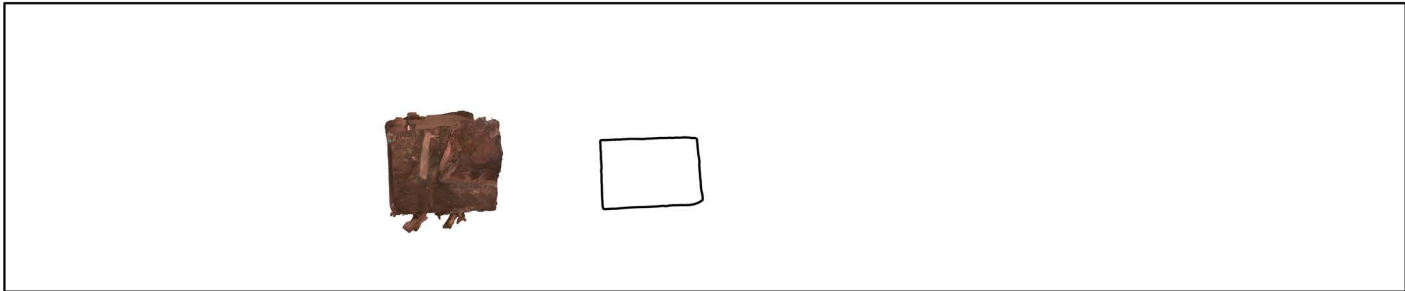
Fore view



Outboard view



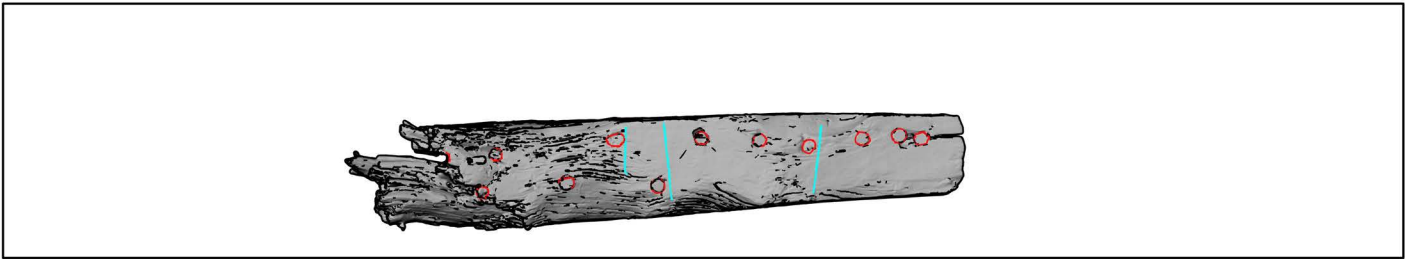
Portside view



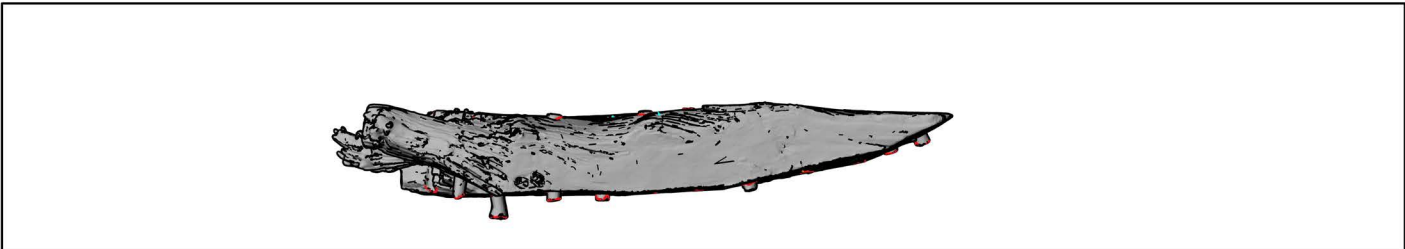
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	50
Timber type:	floor timber	Location:	floor, scarf against futtock 72			
Status:	Final			Drawing No.:	101	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

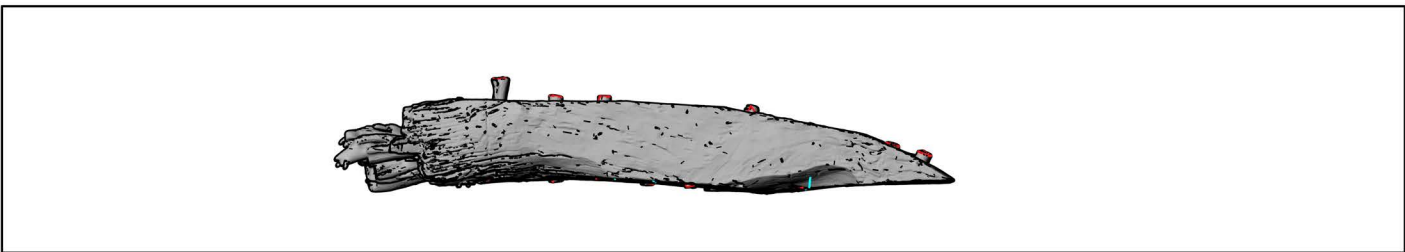
Inboard view



Aft view



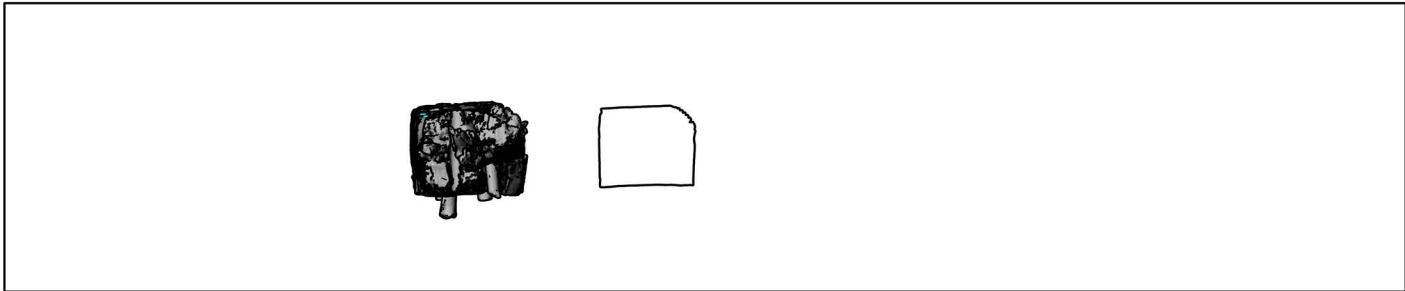
Fore view



Outboard view



Portside view

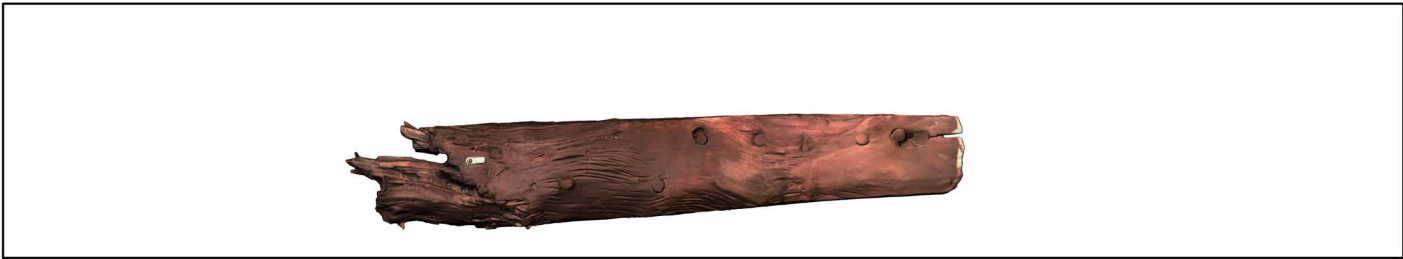


0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Intentional marks
 - Concretion
 - Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004	Previous number:		Timber ID:	51	
Timber type:	floor timber	Location:	master frame, scarf against futtock 78			
Status:	Final		Drawing No.:	102		
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



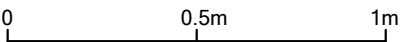
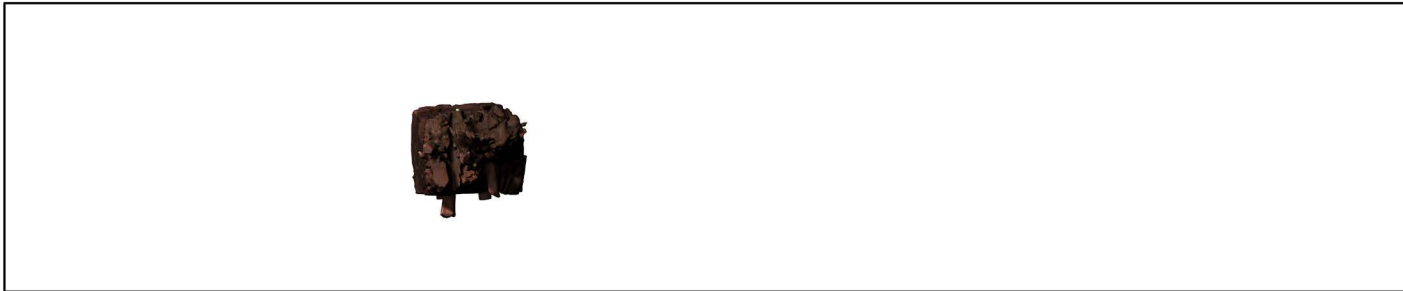
Fore view



Outboard view



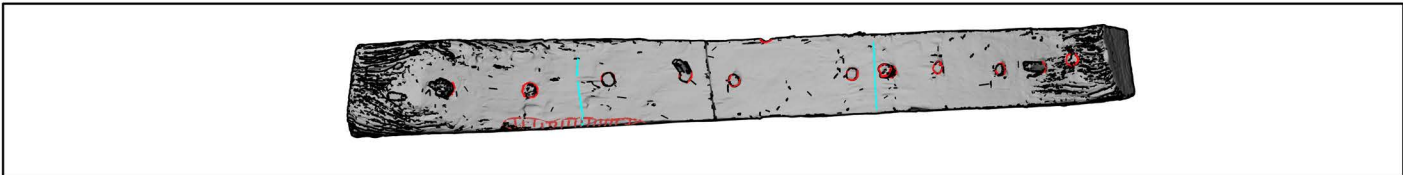
Portside view



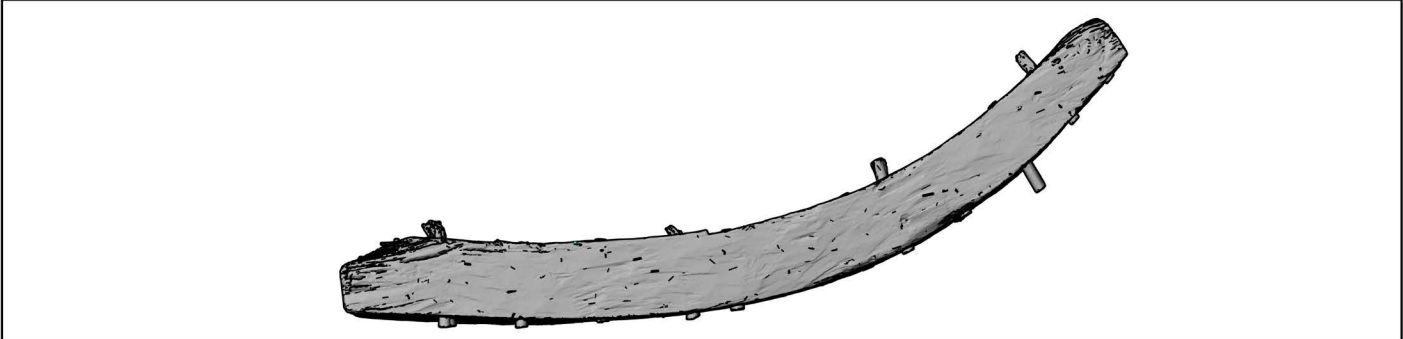
- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Intentional marks
 - Concretion
 - Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	51
Timber type:	floor timber	Location:	master frame, scarf against futtock 78			
Status:	Final			Drawing No.:	103	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

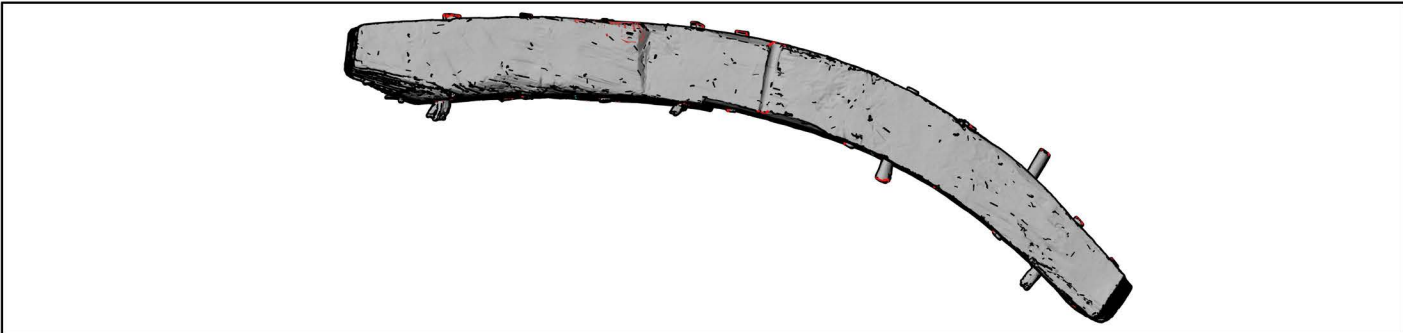
Inboard view



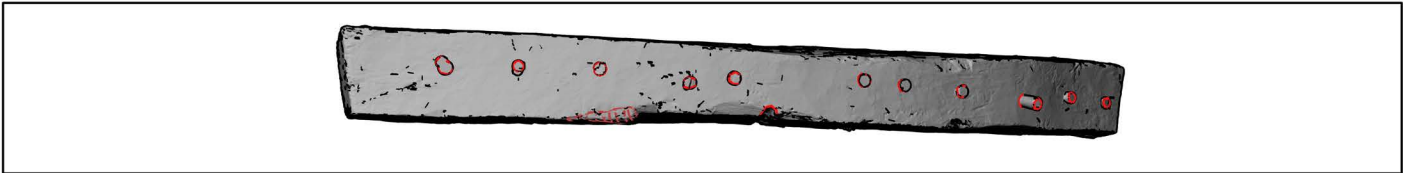
Aft view



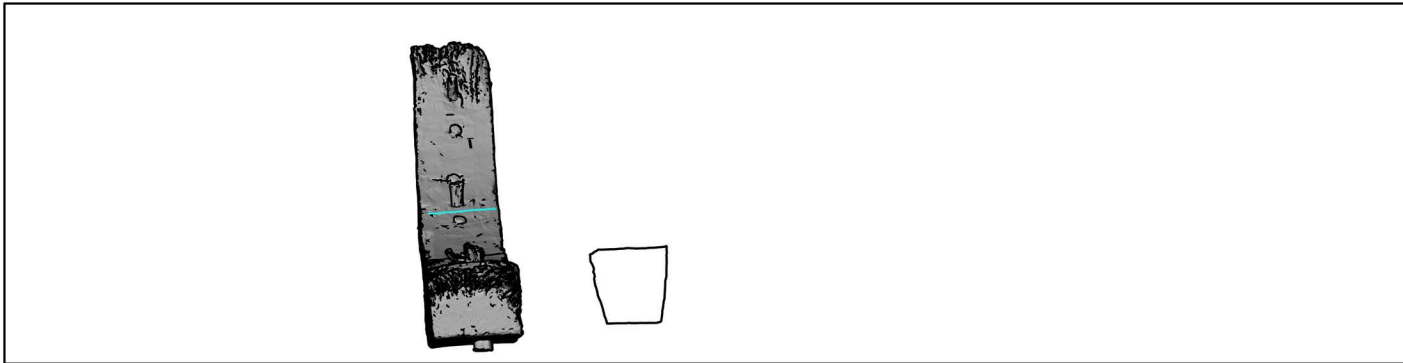
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Intentional marks
 - Sapwood / bark

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	52
Timber type:	filling frame	Location:	between floor 51 and 53, joggled on futtock 73			
Status:	Final			Drawing No.:	104	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



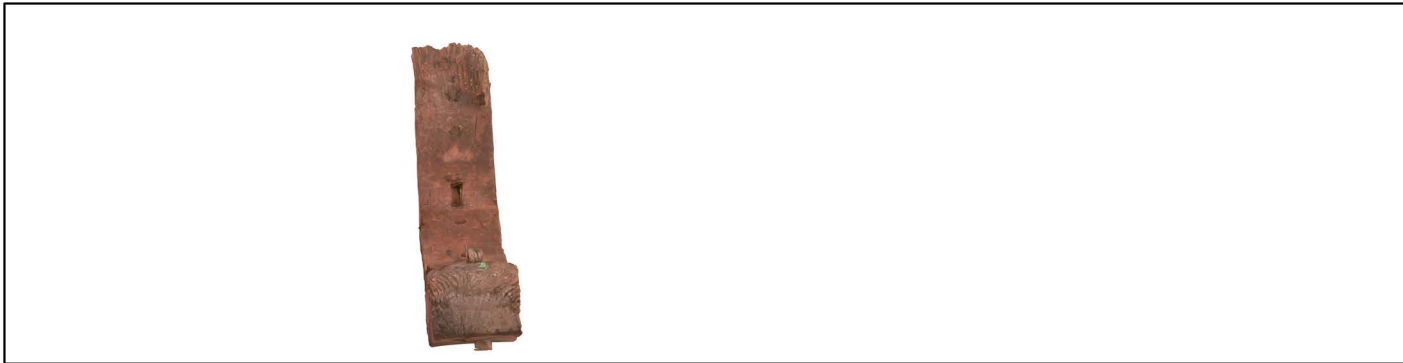
Fore view



Outboard view



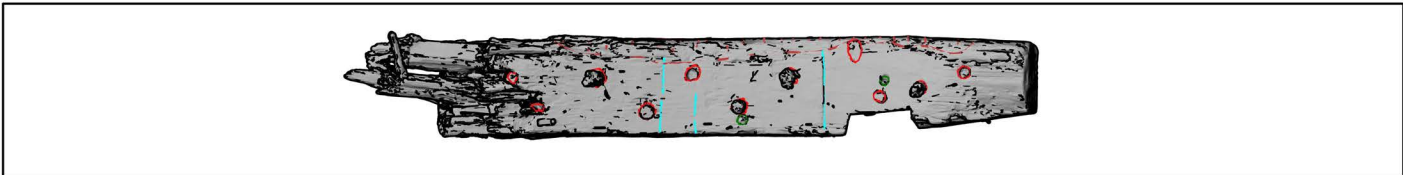
Portside view



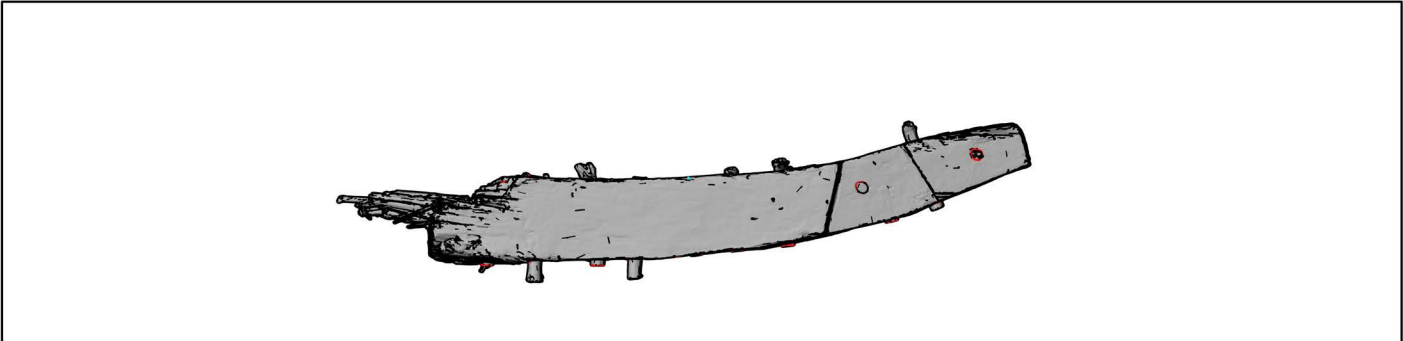
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	52
Timber type:	filling frame	Location:	between floor 51 and 53, joggled on futtock 73			
Status:	Final			Drawing No.:	105	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

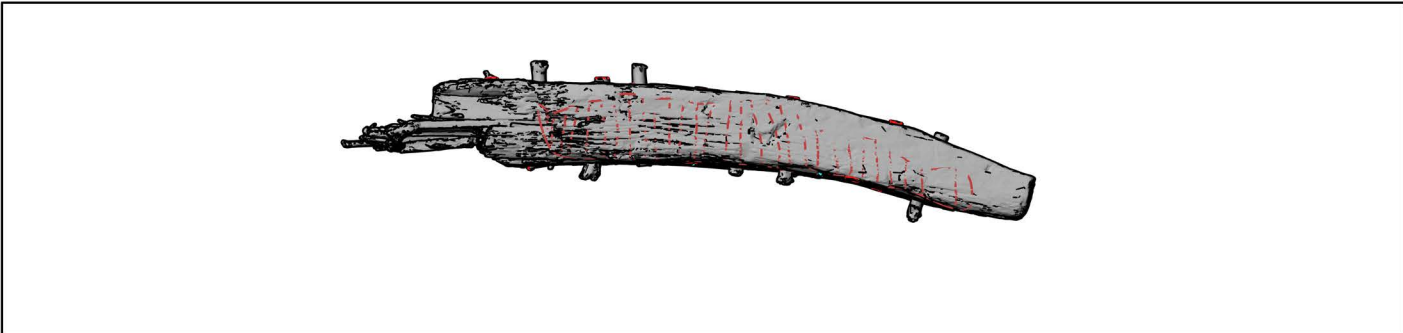
Inboard view



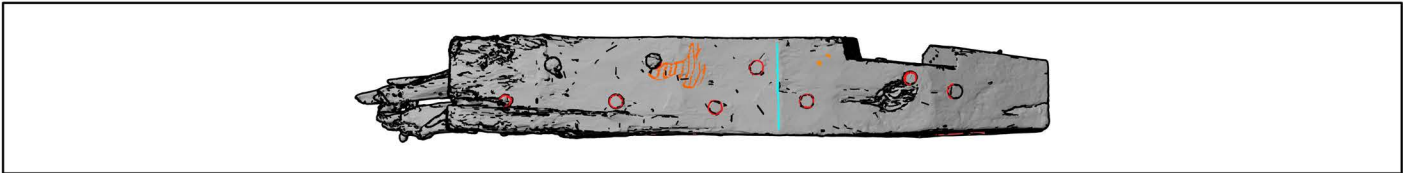
Aft view



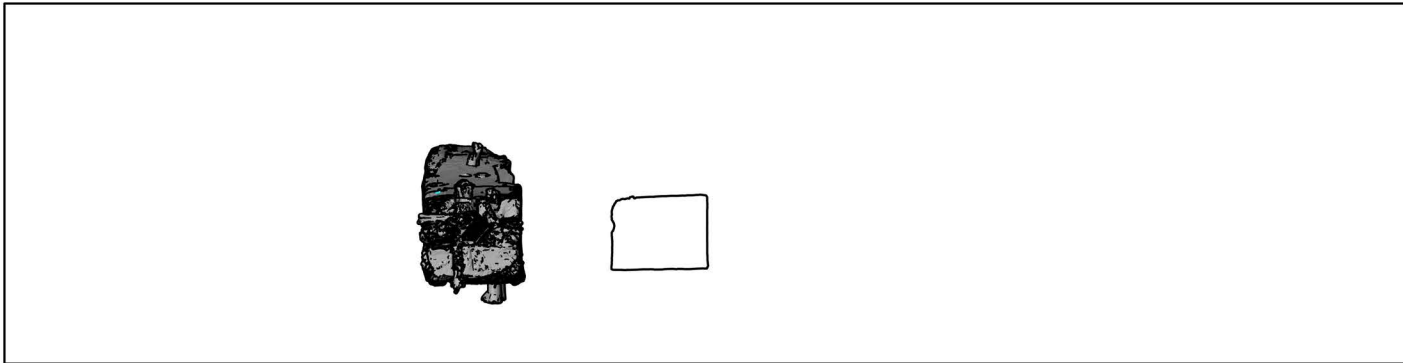
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
-  Trenails and trenail holes / wedged trenails

 Toolmarks (auger)

 Intentional marks

 Iron nail holes / heads

 Concretion

 Sapwood / bark

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	53
Timber type:	floor timber	Location:	first frame fore of master frame, jointed to futtock 73			
Status:	Final			Drawing No.:	106	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



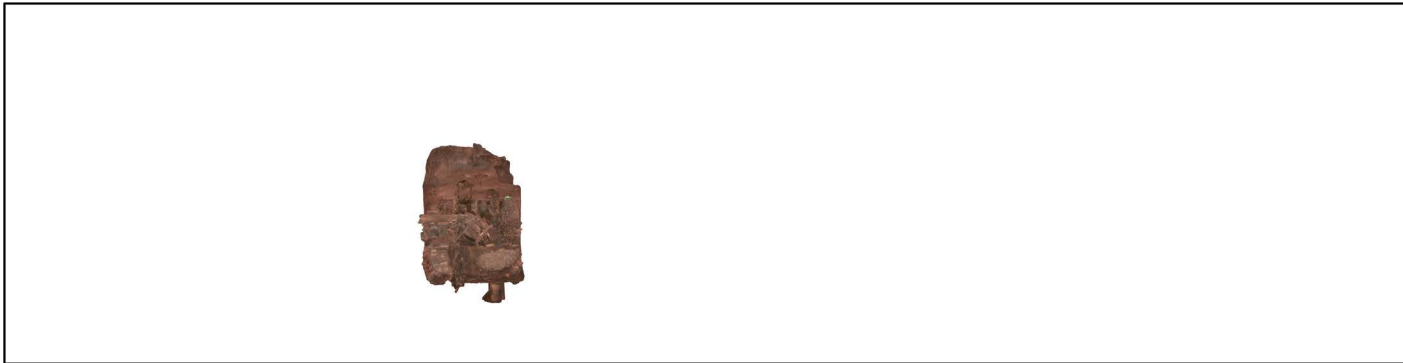
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- 

Trenails and trenail holes / wedged trenails



Toolmarks (auger)



Intentional marks



Iron nail holes / heads



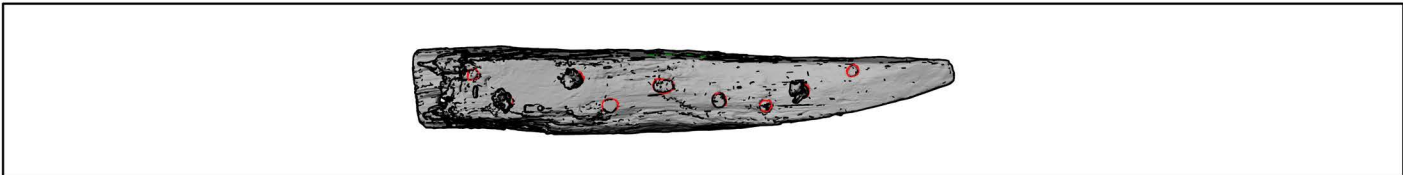
Concretion



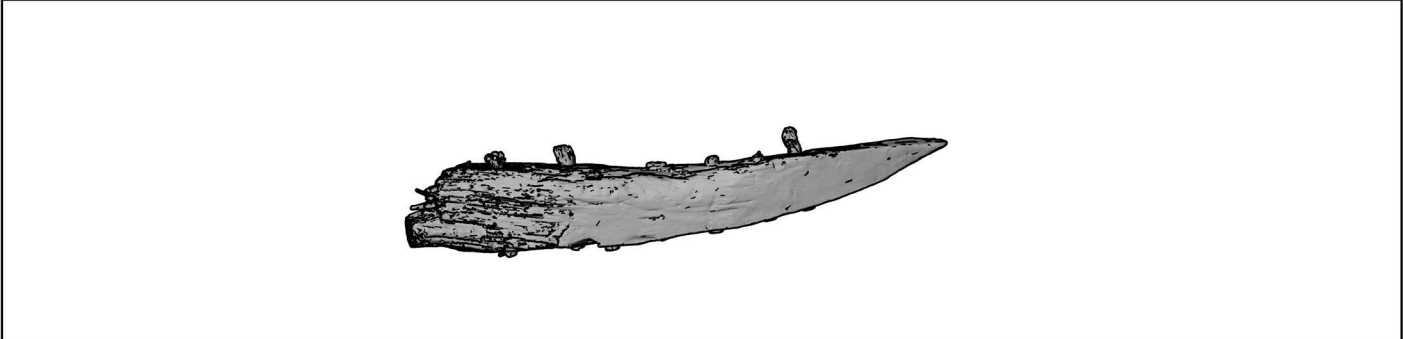
Sapwood / bark

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	53
Timber type:	floor timber	Location:	first frame fore of master frame, jointed to futtock 73			
Status:	Final			Drawing No.:	107	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



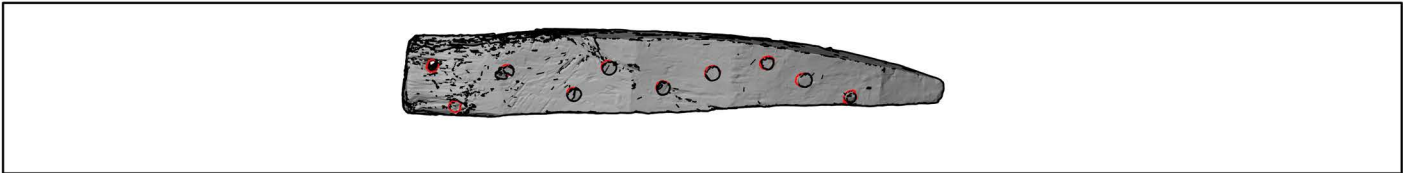
Aft view



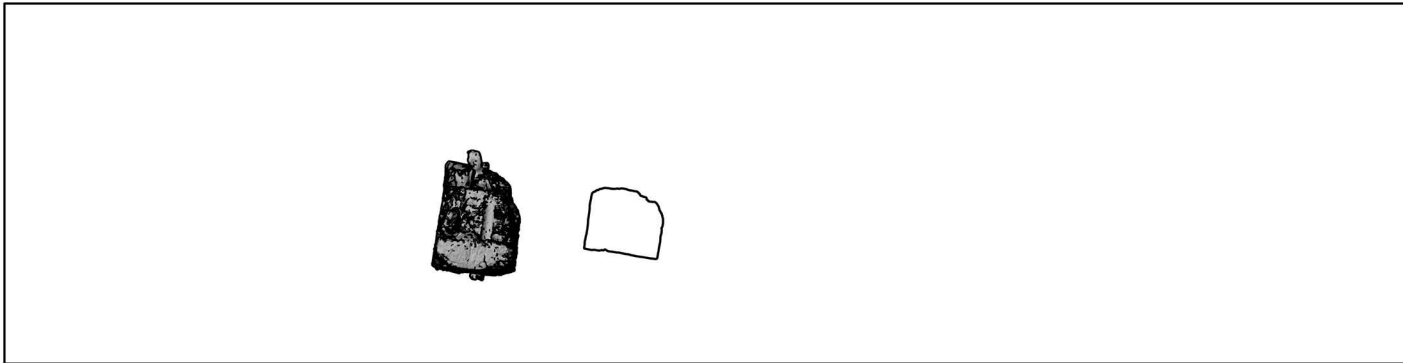
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- ⊙ Trenails and trenail holes / wedged trenails
 - Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	54
Timber type:	floor timber	Location:	floor, next to futtock 74			
Status:	Final			Drawing No.:	108	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



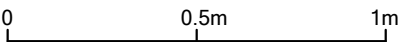
Fore view



Outboard view



Portside view

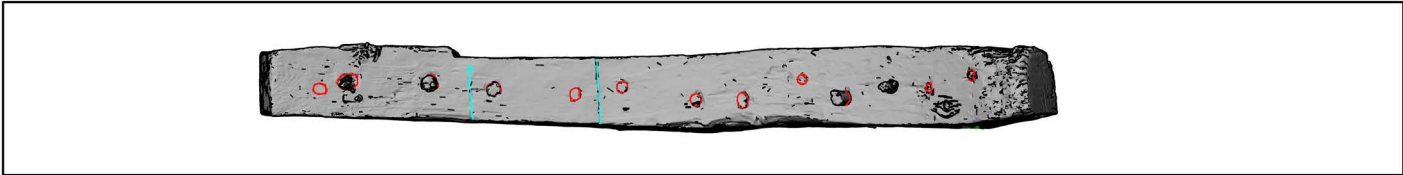


Legend:

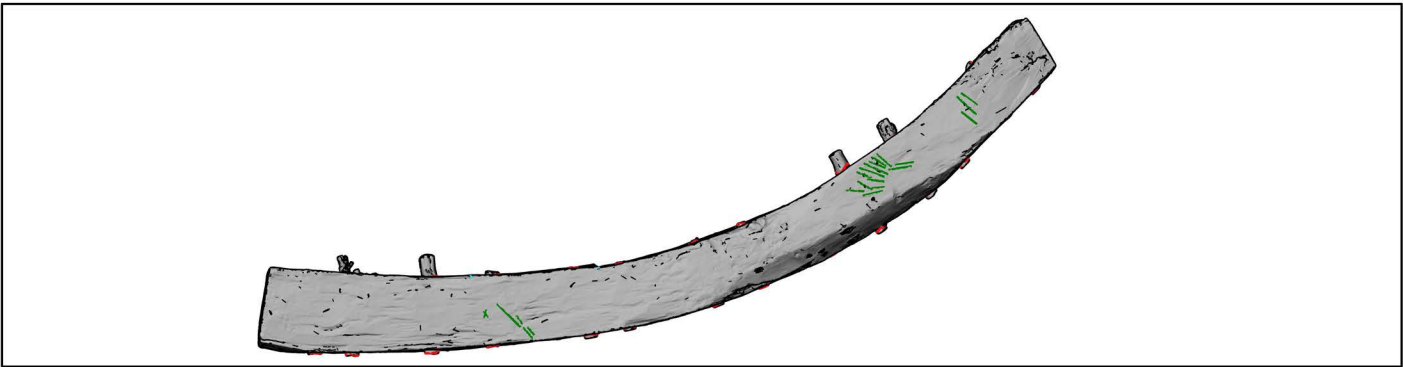
- ⊗ Trenails and trenail holes / wedged trenails
- Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	54
Timber type:	floor timber	Location:	floor, next to futtock 74			
Status:	Final		Drawing No.:	109		
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

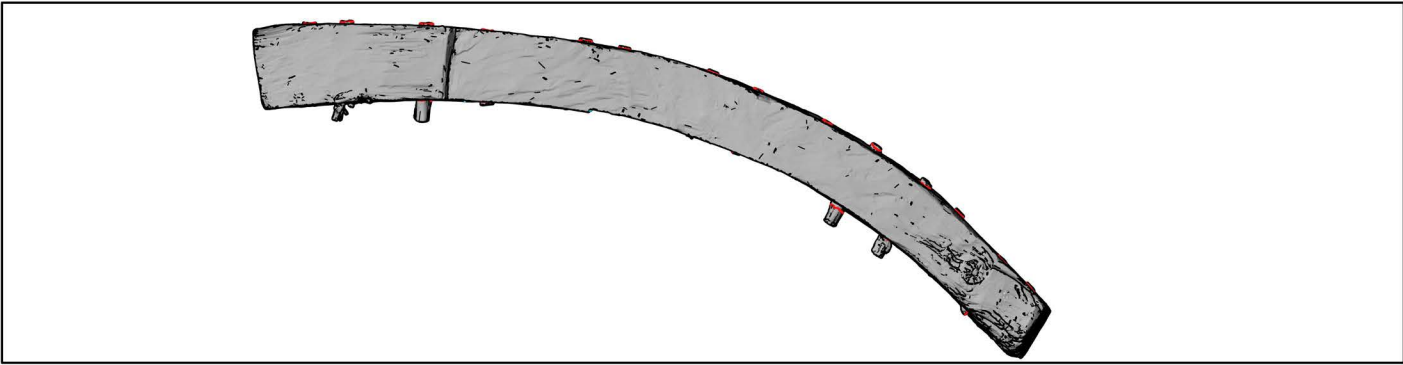
Inboard view



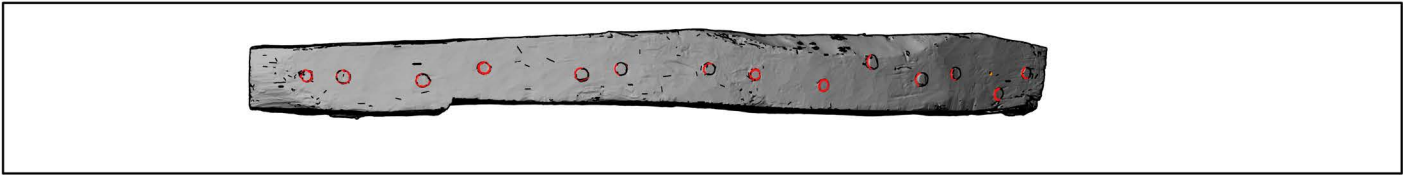
Aft view



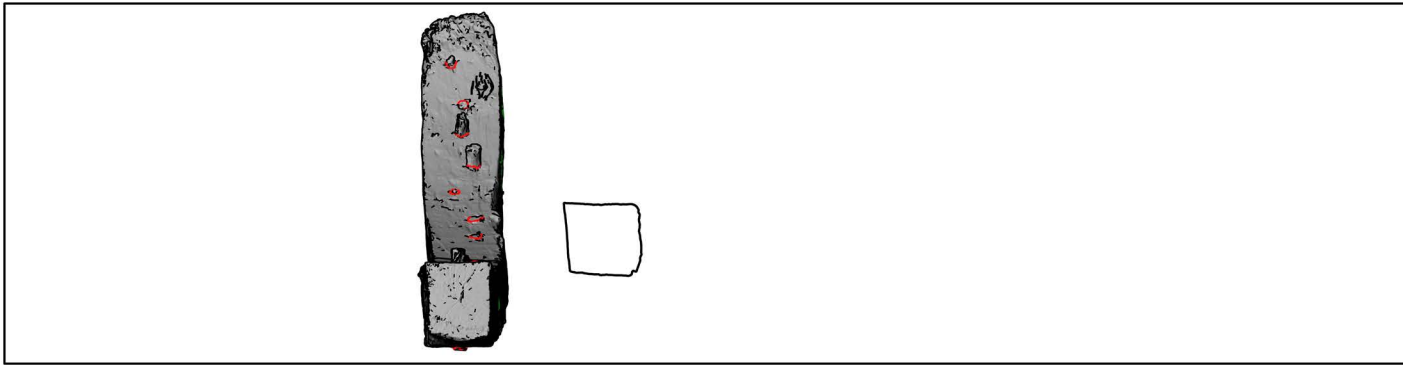
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Iron nail holes / heads

Intentional marks

Concretion

Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	55
Timber type:	filling frame	Location:	filling frame, joggle on fore side to futtock 75, next to floor 56			
Status:	Final			Drawing No.:	110	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



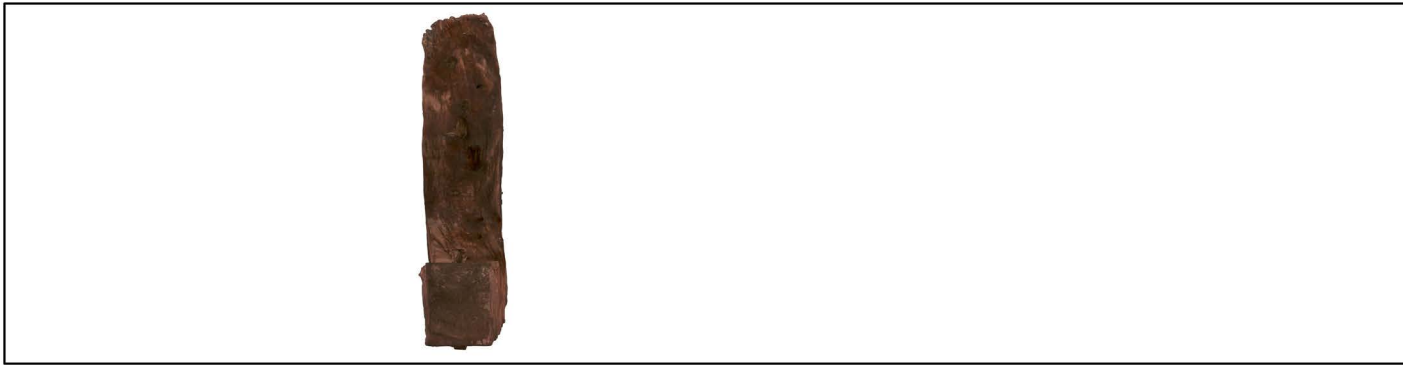
Fore view



Outboard view



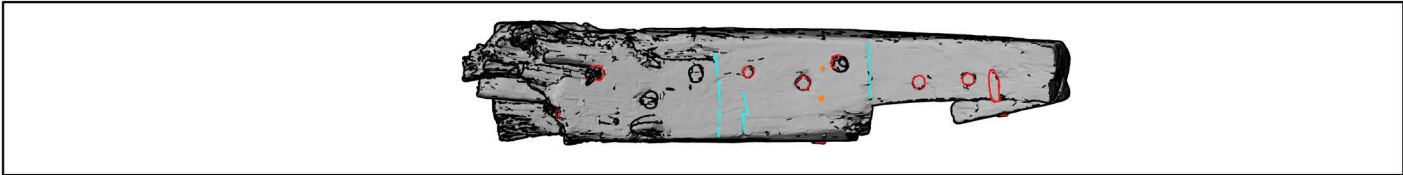
Portside view



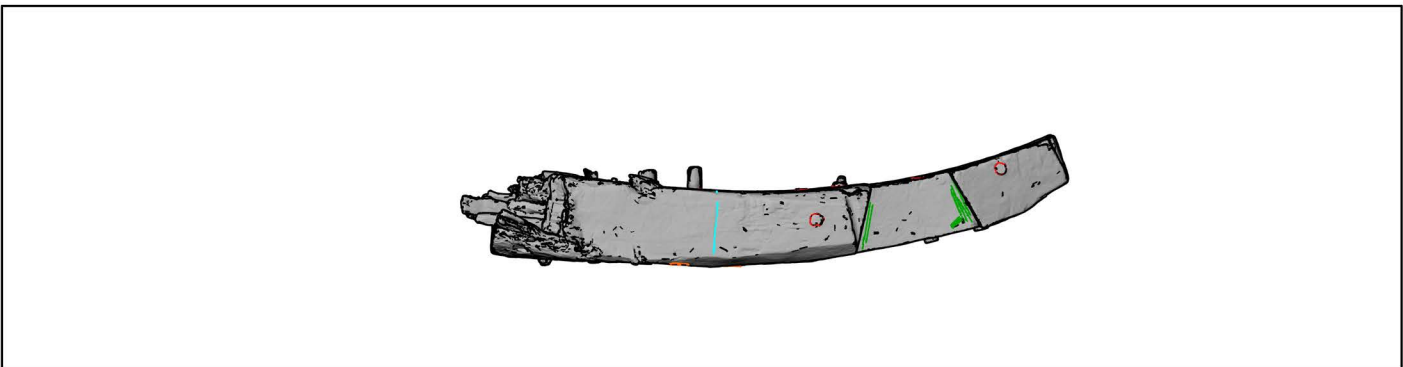
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	55
Timber type:	filling frame	Location:	filling frame, joggle on fore side to futtock 75, next to floor 56			
Status:	Final			Drawing No.:	111	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

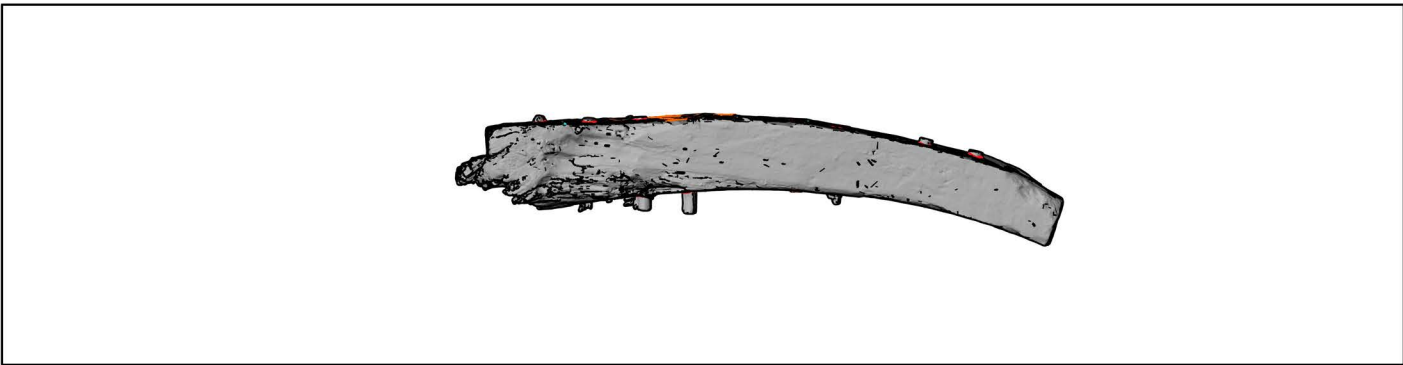
Inboard view



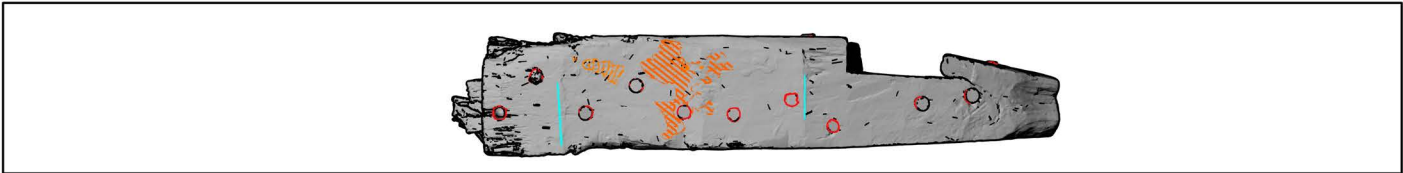
Aft view



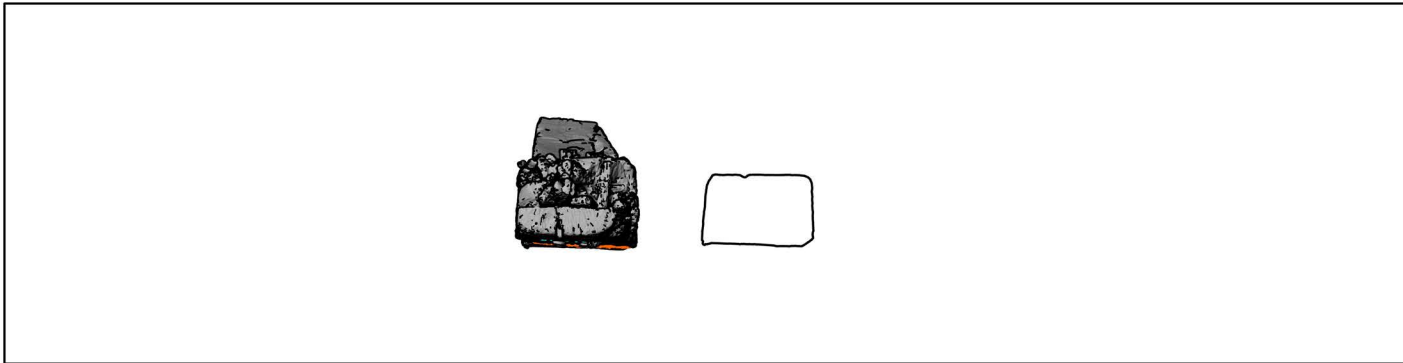
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Intentional marks
 - Concretion
 - Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	56
Timber type:	floor	Location:	floor, fore of futtock 75			
Status:	Final			Drawing No.:	112	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



Fore view



Outboard view



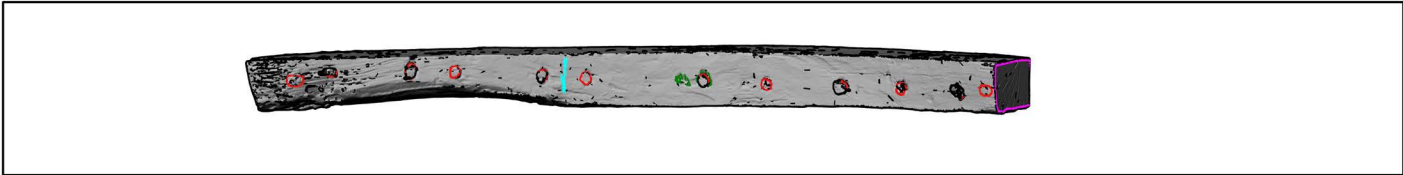
Portside view



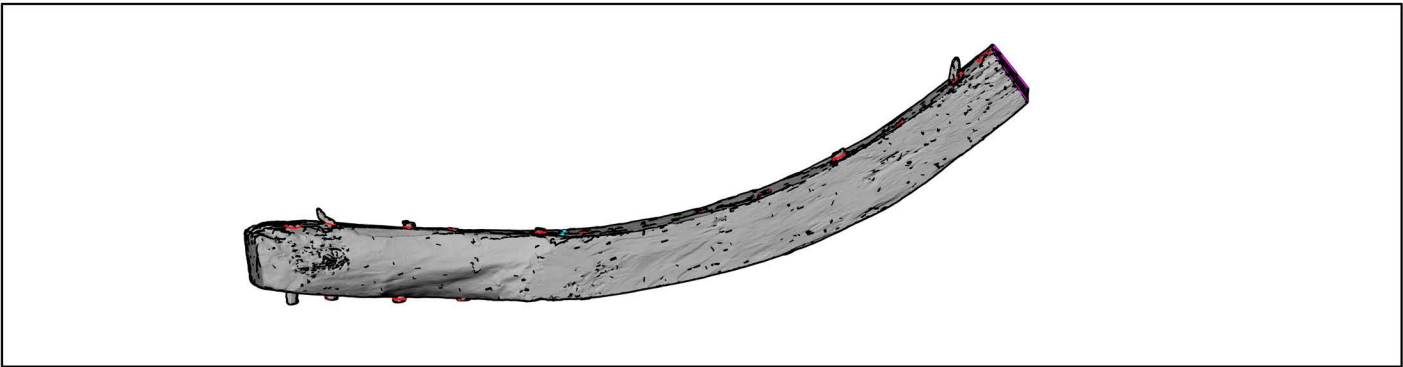
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	56
Timber type:	floor timber	Location:	floor, fore of futtock 75			
Status:	Final			Drawing No.:	113	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

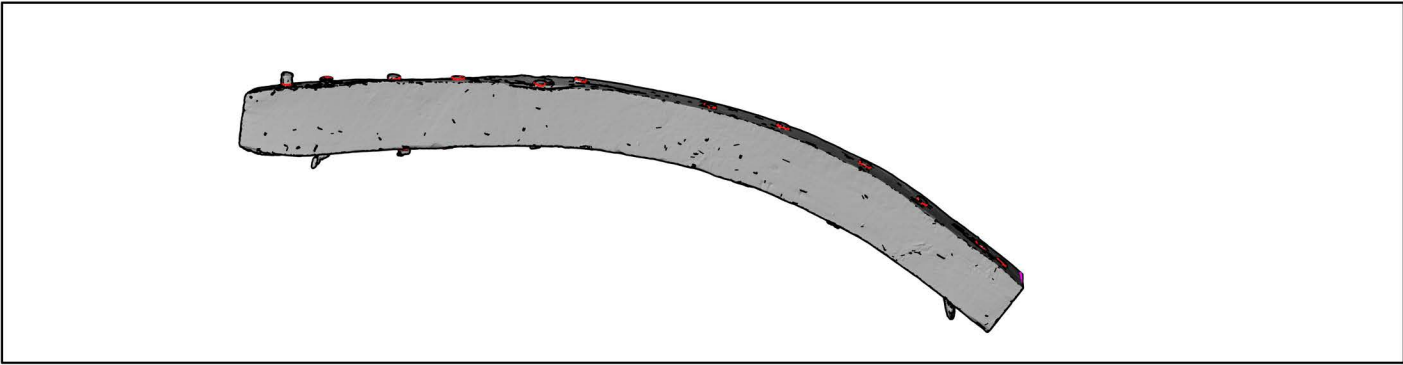
Inboard view



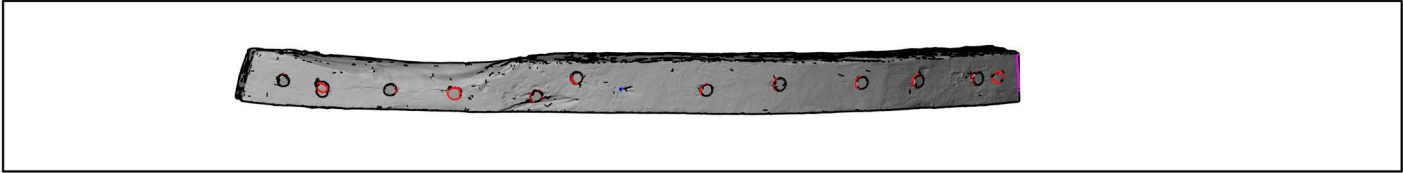
Aft view



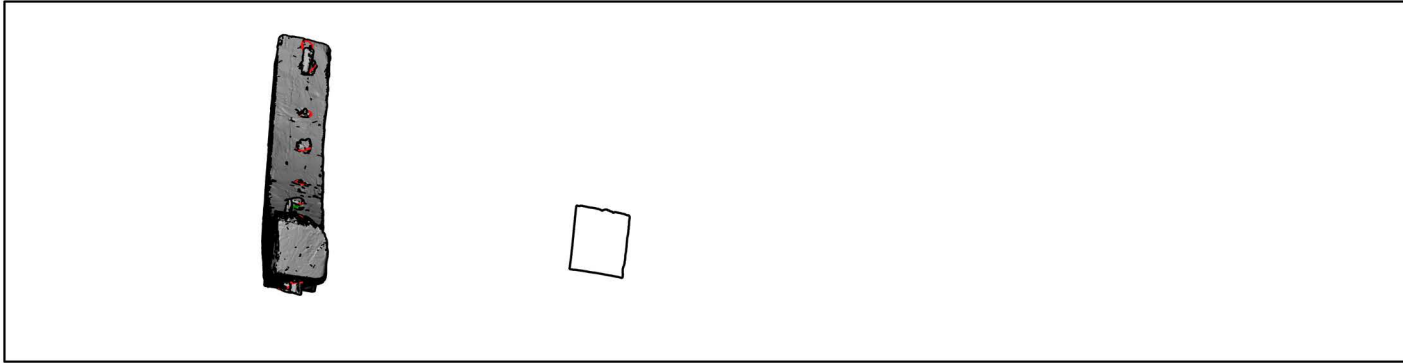
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Dendrosample cut

Wooden plugs / nails

Toolmarks

Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	57
Timber type:	filling frame	Location:	filling frame, between floor 56 and 58			
Status:	Final			Drawing No.:	114	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



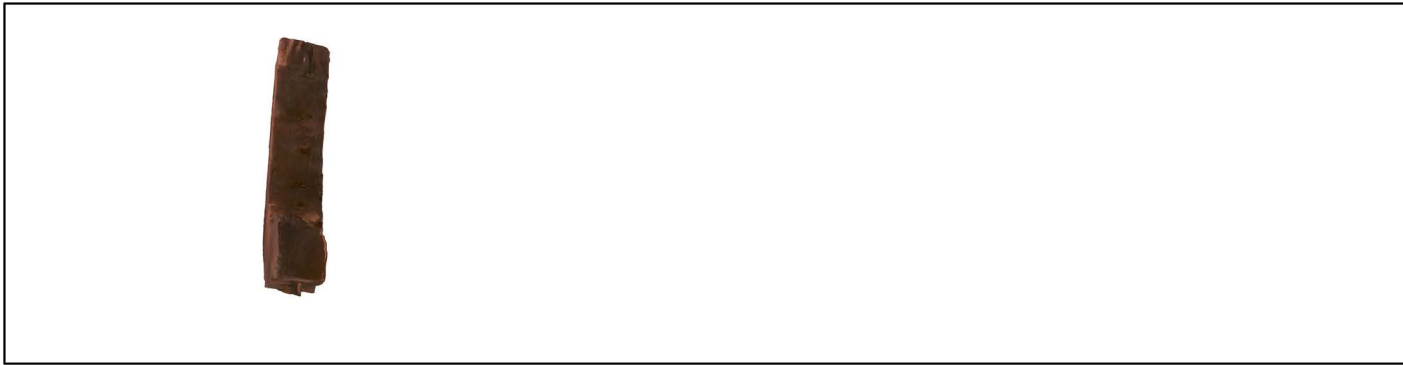
Fore view



Outboard view



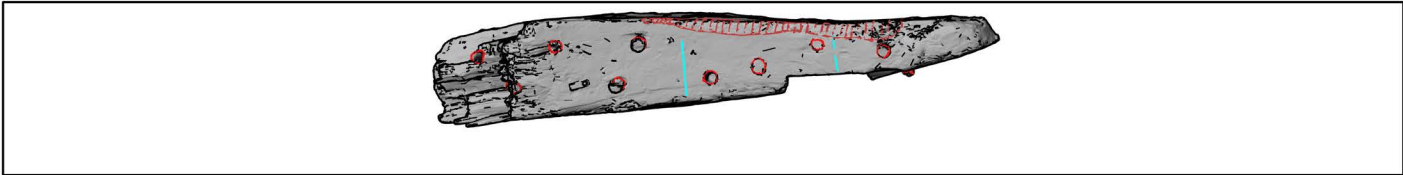
Portside view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	57
Timber type:	filling frame	Location:	filling frame, between floor 56 and 58			
Status:	Final			Drawing No.:	115	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

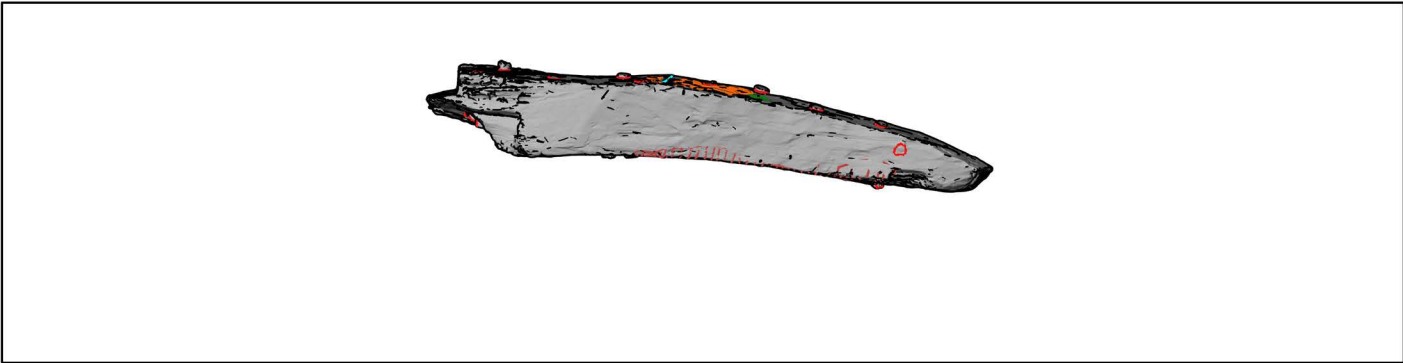
Inboard view



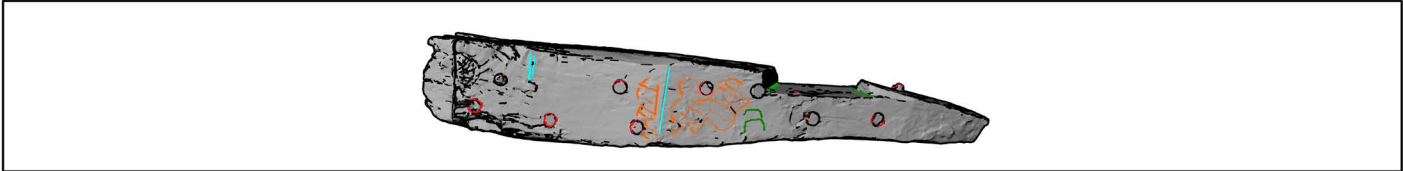
Aft view



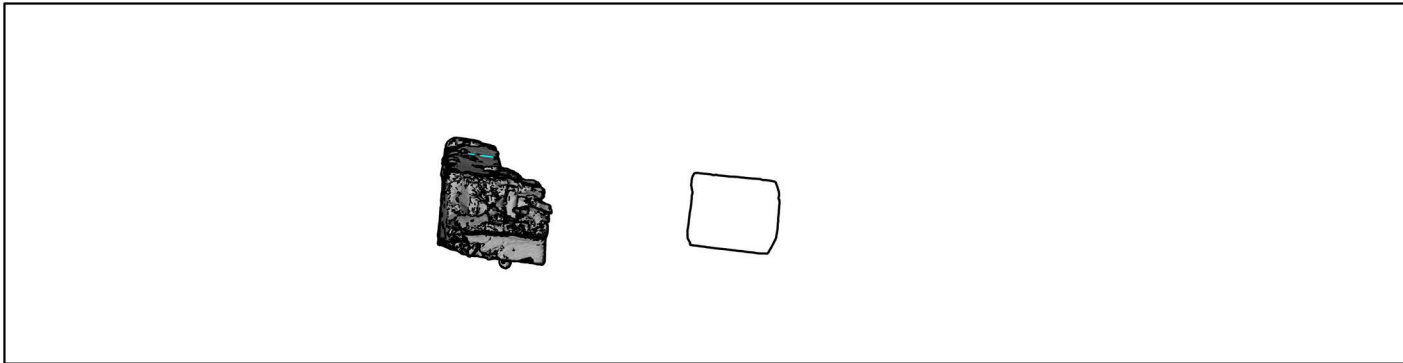
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Sapwood / bark
 - Toolmarks
 - Iron nail holes / heads
 - Concretion
 - Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	57
Timber type:	filling frame	Location:	filling frame, between floor 56 and 58			
Status:	Final		Drawing No.:	116		
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



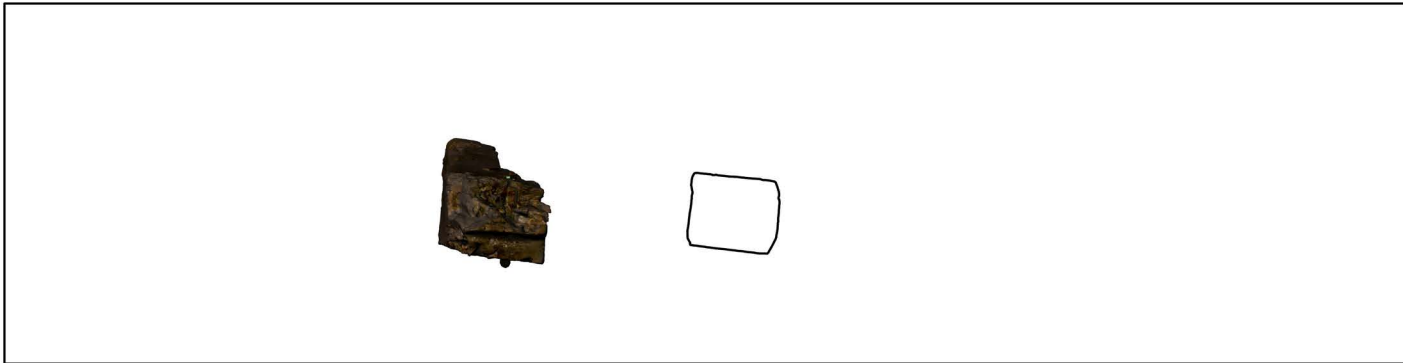
Fore view



Outboard view



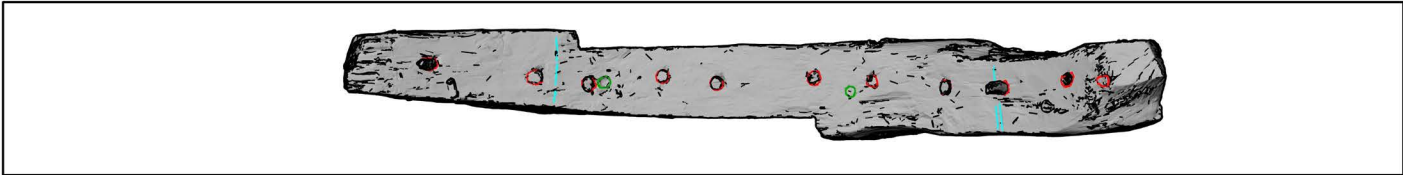
Portside view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	57
Timber type:	filling frame	Location:	filling frame, between floor 56 and 58			
Status:	Final			Drawing No.:	117	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



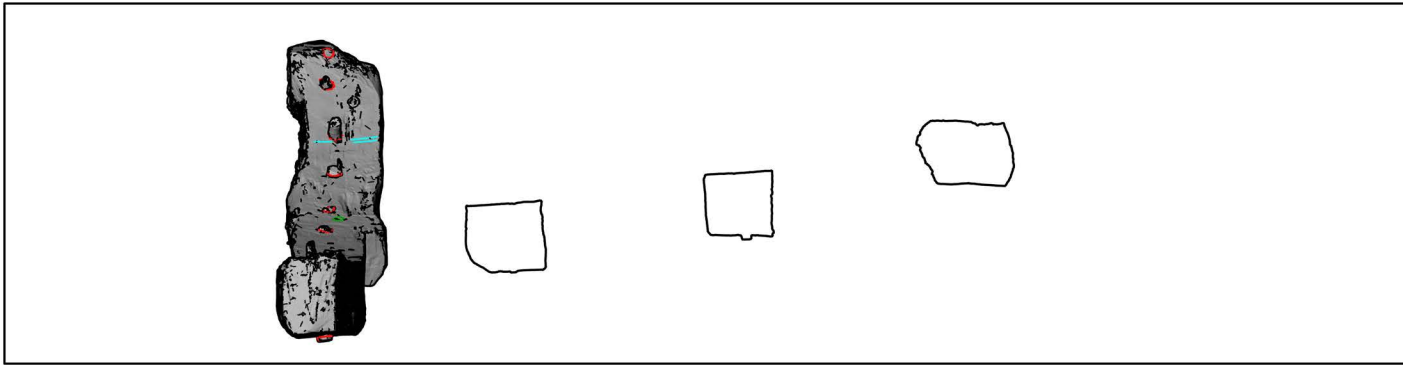
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Toolmarks (auger)
 - Intentional marks
 - Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004	Previous number:			Timber ID:	59
Timber type:	filling frame	Location:	filling frame, joggled onto futtock 077 forward and floor 58 aft.			
Status:	Final			Drawing No.:	118	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



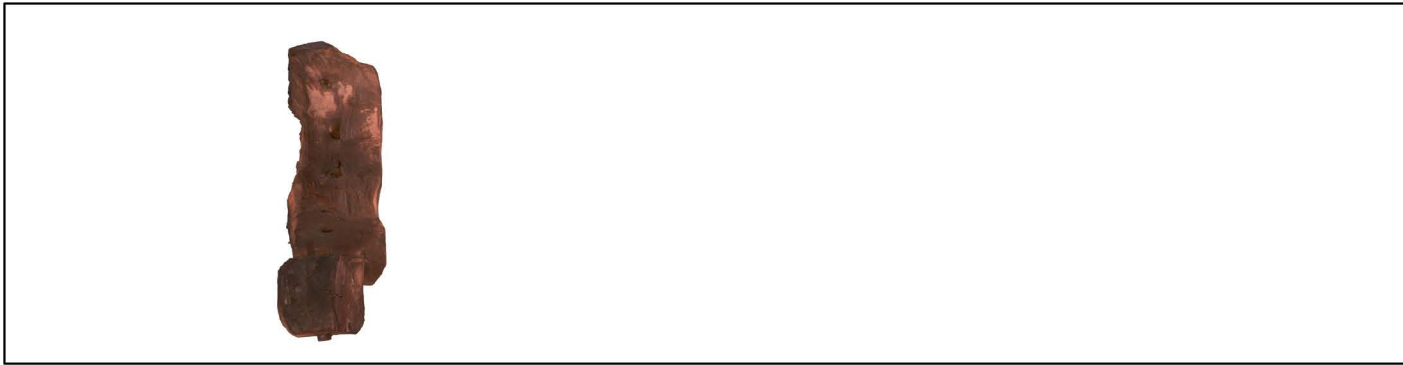
Fore view



Outboard view



Portside view

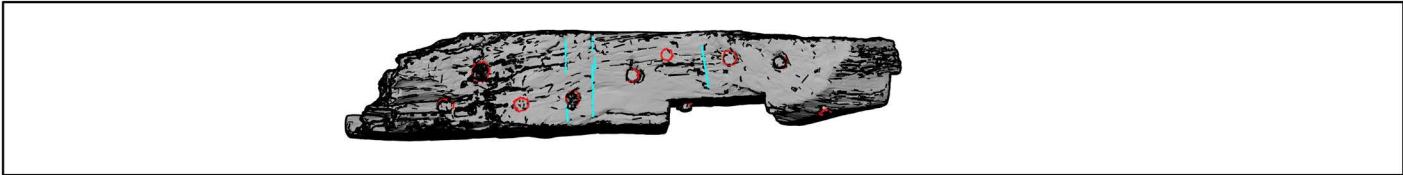


0 0.5m 1m

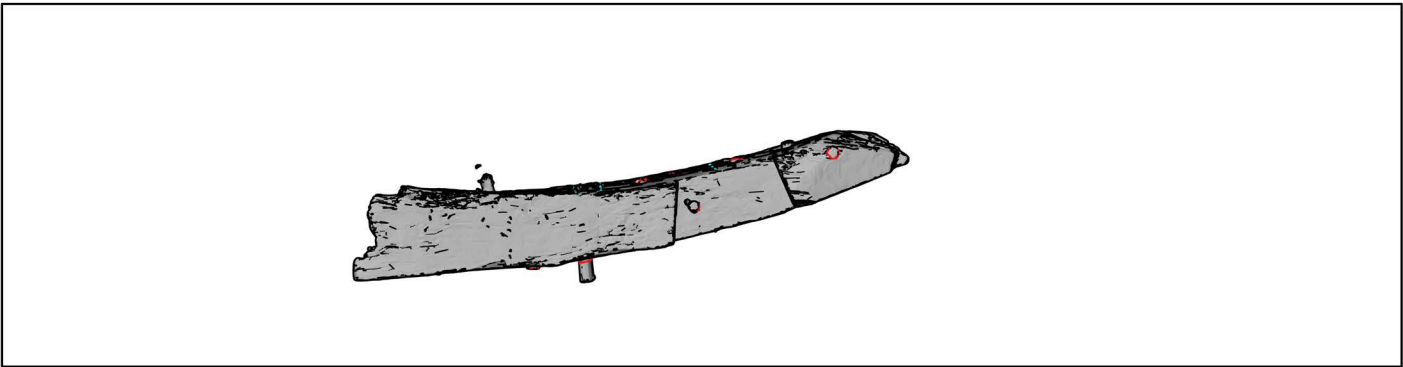
- Legend:
- Trenails and trenail holes / wedged trenails
 - Toolmarks (auger)
 - Intentional marks
 - Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	59
Timber type:	filling frame	Location:	filling frame, joggled onto futtock 077 forward and floor 58 aft.			
Status:	Final			Drawing No.:	119	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

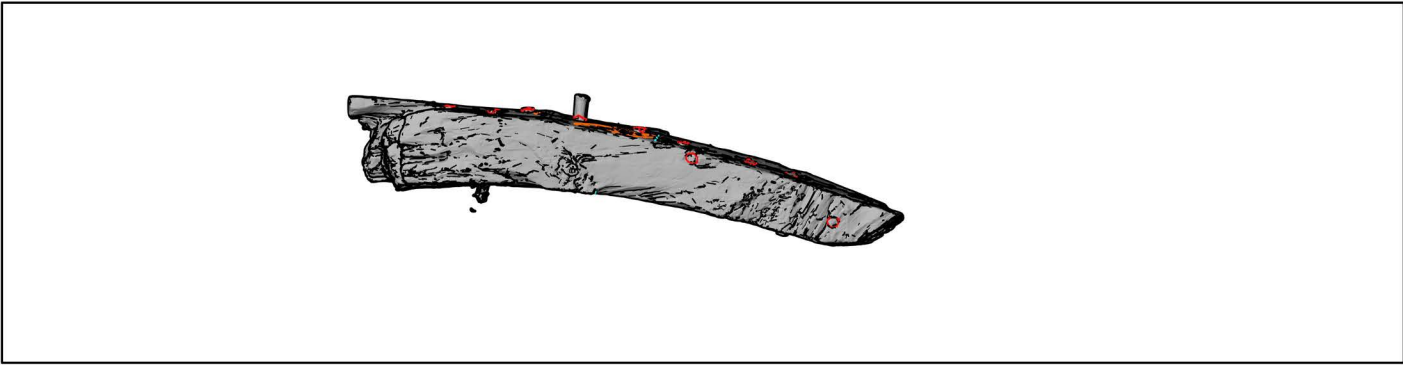
Inboard view



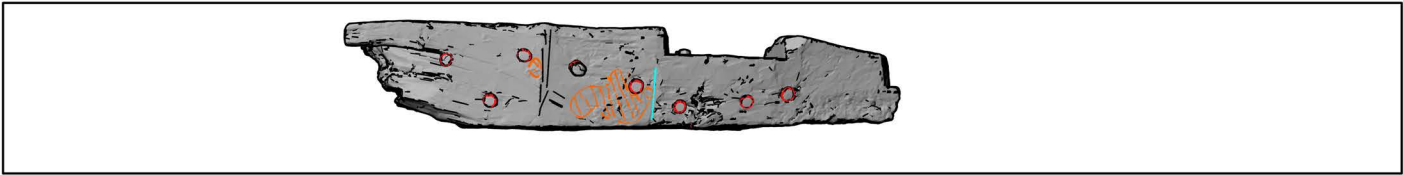
Aft view



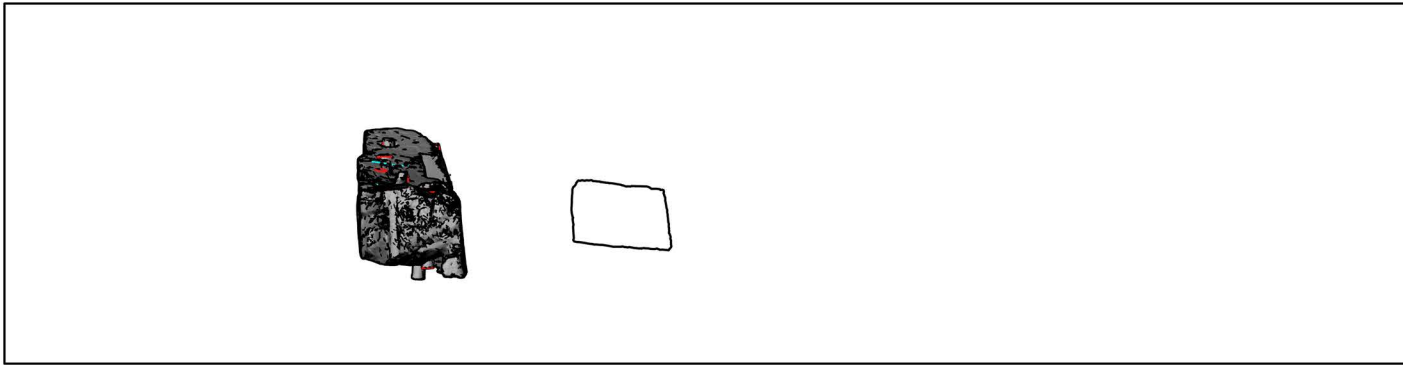
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Iron nail holes / heads

Concretion

Intertional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	60
Timber type:	floor	Location:	foremost surviving floor timber , jointed to futtock 077			
Status:	Final			Drawing No.:	120	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



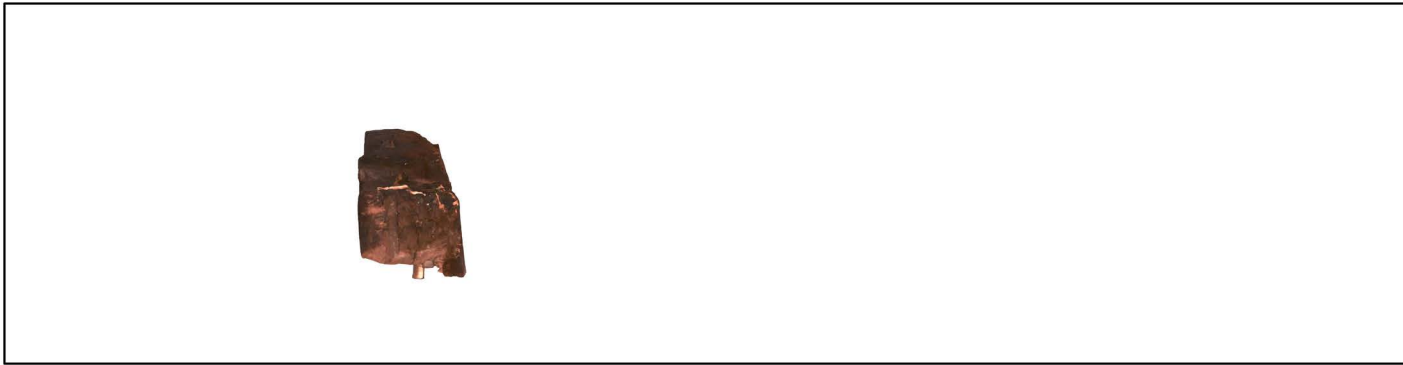
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

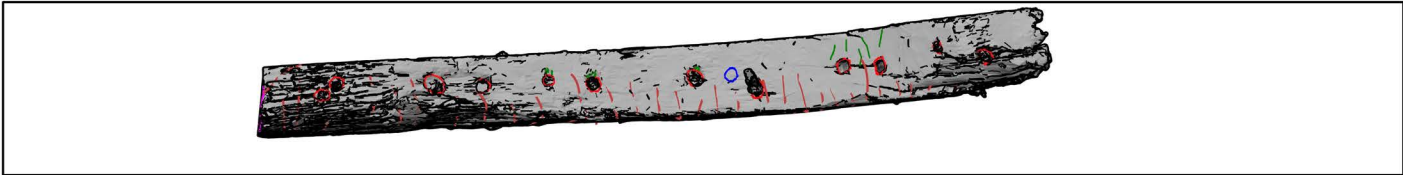
Iron nail holes / heads

Concretion

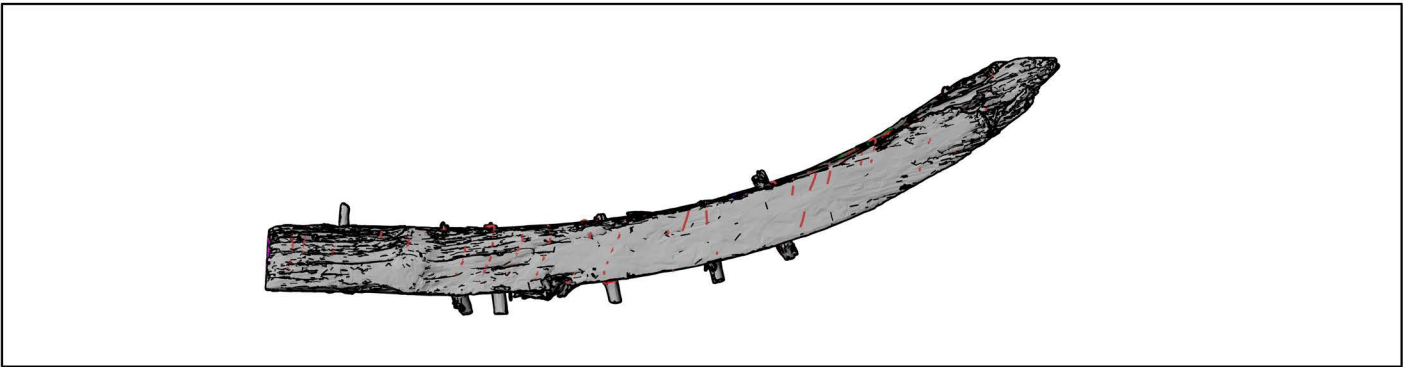
Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	60
Timber type:	floor	Location:	foremost surviving floor timber , jointed to futtock 077			
Status:	Final			Drawing No.:	121	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

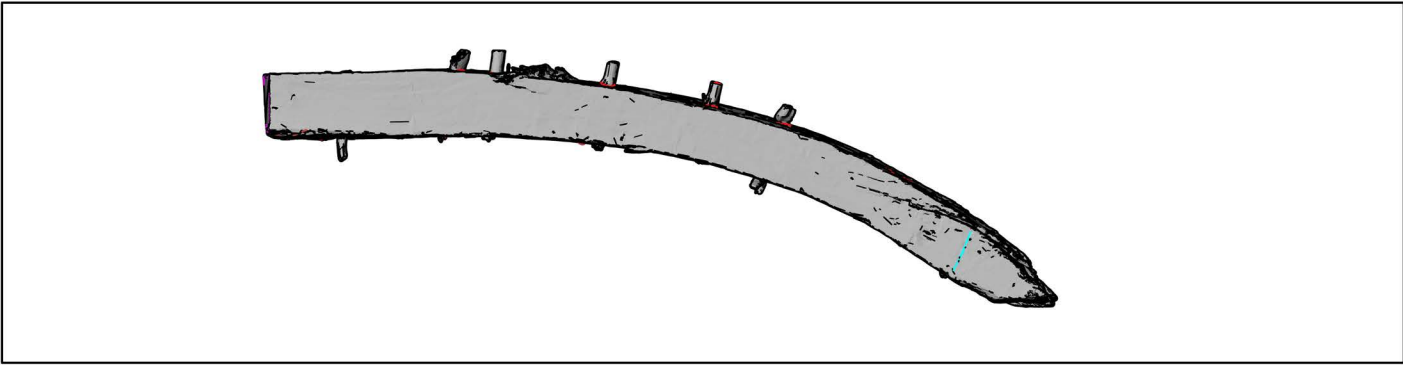
Inboard view



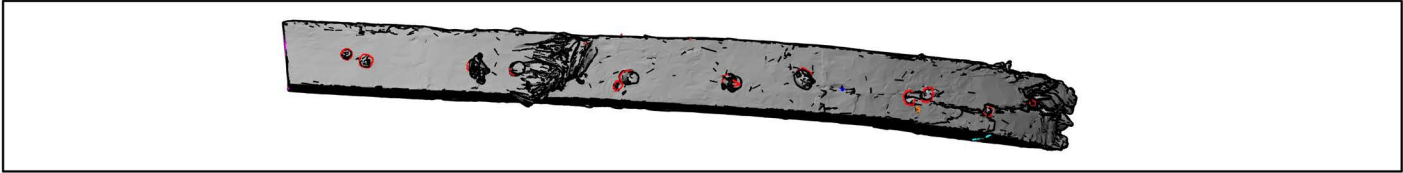
Aft view



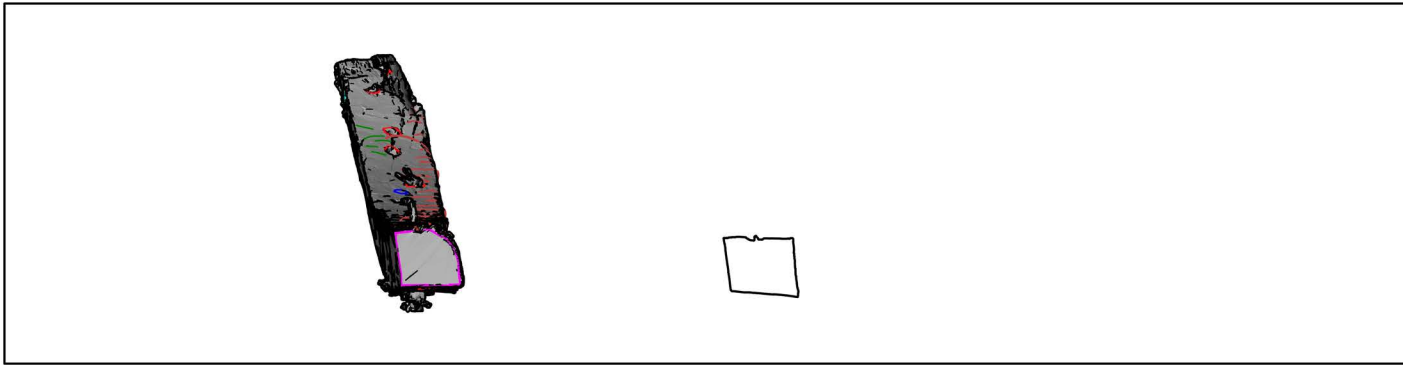
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Wooden plugs / nails
 - Concretion
 - Toolmarks
 - Sapwood / bark

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004	Previous number:	-	Timber ID:	61	
Timber type:	filling frame	Location:	foremost surviving filling frame			
Status:	Final	Drawing No.:	122			
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



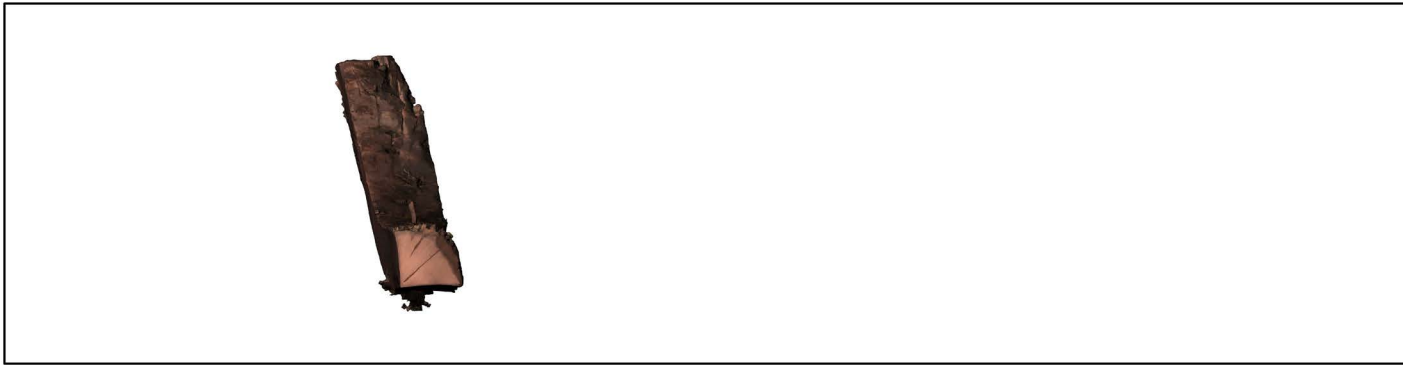
Fore view



Outboard view



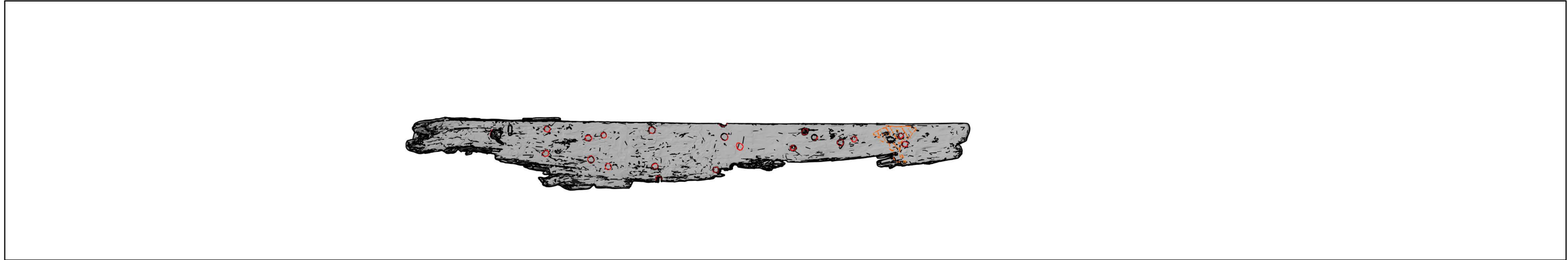
Portside view



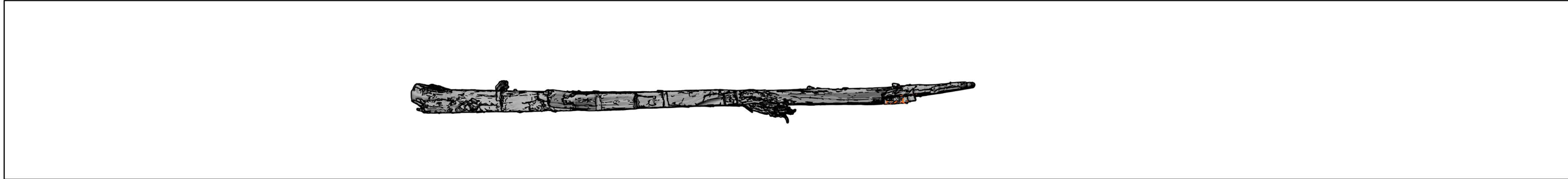
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	61
Timber type:	filling frame	Location:	foremost surviving filling frame			
Status:	Final			Drawing No.:	123	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

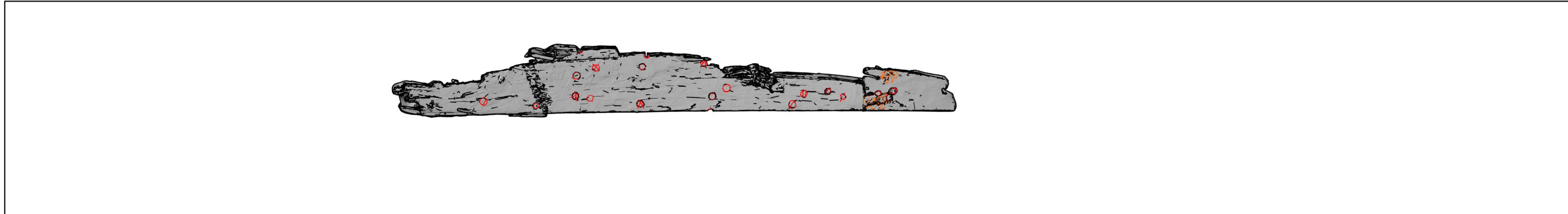
Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

-  Trenails and trenail holes / wedged trenails

 Iron nail holes / heads

 Dendrosample cut
-  Wooden plugs / nails

 Concretion
-  Intentional marks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004	Previous number:			Timber ID:	062	
Timber type:	outer plank	Location:	surviving plank 1 of strake 6 of section 5004, starboard side				
Status:	Final				Drawing No.:	124	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

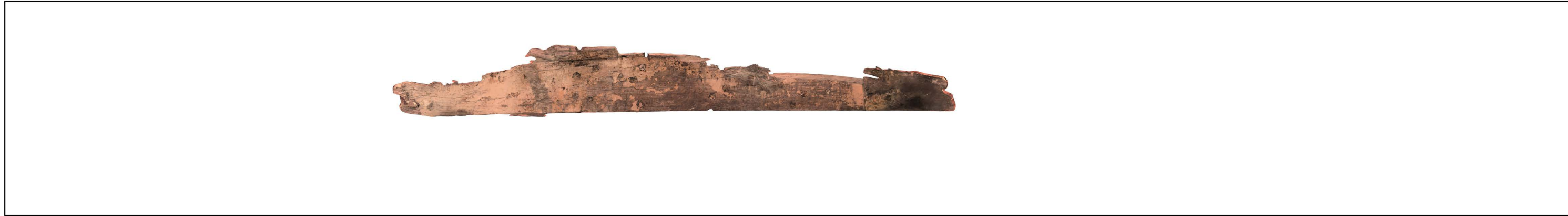
Inboard view



Side view



Outboard view



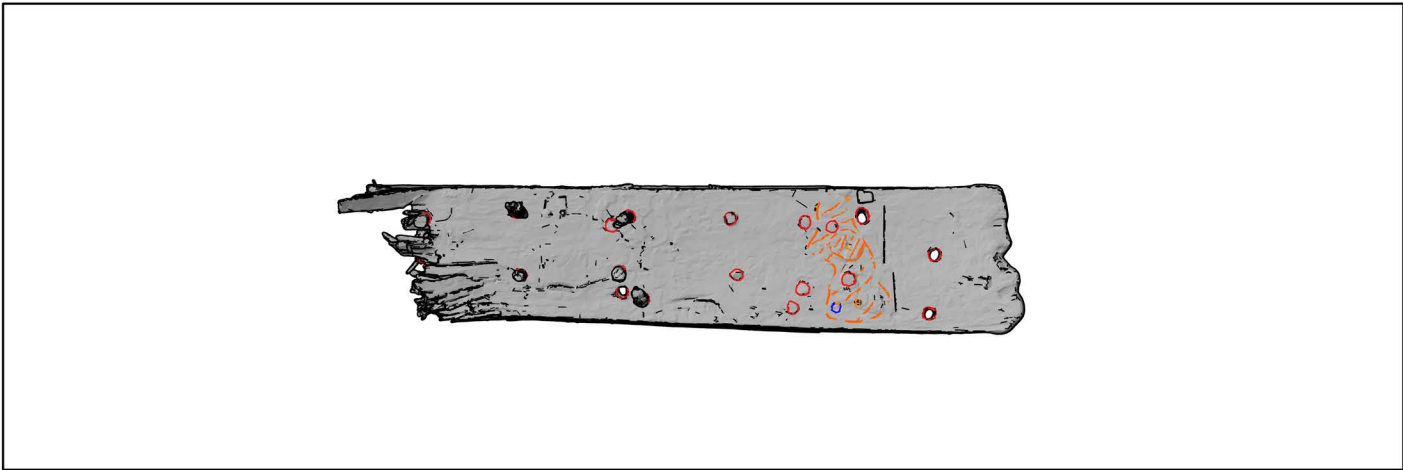
Aft view



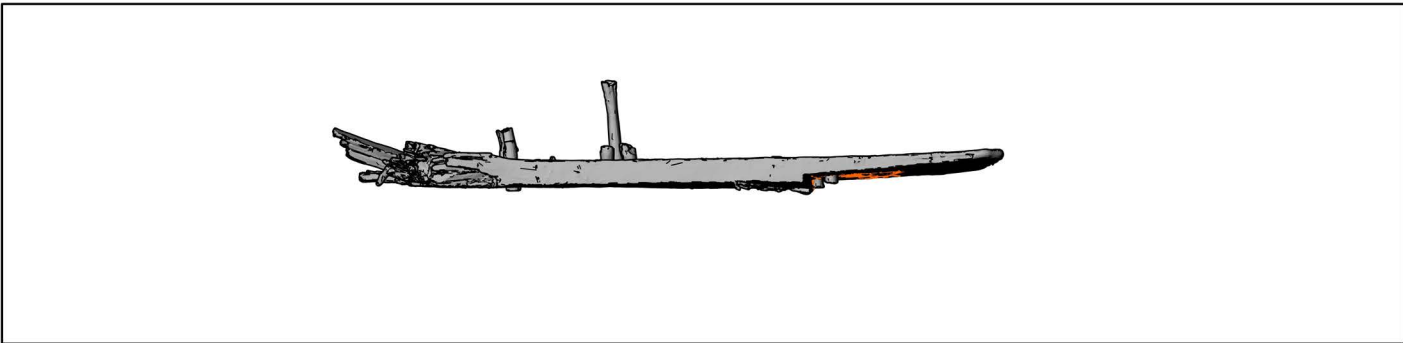
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:			Timber ID:	062
Timber type:	outer plank	Location:	surviving plank 1 of strake 6 of section 5004, starboard side				
Status:	Final				Drawing No.:	125	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

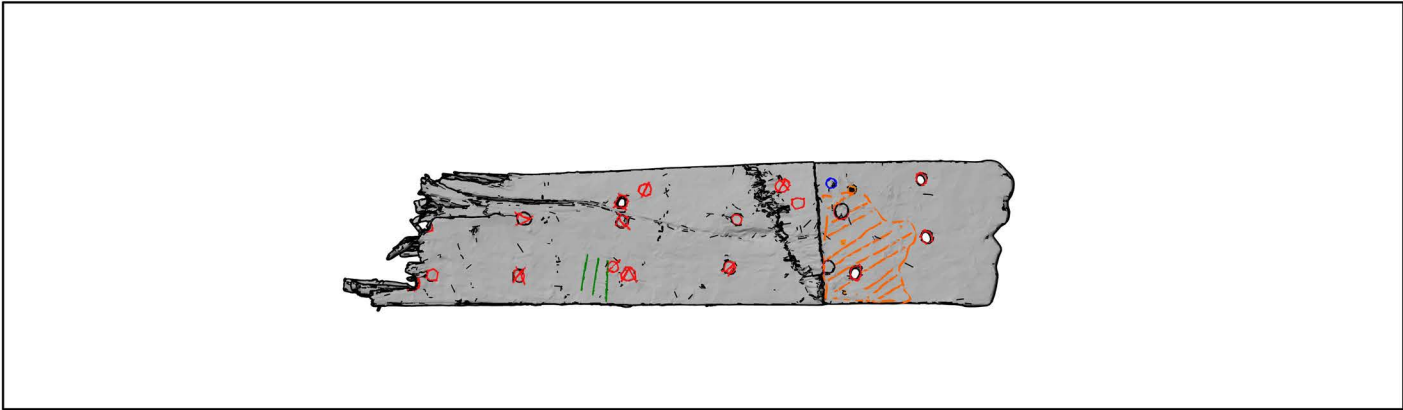
Inboard view



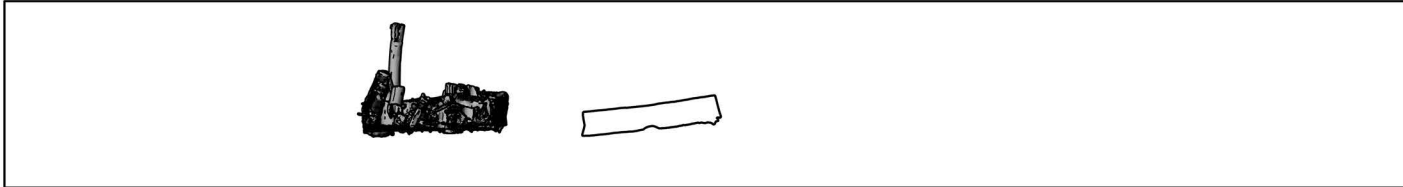
Side view



Outboard view



Aft view



00.5m1m

- Legend:
- Trenails and trenail holes / wedged trenails

Iron nail holes / heads

Toolmarks

Concretion

Wooden plugs / nails

Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004	Previous number:	-	Timber ID:	063	
Timber type:	outer plank	Location:	strake 5, 1 of 3 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	127	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



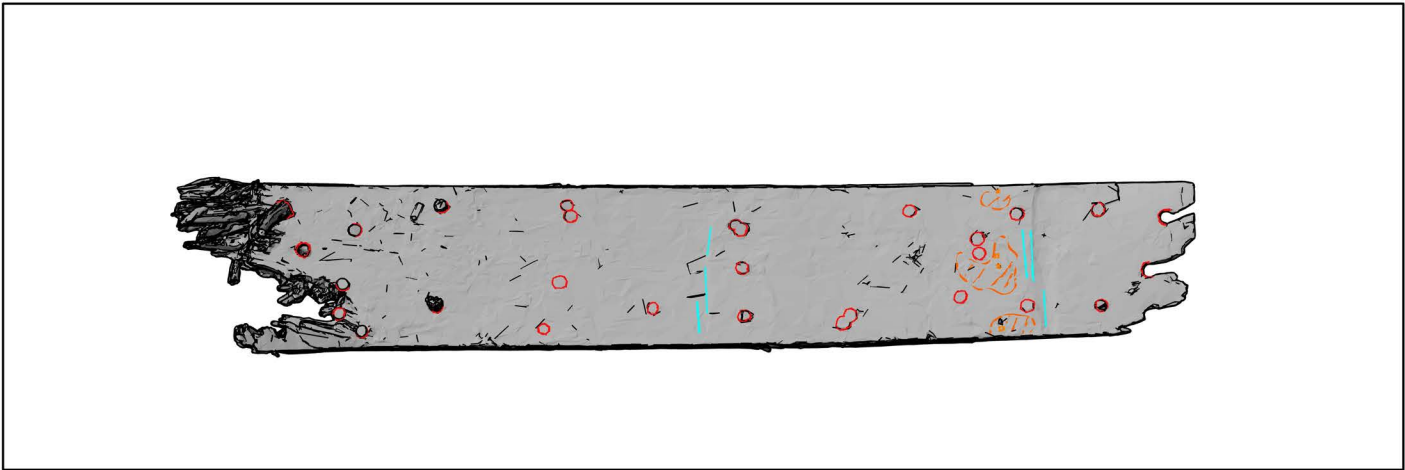
Aft view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	063
Timber type:	outer plank	Location:	strake 5, 1 of 3 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	126	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

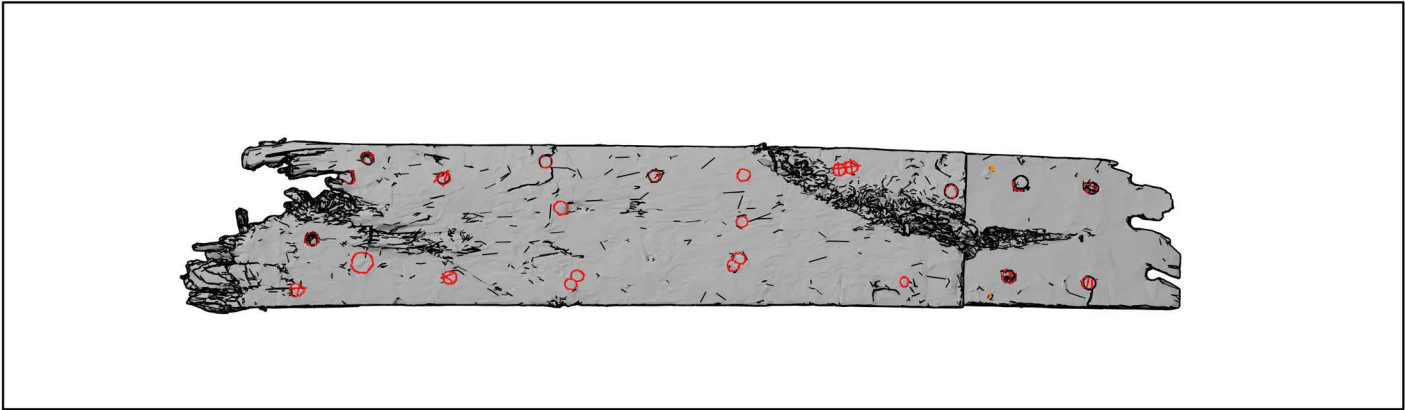
Inboard view



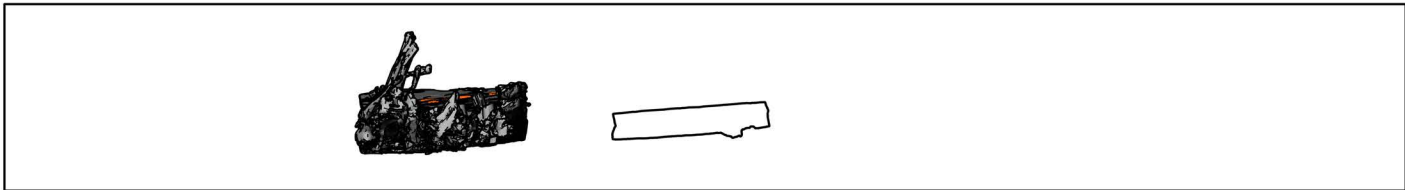
Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

-  Trenails and trenail holes / wedged trenails

 Iron nail holes / heads
-  Toolmarks

 Concretion
-  Intentional marks

 Wooden plugs / nails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	064
Timber type:	outer plank	Location:	strake 4, 1 of 2 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	128	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



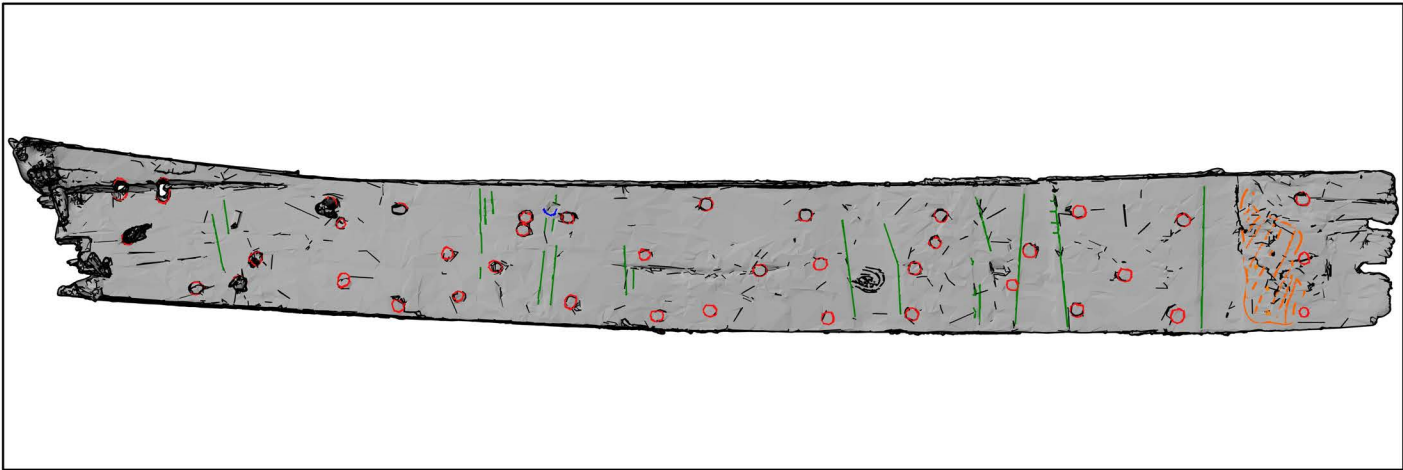
Aft view



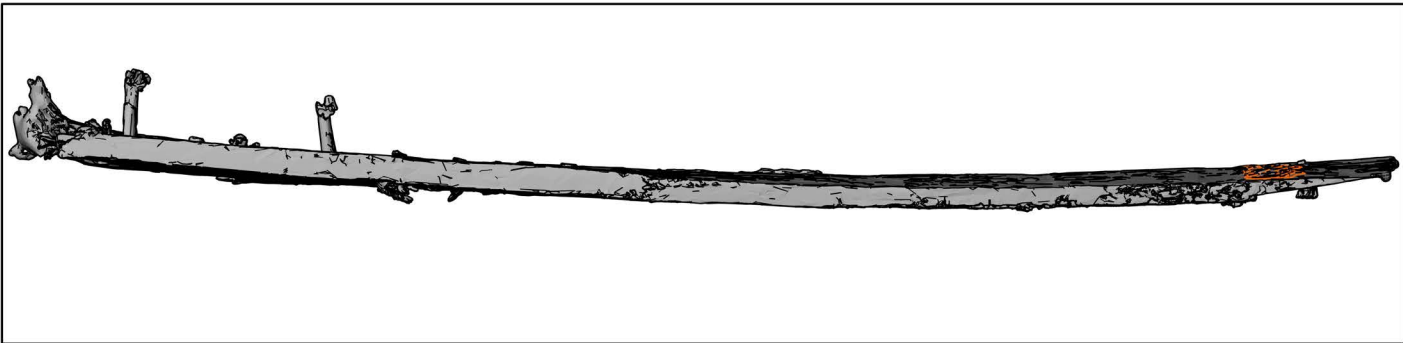
00.5m1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	064
Timber type:	outer plank	Location:	strake 4, 1 of 2 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	129	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

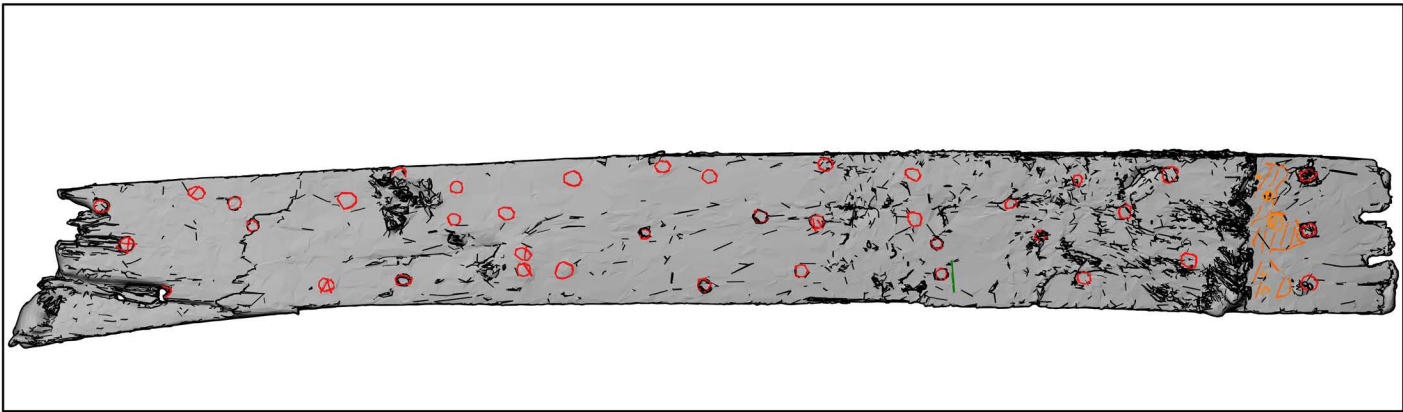
Inboard view



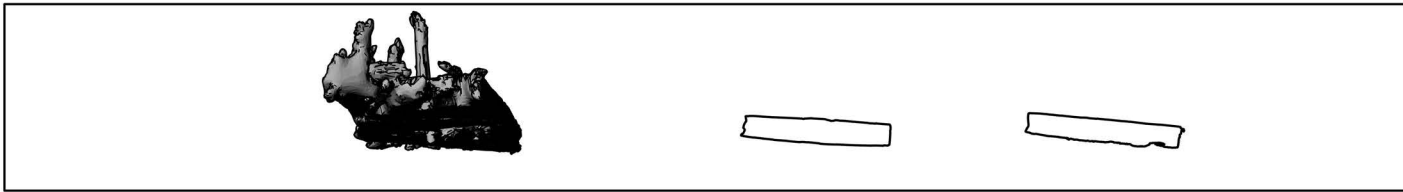
Side view



Outboard view



Aft view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Wooden plugs / nails
 - Concretion
 - Tool marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004	Previous number:			Timber ID:	065
Timber type:	outer plank	Location:	strake 3, 1 of 2 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	130	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



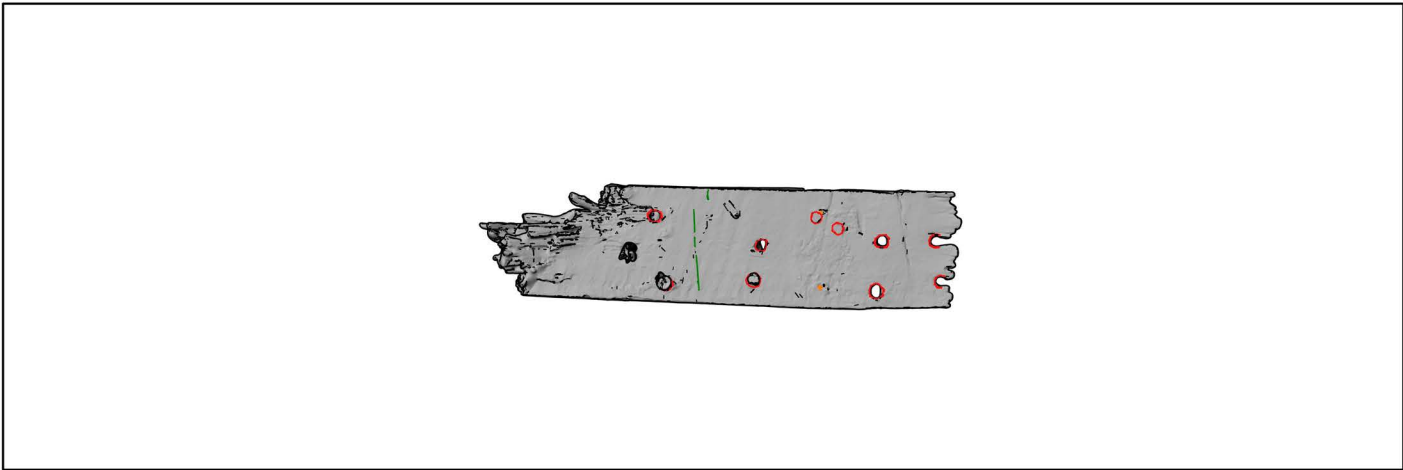
Aft view



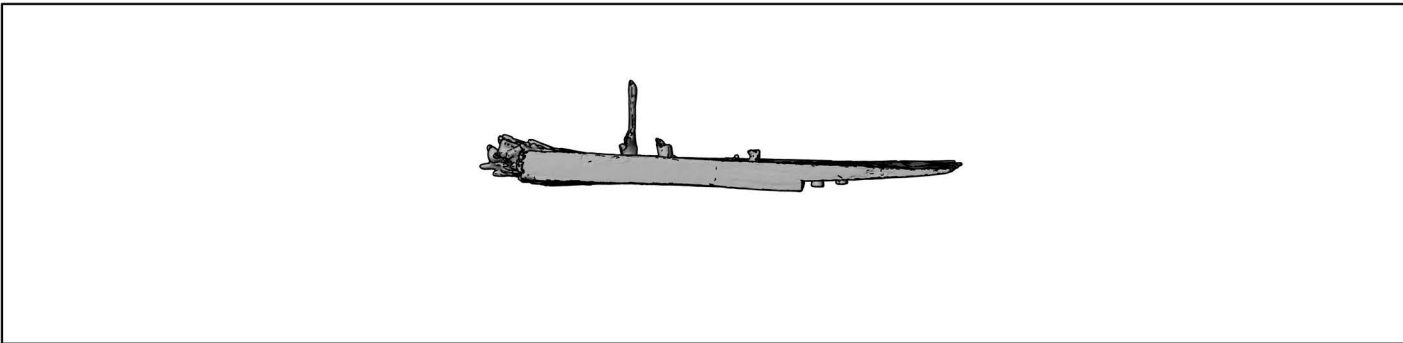
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	065
Timber type:	outer plank	Location:	strake 3, 1 of 2 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	131	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

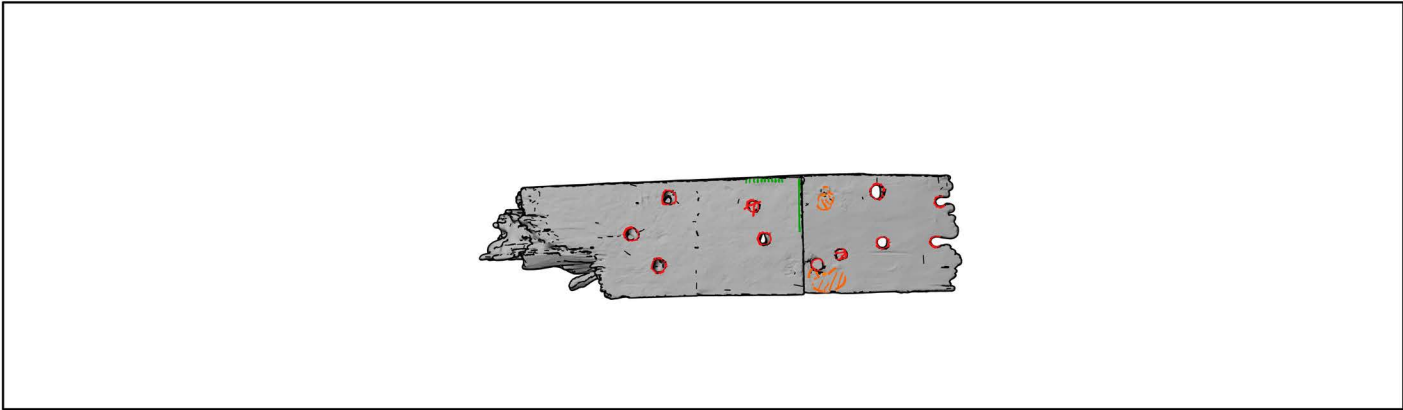
Inboard view



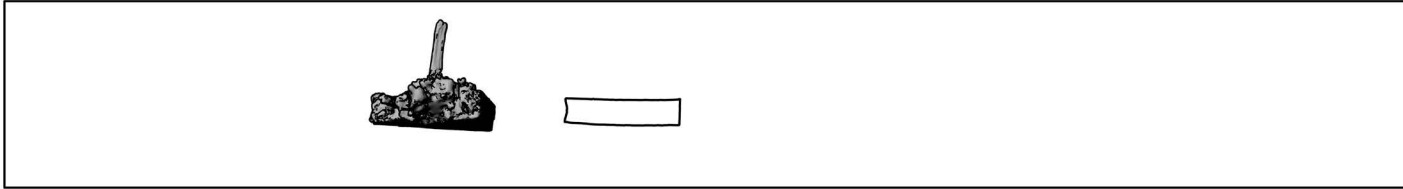
Side view



Outboard view



Aft view



00.5m1m

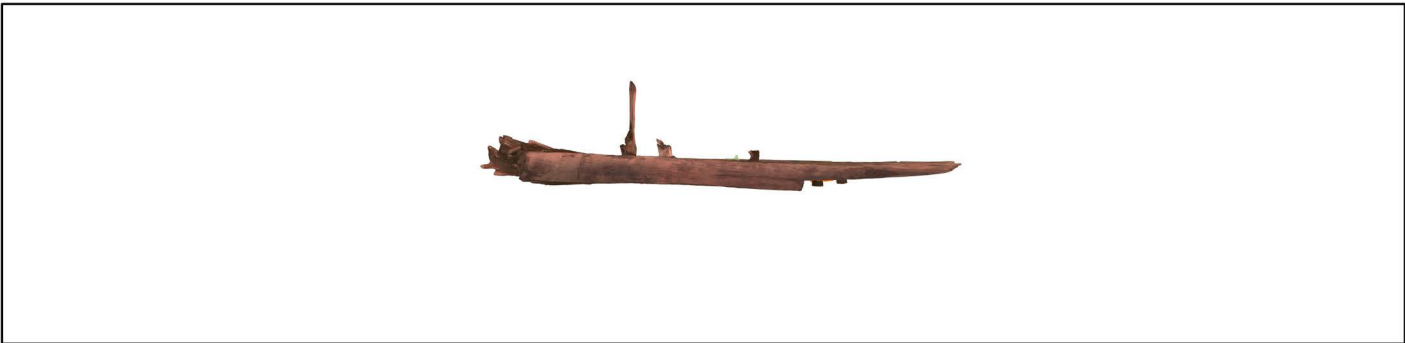
- Legend:
- Trenails and trenail holes / wedged trenails
 - Toolmarks
 - Iron nail holes / heads
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	066
Timber type:	outer plank	Location:	strake 2, 1 of 3 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	132	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



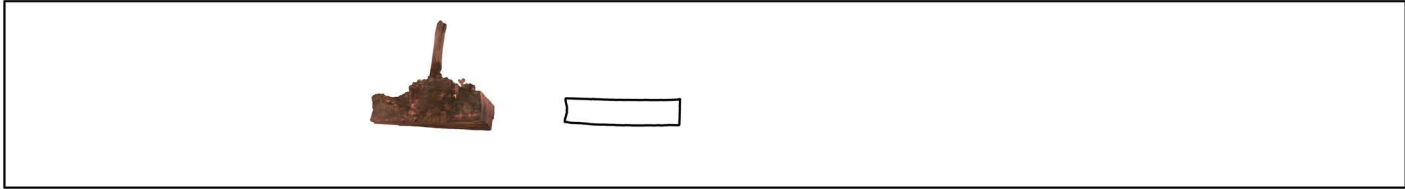
Side view



Outboard view



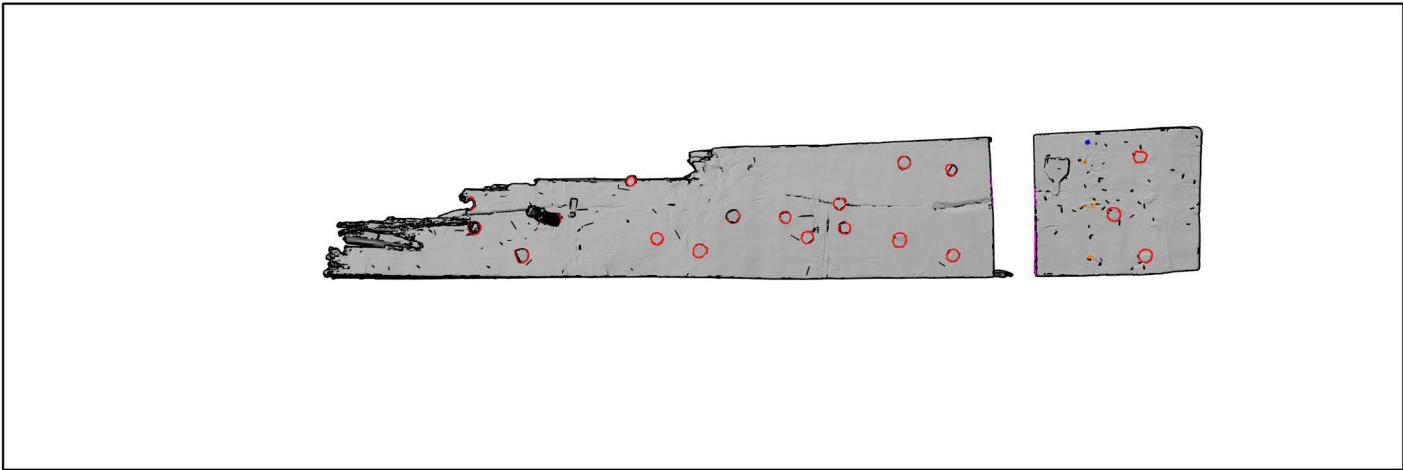
Aft view



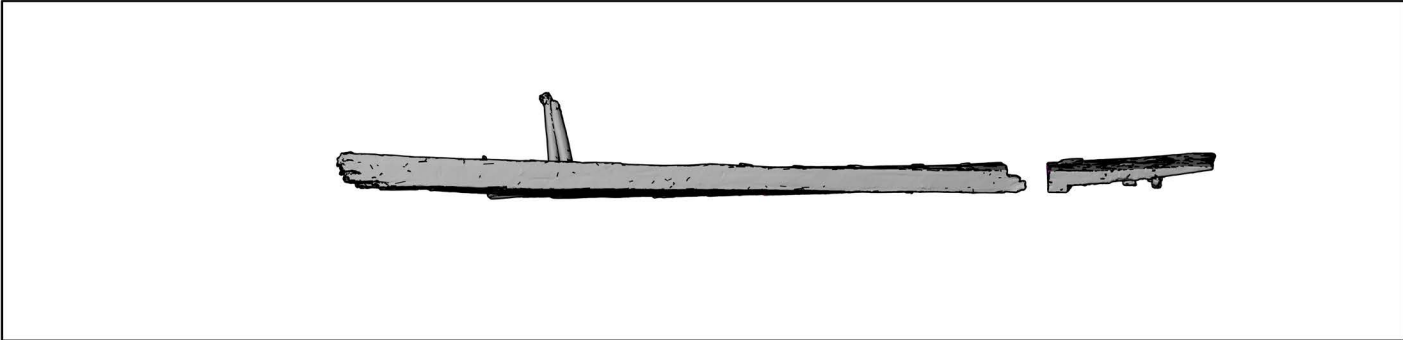
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	066
Timber type:	outer plank	Location:	strake 2, 1 of 3 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	132	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

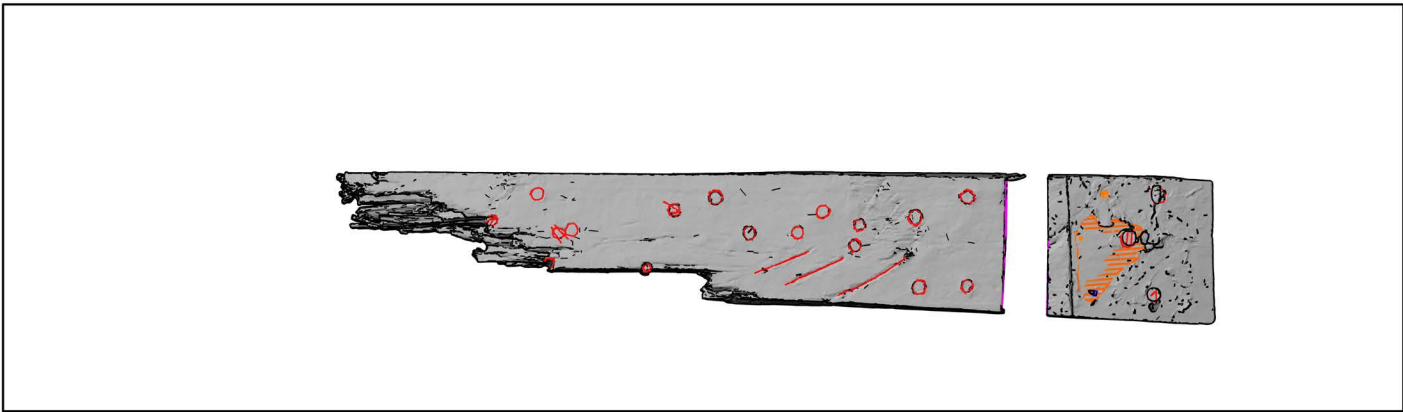
Inboard view



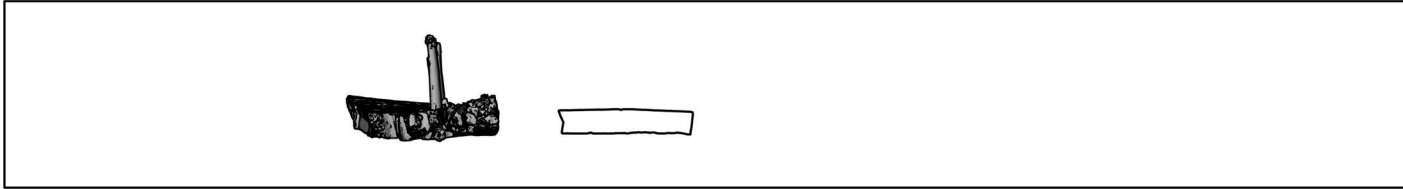
Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

-  Trenails and trenail holes / wedged trenails

 Iron nail holes / heads

 Toolmarks
-  Wooden plugs / nails

 Concretion
-  Damage marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004	Previous number:			Timber ID:	067
Timber type:	outer plank	Location:	strake 1, 1 of 3 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	114	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



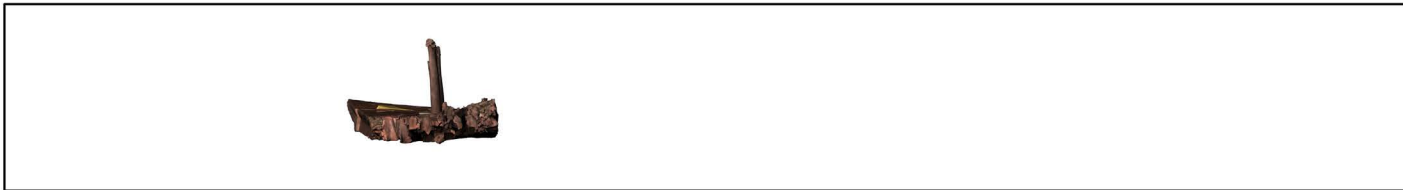
Side view



Outboard view



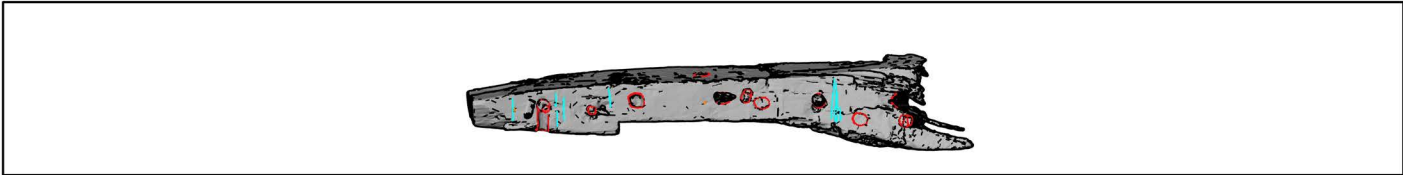
Aft view



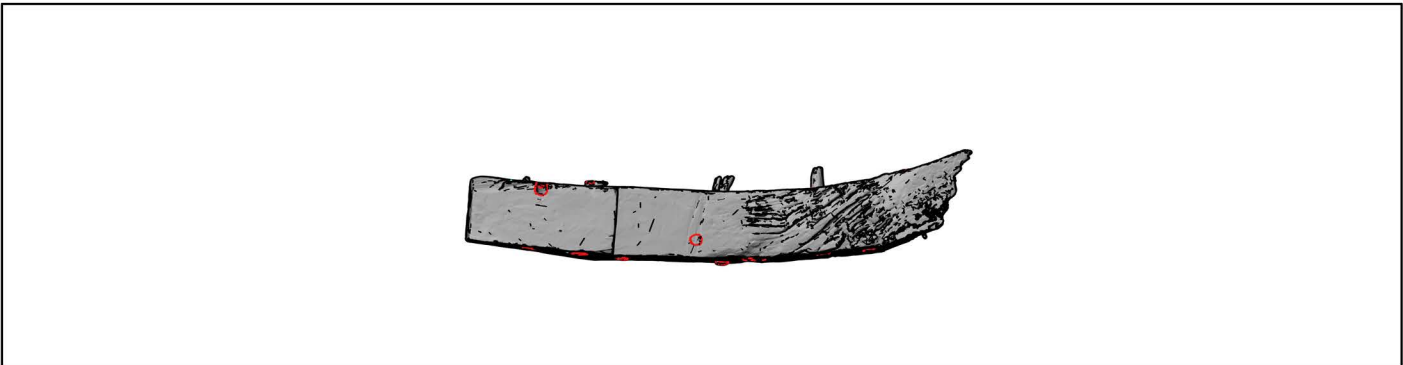
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	067
Timber type:	outer plank	Location:	strake 1, 1 of 3 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	115	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

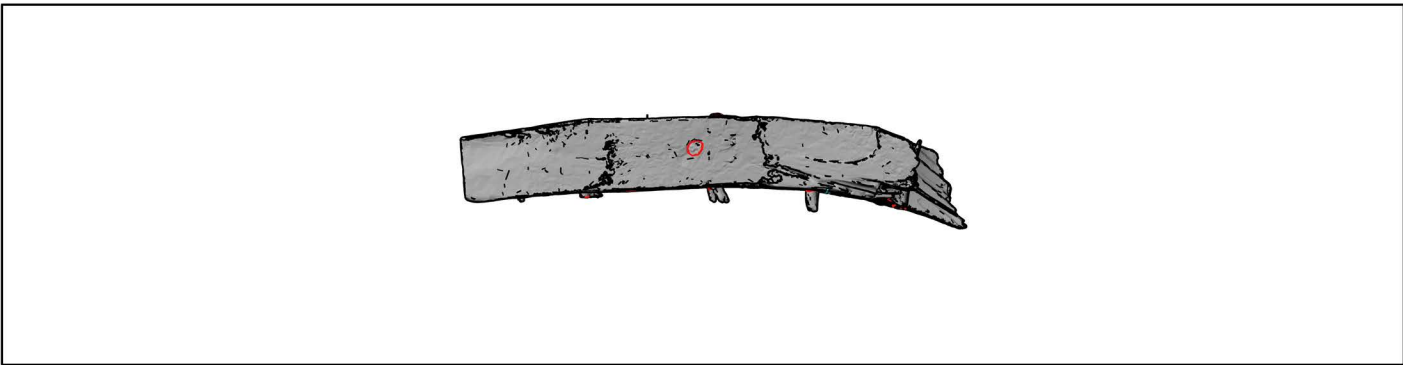
Inboard view



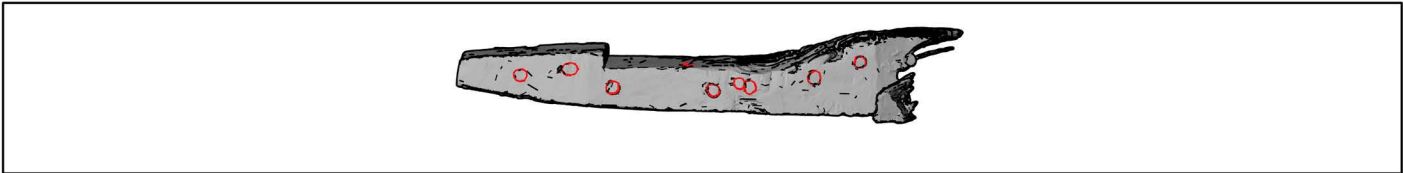
Aft view



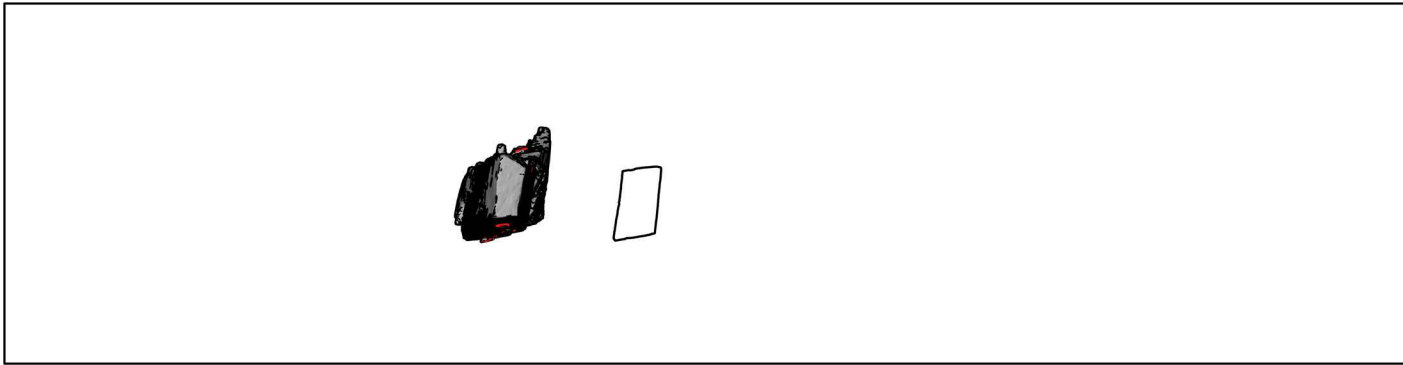
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Treenails and treenail holes / wedged treenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	068
Timber type:	futtock	Location:	aft, jointed to floor 43			
Status:	Final			Drawing No.:	137	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



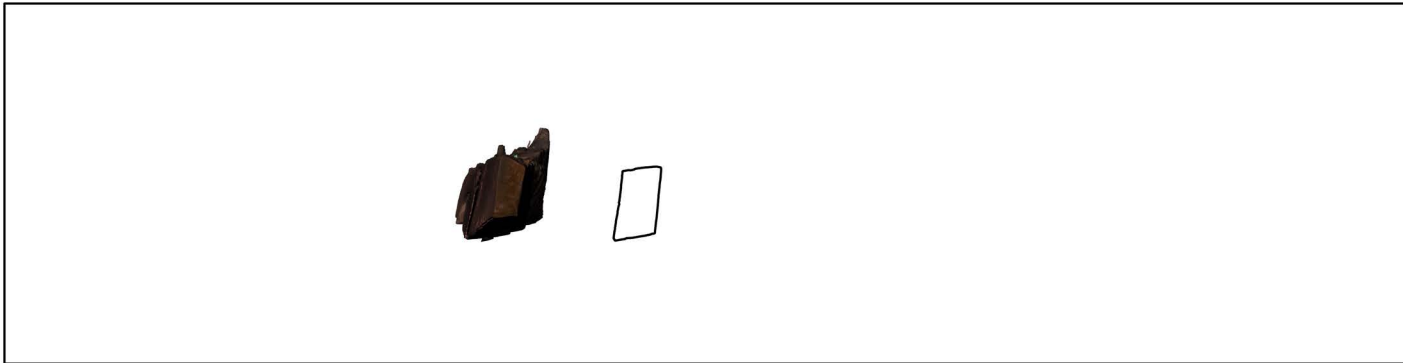
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

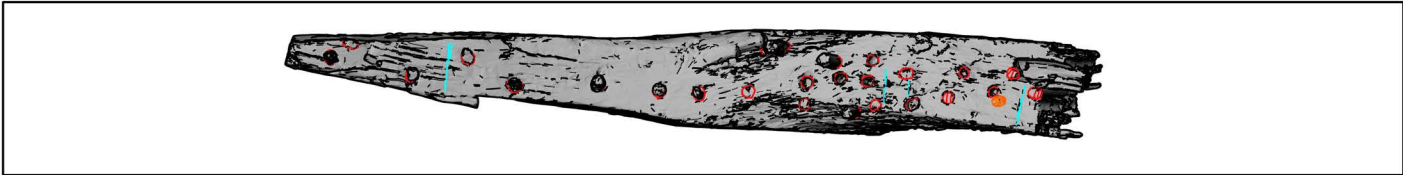
Intentional marks

Sapwood / bark

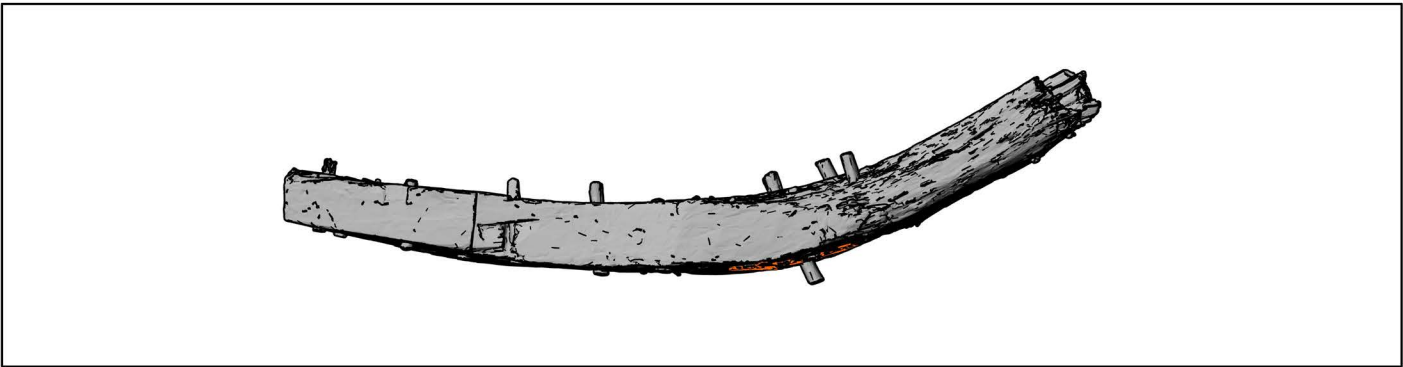
Iron nail holes / heads

Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|--------------------------|--------------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5004 | | Previous number: | | Timber ID: | 068 |
| Timber type: | futtock | Location: | aft, jointed to floor 43 | | | |
| Status: | Final | | | Drawing No.: | 137 | |
| Scale: | 1:20 | Date: | 07/03/2023 | Made by: | Paolo Croce | |
- wessex
archaeology

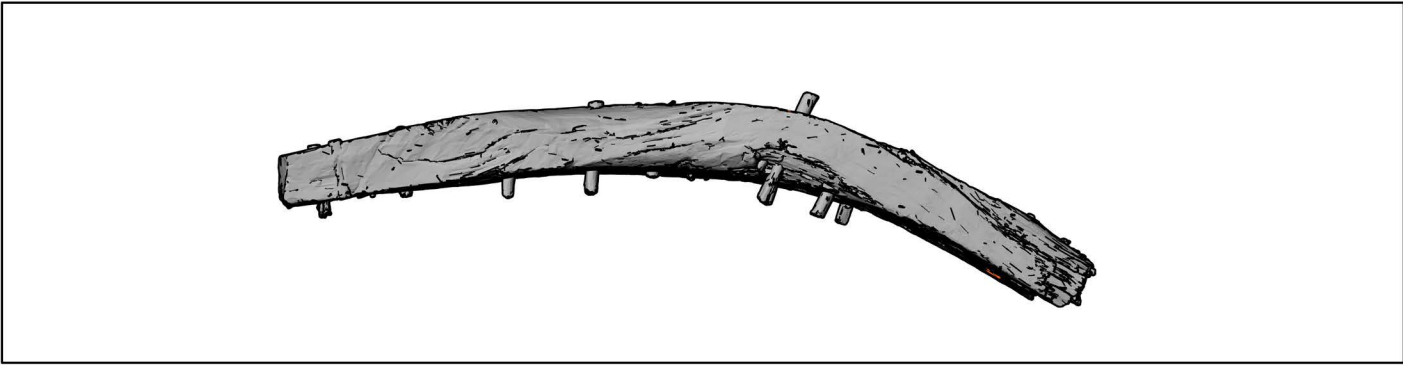
Inboard view



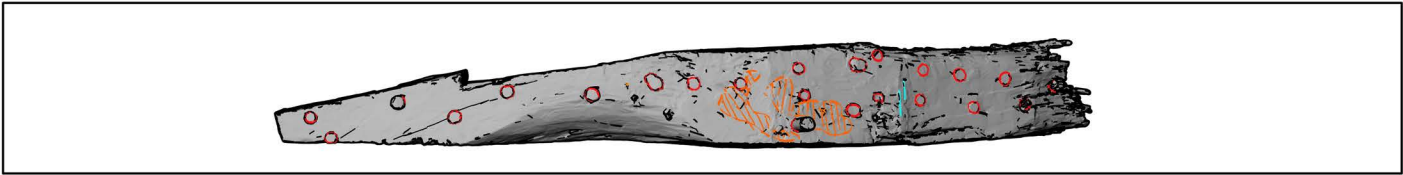
Aft view



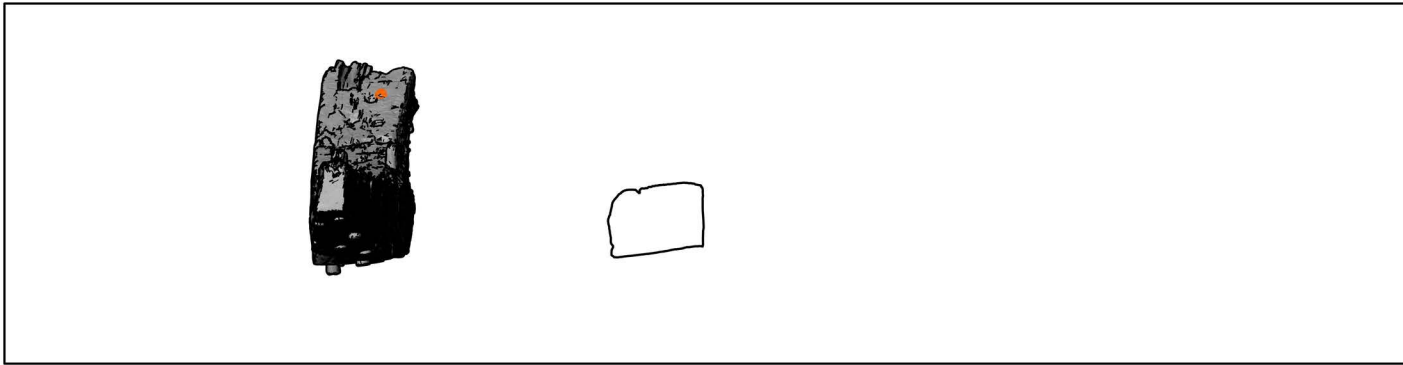
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Treenails and treenail holes / wedged treenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|---------------------|--------------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5004 | | Previous number: | | Timber ID: | 069 |
| Timber type: | futtock | Location: | jointed to floor 45 | | | |
| Status: | Final | | | Drawing No.: | 138 | |
| Scale: | 1:20 | Date: | 07/03/2023 | Made by: | Paolo Croce | |
- wessex
archaeology

Inboard view



Aft view



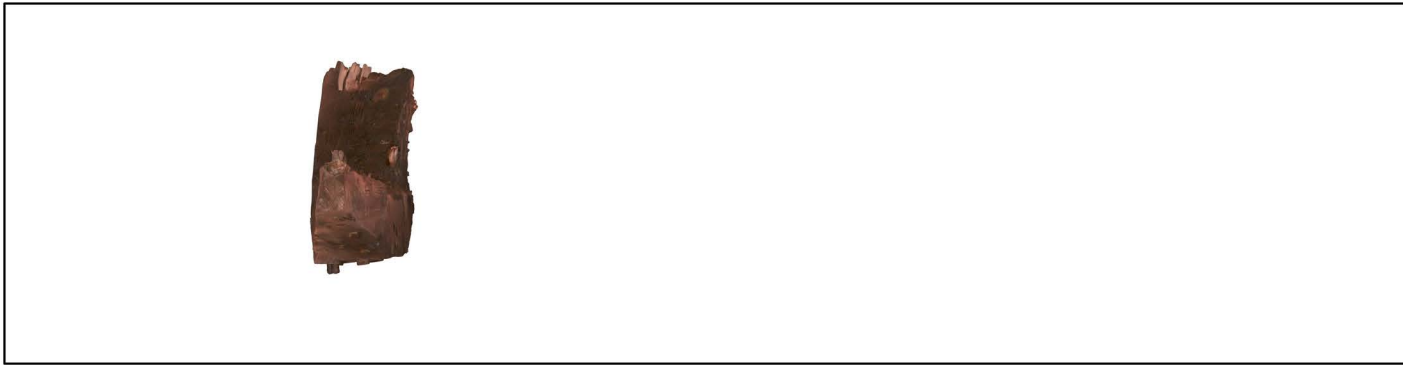
Fore view



Outboard view



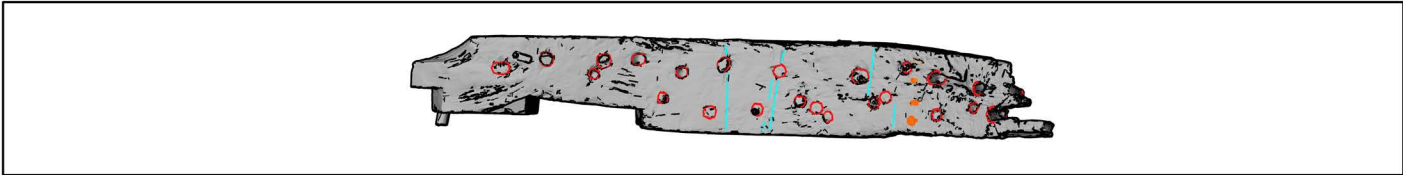
Portside view



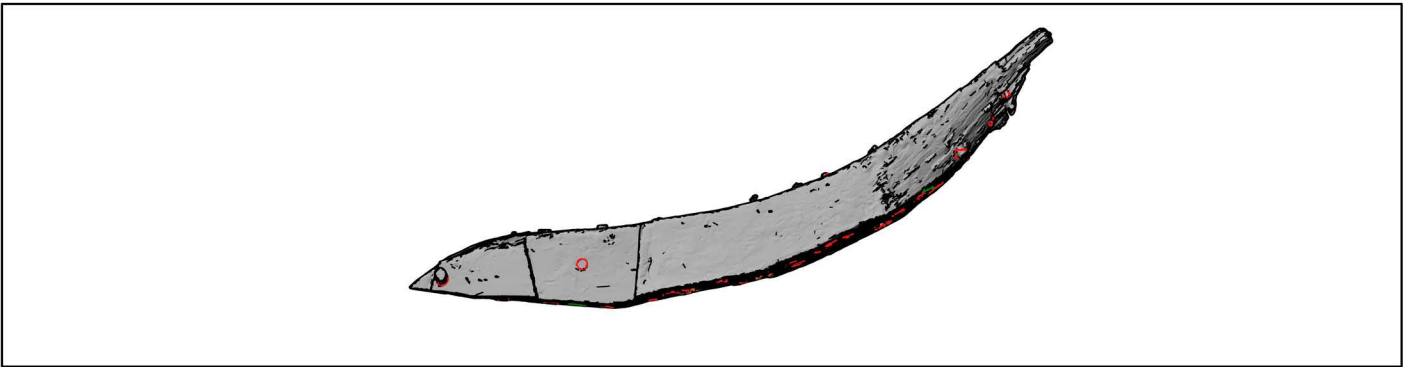
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	069
Timber type:	futtock	Location:	jointed to floor 45			
Status:	Final			Drawing No.:	139	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



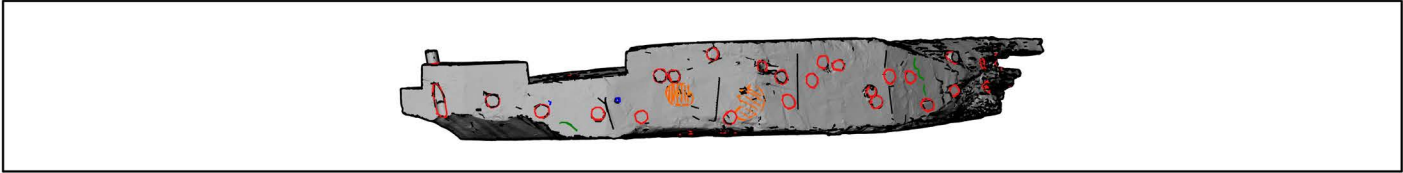
Aft view



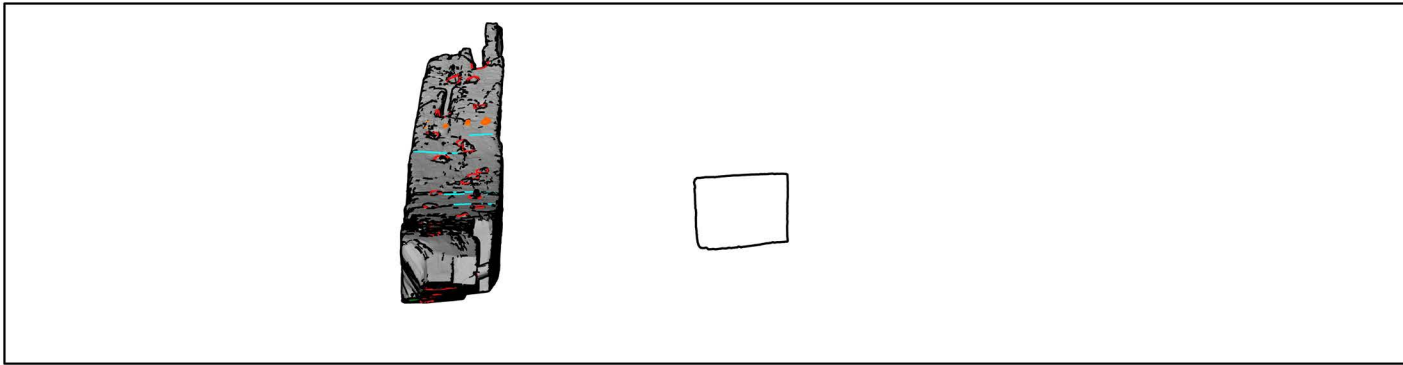
Fore view



Outboard view



Portside view



0 0.5m 1m

Legend:

- Treenails and treenail holes / wedged treenails

—

 Toolmarks

—

 Intentional marks
- ▨

 Sapwood / bark

○

 Iron nail holes / heads

▨

 Concretion
- ⦿

 Wooden plugs / nails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	070
Timber type:	futtock	Location:	jointed to floor 47			
Status:	Final		Drawing No.:	140		
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



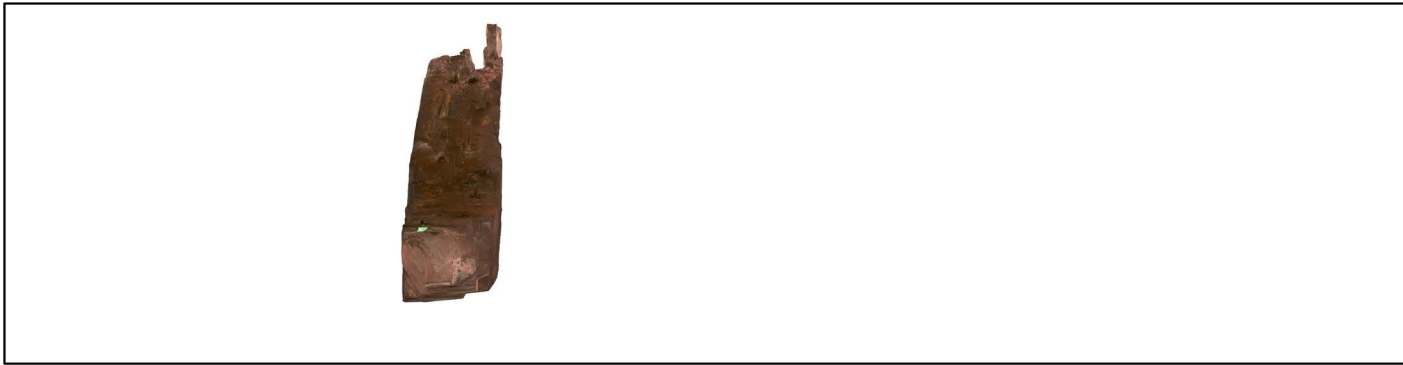
Fore view



Outboard view



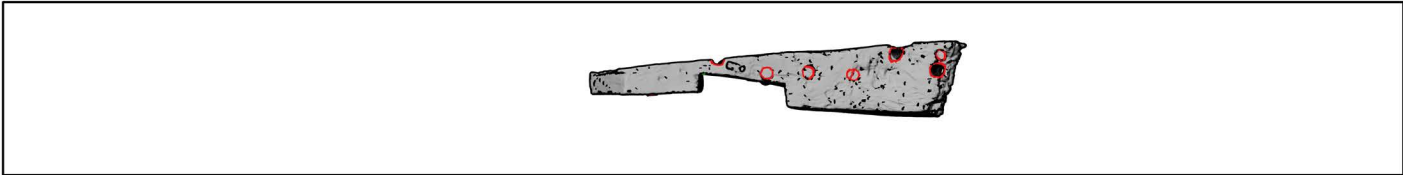
Portside view



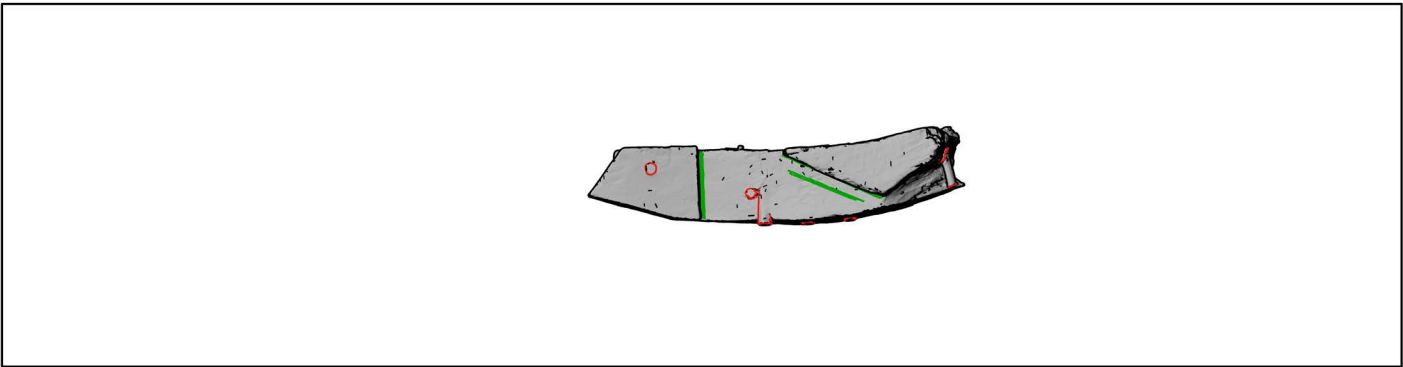
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	070
Timber type:	futtock	Location:	jointed to floor 47			
Status:	Final			Drawing No.:	141	
Scale:	1:20	Date:	07/03/2023	Made by:	Paolo Croce	

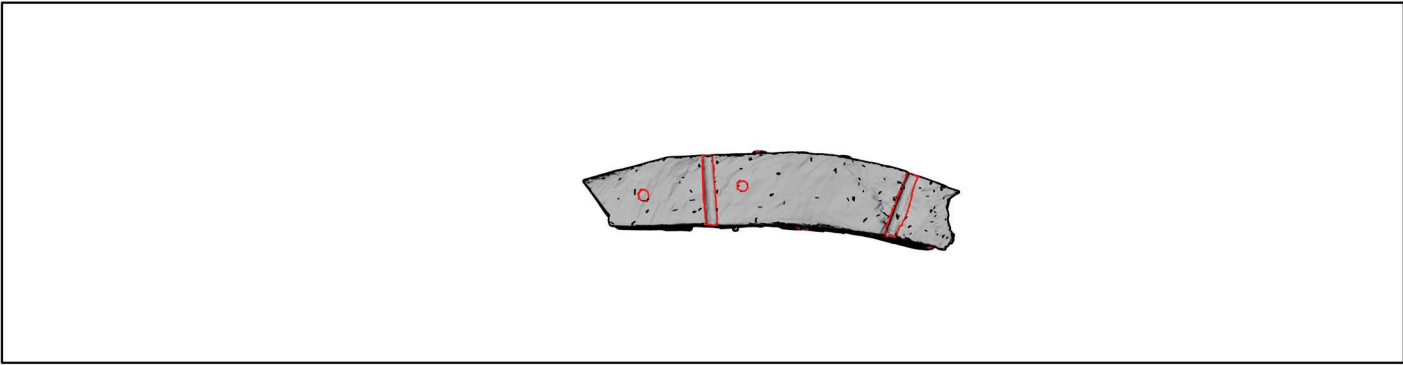
Inboard view



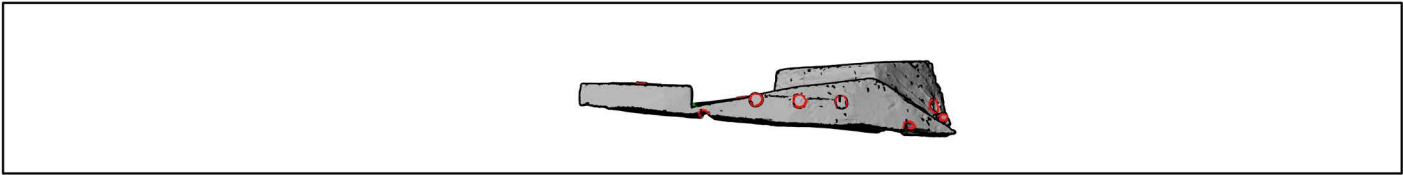
Aft view



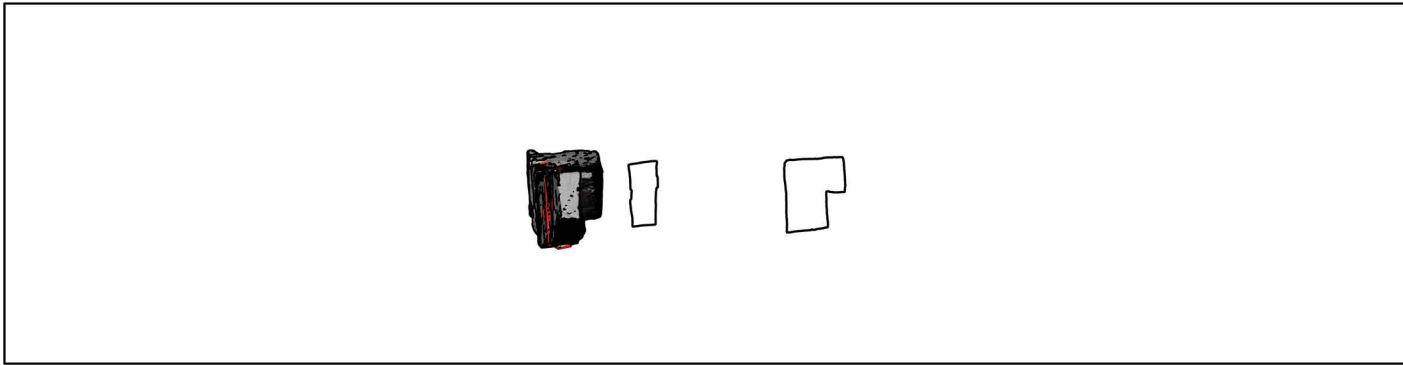
Fore view



Outboard view



View from portside



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Iron nail holes / heads

Toolmarks

Concretion

Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	071
Timber type:	futtock	Location:	jointed to floor 48			
Status:	Final			Drawing No.:	142	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



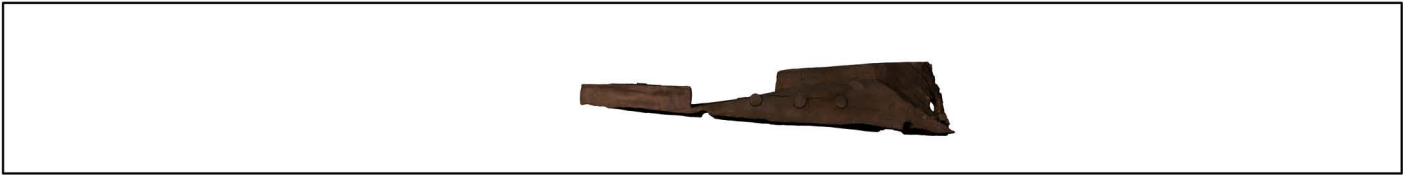
Aft view



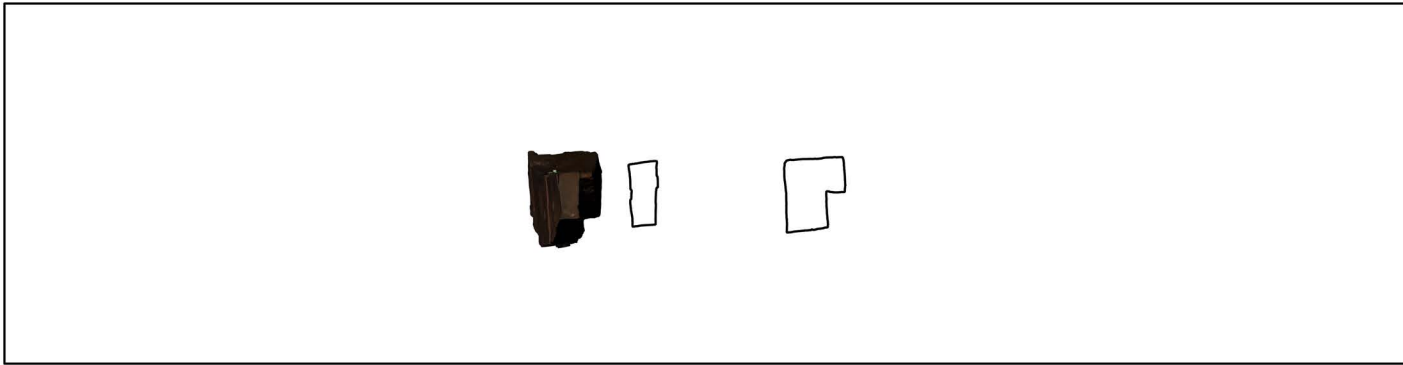
Fore view



Outboard view



View from portside



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

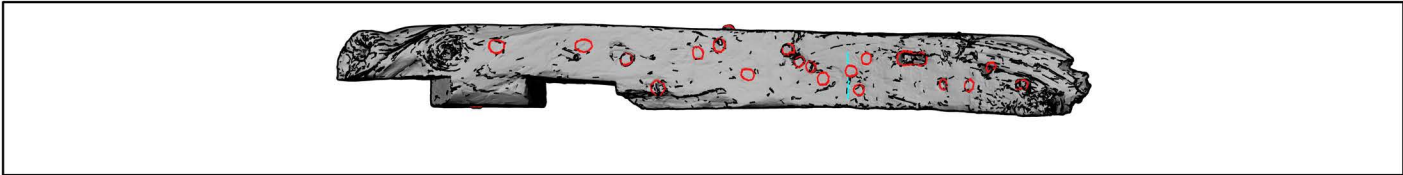
Iron nail holes / heads

Toolmarks

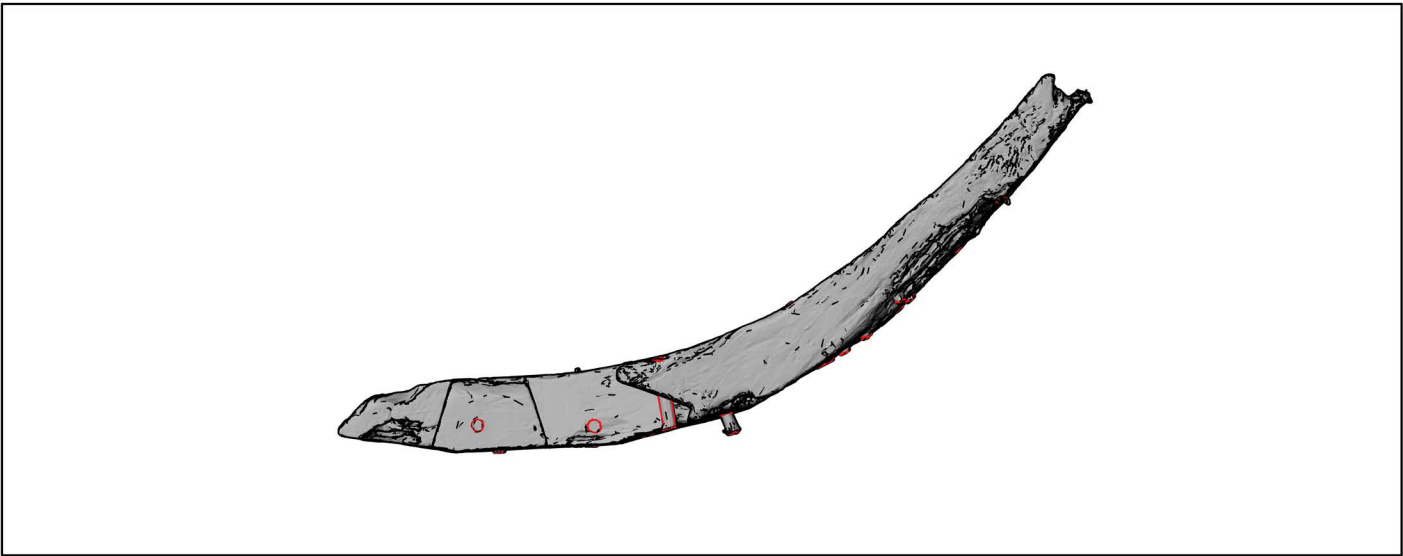
Concretion

Intentional marks
- | | | | | | | |
|--------------|------------------------------|-----------|---------------------|--------------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5004 | | Previous number: | | Timber ID: | 071 |
| Timber type: | futtock | Location: | jointed to floor 48 | | | |
| Status: | Final | | | Drawing No.: | 143 | |
| Scale: | 1:20 | Date: | 10/03/2023 | Made by: | Paolo Croce | |
- wessex
archaeology

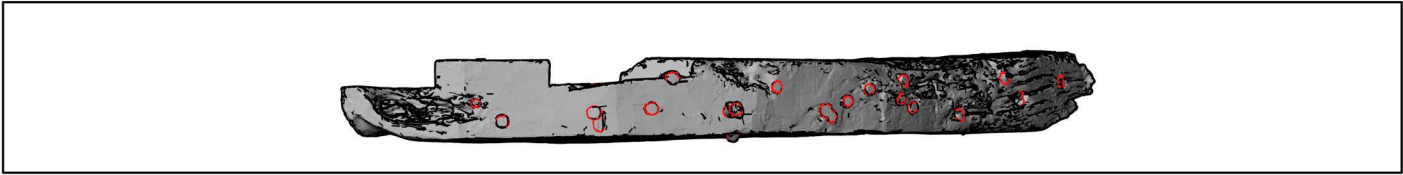
Inboard view



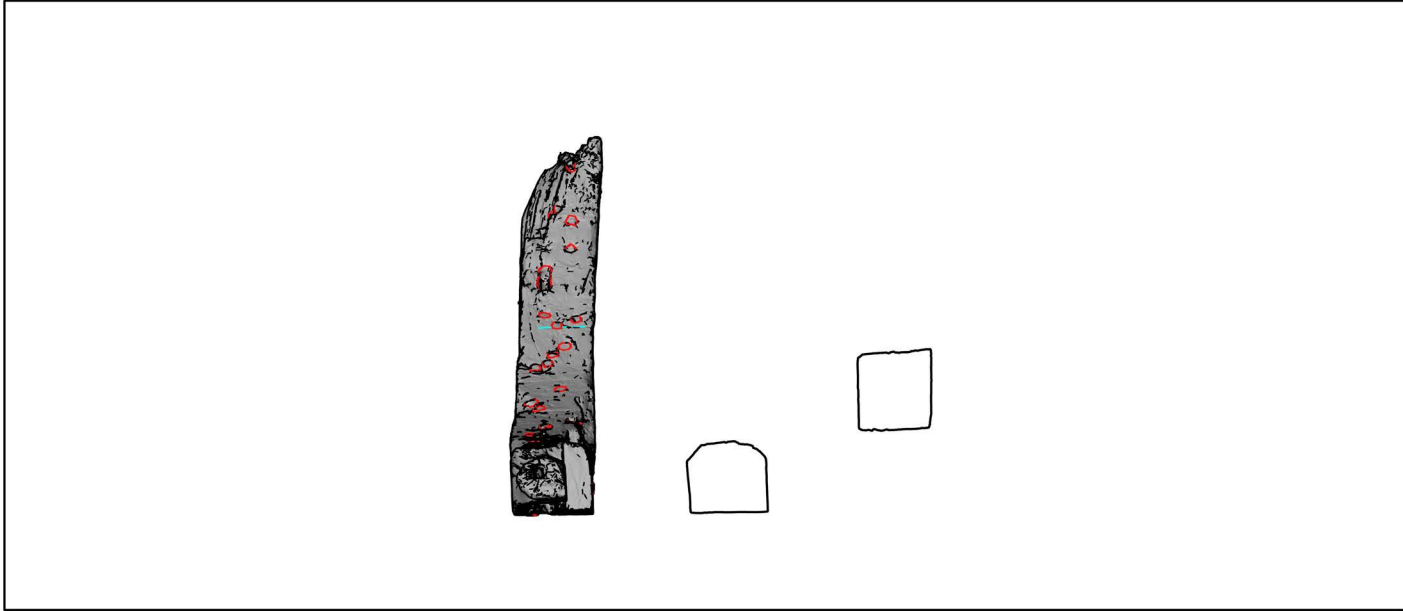
Aft view



Outboard view



Portside view

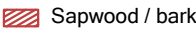


0 0.5m 1m

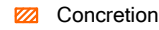
- Legend:
-  Trenails and trenail holes / wedged trenails

 Toolmarks

 Intentional marks

 Sapwood / bark

 Iron nail holes / heads

 Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|---------------------|--------------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5004 | | Previous number: | | Timber ID: | 072 |
| Timber type: | futtock | Location: | jointed to floor 50 | | | |
| Status: | Final | | | Drawing No.: | 144 | |
| Scale: | 1:20 | Date: | 10/03/2023 | Made by: | Paolo Croce | |
- wessex
archaeology

Inboard view



Aft view



Outboard view



Portside view



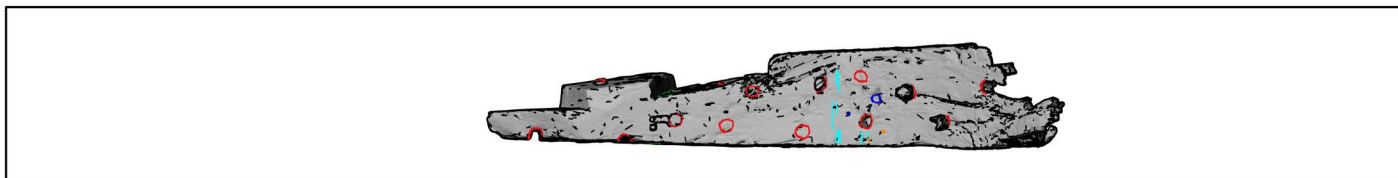
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	072
Timber type:	futtock	Location:	jointed to floor 50			
Status:	Final			Drawing No.:	145	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

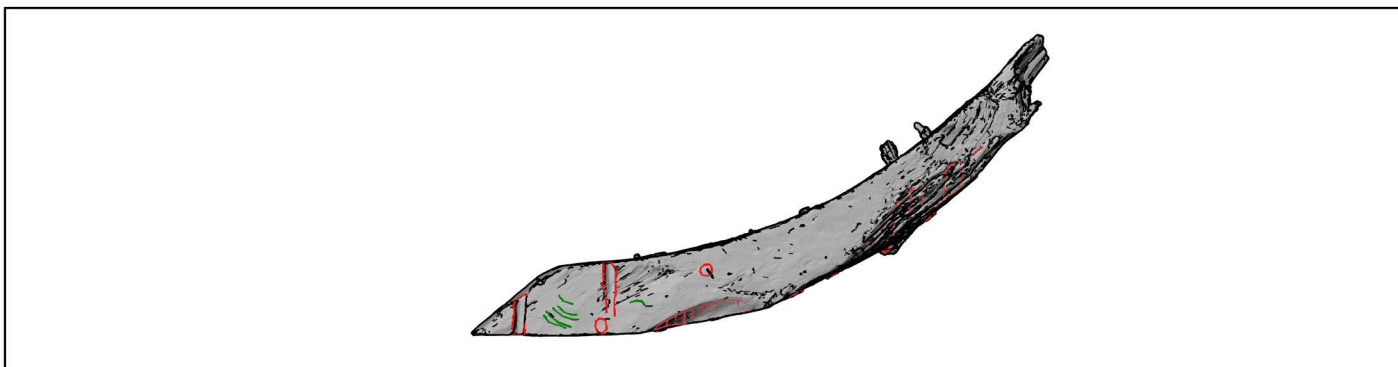
< Port

Starboard >

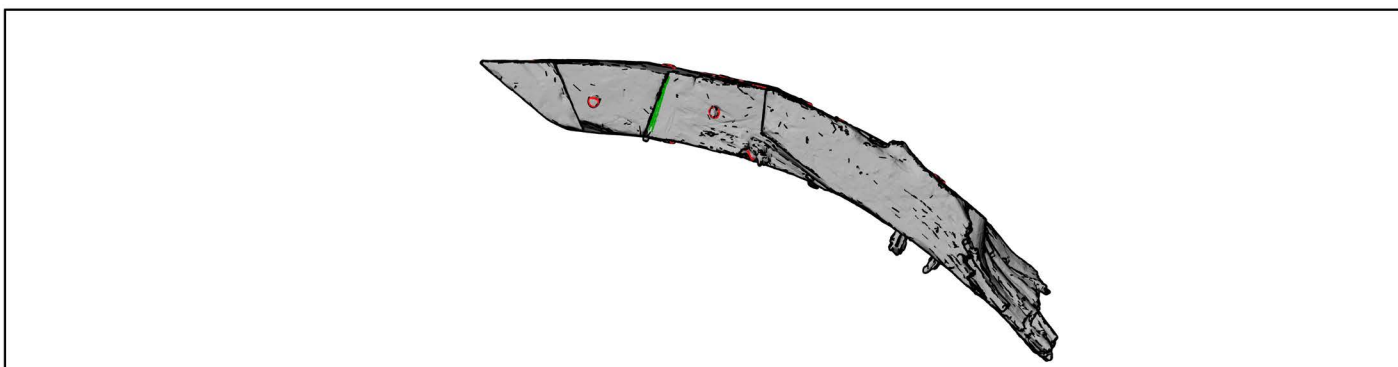
Inboard view



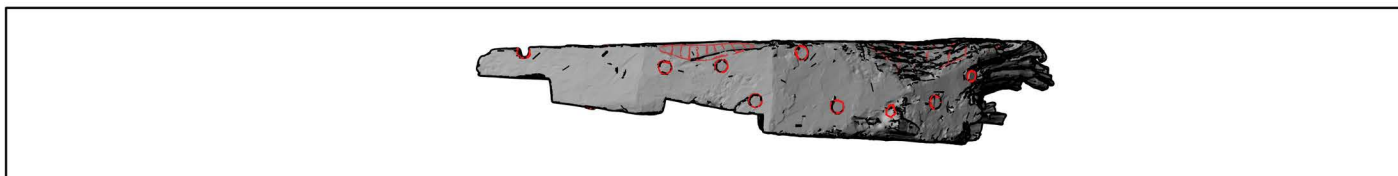
Aft view



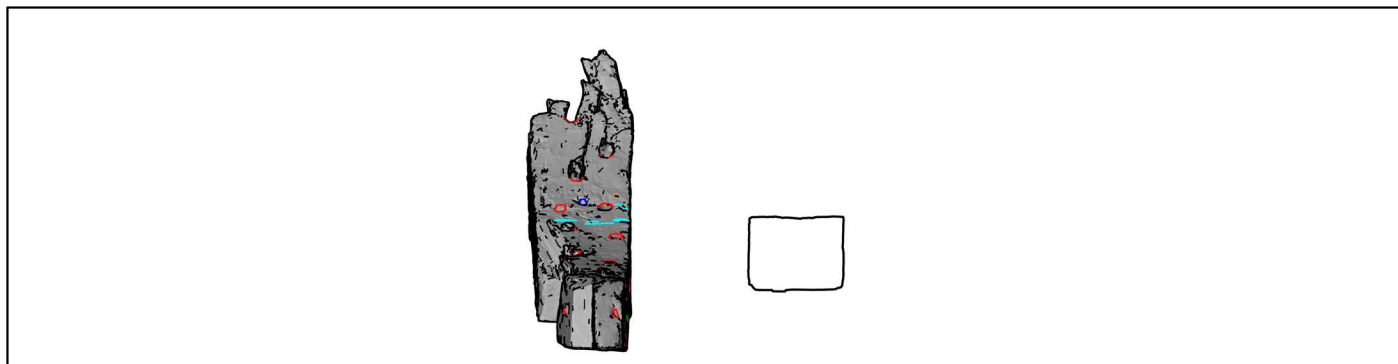
Fore view



Outboard view



Portside view



0 0.5m 1m

Legend:

● Trenails and trenail holes / wedged trenails

— Toolmarks

— Intentional marks

▨ Sapwood / bark

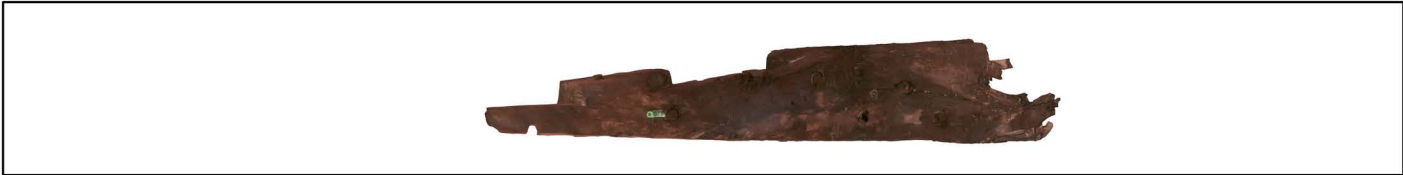
○ Iron nail holes / heads

▨ Concretion

⊗ Wooden plugs / nails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	073
Timber type:	futtock	Location:	jointed to floor 53			
Status:	Final			Drawing No.:	146	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



Fore view



Outboard view



Portside view



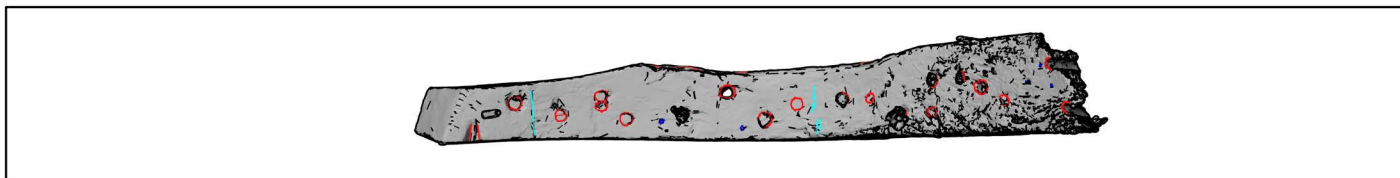
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	073
Timber type:	futtock	Location:	jointed to floor 53			
Status:	Final			Drawing No.:	147	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

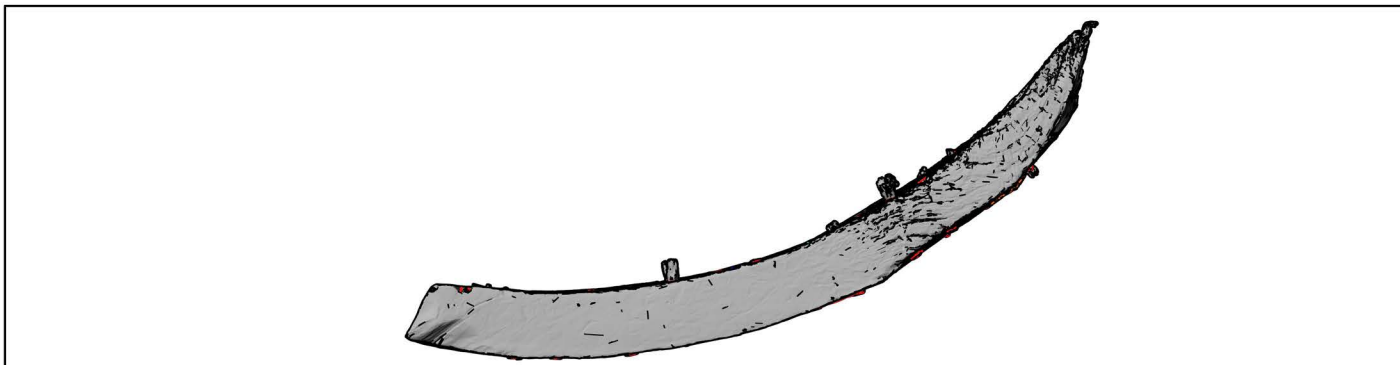
< Port

Starboard >

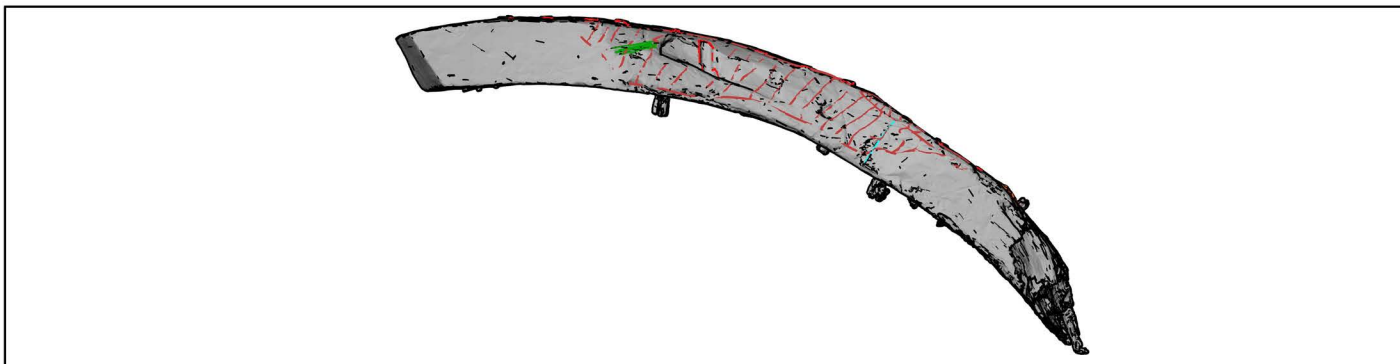
Inboard view



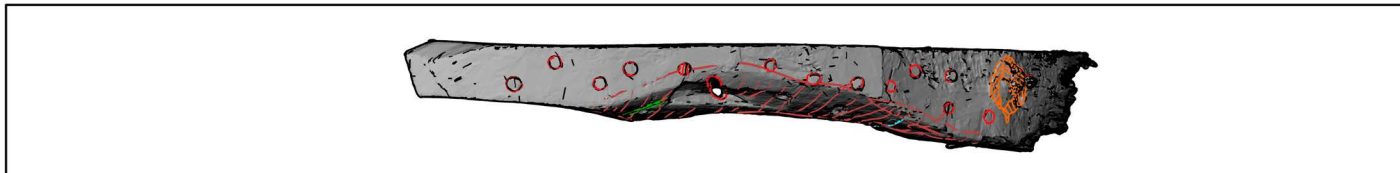
Aft view



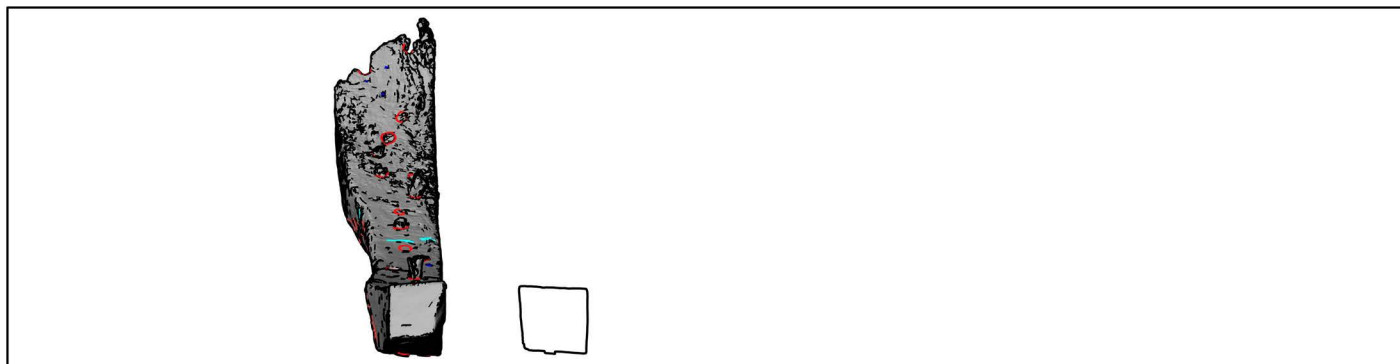
Fore view



Outboard view



View from portside



0 0.5m 1m

Legend:

●○ Trenails and trenail holes / wedged trenails

▨ Sapwood / bark

⊗ Wooden plugs / nails

— Toolmarks

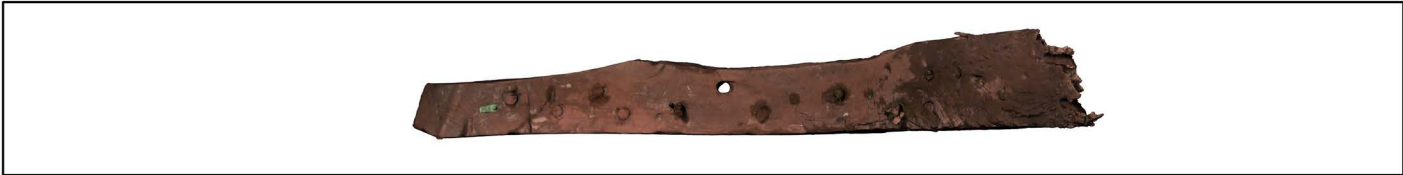
○ Iron nail holes / heads

— Intentional marks

▨ Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	074
Timber type:	futtock	Location:	jointed to floor 54			
Status:	Final			Drawing No.:	154	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



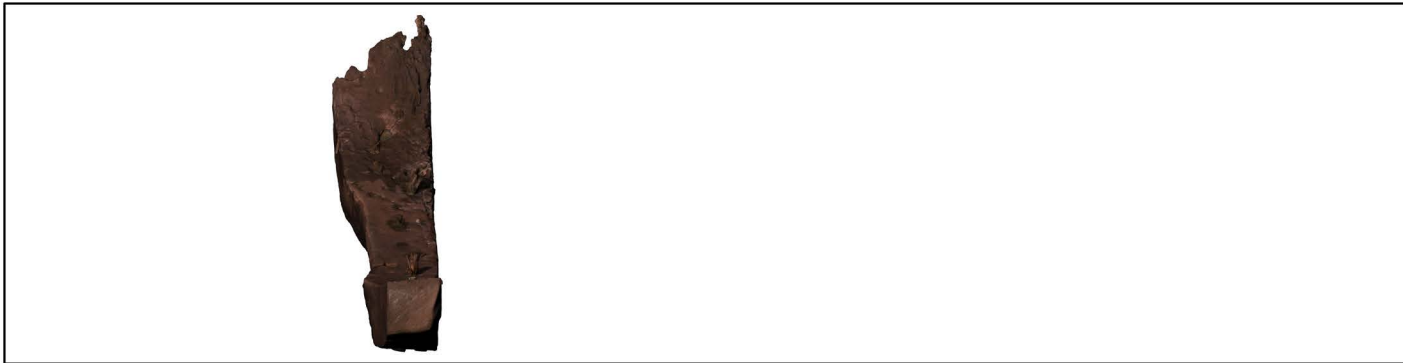
Fore view



Outboard view



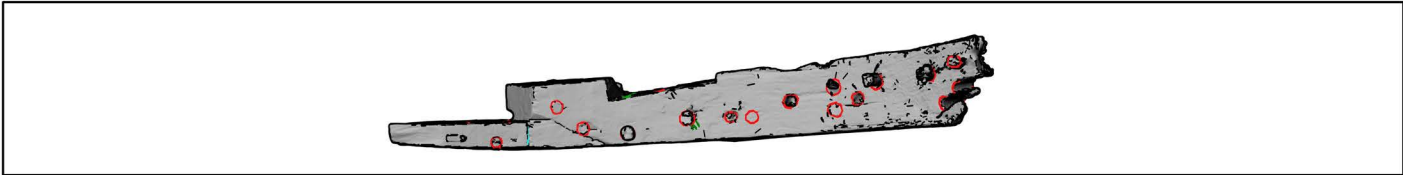
Portside view



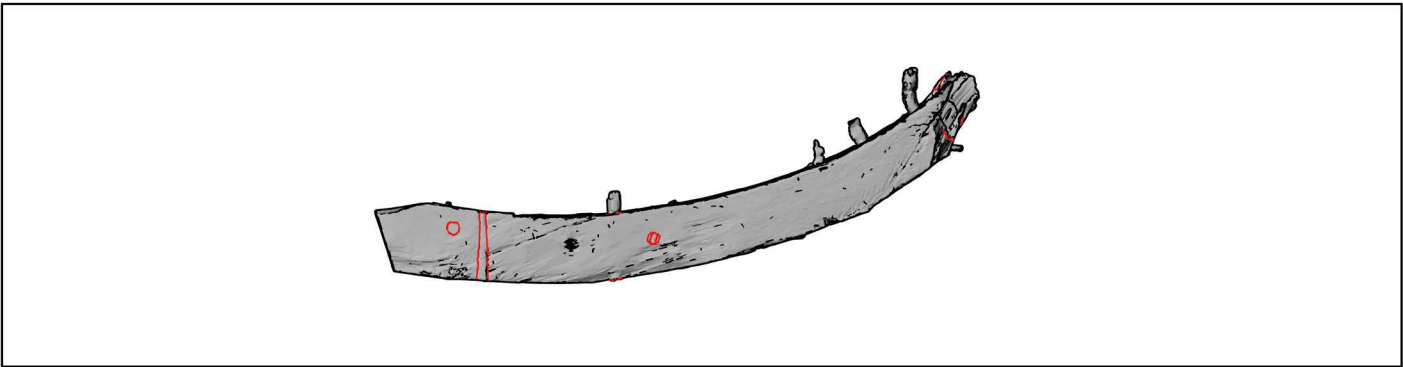
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	074
Timber type:	futtock	Location:	jointed to floor 54			
Status:	Final			Drawing No.:	155	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

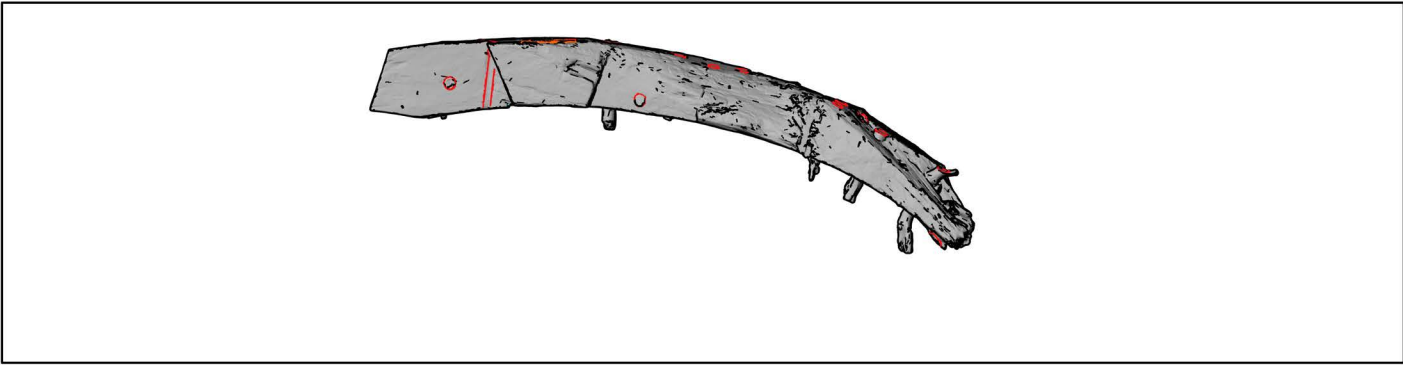
Inboard view



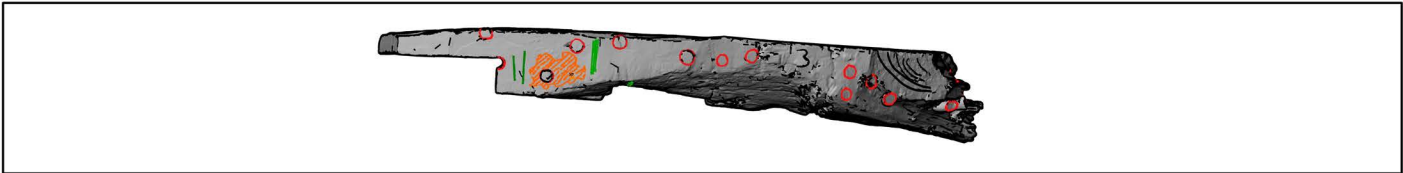
Aft view



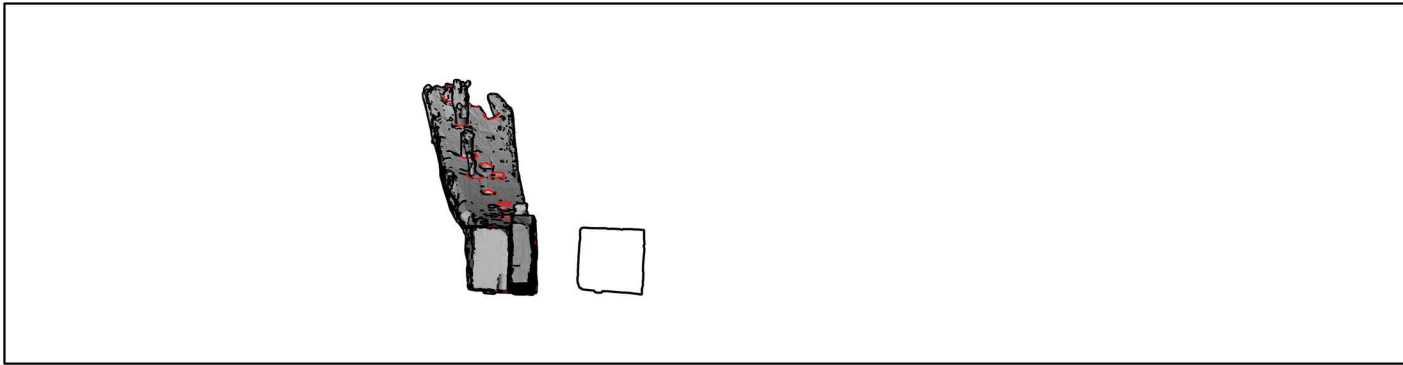
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	075
Timber type:	futtock	Location:	jointed to floor 56			
Status:	Final			Drawing No.:	150	
Scale:	1:20	Date:	18/07/2023	Made by:	Paolo Croce	

Inboard view



Aft view



Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- ○

Trenails and trenail holes / wedged trenails

—

—

Toolmarks

—

—

Intentional marks

▨

▨

Sapwood / bark

○

○

Iron nail holes / heads

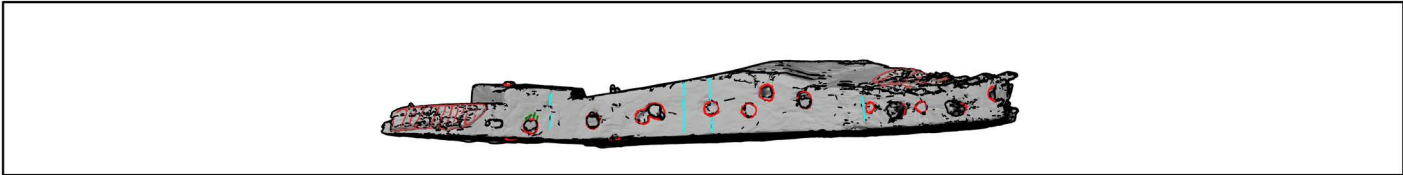
▨

▨

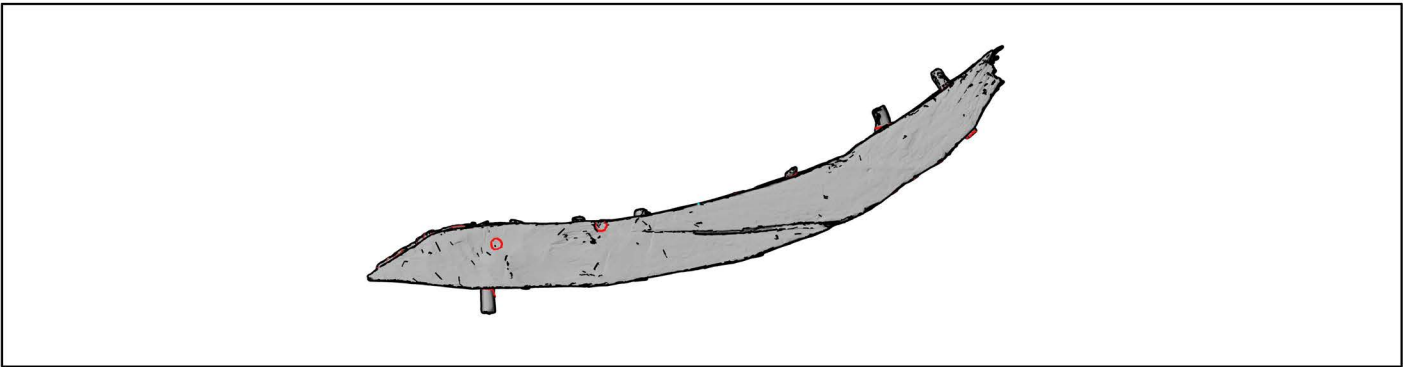
Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	075
Timber type:	futtock	Location:	jointed to floor 56			
Status:	Final			Drawing No.:	151	
Scale:	1:20	Date:	18/07/2023	Made by:	Paolo Croce	

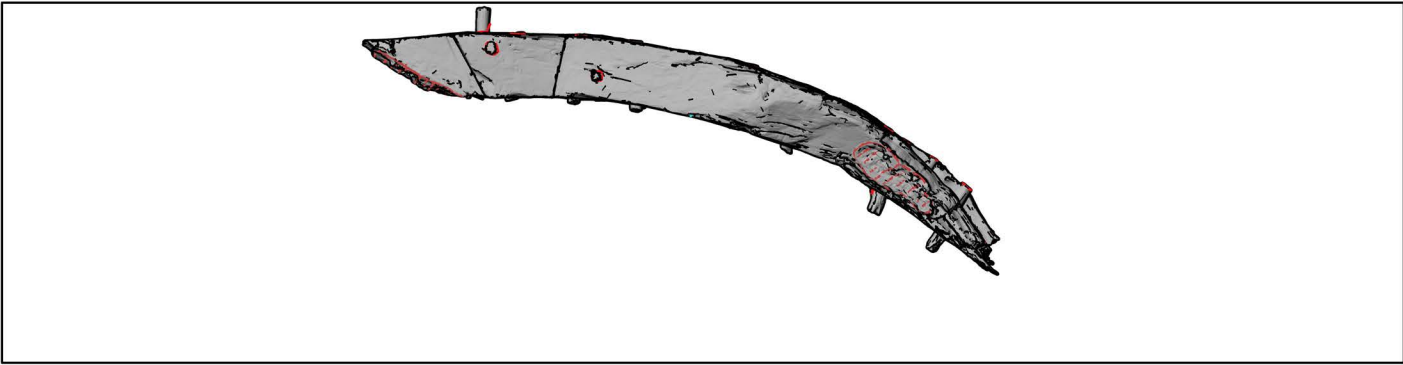
Inboard view



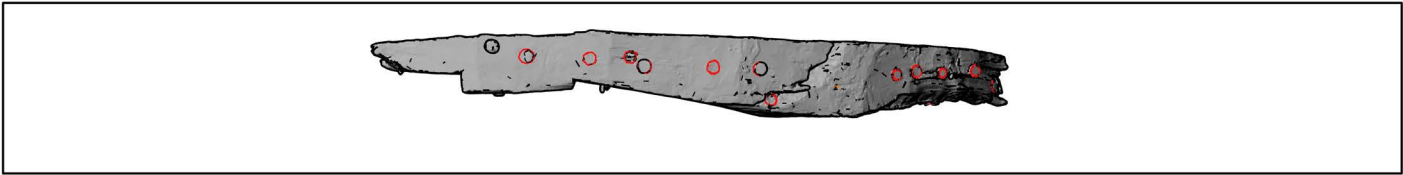
Aft view



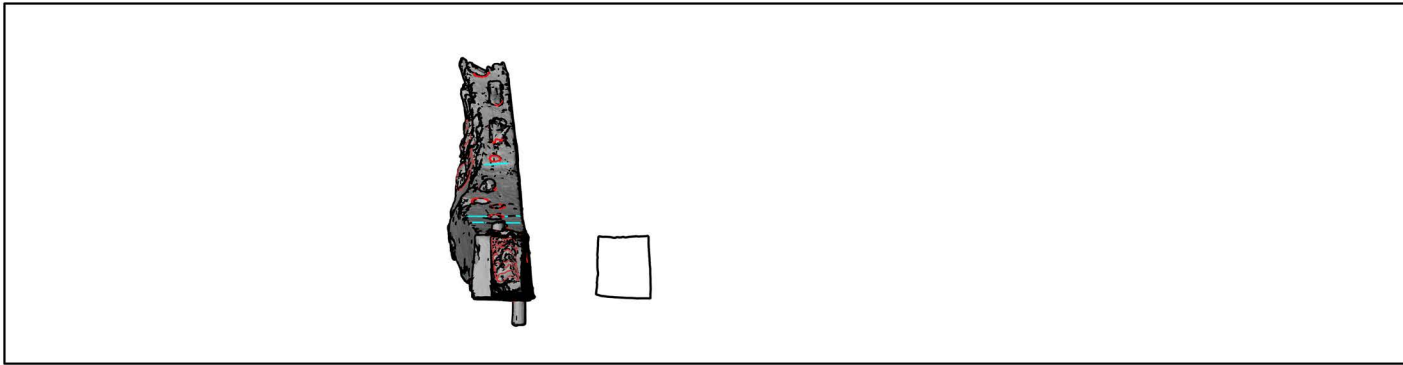
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
-  Trenails and trenail holes / wedged trenails

 Toolmarks

 Intentional marks

 Sapwood / bark

 Iron nail holes / heads

 Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|---------------------|----------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5004 | | Previous number: | | Timber ID: | 076 |
| Timber type: | futtock | Location: | jointed to floor 58 | | | |
| Status: | Final | | Drawing No.: | 156 | | |
| Scale: | 1:20 | Date: | 10/03/2023 | Made by: | Paolo Croce | |
- wessex
archaeology

Inboard view



Aft view



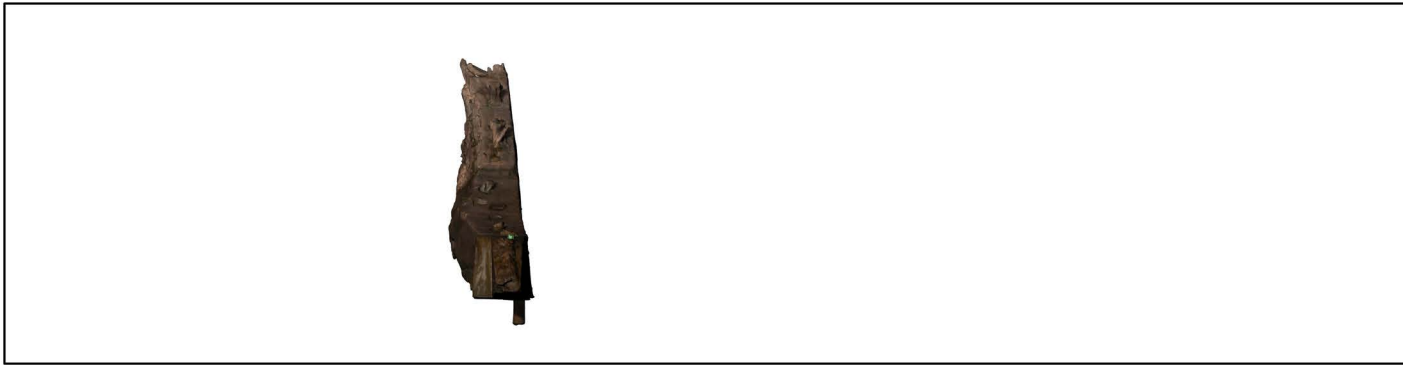
Fore view



Outboard view



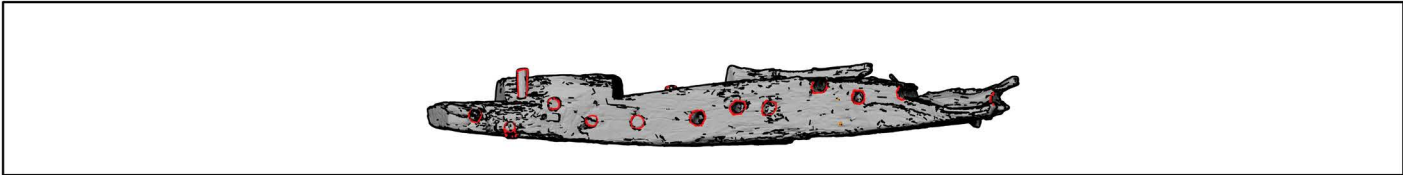
Portside view



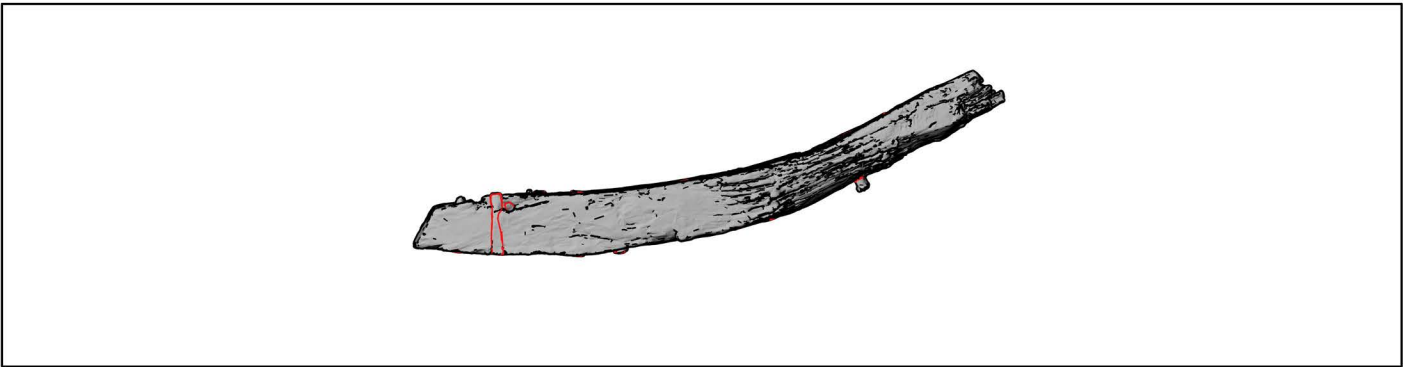
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	076
Timber type:	futtock	Location:	jointed to floor 58			
Status:	Final			Drawing No.:	157	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

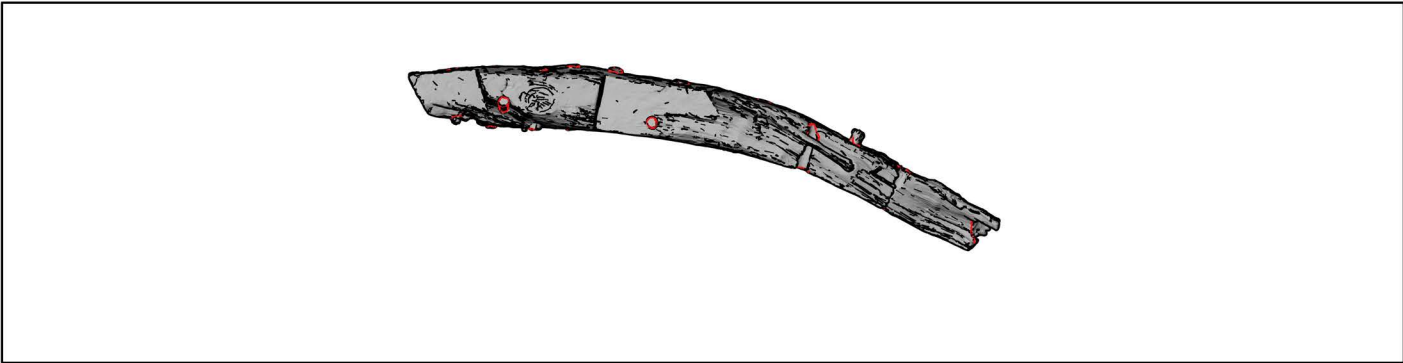
Inboard view



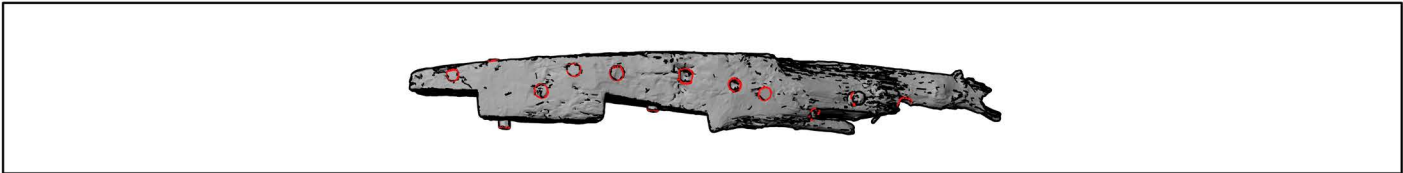
Aft view



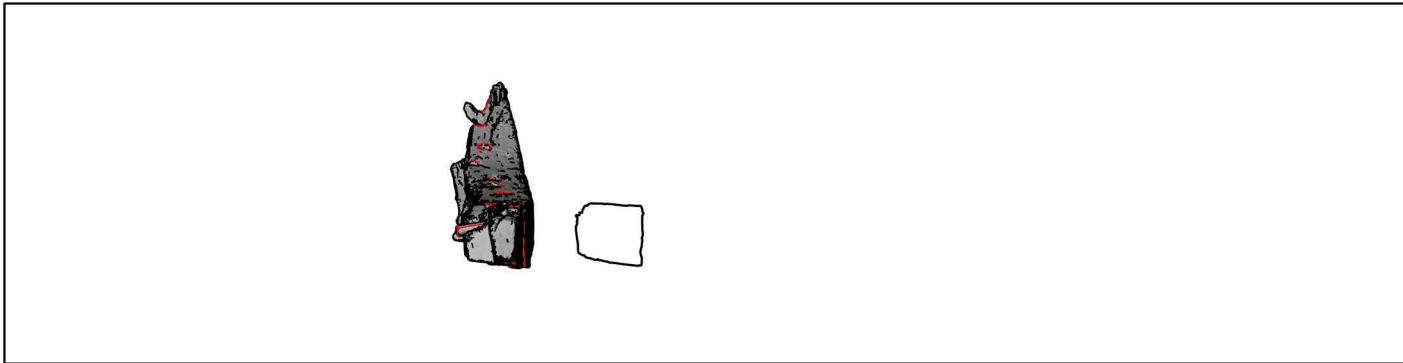
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Treenails and treenail holes / wedged treenails

Toolmarks

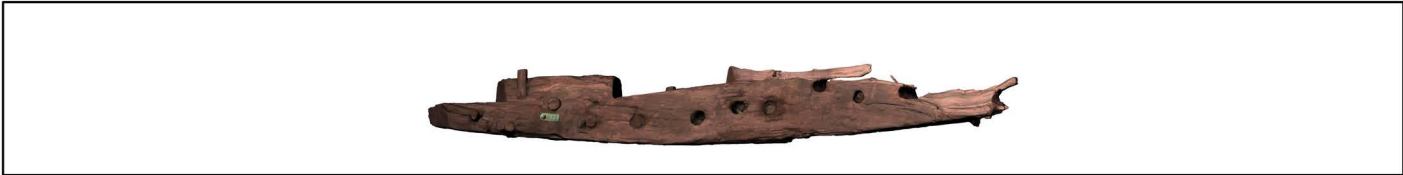
Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|---------------------|----------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5004 | | Previous number: | | Timber ID: | 077 |
| Timber type: | futtock | Location: | jointed to floor 60 | | | |
| Status: | Final | | Drawing No.: | 154 | | |
| Scale: | 1:20 | Date: | 10/03/2023 | Made by: | Paolo Croce | |
- wessex
archaeology

Inboard view



Aft view



Fore view



Outboard view



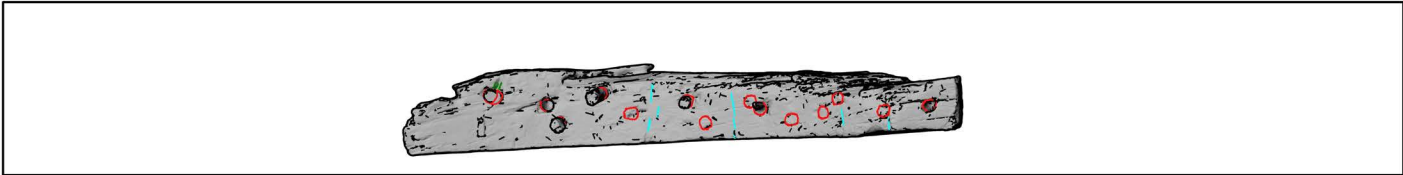
Portside view



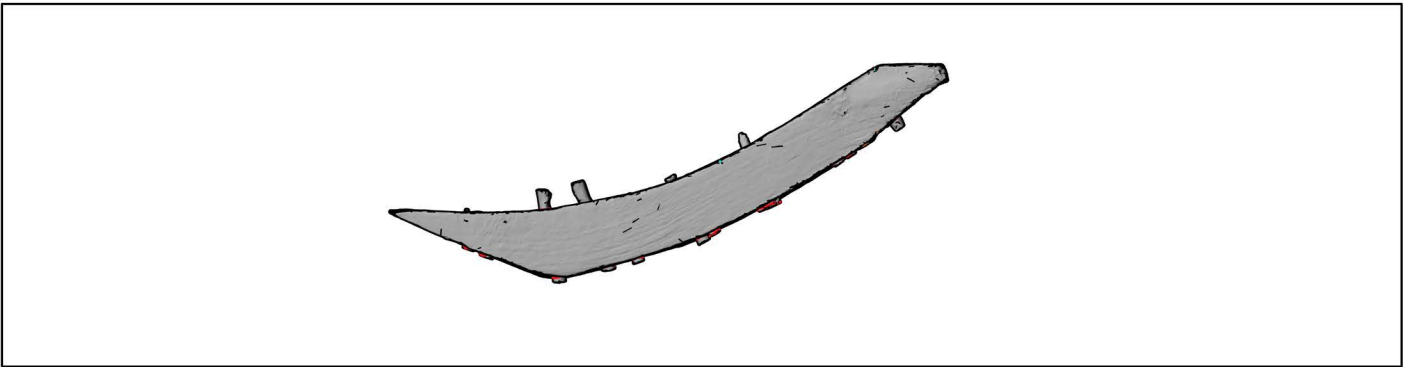
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	077
Timber type:	futtock	Location:	jointed to floor 60			
Status:	Final			Drawing No.:	155	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

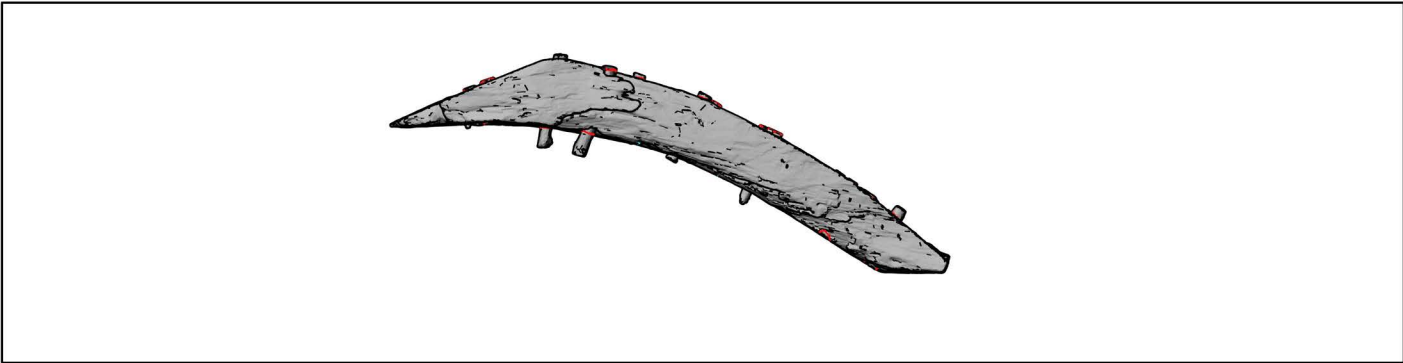
Inboard view



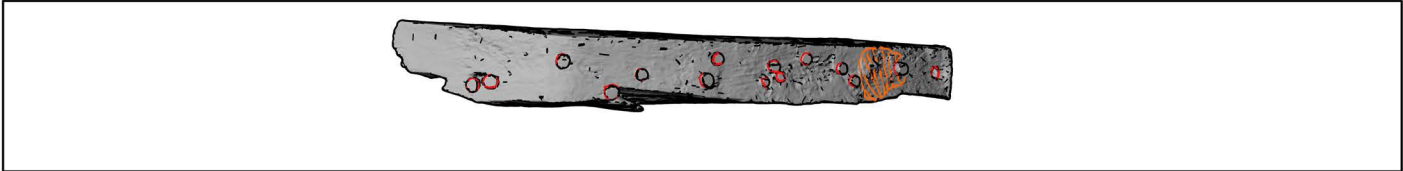
Aft view



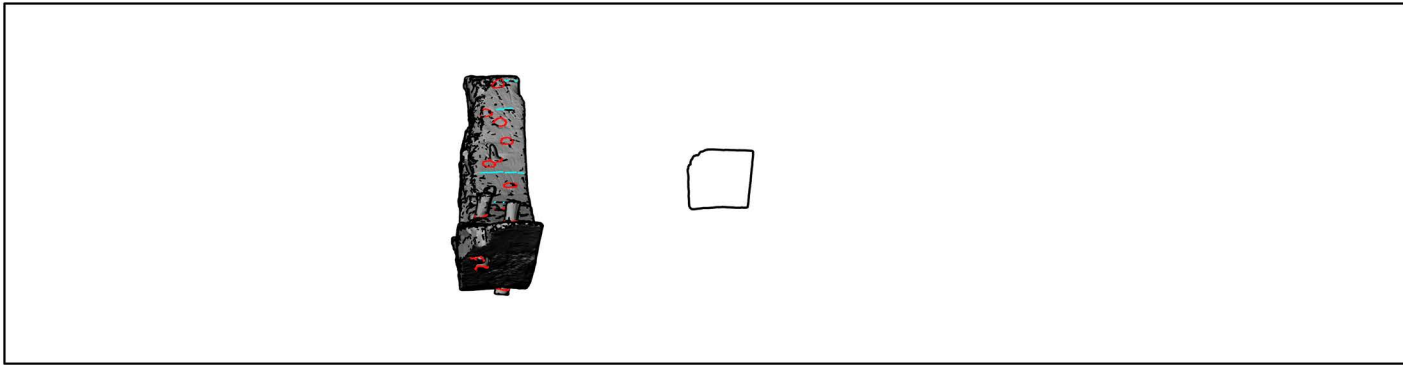
Fore view



Outboard view



View from portside



0 0.5m 1m

- Legend:
-  Trenails and trenail holes / wedged trenails

 Toolmarks

 Intentional marks

 Sapwood / bark

 Iron nail holes / heads

 Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|----------------------------------|--------------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5004 | | Previous number: | | Timber ID: | 078 |
| Timber type: | futtock | Location: | master frame, scarf to floor 051 | | | |
| Status: | Final | | | Drawing No.: | 157 | |
| Scale: | 1:20 | Date: | 10/03/2023 | Made by: | Paolo Croce | |
- wessex
archaeology

Inboard view



Aft view



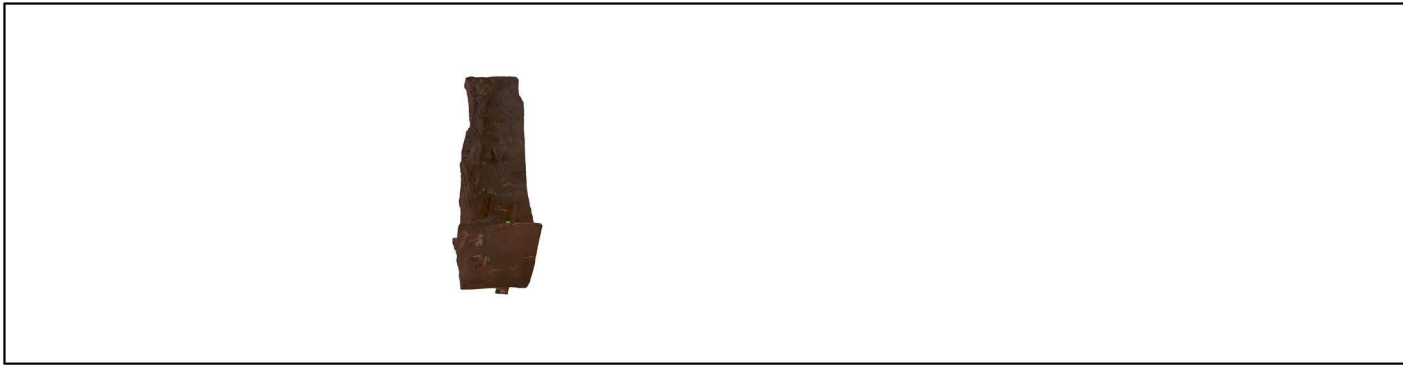
Fore view



Outboard view



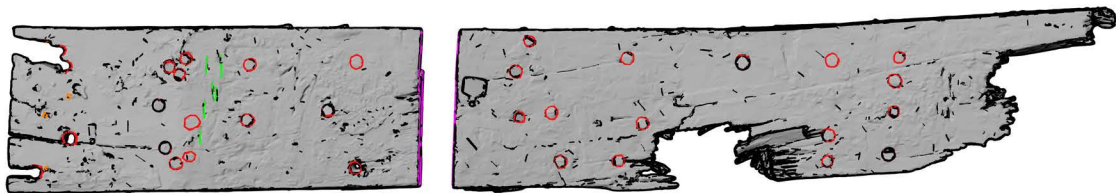
View from portside



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	078
Timber type:	futtock	Location:	master frame, scarf to floor 051			
Status:	Final			Drawing No.:	156	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

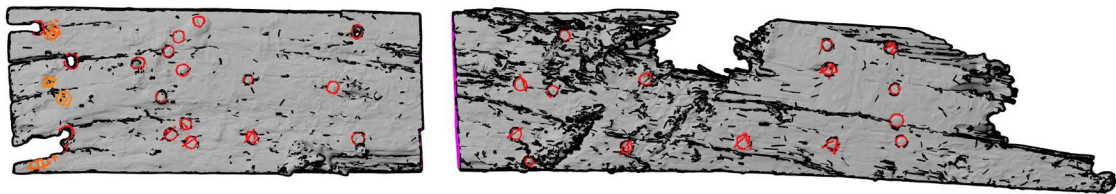
Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

- Treenails and trenail holes / wedged trenails
- Iron nail holes / heads
- Wooden plugs / nails
- Concretion
- Toolmarks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004	Previous number:				Timber ID:	079 , 079b
Timber type:	outer plank	Location:	surviving plank 2 of strake 6 of section 5004, starboard side (sampled)				
Status:	Final				Drawing No.:	158	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce		

Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

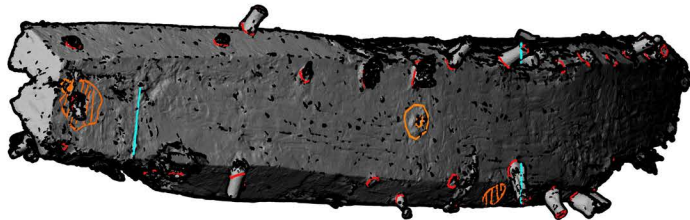
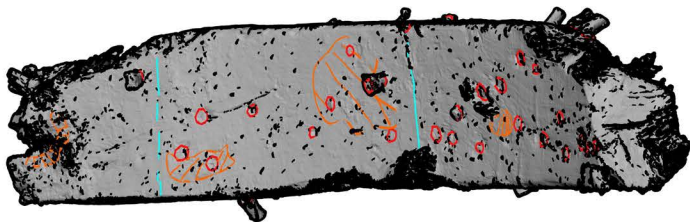
Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004	Previous number:			Timber ID:	079 , 079b	
Timber type:	outer plank	Location:	surviving plank 2 of strake 6 of section 5004, starboard side (sampled)				
Status:	Final				Drawing No.:	159	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce		

< Stern

Bow >

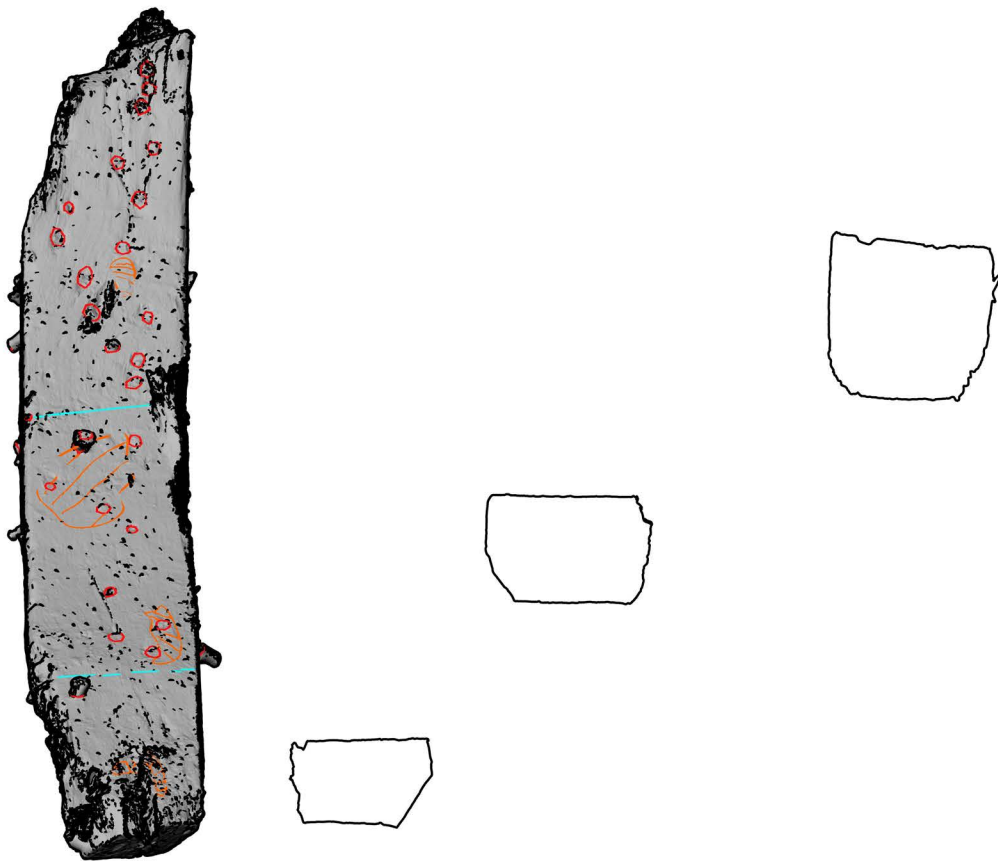
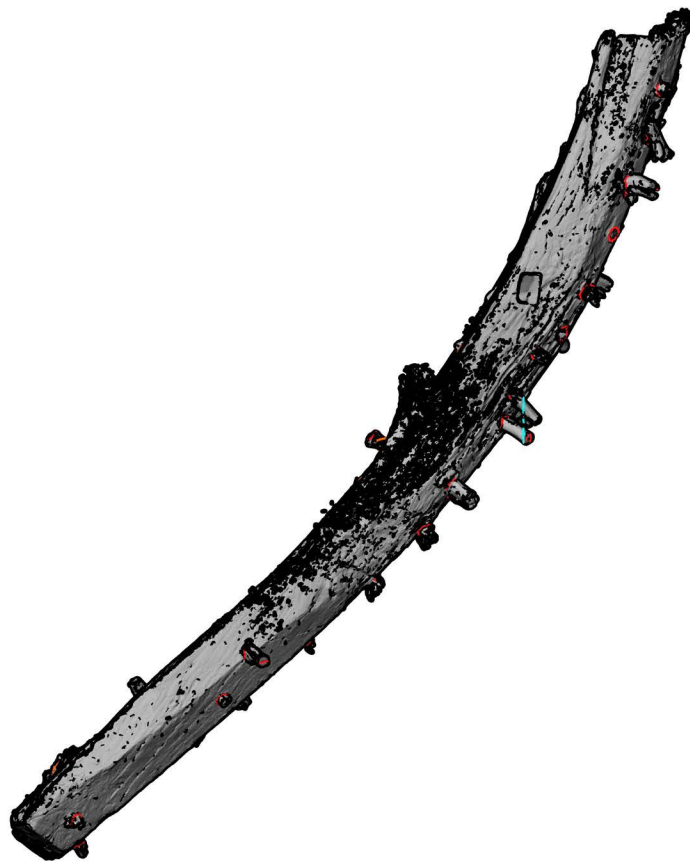
Inboard view

Outboard view



Side view

Aft view



0 0.5m 1m

Legend:

- Trenails and trenail holes / wedged trenails
- Wooden plugs / nails
- Intentional marks
- Iron nail holes / heads
- Bolts holes / roves / heads
- Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5030	Timber ID:	080
Timber type:	poss. apron	Location:	disarticulated			
Status:	Draft			Drawing No.:	160	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

< Stern

Inboard view



Bow >

Outboard view



Side view



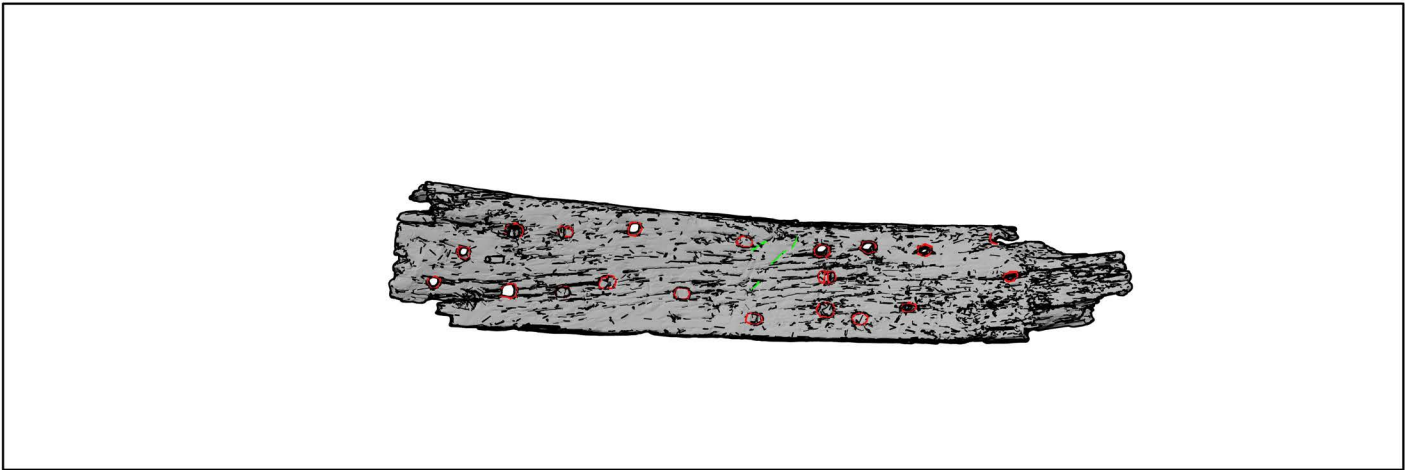
Aft view



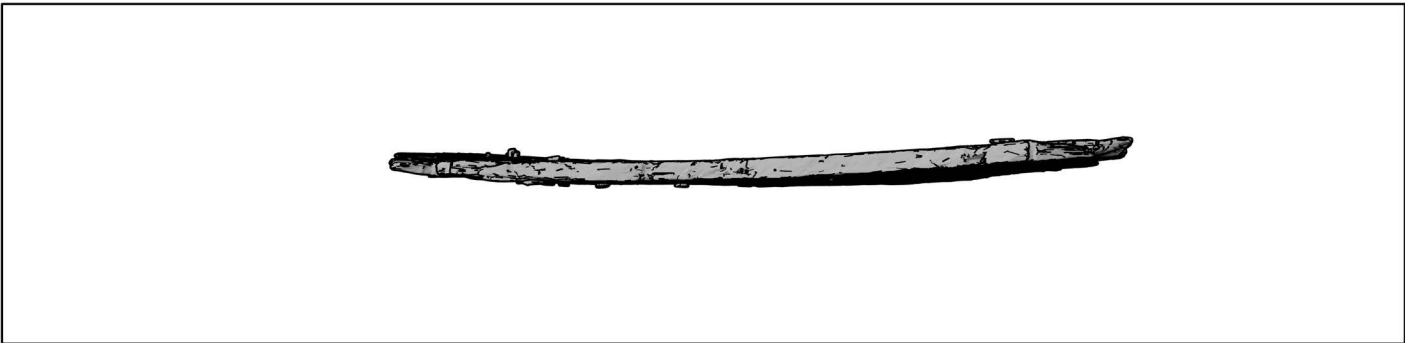
0 0,5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	-		Previous number:	5030	Timber ID:	080
Timber type:	poss. apron	Location:	disarticulated			
Status:	Final			Drawing No.:	161	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

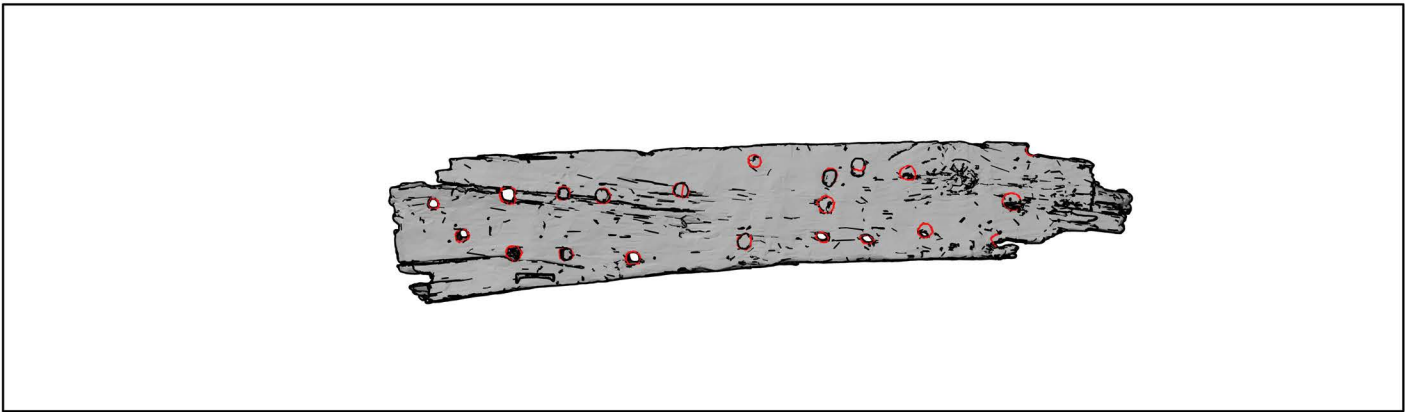
Inboard view



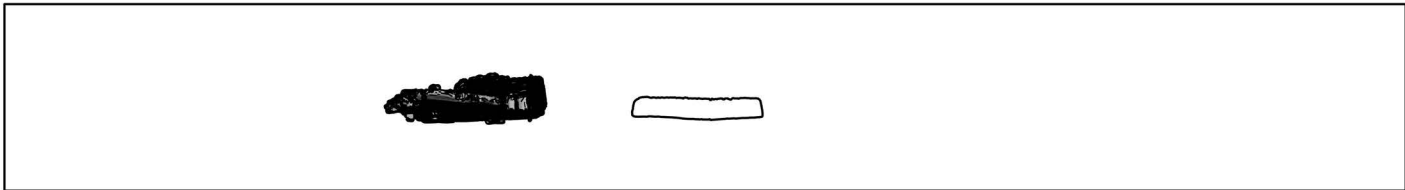
Side view



Outboard view



Aft view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	081
Timber type:	ceiling plank	Location:	ceiling plank, section 5006			
Status:	Final			Drawing No.:	162	
Scale:	1:20	Date:	14/03/2023	Made by:	Paolo Croce	

Inboard view



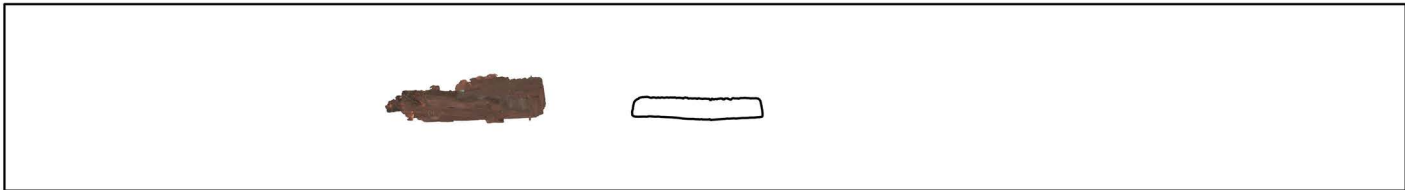
Side view



Outboard view



Aft view

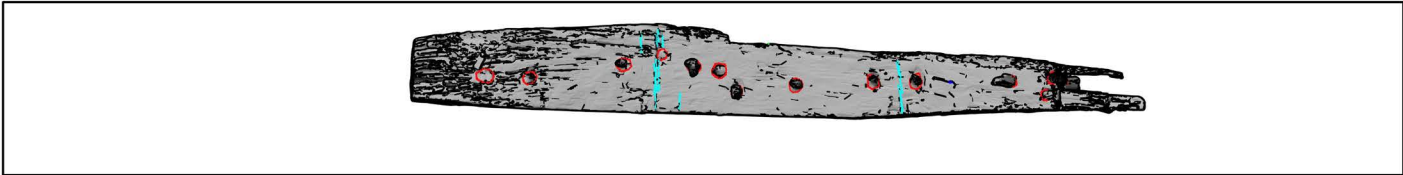


00.5m1m

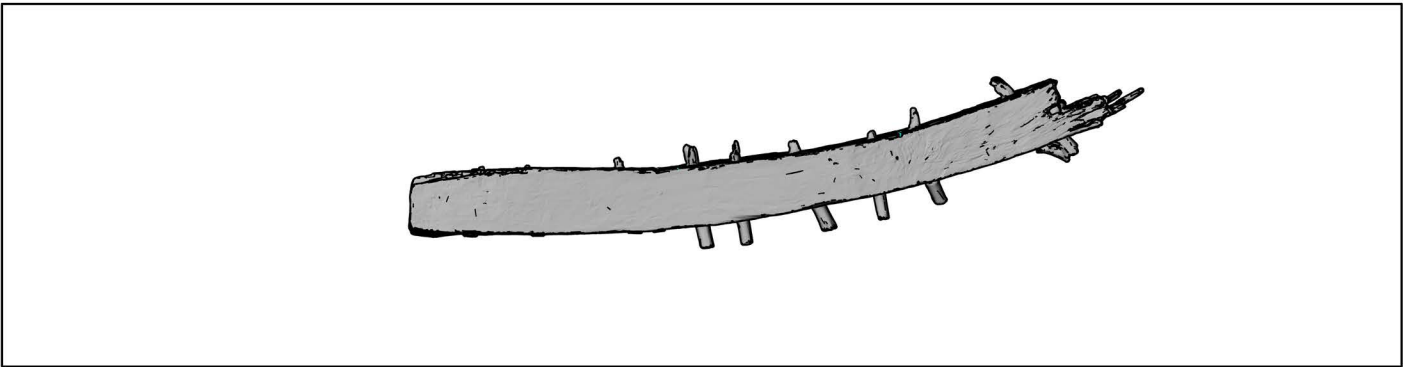
- Legend:
- Trenails and trenail holes / wedged trenails
 - Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	081
Timber type:	ceiling plank	Location:	ceiling plank, section 5006			
Status:	Final			Drawing No.:	163	
Scale:	1:20	Date:	14/03/2023	Made by:	Paolo Croce	

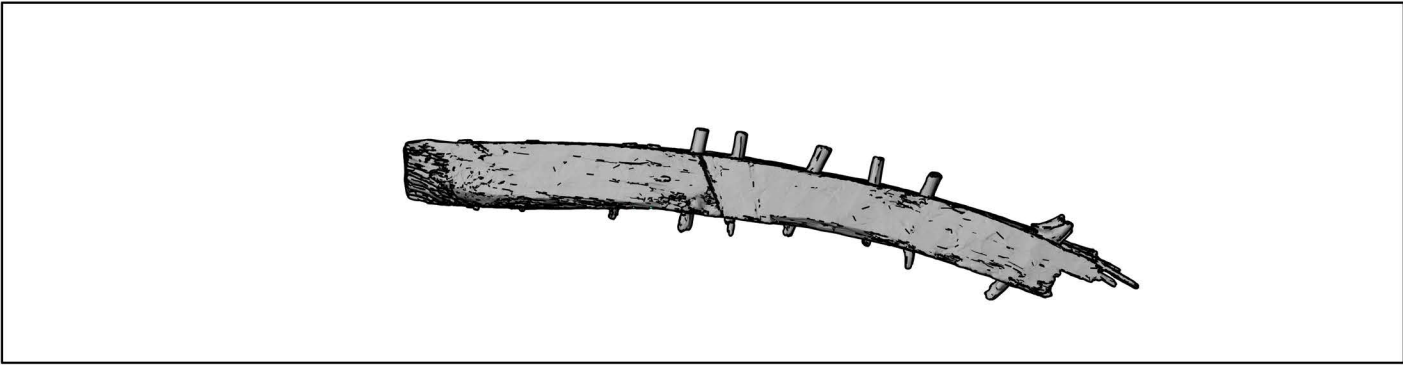
Inboard view



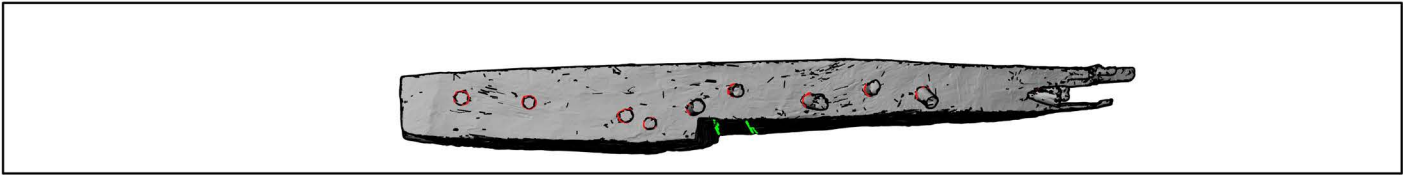
Aft view



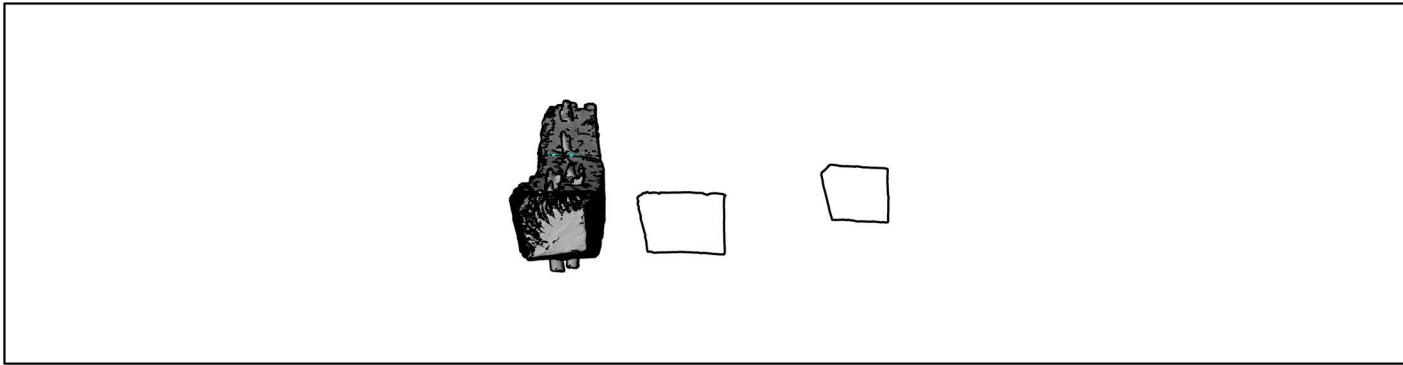
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

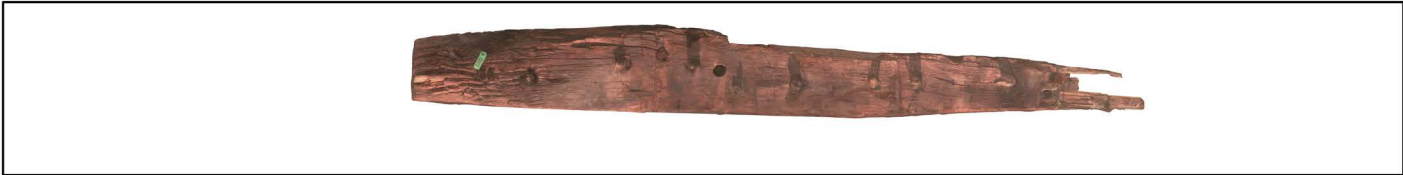
Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	082
Timber type:	filling frame	Location:	aftermost surviving frame on section 5006, next to floor 083			
Status:	Final			Drawing No.:	164	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- 

Trenails and trenail holes / wedged trenails



Toolmarks



Intentional marks



Sapwood / bark



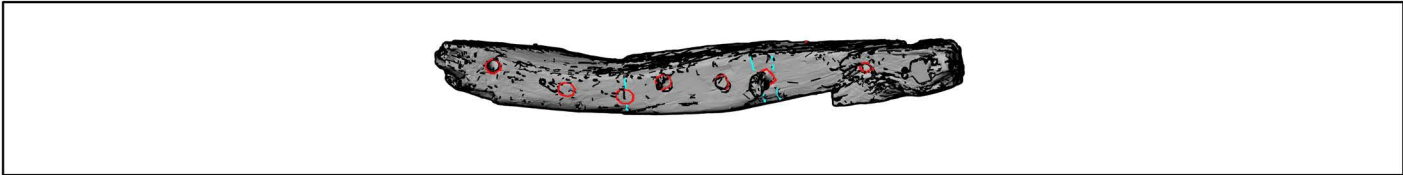
Iron nail holes / heads



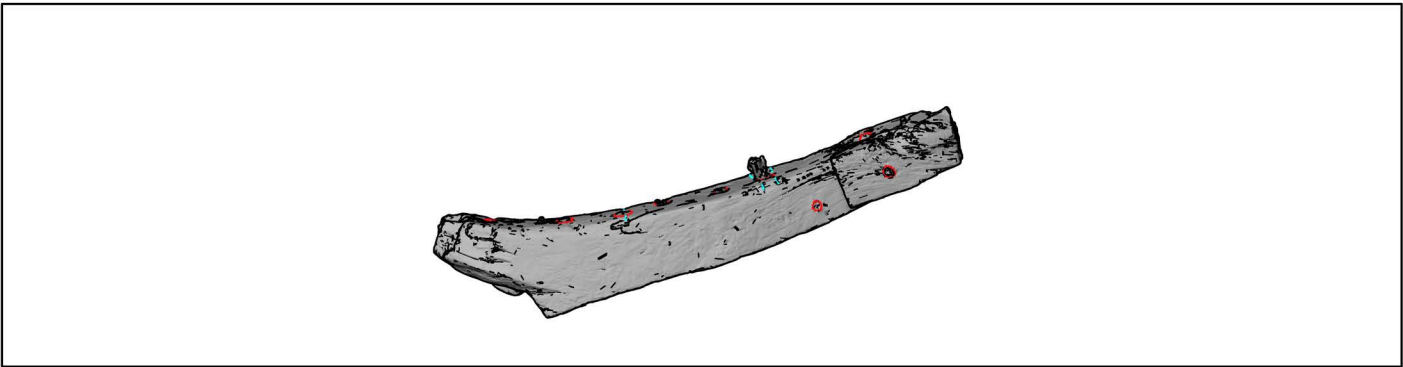
Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	082
Timber type:	filling frame	Location:	aftermost surviving frame on section 5006, next to floor 083			
Status:	Final			Drawing No.:	165	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

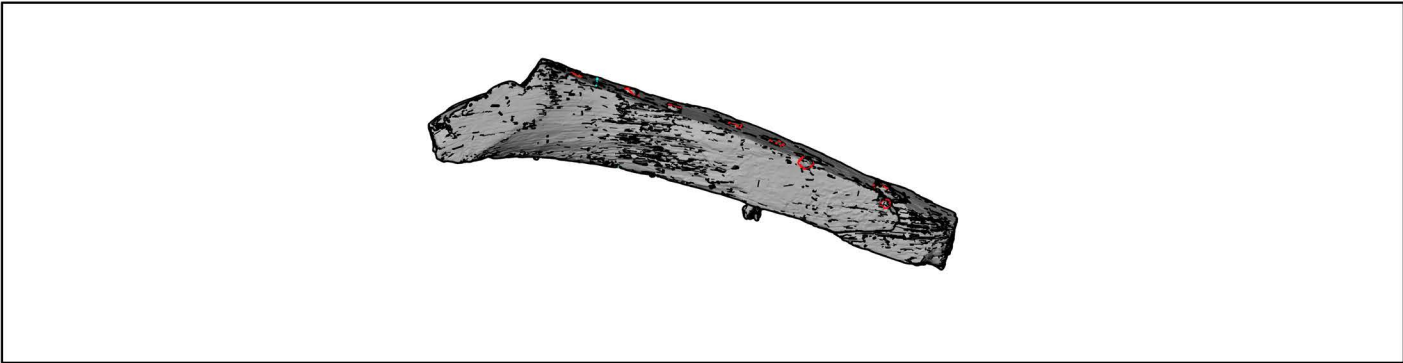
Inboard view



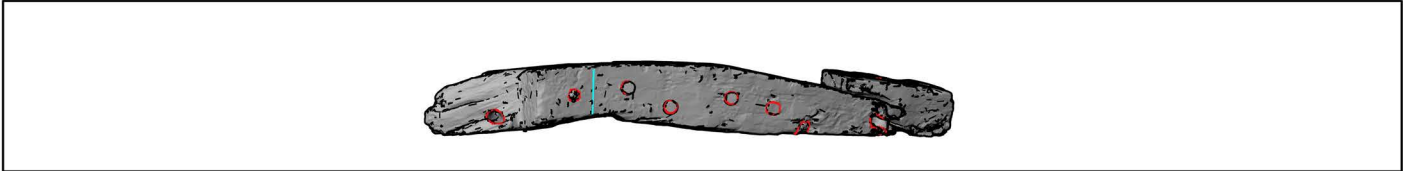
Aft view



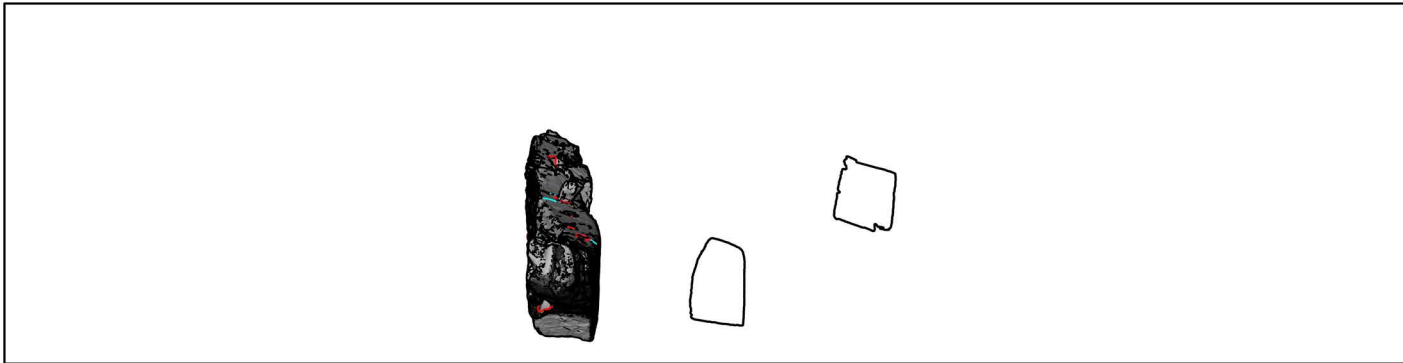
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Treenails and treenail holes / wedged treenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	083
Timber type:	floor	Location:	between filling frames 082 and 084			
Status:	Final			Drawing No.:	166	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- 

Trenails and trenail holes / wedged trenails



Toolmarks



Intentional marks



Sapwood / bark



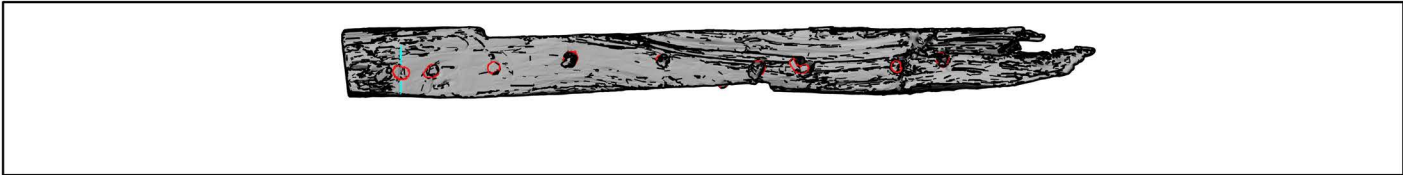
Iron nail holes / heads



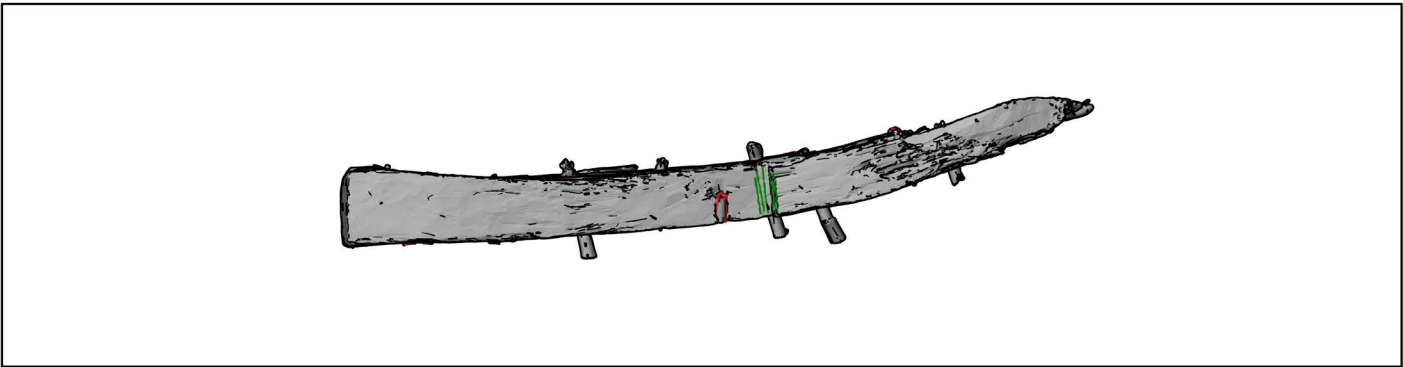
Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	083
Timber type:	floor	Location:	between filling frames 082 and 084			
Status:	Final			Drawing No.:	167	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

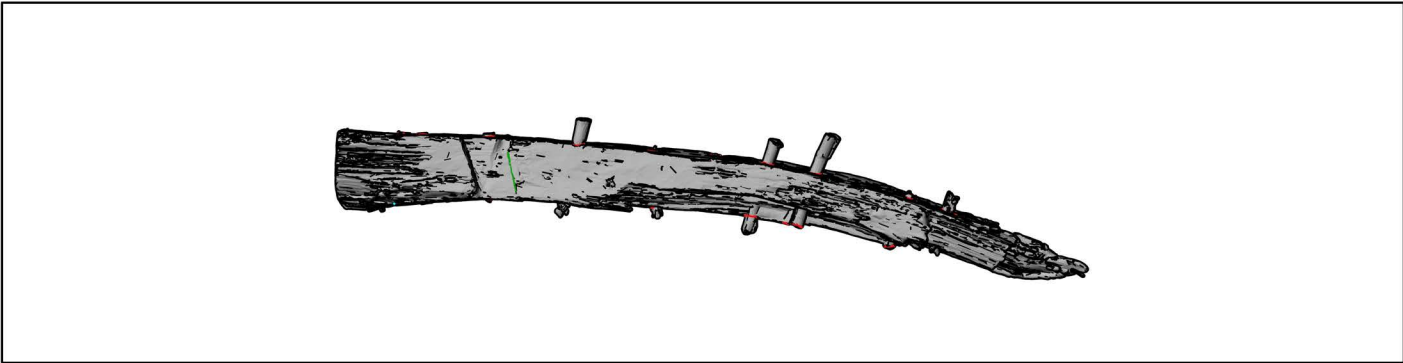
Inboard view



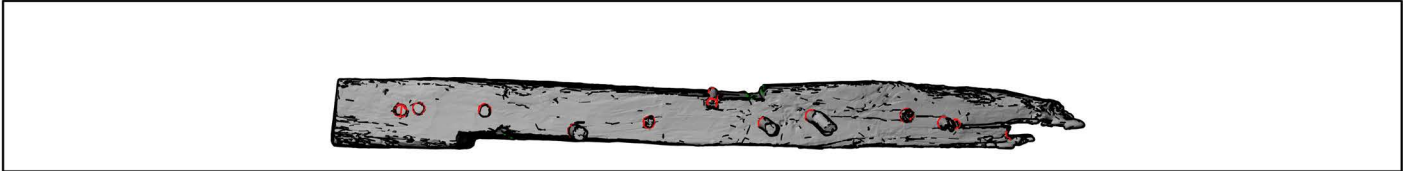
Aft view



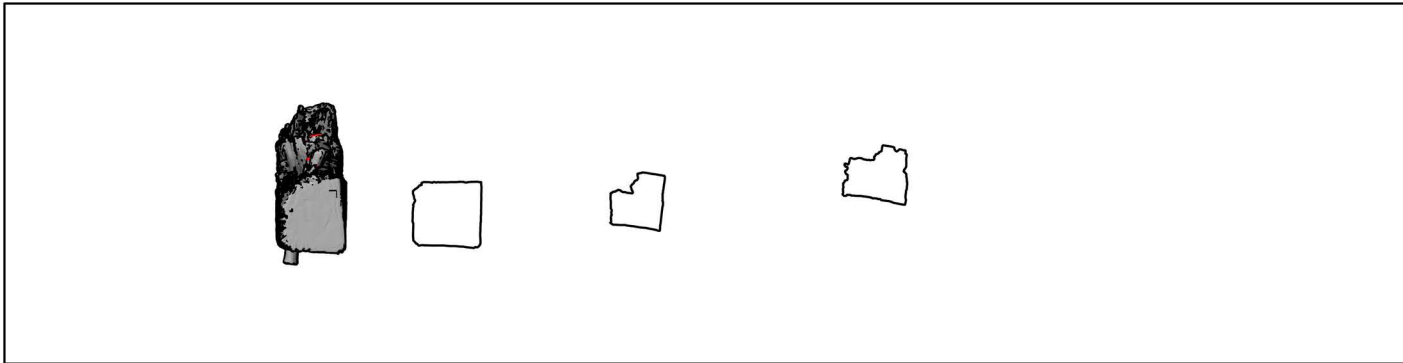
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	084
Timber type:	filling frame	Location:	between floor 83 and futtock 084			
Status:	Final		Drawing No.:	168		
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



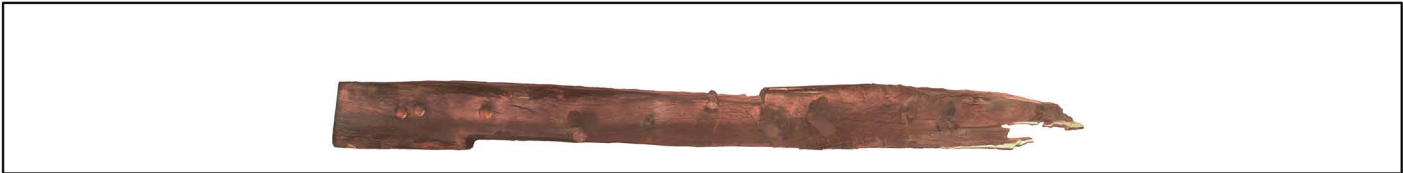
Aft view



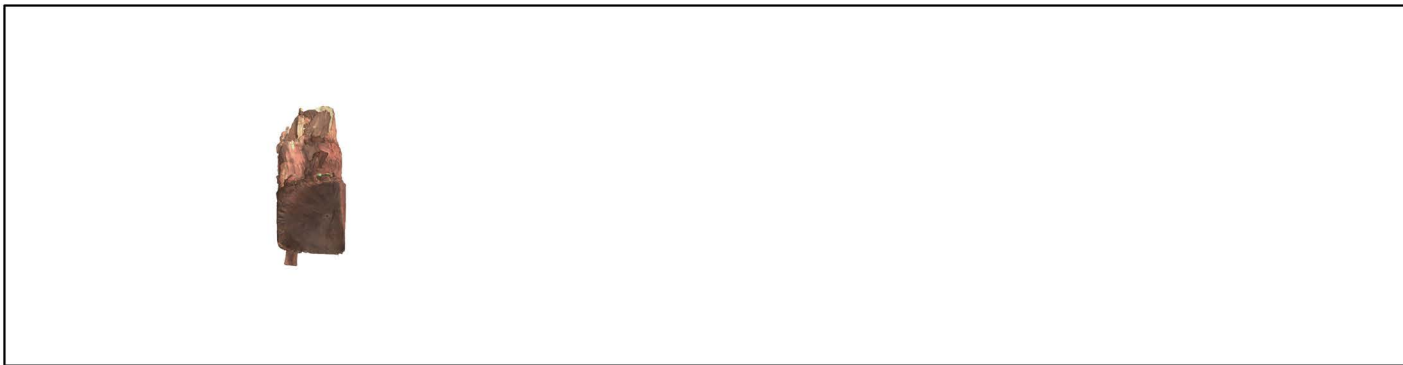
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
-  Trenails and trenail holes / wedged trenails

 Toolmarks

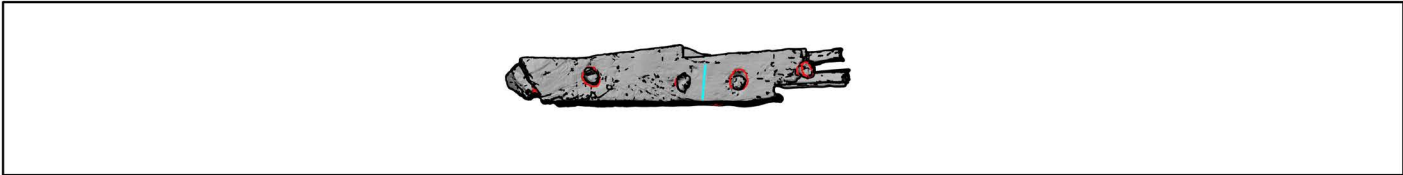
 Intentional marks

 Sapwood / bark

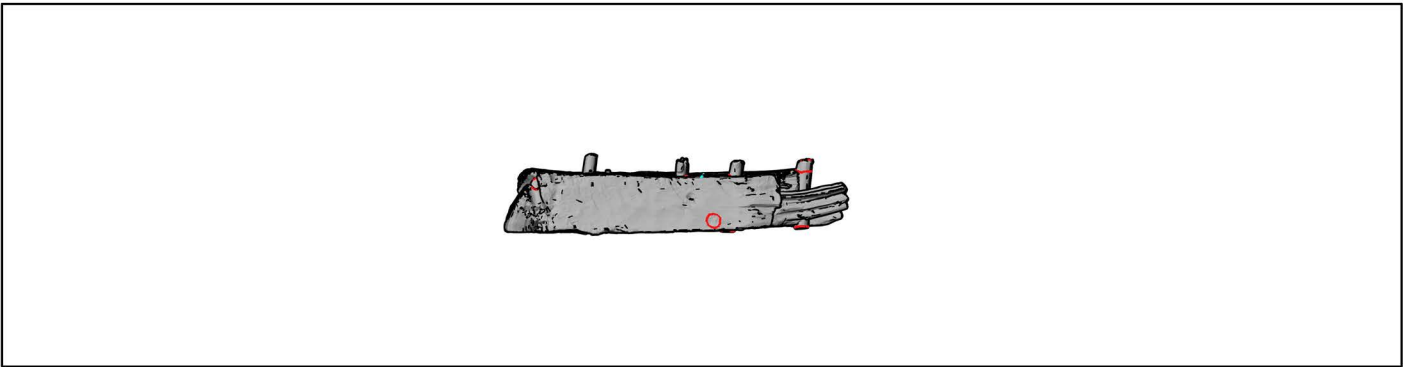
 Iron nail holes / heads

 Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|----------------------------------|--------------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5006 | | Previous number: | | Timber ID: | 084 |
| Timber type: | filling frame | Location: | between floor 83 and futtock 084 | | | |
| Status: | Final | | | Drawing No.: | 169 | |
| Scale: | 1:20 | Date: | 10/03/2023 | Made by: | Paolo Croce | |
-  wessex
archaeology

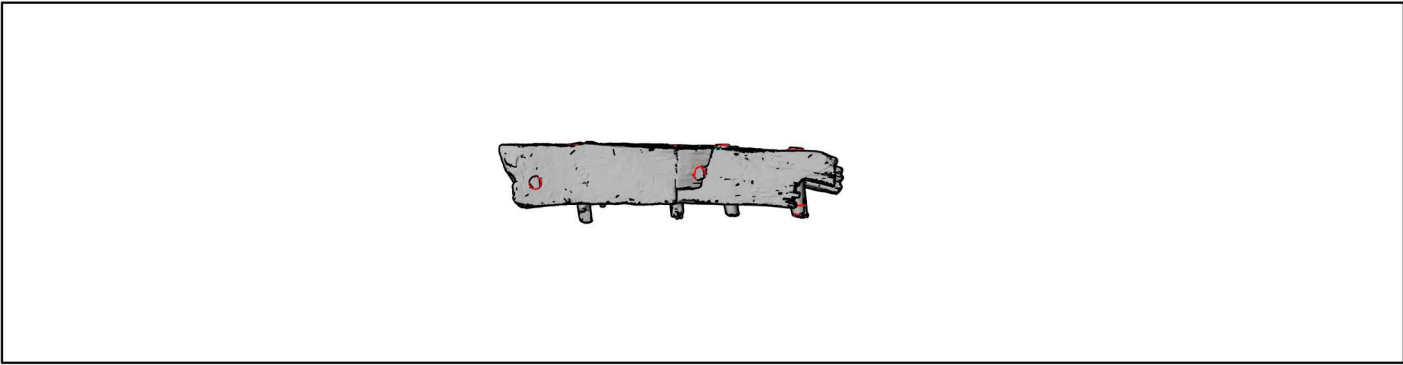
Inboard view



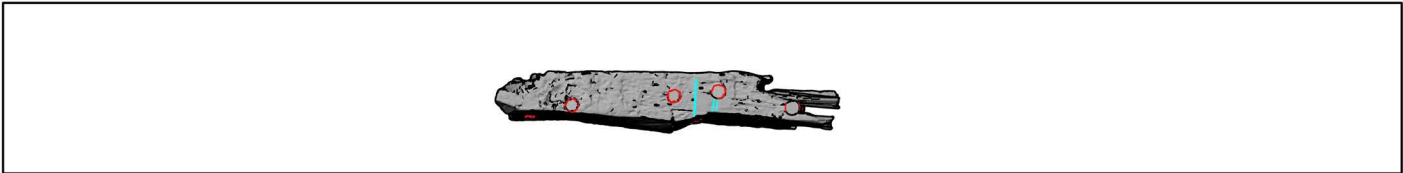
Aft view



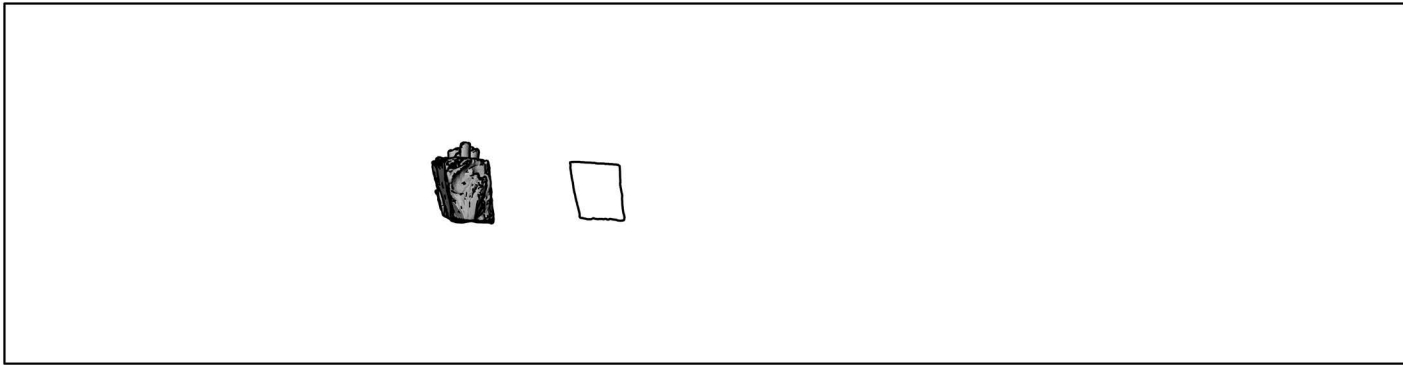
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- 

Trenails and trenail holes / wedged trenails



Toolmarks



Intentional marks



Sapwood / bark



Iron nail holes / heads



Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	085
Timber type:	futtock	Location:	futtock, aft of and jointed to floor 086			
Status:	Final			Drawing No.:	170	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



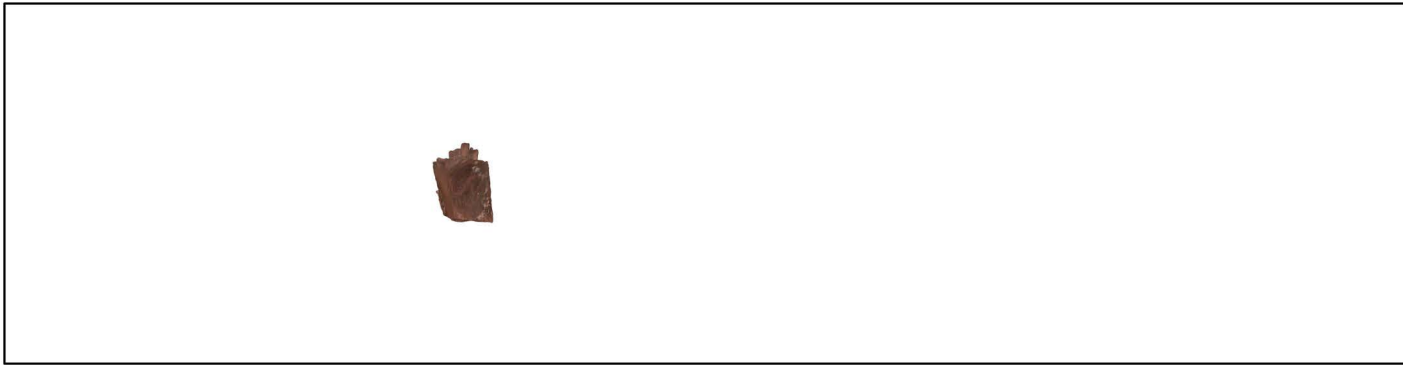
Fore view



Outboard view



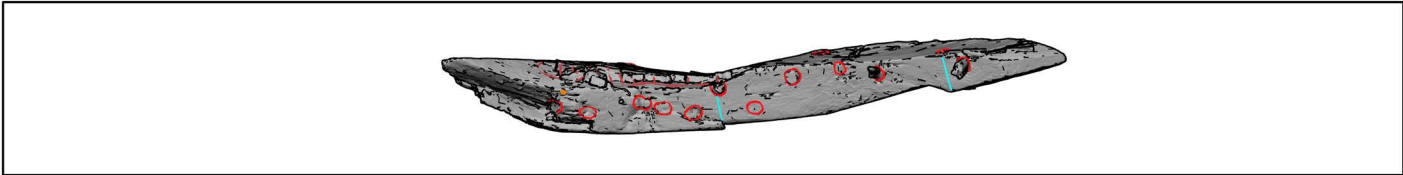
Portside view



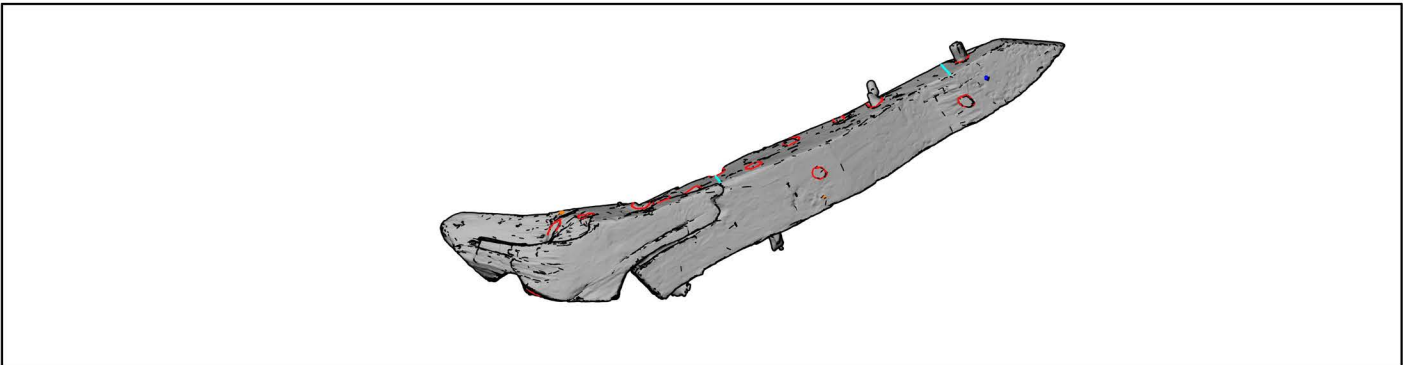
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	085
Timber type:	futtock	Location:	futtock, aft of and jointed to floor 086			
Status:	Final			Drawing No.:	171	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

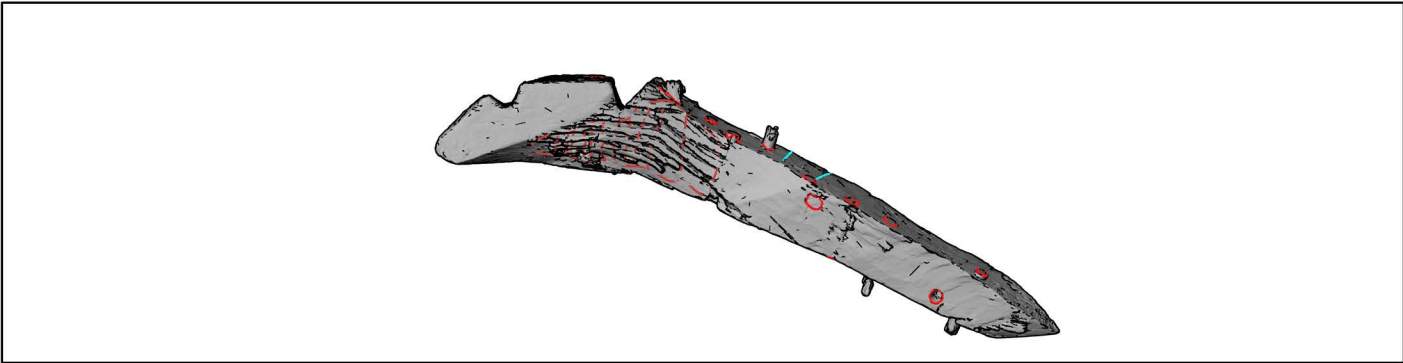
Inboard view



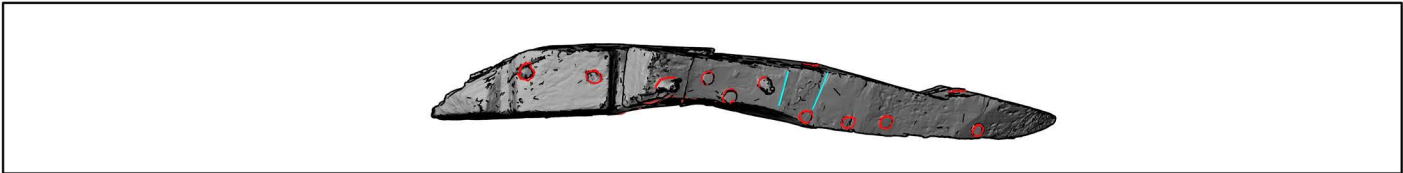
Aft view



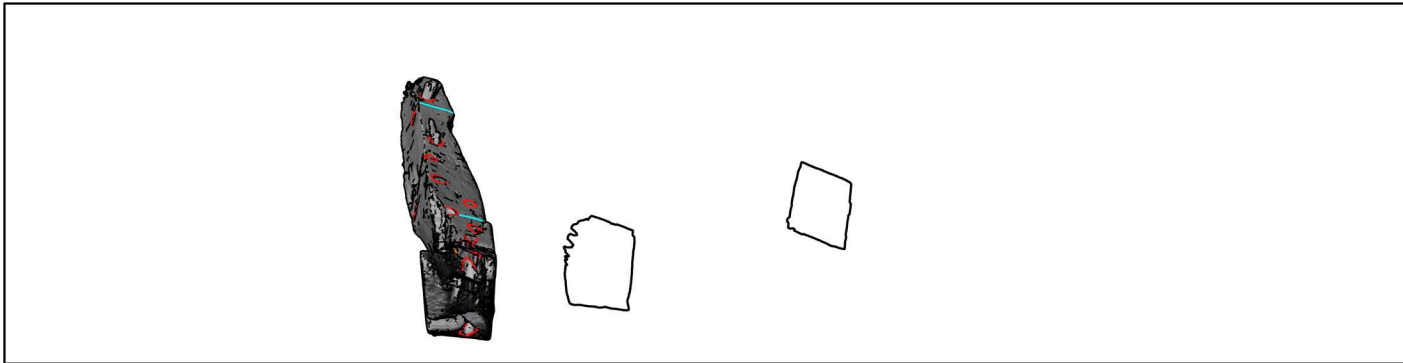
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	086
Timber type:	floor timber	Location:	floor, joint aft to futtock 085			
Status:	Final		Drawing No.:	172		
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



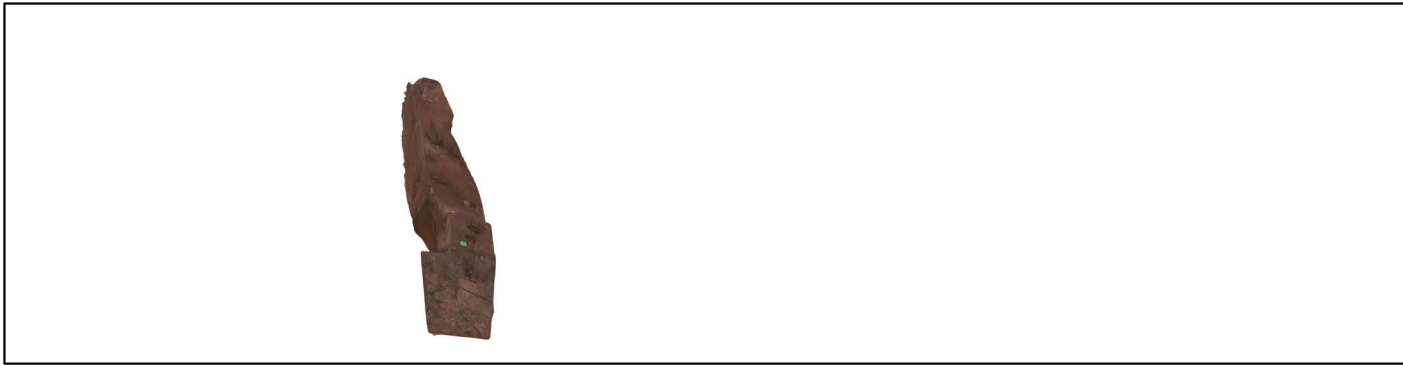
Fore view



Outboard view



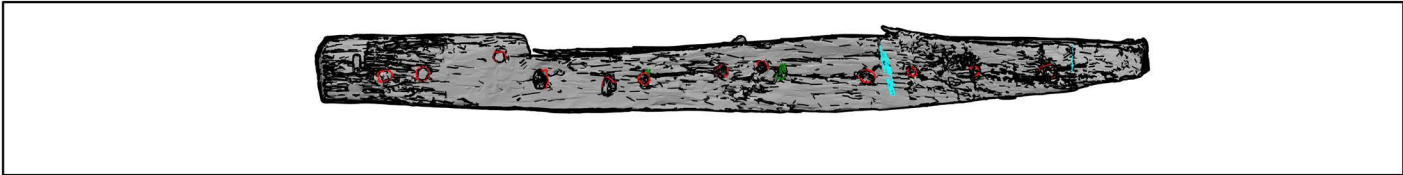
Portside view



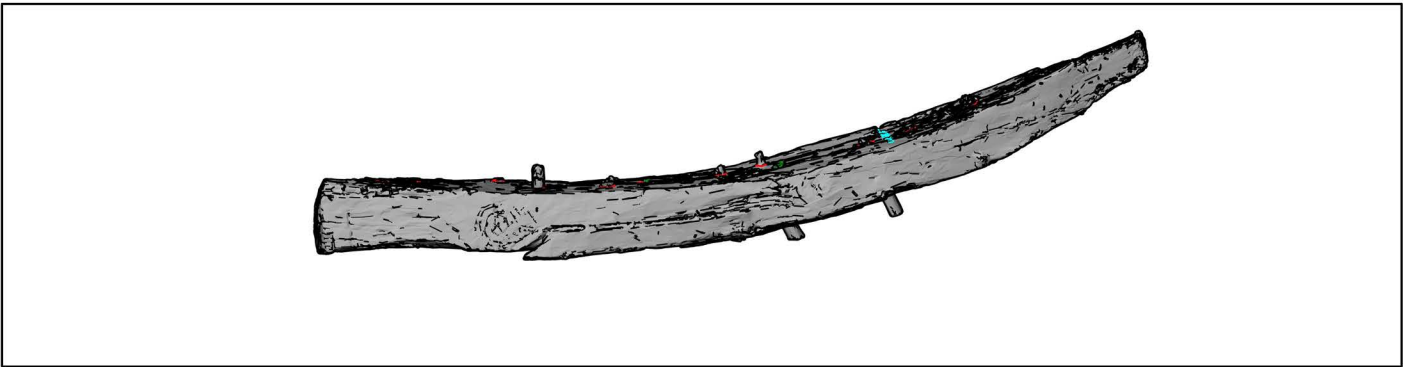
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	086
Timber type:	floor timber	Location:	floor, joint aft to futtock 085			
Status:	Final			Drawing No.:	173	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

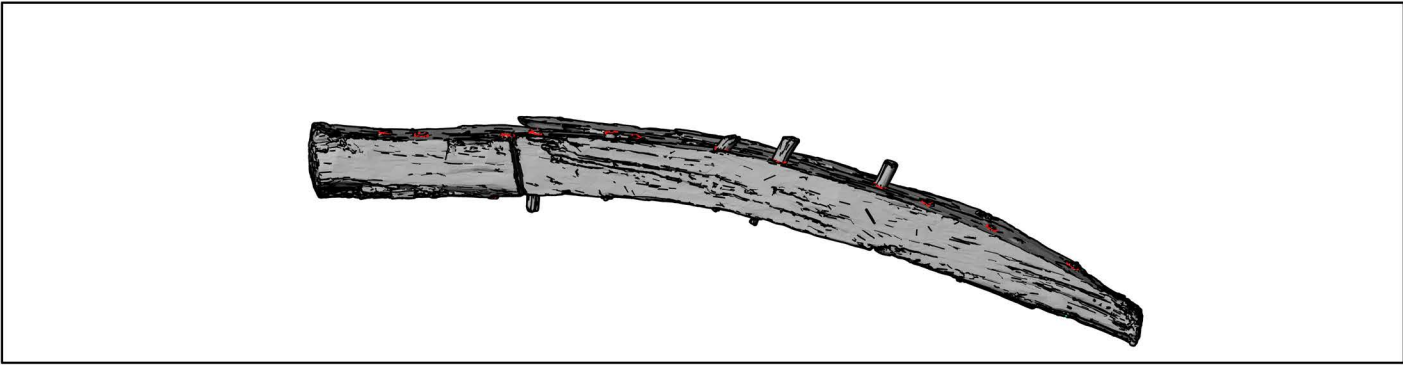
Inboard view



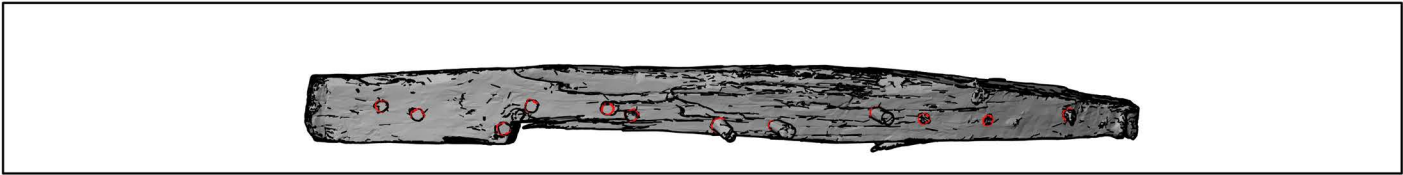
Aft view



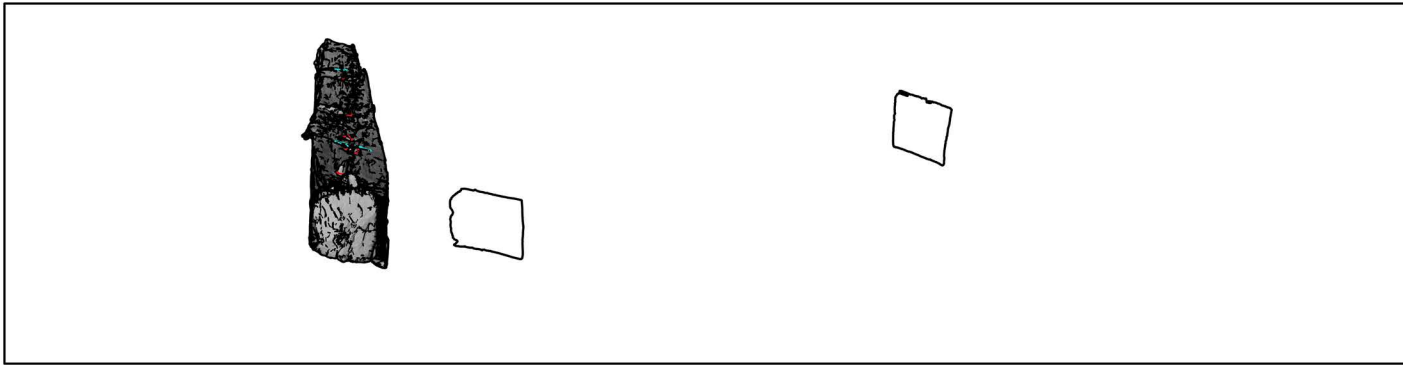
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	087
Timber type:	filling frame	Location:	joggled onto futtock of floor 88			
Status:	Final		Drawing No.:	174		
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



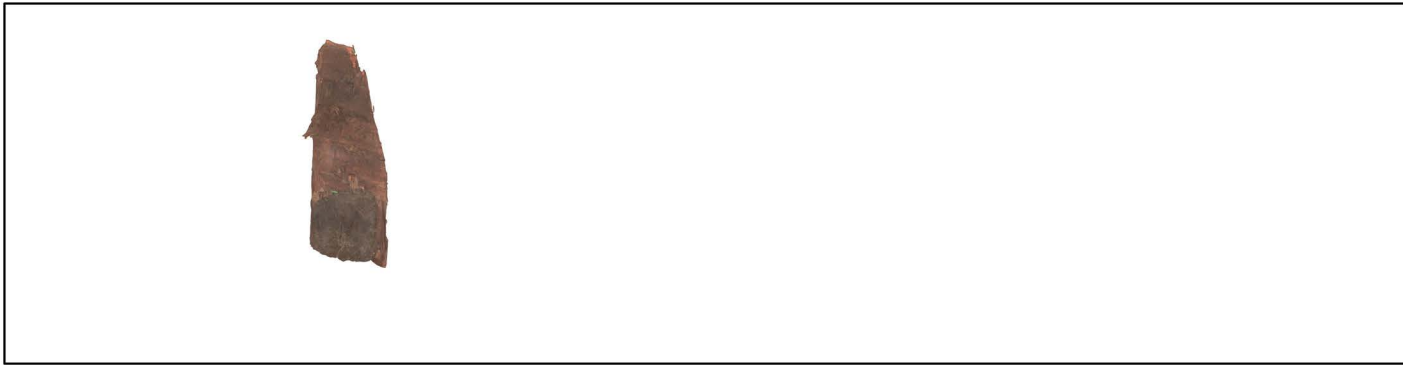
Fore view



Outboard view



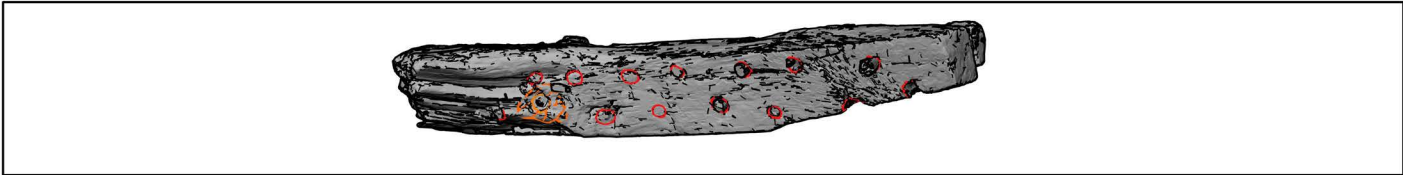
Portside view



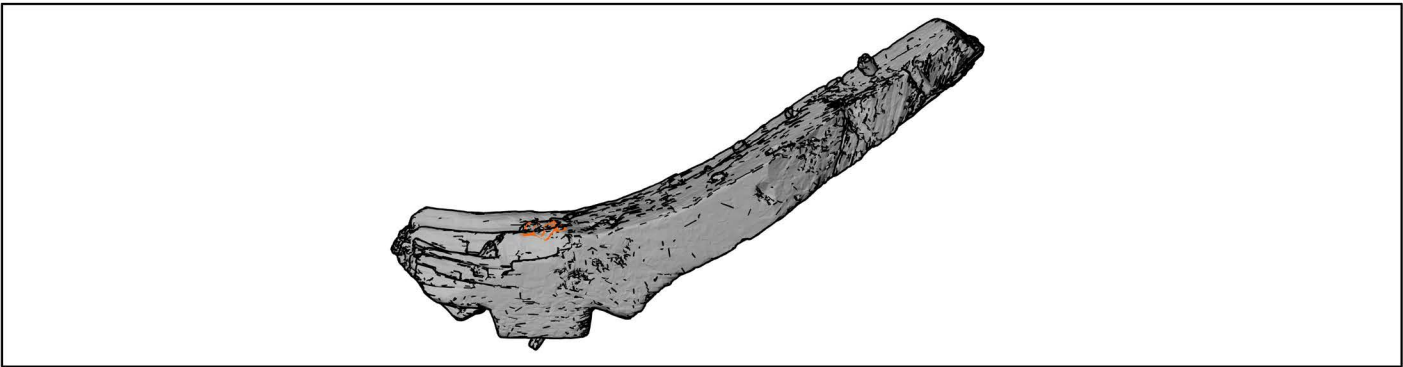
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	087
Timber type:	filling frame	Location:	joggled onto futtock of floor 88			
Status:	Final			Drawing No.:	175	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

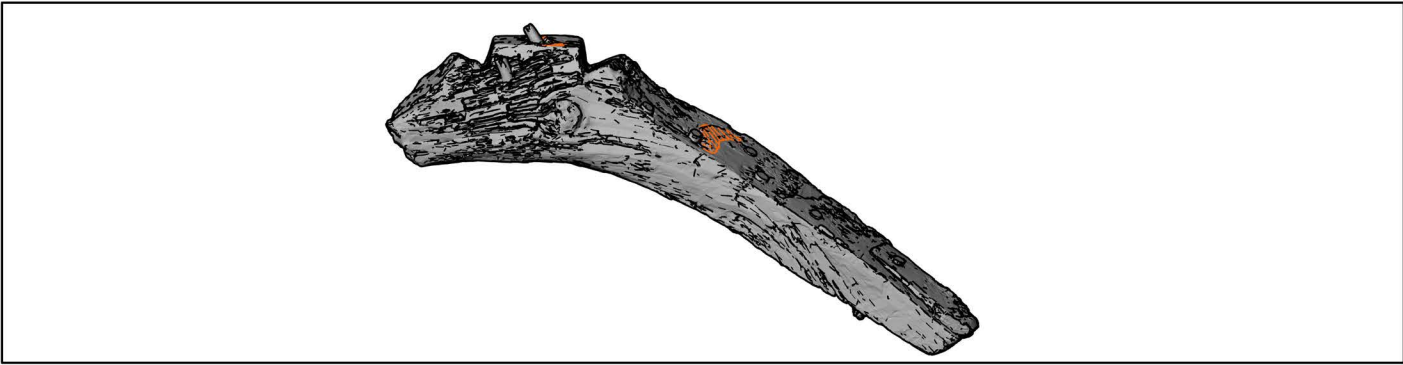
Inboard view



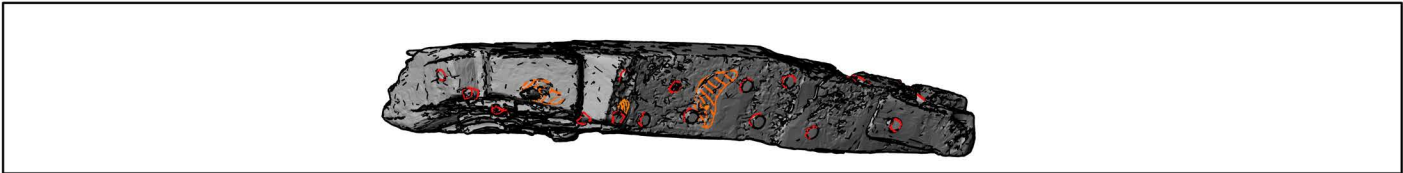
Aft view



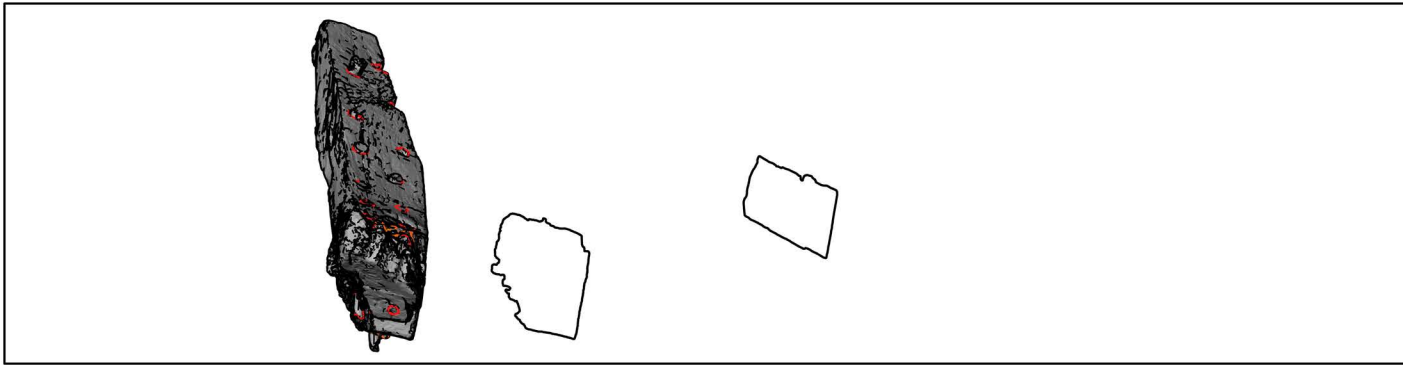
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	088, 148
Timber type:	floor timber	Location:	floor 88, wedge 148			
Status:	Final			Drawing No.:	176	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



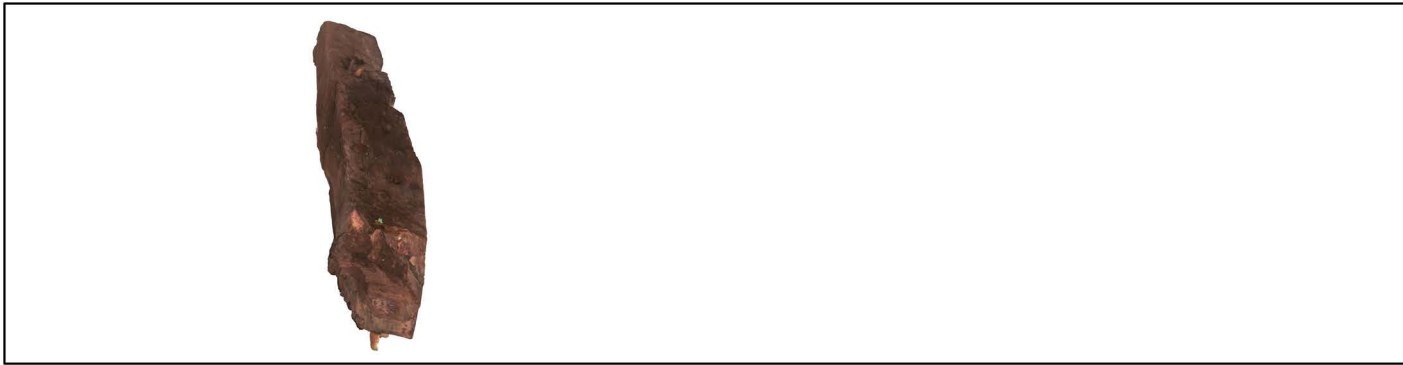
Fore view



Outboard view



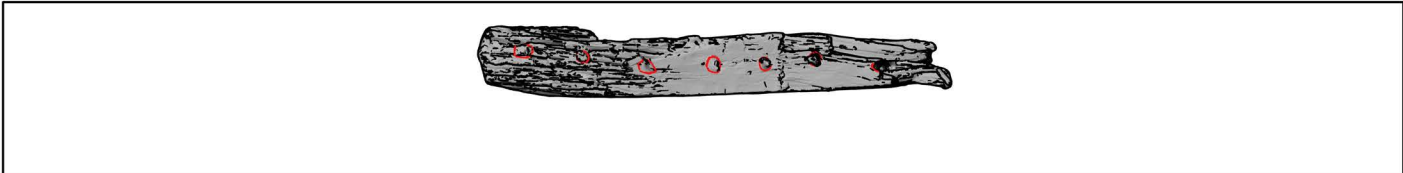
Portside view



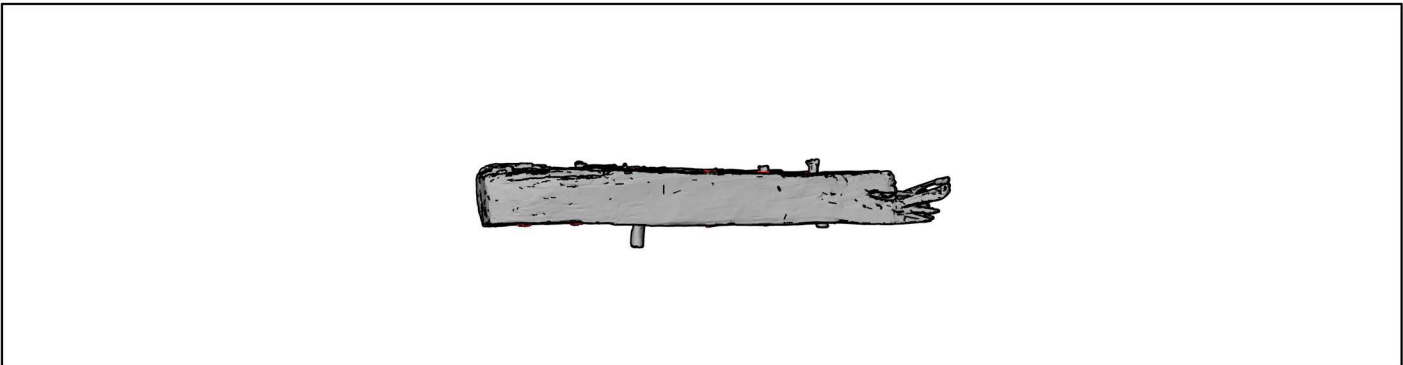
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	088, 148
Timber type:	floor timber	Location:	floor 88, wedge 148			
Status:	Final			Drawing No.:	177	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

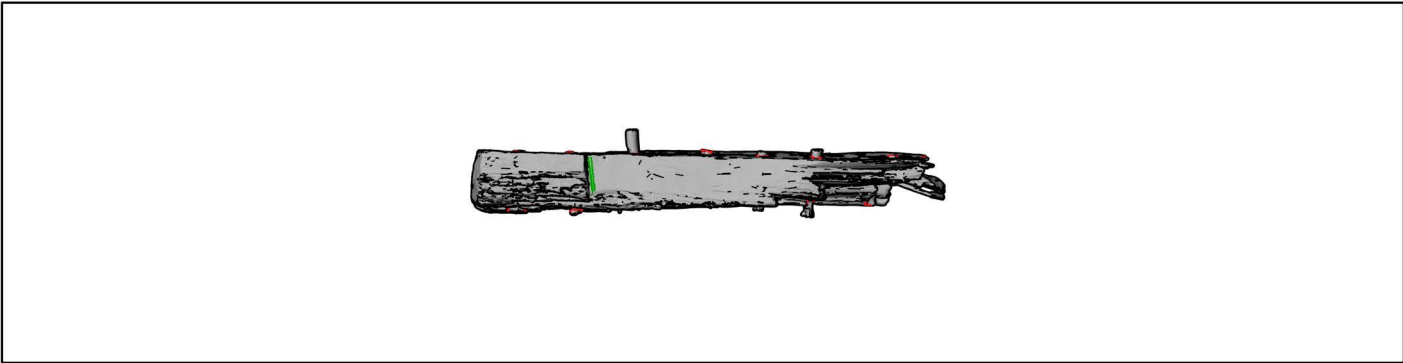
Inboard view



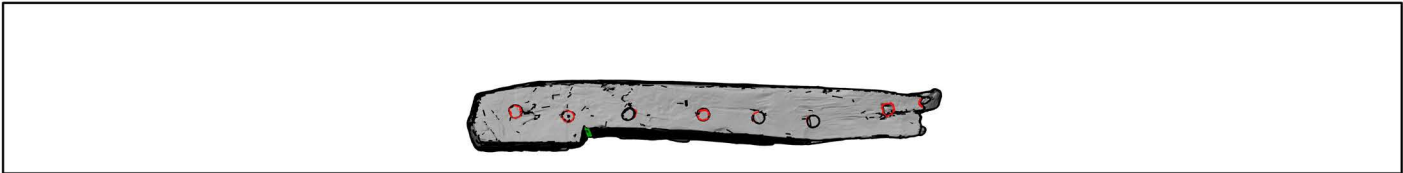
Aft view



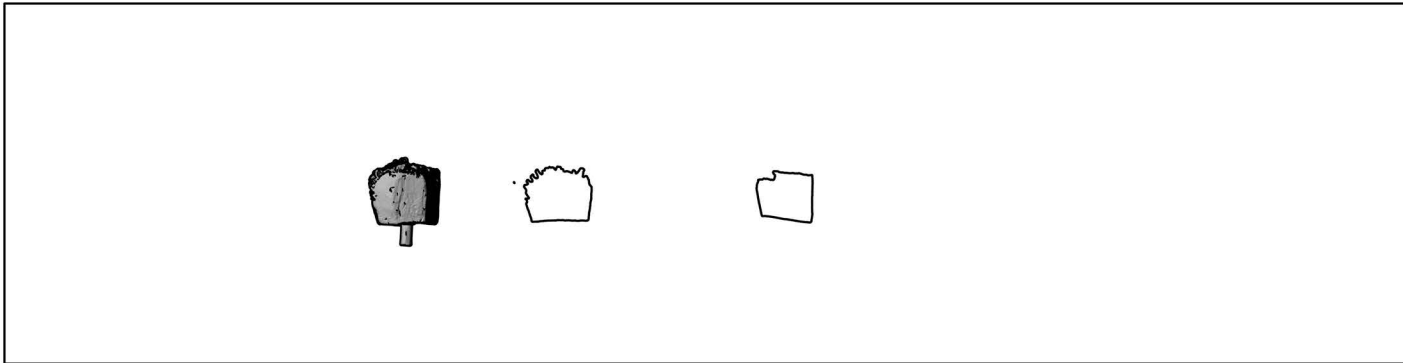
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
-  Treenails and treenail holes / wedged treenails

 Toolmarks

 Intentional marks

 Sapwood / bark

 Iron nail holes / heads

 Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|--------------------------|----------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5006 | | Previous number: | | Timber ID: | 089 |
| Timber type: | filling frame | Location: | joggled onto futtock 090 | | | |
| Status: | Final | | Drawing No.: | 178 | | |
| Scale: | 1:20 | Date: | 10/03/2023 | Made by: | Paolo Croce | |
- 

Inboard view



Aft view



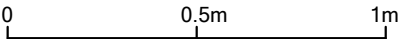
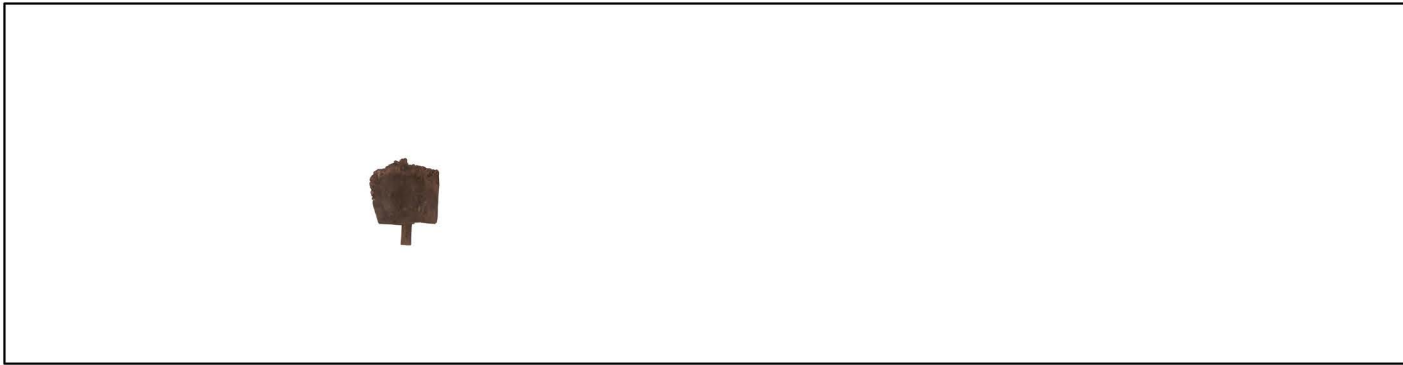
Fore view



Outboard view



Portside view

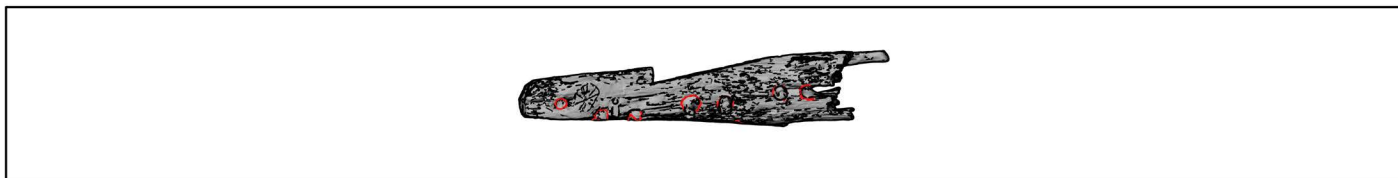


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	089
Timber type:	filling frame	Location:	joggled onto futtock 090			
Status:	Final		Drawing No.:	179		
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

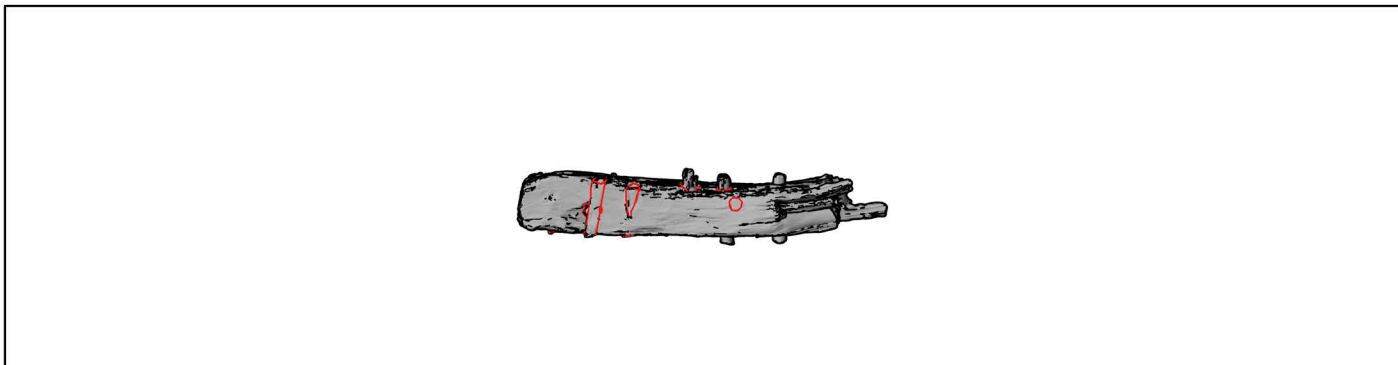
< Port

Starboard >

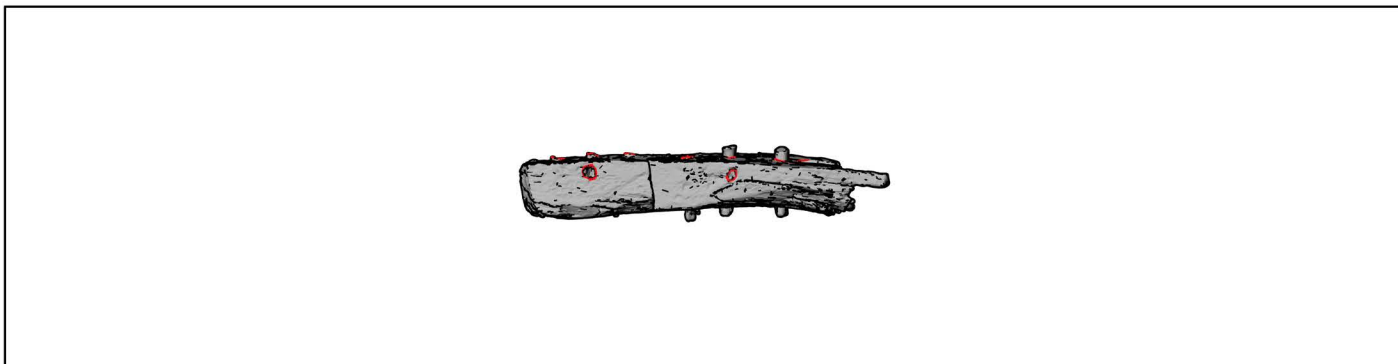
Inboard view



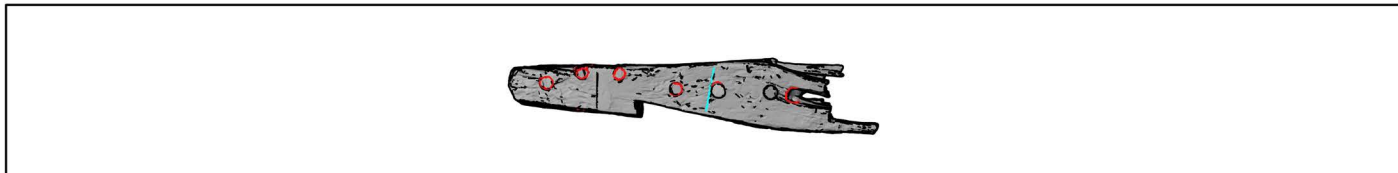
Aft view



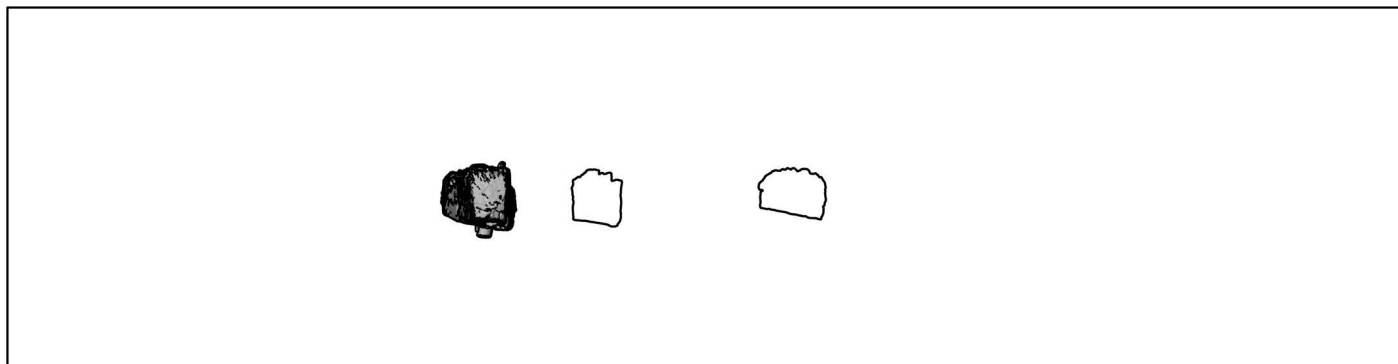
Fore view



Outboard view



Portside view



0 0.5m 1m

Legend:

- ⊙ Treenails and treenail holes / wedged treenails
- Toolmarks
- Intentional marks
- ▨ Sapwood / bark
- Iron nail holes / heads
- ▨ Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	090
Timber type:	futtock	Location:	futtock, joint to floor 091			
Status:	Final			Drawing No.:	180	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



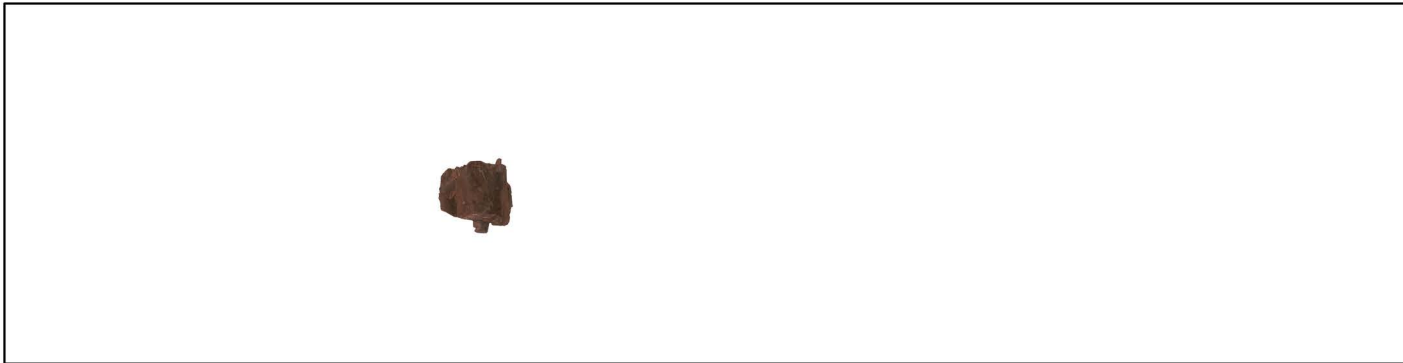
Fore view



Outboard view



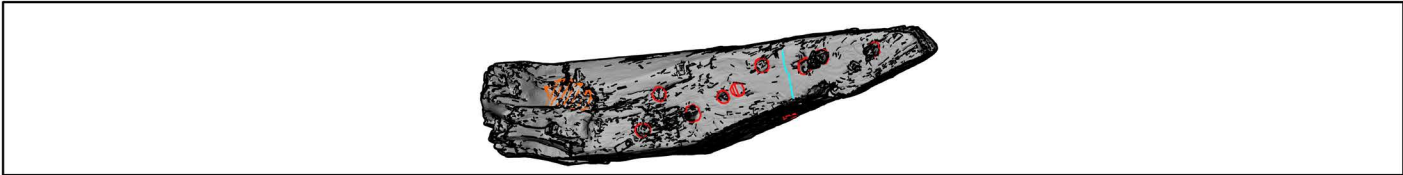
Portside view



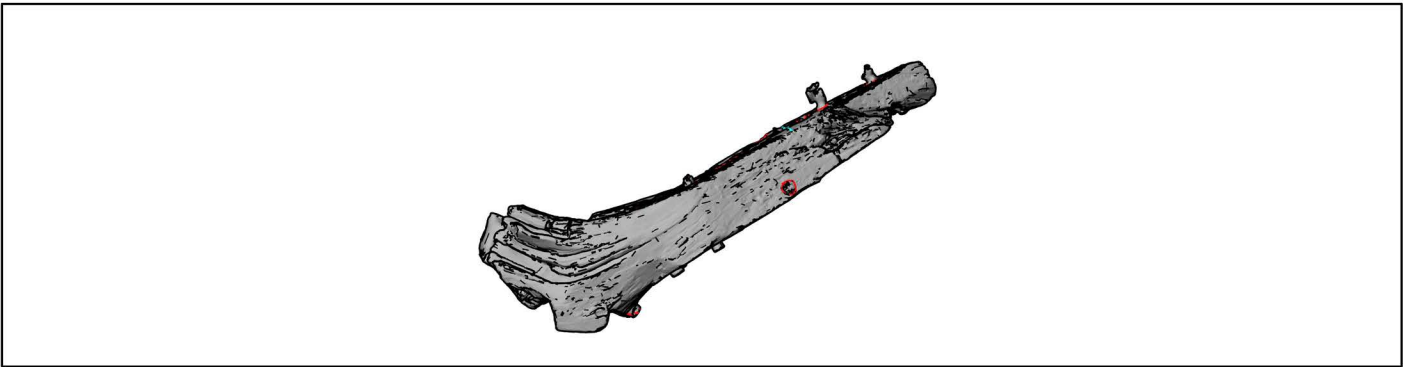
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	090
Timber type:	futtock	Location:	futtock, joint to floor 091			
Status:	Final			Drawing No.:	181	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

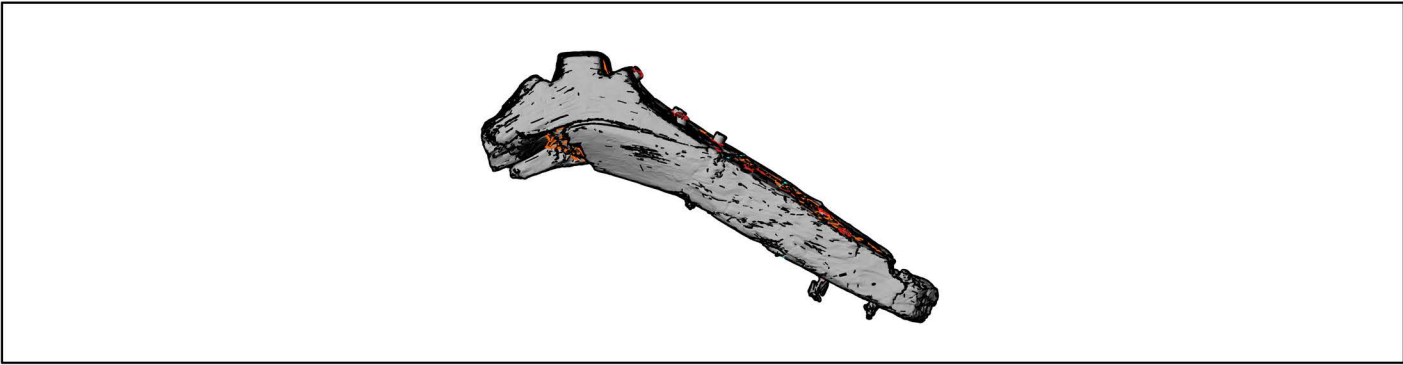
Inboard view



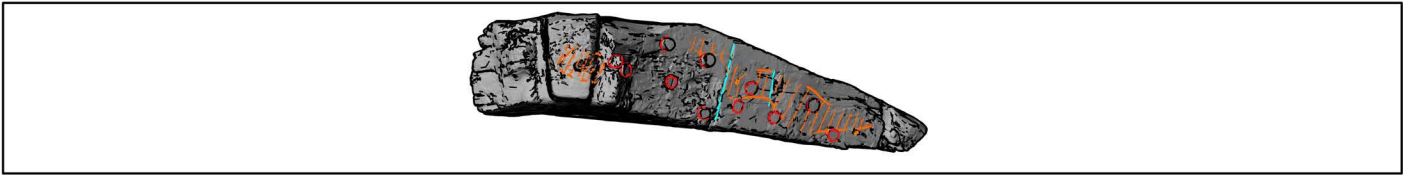
Aft view



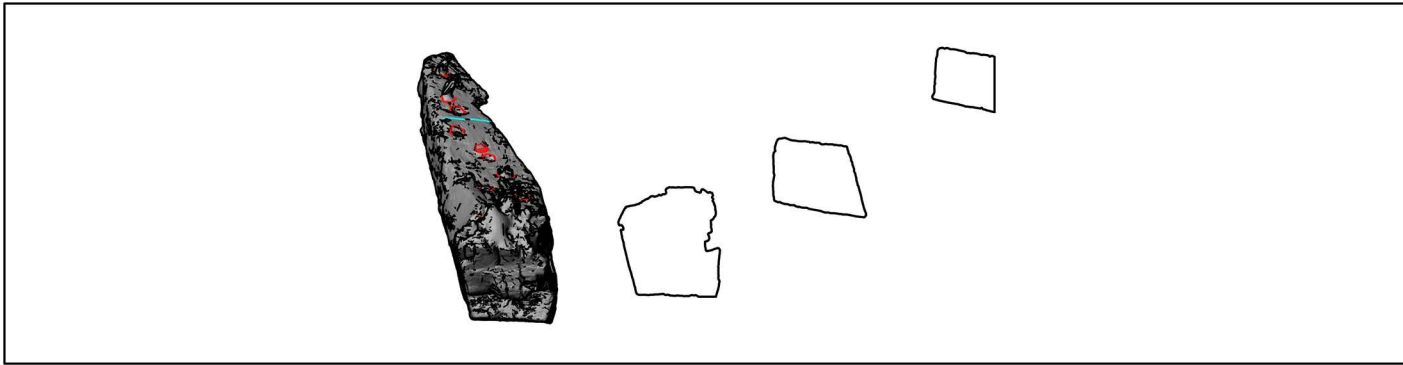
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion
- | | | | | | | |
|--------------|------------------------------|-----------|---------------------------------|--------------|--------------|--------|
| Project: | CEMEX Denge Quarry Shipwreck | | | | Project No.: | 280780 |
| Section: | 5006 | | Previous number: | | Timber ID: | 091 |
| Timber type: | floor | Location: | floor 091, joint to futtock 090 | | | |
| Status: | Final | | | Drawing No.: | 182 | |
| Scale: | 1:20 | Date: | 10/03/2023 | Made by: | Paolo Croce | |
- wessex
archaeology

Inboard view



Aft view



Fore view



Outboard view



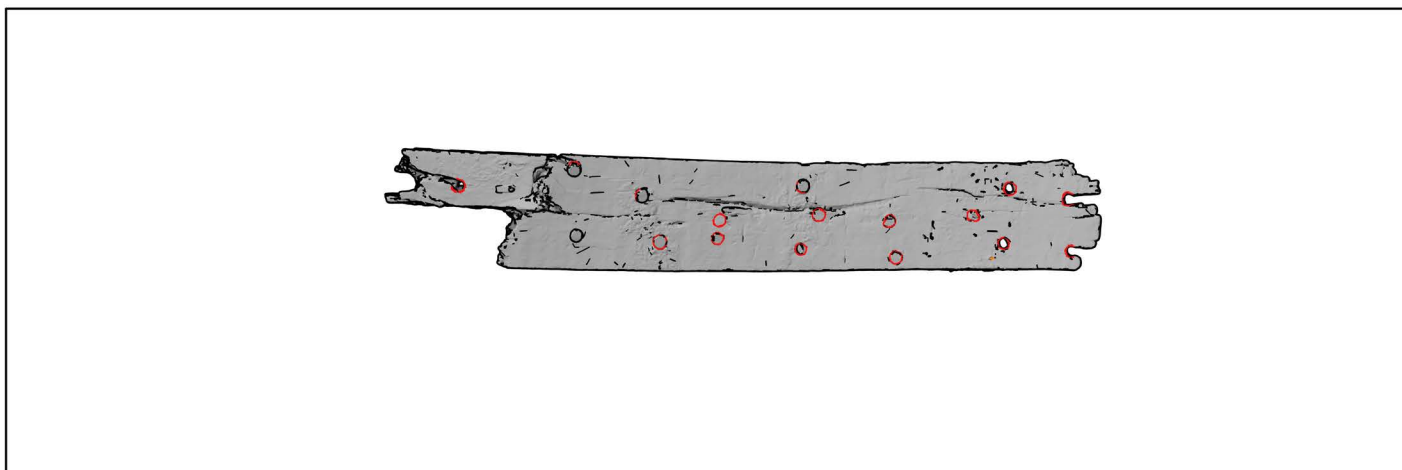
Portside view



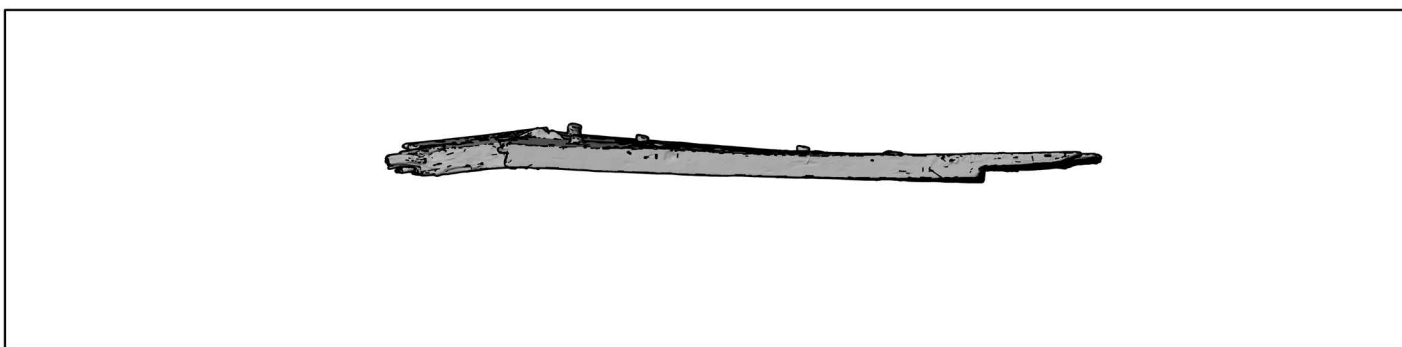
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	091
Timber type:	floor	Location:	floor 091, joint to futtock 090			
Status:	Final			Drawing No.:	183	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

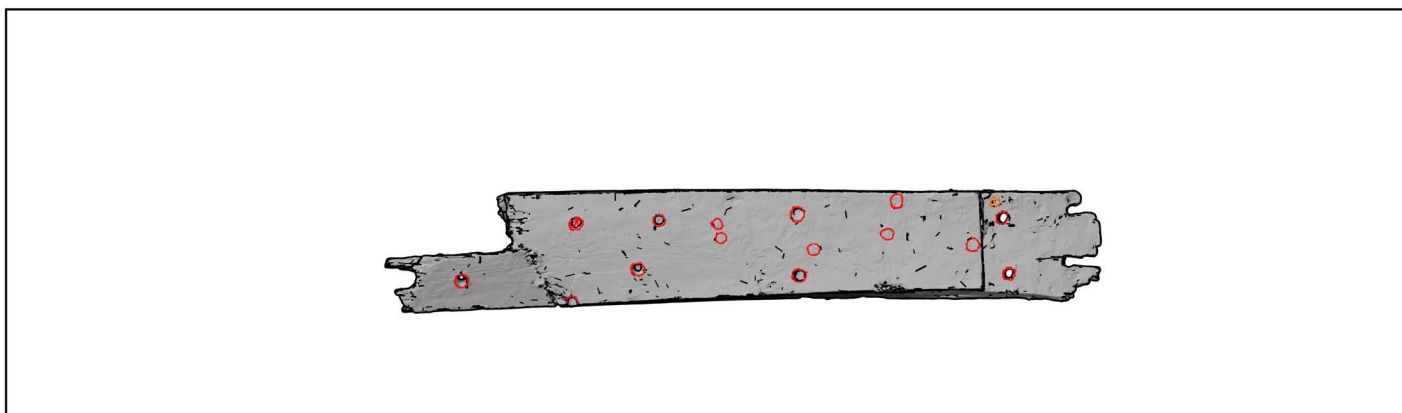
Inboard view



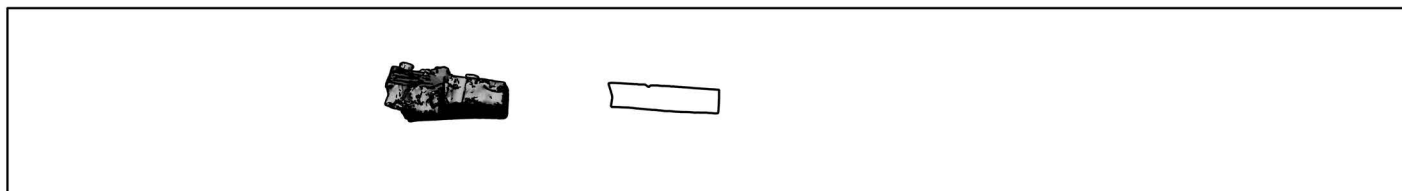
Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

- ⊙ Trenails and trenail holes / wedged trenails
- ⊙ Iron nail holes / heads
- Concretion

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5006		Previous number:		Timber ID:	092	
Timber type:	outer plank	Location:	strake 1, 1 of 2 surviving planks (aft), starboard side				
Status:	Final			Drawing No.:	184		
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		



Inboard view



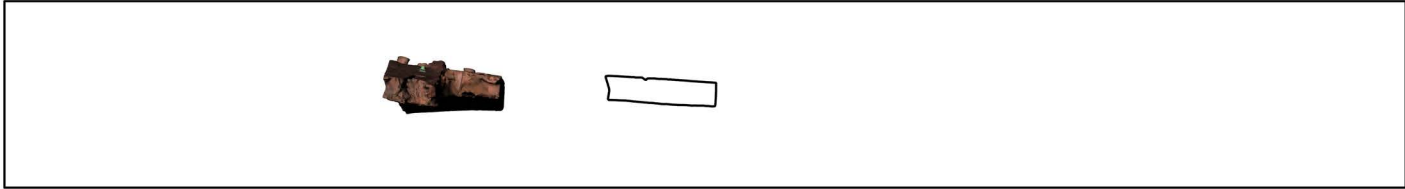
Side view



Outboard view



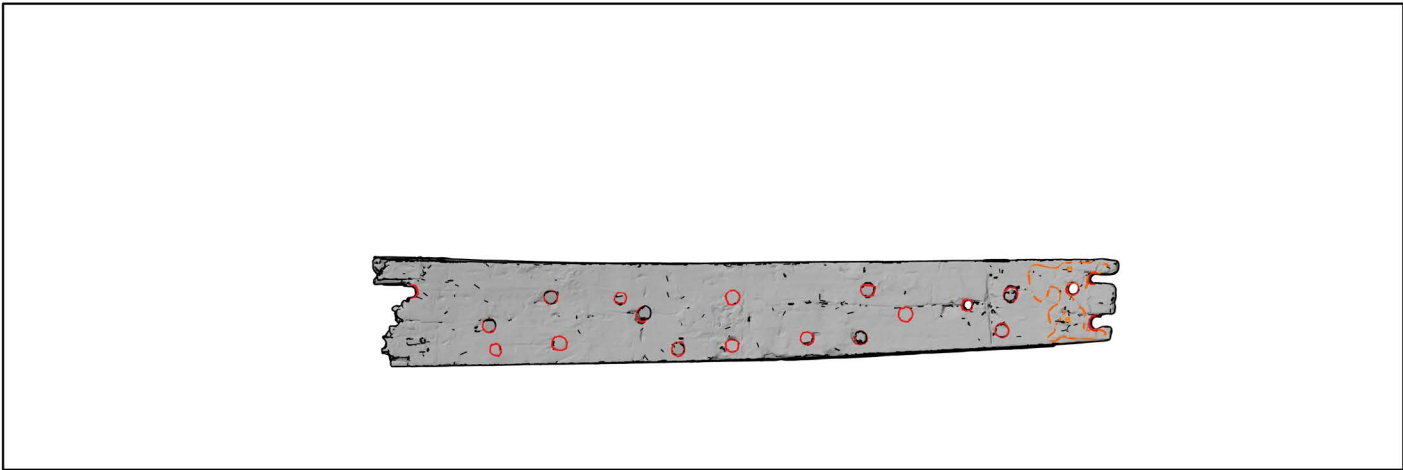
Aft view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	092
Timber type:	outer plank	Location:	strake 1, 1 of 2 surviving planks (aft), starboard side			
Status:	Final			Drawing No.:	185	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



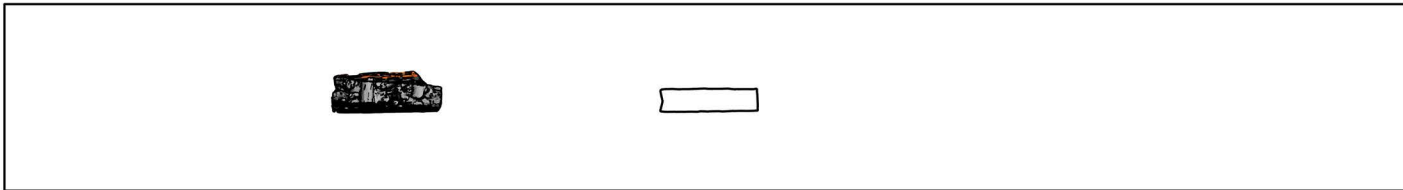
Side view



Outboard view



Aft view



00.5m1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	093
Timber type:	outer plank	Location:	strake 2, 1 of 1 surviving planks, starboard side			
Status:	Final			Drawing No.:	186	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



Aft view



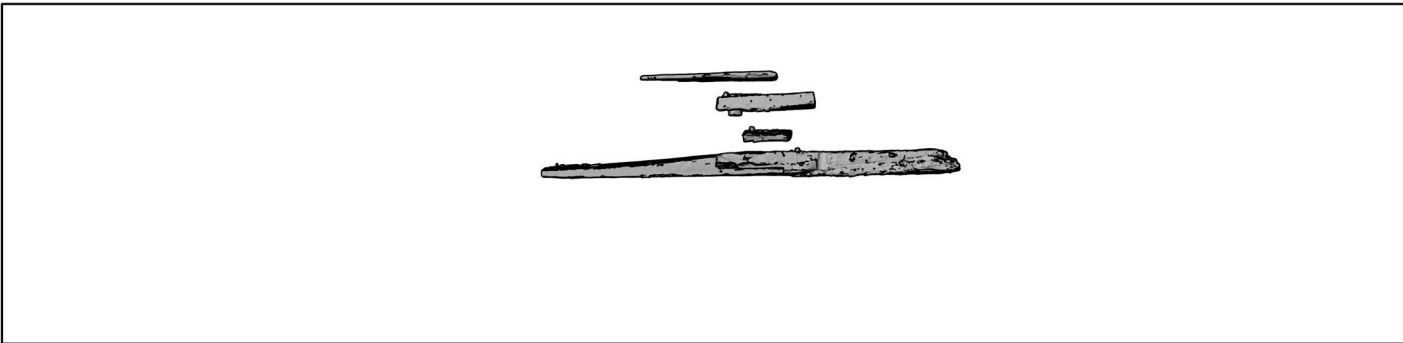
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	093
Timber type:	outer plank	Location:	strake 2, 1 of 1 surviving planks, starboard side			
Status:	Final			Drawing No.:	187	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

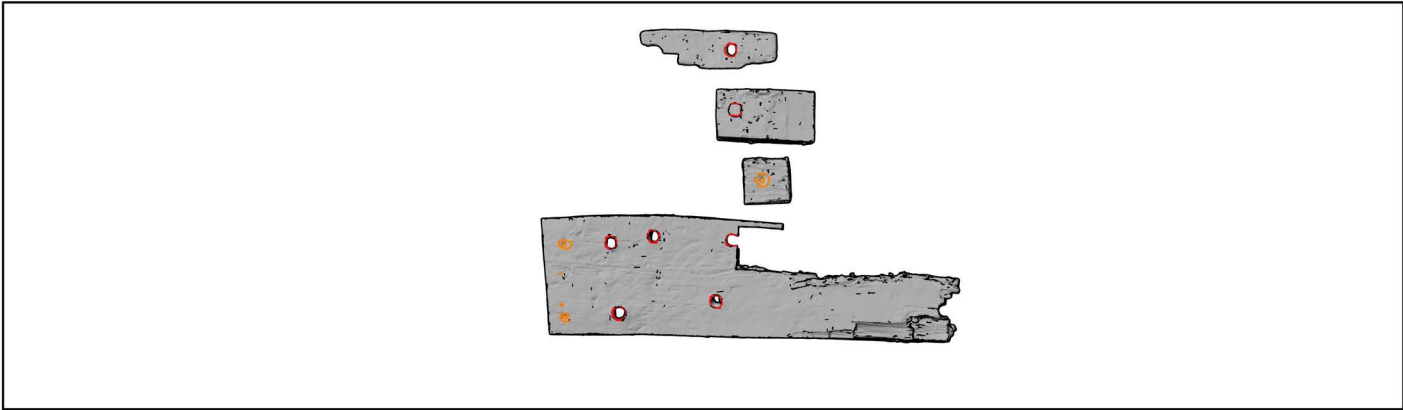
Inboard view



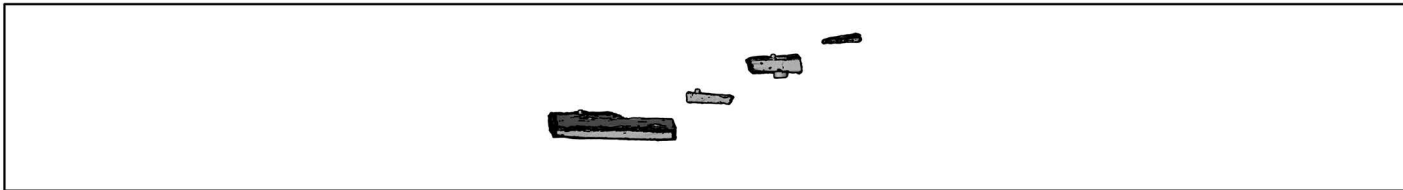
Side view



Outboard view



Aft view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Wooden plugs / nails
 - Iron nail holes / heads
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:			Timber ID:	094, 095, 115, 116
Timber type:	outer plank	Location:	strake 2, 3 of 3 surviving planks with repairs, starboard side				
Status:	Final				Drawing No.:	188	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce		

Inboard view



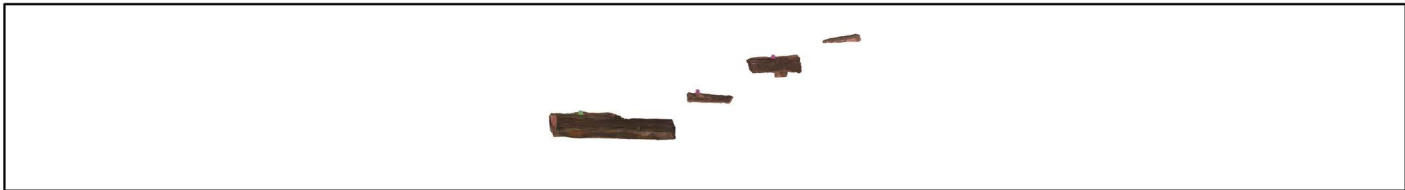
Side view



Outboard view



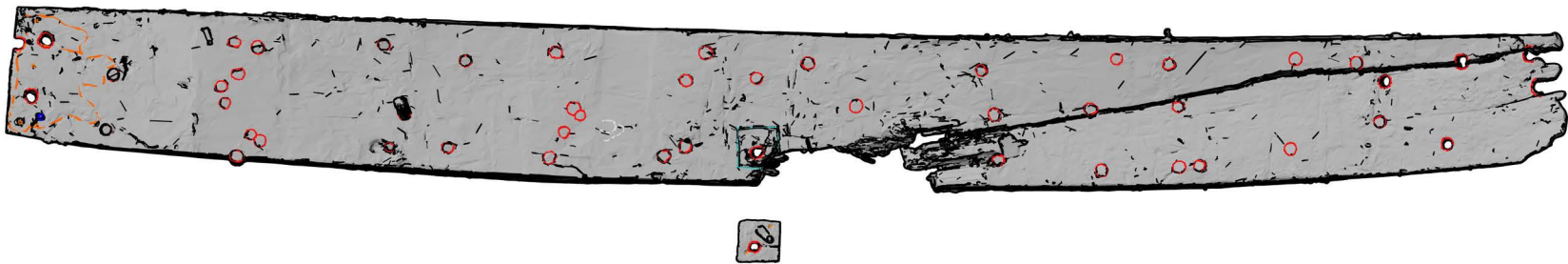
Aft view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck						Project No.:	280780			
Section:	5004				Previous number:				Timber ID:	094, 095, 115, 116	
Timber type:	outer plank		Location:		strake 2, 3 of 3 surviving planks with repairs, starboard side						
Status:	Final					Drawing No.:		189			
Scale:	1:20		Date:	15/03/2023		Made by:	Paolo Croce				

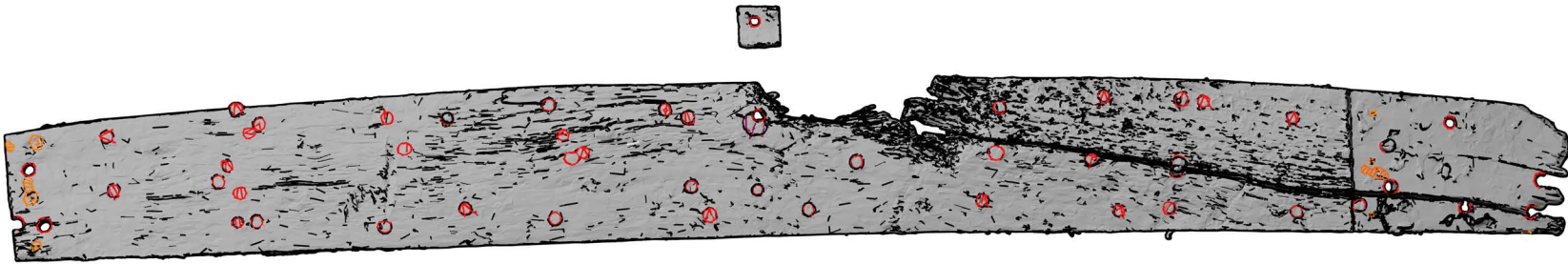
Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

- Legend:
- Treenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Concretion
 - Repairs

Project:	CEMEX Denge Quarry Shipwreck			Project No.:	280780
Section:	5004	Previous number:		Timber ID:	096 , 114
Timber type:	outer plank	Location:	surviving plank 2 of strake 5 of section 5004 and dutchman, starboard side		
Status:	Final			Drawing No.:	190
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce

Inboard view



Side view



Outboard view



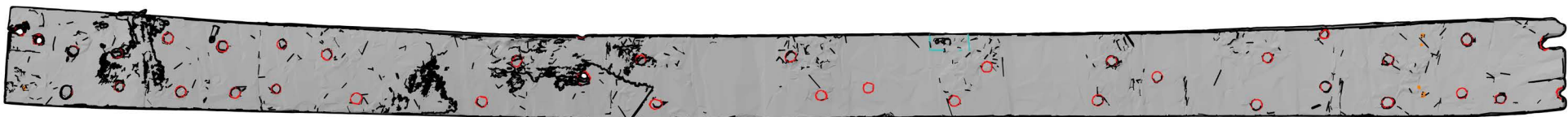
Aft view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:			Timber ID:	096 , 114
Timber type:	outer plank	Location:	surviving plank 2 of strake 5 of section 5004 and dutchman, starboard side				
Status:	Final				Drawing No.:	191	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce		

Inboard view



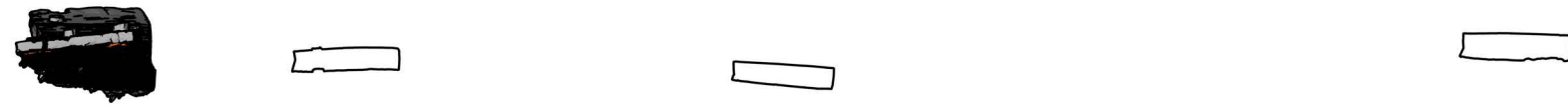
Side view



Outboard view



Aft view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Concretion
 - Repairs

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004		Previous number:			Timber ID:	097, 127
Timber type:	outer plank	Location:	surviving plank 2 of 3, strake 2 of section 5004 and repair, starboard side				
Status:	Final				Drawing No.:	192	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce		

Inboard view



Side view



Outboard view



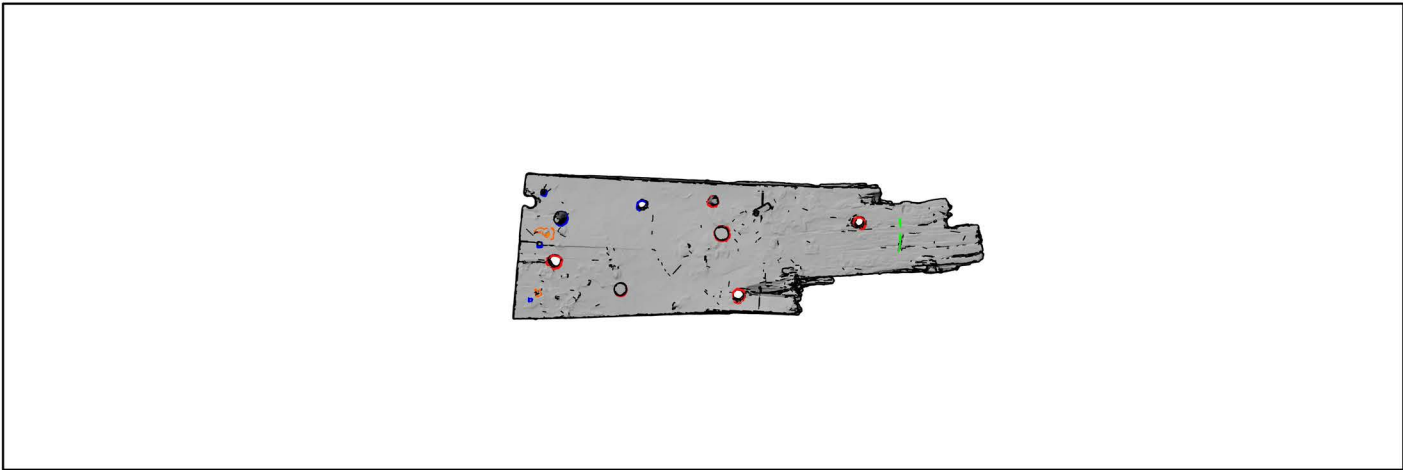
Aft view



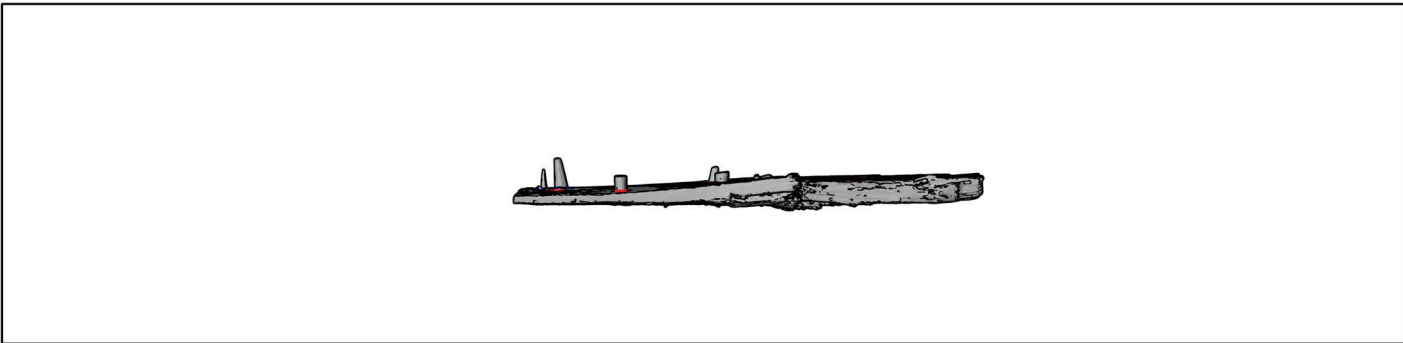
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004	Previous number:				Timber ID:	097, 127
Timber type:	outer plank	Location:	surviving plank 2 of 3, strake 2 of section 5004 and repair, starboard side				
Status:	Final				Drawing No.:	193	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce		

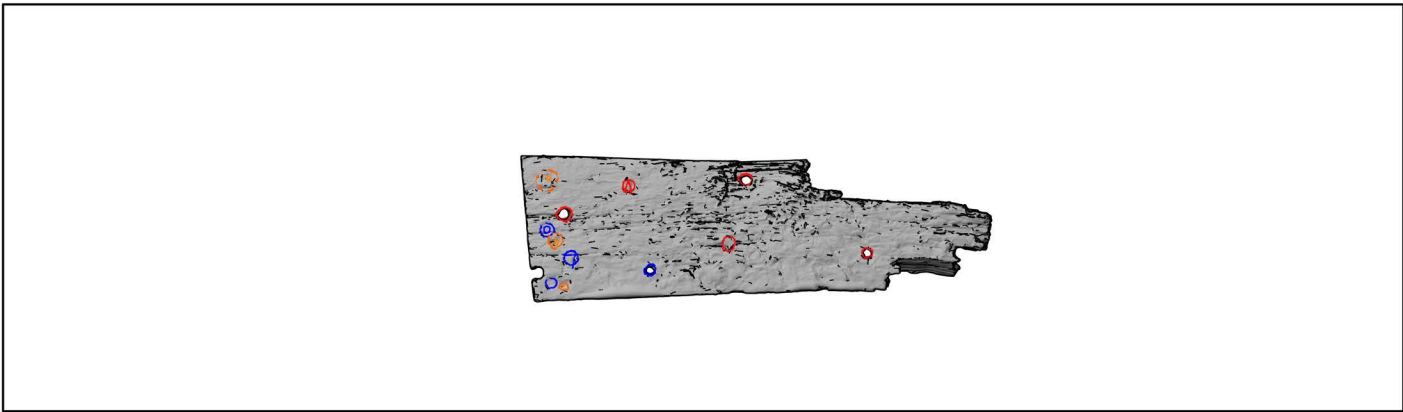
Inboard view



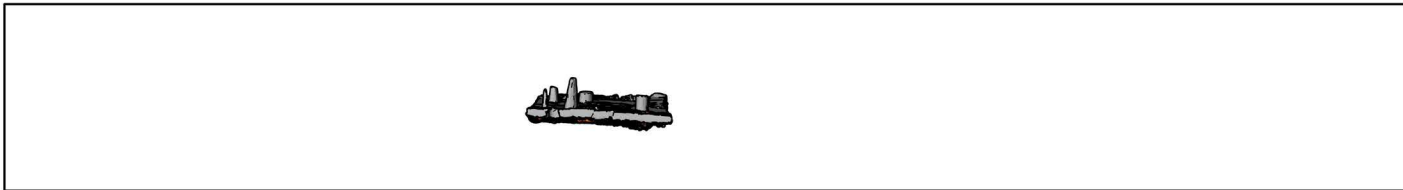
Side view



Outboard view



Aft view



0 0.5m 1m

- Legend:
- Iron nail holes / heads
 - Trenails and trenail holes / wedged trenails
 - Wooden plugs / bungs / nails
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	098
Timber type:	outer plank	Location:	strake 5, 3 of 3 surviving planks, scarf on 096, starboard side			
Status:	Final			Drawing No.:	194	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



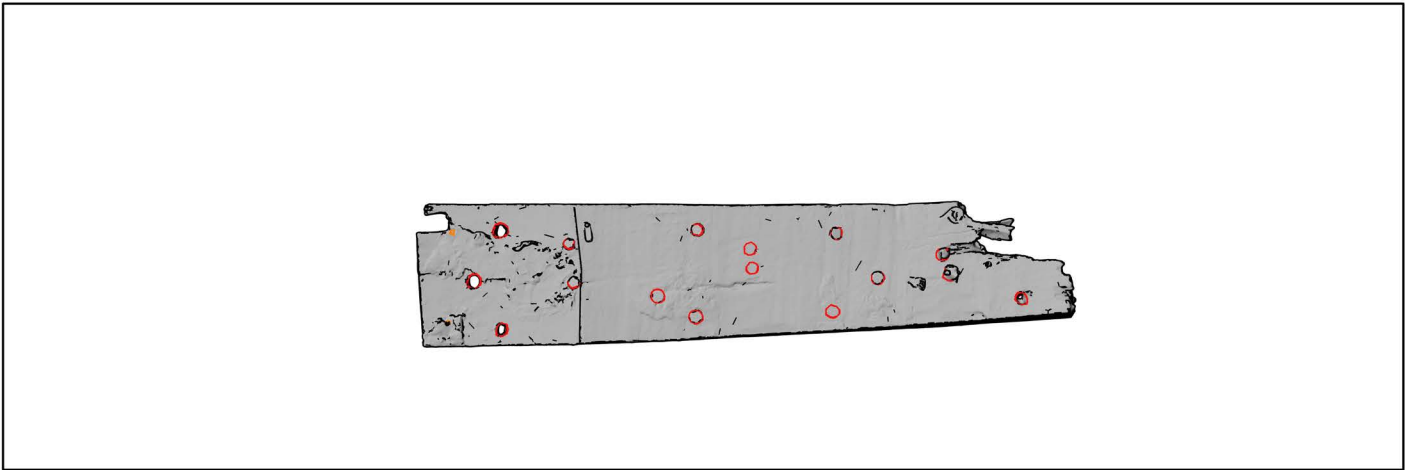
Aft view



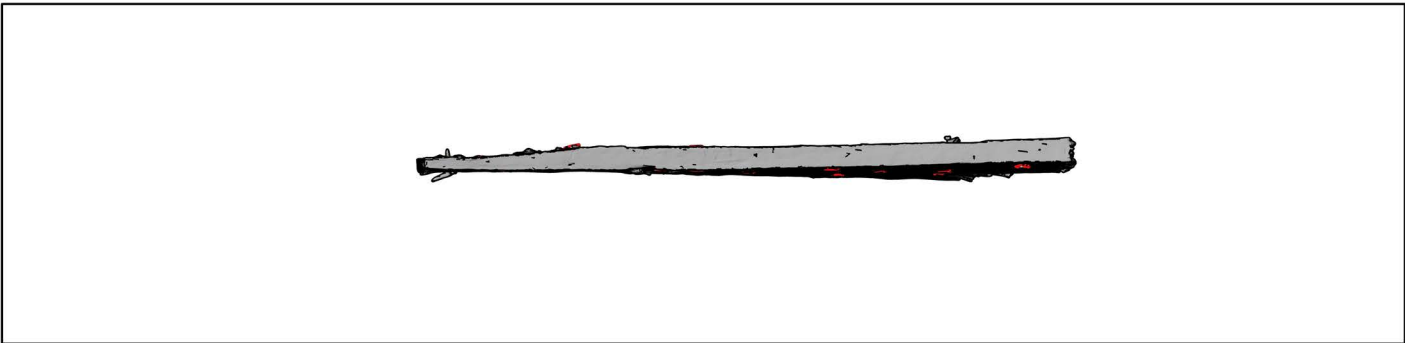
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	098
Timber type:	outer plank	Location:	strake 5, 3 of 3 surviving planks, scarf on 096, starboard side			
Status:	Final			Drawing No.:	196	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

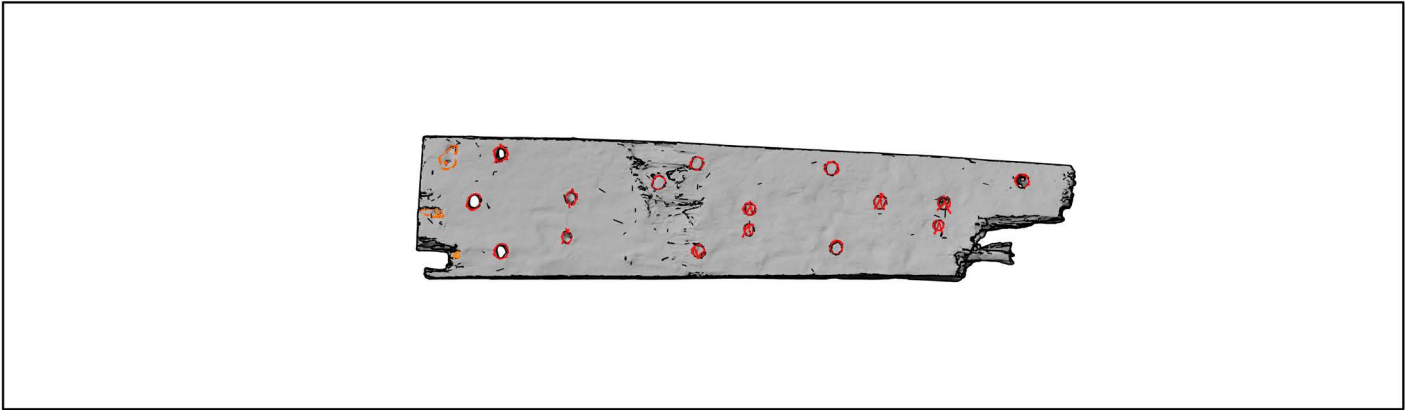
Inboard view



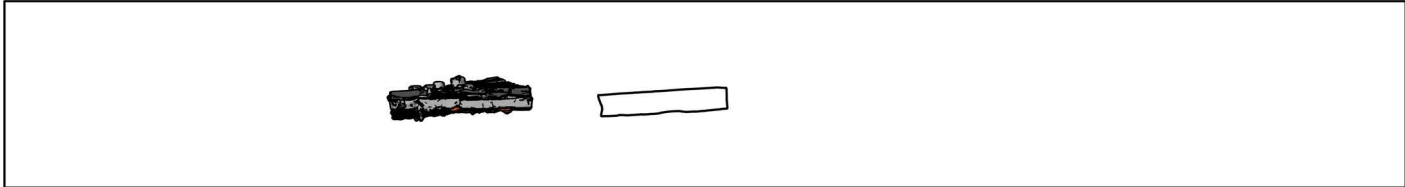
Side view



Outboard view



Aft view



00.5m1m

- Legend:
- Iron nail holes / heads
 - Trenails and trenail holes / wedged trenails

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	100
Timber type:	outer plank	Location:	strake 1, 3 of 3 surviving planks, starboard side			
Status:	Final			Drawing No.:	196	
Scale:	1:20	Date:	24/08/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



Aft view



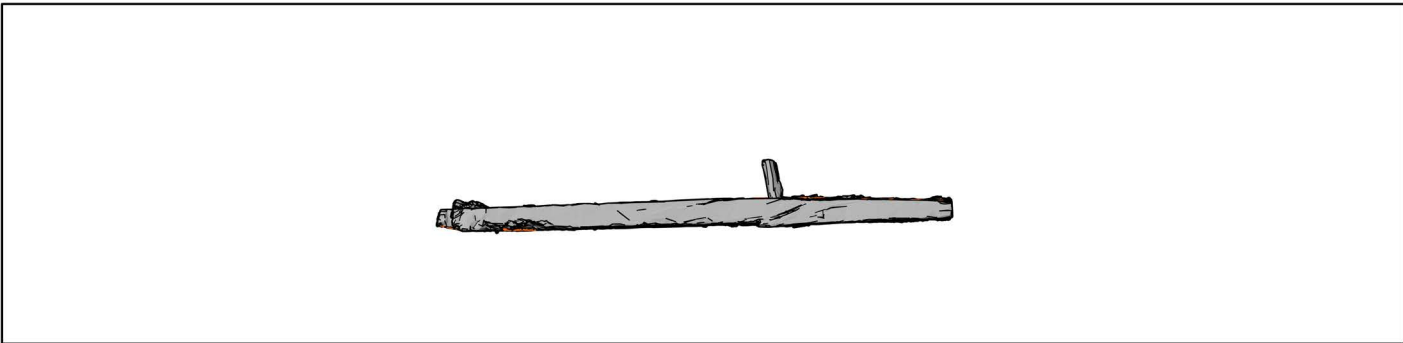
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	100
Timber type:	outer plank	Location:	strake 1, 3 of 3 surviving planks, starboard side			
Status:	Final			Drawing No.:	197	
Scale:	1:20	Date:	24/08/2023	Made by:	Paolo Croce	

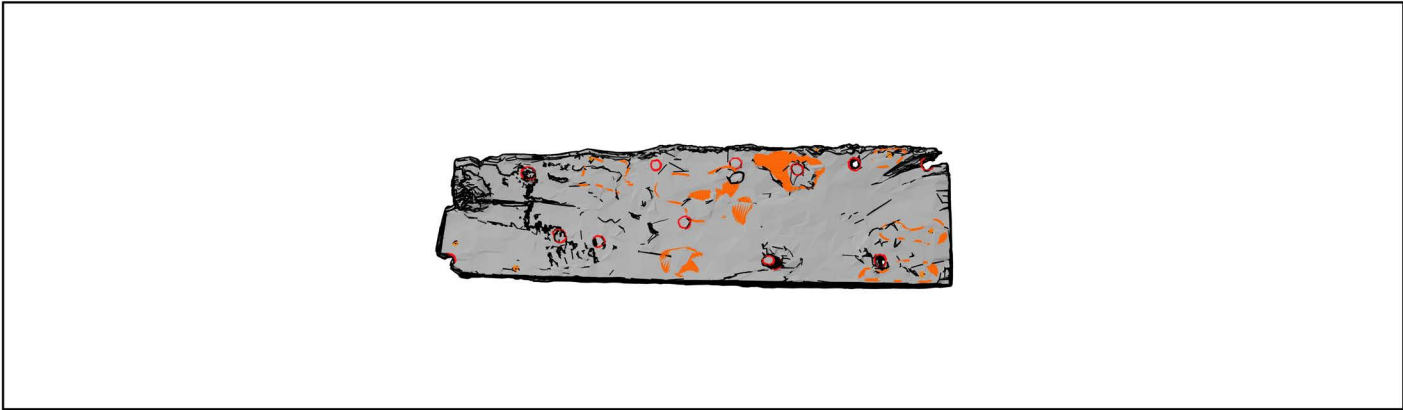
Outboard view



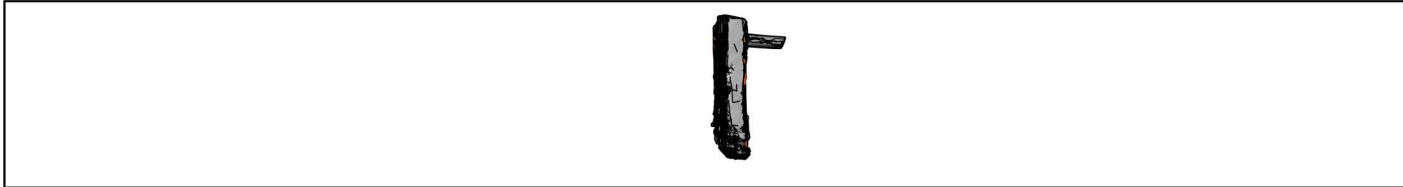
Top view



Inboard view



View from the bow



0 0.5m 1m

- Legend:
- Iron nail holes / heads
 - Trenails and trenail holes / wedged trenails
 - Wooden plugs / bungs / nails
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	101
Timber type:	outer plank	Location:	garboard, fastened to 106			
Status:	Final			Drawing No.:	198	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Outboard view



Top view



Inboard view



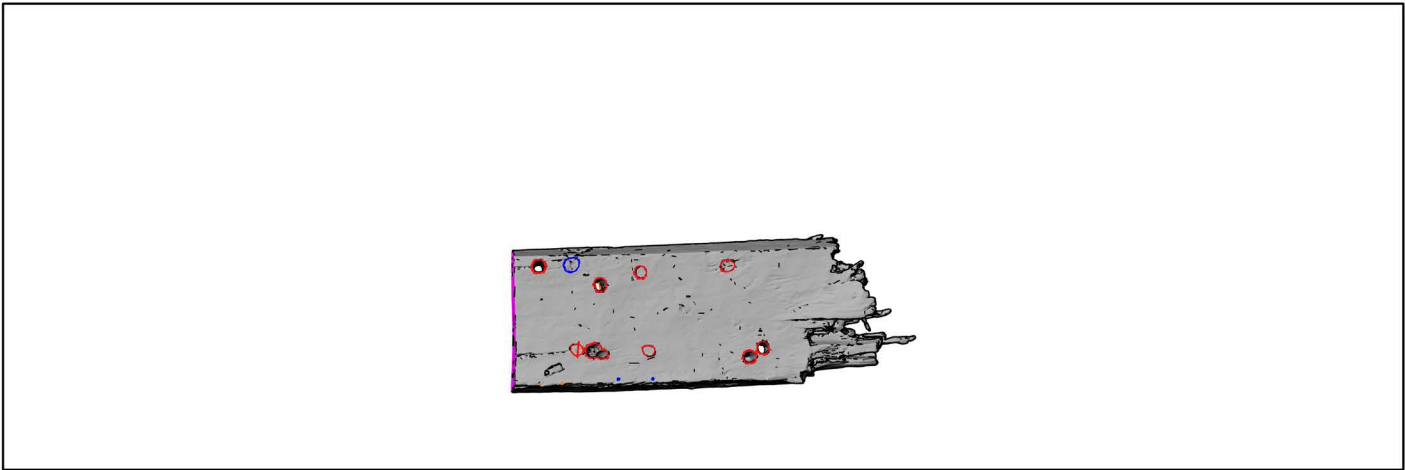
View from amidship



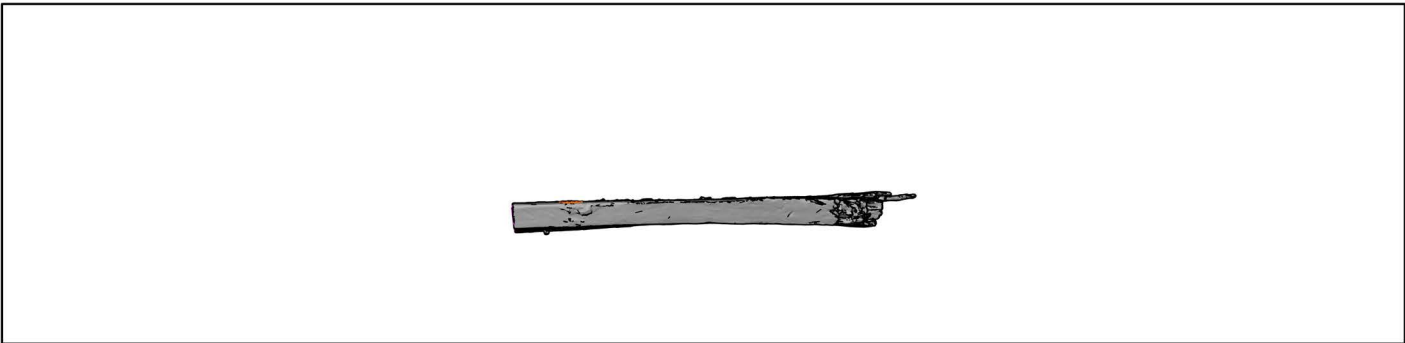
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	102
Timber type:	outer plank	Location:	garboard, fastened to 106			
Status:	Final			Drawing No.:	198	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

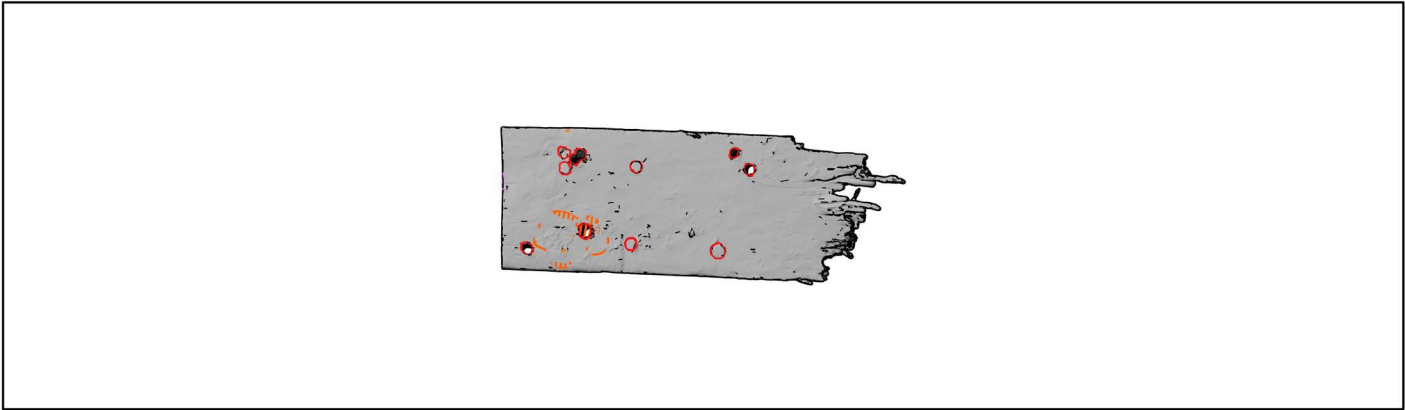
Outboard view



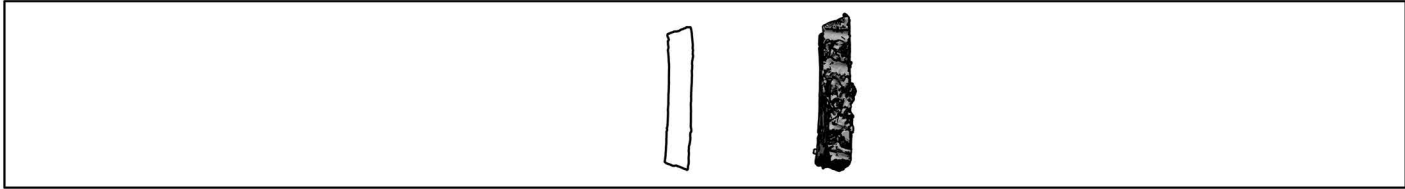
Top view



Inboard view



View from amidship

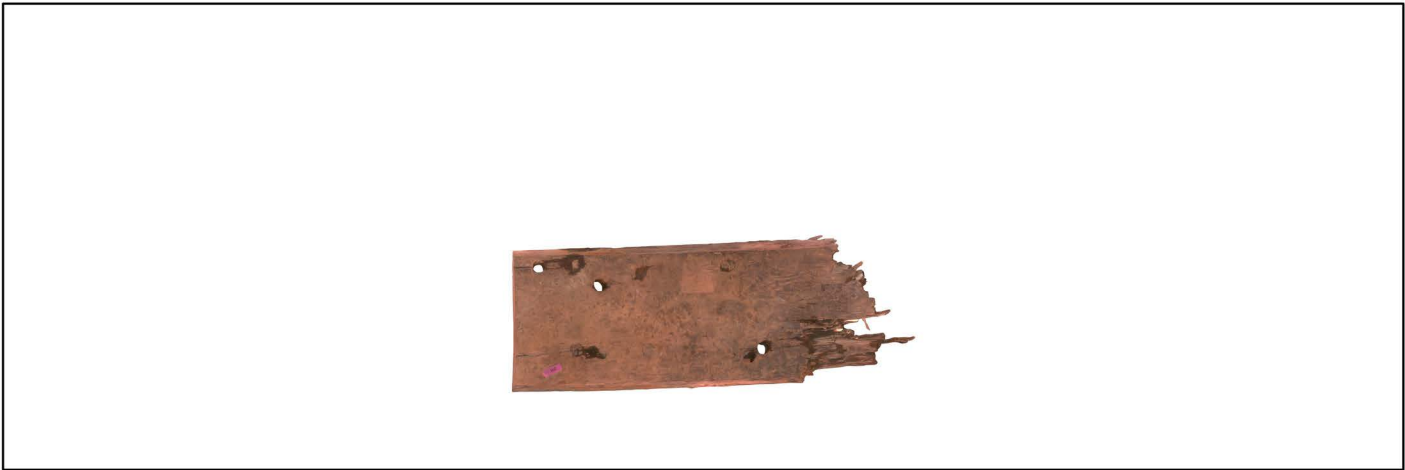


0 0.5m 1m

- Legend:
- Iron nail holes / heads
 - Trenails and trenail holes / wedged trenails
 - Wooden plugs / bungs / nails
 - Dendrosample cut
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	102
Timber type:	outer plank	Location:	first strake, outer plank			
Status:	Final			Drawing No.:	200	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Outboard view



Top view



Inboard view



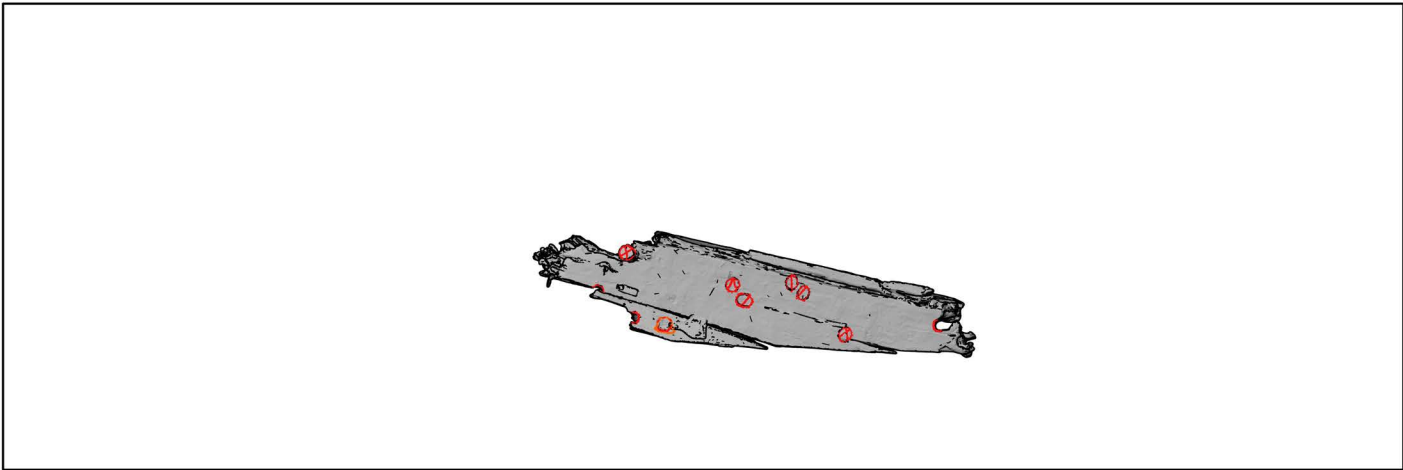
View from amidship



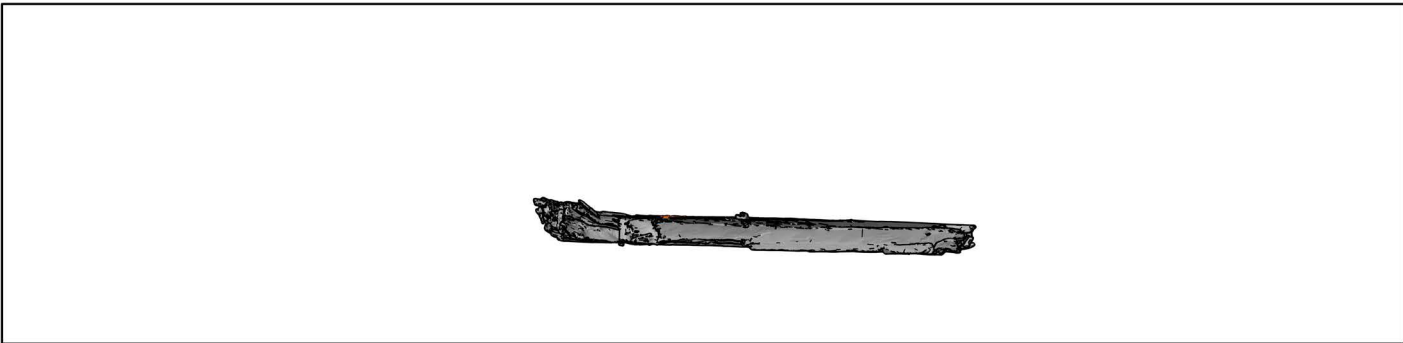
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	102
Timber type:	outer plank	Location:	first strake, outer plank			
Status:	Final			Drawing No.:	201	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

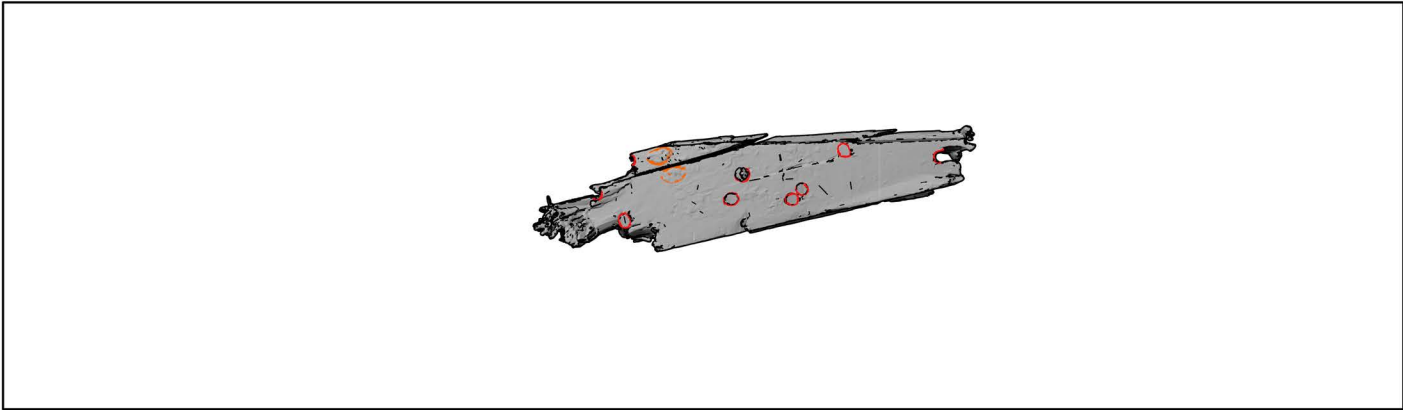
Outboard view



Top view



Inboard view



View from amidship



0 0.5m 1m

- Legend:
- Iron nail holes / heads Trenails and trenail holes / wedged trenails
 - Wooden plugs / bungs / nails
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007	Previous number:			Timber ID:	103
Timber type:	outer plank	Location:	2nd strake, outer plank, above 102			
Status:	Final			Drawing No.:	202	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Outboard view



Top view



Inboard view



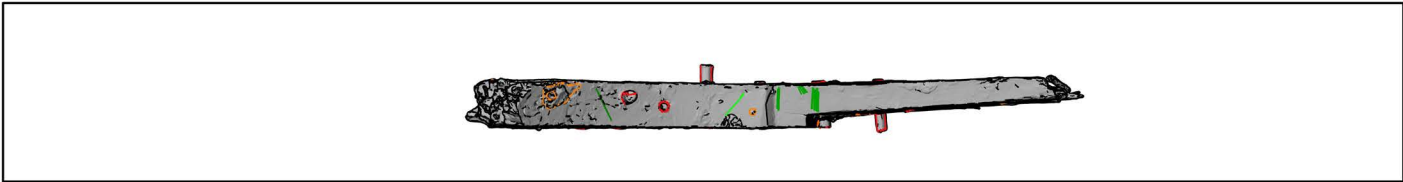
View from amidship



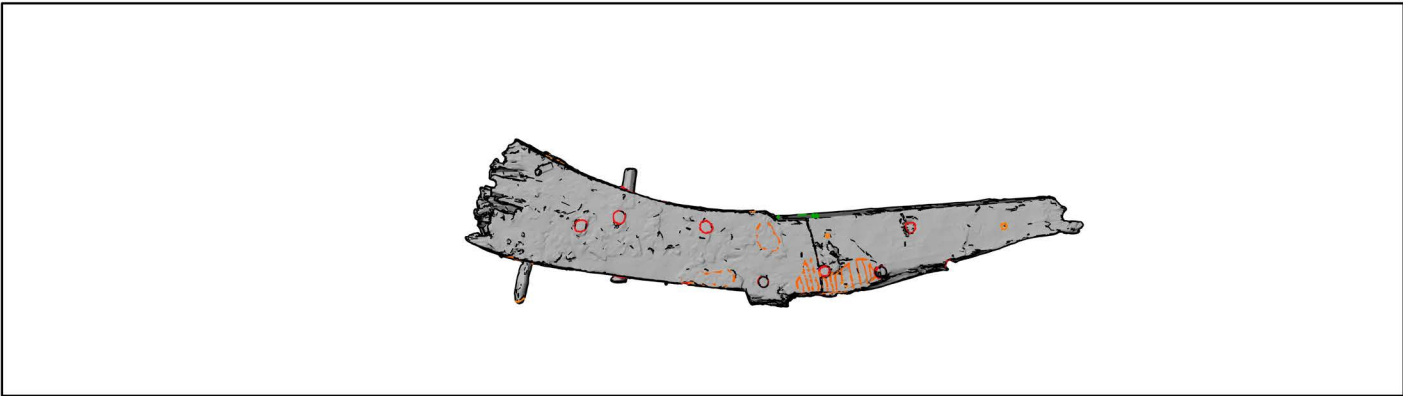
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	103
Timber type:	outer plank	Location:	2nd strake, outer plank, above 102			
Status:	Final			Drawing No.:	203	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

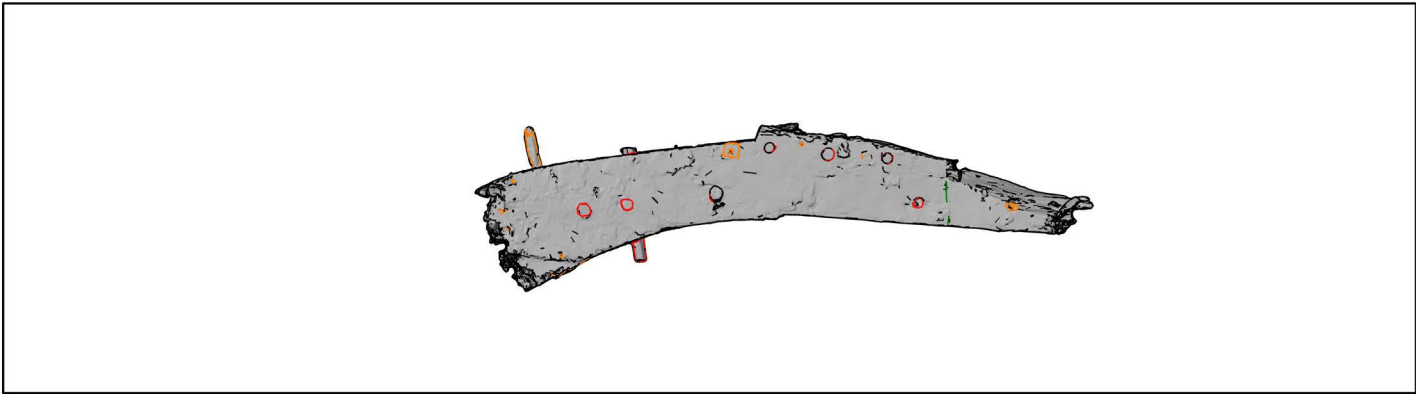
Top view



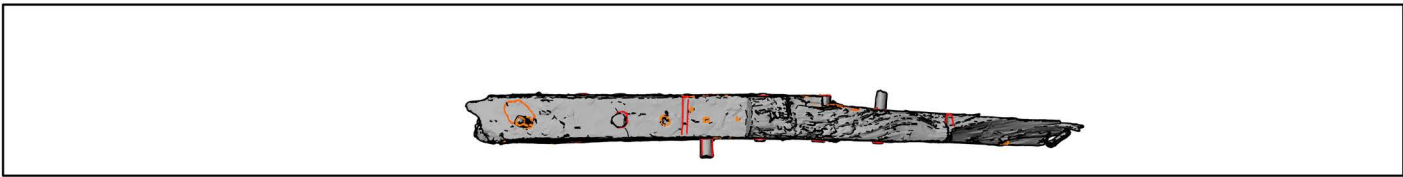
Side view



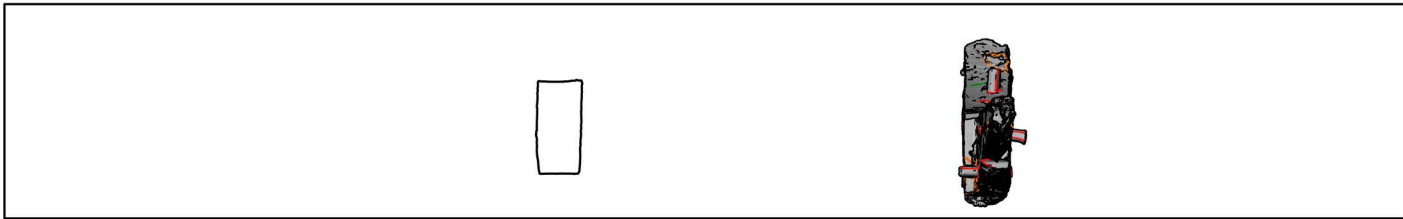
Side view



Inboard view



View from amidship



0 0.5m 1m

- Legend:
- Iron nail holes / heads
 - Trenails and trenail holes / wedged trenails
 - Toolmarks
 - Iron bolts
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	104
Timber type:	deadwood	Location:	above 117, under 109, 101 and 105 fastened on the sides			
Status:	Final			Drawing No.:	204	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Top view



Side view



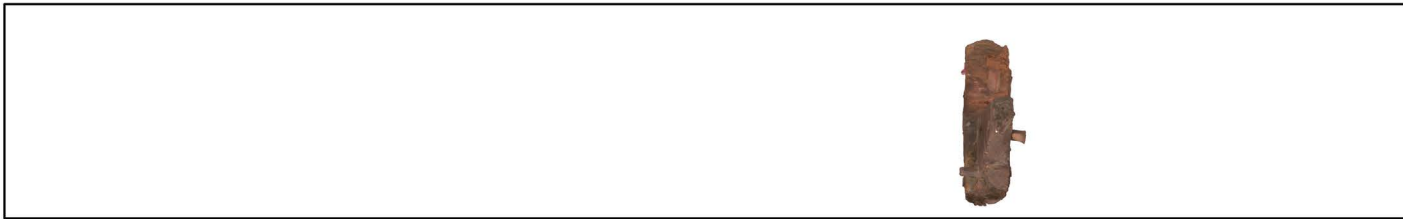
Side view



Inboard view



View from amidship



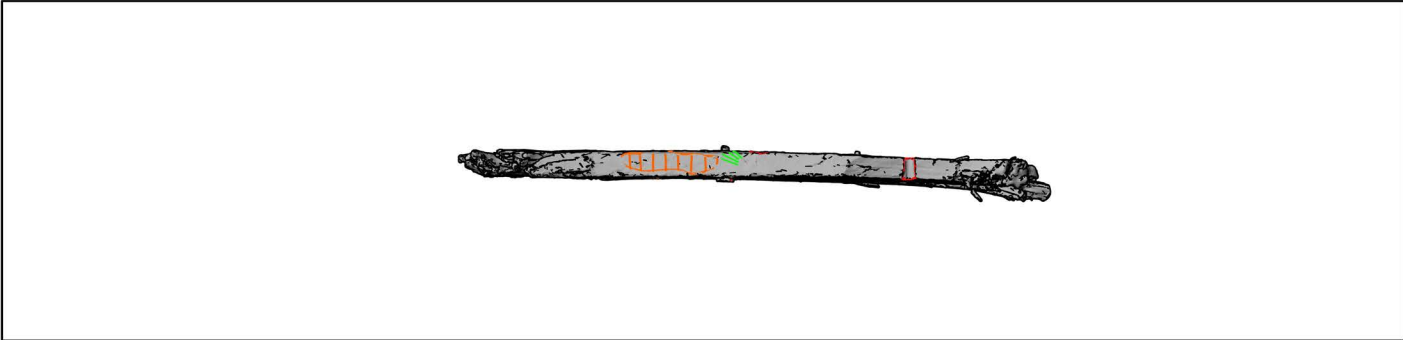
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	104
Timber type:	deadwood	Location:	above 117, under 109, 101 and 105 fastened on the sides			
Status:	Final			Drawing No.:	205	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

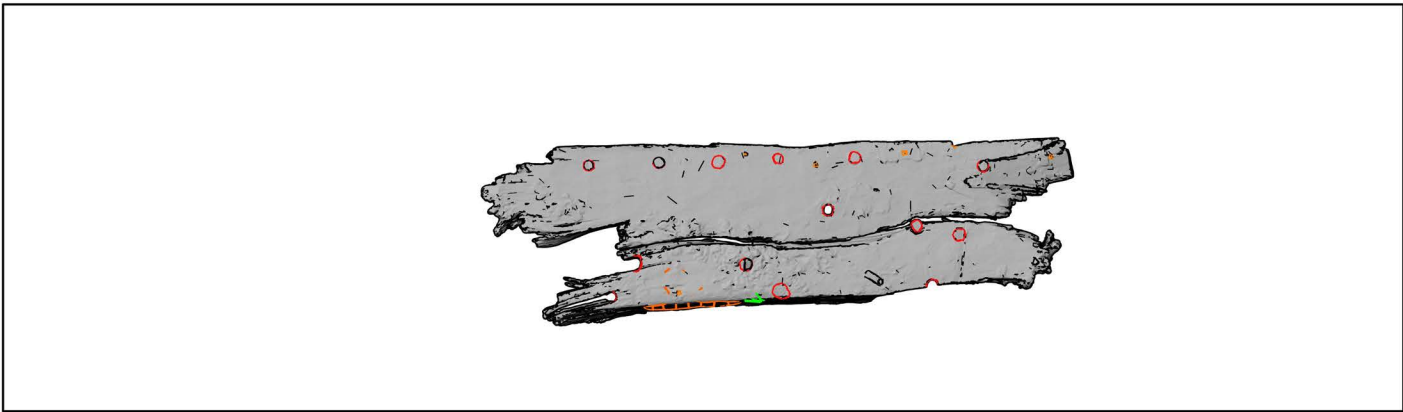
Outboard view



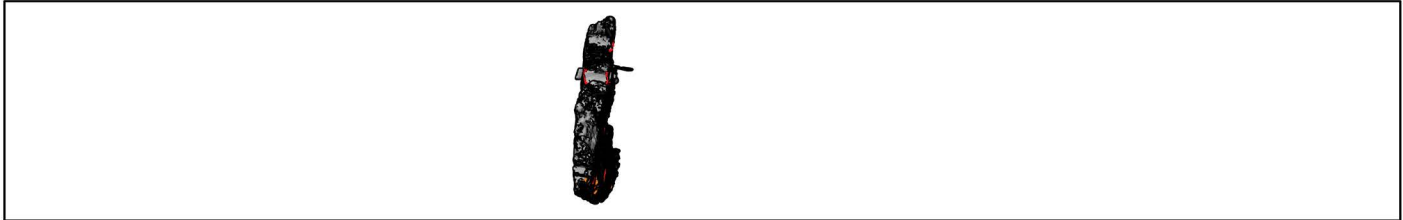
Top view



Inboard view



View from amidship



0 0.5m 1m

Legend:

-  Trenails and trenail holes / wedged trenails
-  Toolmarks
-  Iron nail holes / heads
-  Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007	Previous number:			Timber ID:	105
Timber type:	outer plank	Location:	first surviving strake, portside			
Status:	Final			Drawing No.:	206	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

Outboard view



Top view



Inboard view



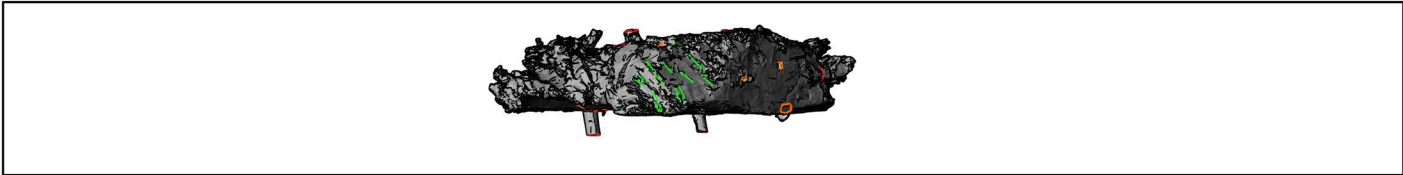
View from amidship



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	105
Timber type:	outer plank	Location:	first surviving strake, portside			
Status:	Final			Drawing No.:	207	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

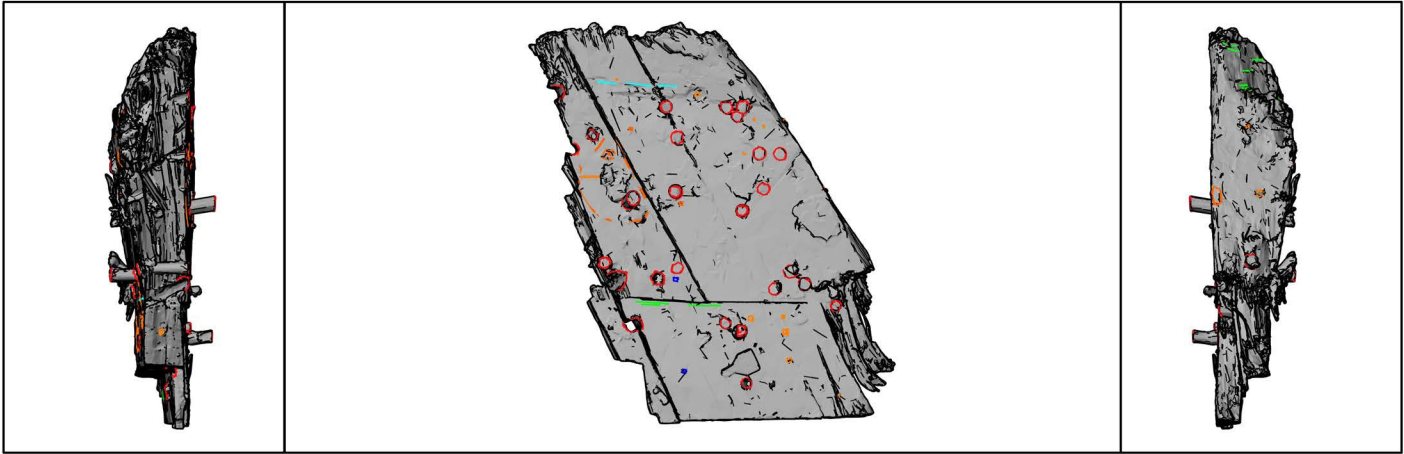
Top view



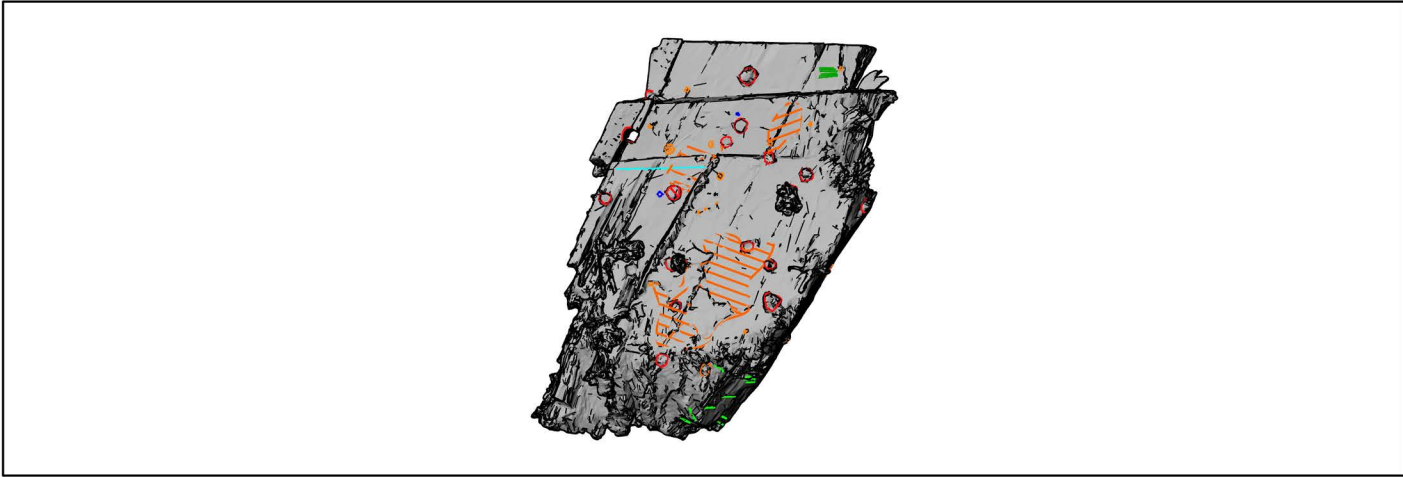
Aft view

Starboard view

Fore view



Portside view



Bottom view



0 0.5m 1m

Legend:

- ⊙

Treenails and trenail holes / wedged trenails
- ⊙

Wooden plugs / nails
- Toolmarks
- Iron nail holes / heads
- Intentional marks
- ▨

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	106 , 109
Timber type:	sternpost assembly	Location:	section 5007, over 104			
Status:	Final		Drawing No.:	208		
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Top view



Aft view

Starboard view

Fore view



Portside view



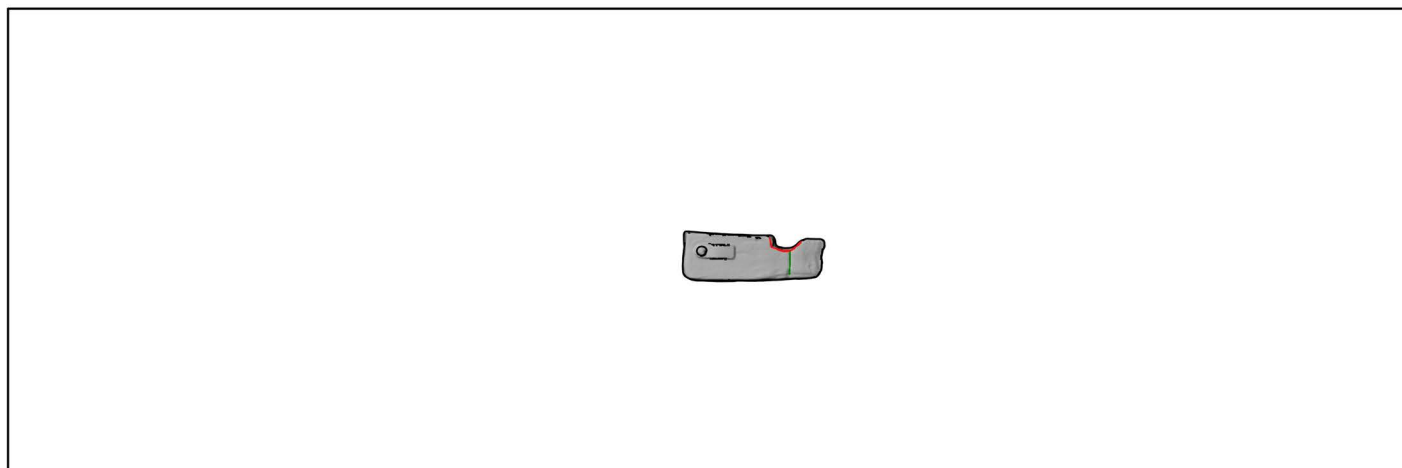
Bottom view



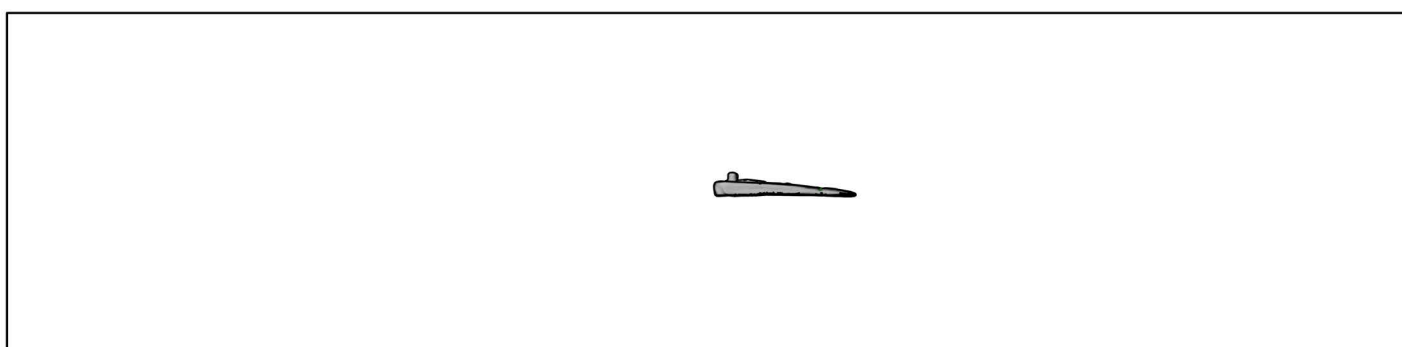
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	106 , 109
Timber type:	sternpost assembly	Location:	section 5007, over 104			
Status:	Final			Drawing No.:	209	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

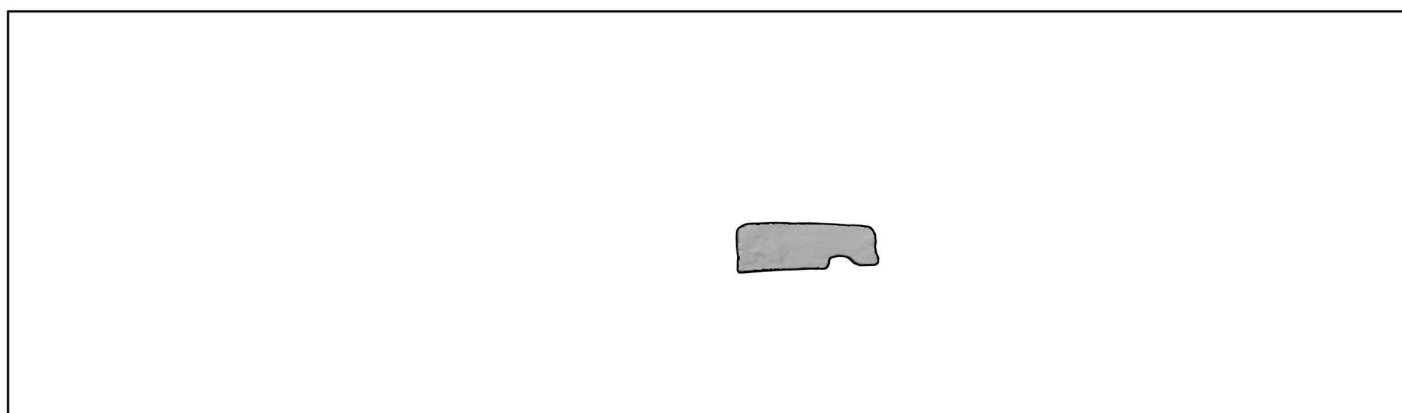
Top view



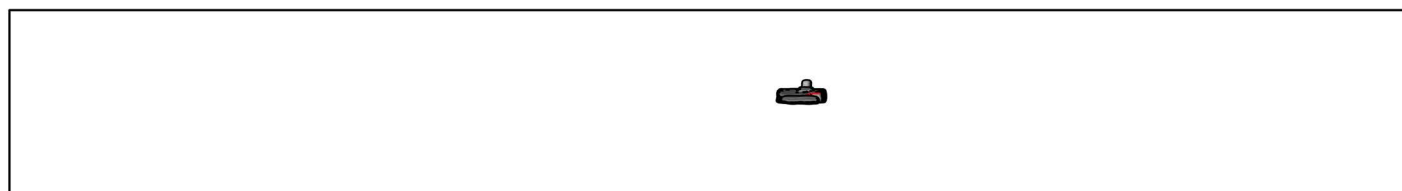
Side view



Bottom view



Front view



0 0.5 1m

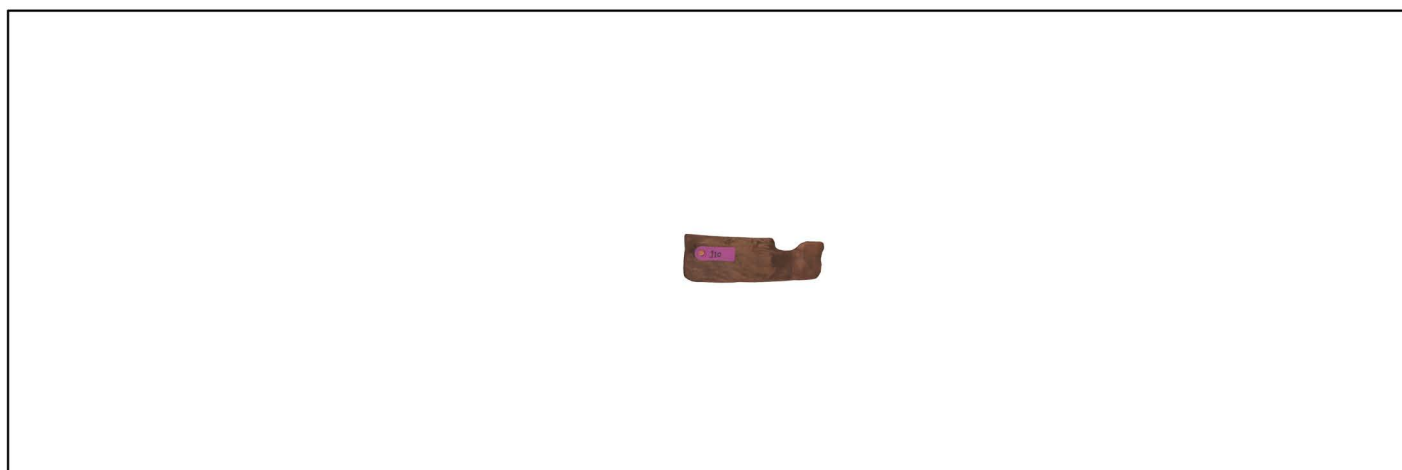
Legend:

● Trenails and trenail holes / wedged trenails

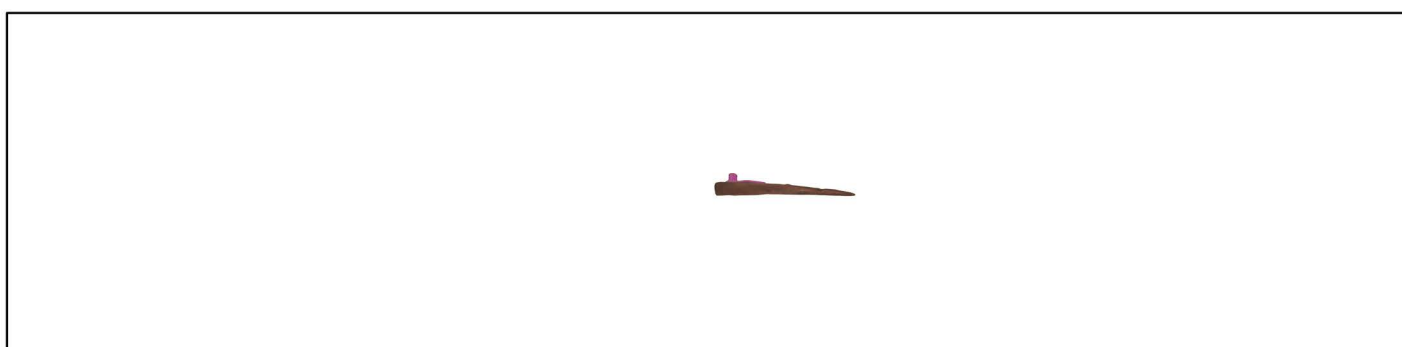
— Toolmarks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	110
Timber type:	wedge	Location:	inserted between floor 50 and futtock 72			
Status:	Final			Drawing No.:	210	
Scale:	1:10	Date:	16/03/2022	Made by:	Paolo Croce	

Top view



Side view



Bottom view



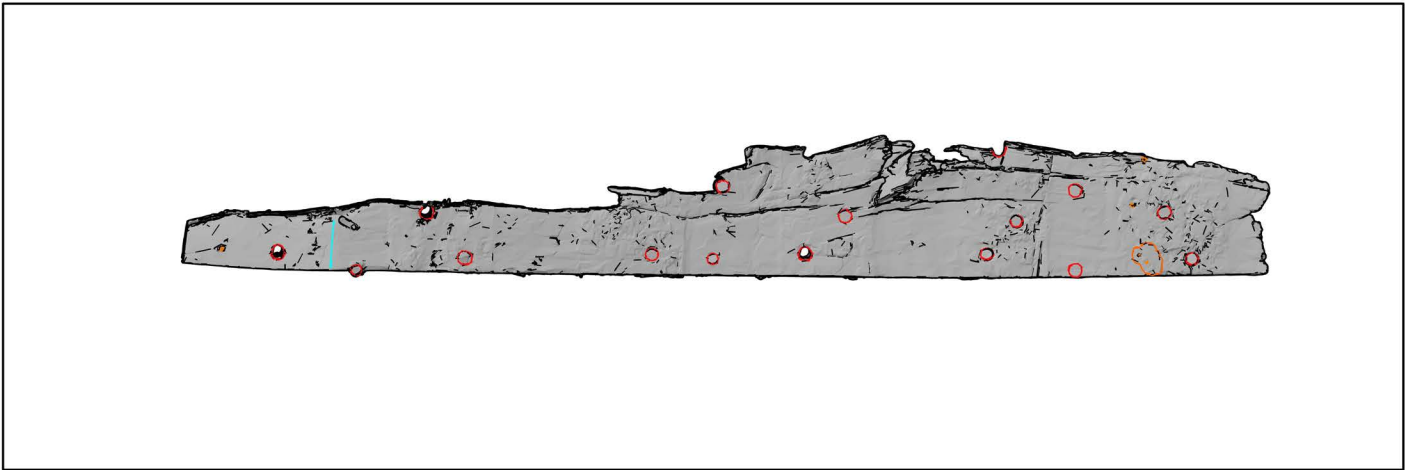
Front view



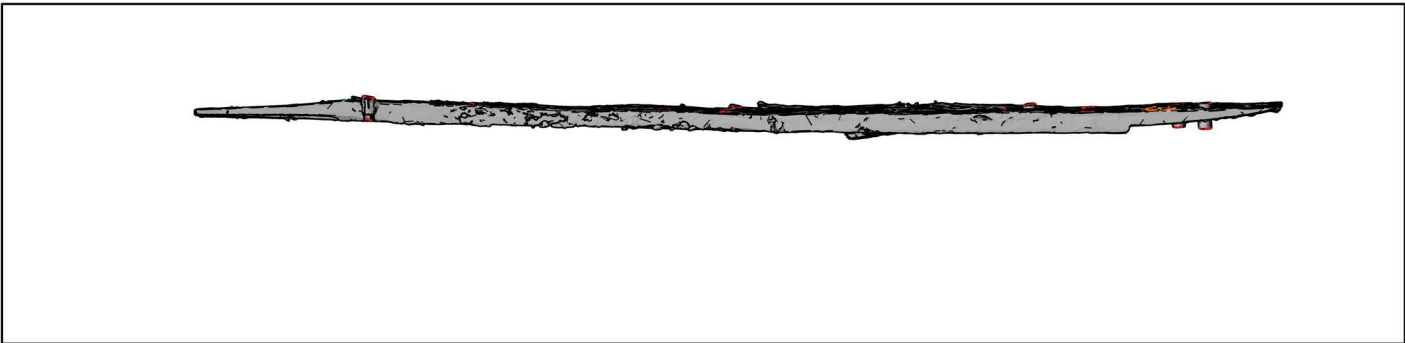
0 0.5 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:	-	Timber ID:	110
Timber type:	wedge	Location:	inserted between floor 50 and futtock 72			
Status:	Final			Drawing No.:	211	
Scale:	1:10	Date:	16/03/2022	Made by:	Paolo Croce	

Inboard view



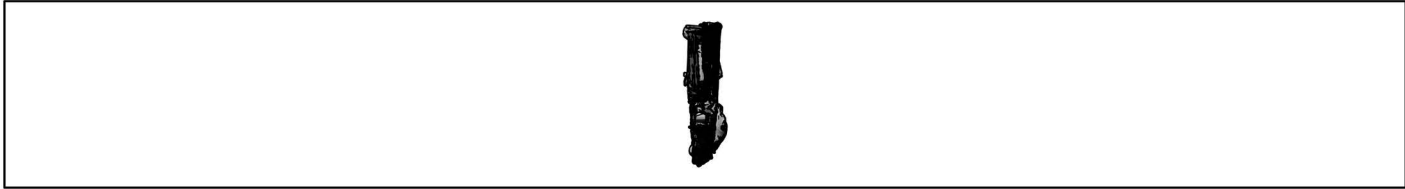
Side view



Outboard view



Aft view



00.5m1m

- Legend:
- Iron nail holes / heads

Concretion

Treenails and treenail holes / wedged treenails

Intentional marks

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	112
Timber type:	outer plank	Location:	strake 1, 2 of 3 surviving planks, starboard side			
Status:	Final			Drawing No.:	212	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



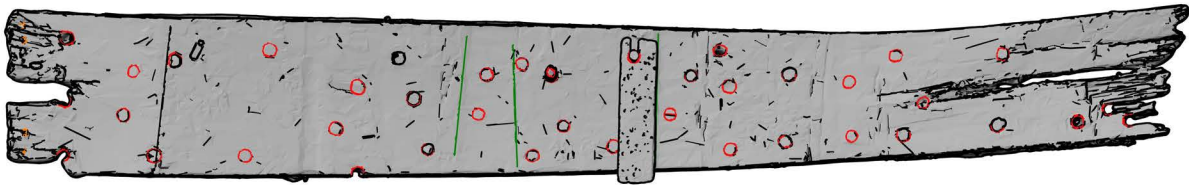
Aft view



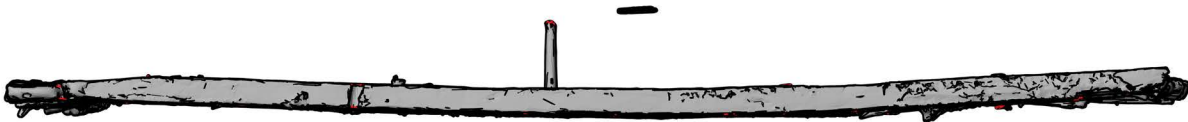
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5004		Previous number:		Timber ID:	111
Timber type:	outer plank	Location:	strake 1, 2 of 3 surviving planks, starboard side			
Status:	Final			Drawing No.:	213	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

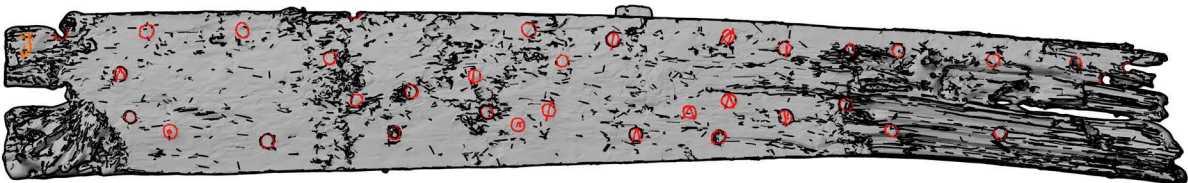
Inboard view



Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

- Iron nail holes / heads
- Concretion
- Treenails and trenail holes / wedged treenails
- Intentional marks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004	Previous number:				Timber ID:	113, 99
Timber type:	outer plank	Location:	plank 2 of 2, strake 3 of section 5004, and tingle under 056, starboard side				
Status:	Final				Drawing No.:	216	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce		

Inboard view



Side view



Outboard view



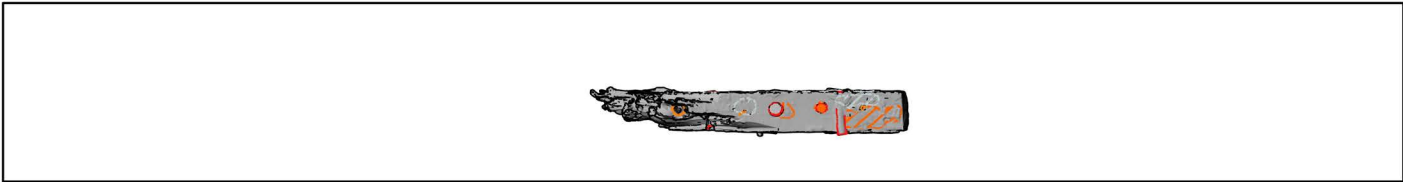
Aft view



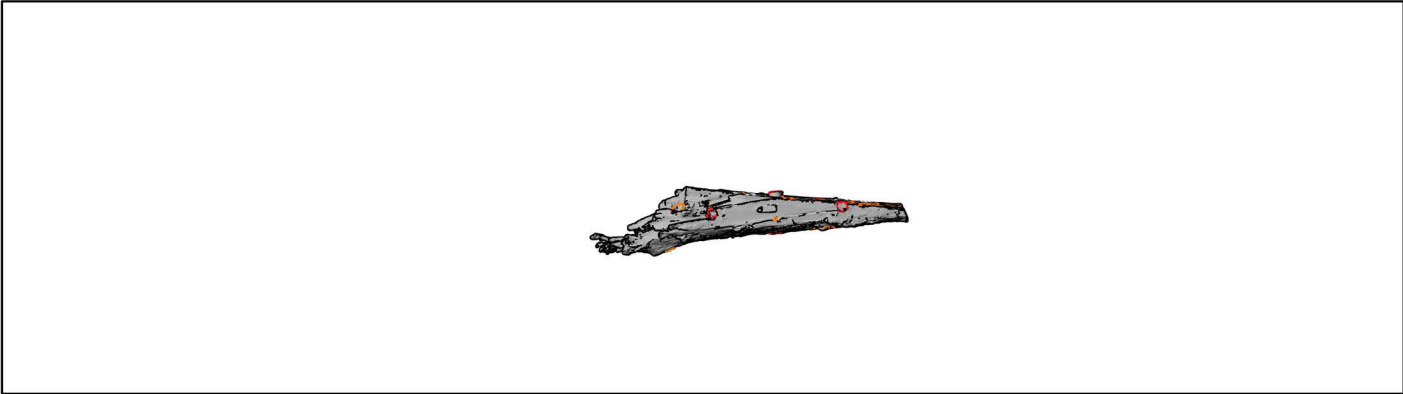
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004	Previous number:				Timber ID:	113, 99
Timber type:	outer plank	Location:	plank 2 of 2, strake 3 of section 5004, and tingle under 056, starboard side				
Status:	Final				Drawing No.:	217	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce		

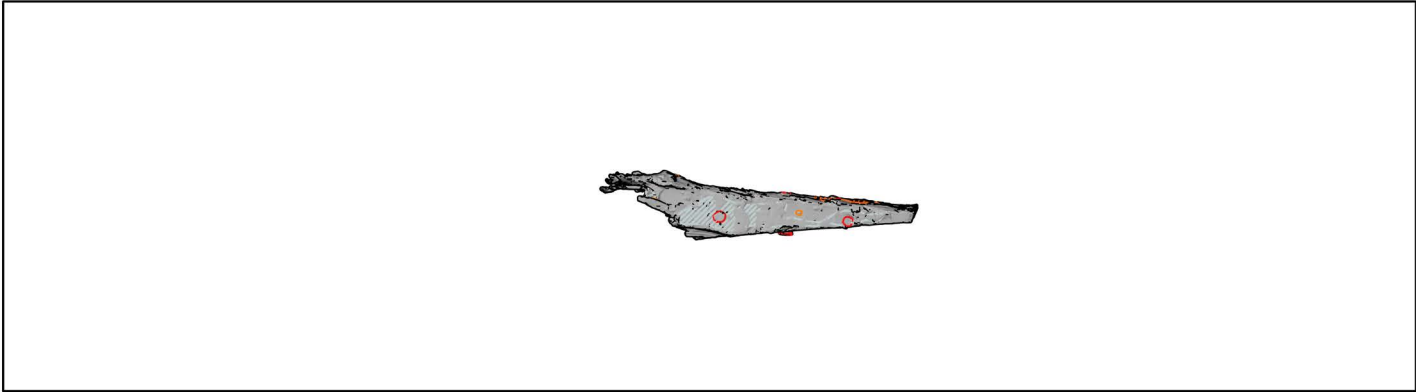
Top view



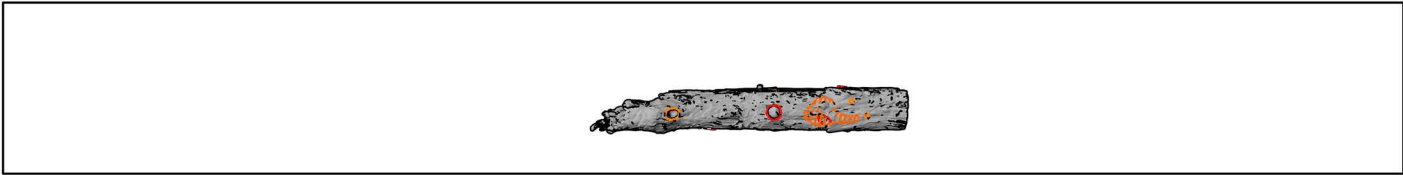
Portside view



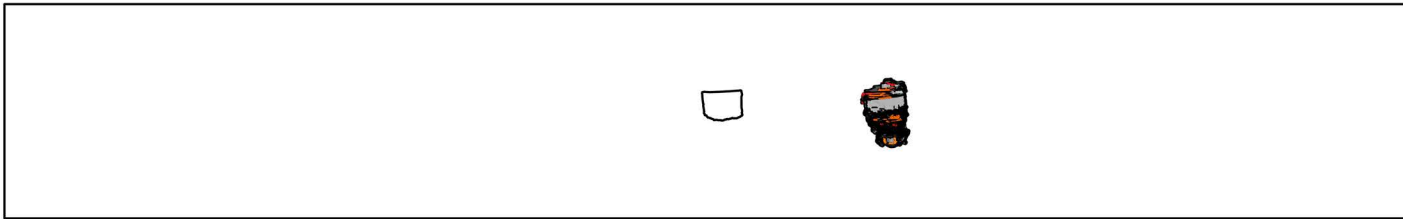
Starboard view



Inboard view



Fore view



00.5m1m

- Legend:
- Trenails and trenail holes / wedged trenails

Iron nail holes / heads

Bolt

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	117
Timber type:	skeg	Location:	sternpost, fastened under 104, between outer planks 101 and 105			
Status:	Final			Drawing No.:	218	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

Top view



Portside view



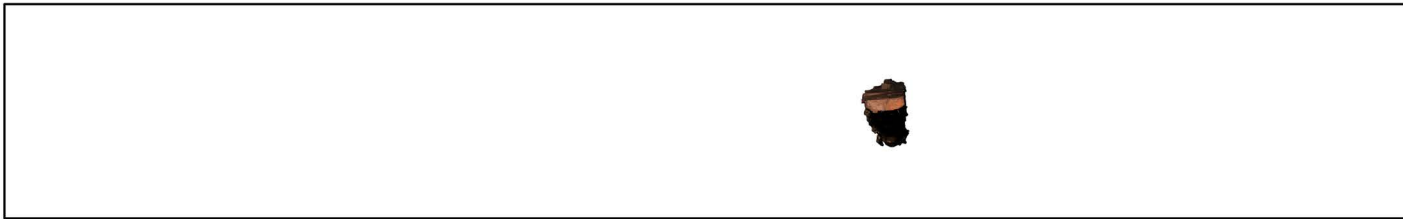
Starboard view



Inboard view



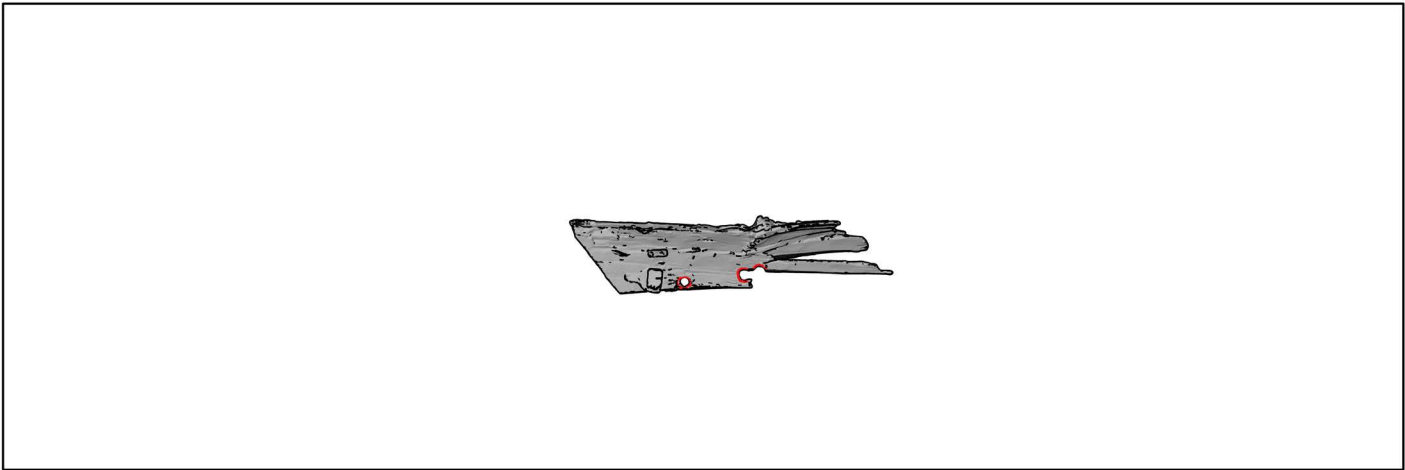
Fore view



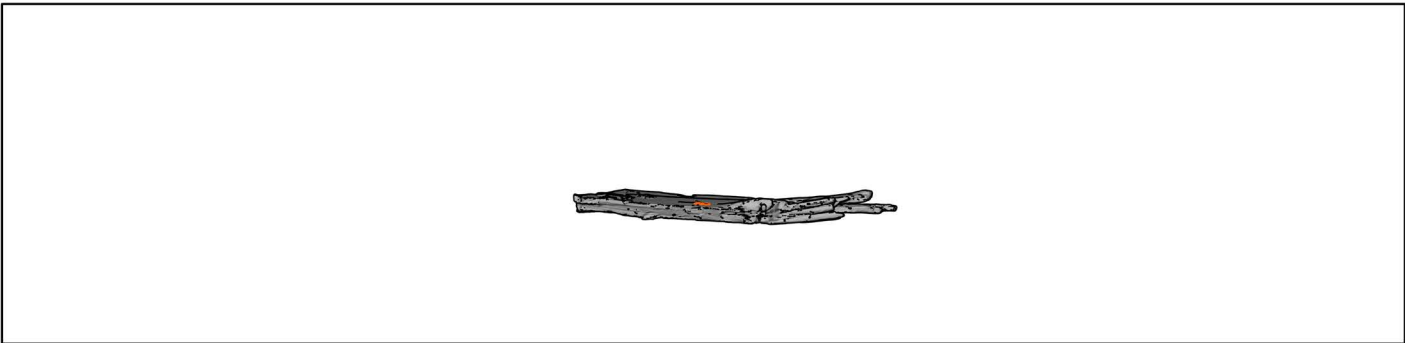
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	117
Timber type:	skeg	Location:	sternpost, fastened under 104, between outer planks 101 and 105			
Status:	Final			Drawing No.:	219	
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce	

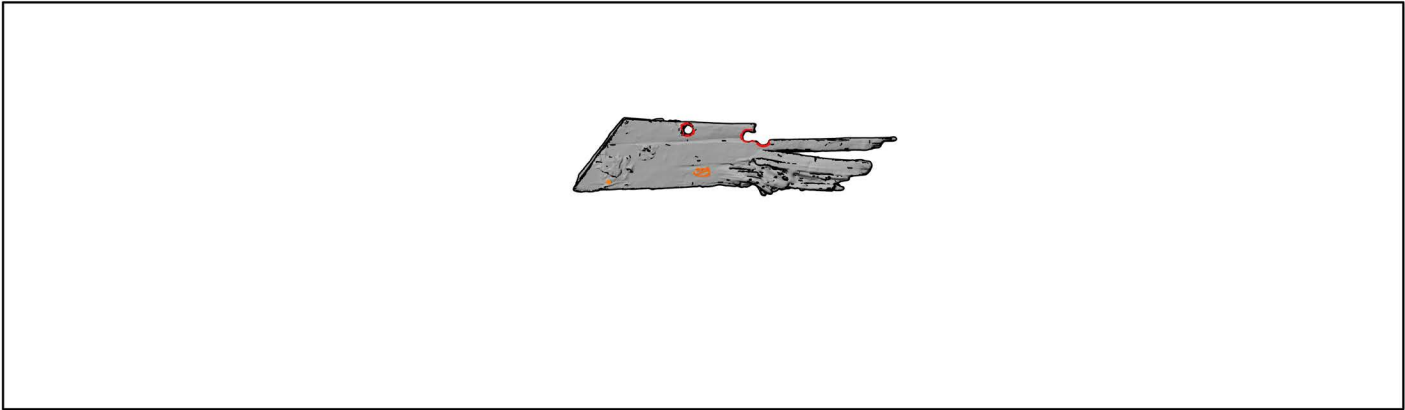
Outboard view



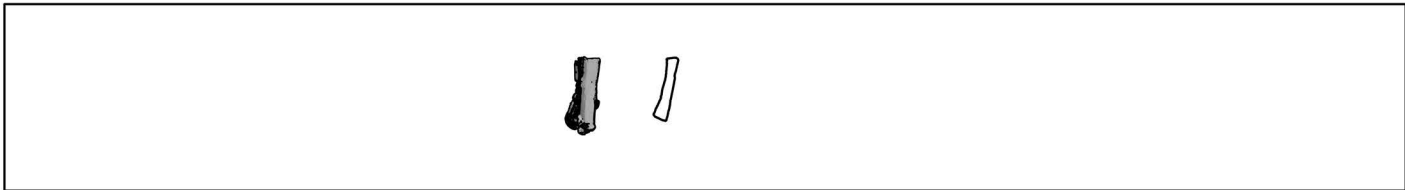
Top view



Inboard view



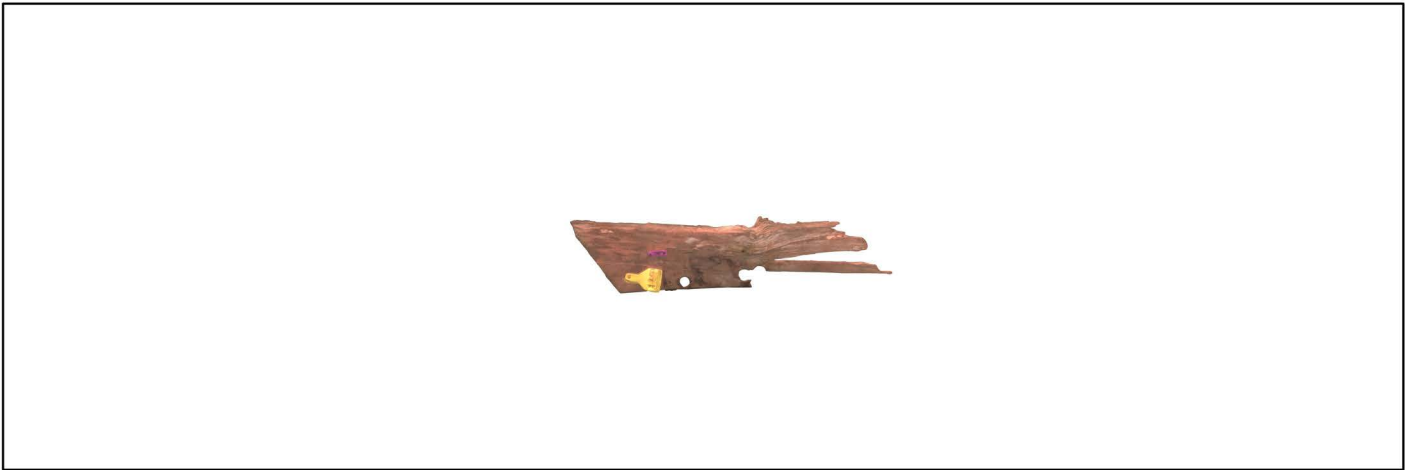
Aft view



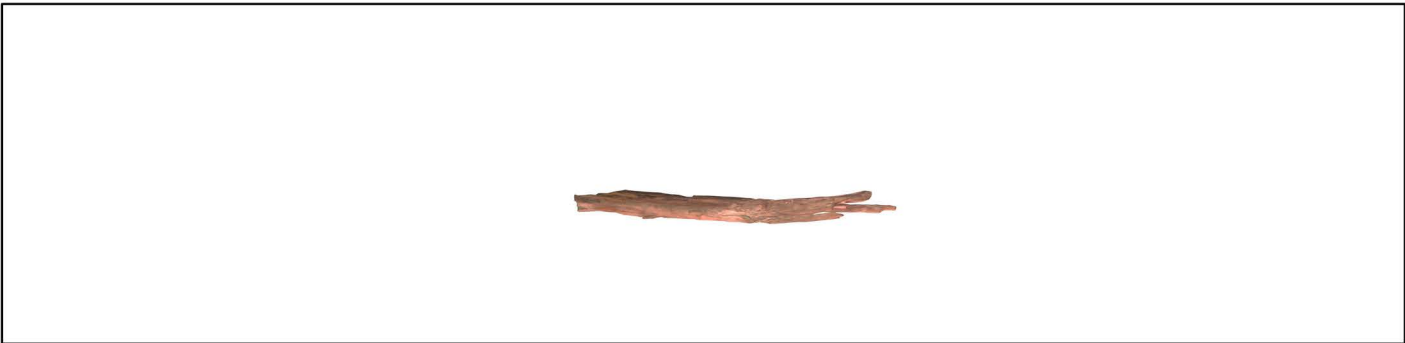
- Legend:
-  Trenails and trenail holes / wedged trenails
 -  Iron nail holes / heads
 -  Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	120
Timber type:	inner outer plank	Location:	(inner) outer planking, 3rd strake, land in rabbet of 109			
Status:	Final			Drawing No.:	220	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

Outboard view



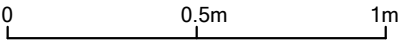
Top view



Inboard view

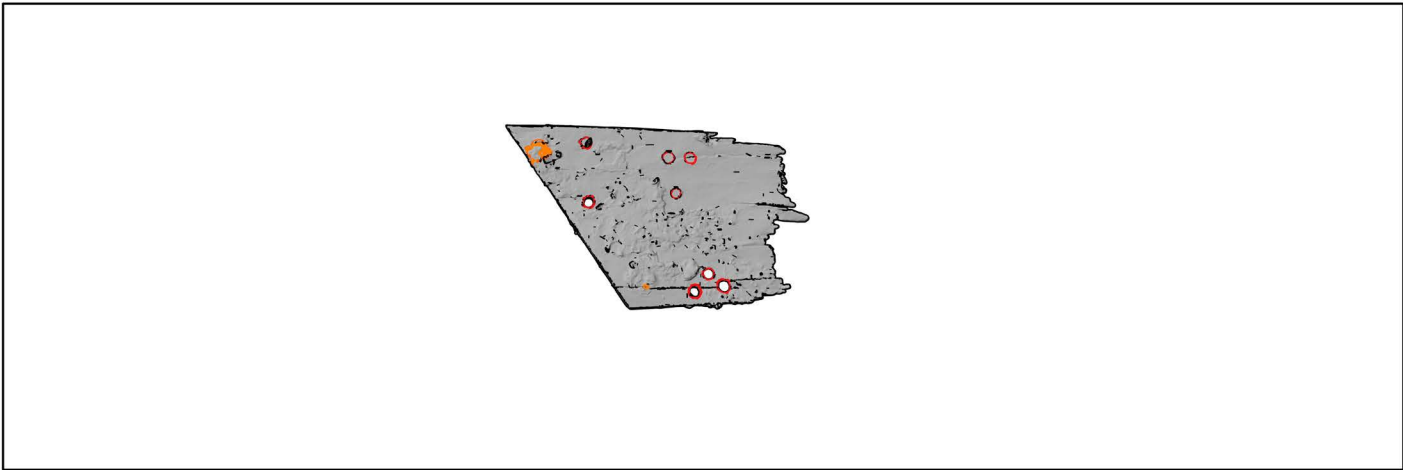


Aft view

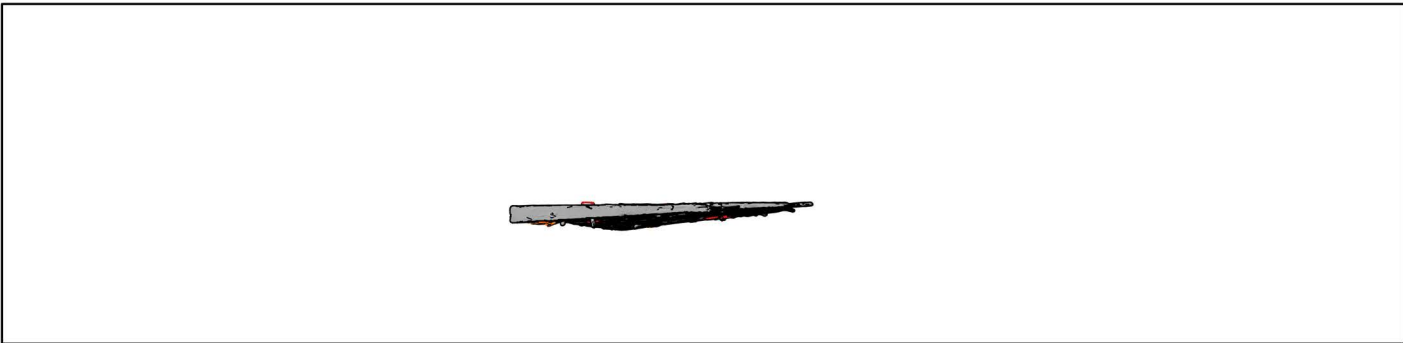


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	120
Timber type:	inner outer plank	Location:	(inner) outer planking, 3rd strake, land in rabbet of 109			
Status:	Final			Drawing No.:	221	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

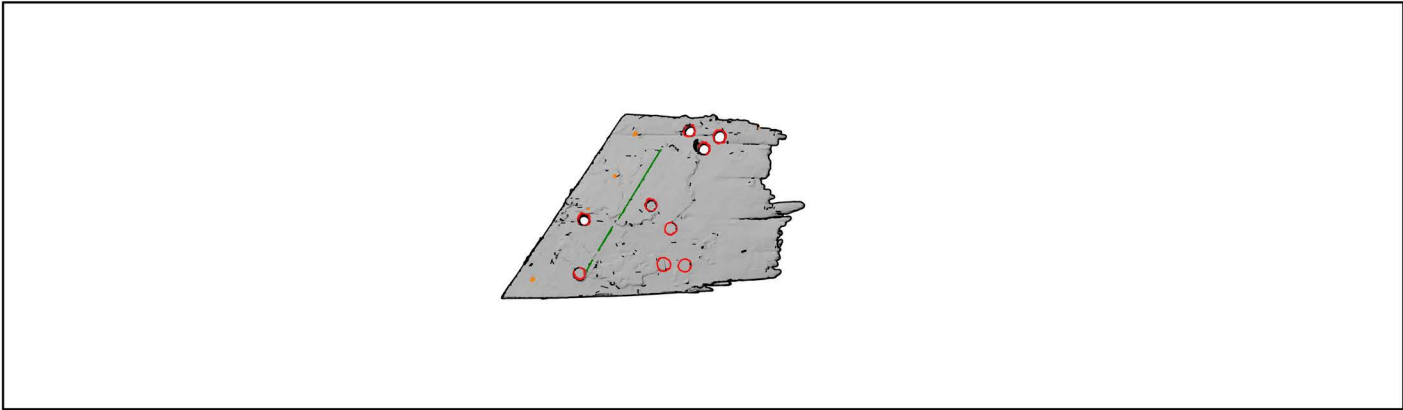
Outboard view



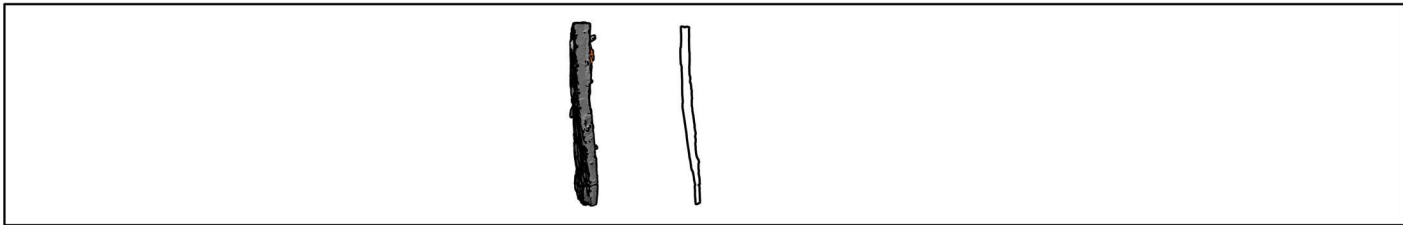
Top view



Inboard view



Aft view



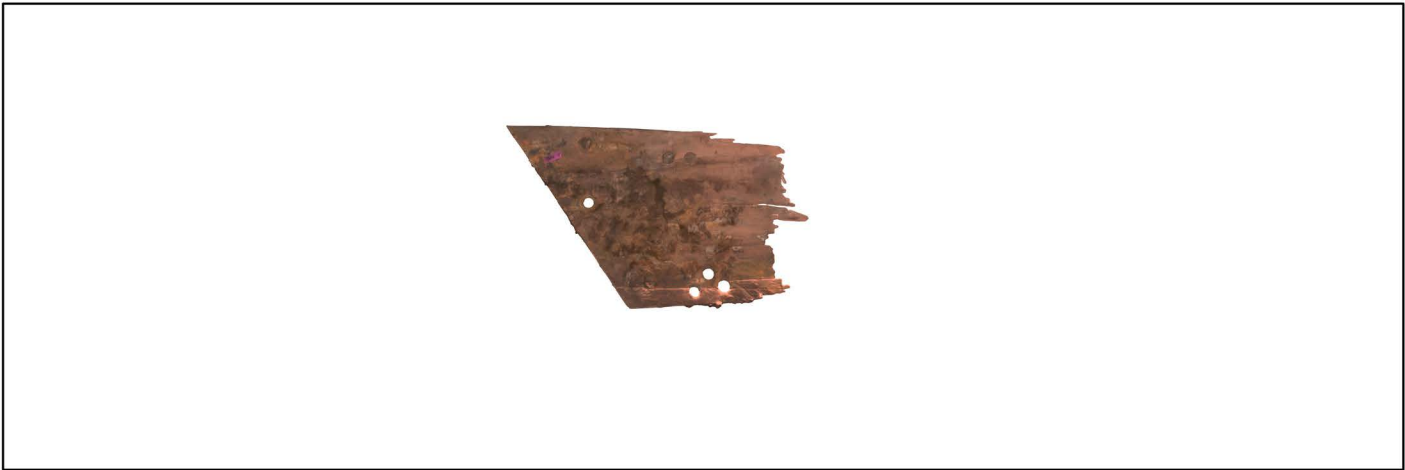
0 0.5m 1m

Legend:

- Trenails and trenail holes / wedged trenails
- Iron nail holes / heads
- Toolmarks
- Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	121
Timber type:	inner outer plank	Location:	inner outer planking, 2nd strake, land in rabbet of 109, starboard			
Status:	Final			Drawing No.:	222	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

Outboard view



Top view



Inboard view



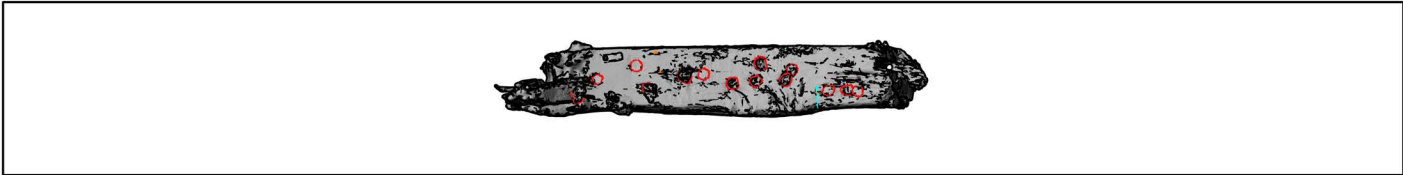
Aft view



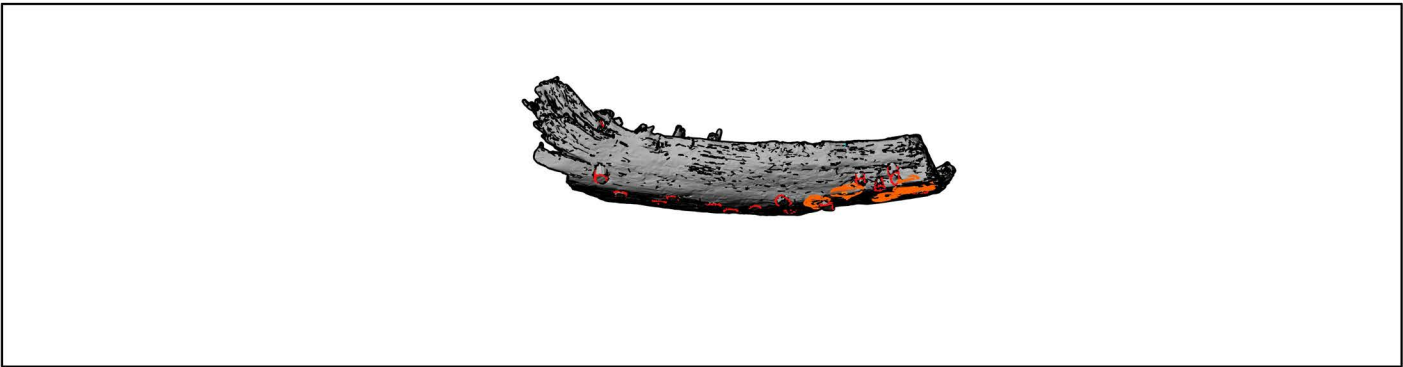
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5007		Previous number:		Timber ID:	121
Timber type:	inner outer plank	Location:	inner outer planking, 2nd strake, land in rabbet of 109, starboard			
Status:	Final			Drawing No.:	223	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

Inboard view



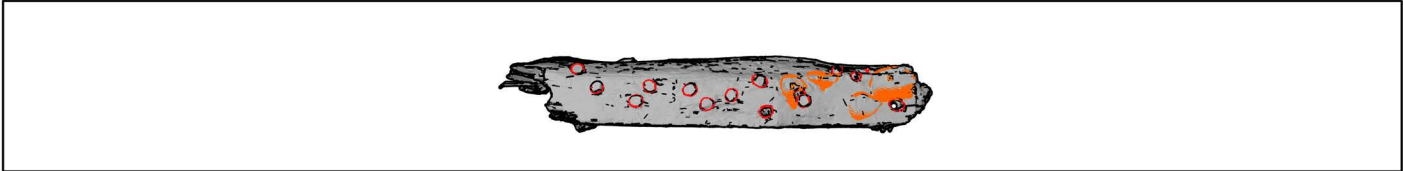
Aft view



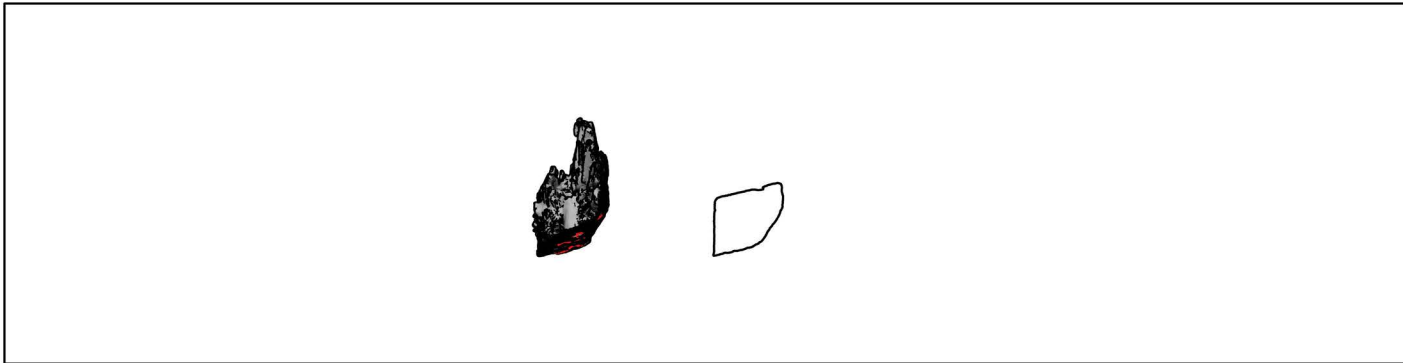
Fore view



Outboard view



Side view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	122
Timber type:	poss. futtock	Location:	1 of 3 surviving frames			
Status:	Final			Drawing No.:	224	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



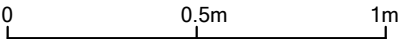
Fore view



Outboard view

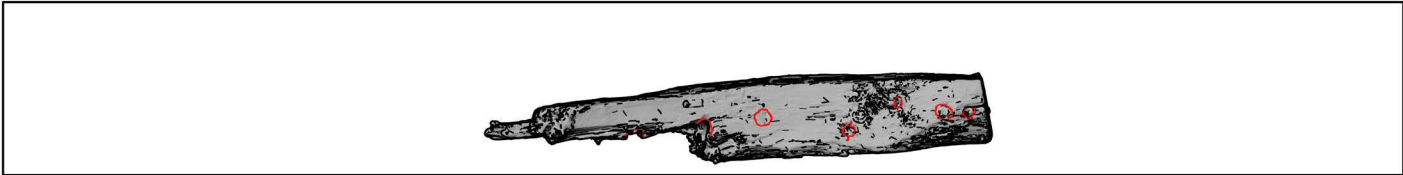


Side view

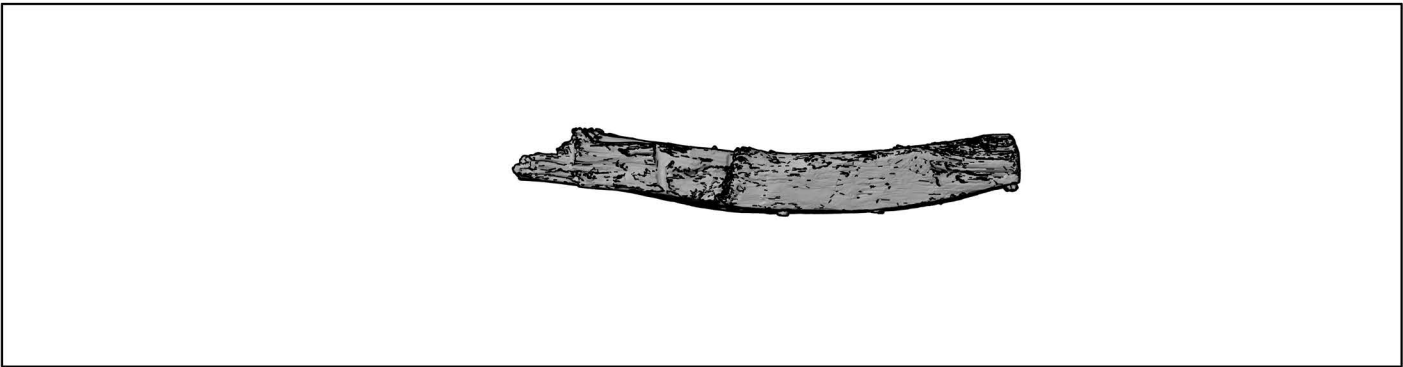


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	122
Timber type:	poss. futtock	Location:	1 of 3 surviving frames			
Status:	Final			Drawing No.:	225	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

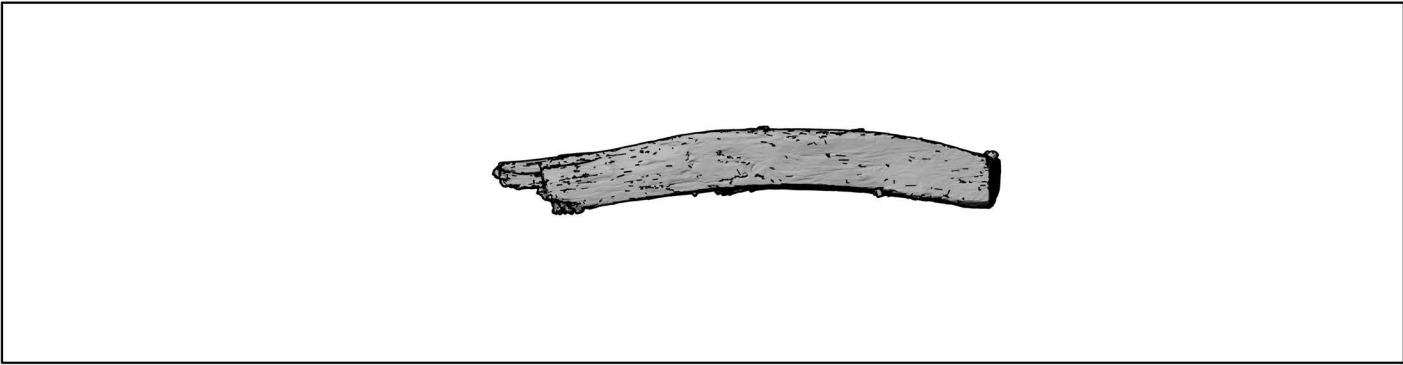
Inboard view



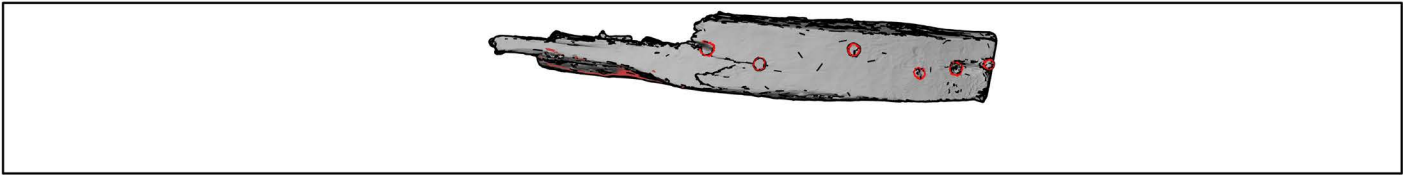
Aft view



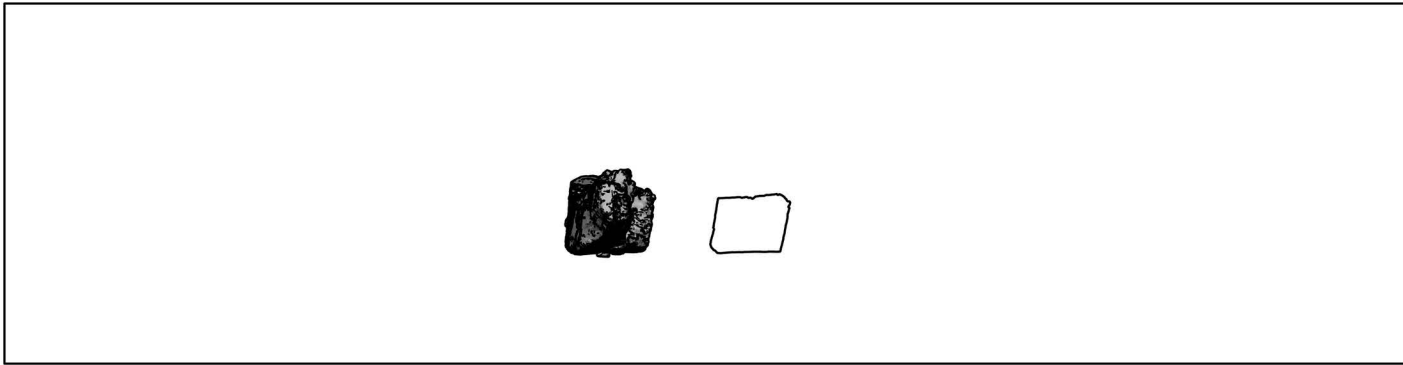
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails

Toolmarks

Intentional marks

Sapwood / bark

Iron nail holes / heads

Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	123
Timber type:	filling frame	Location:	2 of 3 surviving frames			
Status:	Final			Drawing No.:	226	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



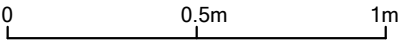
Fore view



Outboard view

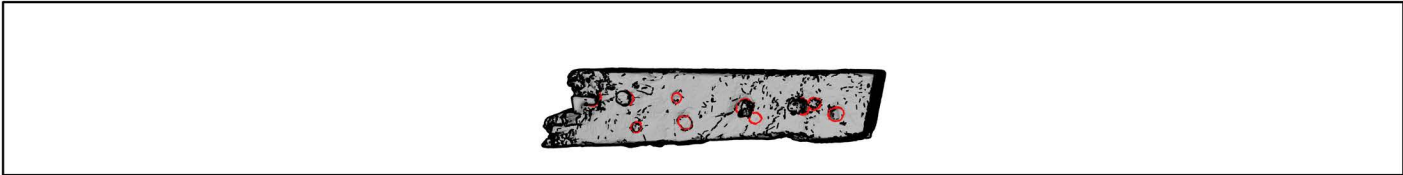


Portside view

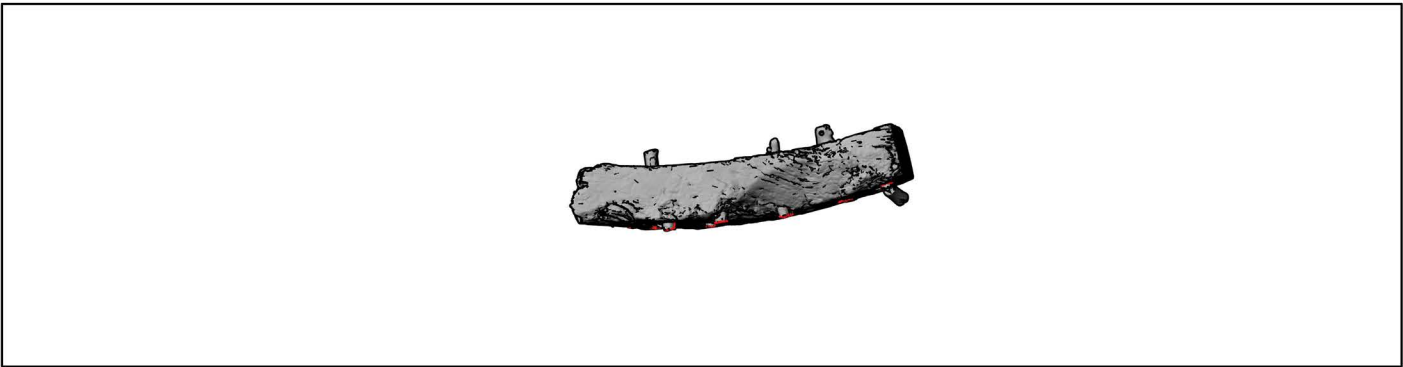


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	123
Timber type:	filling frame	Location:	2 of 3 surviving frames			
Status:	Final			Drawing No.:	227	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

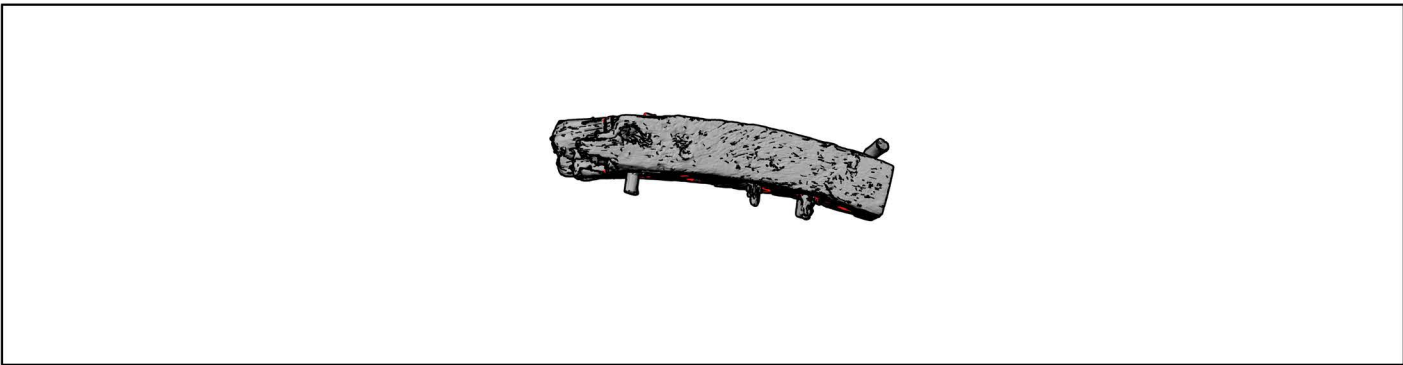
Inboard view



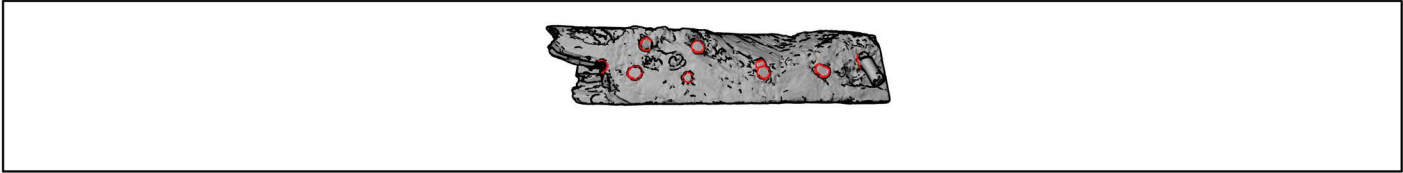
Aft view



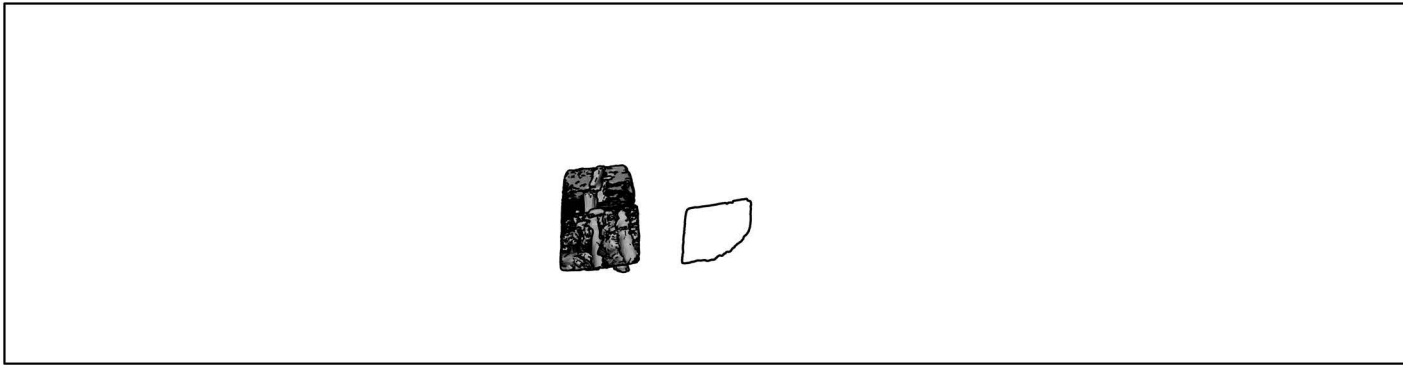
Fore view



Outboard view



Portside view



0 0.5m 1m

- Legend:
- 

Trenails and trenail holes / wedged trenails



Toolmarks



Intentional marks



Sapwood / bark



Iron nail holes / heads



Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	124
Timber type:	filling frame or futtock	Location:	3 of 3 surviving frames			
Status:	Final		Drawing No.:	228		
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

Inboard view



Aft view



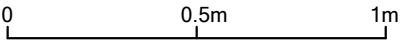
Fore view



Outboard view

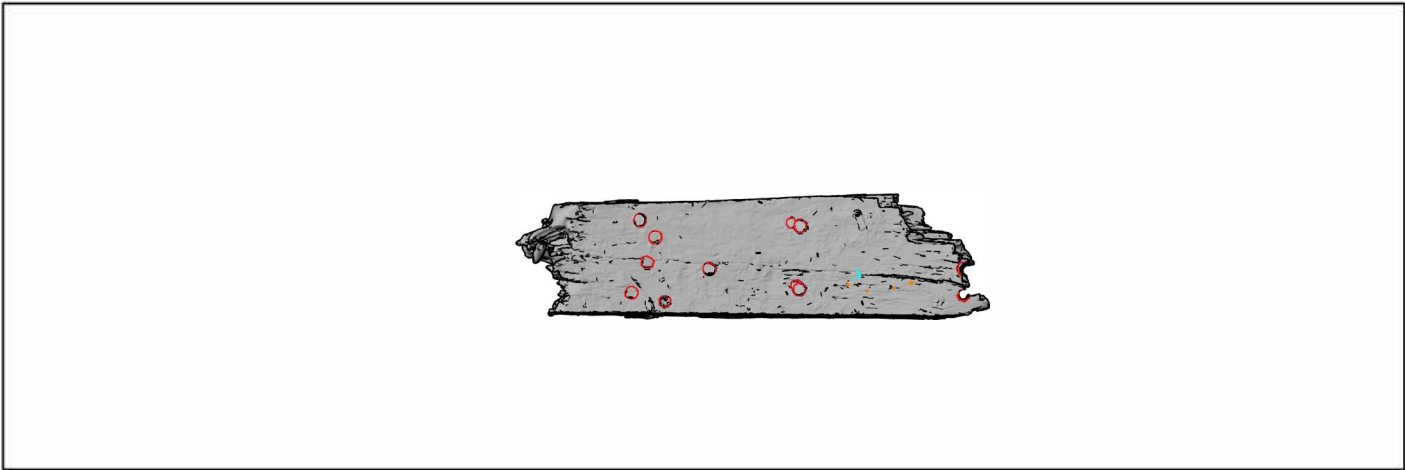


Portside view

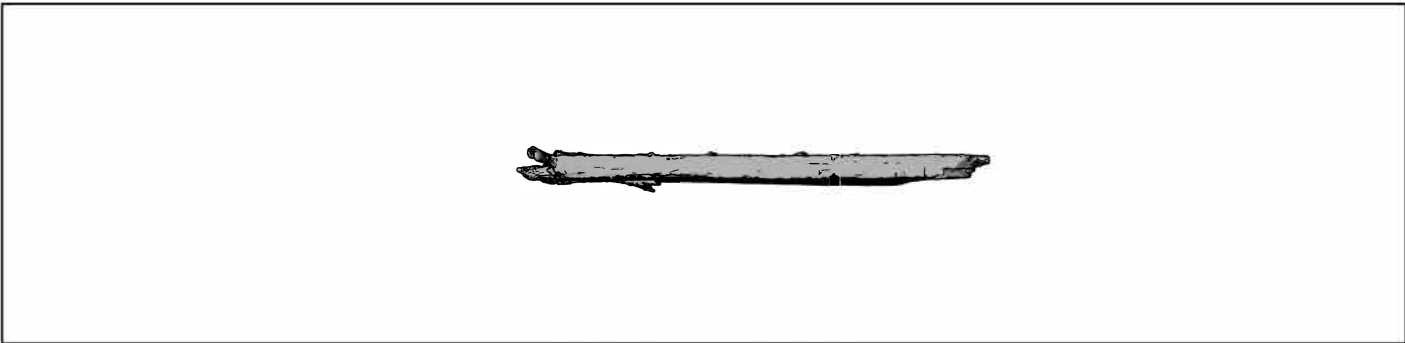


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	124
Timber type:	filling frame or futtock	Location:	3 of 3 surviving frames			
Status:	Final			Drawing No.:	229	
Scale:	1:20	Date:	10/03/2023	Made by:	Paolo Croce	

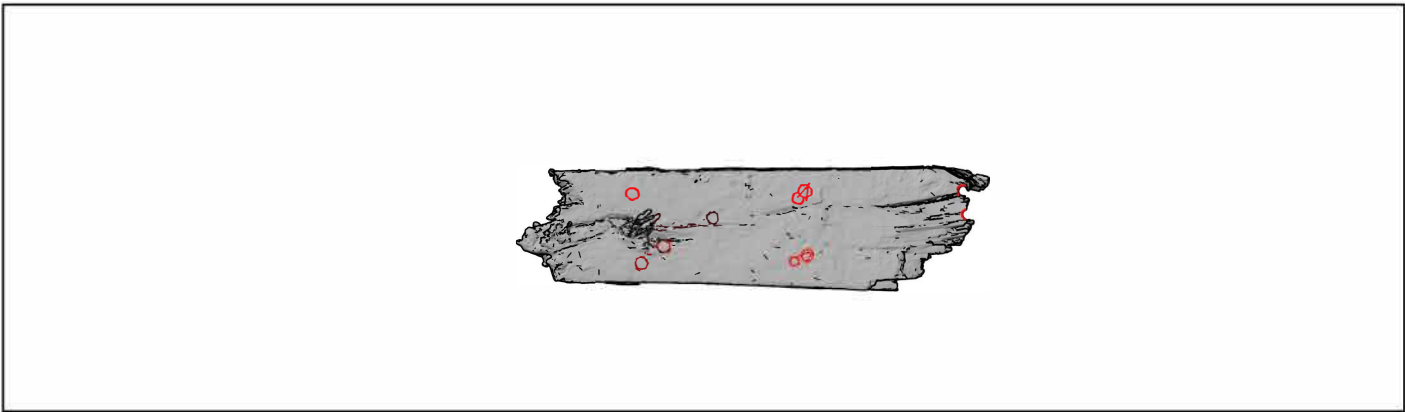
Inboard view



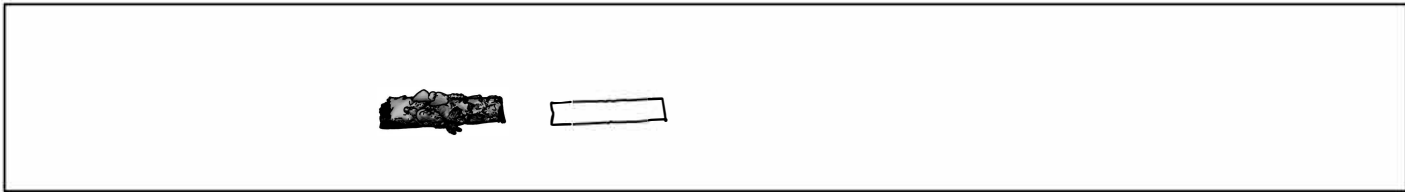
Side view



Outboard view



Aft view



0 0.5m 1m

- Legend:
-  Trenails and trenail holes / wedged trenails
 -  Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	125
Timber type:	outer plank	Location:	outer plank, starboard			
Status:	Final			Drawing No.:	230	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



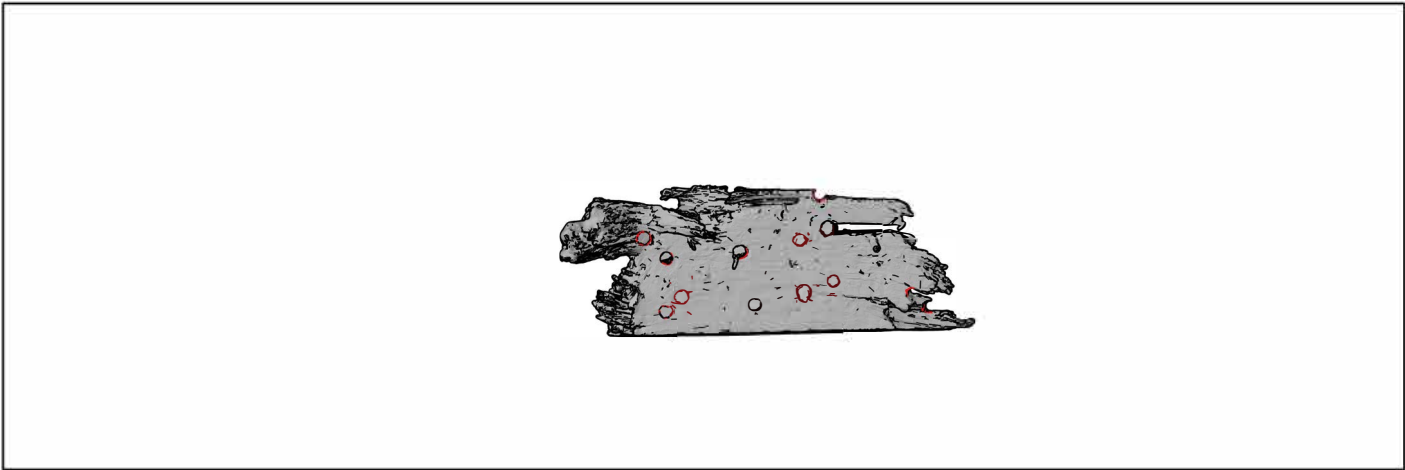
Aft view



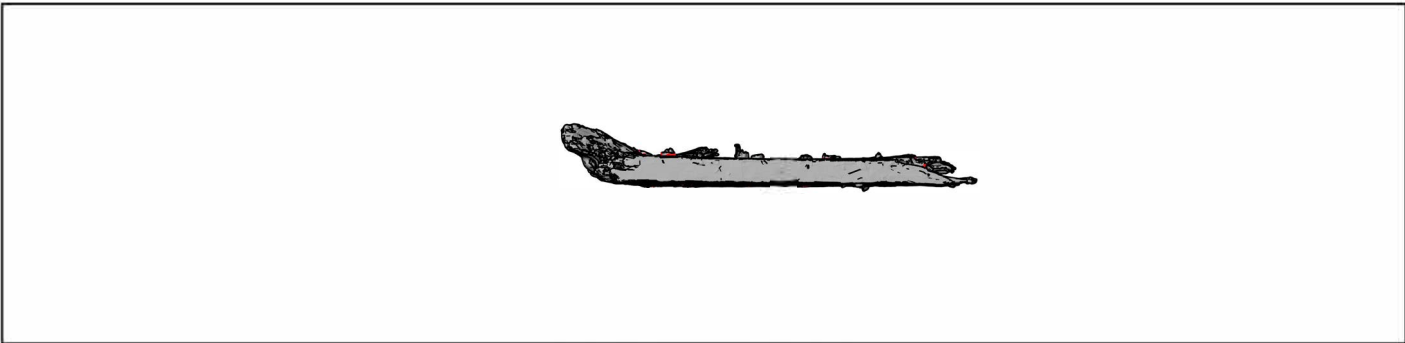
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	125
Timber type:	outer plank	Location:	outer plank, starboard			
Status:	Final			Drawing No.:	231	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

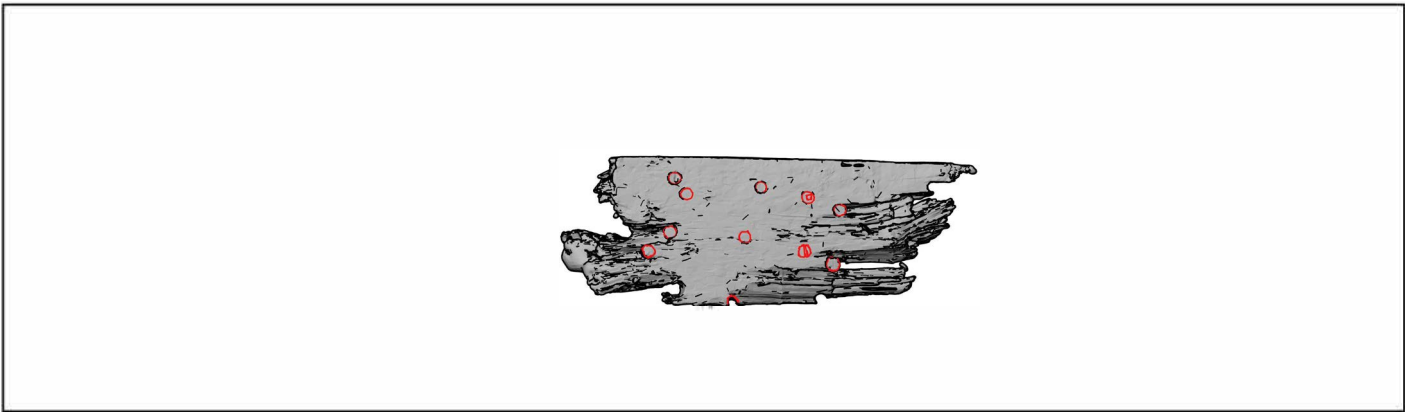
Inboard view



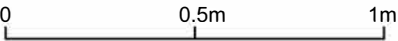
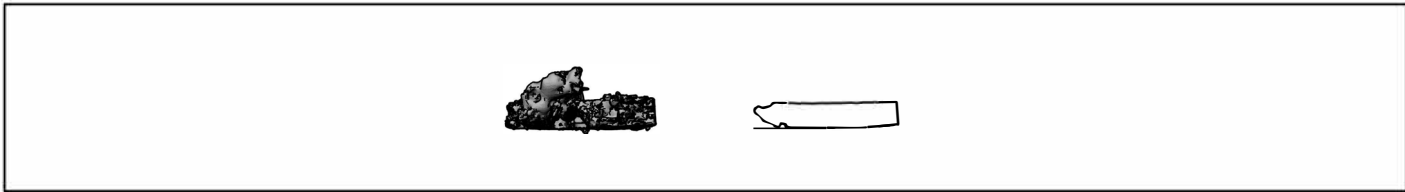
Side view



Outboard view



Aft view



- Legend:
-  Trenails and trenail holes / wedged trenails
 -  Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	126
Timber type:	outer plank	Location:	outer plank, starboard			
Status:	Final			Drawing No.:	302	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

Inboard view



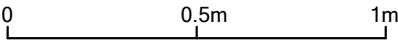
Side view



Outboard view

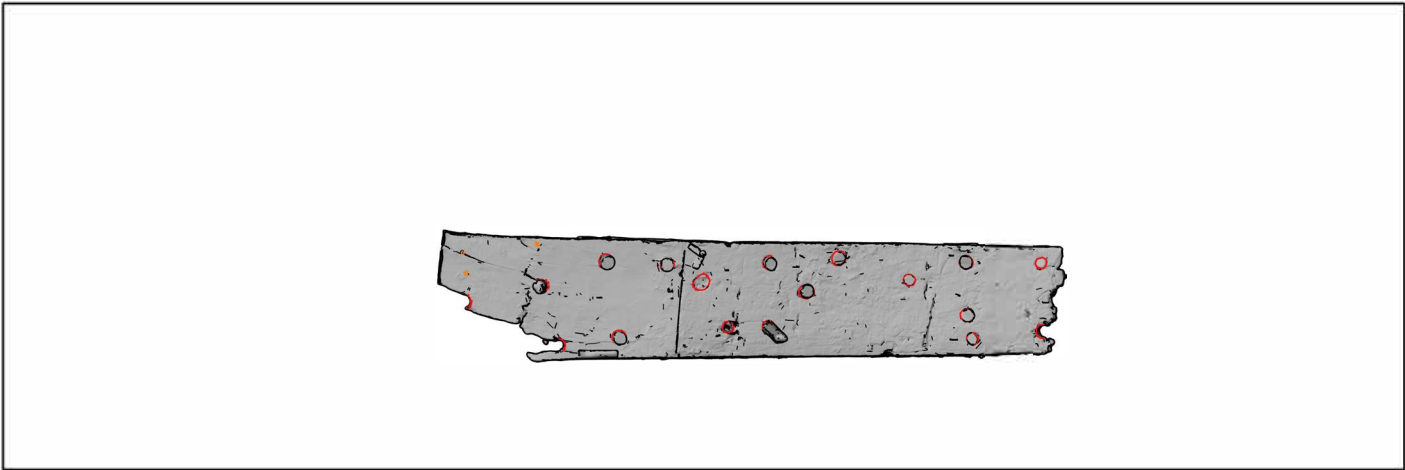


Aft view

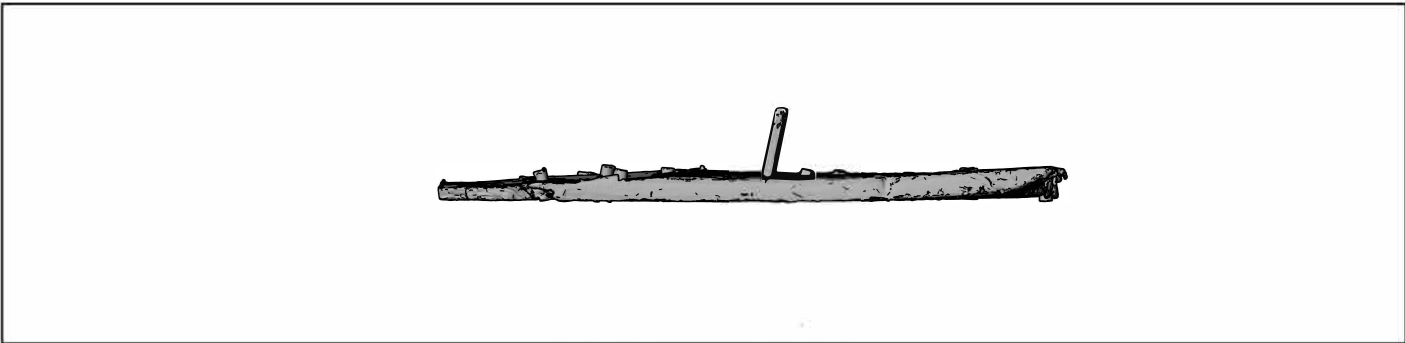


Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5013		Previous number:		Timber ID:	126
Timber type:	outer plank	Location:	outer plank, starboard			
Status:	Final			Drawing No.:	233	
Scale:	1:20	Date:	16/03/2023	Made by:	Paolo Croce	

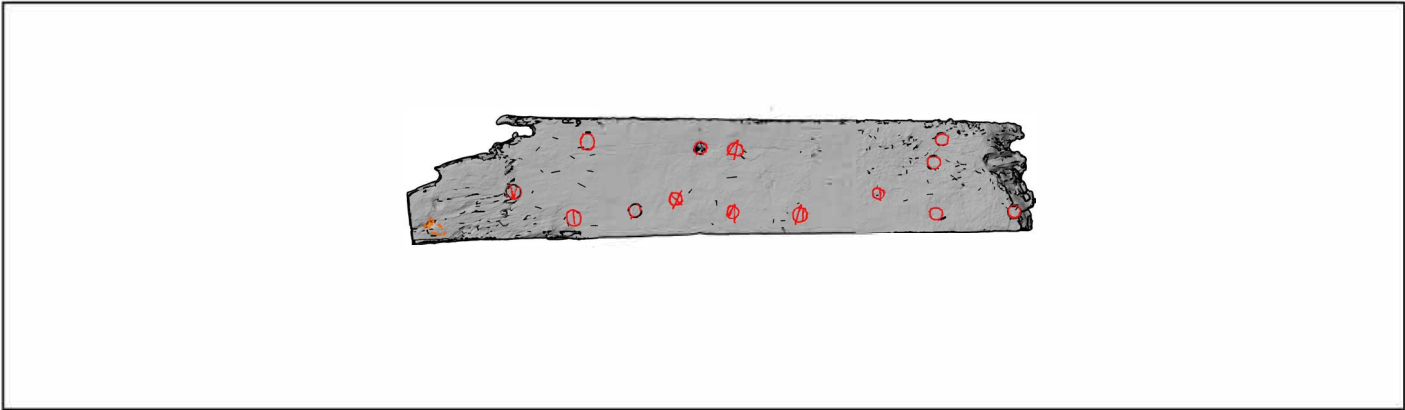
Inboard view



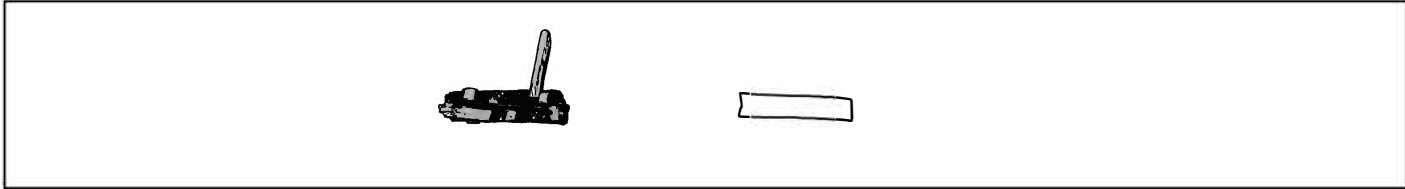
Side view



Outboard view



Aft view



0 0.5m 1m

Legend:

- Trenails and trenail holes / wedged trenails
- Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	128
Timber type:	outer plank	Location:	surviving strake 4, 1 of 2 surviving planks, starboard side			
Status:	Final			Drawing No.:	304	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



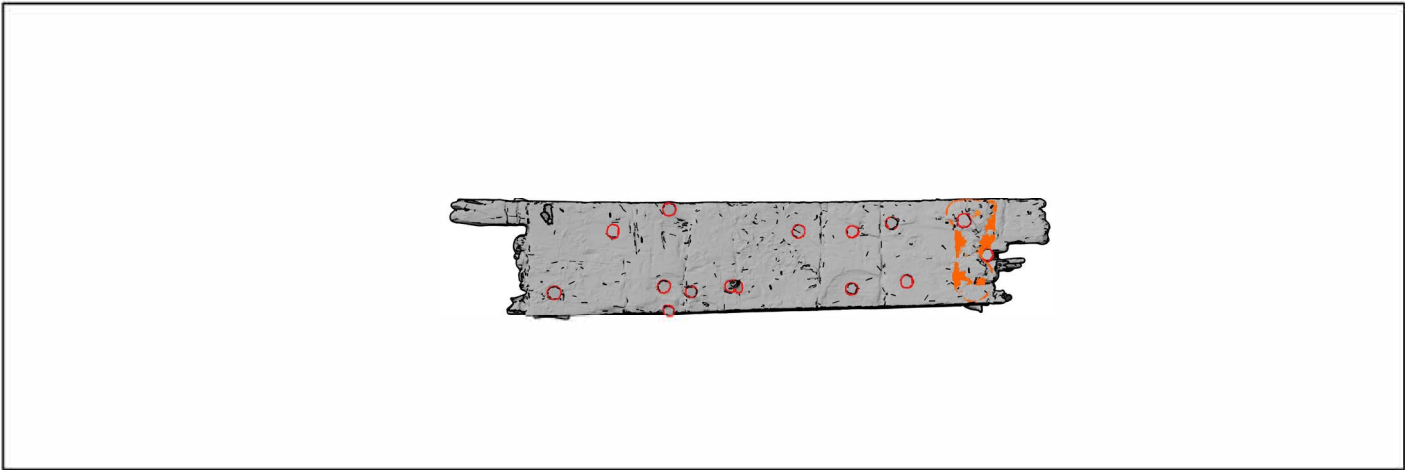
Aft view



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	128
Timber type:	outer plank	Location:	surviving strake 4, 1 of 2 surviving planks, starboard side			
Status:	Final			Drawing No.:	235	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

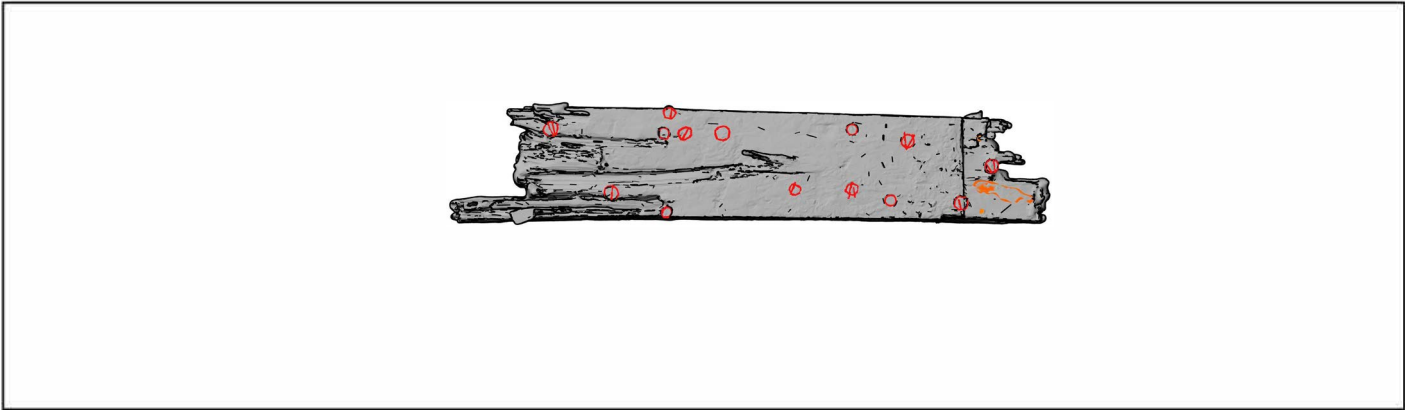
Inboard view



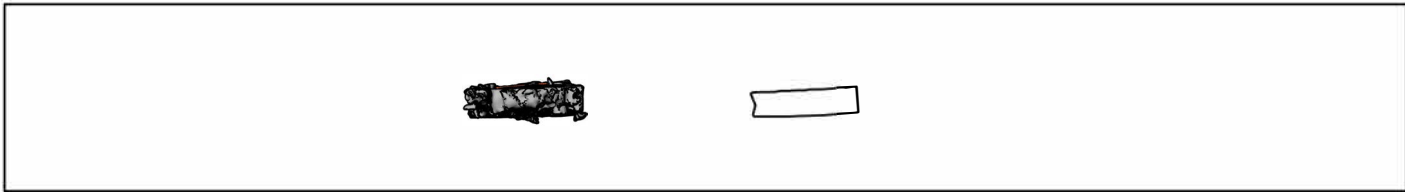
Side view



Outboard view



Aft view



0 0.5m 1m

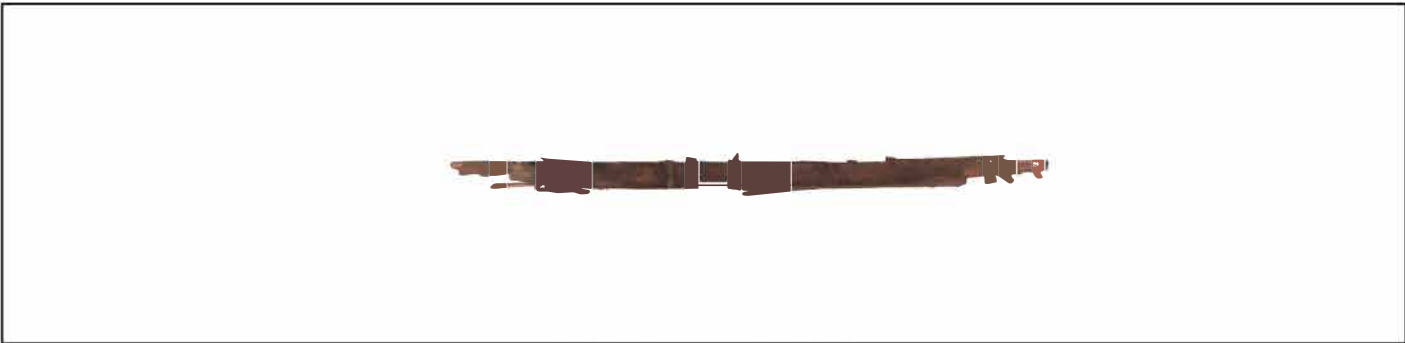
- Legend:
-  Trenails and trenail holes / wedged trenails
 -  Concretion
 -  Iron nail holes / heads

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	129
Timber type:	outer plank	Location:	surviving strake 3, 1 of 1 surviving planks, starboard side			
Status:	Final			Drawing No.:	236	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



Aft view



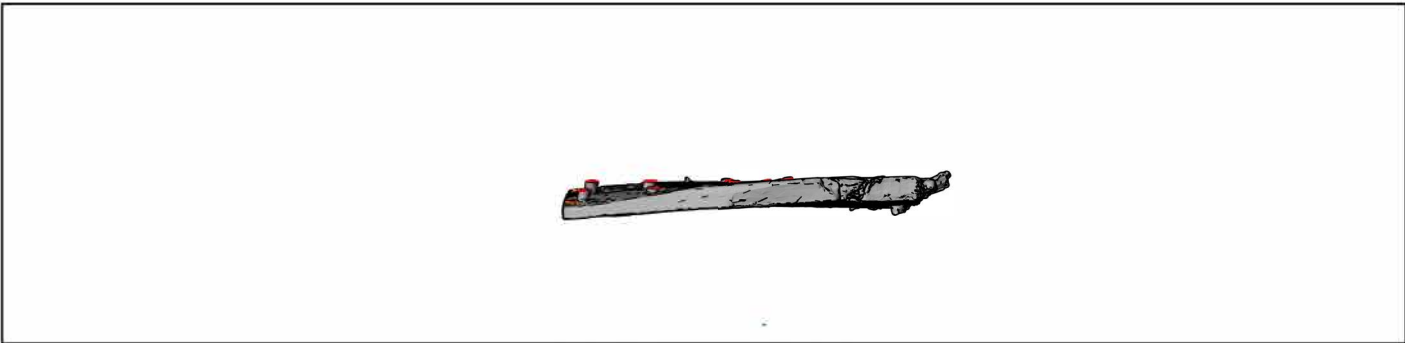
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	129
Timber type:	outer plank	Location:	surviving strake 3, 1 of 1 surviving planks, starboard side			
Status:	Final			Drawing No.:	307	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

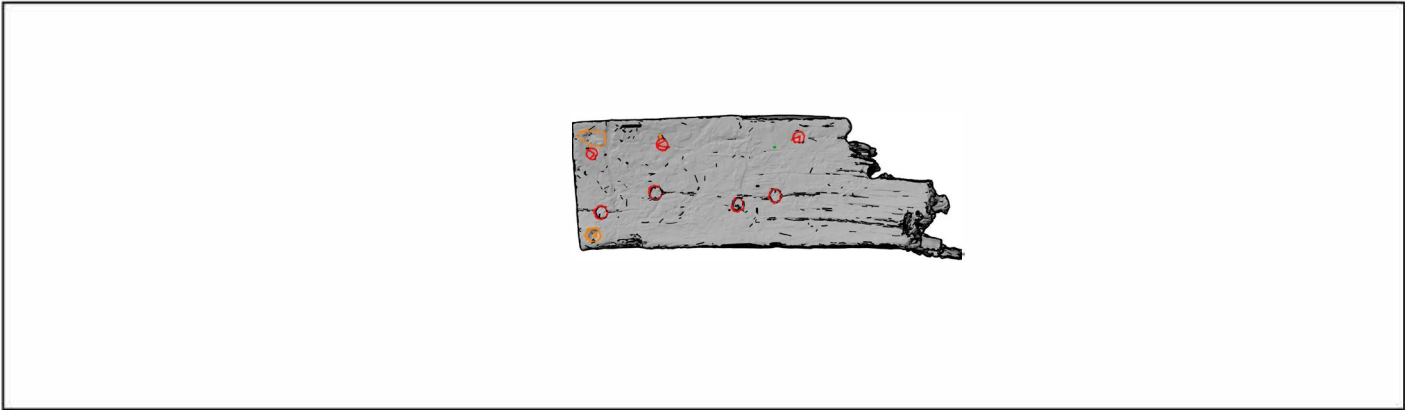
Inboard view



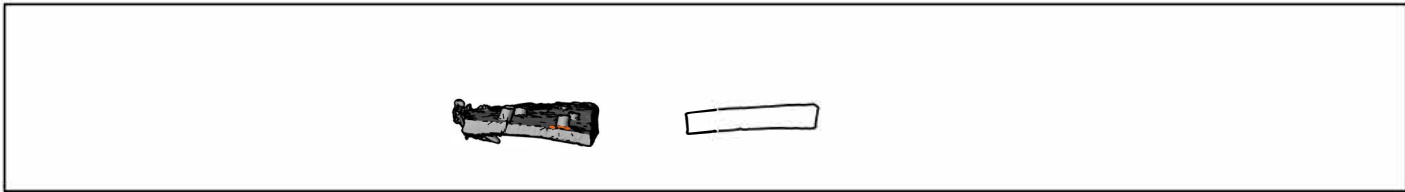
Side view



Outboard view



Aft view

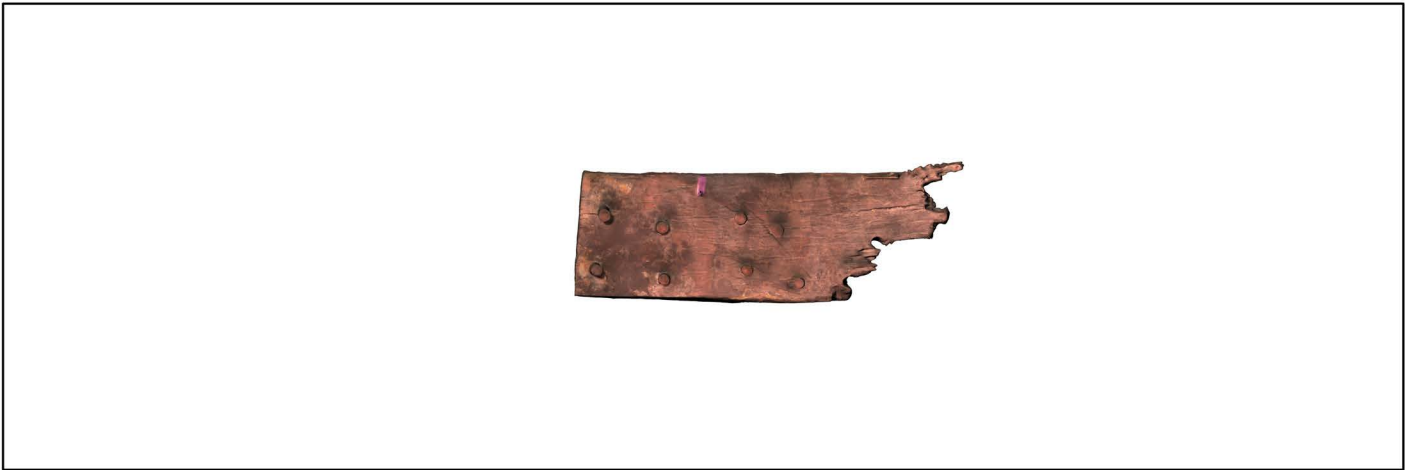


0 0.5m 1m

- Legend:
- Trenails and trenail holes / wedged trenails
 - Iron nail holes / heads
 - Toolmarks
 - Concretion
 - Concretion

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	130
Timber type:	outer plank	Location:	surviving strake 1, 2 of 2 surviving planks (fore) starboard side			
Status:	Final			Drawing No.:	238	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	

Inboard view



Side view



Outboard view



Aft view



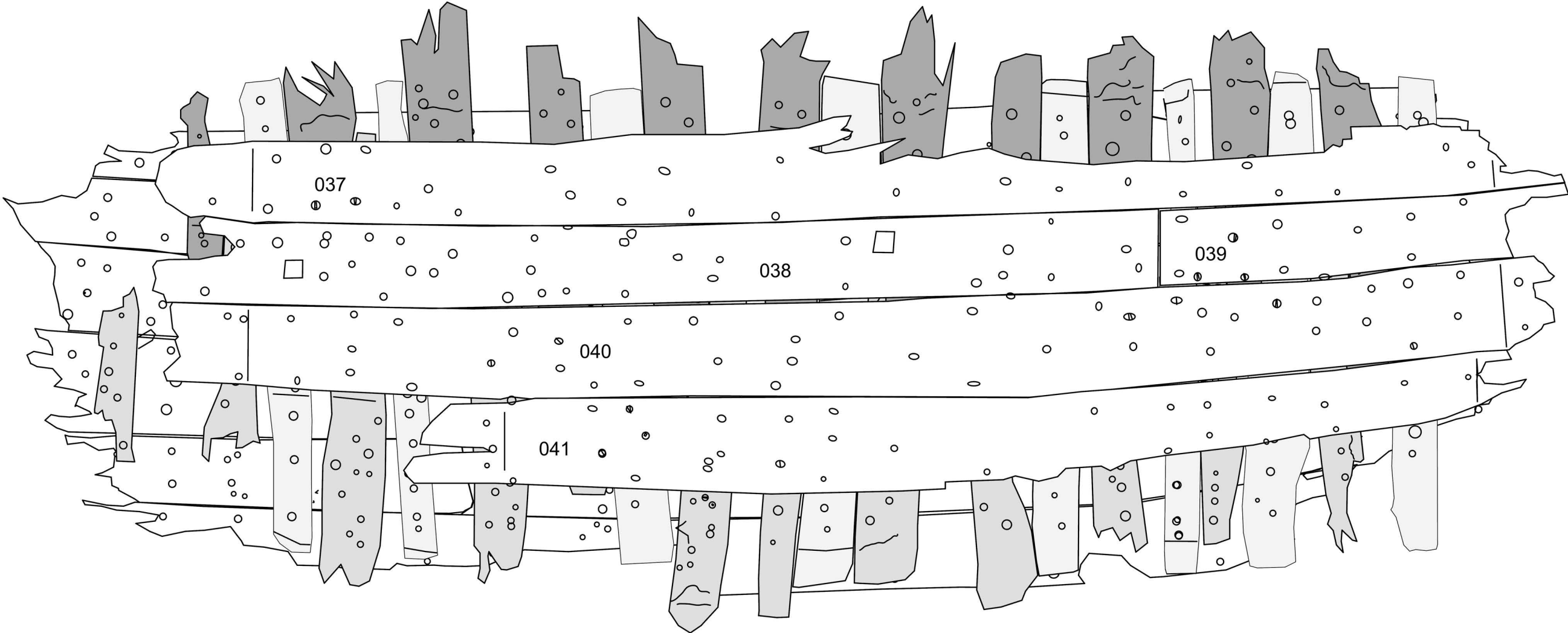
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780
Section:	5006		Previous number:		Timber ID:	130
Timber type:	outer plank	Location:	surviving strake 1, 2 of 2 surviving planks (fore), starboard side			
Status:	Final			Drawing No.:	239	
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce	



Appendix 12

Inboard view

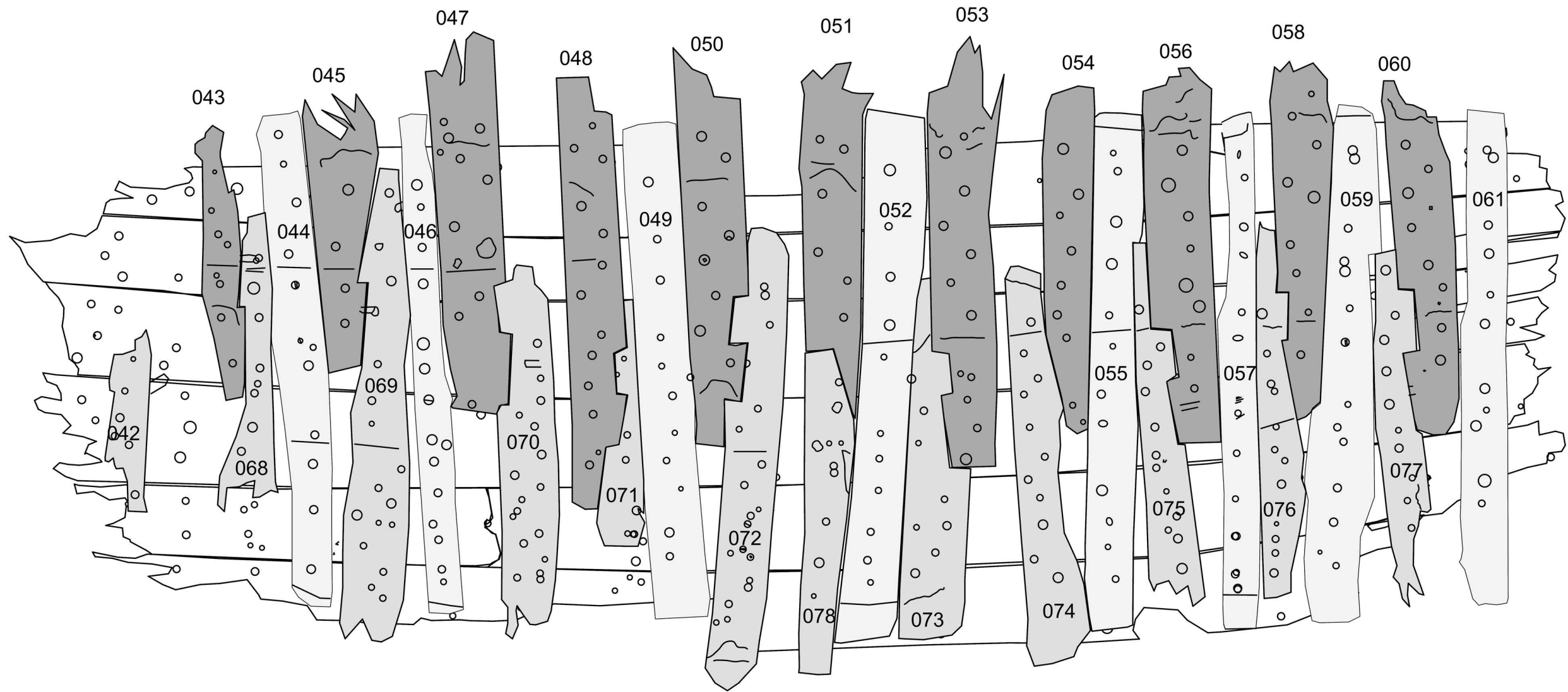


Legend:

- Ceiling planks
- Floor timbers
- Futtocks
- Filling frames
- Fasteners
- Outer planks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004						
Section 5004 - excavation plan at the level of the ceiling planks							
Status:	Final			Drawing No.:			
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

Inboard view



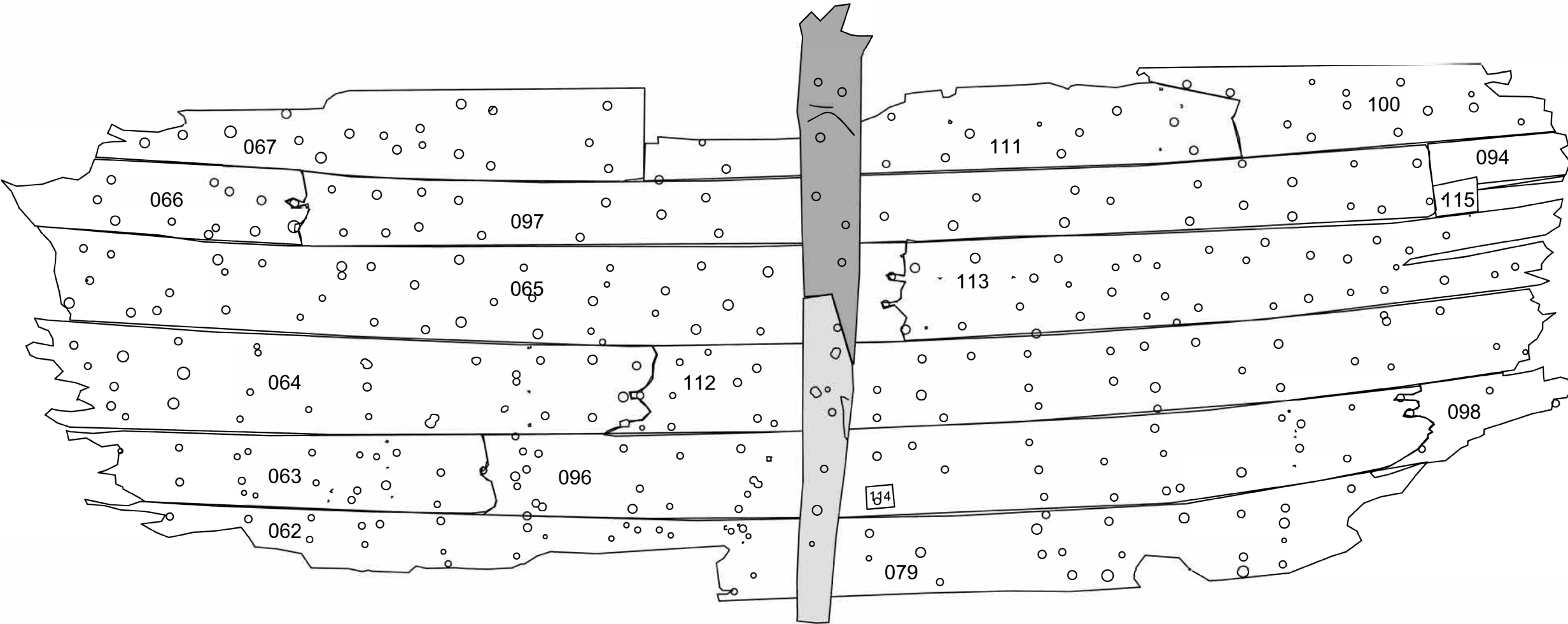
0 0.5m 1m

Legend:

- ☐ Ceiling planks
- ☒ Floor timbers
- ☐ Futtocks
- ☐ Filling frames
- Fasteners
- ☒ Outer planks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004						
Section 5004 - excavation plan at the level of the frames							
Status:	Final			Drawing No.:			
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

Inboard view



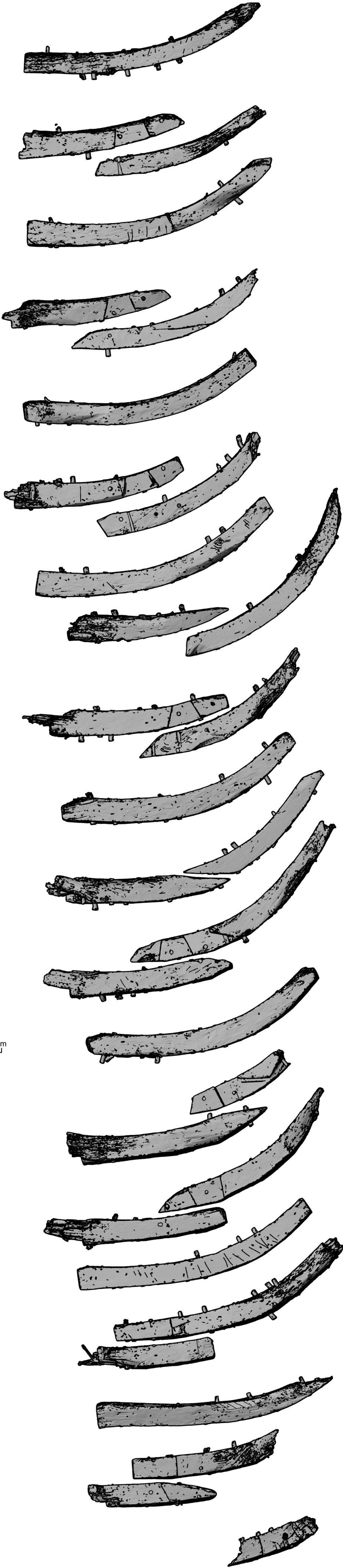
0 0.5m 1m

Legend:

- ☐ Ceiling planks
- ☒ Floor timbers
- ☒ Futtocks
- ☐ Filling frames
- ☒ Fasteners
- ☒ Outer planks

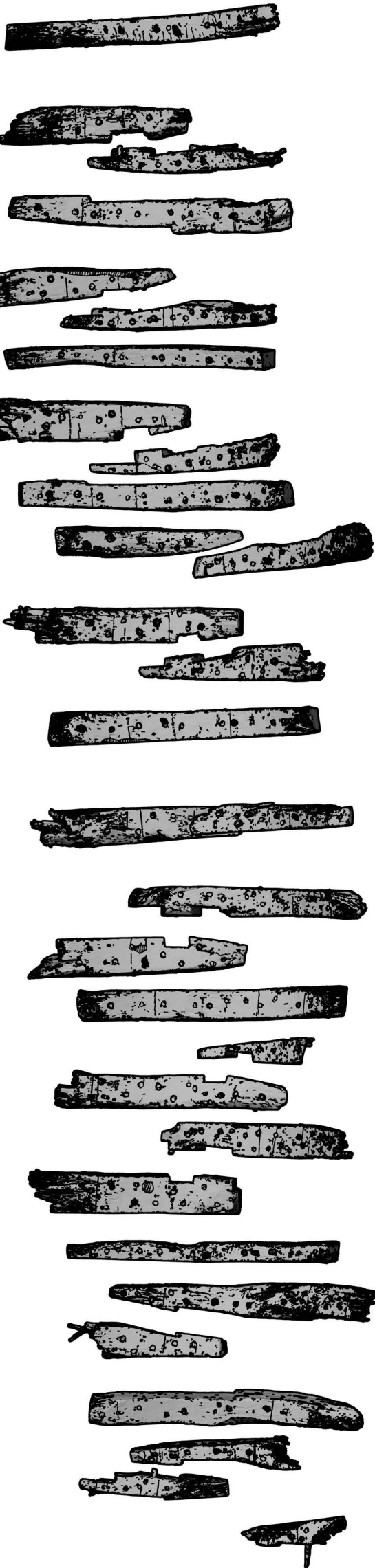
Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5004						
Section 5004 - excavation plan at the level of the outer planks							
Status:	Final			Drawing No.:	240		
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce		

Bow >



0 0.5m 1m

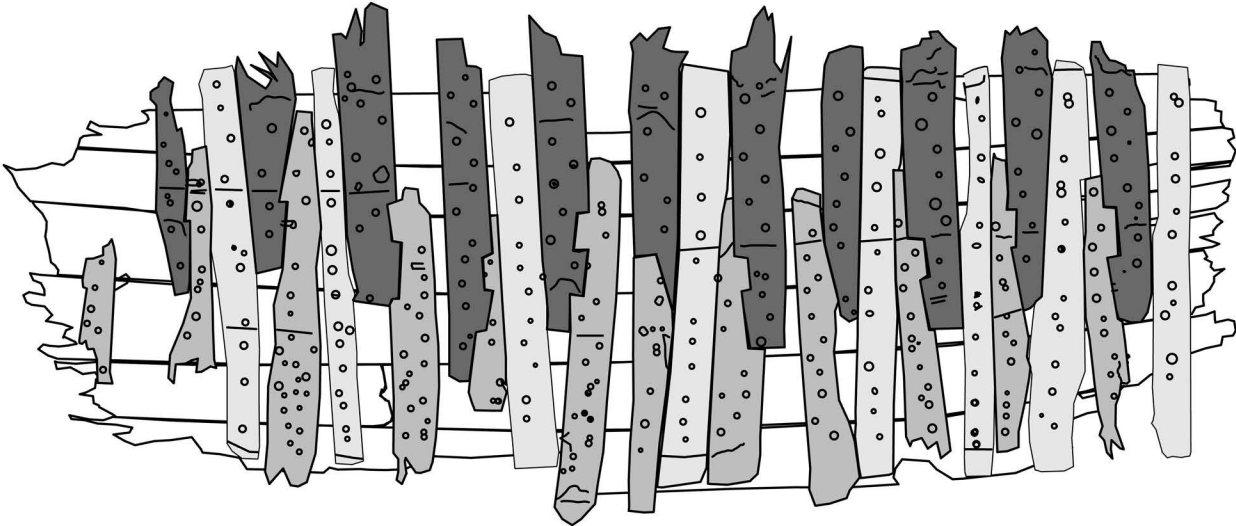
< Stern



0 0.5m 1m

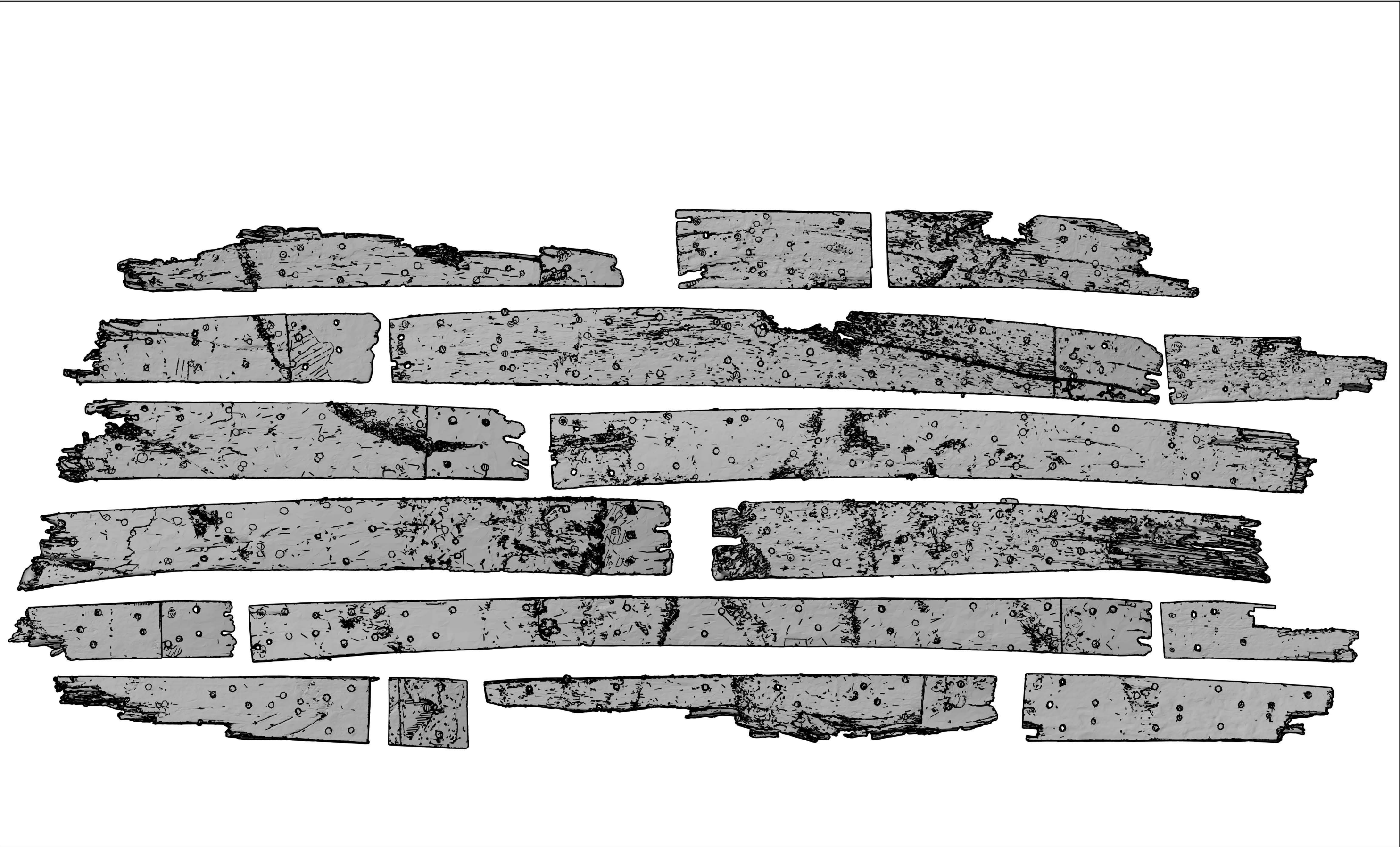
< Stern

Bow >

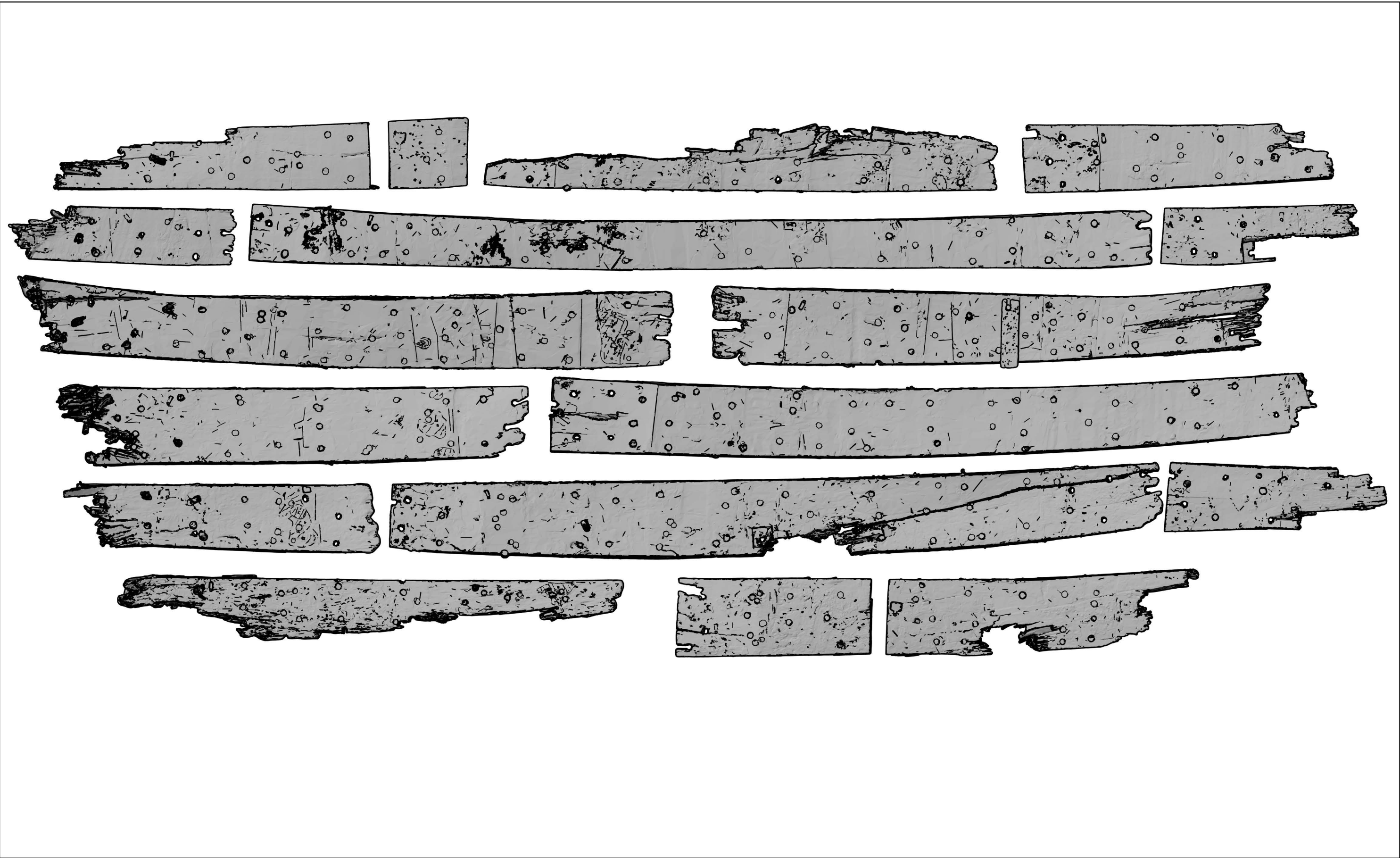


Project:	CEMEX Denge Quarry Shipwreck			Project No.:	280780
Section:	5004	Frames, view from aft			
Status:	Final			Drawing No.:	241
	Date:	06/03/2023	Made by:	Paolo Croce	

Outboard view



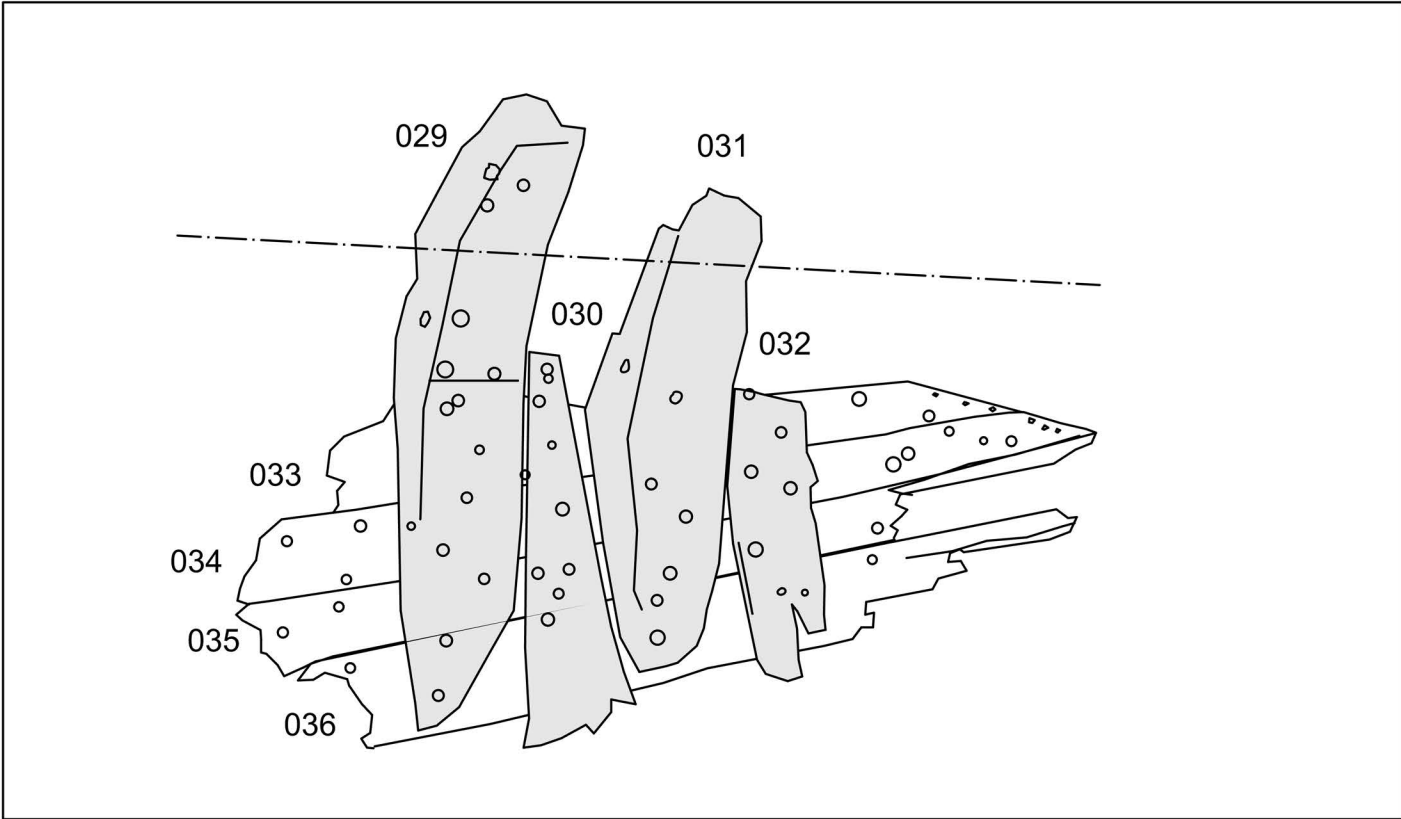
Inboard view



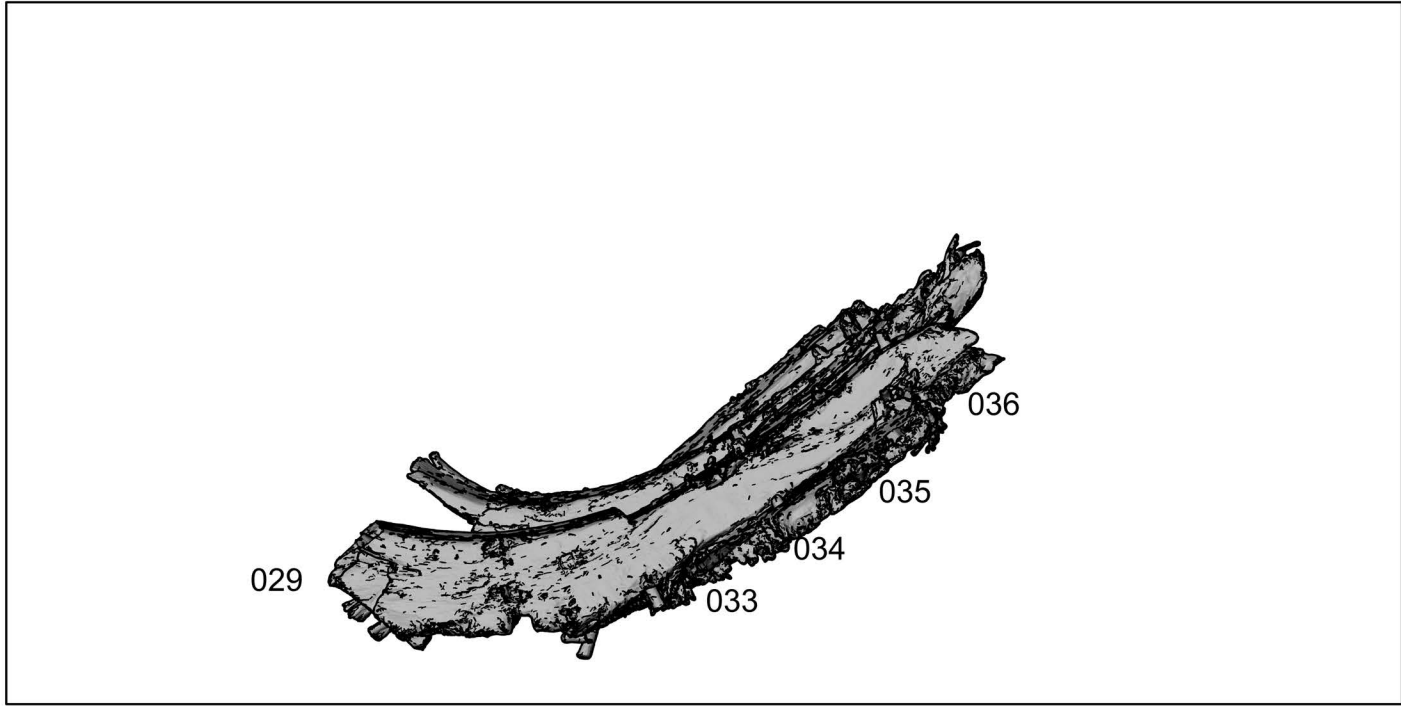
0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck						Project No.:	280780	
Section:	5004								
Section 5004 - outer planks layout									
Status:	Final				Drawing No.:	242			
Scale:	1:20		Date:	06/03/2023		Made by:	Paolo Croce		

Inboard view



fore/aft view



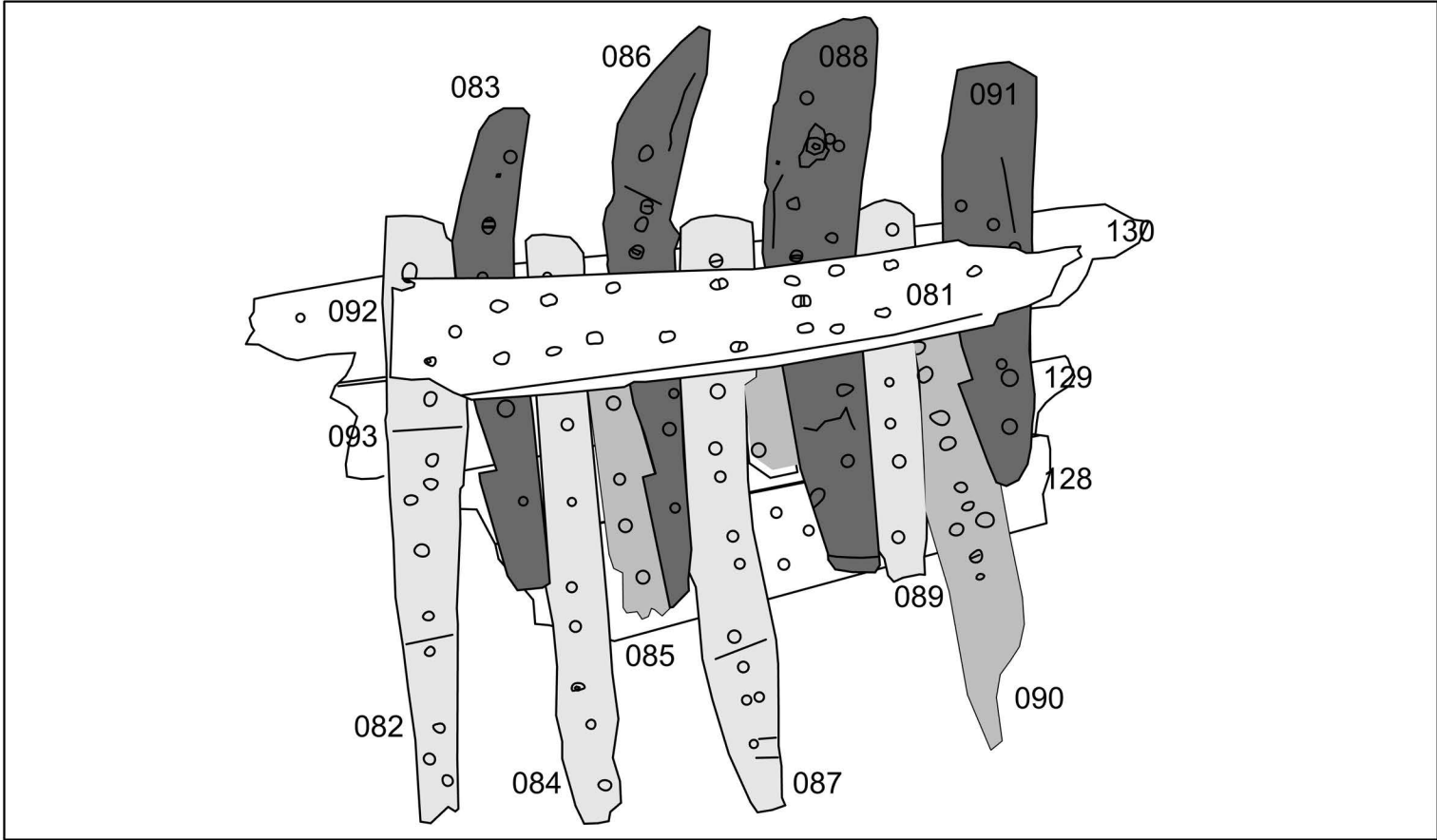
0 0.5m 1m



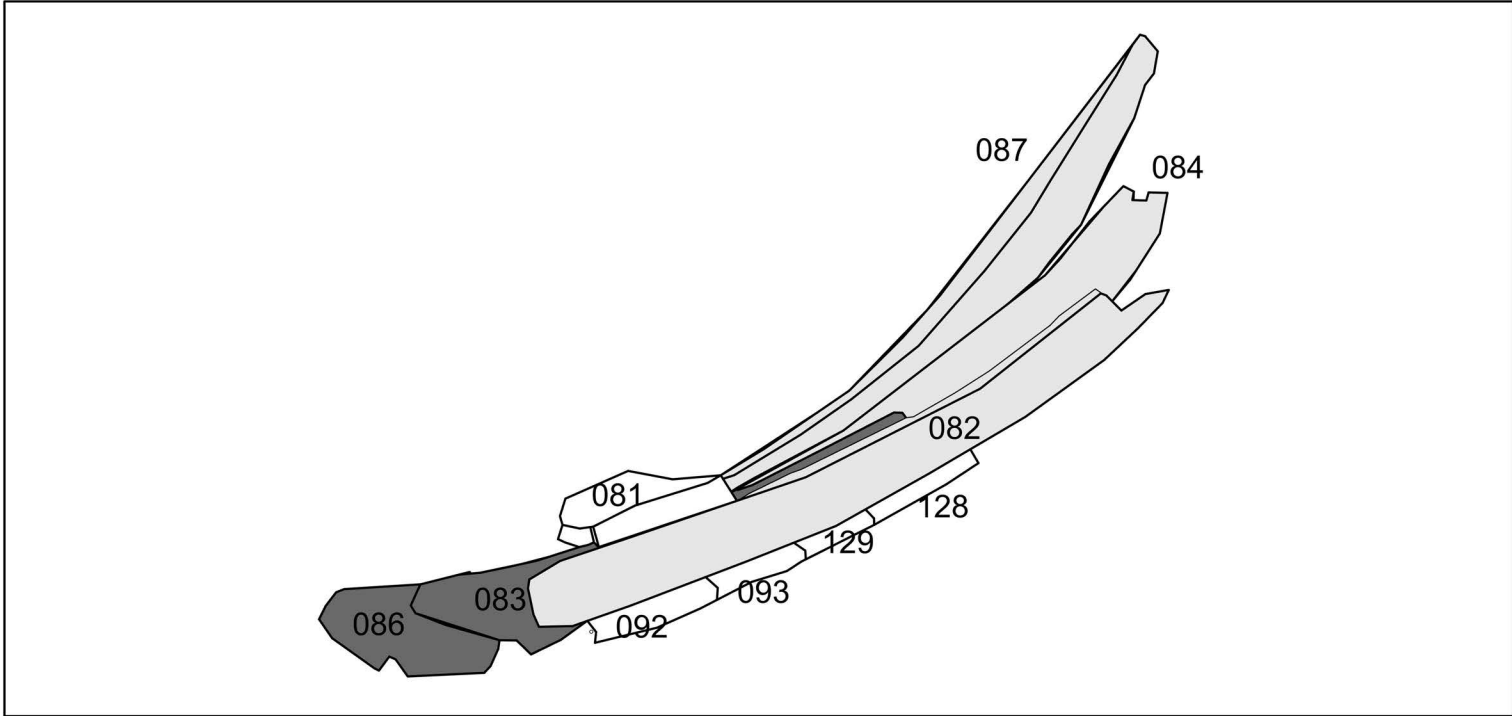
Plan view and section view of 5005

Project:	CEMEX Denge Quarry Shipwreck			Project No.:	280780
Section:	5005	Views of outer planking strakes from inboard and moulded frames from abaft			
Status:	Final			Drawing No.:	243
Scale:	1:20	Date:	06/03/2023	Made by:	Paolo Croce

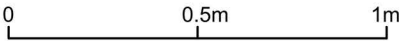
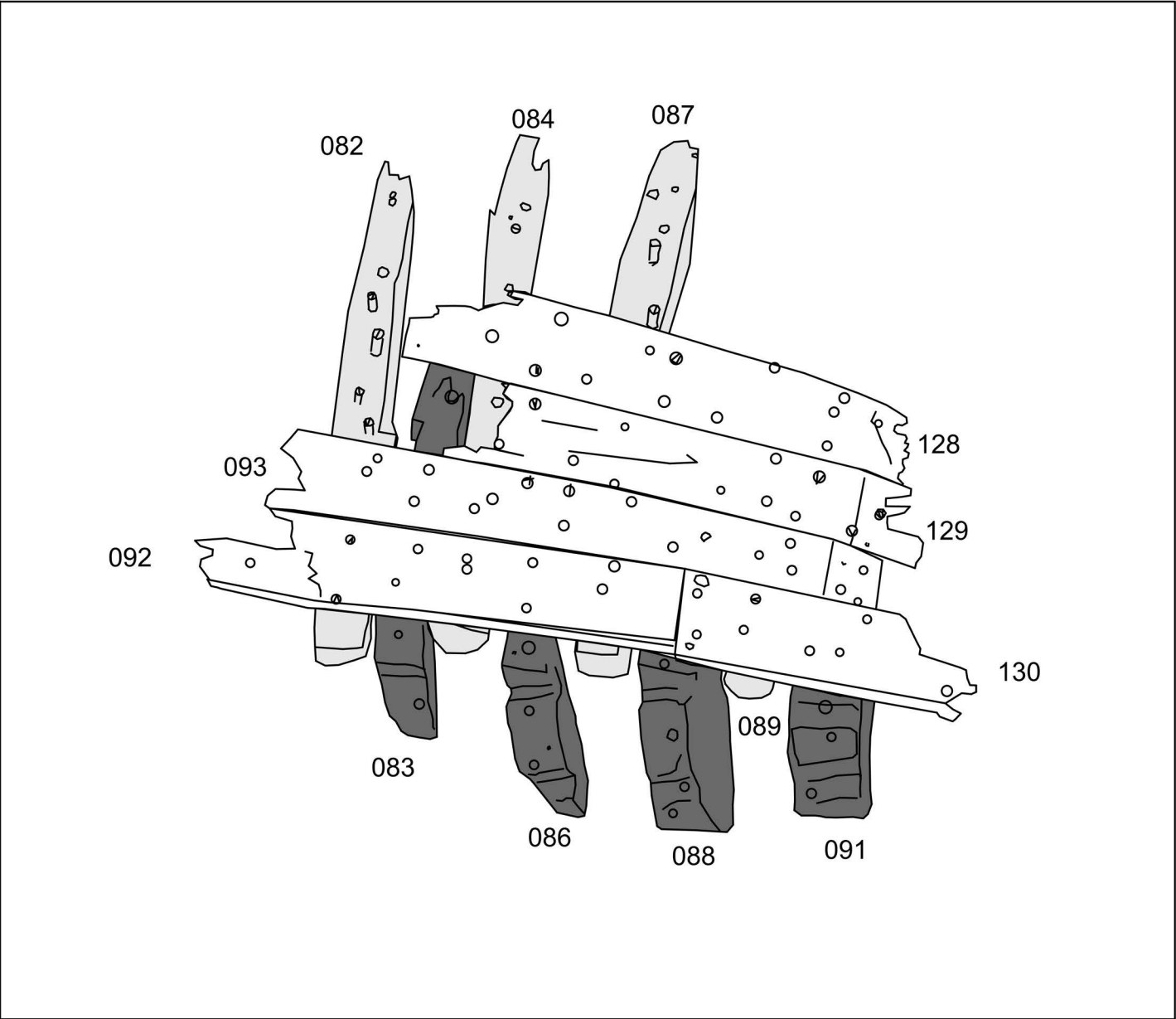
Inboard view



Aft view



Outboard view



Legend:

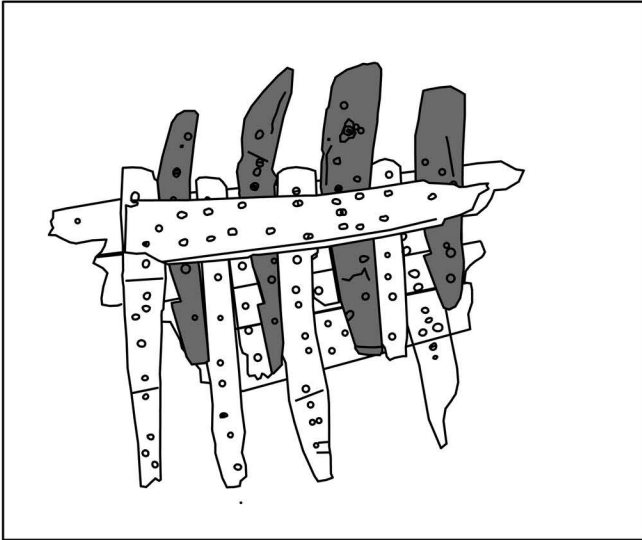
- Ceiling planks
- Floor timbers
- Futtocks
- Filling frames
- Fasteners
- Outer planks

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5006						
Section 5006 - inboard, outboard and moulded view							
Status:	Final				Drawing No.:	244	
Scale:	1:20		Date:	06/03/2023	Made by:	Paolo Croce	

< Stern

Bow >

Aft view

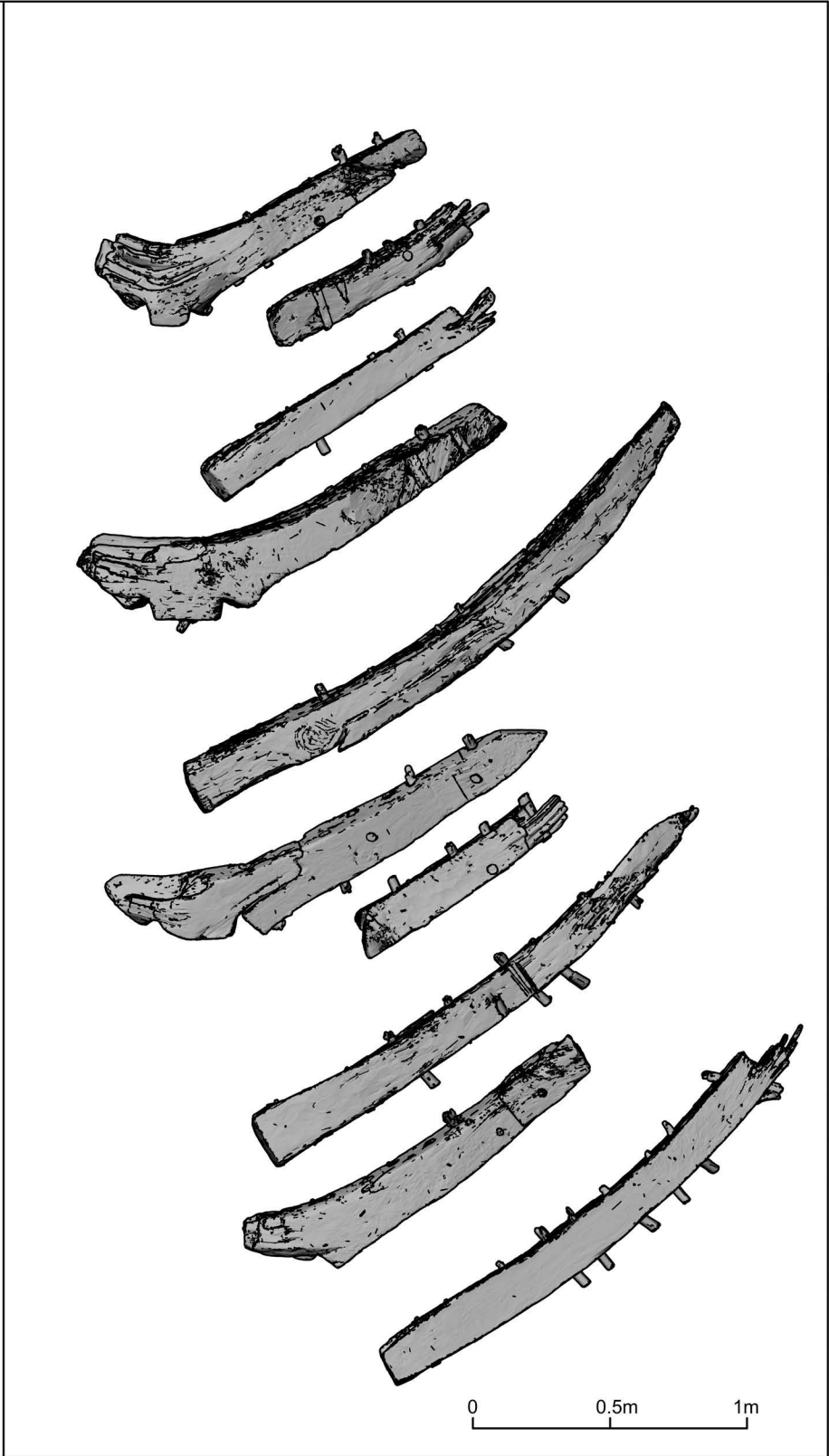
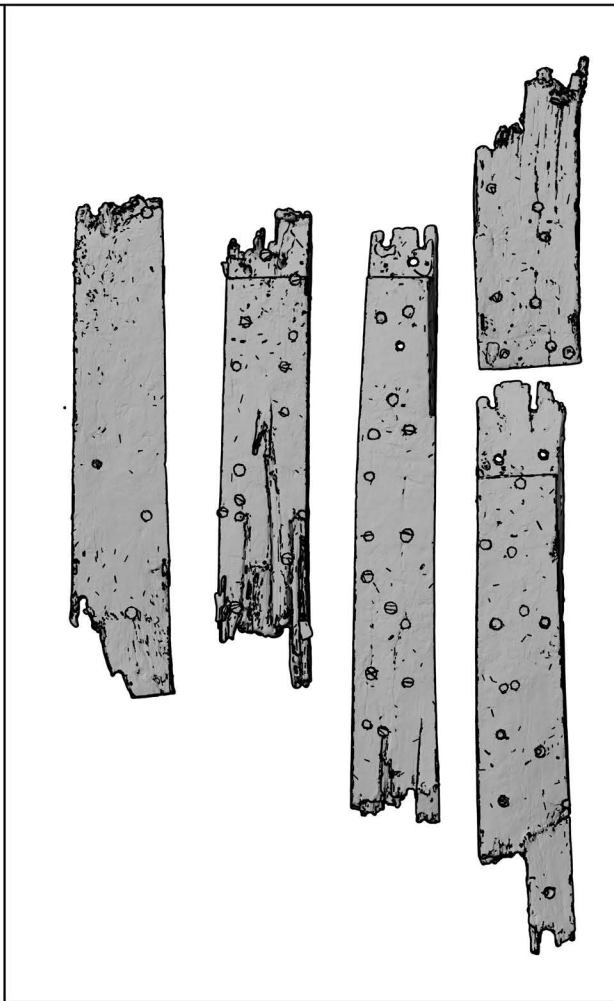
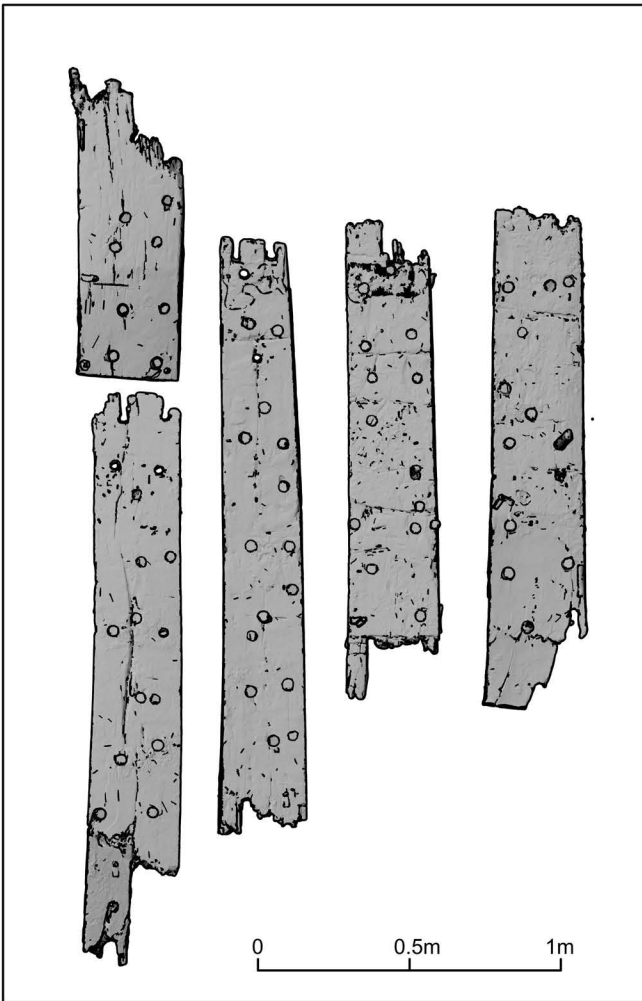


Inboard view

Outboard view

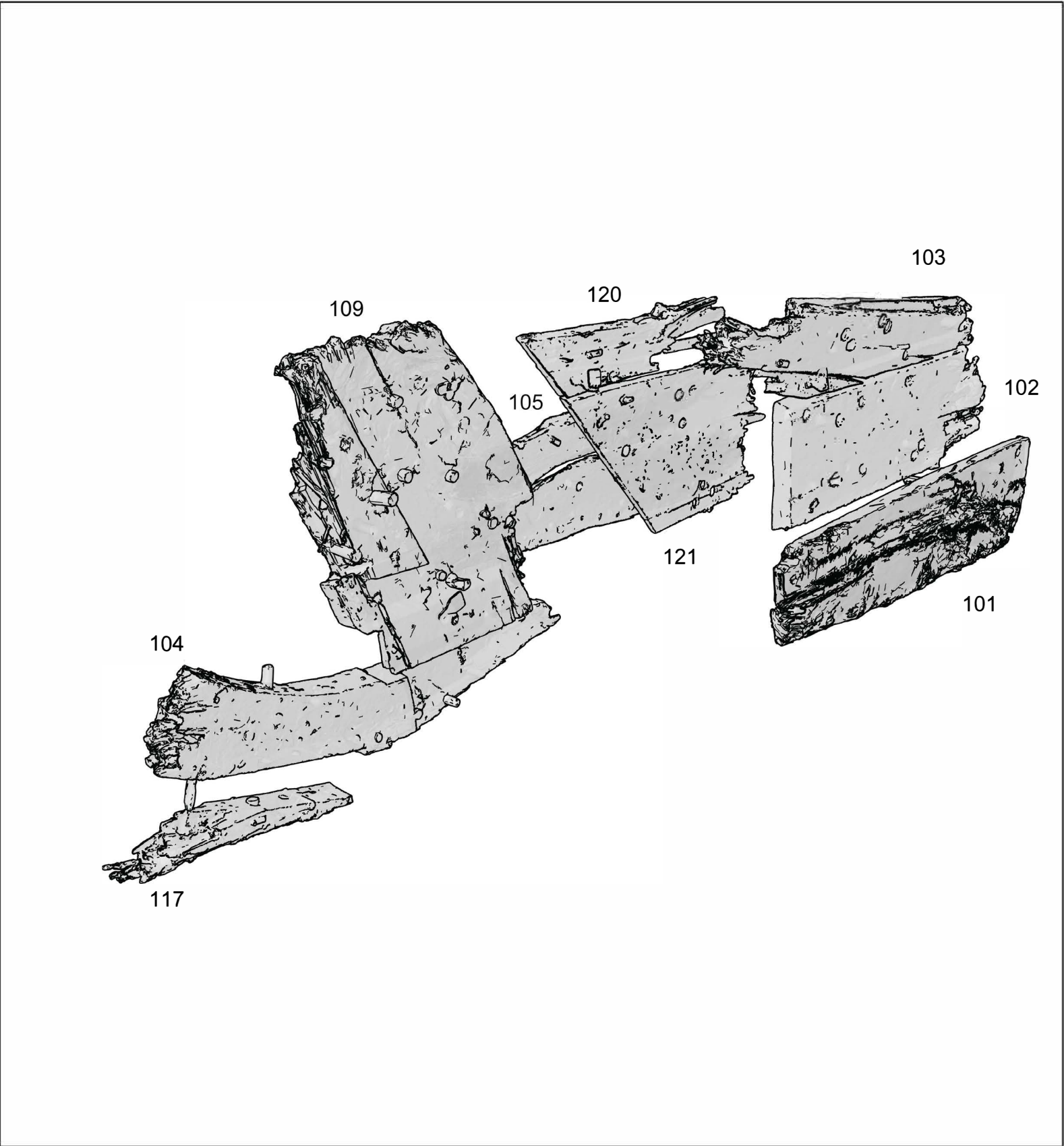
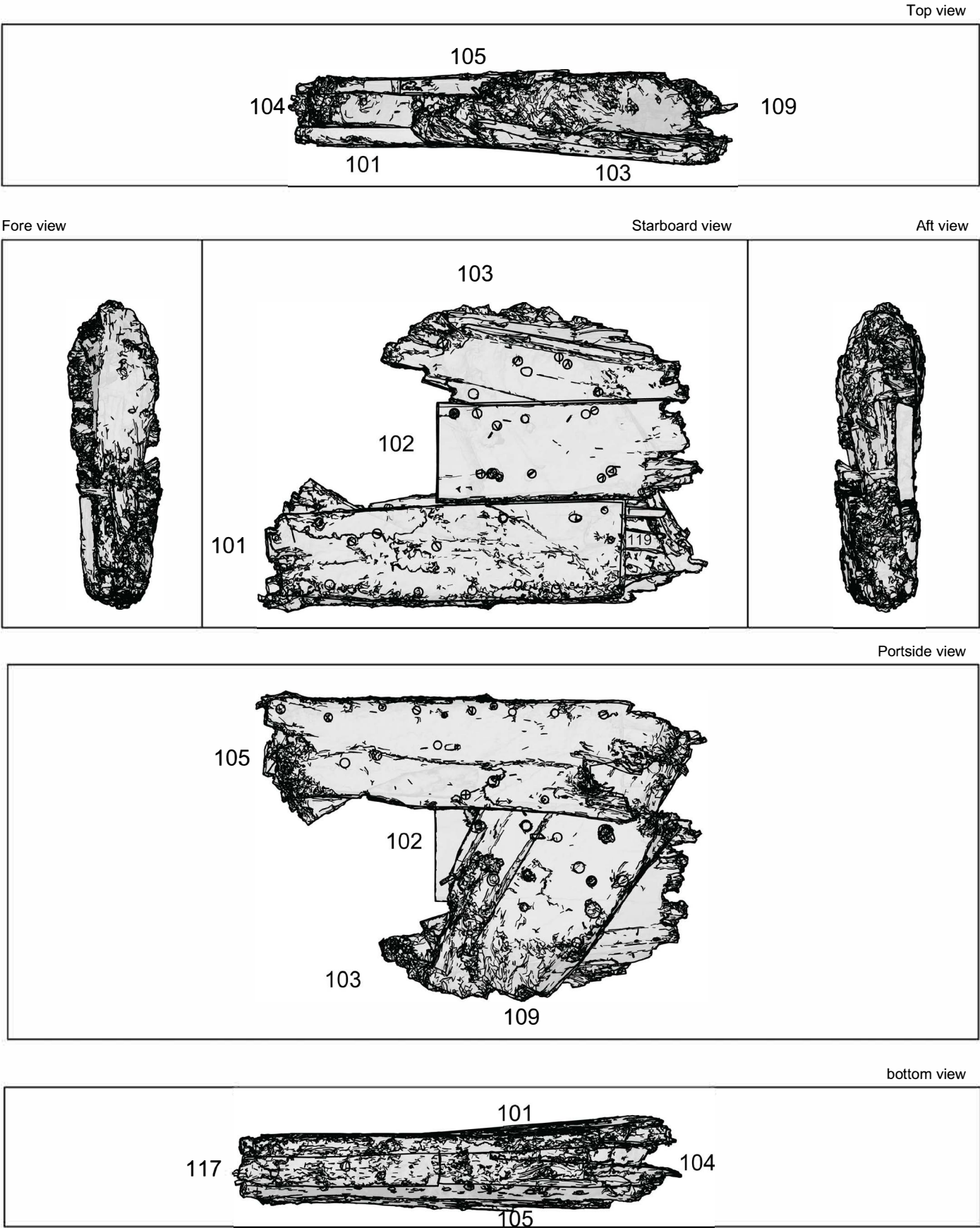
Bow >

< Stern



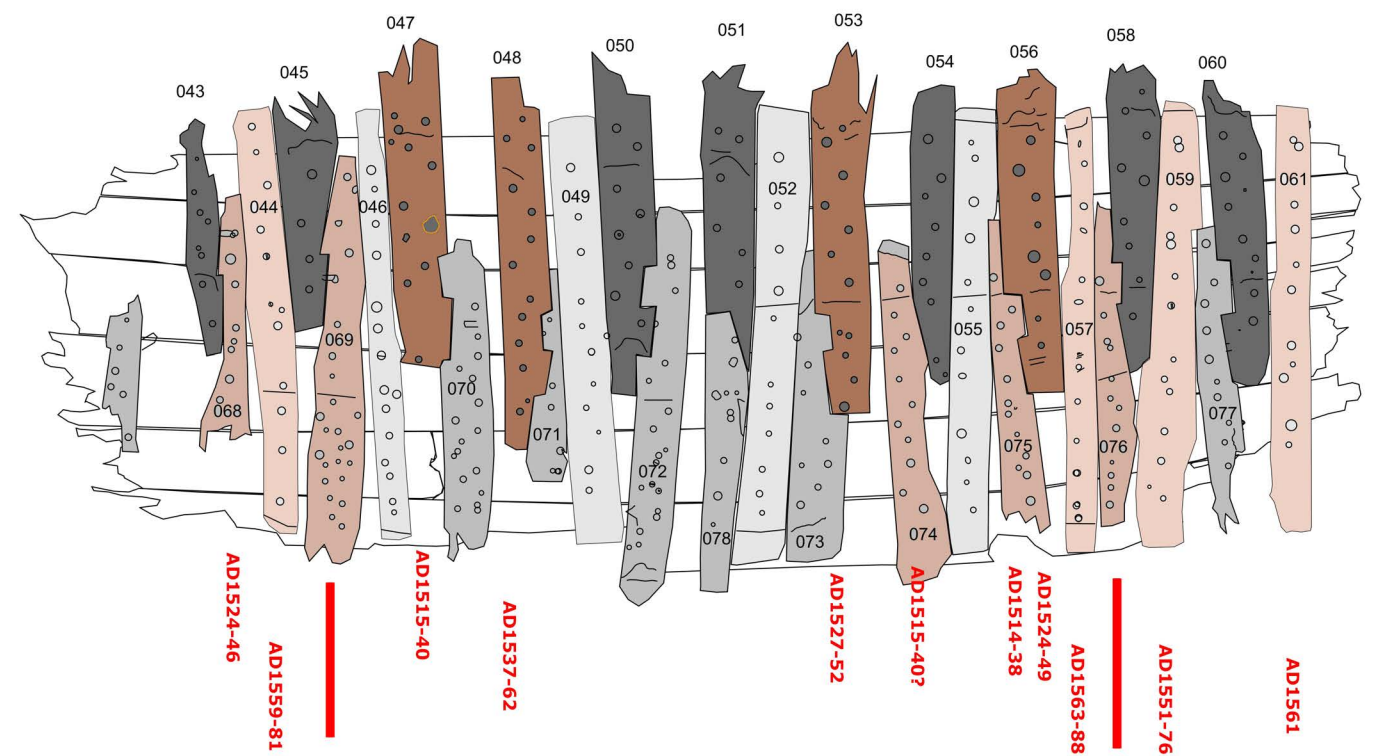
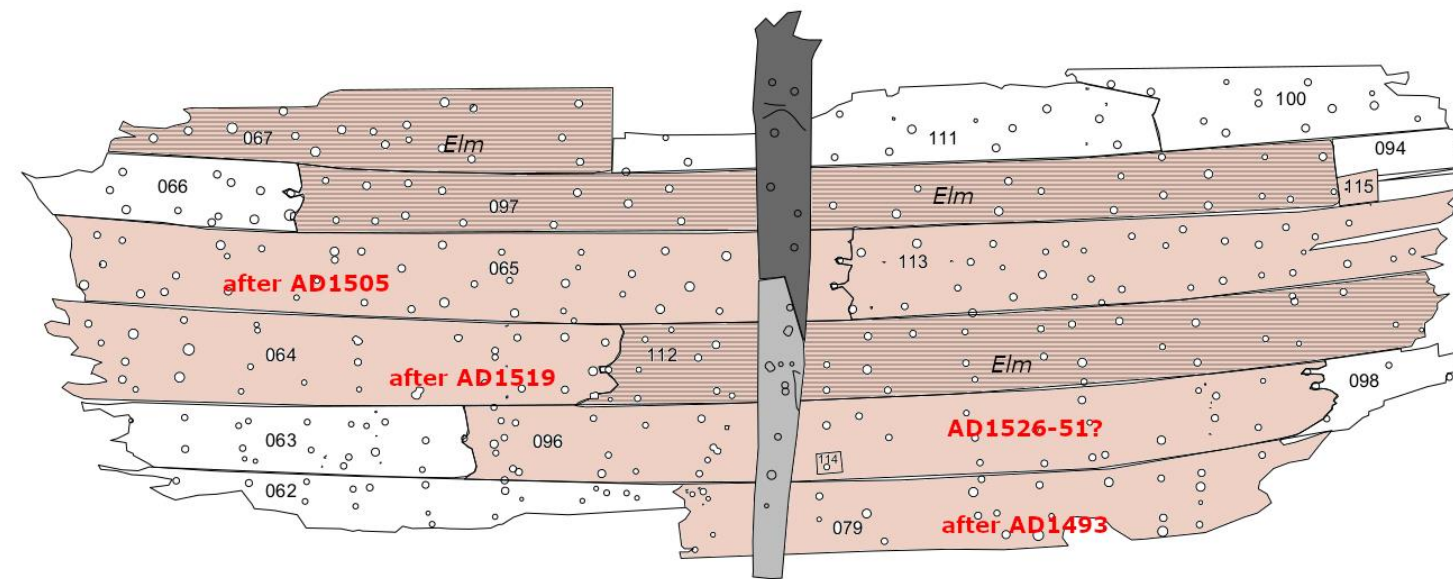
View of outer planking strakes from inboard and outboard

Project:	CEMEX Denge Quarry Shipwreck					Project No.:	280780
Section:	5006						
Frames, top view and moulded view from abaft							
Status:	Final				Drawing No.:	245	
Scale:	1:25	Date:	06/03/2023	Made by:	Paolo Croce		



0 0.5m 1m

Project:	CEMEX Denge Quarry Shipwreck				Project No.:	280780	
Section:	5007						
orthogonal and exploded view of section 5007 - sternpost							
Status:	Final			Drawing No.:	246		
Scale:	1:20	Date:	15/03/2023	Made by:	Paolo Croce		





Appendix 13

GC-MS analysis of caulking materials and coating on timbers from the Denge Quarry Shipwreck

Wren Montgomery, Imaging and Analysis Centre, Science Innovation Platforms, Natural History Museum, London, SW7 5BD

Nicholas Michael, Gunter Kuhnle, and Graham Luke, Chemical Analysis Facility, School of Chemistry, Food & Pharmacy, University of Reading, Whiteknights Campus, Reading RG6 6DZ

1 Introduction

Samples of the organic binder from the Denge Quarry shipwreck (probable 16th C. vessel) were submitted for analysis by gas chromatography-mass spectrometry (GC-MS) by Wessex Archaeology.

This analysis complements and extends previous analysis by FTIR spectroscopy.

2 Materials and Methods

Samples were prepared and analyzed in the Chemical Analysis Facility of the University of Reading. Following previous work (1, 2), an aliquot of 100 mg of sample was added to ~1mL of dichloromethane, sonicated for ~5 minutes and filtered. The extract was dried to completion, then 50µL of the derivatization agent, bis(trimethylsilyl)trifluoro acetamide (BSTFA) + 1% trimethylchlorosilane (TMCS), was added, and the sample was heated at 70°C for 1 hour. The sample (1 µl) was injected in splitless mode with an inlet temperature of 250°C. Separation was performed on an Agilent G3540A oven using a Restek30 m RTX-5MS w/Integra-Guard column. The oven temperature program comprised a start temperature of 35 °C held for 1 minute, followed by a ramp of 10 °C min⁻¹ to 300 °C where the temperature was held for 8 min. Helium column flow was 1.2 ml min⁻¹. Post-separation compound identification took place using an Agilent 5977 inert Mass Selective Detector, which collected data over a scan range of m/z = 40 to 600. Assignments were made by considering the elution order against published work (2-7) and comparing mass spectra against a standard library (NIST17 and NIST20).

3 Results and discussion

Samples 2a, 2b, 3a, 3b, 4a, 4b, and 11a did not differ from the procedural blank. This is consistent with the observation that some extracts remained clear while others had the brown color characteristic of organic compound-rich extracts.

Samples 1a, 1b, 12a, and 12b showed very weak peaks comparable in intensity to the background signal.

As shown in Figure 1, the remaining samples (5a, 5b, 6a, 6b, 7a, 7b, 8a, 8b, 9a, 9b, 10a, 10b, and 11b) contained differing relative abundances of molecules associated with archaeological wood, particularly *Pinus* species. A summary of biomarkers and associated characteristics is provided in Table 1. Specifically, the diterpenoic compounds dehydroabietic acid (DHBA) [5], pimaric acid (PA) [4], and abietic acid (AA) [6], as well as the degradation products retene [3], 4b,8-dimethyl-2-isopropylphenanthrene, 4b,5,6,7,8,8a,9,10-octahydro- [1], and 10,18-bisnorabieta-5,7,9(10),11,13-pentaene [2] were identified (2, 7) (Table 2).

Diterpenoids are commonly accepted as markers for aged conifer resins, in particular those from the *Pinaceae* family (*Pinus*, *Picea*, and *Abies*) (5, 8). The absence of monoterpene and sesquiterpene compounds in this study is likely due to evaporation during the extraction and derivatization process.

Caulking in historic wooden vessels was typically sealed with tar or pitch (2, 3, 6). Both are distilled from conifer resins; tar is produced at lower distillation temperatures, while pitch is the thicker product of higher temperatures. The presence of retene in nearly all of the samples indicates that these samples are distillation products. The presence of unaltered resin acids (pimaric and abietic acid) indicates that these samples were processed at temperatures <350°C, so they are more likely to be conifer tars than pitches (9).

These acids have not been found in caulking samples from the Mary Rose (1509) (6); they have been found in caulking from the Newport Medieval Ship, which dates from 1449 (2). Based on the presence of pimaric and abietic acids, as well as abundant dehydroabietic acid, the caulking from this vessel is more similar to that of the Newport Medieval Ship, what has been identified as a conifer tar; samples from the Mary Rose have been identified as pitches rather than tar but were also derived from conifers.

Variation was observed in the relative abundances of compounds across the 12 sites studied within the ship. 4b,8-Dimethyl-2-isopropylphenanthrene, 4b,5,6,7,8,8a,9,10-octahydro- [1] was the most abundant compound in 5a, 5b, 6a, 6b, and 11b. DHBA [5] was the dominant compound in 7a and 7b, while they were about equal in 8a, 8b, 9a, 9b, 10a and 10b. There is insufficient evidence to establish whether this variation is due to repairs or environmental exposure (i.e. light and air) during the working life of the vessel or chemical or microbiological changes pre- or post-burial.

4 Conclusions

Molecular analysis of the organic residues associated with caulking and coatings of the Denge Quarry Ship was undertaken using GCMS. The goal of the analysis was to establish their nature and manufacturing technique. Some of the samples were identified as conifer tars, prepared at <350°C. The samples vary with location, which may reflect repairs during

the vessel's working history, environmental exposure, or microbiologically driven changes post-burial.

Unlike the previous FTIR analysis, no evidence was found for the addition of proteinaceous glue to any of the samples.

Potential further analysis could include $\delta^{13}\text{C}$ analysis to identify the geographic original of the tar. Targeted GCMS analysis might yield further information about the species (and origin) of the conifers used to produce the tar.

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Figure 1: Examples GCMS chromatograms from this study. Compounds are identified in Table 1.

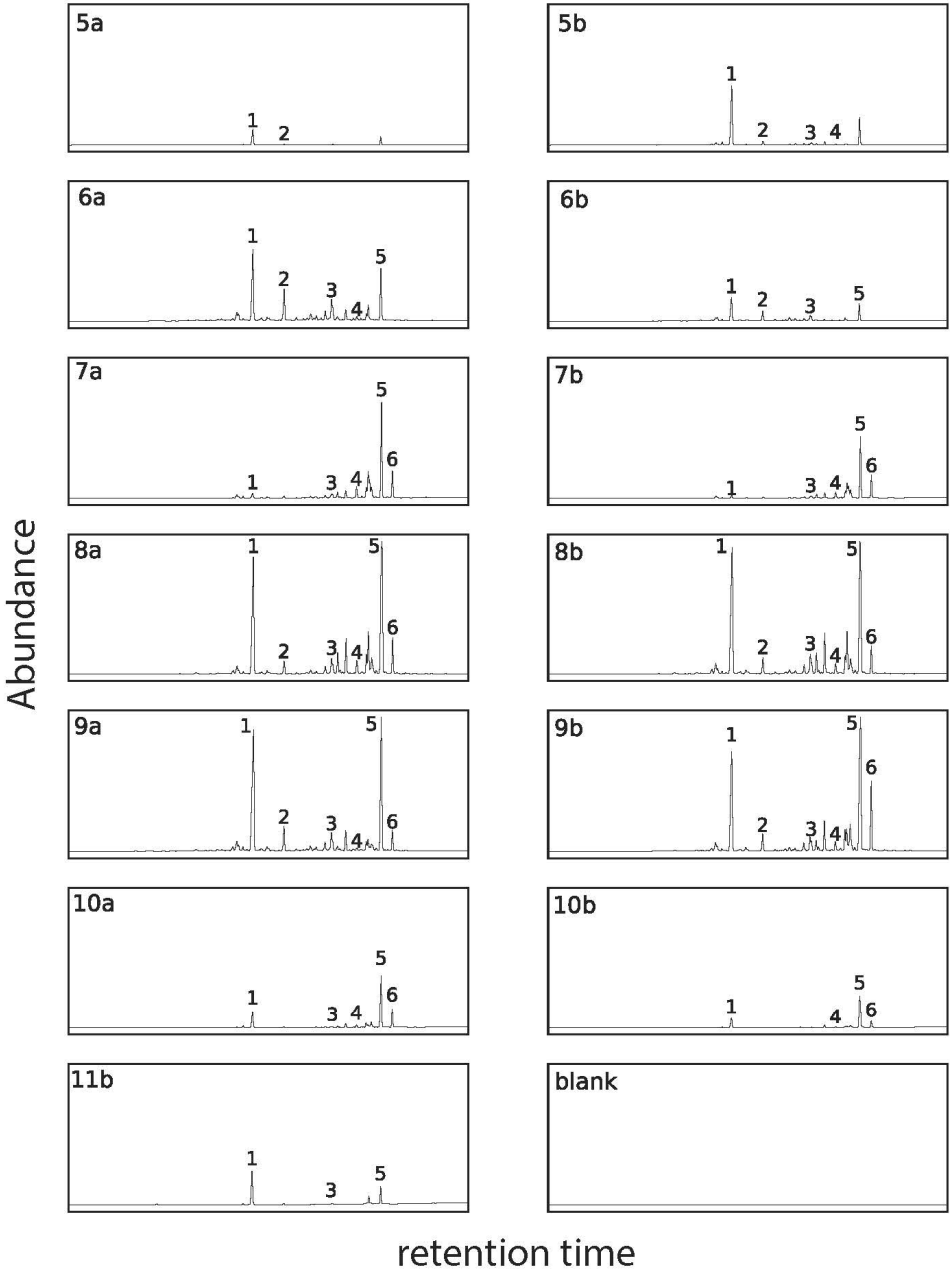


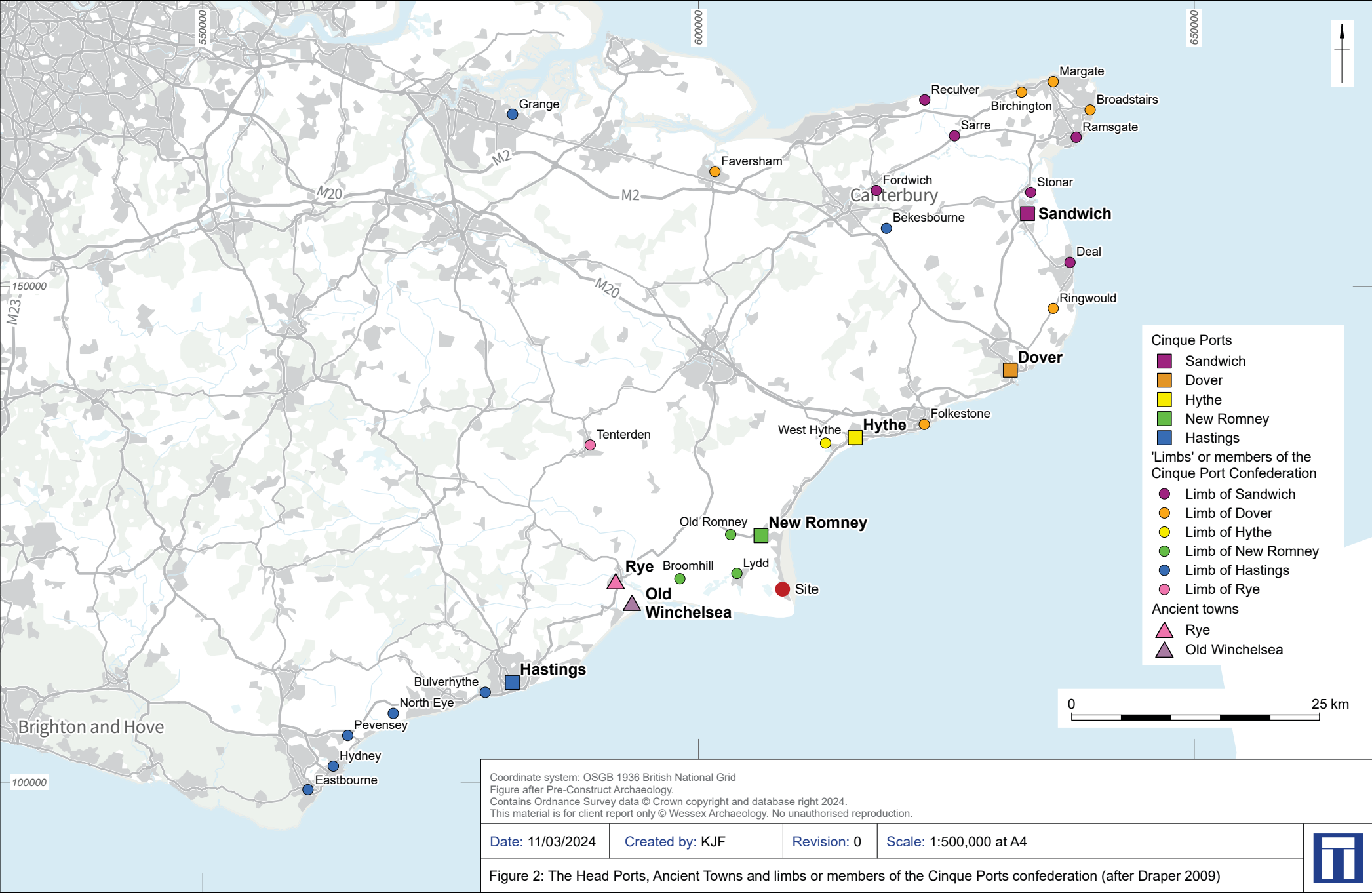
Table 1: Significant biomarkers and corresponding environmental interpretation

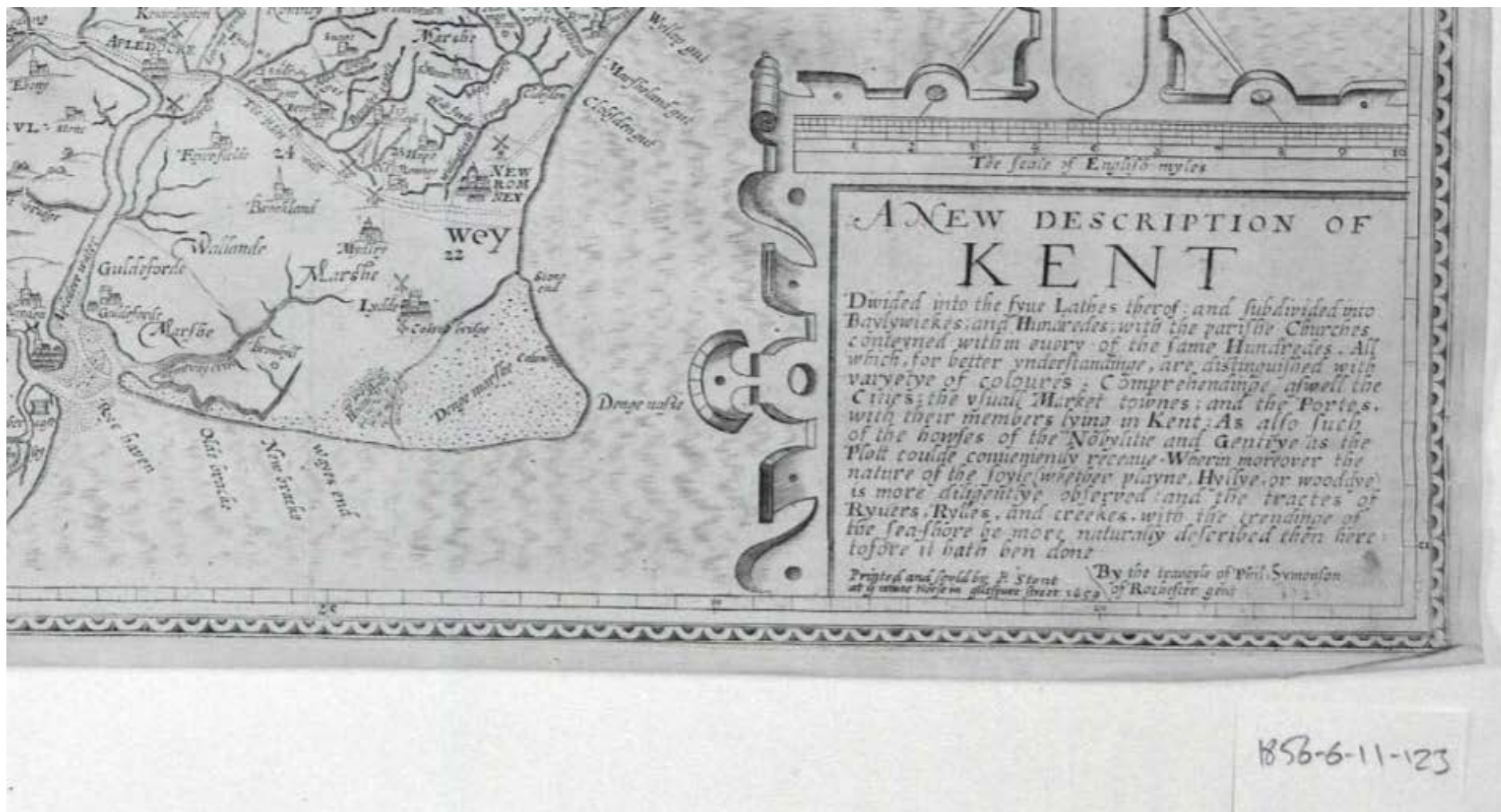
Compound	Environment
<i>Dehydroabietic acid (DHBA) [5]</i> <i>Pimaric acid (PA) [4]</i> <i>Abietic acid (AA) [6]</i> <i>4b,8-Dimethyl-2-isopropylphenanthrene,</i> <i>4b,5,6,7,8,8a,9,10-octahydro- [1]</i>	Typical of <i>Pinaceae</i> family (conifers), including <i>Pinus sylvestris</i> (2, 5, 8)
<i>Retene (R)[3]</i>	Stable final product of pitch/tar production (2)
<i>Pimaric acid [4]</i> <i>Abietic acid [6]</i>	Thermal processing at <350°C, indicative of tar (6, 9)
<i>10,18-Bisnorabieta-5,7,9(10),11,13-pentaene [2]</i>	Aged resins (7)

Table 2: Compounds identified in this work

sample number	sample ID	description	23.607 (1)	24.371 (2)	Retene 25.573 (3)	PA 26.209 (4)	DHBA 26.814 (5)	AA 27.100 (6)
5a	WA 264780 (103)	From timber 96	+	+				
5b			+	+	+	+		
6a	WA 264780 (113)	From timber 009	+	+	+	+	+	
6b			+	+	+		+	
7a	WA 264789 (116)	Loose caulking (1029-5001)	+		+	+	+	+
7b			+		+	+	+	+
8a	264780 (114) T129	From timber 129	+	+	+	+	+	+
8b			+	+	+	+	+	+
9a	WA 264780 (5003 5005?) T110	From timber 35	+	+	+	+	+	+
9b			+	+	+	+	+	+
10a	WA 264780 (5005) (117)	From timber 033	+		+	+	+	+
10b			+			+	+	+
11b	WA 264780 (119) 103	Pine tar from Timber 103 (surface waterproofing)	+		+		+	







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Figure 3: Detail from "A new description of Kent" after Philip Symonson 1596, reg. no. 1853,0611.123



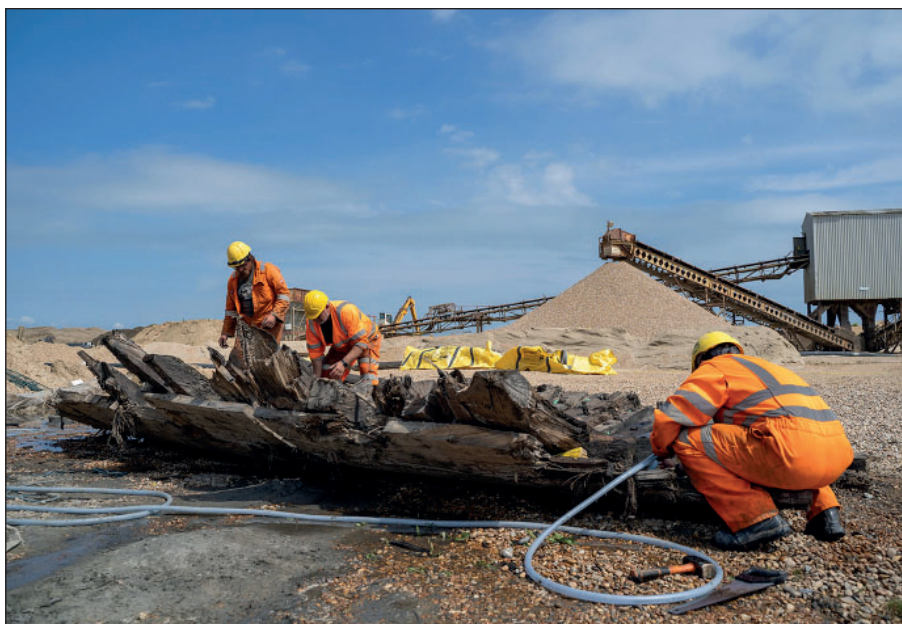


Figure 4: Archaeologists at work



Figure 5: The timbers were damaged during the recovery from the quarry



Figure 6: The largest surviving portion of hull being recovered by excavator



Figure 7: Section 5005. The notch in the underside of the aftermost frame can be seen at the back

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Figure 8: The hood end of the planks of section 5005. A matt of hair and tar is visible in the landing of plank [033]



Figure 9: Timber [080] forward face



Figure 10: Section 5006, a ferrous bolt fastened the center of the floors timber to the keel. The scarfs on the outer planking have very little shift



Figure 11: Section 5004, is the largest portion of hull preserved



Figure 12: Section 5004, Filler frames were added between frames



Figure 13: Section 5004, Outer planking visible after the frames were removed. The V-groove chiselled in the lower edge of the planking is visible on the left



Figure 14: Section 5007, upright, portside, the bow is on the right. The straight cut on the thick broad plank on the starboard side [102] is from sampling

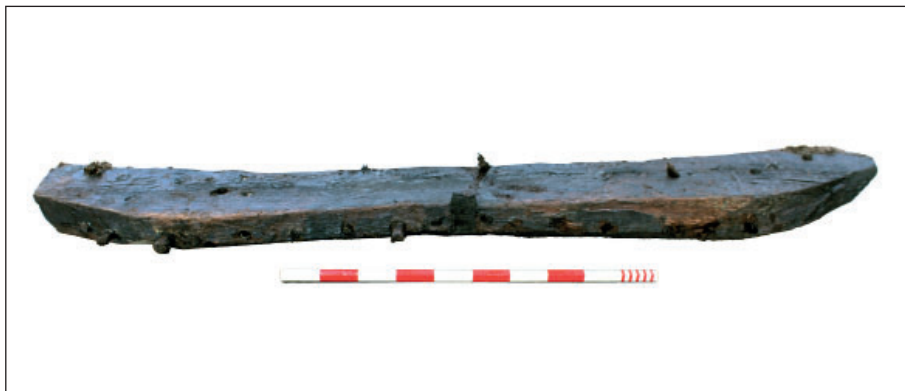


Figure 15: This is one of the few floor timber that is complete. Initially it was thought it belonged to a second wreck



Figure 16: Example of treenails, some of which do not extend to the ceiling planks. Other details such as a frame mortise are also visible



Figure 17: A blindhole on frame [061]. Near the upper treenail, chisel marks marked the position of the treenail before augering



Figure 18: Example of expanded treenail head



Figure 19: Example of treenails scored with two blows



Figure 20: Hemp caulking on treenail



Figure 21: Example of the morphological variety of fasteners at the scarf of plank [098]



Figure 22: Small plug for temporary fasteners found on the underside of the frame [069]



Figure 23: Line of nails at lip of scarf in the outer planking



Figure 24: Groove within inner edge of outer planks



Figure 25: Example of waterproofing material



Figure 26: Waterproofing material paid in scarf at plank [067]



Figure 27: Pitch was applied to the inner face of the outer planking. The nails holes on the left hand side show the extent of the scarf lip at plank [098]



Figure 28: Possible white stuff coating on outer hull



Figure 29: Pit saws marks can be seen under the pitch on the inner surface of this outer plank



Figure 30: Charring on planks [040]



Figure 31: Outer plank scarf



Figure 32: A frame quartered [061]



Figure 33: The floors and futtock were secured with mortices



Figure 34: Two treenails secured the connection at the mortise



Figure 35: This frame was interpreted as the masterframe and show a different joint from all the other ones



Figure 36: The angle with which the side trenails were driven indicates that these were pre-assembled before being raised



Figure 37: Small wedges were inserted underneath some of the frames



Figure 38: Some of the frames were left with bark



Figure 39: The coating of the inner hull was scraped off



Figure 40: Ceiling plank [040] was bent on an open fire



Figure 41: Scarf on ceiling plank [039]



Figure 42: Possible marks seen on timbers



Figure 43: Graving piece on plank [097]



Figure 44: A large wedge sat on top of this repair. The fact that the waterproofing material was removed from the patch suggest that this repair was done before the insertion of the filler frames



Figure 45: Large broads planks lined the lower stern. The garboard is in the foreground



Figure 46: Tool marks on the upper part of the sternpost might be evidence of salvage



Figure 47: The sternpost assembly is made by two large vertical timber assembled together



Figure 48: Starboard side of the keel heel, a ferrous bolt fastened to the skeg on the lower aft side

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Figure 49: Once the garboard and the other boards are removed the planking that fits in the rabbet is visible. This is covered with waterproofing material



Figure 50: Vertical fasteners indicate the presence of further timbers that extended the post aft. On the upper aft corner of the outer face of the garboard a faint square recess might indicate the position of an iron strap



Figure 51: The lower aft heel of the post sat onto the keel. It broke during the dismantling but it was originally all one piece. A concavity is visible on the aft face



Figure 52: Wooden dish



Figure 53: Ceramic fragment



Plate 1: Section 5005, top view, bow on the right, from photogrammetry model



Plate 2: Section 5005, bottom view, bow on top, from photogrammetry model



Plate 3: Section 5005, view from aft, from photogrammetry model

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Plate 1-3: Section 5005





Plate 4: Timber [080], side view, bow on the right, from photogrammetry model

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Plate 4: Timber [080]





Plate 5: Section 5006, top view, bow on the right, from photogrammetry model

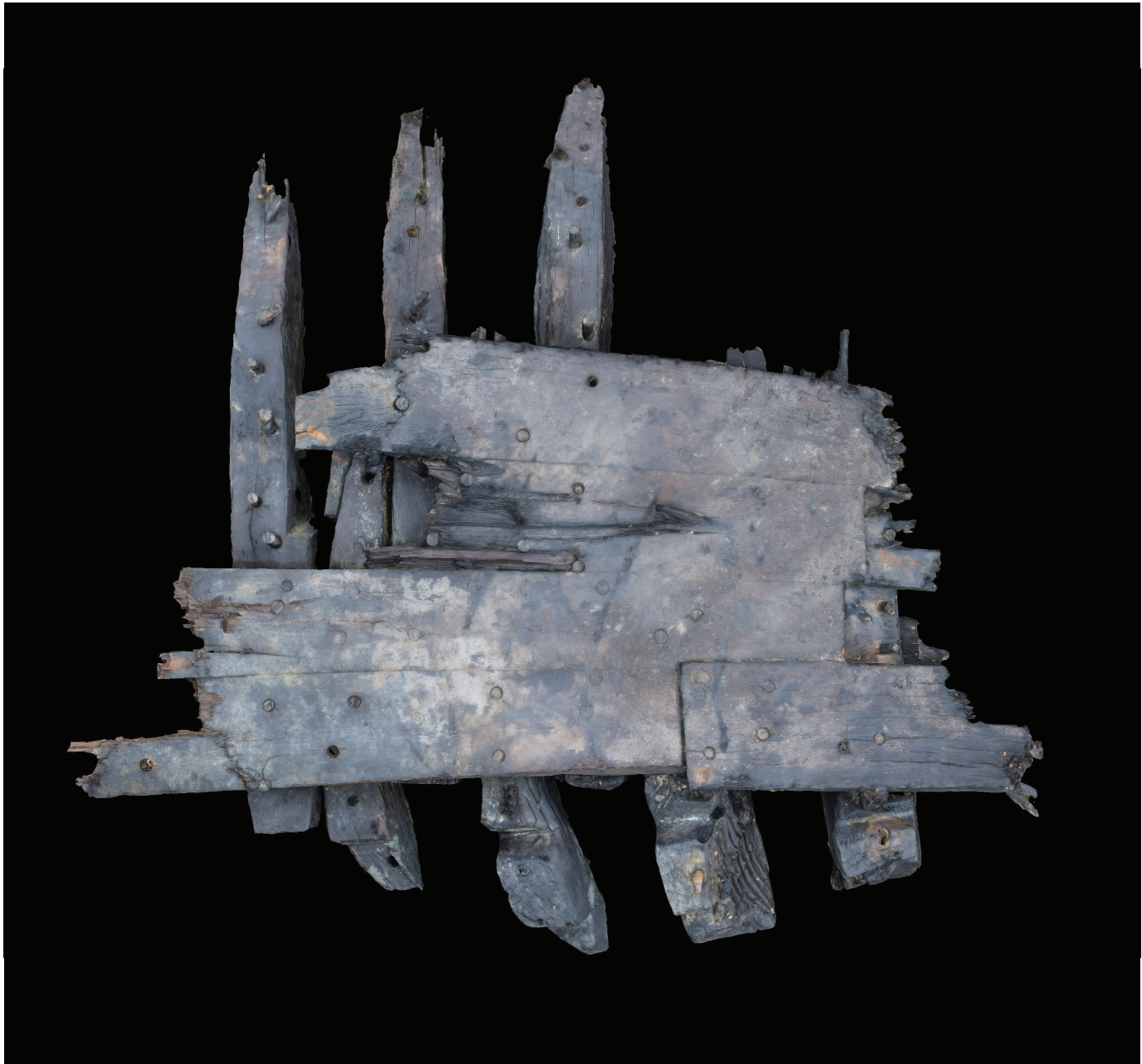


Plate 6: Section 5006, bottom view, bow on the right, from photogrammetry model

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Plate 5-6: Section 5006





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Plate 7: Section 5004, top view, ceiling planks, bow on the right, from photogrammetry model





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Plate 8: Section 5004, top view, frames, bow on the right, from photogrammetry model





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Plate 9: Section 5004, top view, outerplanks, bow on the right, from photogrammetry model





Plate 10: Section 5007, side view, bow on the left, from photogrammetry model



Plate 11: Section 5007, side view, bow on the right, from photogrammetry model

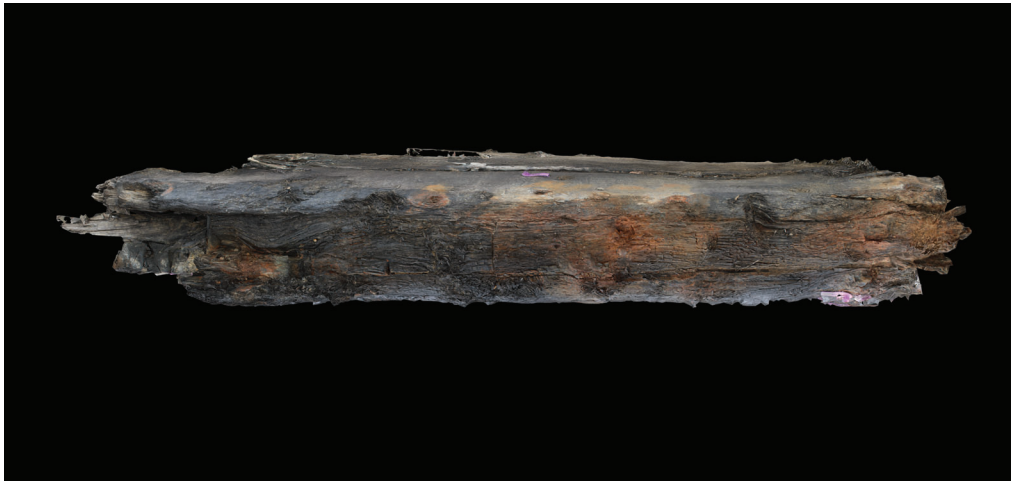


Plate 12: Section 5007, bottom view, bow on the left, from photogrammetry model

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Plate 10-12: Section 5007





Plate 13: Section 5013, top view



Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk