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Contents

Umay Oğuzhanoglu <i>What Happened Between Beycesultan XIII and XII? New Answers from Laodikeia-Kandilkırı Early Bronze Age Levels</i>	1
Meltem Doğan-Alparslan – K. Serdar Girginer <i>A Hittite Seal and Seal Impressions from Tatarlı Höyük</i>	31
Bülent İşler – Ş. Recai Tekoğlu <i>Rock-Cut Tombs and Two Lycian Inscriptions from Karabel-Çamdağı</i>	43
Gül Işın <i>The Farewell Dance to the Dead: The Dancers on the Portal of Trysa's Heroon and the Xanthos "Dancers Sarcophagus"</i>	61
Gonca Cankardeş-Şenol – Aygün Ekin-Meriç <i>Stamps of Hellenistic Imported Amphorae Found in the Excavations of Nicaea (Iznik) Theater</i>	79
Pınar Çağnis <i>Trade Relations between Byzantium and the Black Sea Region in the Hellenistic Period: An Assessment through Recently Found Amphora Stamps</i>	101
Burak Arslan <i>The Stylistic Features and Stonework Details of the Prohedriai and Lion's Feet in the Metropolis Theater</i>	123
Gürkan Ergin <i>Modes of Viewing the Urban Landscapes and Public Gardens of Early Imperial Rome</i>	153
Tuğba Taş Giese <i>Die Waffenreliefs im Versturz des Marktgebäudes von Kapıkaya in Pisidien</i>	183
Seçil Tezer Altay <i>A Late Recompose: The Rediscovered Monumental Octagon at Pergamon</i>	215
Bahar Oğuş <i>Animal Footprints on Roman Tiles from Perge and Aizanoi</i>	229
Burhan Varkıvanç – İsmail Akan Atıla <i>A New Monumental Gate from the Roman Imperial Period on the Attaleia City Walls</i>	249
Ceren Ünal – İsmail Özcihan – Merve Toy <i>A Group of Roman and Late Antique Bone Objects Found in Ancient Tralleis</i>	269

Emanuela Borgia	
<i>Minima Epigraphica: On Some Roman and Byzantine Inscribed Objects from Elaiussa Sebaste (Cilicia)</i>	297
Antonios Vratimos	
<i>Ṭoghrlil Beg and Alp Arslan in the Historia of Michael Attaleiates</i>	311
Mustafa Nuri Tatbul	
<i>Abandonment, Continuity, Transformation: Setting Komana into Archaeological Context through the Middle Byzantine and Early Turkish Periods</i>	325
İklil Selçuk	
<i>Ottoman Market Regulation and Inspection in the Early Modern Period</i>	355
Erdoğan Aslan – L. Ufuk Erdoğan	
<i>The Underwater Recovery Excavation at Kekova Adası: Observations on the Tek Ada Shipwreck and Finds</i>	375
Şamil Yırşen	
<i>The Construction Process of a School: The Antalya Kaleiçi Orthodox Christian Girls' School (Dumlupınar Secondary School) in Ottoman Archival Documents</i>	395

The Underwater Recovery Excavation at Kekova Adası: Observations on the Tek Ada Shipwreck and Finds

ERDOĞAN ASLAN – L. UFUK ERDOĞAN*

Abstract

The Tek Ada Shipwreck was discovered during underwater surveys around Kekova Adası, which is located within the district of Demre in the province of Antalya. The shipwreck, first detected in 2015, had been damaged by illicit diggings in 2017. As a result of excavating some of the sand on it, some timbers from the shipwreck were exposed. This situation caused the decomposition of the ship to increase rapidly. For this reason, to understand the characteristics of the shipwreck and to determine what necessary protective measures should be taken, studies were carried out within the scope of the “Kekova Adası Archeological Underwater Detection-Protection and Rescue Excavation Project” in 2018. During the excavation works, we observed that some of the timbers of the ship’s lower hull and its ballast have survived until today. The ship was built by using the frame-based method of construction. The Tek Ada Shipwreck is one of the rare shipwrecks on the Anatolian coast whose timbers have been preserved. These are thought to belong to the medieval period or later. In addition, around the shipwreck area and during the excavation, fragments from the ship in various forms and from different periods - made both of terracotta and lead and copper/cooper alloy - were also identified.

Keywords: Kekova Adası, Tek Ada Shipwreck, Skerki Bank Type IV, shipbuilding

Öz

Tek Ada Batığı, Antalya ili Demre ilçesi sınırları içinde yer alan Kekova Adası’nın çevresinde yürütülen sualtı araştırmaları sırasında keşfedilmiştir. 2015 yılında tespiti yapılan batığın 2017 yılında kaçak kazılarla tahrip edildiği ve üzerindeki kumun bir kısmının kaldırılması sonucu batığa ait ahşapların bir bölümünün açığa çıkmış olduğu tespit edilmiştir. Bu durum, batıktaki tahribatin hızlanarak artmasına neden olmuştur. Bu sebeple, batığın niteliğinin anlaşılması ve gerekli görülen koruma önlemlerinin alınmasına yönelik olarak 2018 yılında “Kekova Adası Arkeolojik Sualtı Tespit-Koruma ve Kurtarma Kazı Projesi” kapsamında çalışmalar gerçekleştirilmiştir. Kazı çalışmaları sırasında geminin safrası ile alt gövdesine ait ahşapların bir kısmının günümüze kadar sağlam olarak ulaştığı görülmüştür. Gemi, iskelet tabanlı yöntem kullanılarak inşa edilmiştir. Tek Ada Batığı, Anadolu kıyılarında Orta Çağ veya sonrasında ait olduğu düşünülen, ahşapları korunmuş ender batıklardan biridir. Ayrıca batık alanının yüzeyinde ve kazılar sırasında pişmiş topraktan yapılmış çeşitli formlardaki ve farklı dönemlere ait kap parçaları ile kurşun ve bakır/bakır alaşım malzemeden yapılmış metal objeler de tespit edilmiştir.

Anahtar Kelimeler: Kekova Adası, Tek Ada Batığı, Skerki Bank Tip IV, gemi yapımı

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Introduction

We conducted the first systematic survey between the years 2012 and 2019 both underwater and on the coastline of Kekova Adası.¹ The island is located within the district of Demre in the province of Antalya and has an approximate length of seven km and a width of 1.6 km (fig. 1). As a result of our exploration, religious and civil structures dating between the fourth century BC to the Early Byzantine period were found and documented in three settlement units² on the island.³ In work carried out on the island's coastal settlement, which is more a village or a small town, and underwater, 3 harbors, 2 landing places, 13 quays, 7 shipwrecks, and 45 different types of amphora were found and documented.⁴

As per its location, Kekova Adası has served almost as a natural breakwater along the Central Lycia coast, including Simena (Kaleköy) and Teimiussa (Üçağız), and the open Mediterranean Sea. Thanks to this natural advantage, it stands out as a safe stopping and transit point in sea transportation between the east and west. This conclusion can be made while monitoring the coast because of the discovery of numerous wrecks in its nearby geographical area from the Late Bronze Age to the Late Byzantine period.

Underwater surveys were conducted in the area considered rich in terms of underwater cultural heritage. This included the coasts of the settlement units, in the Tersane Bay archaic shipwreck site, along the Geyikova Cape coasts, in the Karaöz locality, around Tek Ada and Sezgin Adası and in Salyangoz Bay. As a result of these operations, both the shipwrecks⁵ discovered during previous operations and four more shipwrecks⁶ were explored and documented. Unlike the other shipwrecks found throughout this area during other years, we found during the 2015 exploration wooden ship parts that were preserved relatively well despite microorganisms and wood-boring organisms. Due to the wooden remains conserved until today and this shipwreck's locality, it has been named the Tek Ada Shipwreck. However, in 2017 we determined that part of the sand over this shipwreck had been removed and the positions of the likely ballast had changed. Additionally, some equipment used for illegal excavations on the shipwreck site were found. The illegal excavations had removed some of the sand over the shipwreck, thus revealing a section of the wood. This exposure had led to a rapid increase in

¹ These surveys were carried out by Erdoğan Aslan and his team from the Archaeology Department of Selçuk University. This research has been supported by the Selçuk University Scientific Research Projects Coordination Unit. Project Number: 18401070 and supported by the Koç University AKMED (Suna & İnan Kıraç Research Center for Mediterranean Civilizations). Project No. KU AKMED 2018 / P.1015.

² These settlements are the Tersane Bay Settlement located at the west end of the island, which takes its name from the sheltered natural bay; the North Settlement, which is parallel to the north-facing coast of the island; and the Fener Settlement established on the south-facing rocky slopes on the east end of the island.

³ Despite this, the fish sauce / garum workshop, found in the unit called the Tersane Bay Settlement and substantially preserved to our day, features graffiti on the arch blocks indicating activity from later periods.

⁴ Among these underwater finds, the earliest is the Cypriot origin Basket Handle Amphora Shipwreck dated between the eighth-seventh centuries BC. The latest finds are the Günsenin Type III amphorae dated to the 13th century AD; see Aslan 2015, 324, 343.

⁵ These include the Archaic Era Shipwreck / Archaic Period Basket Handle Amphora Shipwreck dated to the eighth century BC, the Kekova Byzantine Shipwreck I / Byzantine Shipwreck / AE 5-6 Gaza Shipwreck dated between the fifth-seventh centuries AD, and the Kekova Byzantine Shipwreck II / LR 1b Amphora Shipwreck dated to the seventh century AD.

⁶ These shipwrecks include the Tek Ada Shipwreck, the subject of this study, the Zemer 41 Amphora Shipwreck dated between the second-fourth centuries AD located north of Tek Ada, the Shallow Reef Eastern Shipwreck dated between the sixth-eighth centuries AD located at the Archaic Shipwreck Site, and the AE 3 Amphora Shipwreck dated between the first-third centuries AD located between Sezgin Adası and Tek Ada.

the deterioration of the shipwreck. Thus, a recovery excavation was planned to understand the state of the shipwreck, its nature, and what necessary conservation measures should be taken. Operations were launched in 2018 within the scope of the “Kekova Adası Archaeological Underwater Exploratory-Conservation and Recovery Excavation Project.” The excavation and conservation operations were carried out under the supervision of the Museum of Lycian Civilizations and conducted by our team.⁷

The recovery excavation and the conservation of the finds extracted from underwater during this process were performed within certain procedures (fig. 2).⁸ Prior to commencing these operations, first a plan was drawn and photographs were taken of this site. Besides taking detailed photographs, a photo-mosaic image of the shipwreck was obtained by joining numerous photographs. Where the ship finds were located was documented by means of a current state pre-operation and then a grid system was formed. This grid system consists of 66 2 x 2 m squares - 22 m northeast to southwest, 12 m to the southeast. In the coding of the squares, one grid plane consists of numbers while the other consists of letters respectively. Considering the likelihood of the expansion of the work site in later periods, the letters (from northeast to southwest) and the numbers (from northwest to southeast) began with the letter “C” and the number “3.” As a result of the documentation operations, excavation work began by removing the approximately 35 cm-thick sand layer in trenches H6 and H7 located southwest of the stone heap believed to be ballast belonging to the ship. A section of the wooden components belonging to the shipwreck could be seen. The finds determined to be open to natural and artificial deterioration and situated independently on the surface of the other squares were also extracted from underwater. Following the completion of the excavation process, the plan and cross-section were drawn, and photographs were taken again of the excavation site. This process was additionally applied for the ship that was uncovered. The conservation and restoration process of these extracted finds are currently being continued by experts at the Museum of Lycian Civilizations by the Ministry of Culture and Tourism Antalya Regional Restoration and Conservation Laboratory Directorate.⁹ Following excavation work, the site and the area where the wreck was found was taken under protection against natural deterioration.¹⁰ This protection was instituted especially against wood-boring organisms such as mollusks and crustaceans known to pose the greatest biological harm to wood - the main item used in shipbuilding for centuries.¹¹ The damage caused to the wreck’s wooden parts by the naval shipworm called the

⁷ We are grateful to all of the staff of the Museum of Lycian Civilizations, especially its manager Ms. Nilüfer Sezgin. These exploratory and recovery excavation operations were conducted with the permission and financial support of the Ministry of Culture and Tourism General Directorate of Cultural Assets and Museums. The operations of our excavation operations were conducted in 64 dives over approximately 70 hours by an eight-person team consisting of undergraduate and master’s students from Konya Selçuk University, Ege University, Mimar Sinan Fine Arts University, and Kahramanmaraş Sütçü İmam University.

⁸ This excavation was limited to only one season, since the Ministry of Culture and Tourism, General Directorate of Cultural Assets and Museums did not grant the necessary permits for further studies.

⁹ The finds extracted from underwater were first moved to the excavation boat, then into barrels containing seawater, and finally into water tanks in the museum developed in accordance with the materials of the finds.

¹⁰ The other finds subjected to the conservation process are wood components belonging to the ship. Following the completion of the excavation and the gathering of preliminary data, temporary conservation measures were taken for the period during the shipwreck will be fully excavated and the necessary infrastructure is completed. The 8 m² section belonging to the uncovered ship’s hull was completely covered with a thicker layer of sand (ca. 60 cm) than before. This was done to cut off the oxygen needs of the *Teredo Navalis* that feed on wood. The same process was also applied to the independent wooden pieces exposed on the surface.

¹¹ Sivrikaya 2004, 136; Müller 2010, 2-6.

Teredo Navalis,¹² which entered especially through the open ends, was revealed during the excavations (fig. 3).

This research article focuses on the excavation work including the preservation and recovery of the wooden shipwreck detected near Tek Ada, which is situated at the east end of Kekova Adası. Through this excavation work, the basic structural specifications of the wreck were identified. These structural specifications were then compared with similar ship examples in the Mediterranean region. Additionally, evaluations were also made on the terracotta, glass, and metal finds detected at the shipwreck site. As a result, utilizing all the data obtained in the initial stage, efforts were made to make suggestions regarding the period/age of the wreck, its origin and its function.

Tek Ada Shipwreck

Another small island called Tek Ada is located approximately 350 m southeast of Kekova Adası. During exploration work conducted along its unsettled northern coast, remains of a wooden wreck were found (figs. 1, 4).

Examination of the floor structure in this area where the wreck was found revealed it is shallower and sandy compared to its surroundings. The ship's wooden parts were found in varying depths ranging between 10-13 m. Its ballast and other surface finds are spread throughout an area of approximately 160 m².

*Hull Components*¹³

Excavation work uncovered a 3.40 x 2 m - sized section belonging to the Tek Ada Shipwreck. This is situated on the bottom of the ship and lays in a northeast-southwest direction. In this uncovered section, a total of 25 parts were determined: three *in situ* pieces of planking (P),¹⁴ 10 pieces belonging to the frame system (F),¹⁵ three bilge stringers (BS), and 9 pieces of timber partially visible on the surface (figs. 5-6).¹⁶

There is no data on the keel, stem and sternposts, garboard strakes, and upper structure components. Only a small section of the rigging was uncovered. Data related to the ship's prow and aft sides as well as the starboard and port sides currently remain unknown. Though no keel parts were found during our operations, it is believed that the iron nails at the center of floor timbers F1, F3, F5 and F7 were used to affix the floor timbers to the keel. Looking at the direction and alignment of the nails in question based on these data, it is projected that they constitute the longitudinal axis of the hull.

¹² These shipworms, observed to feed themselves by eating the wood and draining the water, grow to a length of 2 m; see Sivrikaya 2004, 136.

¹³ The terminology used in the identification of the Tek Ada Shipwreck is based on those used in the "Wooden Ship Building and the Interpretation of Shipwreck"; see Steffy 1994, 265-98.

¹⁴ The planking remaining within the H7 grid has been numbered in order (P1, P2, and P3).

¹⁵ The parts on this frame system consisting of floor timbers and futtocks have been coded respectively, starting from the southwest of the H6 grid. While the floor timbers are coded as "F1, F2, etc.", the futtocks belonging to the second-floor timber are coded "F2-1"; those belonging to the 3rd floor timber are coded "F3-1", etc. As the starboard and port directions of the ship remain unknown, no direction was distinguished regarding the futtocks.

¹⁶ The first piece belonging to the bilge stringer on the northwest side of the H6 grid has been coded as BS1, and the other two have been coded as BS2 and BS3, respectively.

Planking (P)

Planking constitutes the outer section of a ship and extends across its length. After excavating the ship, only three of the planking strakes belonging to its bottom were uncovered, between F1 and F2 (figs. 6-7). While P1 and P2 are intact, P3 was in two parts. The intact planking, whose length is unknown at this stage, has a width of 18-20 cm and a thickness of 2-3 cm. If these three planking strakes are regarded as exemplary, the other hull planking strakes must also have had similar characteristics.

The edges of the planking were built using the traditional Mediterranean carvel construction technique and placed in an exceptionally even order. Extracting the pieces of planking from the water and disassembling them is the most proper way to understand the joint details. Since we did not have this opportunity unfortunately, questions remain unanswered that would provide critical information with respect to construction techniques, such as the form of connections used at the plank seams between the strakes, the type of scarves preferred at the plank ends, and how the planking was fastened to the floor timbers whether by using treenail or iron nail. Also, whether any putty, resin or caulk were used in the carvel separations cannot be determined at this stage.

Frame System (F)

The frame system consists of floor timbers fastened transversely on the ship's keel, from the bow to the stern, and the wooden futtocks scarfed to the ends of floor timbers. During the excavations, all of this wreck's floor timbers and futtocks, important within the ship's framing system, were found *in situ*. In its current state, this frame system consists of seven floor timbers and three futtocks (figs. 6, 8). While a section of most of the floor timbers was found relatively intact, the ends in particular have deteriorated.¹⁷

The extant floor timbers have an average length of 3.34 m, a top surface width of 17 cm (sided dimension), and a height (molded dimension) of approximately 15 cm. Though the bottom corners of the rectangular floor timbers - placed 12.5 cm apart - are partially sharp, the top corners have been slightly beveled. All floor timbers other than F2, F3, and F4 were found without futtocks. The extant futtocks have an average length of 1 m, a top surface width (sided dimension) of 11 cm, and an approximate height (molded dimension) of 15 cm. The room-and-space is approximately 30 cm.

Though all futtocks are not in place, futtock parts F2-1, F3-1 and F4 found on the three floor timbers F2, F3 and F4 allow us to understand the floor timber-futtock joint details. Upon examination of the joints of the frame system, which are in perfect harmony, we observed that the "L"-shaped scarves having an average depth of 3 cm were opened to install the futtocks on the northwest ends of the floor timbers. As the deterioration on the northwest side of the floor timbers is excessive, only the "L"-shaped scarves on F3 and F4 are extant (figs. 6, 8). In addition, two square profile, round-headed iron nails were detected on the side surface of F2's east end (figs. 6-7). The length of one nail is almost equivalent to the width of the floor timber. One other nail with similar properties, which remained partially intact, can be seen inside a deteriorated wooden part on the northwest end of F1. These iron nails found on the scarf show that the floor timber and the futtock were fastened to each other.

¹⁷ The like cause of this deterioration is the exposure of these sections not buried in the sand to wood-boring organisms; see n. 10.

Though no remains of the keel were found, the remains of iron nails placed in the same direction 60 cm apart (skipping one floor timber) on the top surfaces of the floor timbers indicate the existence of a keel directly below. Examination of the position of the said iron nails in F1, F3, F5, and F7 show that the floor timbers were fixed on the keel in the one iron nail and no nail order, respectively.¹⁸ Meanwhile, no connection components were needed in F2, F4 and F6. These iron nails joining the floor timbers to the keel have circular shaped heads. Taking the height of the floor timbers as a guide, their lengths should be at least between 20-25 cm.

As can be understood from F3,¹⁹ the connection points of the floor timbers to the keel right at the center of the floor timbers reveals that the futtocks and floor timbers were placed on the keel systematically within the same order.

Bilge Stringers (BS)

Bilge stringers are the wooden components that join the ship's futtocks from the prow to the aft. They also support the ship's skeletal structure lengthwise. Parts of two bilge stringers (BS1, BS2) with this function were found *in situ* on the Tek Ada Shipwreck (figs. 6, 8). Besides these parts and in addition to BS3 found unattached on the floor timbers coded F5 and F6, independent wooden parts, most likely bilge stringers, were found on the surface in the J7 and K7 grids.²⁰ The parts that feature intense deterioration on their broken ends have a rectangular profile. On the preserved part of BS1, which is in a better state compared to the other, its height/thickness was measured as 10 cm, length as 1.85 m, and width as 25 cm.

The bilge stringers were placed parallel and approximately 20 cm apart. They vertically intersect the line at which the futtocks and floor timbers are aligned side by side.²¹ Despite deterioration, traces of the iron nails joining the bilge stringers together with the floor timbers and futtocks are still visible on the top surface of the bilge stringers (fig. 9). These clearly visible traces of iron nails on the top surface of BS1 are in the form of two rows, 30 cm apart. One of these nail rows joins the bilge stringer to the futtocks, while the other joins the floor timbers to the bilge stringers. Upon examination of the traces belonging to the nails joining the frame system to the bilge stringers, we understood that these nails are rectangular with a 1 x 1 cm sized shank, while the head section is 8 mm high with a diameter of 3 cm.

In addition, five pieces belonging to the frame system (grid G7 and I7), two pieces belonging to the bilge stringer (grid J7 and K7), and two unidentified pieces belonging to the frame system (grid H5) were identified. These were partially visible on the surface except those unearthed by excavation. However, these pieces can only be partially seen since they are under the sand.

Finds

A vast number of rubble stones of different dimensions, shapes, and weights were found in the form of a scattered heap in the northeast part of the shipwreck site (fig. 2). These stones, some

¹⁸ A similar application is also observed in the Yenikapı 7 Shipwreck (YK7); see Özsait-Kocabaş and Kocabaş 2012, 134, fig. 33a, b.

¹⁹ F3 is the sole extant example among floor timbers or attachment to the futtock on both ends.

²⁰ Since these pieces have been subjected to intense deterioration, no nail traces, etc. were found on them.

²¹ A similar bilge stringer installation is seen in the Les Sorres X Shipwreck in Spain, which is dated between the 13th-15th centuries AD; see Hamelink 2016, 289, fig. 3.

of which are on top of the wreck, must most likely be the ballast used for balancing the ship's load. Such ballast weights, in use since ancient times,²² are loads that provide the ship an extra balance or they ensure equal amounts of submersion level on its back or front section.²³ Considering the ballast finds in the shipwreck site, these must have been at the prow or aft section, while the cargo would be in the completely opposite section.

Besides the ship's ballast and wooden remains mentioned above, various shaped ceramic rim pieces made from terracotta designed for everyday use, unidentifiable metal objects made from lead and copper or copper alloy (fig. 10), and formless glass pieces in various colors, as well as a rim piece of a glass bottle (fig. 11) were also found during the excavation. Among these finds was also a sgraffito bowl dated to the 12-13th centuries, and glazed ceramic pieces from plates and bowls made of different clay (fig. 12). These pottery pieces were found from the surface and inside the excavated sand. It is thought that they are not related to the shipwreck due to their very few number and lack of other parts.

In addition to the excavation finds, one terracotta mortar and two copper/copper alloy pipe parts were found independently on the surface of the shipwreck site. In its immediate area, one almost complete terracotta amphora and one jug were detected.

Among these surface findings, a piece of a mortar - used to crush and grind grains and sometimes to crush and mix food - was found on the site (fig. 13). This mortar is sporadically covered with marine growth, with half of it reaching our day in a preserved state. The edge of the rim features a large round rim that widens outward with a spout at the tip. On the outward widening edge of the rim of the mortar, there is a spout that narrows from the inside out. This was made to drain the liquid used during the maceration of the grain.²⁴ In the section where the passage from the rim to the body starts, there is an obvious groove surrounding the inner edge of the rim, which continues parallel to the spout. While the section of the body going downward after the groove makes a perpendicular angle to the outer side, it is quite curved on the interior. The body that has a relatively deep and quite thick internal wall ends with a flat, round-shaped base. This mortar has a granular surface containing sand, lime, mica, and small abrasive stone particles inside the red and brown colored hard clay but features no seal. The origin of this rim, produced in abundance during the Early Imperial period,²⁵ is central / middle Italy.²⁶ Similar examples²⁷ are named Hartley Type 2 and Dramont Type 2.²⁸ This type of Italian mortar was spread throughout the Mediterranean region by the Roman legions²⁹ and

²² Ballast weights may be iron, lead, stone, terracotta brick, etc.

²³ Steffy 1994, 267; Kocabaş 2012, 219; Türkmenoğlu 2018, 25.

²⁴ For detailed information on mortars, see Olcese 2003, 43; Matteucci 1987, 239-40, 243; Espinosa 2011, 284; Hargis 2007, 16; Maritan 2009, 162; Pallecchi 2002, 34-38; Gonzáles and Ibáñez 1989, 70; Tek 2003, 395.

²⁵ Hayes 1991, 73.

²⁶ Espinosa 2011, 288; Maritan 2009, 162-63; Pallecchi 2002, 45-53; Willems 2005, 16-17.

²⁷ For similar ones in Ostia, Terme del Nuatatore and Caere, the first and second centuries AD are suggested; see Olcese 2003, table 39, nos. 5, 7. For similar ones in Baetica, the second half of the first century AD is suggested; see Espinosa 2011, 287, fig. 1.6. for similar ones in Salla, the mid-first century and early second century AD are suggested; see Varga 2010, 147, fig. 2.12-13; 152, fig. 5.32; 168, fig. 16.134. For similar ones in Altino, see Maritan 2009, 174, fig. 4.42; 177, fig. 6.52. A similar one in Paphos was found in a context belonging to the first half of second century AD; see Hayes 1991, fig. 26.1. For similar ones in Berenice, see Riley 1979, fig. 112.669-71. For similar ones from Spain, the years pre-AD 79 and AD 40 are suggested; see Gonzáles and Ibáñez 1989, 89, fig. 1; 95, fig. 14.

²⁸ Joncheray 1972; Hartley 1973; Hayes 1991, 73; Olcese 2003, 43.

²⁹ Espinosa 2011, 286.

most commonly in use between the first and second centuries AD.³⁰ Probably this mortar is a find intrusive in the shipwreck.

A survey was conducted around the shipwreck that considered the possibility that the finds were dispersed due to the flow in the area where the wreck was located. An amphora and one jug were found 1 m apart among the reefs 10 m deep, approximately 30 m west of the shipwreck site. The amphora is sporadically covered in shipworms, and there is a small round fracture on the body. It has parts missing on the whole rim as well as on a part of the neck (fig. 14). Despite all these deficiencies and its thin internal wall, it has reached our day in a very intact state. The amphora has the same internal wall almost everywhere and features a short, cylindrical, narrow neck, and a spherical body that meets this neck with a slight incline. This body goes down straight from the middle section and ends at the bottom with a slightly concave base that has a thin internal wall. The wide-diameter handles of the amphora, placed opposite one another, have a lentoid profile and are attached perpendicularly a little higher above the central body. Stains are forming on this container which has deterioration on its surface. The color of the outer surface ranges between light reddish yellow, light red and light brown. Its clay contains abundant mica additive and smaller white limestone granules. Two examples with a comparative characteristic style were found during underwater surveys conducted in 1994 in the strait called Skerki Bank situated between Tunisia and Sicily. These amphoras, with no similar examples found before then, have been dated between AD 850-1150. There is no certain knowledge on the origin of this type named Skerki Bank Type IV.³¹ The jug found in the same location as the amphora was also sporadically covered in shipworms (fig. 15). This container is complete with the exception of a small fracture on the edge of the rim. It features an outward spouted rim, a long and cylindrical neck, a spherical compressed body, and a ring base that was applied afterwards. The dual-banded handle starts from the edge of the rim and forms an elbow after rising 4 cm. It then joins to the middle section of the body with an almost perpendicular angle.

Another find discovered on the surface is two copper or copper alloy pieces of pipe (fig. 16). These pipes are ca. 5.5 cm in diameter. They possibly belonged to the ship's equipment and would be for a bilge pump or stove. An examination of these pieces shows they must belong to the same component in terms of workmanship. For the pipes first, a flat sheet was given a cylindrical form, then it was joined by super positioning the edges and forging them. These joining process were performed using two different methods.³²

The first was to make jagged teeth on both ends similar to saw teeth, then place soldering alloy between them. The edges were then joined and forged by bringing them on top of each other. The only difference in the second method is to leave one of edges straight, and making jagged teeth on the other edge like in the first method. The pipes were formed using one of these two methods and then joined perpendicularly using riveted joints both to ensure the connection and to prevent leakage. Since the pieces feature no adornments and were not

³⁰ Hartley 1973, 54-55.

³¹ J. Freed says that since they are spherical, small and have a thin internal wall, it was not functional to use these containers as transport / commercial amphorae in any period. He suggests that they cannot be of North African, Spanish, or Sicilian origin but have clear ties to characteristic forms originating from the Levant and adopted first by the Punic culture and then the Islamic world. They may also have their origins in Palestine or Syria. For detailed information, see Freed 1994, 82-84.

³² This technique is called "jagged joint" in English and "zinnenartige naht" in German. For detailed information, see Mustață 2017, 174, figs. 1-2.

found in a certain context, it is not possible to suggest a clear date with respect to their period. However, considering that this joining method of making teeth and bringing the edges on top of each other emerged in the third century AD,³³ this date may be considered the *terminus post quem* for the pipes.

In addition to evaluating the aforementioned finds, radiocarbon analysis³⁴ was performed on a sample taken from the bilge stringer to give an idea about the period of the ship (table 1). When the stringer and excavation findings dated by the radiocarbon method were compared, no chronological relationship existed between them.

Evaluation

According to the available data, it was determined that the body parts of the shipwreck were scattered in an area measuring 5 x 10 m. However, the cargo was not found. It is likely that upon understanding that the vessel would sink as a result of the damage it incurred, the crew took shelter in this location. It is one of a limited number of shallow and safe areas against waves around the island. Thus, the items belonging to the ship's cargo must have been easily removed from the wreck. Besides this possibility, it is also likely that the remaining finds were looted or decayed throughout time. Associating the wreck with finds discovered during the operations conducted at the wreck's location - a transit route for numerous ships - will not provide a sound result at this stage.

It is profoundly difficult to fully determine the construction technique before the excavation of this *in situ* wreck is completed and samples from the wooden parts are extracted from underwater. In the examinations conducted in its current underwater state, we observed that the workmanship of the wooden components used in the frame system and planking line-ups were shaped meticulously within a certain order. Yet the same care was not taken with the wooden components used on the bilge stringers. Various features showed that the builders aimed to ensure the durability of the hull: 1) the placement of the floor timbers quite close to one another and at fixed distances, 2) the futtocks being installed meticulously in "L" shaped scarves that opened on the side surfaces of the floor timbers, 3) the floor timbers being connected to the likely keel with iron nails one row apart on the side of one of the floor timbers, 4) the remains of an iron nail possibly fixing the futtock, and 5) the bilge stringers being attached on the floor timber-futtock joints with iron nails in a certain systematic manner to clearly reveal the ship's frame system and bilge stringers. Various techniques, such as overlap o,³⁵ dovetail scarf,³⁶ square scarf,³⁷ hook scarf³⁸ and plain scarf,³⁹ were used from the ancient period to the present to join the floor timbers and futtocks of ships. Though different than these techniques, the "L"-shaped floor-futtock scarf was used on the Tek Ada Shipwreck. Furthermore, the alignment of the hull components shows that the starboard and port sections were built within a standard symmetry. Partially similar examples of floor timber – futtock connections are seen in the Contarina I Shipwreck⁴⁰ (Italy, Rovigo) dated to AD 1300s, the

³³ Mustață 2017, 174-75; Pitarakis 2005, 23.

³⁴ TÜBİTAK Marmara Research Center Earth and Marine Sciences Institute report no. 6/449, dated 24.01.2019.

³⁵ Hamelink 2016, 289, fig. 3.

³⁶ Oertling 1989, 246, fig. 6.

³⁷ Castro 2003, 9, fig. 6.

³⁸ Pulak 2005, 141.

³⁹ Özsait-Kocabaş and Kocabaş 2012, 121, fig. 19.

⁴⁰ Bonino 1978, 13-14, figs. 3-4; Steffy 1994, 91, 93, fig. 4.17-18; Beltrame 2009, 414, figs. 6-8.

Les Sorres X Shipwreck⁴¹ (Spain, Barcelona) dated to the end of the 14th century AD, and the Akko 1 Shipwreck⁴² (Israel, Akko) dated between AD 1775-1845.

In accordance with the construction specifications mentioned above, we suggest that the Tek Ada Shipwreck was a trade ship that featured probably a flat hull that could enter shallow harbors. Since the region of the ship's origin can be confirmed with several types of data,⁴³ it is not possible to comment at the current stage. Evaluating it in terms of its shipbuilding tradition, although there is insufficient data regarding the construction of the planking, the technique used is skeletal construction.⁴⁴ This led to significant political and technological changes⁴⁵ in the Mediterranean by which the durability was ensured with the frame system and keel. The Culib VI Shipwreck,⁴⁶ dated to the 14th century AD, is the first example to fully use the frame-based technique. Considering that this technique started to be used then,⁴⁷ it is likely that the ship was built after the 14th century AD. Since the finds are from different dates, it would not be feasible to suggest a date based on these finds. The results of the radiocarbon analysis (table 1) show that the ship may have been built in the early 20th century at the latest.

⁴¹ Hamelink 2016, 289, fig. 3.

⁴² Cvikel and Kahanov 2009, 41, fig. 2; 45, fig. 7; 2013, 173, fig. 7.176-77.

⁴³ Analyses to be conducted on the ship's cargo, the personal items belonging to the crew, the wooden components, etc. elements should be taken into consideration.

⁴⁴ Steffy 1994, 280; Casson 2002, 26-27; Özsait-Kocabaş and Kocabaş 2012, 100-1.

⁴⁵ McGrail 2004, 164. For Transition from Shell to Skeleton in Ancient Mediterranean Shipbuilding, see Pomey 2012.

⁴⁶ Hamelink 2016, 287-88.

⁴⁷ Rieth 1998, 205; 2003, 9-12; McGrail 2004, 163-65; Güler 2019, 59.

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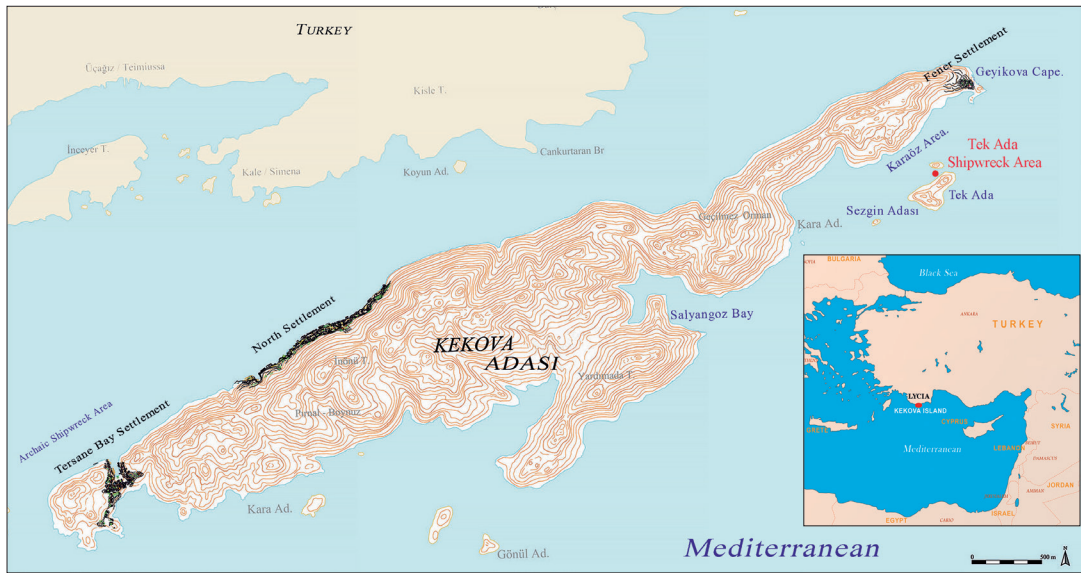


FIG. 1 Kekova Adası and shipwreck area (Excavation Archive).

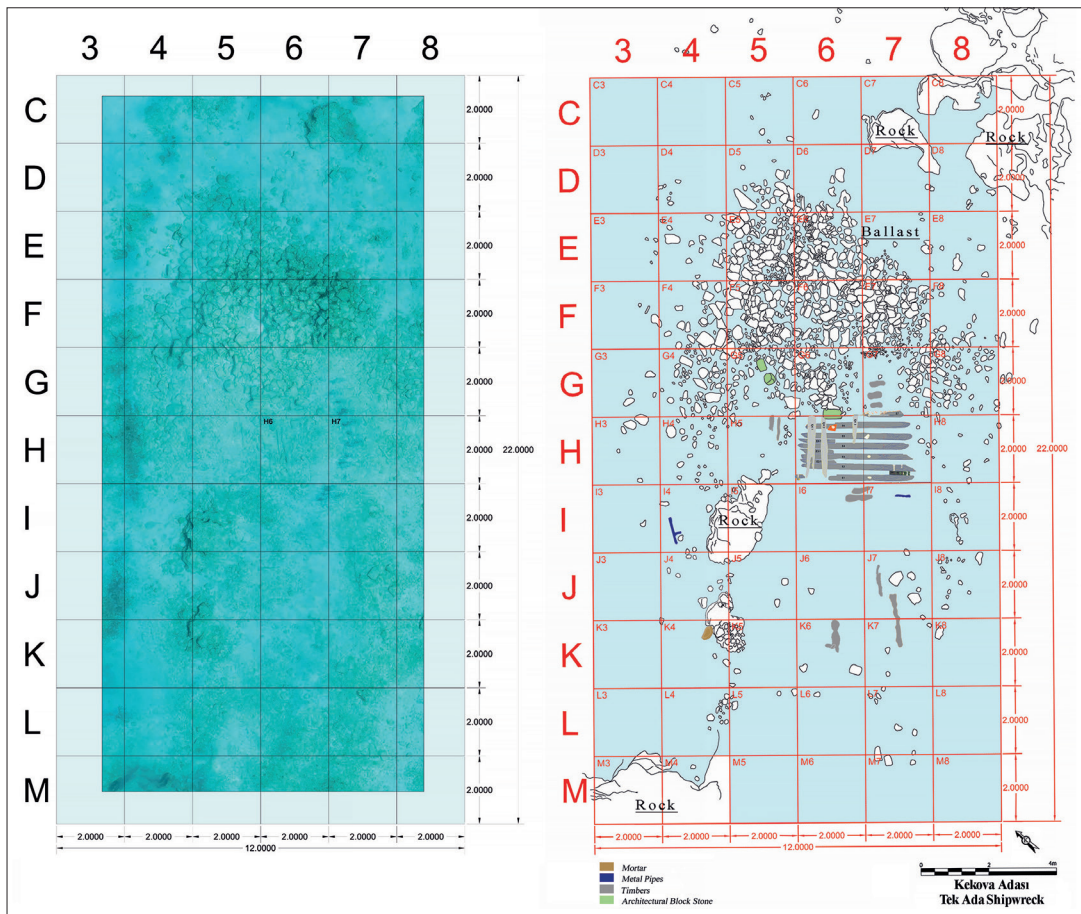


FIG. 2 Orthophoto of the Tek Ada Shipwreck before excavation and its drawing after excavation (Excavation Archive).



FIG. 3 Damage caused to wooden components by *Teredo Naualis* (Excavation Archive).



FIG. 4 Tek Ada Shipwreck location (Excavation Archive).



FIG. 5 Section of the hull uncovered during the excavation (Excavation Archive).

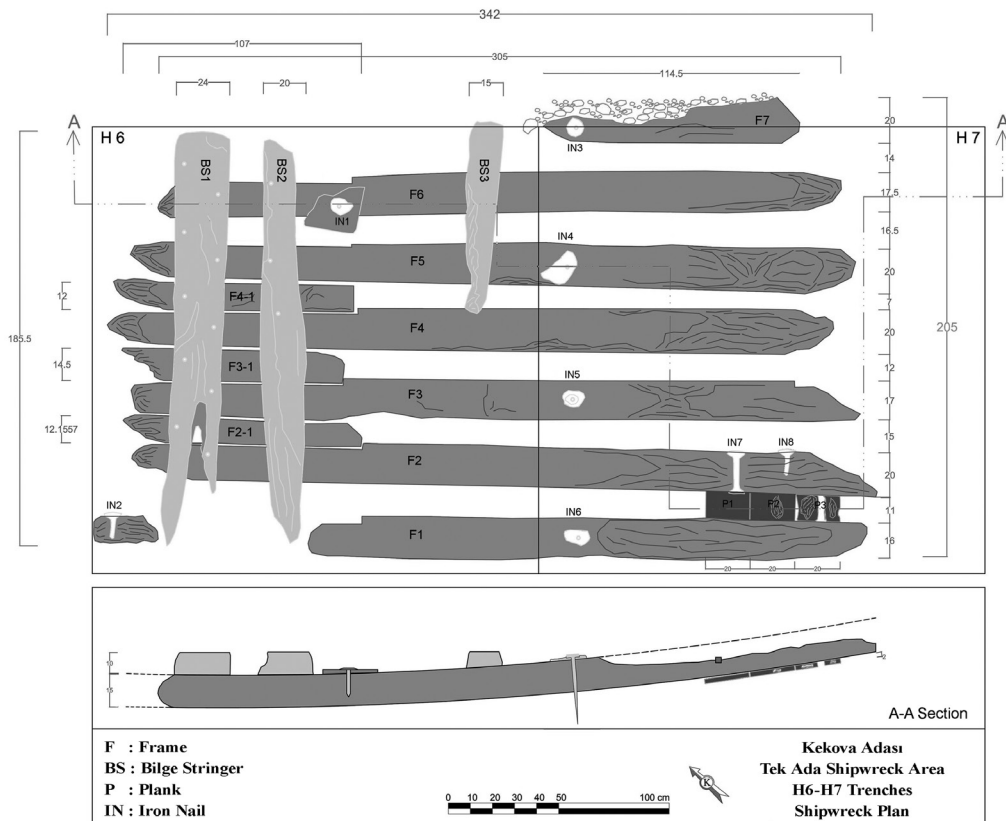


FIG. 6 Plan and cross-section of the hull remnant (Excavation Archive).

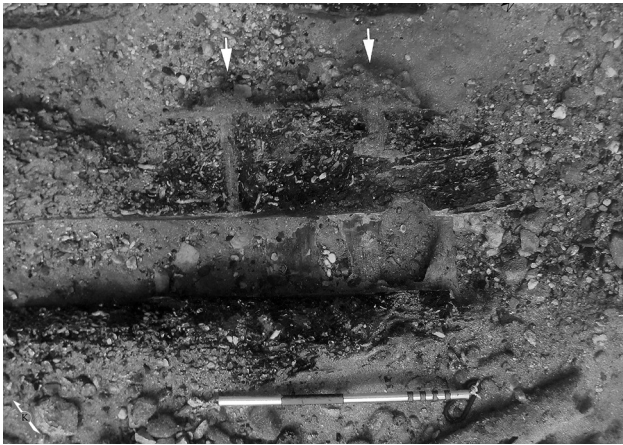


FIG. 7
Planking strakes
(Excavation Archive).



FIG. 8
Bilge stringers
(Excavation Archive).



FIG. 9
Bilge stringer detail
(Excavation Archive).

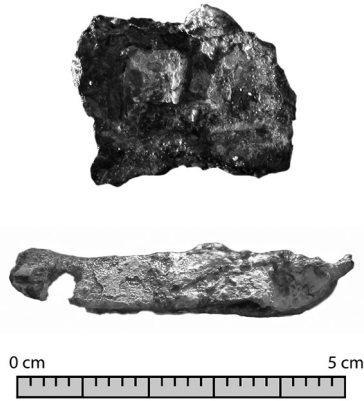


FIG. 10 Metal objects (Excavation Archive).

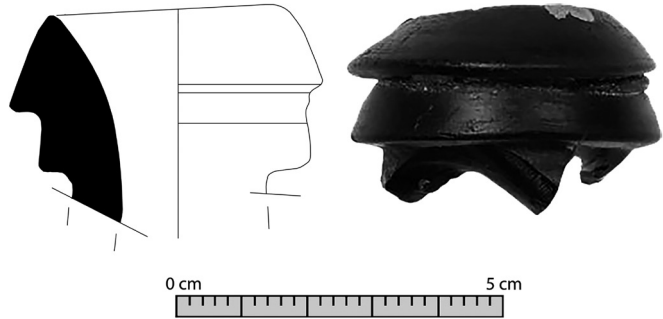


FIG. 11 Glass bottle mouth fragment (Excavation Archive).

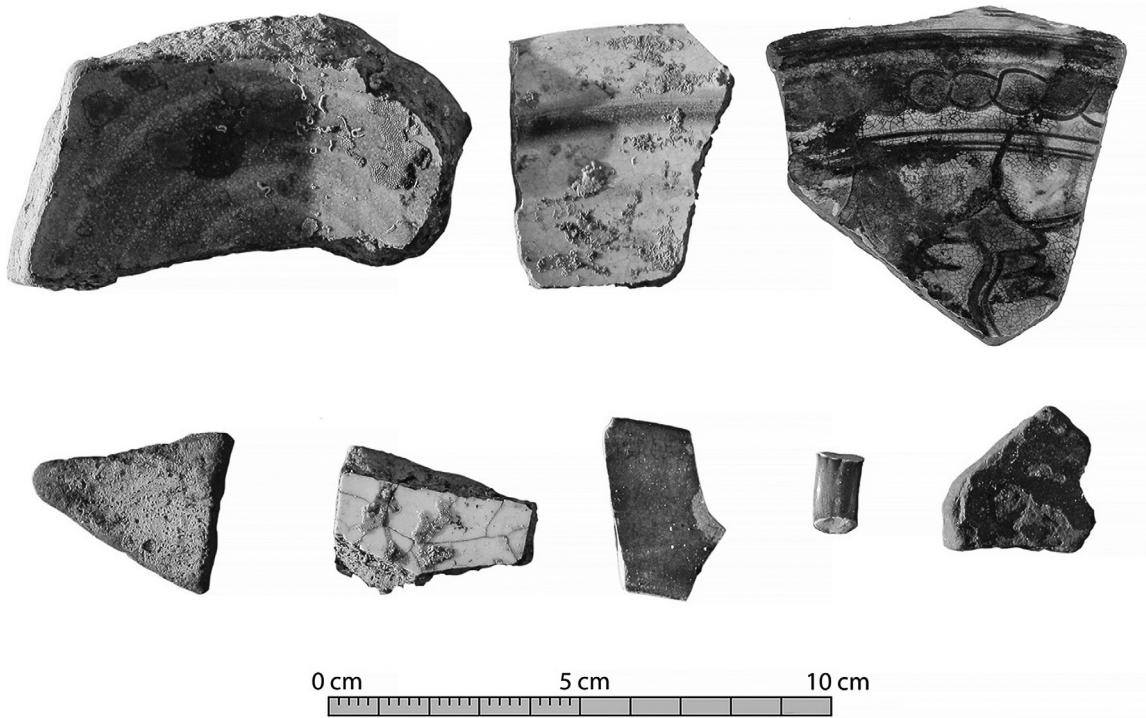


FIG. 12 Glazed ceramic fragments (Excavation Archive).



FIG. 13 Hartley Type 2 - Dramont Type 2 mortar fragment (Excavation Archive).

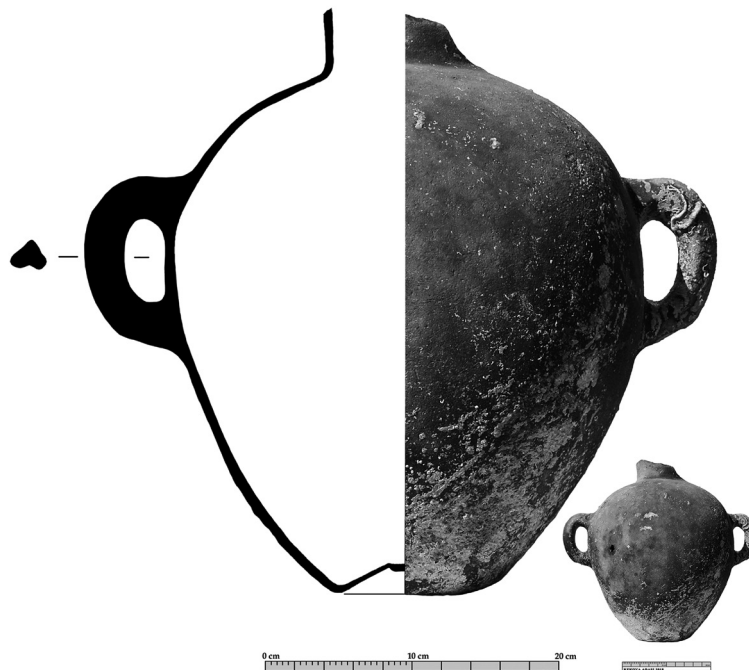


FIG. 14 Skerki Bank Type IV amphora (Excavation Archive).



FIG. 15 Jug (Excavation Archive).

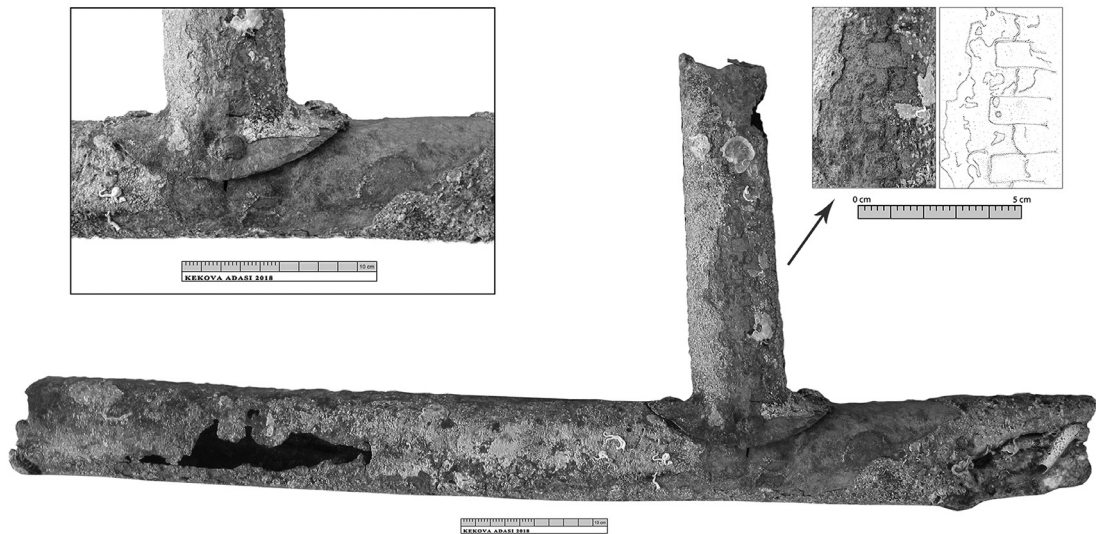


FIG. 16 Copper or copper alloy pipe fragments for ship's hardware? (Excavation Archive).

TABLE 1. Calibrated date of the radiocarbon determination
(TÜBİTAK analysis report no. 82325108-125.05-6/449).

TÜBİTAK-0542 Demre - Ahşap Gemi Parçası 166±23 -23,7±0,4

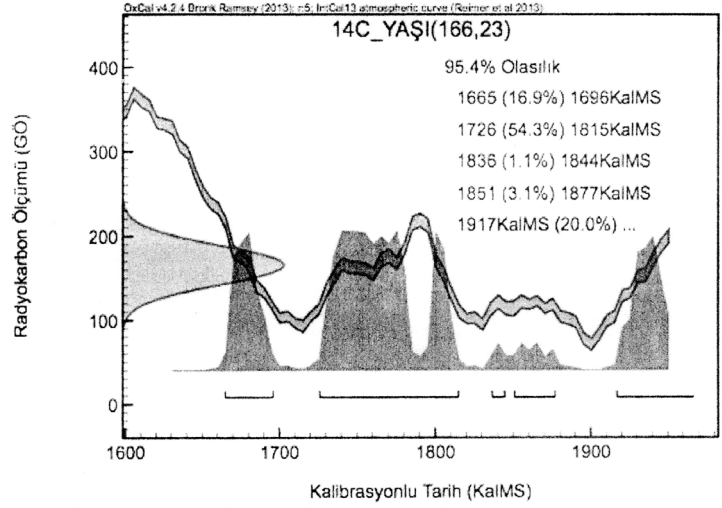
Malzeme / Ön İşlem: Ahşap / Asit - Baz - Asit

Karbon 14 Yaşı (G.Ö.): Numunede ölçülen 14C miktarına bağlı olarak delta 13C düzeltmesi yapılmış Karbon 14 yaşıdır.

G. Ö.: Günümüzden önce (MS 1950'den önce)

OxCal v4.2 Kullanılarak Kalibrasyonu Yapılmış Karbon 14 Yaşı (Takvim Yılı Aralıkları)

2 Sigma Kalibrasyonu		
	Takvim Yaşı	Olasılık
MS	1726 - 1815	%54,3
MS	1917 - ...	%20,0
MS	1665 - 1696	%16,9
MS	1851 - 1877	%3,1
MS	1836 - 1844	%1,1



Referans:

Bronk Ramsey, C., & Lee, S. (2013) Recent and Planned Developments of the Program OxCal. Radiocarbon, 55 (2-3), 720-730

Reimer PJ et al (2013). Intcal13 and Marine13 Radiocarbon Age Calibration Curves 0-50,000 Years cal BP. Radiocarbon 55 (4) 1869-1887

