

THE *LECHAION* HARBOUR PROJECT (2013-2018): EXCAVATIONS AT THE HARBOUR OF *LECHAION* IN CORINTH, GREECE

El proyecto Puerto de *Lechaion* (2013-2018). Excavaciones en el puerto de *Lechaion* en Corinto (Grecia)*

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Abstract

Corinth lies on the northeastern part of the Peloponnese peninsula in south Greece with access to both the eastern and western Mediterranean. This geographical advantage partly explains the influence the city had on ancient maritime networks and trading routes throughout the Mediterranean Sea. The harbour of *Lechaion* was one of the two ports of the ancient city, and it was located on the shores of the Corinthian Gulf. The first phase of the harbour construction is placed at around 600 BC, and recent evidence suggests that the harbour remained in use until the 12th century AD. Extensive excavations at *Lechaion* from 2013 to 2018 by the *Lechaion* Harbour Project brought to light, among many other harbour-related structures, submerged remains of exceptionally well-preserved wooden constructions. The paper presents a general overview of the results of the excavations of those harbour structures and addresses issues raised regarding their chronology, typology and the advanced building techniques employed in their construction.

Keywords: *Lechaion harbour, Corinth, timber structures, Late Roman, Early Byzantine.*

Resumen

Corinto se encuentra en la parte nororiental de la península del Peloponeso, en el sur de Grecia, con acceso tanto al Mediterráneo oriental como al occidental. Esta ventaja geográfica explica en parte la influencia de la ciudad en las antiguas redes marítimas y rutas comerciales de todo el Mediterráneo. El puerto de *Lechaion* era uno de los dos puertos de la antigua ciudad y estaba situado a orillas del golfo Corintio. La primera fase de la construcción del puerto se sitúa en torno al año 600 a.C., y pruebas recientes sugieren que el puerto siguió en uso hasta el siglo XII d.C. Amplias excavaciones realizadas en *Lechaion* entre 2013 y 2018 en el marco del Proyecto del Puerto de *Lechaion* han descubierto, entre otras muchas estructuras relacionadas con el puerto, restos sumergidos de construcciones de madera excepcionalmente bien conservadas. El artículo presenta una visión general de los resultados de las excavaciones de dichas estructuras portuarias y aborda las cuestiones planteadas en relación con su cronología, tipología y las avanzadas técnicas constructivas empleadas en su construcción.

Palabras clave: Puerto de *Lechaion*, Corinto, estructuras de madera, época romana tardía, época bizantina temprana.

* La traducción del título al castellano, el resumen y palabras clave se deben a los editores.

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In strongly sea-oriented societies maritime affairs were predominant, overshadowing almost every aspect of life (Arnaud and de Souza, 2016). Sea routes, prevailing winds, landscapes, seascapes, sailing rules, agencies and communities are the composed parameters that illustrate what could be called maritime culture (Arnaud, 2005). The tighter the bond between community and the sea the easier it is to identify and deconstruct the maritime components that constitute a maritime culture. Under this scope, harbours play a vital part in history making, and inevitably ancient harbour studies have developed significantly within the archaeological and academic community in recent years (Blackman, 1982, 79-104 and 185-211; Hohlfelder, 1997, 367-380; Rickman, 2008, 5-8; Keay, 2012; De Graauw, 2017; Keay and Arnaud, 2020).

In this context, extensive underwater excavations at the site of *Lechaion* were conducted by the *Lechaion* Harbour Project from 2013 to 2018 and brought to light, among many other harbour related structures, submerged remains of exceptionally well-preserved timber constructions¹. The remains consist of several wooden formworks and posts, all forming supplementary piers or jetties to the existing massive stone structures. They constitute a unique archaeological find in Greek seas and are rare in the Eastern Mediterranean Sea (Hohlfelder, 1988, 54-62; Brandon, 2011, 121-138; Brandon, 2014, 189-222). The extensive historical presence of *Lechaion* harbour and its almost uninterrupted use for many centuries signifies a highly dynamic environment in terms of geological, historical, and archaeological developments (Lovén *et al*, 2018, 85-90).

The city of ancient Corinth lies on the northeastern part of the Peloponnese peninsula in south Greece (Fig. 1). That exceptional geographical position partially explains the crucial impact the city had in the history of the ancient world (Athanasoulis, 2013, 192-195). With access to both the Corinthian and the Saronic Gulf, it was expected to turn to the sea and gradually create the suitable maritime infrastructures to support her growing needs (Pettegrew, 2014; 137-140; Sanders, 2014, 119-120). Corinth is credited by ancient historians with a strong maritime tradition, and ancient and modern literature suggest that most of the city's wealth derived from the maritime trade that passed through her two harbours, Kenchreai and *Lechaion*, which were crucially placed on the eastern and western side of the Isthmus of Corinth thereby connecting the eastern and western basins of the Mediterranean Sea (Sanders, 2005, 4-14; Rothaus, 2000, Brown, 2019).

The harbour of Kenchreai was built on the shores of the Saronic Gulf at a substantial distance from the city (Scranton *et al.*, 1978). Hence the necessity for a harbour more closely associated to the city was fulfilled with the construction of *Lechaion* harbour on the Corinthian Gulf. The harbour was situated on the north shores of the Peloponnese peninsula facing onto the Corinthian Gulf less than three kilometers from ancient Corinth. The harbour site was later incorporated into the city walls and could offer a clear gateway to the north and to the west (Fig. 1). The first phase of harbour construction in *Lechaion* should be placed around 600 BC. It could be associated with the preliminary planning of the diolkos and the initial colonization expeditions to the west. Vast numbers of small-scale industries and merchants were active in Corinth at that time. Their products together with the crops of the fertile Corinthian land were facilitated through the Corinthian harbours across the sea and brought together the citizens of the newly founded colonies with the metropolis of Corinth (Freitag, 2005; Salmon, 1984, 80, 135, 141, 148). After several centuries of being at the forefront of historical processes, Corinth was sacked by the Roman General and Consul Lucius Mummius in 146 BC. After almost 100 years in 44 BC, Colonia Laus Julia Corinthiensis was founded and signaled a new, monumental era for

¹ The *Lechaion* Harbour Project is a collaboration between the Danish Institute at Athens and the Department of Underwater Antiquities of the Greek Ministry of Culture and Tourism. The project is directed by Dr. B. Lovén and Dr. D. Kourkoumelis and co-directed by P. Micha and P. Athanasopoulos. Work has been funded primarily by the Carlsberg Foundation and the Augustinus Foundation and has been generously assisted and facilitated by the former Director of the Danish Institute at Athens, Dr. K. Winther-Jacobsen, and former Directors of the Department of Underwater Antiquities of the Greek Ministry of Culture and Sports, Dr. A. Simossi and Dr. P. Kalamara.



Fig. 1. Aerial photograph of *Lechaion* harbour (GoogleEarthPro 2014). In upper right corner, map of Corinth and Environs (©American School of Classical Studies in Athens).

the harbour of *Lechaion* (James, 2014, 17-37; Gregory, 1993). Years of constant expansion and building works followed and consequently *Lechaion* flourished and reclaimed its predominant position in Mediterranean seafaring. The last monumental building erected in the area must have been the large Basilica on the western side of the port. It was built at the end of the 5th-early 6th century AD, and it was the largest religious building of its time (Pallas, 1959, 126-140; Pallas, 1962, 69-78; Slane and Sanders, 2005, 243-248). The remaining harbour structures seem to have been in use at least until the 12th century AD (Kordosis, 1981; Sanders, 2002, 649-652)². Throughout its history, the harbour of *Lechaion* varied greatly in size and use and served as both a military and commercial harbour (Shaw, 1969, 70-72; Wiseman, 1978, 82-88, Rothaus, 1995, 293-306; Theodoulou, 2002, 83-99). The constant function of the site for more than a thousand years is unequivocal proof of its significance for the city of Corinth regardless of the existing regime or the origin of its rulers.

Nowadays, the visible structural remains cover an area of more than 170.000 m² both on land and underwater (Fig. 2). The harbour front is more than one kilometer long and the port structures extend more than 550 m inland from the current shoreline. The total size of the harbour area is more than 500.000 m², which means that it is the largest known artificial harbour in Greece. It is very important to stress that regardless of the lack of any natural features that would favor the construction of a harbour, and even though the area was completely exposed to the prevailing north/north-western winds, the Corinthians decided to overlook those constraints and build a port there (Oleson, 1988, 147-148; Marriner *et al.*, 2017, 382-403). The reasons were as mentioned above: the proximity of the area to the city of Corinth and the open navigation corridor it could offer to the west. The artificial harbour that was subsequently created occupied a marshy area located on an ancient river delta, which was dredged accordingly to incorporate the necessary harbour basins and connecting channels. Many of the

² This is further supported by the ongoing study of the ceramic material retrieved from the underwater excavations on the site from 2014 to 2018. The soon-to-be-published ceramic assemblage from the outer harbour by P. Micha and K. Vafeiadou indicates extensive use of the harbour area until at least the end of the 12th century AD.

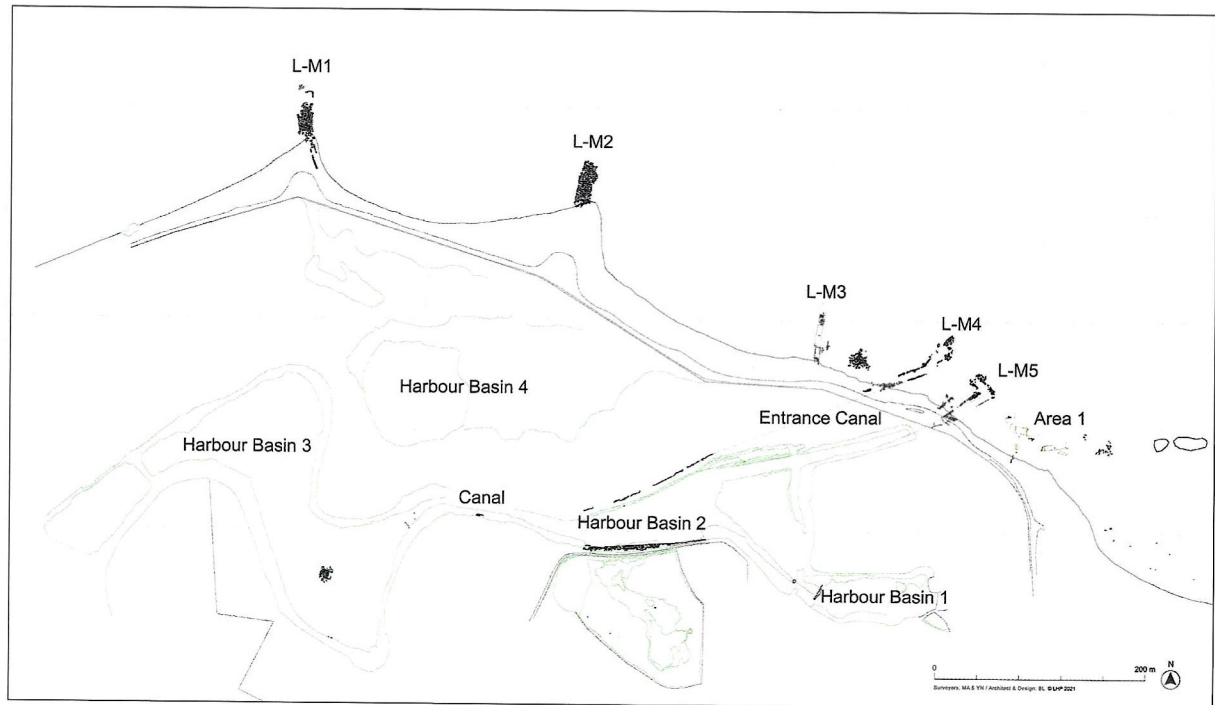


Fig. 2. General plan of the harbour (©Lechaion Harbour Project).

visible structural remains in the inner and outer harbour should be dated to the Roman period and the early Byzantine period. Today, the inner harbour is a wetland area, home of unique fauna and flora. The monumental remains of the outer harbour are still preserved in shallow depths (often protruding out of the water) along the modern beach. The well-attested sea level change in the Mediterranean Sea and the specific geological conditions of the Corinthian Gulf are partially responsible for the submergence of the outer harbour structures (Papadopoulos *et al.*, 2000, 9-119; Stiros, 2005, 79-89).

A detailed topographical documentation of the inner harbour took place between 2016 and 2017 and offers a better understanding of the layout of the harbour area (Fig. 2). In the eastern part of the harbour area, there is a stone-built L-shaped entrance that connects the outer harbour with the inner harbour. The entrance canal is approximately 195 m long and leads directly to Harbour Basin 2. The width of the channel varies from 30 to 50 m. The noticeable difference in width must be connected to the gradual silting of the canal. Smaller canals lead to the somewhat isolated Harbour Basin 1. Harbour Basin 2 has a rectangular shape and measures almost 214 x 110 m. It is divided into two separate parts by a late Roman quay that is 102 m long and 5 m wide. From the latter basin, there is a 168-m-long and 13-m-wide canal that connects it to what seems to be the main harbour basin, Harbour Basin 3. This basin has an S-shape and is 302 m long and 142 m wide. Most of the inner harbour basins are heavily silted, although they maintain some level of water throughout the year (the depth varies from a few centimeters up to 1.50 m).

As one would sail towards the harbour area from the west, the two structures that stand out are the massive stone moles in the western part of the outer harbour (Fig. 3). The structures are now partially submerged but at the time of their construction they would also function as breakwaters. Both continue further south under the modern shore and most probably would have connected either to the city walls or to other inner harbour structures. Mole L-M1 was traced and documented for a total length of 70 m with maximum width of 15 m. The structure consists of very large rectangular blocks and is preserved to a height of three courses. Accordingly, 250 m east of and parallel to Mole L-M1 there is a mole similar in construction, Mole L-M2, which is exposed for a total length of 35 m and a width of 16 m.



Fig. 3. Aerial photograph of Moles L-M1 and L-M2 (photographers: K. Xenikakis and S. Gesafidis).

This structure is made also with ashlar masonry and preserves three courses of rectangular blocks.

Underwater excavations at the stone structures of the outer harbour yielded significant results with regard to ceramic distribution, building techniques, and stratigraphic sequences. However, it was not until those results were correlated with the results of the extensive geoarchaeological survey and the analysis of the core drills performed at the site that we acquired a better overview of the geomorphology of the harbour area and established that the area between Moles L-M1 and L-M2 was used as a basin before the Roman period of the port. In general, sites like *Lechaion* that extend in space and time require such an interdisciplinary approach to provide the best results³.

What was evident from the beginning of excavations at *Lechaion* was the good state of preservation of organic material. Even if one would expect such conditions in the marshlands of the inner harbour this is rarely the case for remains underwater, especially in the Eastern Mediterranean. Nevertheless, it was soon proven that similar preservation conditions could be found in the submerged areas of the outer harbour. The small wooden objects recovered from the basins of the inner harbour were tallied with the substantial wooden harbour structures discovered in the outer harbour. Underwater excavations from 2014 to 2018 brought to light four different areas of timber harbour structures that cover an area of 1200 m². Two of those areas include wooden formworks (caissons), and the other two include

³ In the case of *Lechaion* harbour, the geomorphological survey and the geological drills were conducted by Dr. A. Chabrol, Dr. H. Delille and Dr. J.P. Goiran of Maison de l'Orient et de la Méditerranée, University of Lyon. The geophysical survey in the outer harbour took place in 2016 by Professor G. Papatheodorou and Dr. D. Christodoulou from the University of Patras, Greece.

wooden posts either supplementary to the stone moles or separately forming smaller structures. All of them are located around the L-shaped harbour entrance-canal (Fig. 2)⁴.

The first area is west of the entrance channel and consists of six rectangular wooden formworks placed end to end, perpendicular to the shore, all together forming a jetty with a total length of 60 m (Mole L-M3) (Fig. 4). Each caisson measures approximately 10 x 5 m with a height of almost 0.80 m. Excavations took place on two of those formworks (Caisson 5 and 6). Their construction is quite straightforward. There is a frame consisting of four thick beams. The long side beams (N-S) overlap the narrow side (E-W) beams and are put together only with shallow mortises. Dimensions of the longer beams are 0.25 x 0.25 m and of the smaller one is 0.22 x 0.17 m. A series of semi-round posts (with straightened inner side) are placed perpendicular to the beams to form the upper part of the construction. Shallow mortises are cut on the beams to support the posts. The corner posts are different in shape as they appear more rectangular with an L-shaped edge. Corner posts accommodate the three preserved side planks of the caissons. The side planks are about 0.25 m wide and 0.06 m thick. They are directly nailed on the semi round posts from the inner side. Based on excavations on the southwest corner of Caisson no. 5, the formworks also seem to have had a plank floor. Small beams are fitted into the longer frame beams and planks are placed perpendicular on top of them. Side planks seem to have been plastered from the inside with a simple limestone mortar. The remaining layer of the mortar is now encrusted with natural debris; the original purpose of its application remains unknown. Each caisson was filled with aggregated rubble consisting of irregular size stones (Fig. 5). Currently, structures are preserved at a maximum depth of 1.50 m. As it seems, at the time of their construction they would have been placed in very shallow waters to function as foundations for an upper structure. The reason they are preserved so well is partially because of the low salinity of the waters there (mixed with fresh water of natural springs) and because they were quickly covered with sand, thus remaining in an anoxic environment. Whether this happened on purpose or because of the constant wave action that led to the rapid accumulation of sediments remains unknown. The wood species analysis of samples taken from Caisson 5 has shown that planks are made of *Pinus nigra* and the upright elements are of Greek fir (*Abies*). Both species are known to have been in abundance in Greece and in the Peloponnesian forests already from before Roman times (Meiggs, 1982, 39-48). Visual observations and detailed digital survey on the exposed parts of the other four caissons indicate a similar type of construction. Time constraints and preservation challenges led the project to leave them unexcavated for now.

On the eastern end of the harbour, we have another area with wooden caissons (Area 1) (Fig. 2). In this area we have a total of 11 formworks, each one measuring 10 x 5 m. The formworks here appear similar in size and construction with those in Mole L-M3. What is different in this area is that they are placed in a different manner and seem to create a large (550 m²) plateau. Whether this layout was destined to function as a loading platform, which would be useful next to the harbour entrance, or served as a foundation level for a larger structure, is still under discussion. Those remains are preserved in very shallow waters (less than 0.50 m) in the surf zone. Most of the formworks preserve only their lower part. The constant wave action and the harsh weather conditions are clearly endangering the integrity and preservation of the structural remains. Therefore, instead of excavating any of those remains we conducted an extensive digital documentation of the area followed by an in-situ conservation scheme to fully cover and protect the exposed remains. Preliminary ¹⁴C analysis of the wood date the structure to the 4th century AD. This could be connected to harbour works conducted in the years between 353-358 AD, as it is known by an inscription found in Corinth (Kent, 1966, 164, n^o. 503).

⁴ With respect to the editor guidelines for the size of the current article, only a brief description is to be fit. The full volume of data and documentation would far exceed the purposes of this presentation.



Fig. 4. Top plan of wooden caissons on the left. On the right, aerial photograph of the caisson area (photograph: S. Kokkinakis ©Lechaion Harbour Project).



Fig. 5. Western side of Caisson n°. 5 (photograph: V. Tsiaris ©Lechaion Harbour Project).

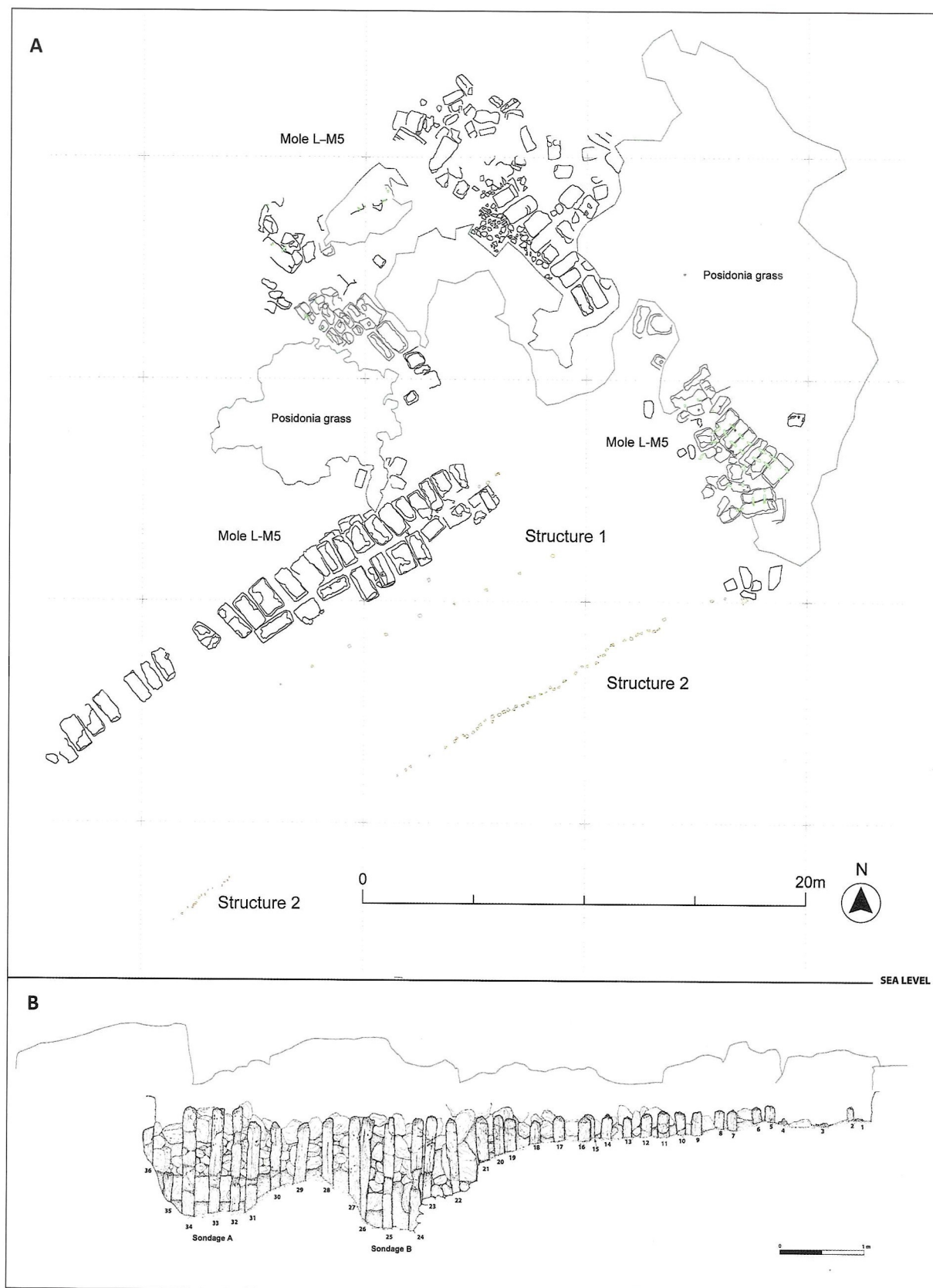


Fig. 6. A) Plan of wood pilings east of Mole L-M5; B) Cross section of posts in area of Mole L-M4 on top (©Lechaion Harbour Project).

In 2016, a row of round wooden posts was discovered west of the entrance channel, west of Mole L-M4 (Fig. 2, 6B). L-M4 consists of large rectangular blocks. However, in the middle of the western outer face of the mole there seems to be a shift of the blocks of the wall. The 40 wooden posts run parallel and at a very close distance to the wall most probably functioning as a repairment. In between the posts and the blocks is a rubble fill with small- and medium-size stones. The rubble fill layer exceeds the height of the posts and reaches the top course of the blocks of the mole. Each post has a height of approximately 1.30 m with a diameter range of 0.10-0.12 m. All posts are simply inserted into the soft sandy sediments of the seabed. The exposed parts of the posts are heavily eroded mainly due to *teredo navalis* (Eriksen *et al.*, 2015, 9-15). Smaller cracks, splits, and bends observable on the wood could be from the expected mechanical stress of the material.

Similarly, two rows of well-preserved round wooden posts were discovered and excavated just east of the entrance channel, east of Mole L-M5 (Fig. 2, 6A). The pilings in question are parallel to each other and perpendicular to the modern shoreline. The westernmost one (Structure 1) consists of 9 posts. Each post is placed 1.5 m apart. The total length of the structure is 13.7 m. Structure 2 lies 5.5 m east of Structure 1 and consists of 65 posts that are very densely placed. Structure 2 is 29 m long in total. Both rows seem to continue northwards and southwards. As with the posts in L-M4, they are directly placed on the seabed without prior foundation layering. In the space between the two pilings there is a compact rubble fill. The fill is still preserved to what would be its original height, just below the top level of the posts; this is an indication that both rows are part of the same structure that was most probably used as the foundation for a wharf or jetty. This idea is further enhanced by the fact that the dense placement of posts in Structure 2 most probably defines the eastern edge of the construction as it would require a more robust construction. Structure 1 would have been further supported by the blocks of Mole L-M5 and therefore only few posts were needed. Also, east of Structure 2 the seabed consists of fine sand without any signs of manmade interference. Posts in Structures 1 and 2 and the posts from Mole L-M4 were sampled for microscopic and macroscopic analysis; the best anatomical matches show that the timber used belongs to the white oak family and specifically to the *Quercus pubescens* and *Quercus frainetto* species. In the north Peloponnese, white oaks constitute one of the oldest known forests (Meiggs, 1982, 39-48) and it seems that the use of local resources was the standard practice for the *Lechaion* harbour structures. Finally, the ^{14}C analysis on different wood samples from this area provide a terminus ante quem between 536 and 871 AD with a chronology between 536-644 AD to appear the safest so far.

In general, an important task for the *Lechaion* Harbour Project in each field season was the protection of the exposed wooden remains. At the end of every excavation year, all structures were meticulously covered with non-woven geotextile prior to backfilling. In many cases, a small ditch was dug around the wooden structures and was filled with fine quartz sand (grain size: 0.01-0.04 m). The use of such sand prevents to a certain extent the growth of wood degrading microorganisms and wood borers that are harmful to the timbers (Treu *et al.*, 2019, 10180-10184). For the final backfilling, custom made hessian sacks were used, replacing the commonly used plastic bags and thereby minimizing the environmental impact the excavation has left⁵.

The harbour area of *Lechaion* extends for more than one kilometre along the north coast of the Peloponnese. Although at close distance from the modern city of Corinth, it has been overlooked archaeologically. The first attempt of systematic archaeological work at the site and the awareness that that subsequently created has led to discussions about the sustainable management of the archaeological site and the adjacent area. In a site largely untouched to date, the *Lechaion* Harbour

⁵ The demanding task of in situ conservation was designed and implemented by the conservator of the *Lechaion* Harbour Project Dr. A. Zisi. In general, regarding conservation practices for waterlogged wood through the eyes of cultural heritage conservator, see Zisi, 2021, 2-23.

Project attempted to detect the historical and topographical transformations of the harbour site, to clarify research ambiguities, to demonstrate how the harbour supported the city in different historical periods and to highlight the involvement of the harbour in important historical events that eventually shaped the construction or deconstruction of it. An international, interdisciplinary team of 35 people have devoted themselves to the project, on and off the site. The initial five-year phase of excavations was concluded in 2018 but more fieldwork is already planned. The study of the material and the detailed laboratory analyses that are currently underway will result in a coherent and detailed publication.

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The Lechaion Harbour Project (2013-2018): Excavations at the harbour of Lechaion in Corinth Greece

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Dimitris Kourkemelis, Micha Paraskevi, Hellenic Ministry of Culture and Sports,
Department of Underwater Antiquities





ATHANASOPOULOS, P., LOVEN, B., KOURKOUMELIS, D. & MICHA, P.

The Lechaion Harbour Project (2013-2018): Excavations at the harbour of Lechaion in Corinth, Greece



LECHAION HARBOUR
PROJECT
@LechaionHarbourProject



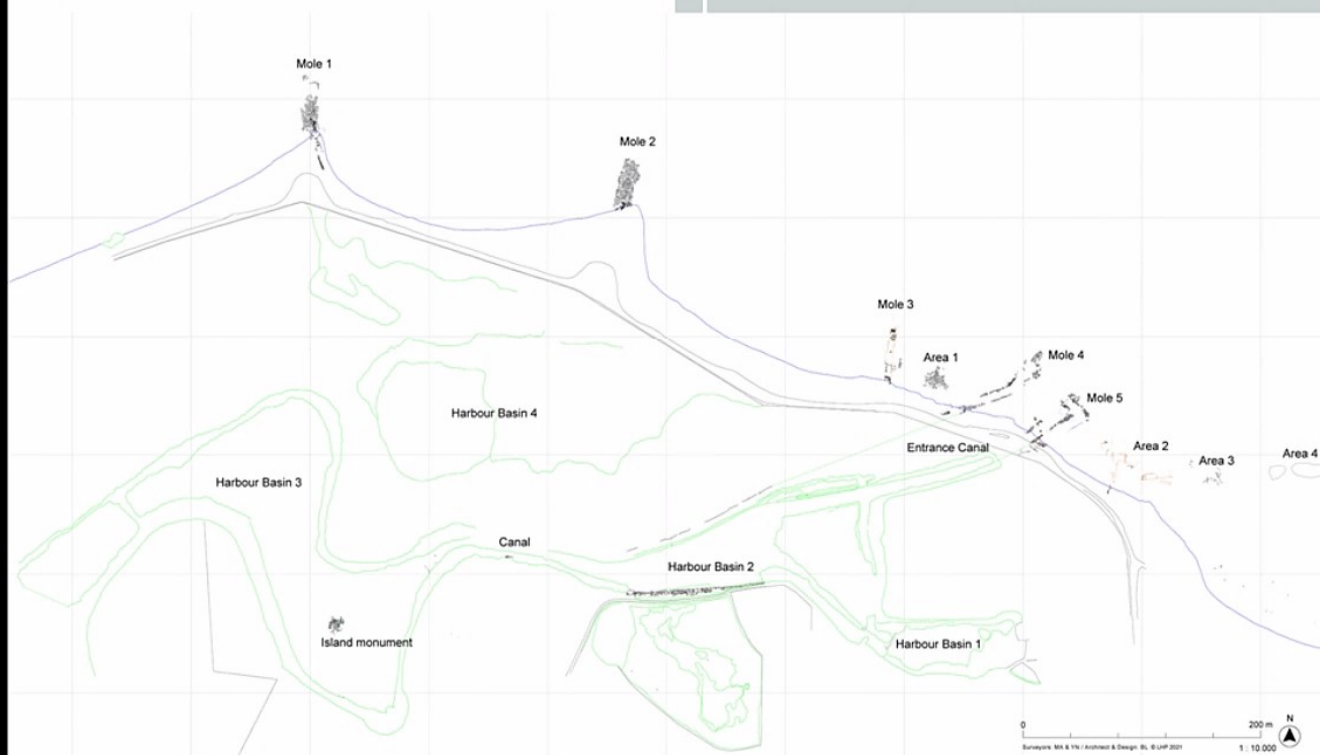
Lechaion – the site in 2013

Google Earth Pro (2013)



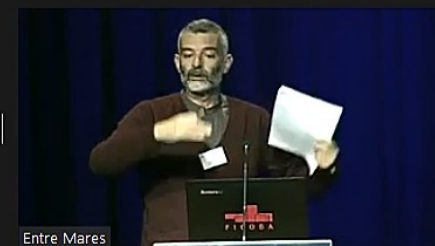
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Lechaion Harbour

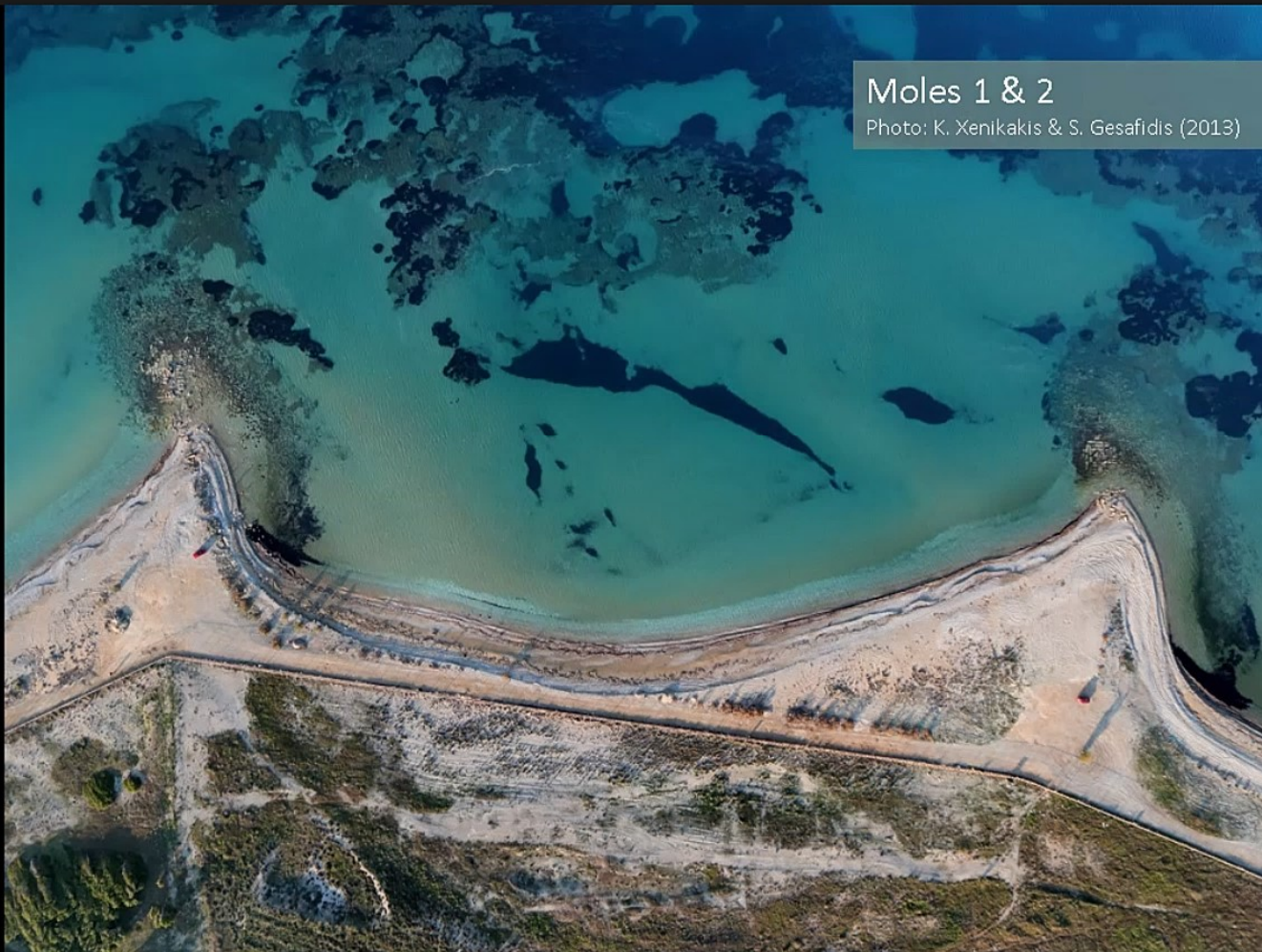


Inner Harbour- Harbour Basin 3

Photo: Spyros Kokkinakis (2017)

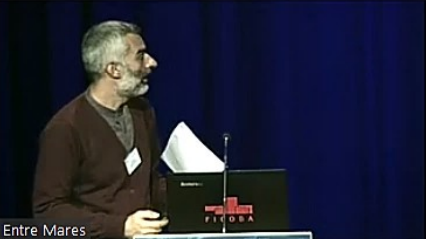


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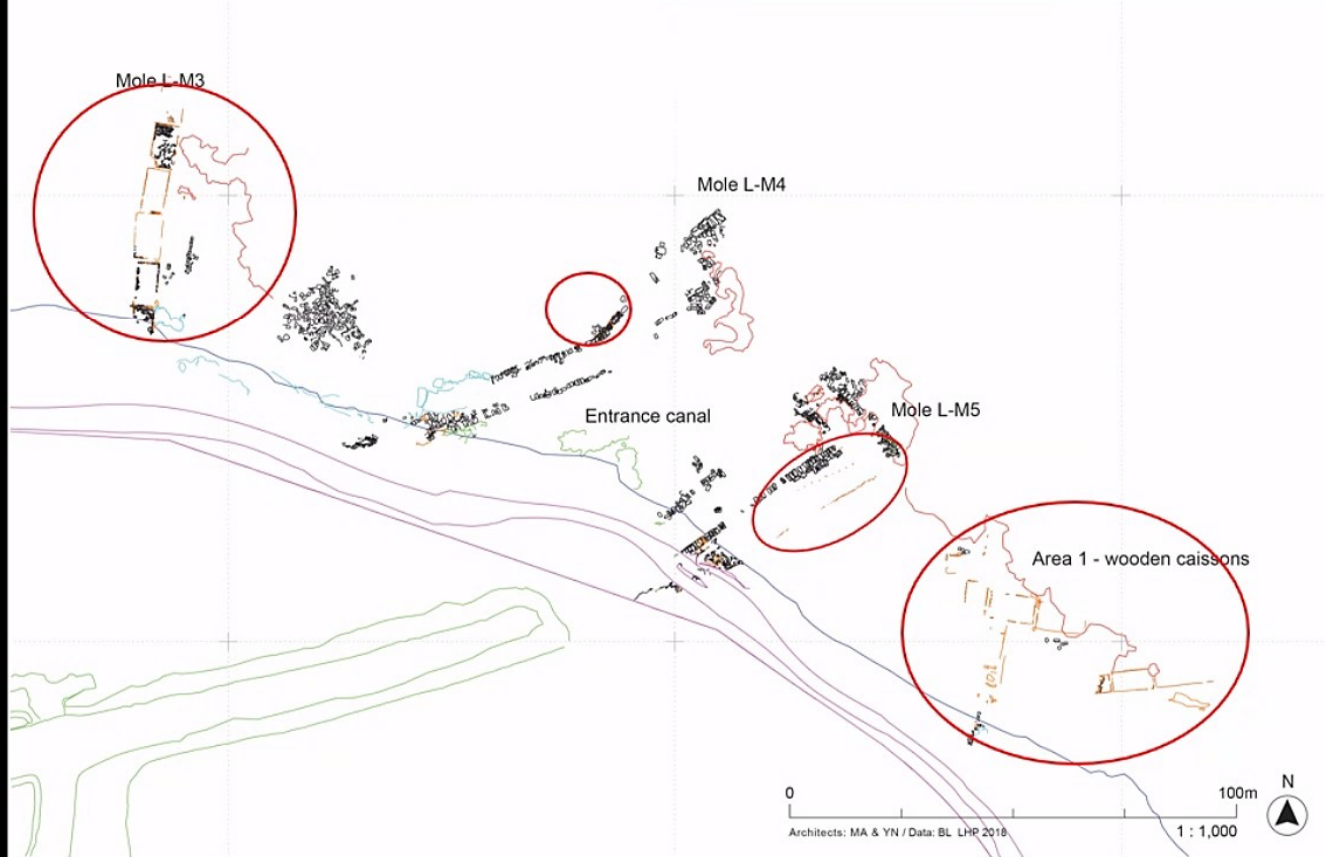




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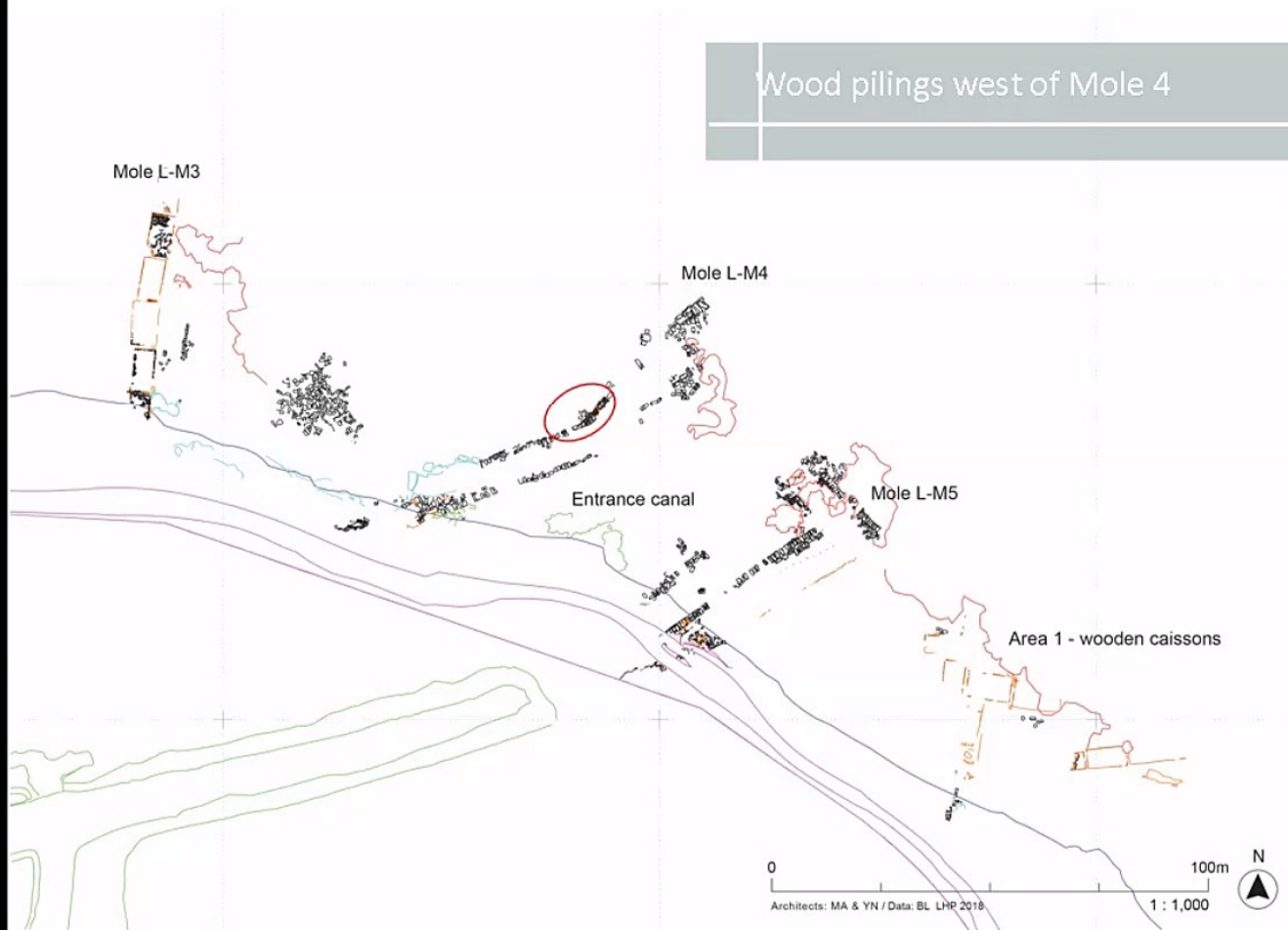


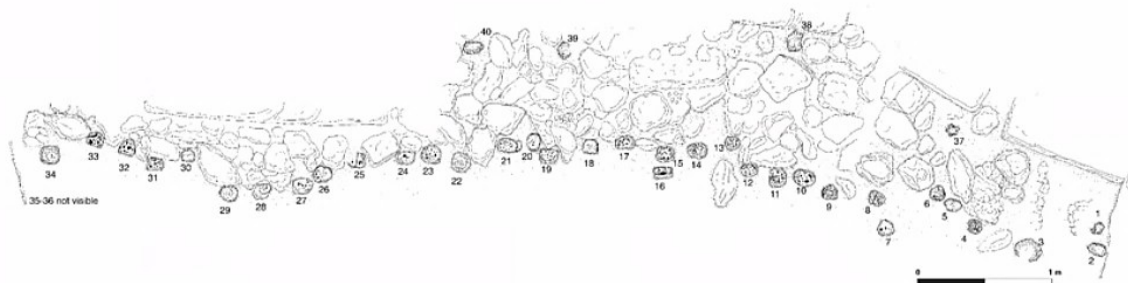
Lechaion Harbour-Entrance Canal Area



Entre Mares

Wood pilings west of Mole 4

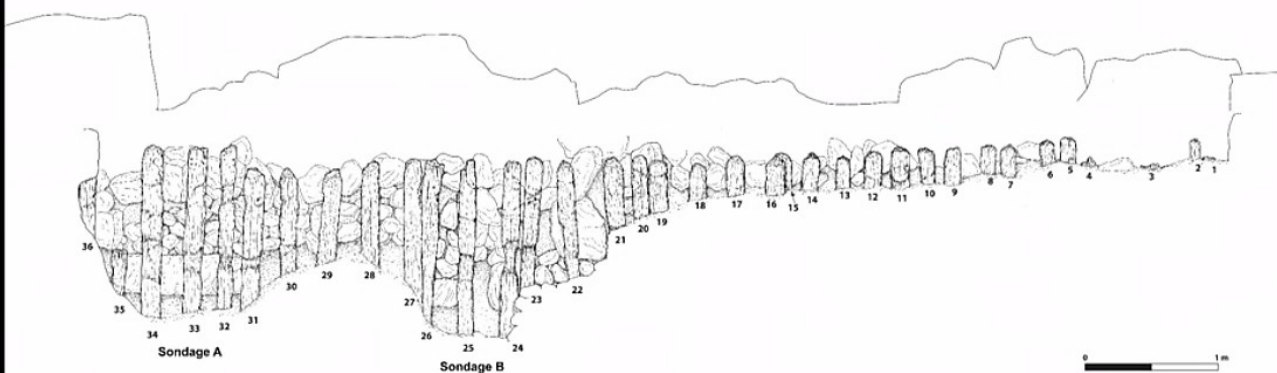




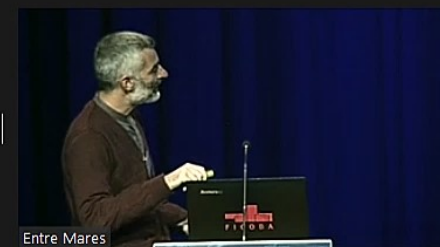
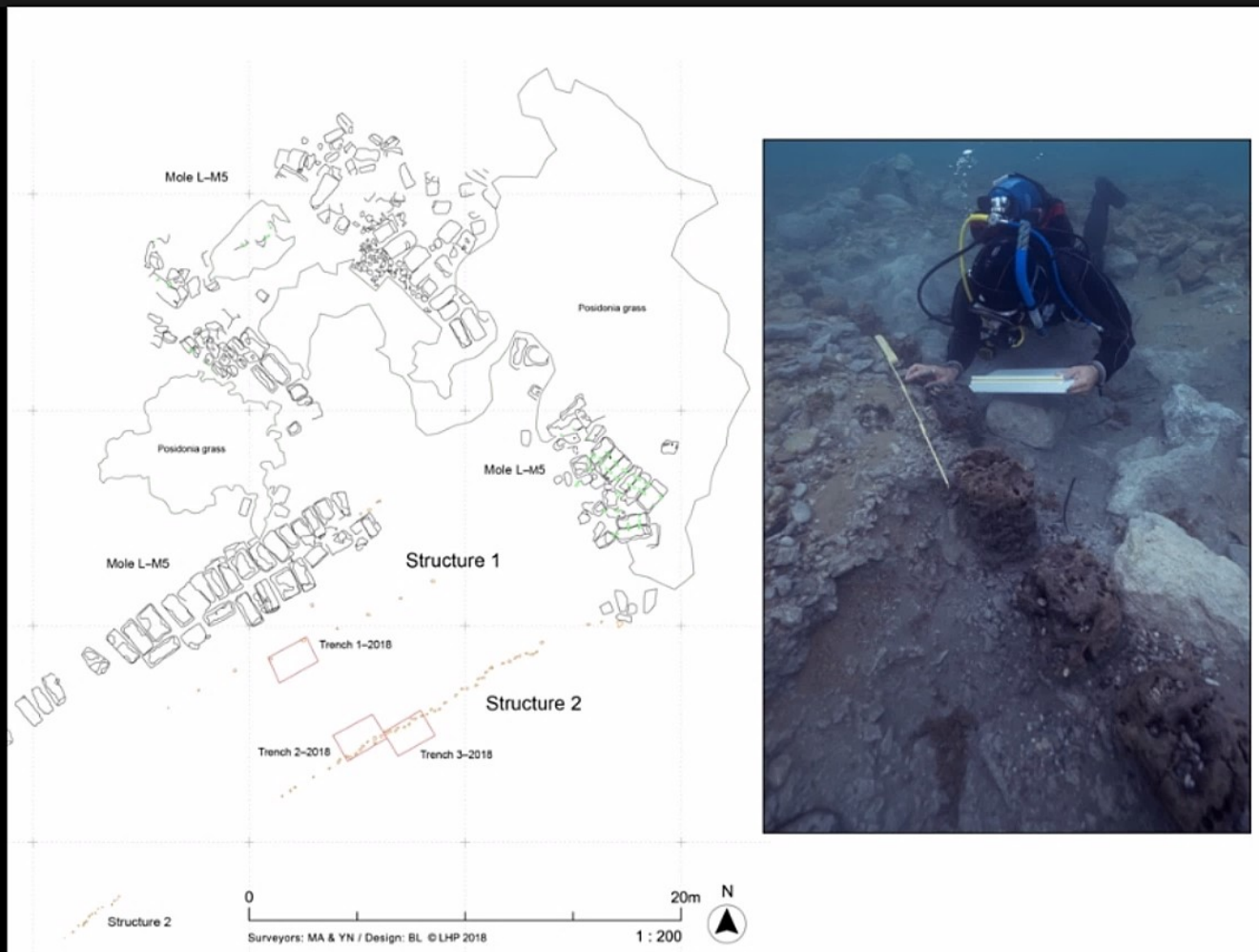
Plan and section of wooden bulwark facing Mole 4

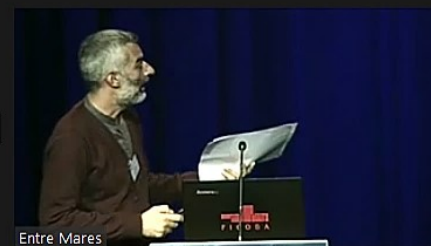
Illustrator: Yiannis Nakas (2016)

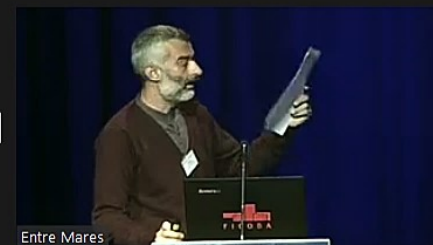
SEA LEVEL

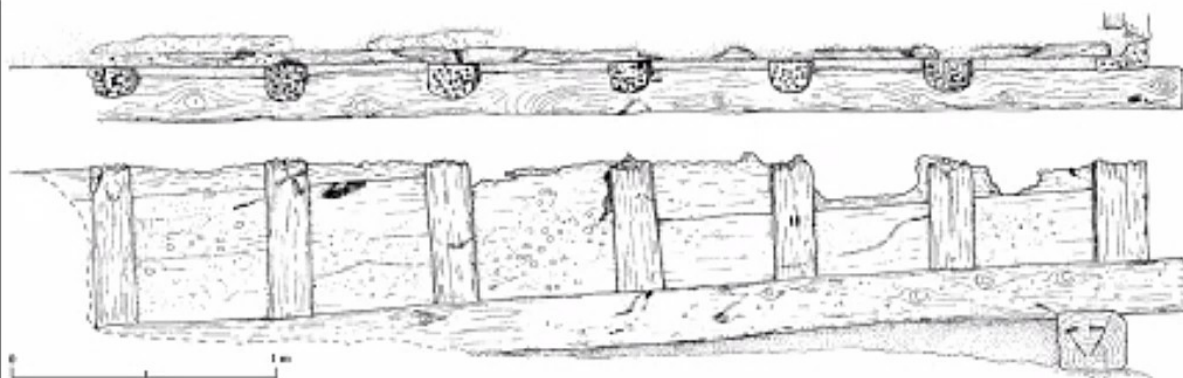




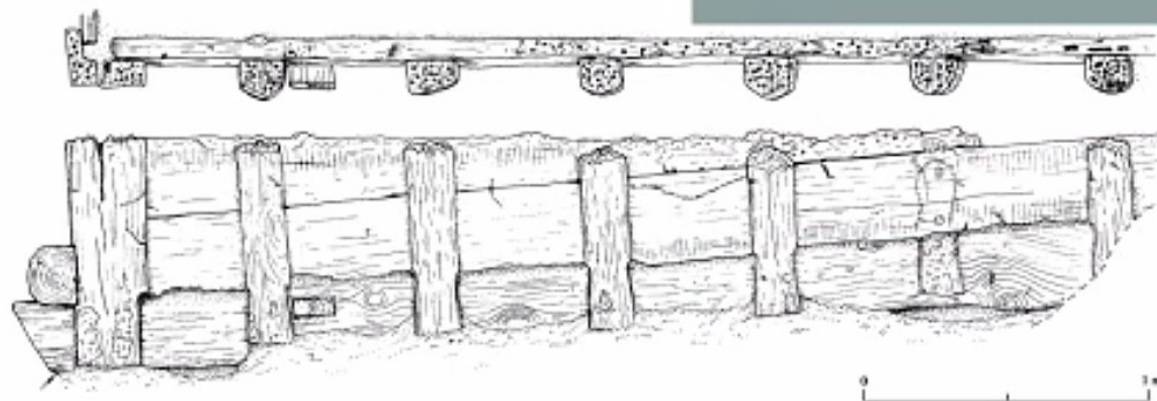




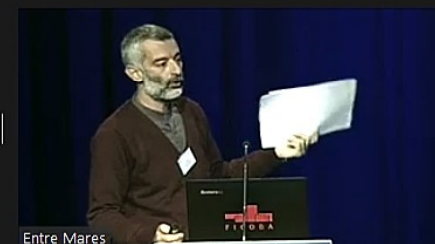




Caisson 5, northern side
Drawing: Yiannis Nakas (2015)



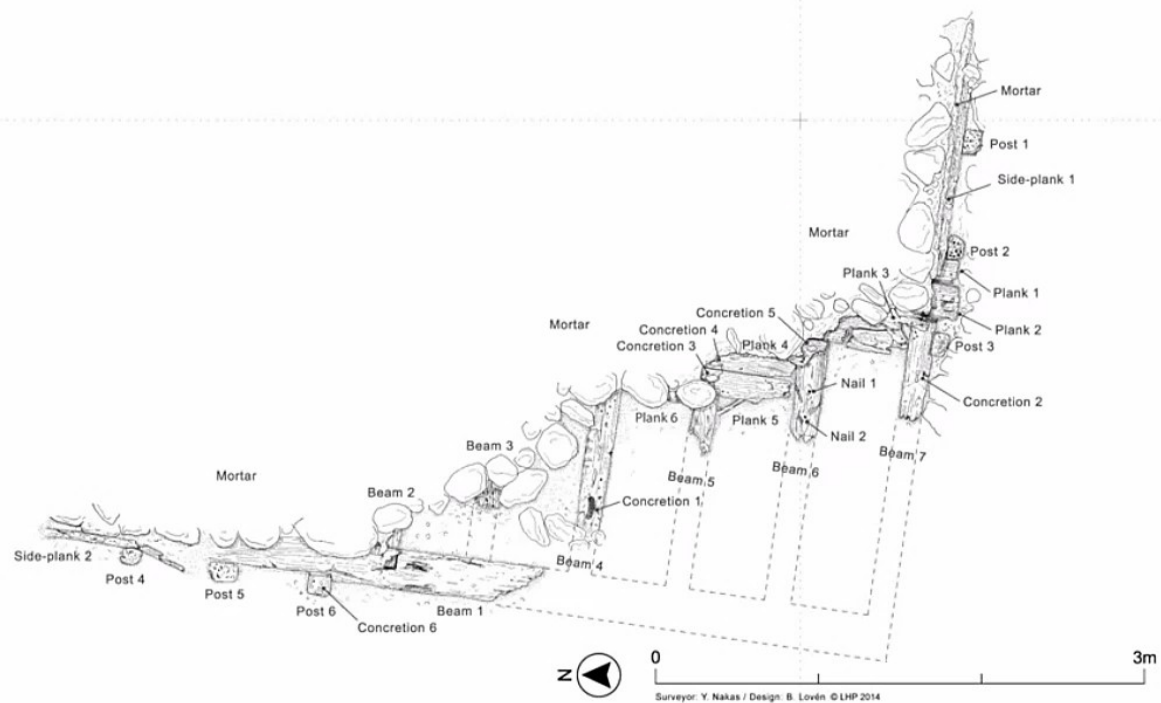
Caisson 5, western side
Drawing: Yiannis Nakas (2015)

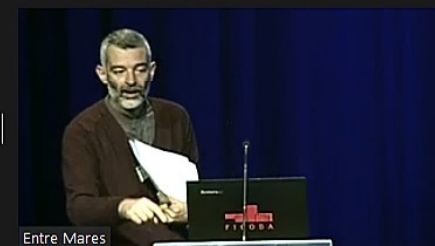
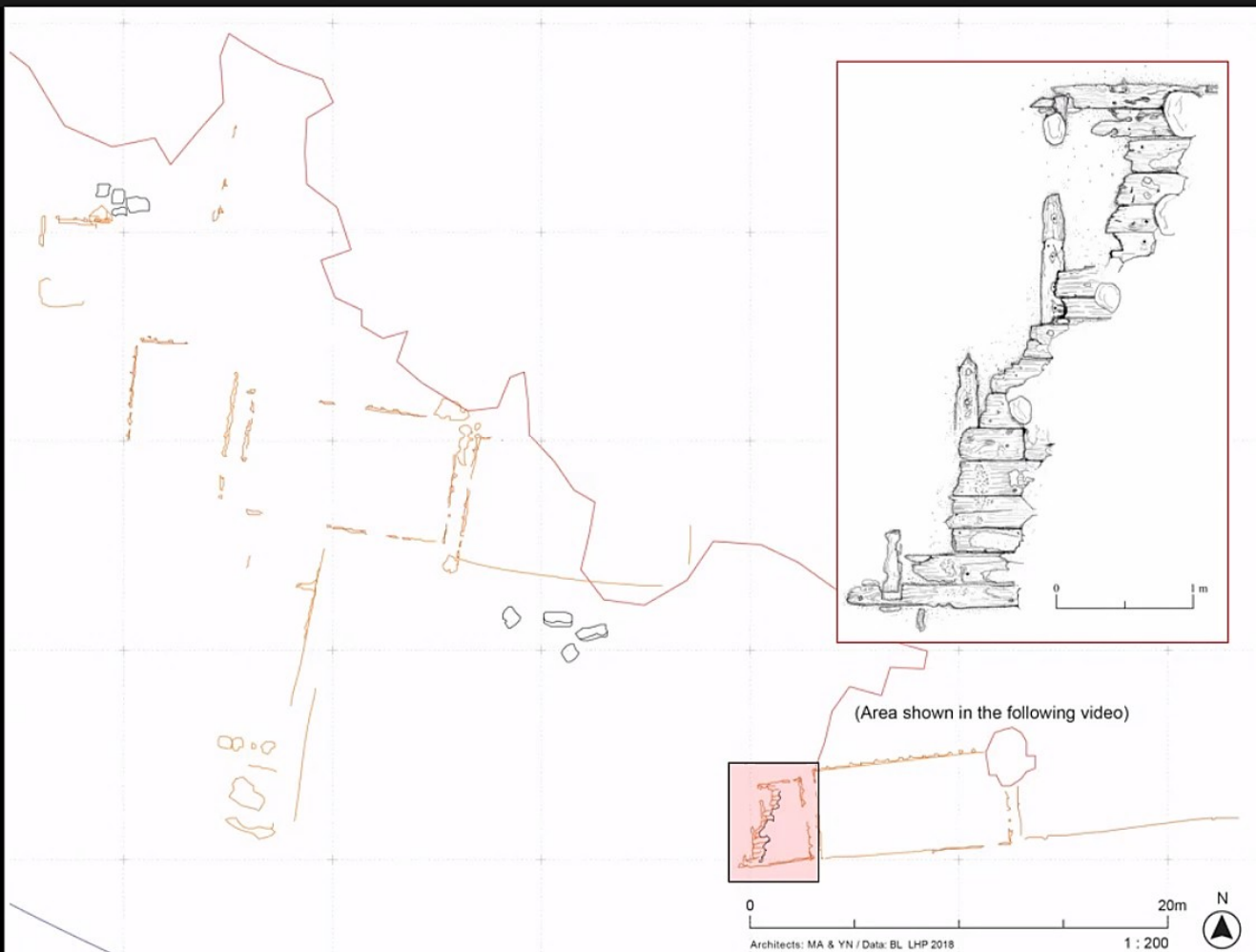


Entre Mares

Southwest corner of Caisson 5

Drawing: Yiannis Nakas (2015)





Entre Mares