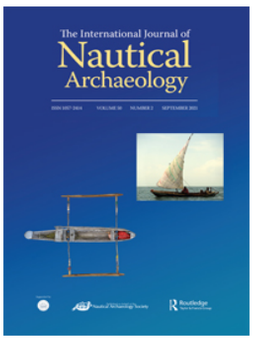

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The Survey of Adramytteion (Ören) Harbor, Turkey

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ABSTRACT
The harbour structures that form the subject of this study are some of the best-preserved examples in western Anatolia. A plan of Adramytteion city harbour has been drawn to evaluate the character of the harbour architecture and identify different types of blocks used. Together with geo-radar and geomagnetic survey, these data have been used to consider the construction techniques and phases of the harbour. Dating has been made through comparisons with similar harbours and excavated material from the adjacent town.

KEYWORDS
Turkey; Edremit; Mysia; Adramytteion; ancient harbour; underwater archaeology

Introduction

The ancient city of Adramytteion, located in the Ören District of Balıkesir Province, Burhaniye District, is situated in a basin bordered by the Kaz (Ida) Mountains to the north, the Madra (Pindasos) Mountains to the south, and a topography where these mountains intersect in the east. During the excavations carried out in the city, imported ceramics dating from the Archaic Period and earlier were found (Özgen, 2016, p. 236, 2018, p. 523). Although the city is located in a closed basin with limited connections to the hinterland, it has ensured connections overseas through the harbour at the eastern end of Edremit Bay (Adramyttenus Sinus/Adramyttenos Kolpos) in the Mysia region (Özgen, 2013, pp. 4–13).

The most important factor in the establishment of Adramytteion was undoubtedly its location on the coast and its convenience for maritime trade. Excavations within the city have revealed trade goods especially olives and olive products (oil, soap, pomade) and the presence of copper, iron, and timber with the raw materials provided by the Ida and Madra Mountains (see Çoruhlu, 2006, pp. 229–240, 2007, pp. 479–500, 2008, p. 534). Adramytteion's harbour is situated in the northwest of the city, directly on the coast (Figures 1-2). Among ancient writers Herodotus (*Hist.* 7.42.6), Xenophon (*Anabasis 7.8.8*), Thucydides (*5.1, 8.108.4*) and Strabo (*Geog. 13.1.51*) mention the city, but only Strabo mentions the harbour. However, Strabo does not provide a detailed description, mentioning only that there was both a harbour and a naval base in the city (*Geog. 13.1.51*). It is stated in the the New Testamant (Acts 27:2) that Saint Paul sailed to Rome in a ship of Adramytteion, so it is also suspected that the city had a shipyard (Özgen, 2013, p. 6).

Investigation of the ancient city of Adramytteion began in the 17th, 18th, and 19th centuries and the city was visited by researchers such as C. Texier (in 1833–1837), G. Earinos (in 1870) and H. Kiepert (in 1888) (Stauber, 1996, pp. 129, 145, 147, n. 79). The exploration and excavations started by E. Beksaç in the 2000s are continuing, led by H. M. Özgen (Beksaç, 2000, pp. 115–126, 2001, pp. 113–122, 2002, pp. 283–288, 2004a, pp. 193–202, 2004b, pp. 327–338; Çoruhlu, 2006, pp. 229–240, 2007, pp. 479–500; Özgen, 2013, pp. 4–13, 2014, pp. 178–194, 2015, pp. 1–18). In the research literature, discussion of the harbour is limited to references made to the ancient sources; there has been no scientific study of the architecture of the harbour. The aim of this study is to contribute to filling this deficit.

Methods

Orthophotos of Adramytteion harbour were obtained primarily using unmanned aerial vehicles. After that, each of the *in situ* and scattered blocks was numbered, documented with the help of Trimble R4 GNSS GPS, and transferred to the CAD environment. In this way, by identifying and documenting the elevation of the alignments of *in situ* blocks, the way the blocks are dispersed, and the distribution of different types of blocks, plans and sections were prepared to evaluate the character and phases of the harbour infrastructure. In the underwater areas, on the other hand, images were obtained through documentation carried out by diving archaeologists. As a result of these studies, a total of 1557 blocks belonging to harbour structures, 497 of which were *in situ* and 1060 of which were dispersed, were documented and numbered in the area studied (Figure 3). In addition,

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Figure 1. Adramytteion harbour and location.

Figure 2. General view of Adramytteion harbour and its surroundings, viewed from the south.

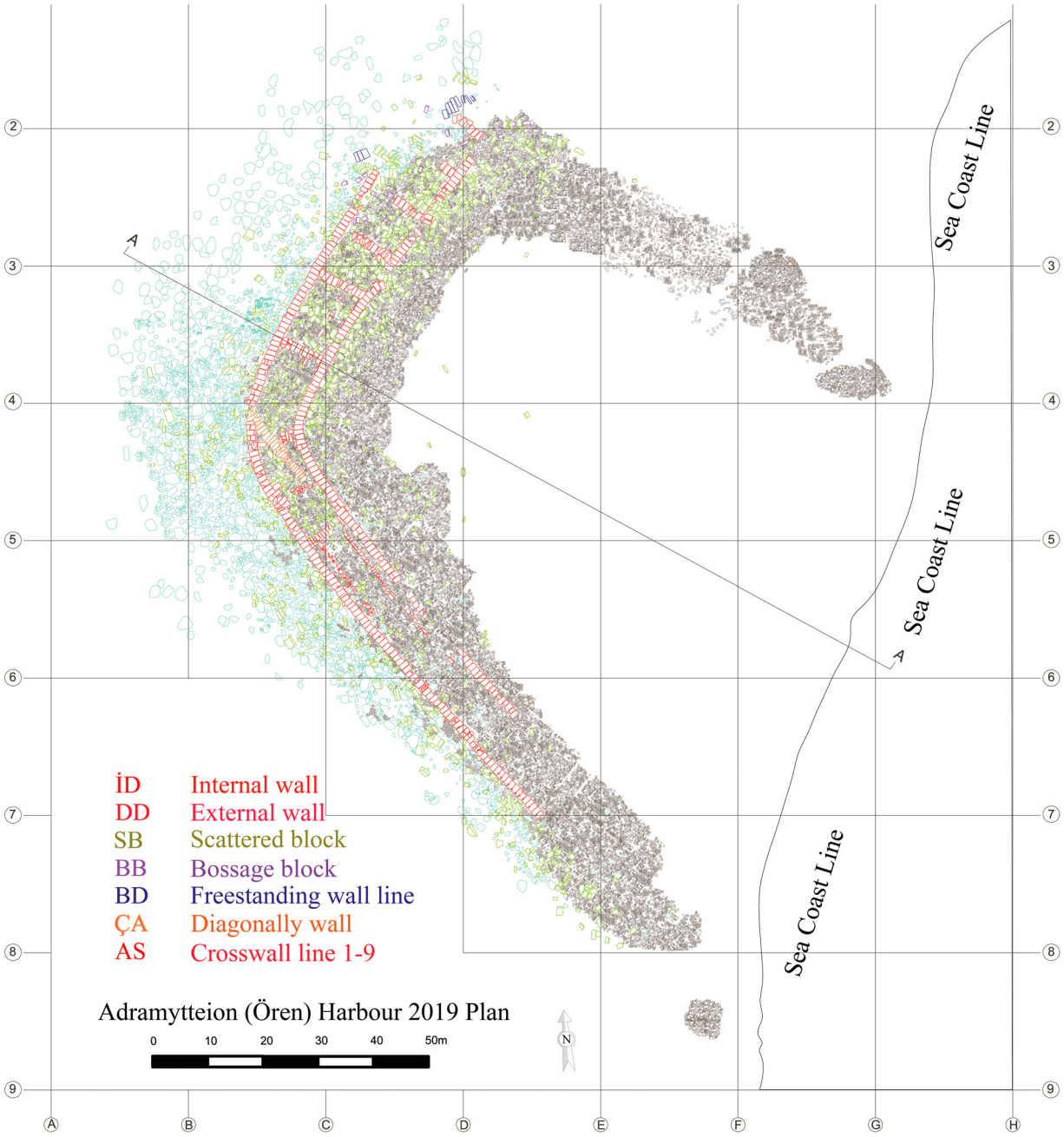

Figure 3. General plan of the Adramytteion harbour.

within the scope of the excavations carried out in the city, geo-radar and geomagnetic studies were carried out on land to look for harbour walls under the beach. Finally, by bringing together all these data, an attempt was made to understand the plan, construction techniques, and phases of the harbour, and comparison with similar examples has allowed dating to be suggested.

Adramytteion Harbour

The foundations of the harbour, located northwest of the city on the current coastline, are entirely under water and scattered over an area of 17,000 m^2 (Figures 3). The superstructure has not been preserved. The *in situ* internal and external facing walls of the seawall, which run parallel, extend from the coast out to sea to the northwest for 150 m, then turn northeast at an angle of 117 degrees and continue for another 75 m, reaching a total length of 225 m. A rubble stone layer found in the area beyond the *in situ* blocks continues in a southeast direction, closing the harbour basin, but there are no aligned blocks on this stretch.

The harbour basin delineated by these features, has a U-shape, and provides an anchorage area of 8000 m^2.

A rubble foundation layer was placed covering an area wider than the seawall to even out the seafloor and distribute the load of the wall. The main structure of the seawall consists of rectangular stone blocks, with an average size of 1.7 × 0.9 × 0.6 m, that form of

Figure 4. Detail of the crosswalls.

an outer facing wall, an internal facing wall, and nine cross-walls connecting them placed directly on the rubble layer (Figure 4). There are 174 *in situ* blocks in the outer row, 192 in the inner row, and 99 in the nine cross rows. The external facing wall and the internal facing wall are 8.25 m apart and the total width of the seawall is approximately 11.5 m.

The remains of two other alignments of blocks, laid parallel to the seawall, are found within the main wall, traces of which can only be seen in the south section (Figure 5). These walls, with an interior span of 4.2 m, are built with smaller blocks form the interior surface of the main walls.

The thickness and character of the stone blocks forming the cross-walls, placed at intervals varying between 8 and 12 m, are made from blocks similar to the external walls. The rectangular spaces formed between the cross-walls built are filled with stone rubble to produce a solid seawall in the manner of gabion construction. Similar examples can be found in Soli-Pompeiopolis (Vann, 1994, pp. 68–73, 1995, pp. 529–534) and Kyme Harbour (Lagona, 1983,

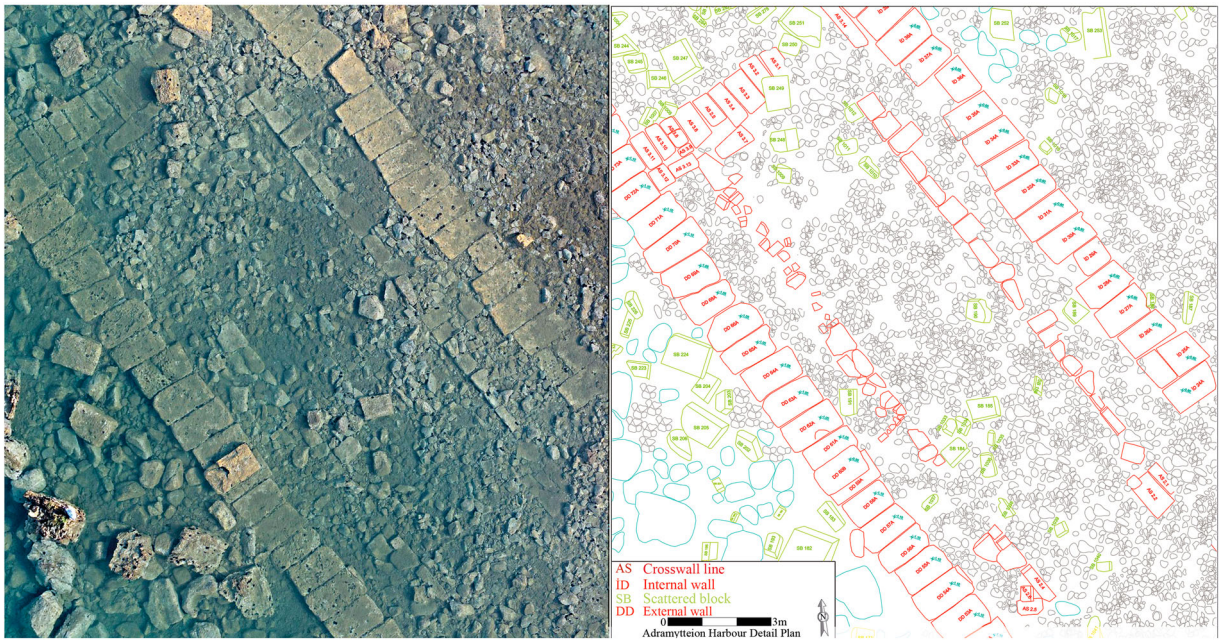

Figure 5. Rows of inner wall facing.

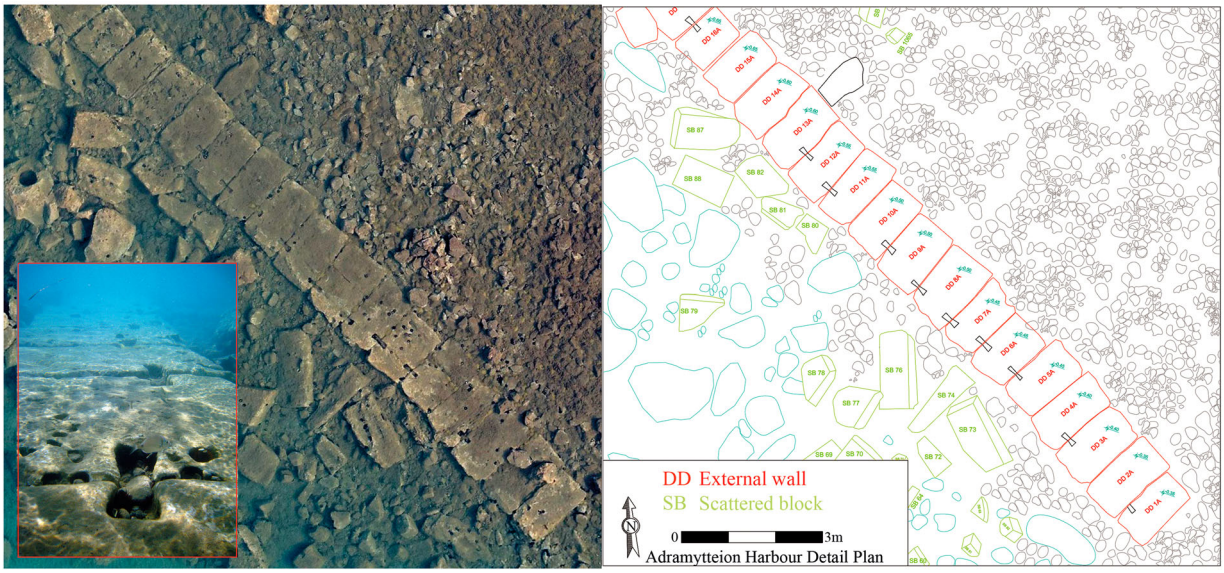

Figure 6. Adramytteion harbour A-A′ section.

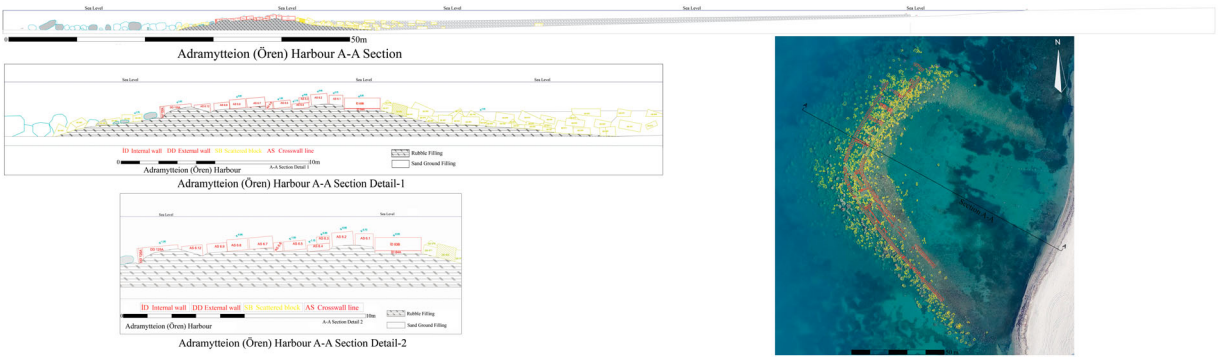

Figure 7. Adramytteion harbour A-A′ section detail.

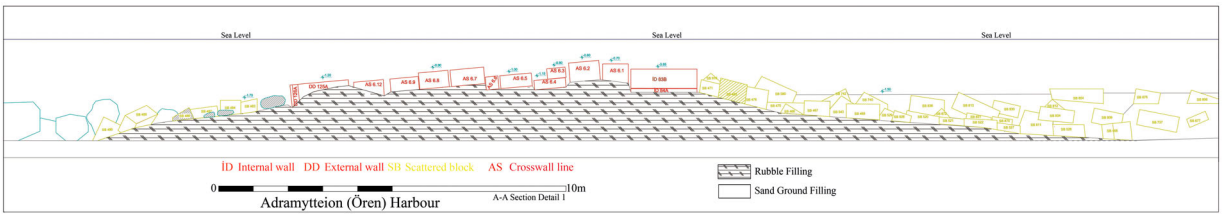

Figure 8. Dovetail clamps on seawall.

pp. 47–49, 1989, p. 23; Esposito et al., 2002, pp. 1–38), and at Side (Knoblauch, 1977, pp. 31–47; Mansel, 1978, pp. 71–78).

Where exactly the seawall is not visible on the surface is due to alluvial deposits. The Havran stream, north of the ruins, and the Hocazade stream, to the south, and the Karinca creek have deposited a thick alluvial layer covering the shore.

The first block of the seawall is situated 15 m from the beach. Only in the part of the seawall nearest the shore, a row of clamp sockets, called dovetail or butterfly wings, are found over a total of 12 blocks. The length of the clamp sockets is 0.4 m, the ends are 0.15 m wide, the waist is 0.08 m wide, and the depth is 0.06 m (Figure 6) (for similar examples see Nylander, 1966, p. 143, fig. 6; Knoblauch, 1969, p. 104; Tigrel, 1975, p. 622, figs 9, 10; Lagona, 1989, p. 23; Brandon et al., 2010b, p. 197, fig. 3). Although it is not known why this method of binding, which is frequently encountered in monumental buildings and harbour structures in antiquity, was applied for only 12 blocks of the Adramytteion seawall, it is known that these clamps were formed from molten lead. The clamps, now under water, were above sea level at the time of construction and subsequently have been submerged as a result of rising sea level or subsidence.

In addition to the main wall, 1032 blocks of similar dimensions and characteristics are dispersed in the area: these probably belonged to the upper layers of

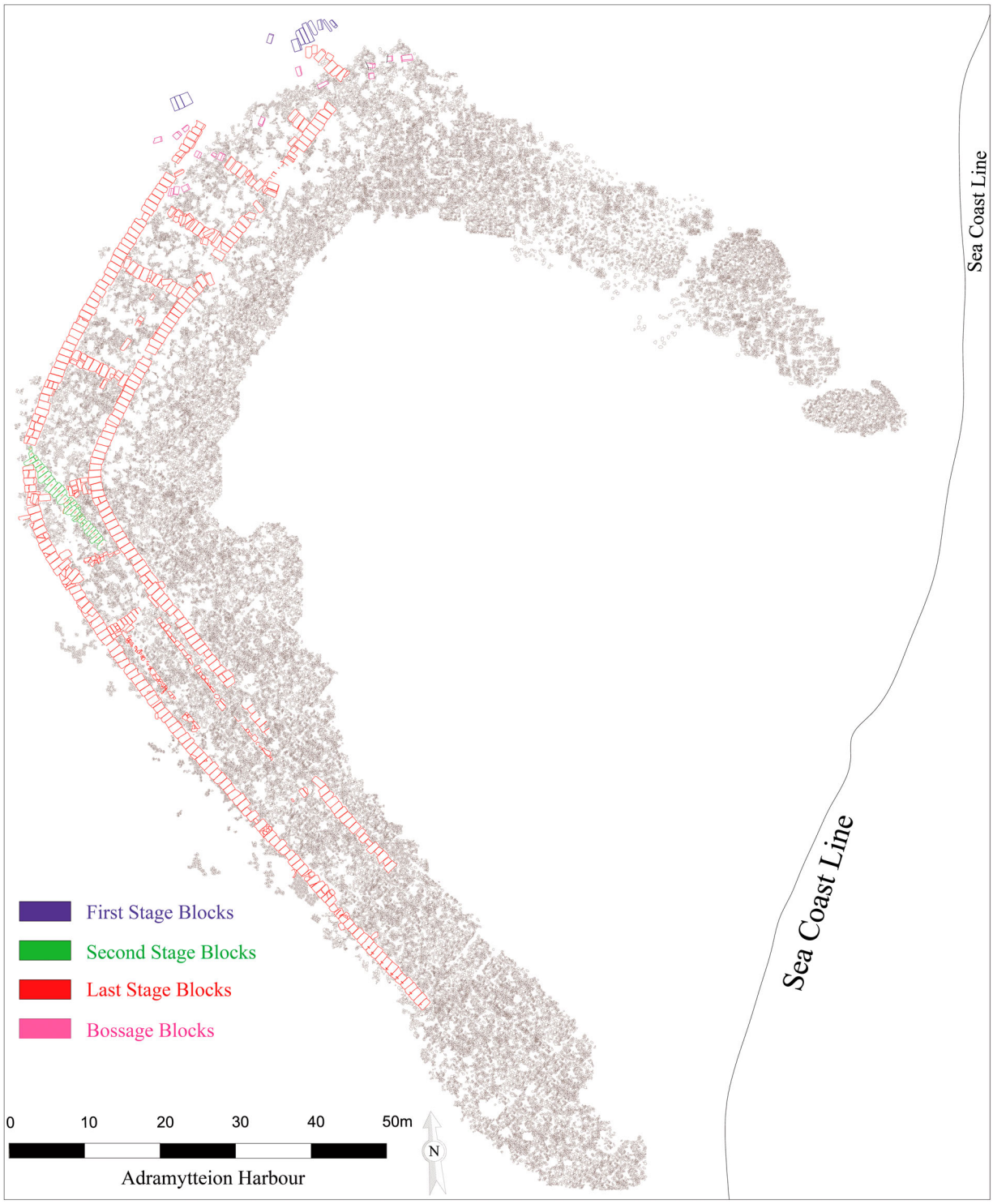

Figure 9. Possible phases of the harbour structures.

the walls. It can be observed on the plan (Figure 3) that the majority of the scattered blocks are concentrated around the northwest part of the seawall, facing the open sea. Strong waves arriving from the open sea likely pushed these blocks towards the land. This distribution seems to be the result of a single destructive event, perhaps a tsunami caused by an earthquake. There are relatively few scattered blocks close to the shore, and this must be because, as in many similar ancient harbours, modern settlers robbed these blocks in subsequent periods for reuse in new buildings.

Where the wall turns on the western side, a large pile of rubble stones, 3–5 m wide, was dumped outside the seawall to reduce the severity of the waves caused by the western and southwest winds in the region and to strengthen the seawall where it turns. Similar practices are seen in the Ptolemaic harbour in Pamphylia, Antalya Province (see Tigrel, 1975, pp. 613–628; Harmandar, 2015, pp. 36–62, 2016, p. 43). The main body of the seawall has a width of 10.65 m near the shore and expands up to 12.8 m in the strongest preserved part facing the open sea. The cross-walls are denser

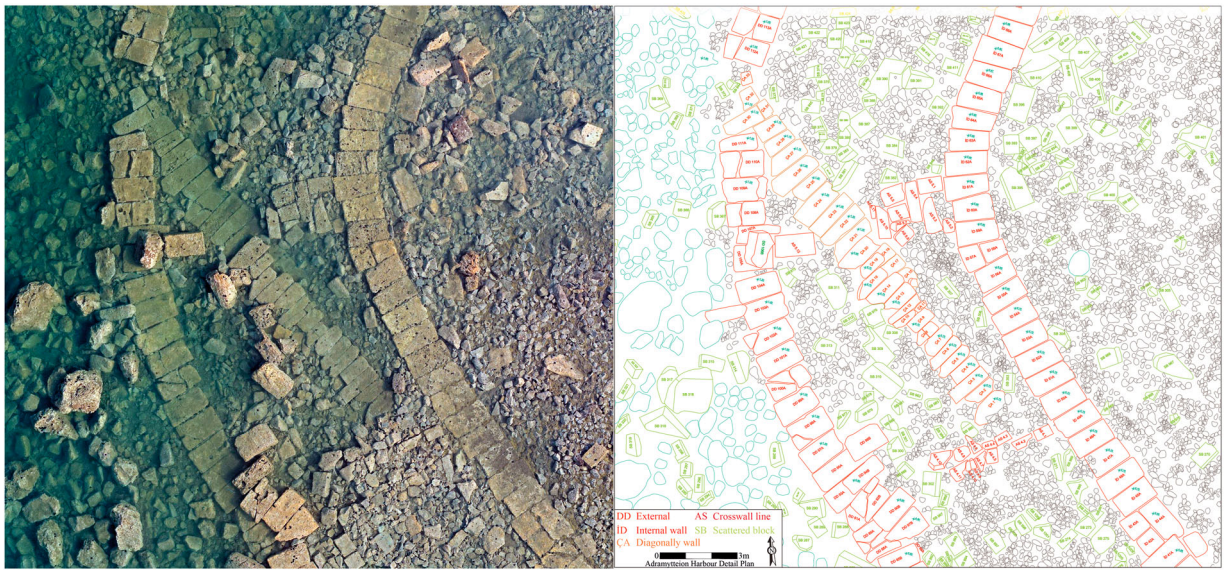

Figure 10. Diagonal row of blocks of different types and sizes from the main seawall.

in the wider parts of the wall and increase its resistance.

Although the foundation of the north wall was built, no ashlar blocks have been found on it, which suggests that either the harbour was not completed or that high walls were not needed because this section did not face the open sea and the incoming waves. The stone pile may have formed an adequate breakwater.

When the seawall facing the open sea is examined, it is observed that while the blocks in the internal facing wall are preserved horizontal, at an elevation of −0.7 m, the blocks of the external facing wall are inclined towards the open sea and are at a lower elevation varying between −1.2 m and −1.6 m. There is a similar situation for the cross-walls: while they are at −0.73 m where they meet the internal facing wall, they are at −1.1 m at the external facing wall, and are inclined in this direction. This situation shows that the harbour has subsided and tilted towards the open sea (Figures 7 and 8).

In the northwest section, the scarcity of small rubble stones used as a foundation and the shortage of larger rubble as a breakwater appear to have caused the seafloor sand to move and increased subsidence.

Phases

There are architectural elements indicating different construction phases within the seawall at the northwest corner (Figure 9). The first of these is a 16.9 m-long single alignment of blocks, varying between 1.1 × 0.55 m and 1.9 × 0.6 m, forming a wall structure crossing diagonally from the internal facing wall to the external facing wall. This appears to end as the external facing wall turns and there are blocks missing at this point (Figure 10); blocks

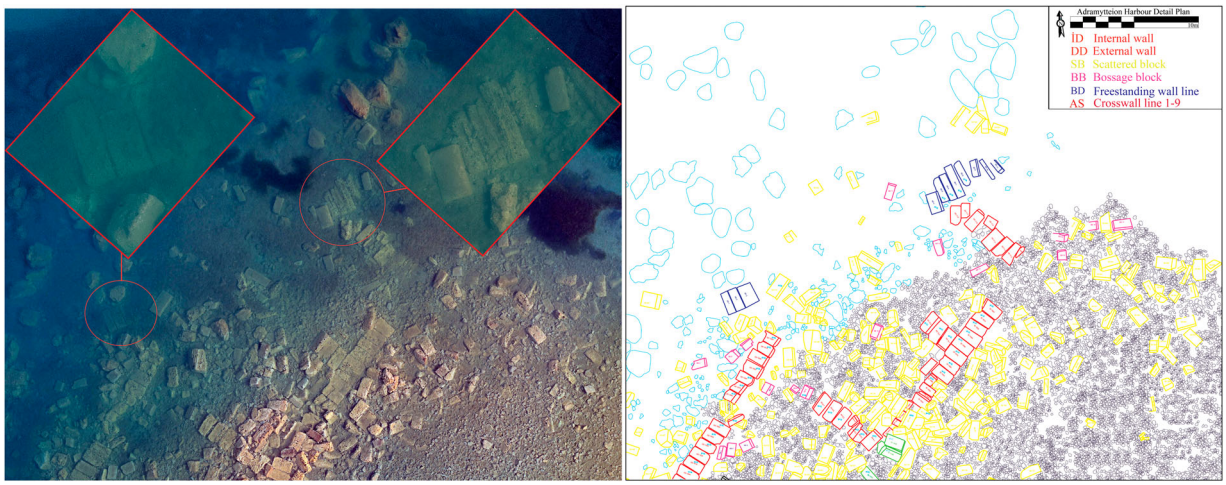

Figure 11. Wall segments in different directions and at different levels than the main seawall.

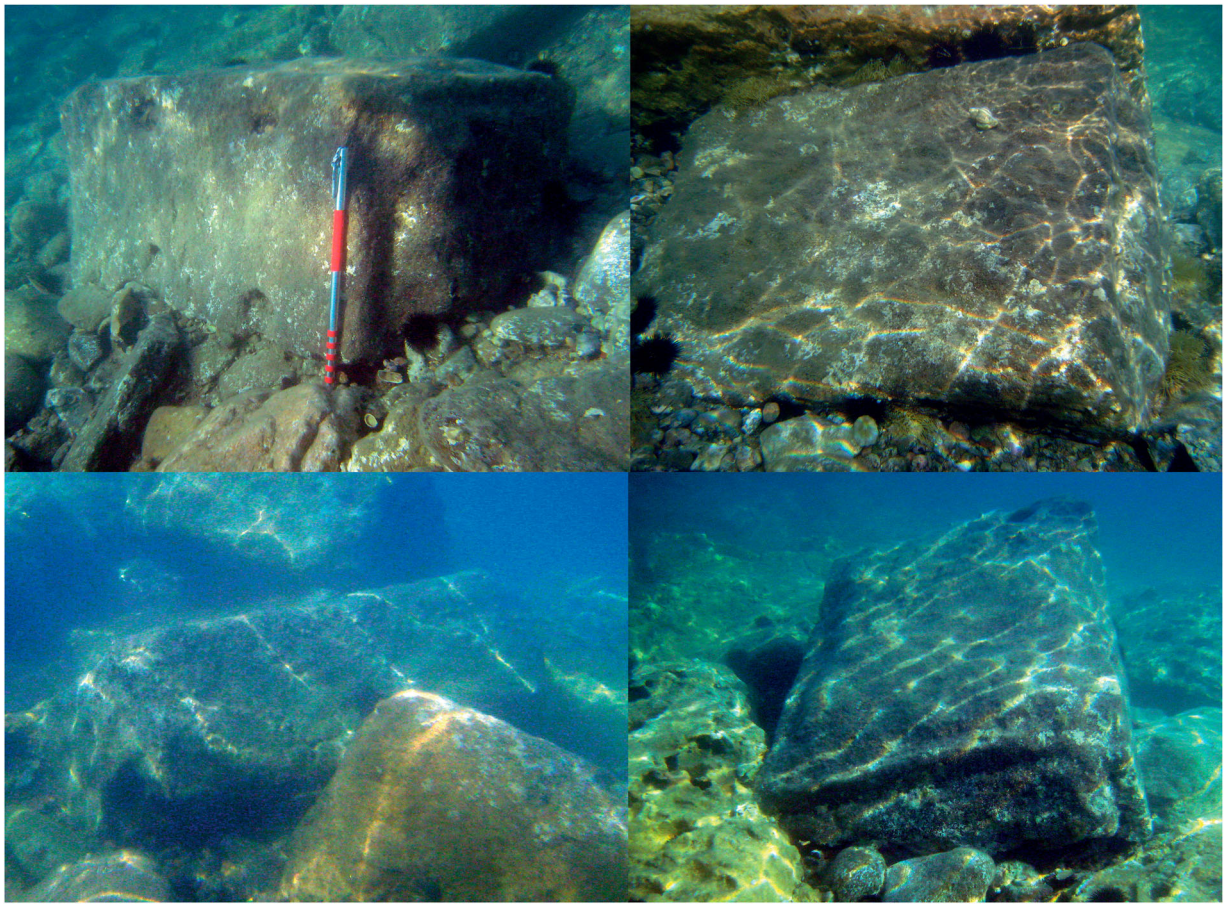

Figure 12. Bossage blocks.

Figure 13. Geomagnetic and georadar study area.

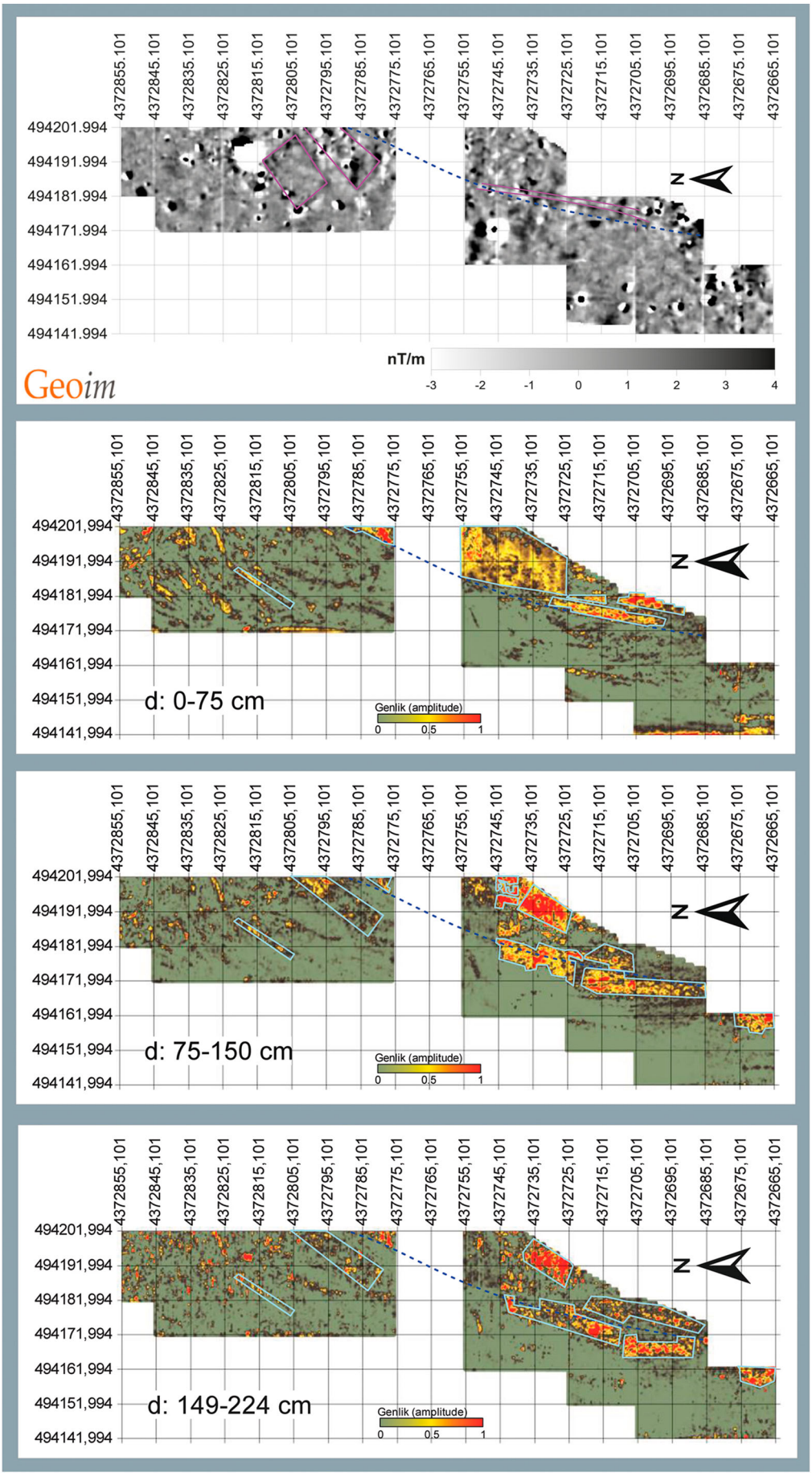

Figure 14. Geomagnetic and georadar research results.

or rubble must have previously filled the gap in the external facing wall. The diagonal wall is 0.30 m lower than the main seawall and the size of the blocks used are smaller.

Another structural element indicating a separate construction phase is a series of 11 blocks forming a northeast-southwest alignment located at −2.6 m elevation in the northwest corner of the harbour (Figure 11). This row differs from the main seawall in terms of its direction, its elevation, and in the size of the blocks used, which range from 1.78 × 0.75 m to 2.65 × 0.65 m.

Lastly, an element indicating another phase is the scattered bossage blocks found in the northwest part of the main harbour body, both between the *in situ* external and internal walls and in the immediate surrounding area. Consisting of 17 blocks in total, these grey-coloured blocks measure approximately 1 × 0.65 m (Figure 12). It is noteworthy that these blocks, some of which have clamp sockets in their surfaces, are not aligned, but are concentrated in one area and are quite different from the blocks of the seawall.

Geophysical Studies

Geophysical surveys were carried out on the shore by Geoim Ltd, within the scope of the Adramytteion excavations, employing geomagnetic and geo-radar, to connect the harbour structure to the land (Figure 13). A survey 20 × 20 m grid was set out over a 5500 m^2 area using a Trimble R4 GNSS GPS device. It was observed that anomalies in the south had higher amplitudes than those in the north of the study area. This is a result of progradation to the north covering any ancient structures. It was observed that the structures on the beach extend from a level close to the current ground surface to a depth of about 2 m. An attempt was made to delimit the archaeological structures located (see Figure 14, top). It is thought that the high amplitude reflection anomalies, especially in the southern part of the study area, display a character similar to the ancient seawall: the structures found were approximately 8 m apart and stood at least 2 m high. Both geo-radar and magnetic surveys revealed archaeological structures that may be the continuity of the harbour structures.

Concluding Remarks

Although it is not possible to compare ancient harbours typologically, as they differ according to need and topography in terms of their size and shape, these structures can be classified (Aslan, 2014, pp. 138–154). According to their features, ancient harbours can be categorized as natural bays, artificial harbours built in natural bays, and entirely artificial harbours built on a straight coastline such as Soli-Pompeiopolis or Caesarea (Blue, 1997, pp. 31–32; Raban, 2009, p. 63; Özdaş, 1995, pp. 259–266). Within this classification, the Adramytteion harbour is an artificial harbour, consisting of a seawalls of approximately 200 m length formed of facing walls extending parallel to each other built of isodomic ashlar blocks, connected by cross-walls and filled with rubble. The total width of the seawall reached 11.5 m, and each facing wall is 1.6 m wide. In the northern part of the harbour, no stone block alignment is visible, but a 94 m-long rubble-stone breakwater closes the harbour. In this state, the harbour basin covers approximately 8000 m^2. For comparison, the large-scale Knidos commercial harbour has a basin of approximately 130,950 m^2, and the medium-sized Knidos military harbour, 20,560 m^2 (Büyüközer, 2012, p. 41, 103, 2013, p. 11). Strabo stated that this harbour could house 20 *triremes* (Strab. *Geog*. 14.2.15).

The harbour was built aligned northwest-southeast. Although the entrance to this harbour is not yet understood, it would probably have been on the northern part. The would have prevented ships entering or leaving the harbour being directly exposed to waves from the open sea.

Other constructions, such as warehouses, shops, quays and facilities related to the harbour may also have been situated on the shore (Shaw, 1972, p. 91; Blackman, 1982, p. 204; 2008, p. 653; Casson, 1994).

Where the seawall meets the mainland cannot be seen because the ancient coastline is now covered by alluvial sediments. However, the results of the geo-radar research in this area show that the seawall extends towards the land. The morphology of this part of the harbour, its facilities, and how it relates to the city plan are not yet understood. In addition, no excavations have been made in the harbour area and no finds other than the architectural blocks have been recorded. Dating is limited to the architectural elements, although the abandonment of the city, and likely the harbour, took place in the late 13th century or later, leaving alluvial sediments to fill the harbour (see Özgen, 2013, pp. 4–13, 2014, pp. 178–194, 2015, pp. 1–18).

There are three block alignments showing different masonry in the harbour area. The best preserved of these are the isodomic masonry ashlar walls that form the main seawall. Considering landscape context, it is similar to the harbours of Caesarea (Blue, 1997, pp. 31–32; Raban, 2009, p. 63) and Soli-Pompeiopolis (Vann, 1994, p. 68, 1995, p. 529; Brandon et al., 2010a, p. 390, 2010b, p. 195), dated to between the end of the 1st century AD and the middle of the 2nd century AD, with their artificial walls extending towards the sea from the shore without a natural bay. The gabion construction technique and the examples of dovetail clamping ties used are close to those seen at the Soli-Pompeiopolis harbour.

Construction activity in the city increased in the early 2nd century AD, as revealed by excavations carried out since 2012, which also supports this date (Özgen, 2013, pp. 4–13, 2014, pp. 178–194, 2015, pp. 1–18).

We can define an earlier phase of construction, evidenced by the other two walls of different types and orientations located at lower levels. Nonetheless, since no excavation work has been carried out in the harbour area, no comment can be made for the time being about the exact function of these walls and their date.

As a result, Adramytteion, with a location befitting a harbour city, has buried and underwater harbour remains that can be dated to the end of the 1st century AD and the beginning of the 2nd century AD, with evidence of earlier phases.

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