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Harbour of Soli-Pompeiopolis: recent underwater archaeological research

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Underwater archaeological work at Soli-Pompeiopolis in 2017 has challenged previously published descriptions of the harbour works. Excavation, sonar survey, and aerial drone survey have provided an asymmetric plan of the harbour moles with an entrance to the east, which reflects local knowledge of the wind and wave conditions. The presence of beachrock blocking the harbour is explained by Beaufort's depiction in 1811–1812 of a defunct sluice, no longer visible on the site.

Key words: Harbour works, sonar survey, drone survey, sluice, Soli-Pompeiopolis.

The ancient city of Soli-Pompeiopolis is located on the Mersin-Mezitli coast, at the junction of Rough Cilicia and the Plain of Cilicia, in modern Turkey (Fig. 1). Excavations carried out in the city by Remzi Yağcı since 1999 have revealed settlement from the Bronze Age-Hittite and Early Iron Age periods (Yağcı, 2010: 107). Remains dating to the Geometric, Archaic, Classical and Hellenistic Periods were also found (Yağcı, 2001: 165). In the 4th century BC, Alexander the Great attacked the city and installed a garrison (Ünal and Girginer, 2007: 218). The city's fortunes grew in the Hellenistic period (Yağcı, 2002: 285), with its own coinage being struck in the 5th and 4th centuries BC (Yıldırım, 2017: 71). Later, in the 1st century BC it was used as a base for Cilician pirates: the city had been named Pompeiopolis by the conquering Roman General Pompeius, (Yıldırım, 2017: 71), who, Strabo mentions, settled pirates there (*Geographica*, XIV.V.8). The city, became a bishopric during the Late Roman/Early Byzantine period. It was heavily damaged by an earthquake in AD 527 and subsequently the city lost significance as a result of attacks by the Arabs and Sassanids (Girginer and Uygur, 2014: 133).

For this rich history, Soli-Pompeiopolis has attracted the attention of historians, writers, travellers, and scientists from classical antiquity to modern times, as exemplified by Strabo's *Geographica* (XII, XIII, XIV). Philosophers Chrysippos, Klearchos, and Athenodoros, comedian poet Philemon, and writer Aratos lived in Soli during the Hellenistic period (Yağcı, 2004: 214, 216). The importance of the harbour is recorded in the *Stadiasmus Maris Magni,* the Roman periplus written in Greek in the second half of the 3rd century AD:

> when a straight line with a slight south-eastern wind is followed, there's a distance of 500 stadia from the Pyramos River to Soloi, 150 stadia from Zephyrion to Soloi, 150 stadia from Soloi to Kalanthia village, and 280 stadia from Soloi to Korykos (Anon., *Stadiasmus Maris Magni*, translated by Özge Acar, 2017: 511, vs 165–171)

In 1811–1812, British Admiral Francis Beaufort visited the region and made drawings and plans of the

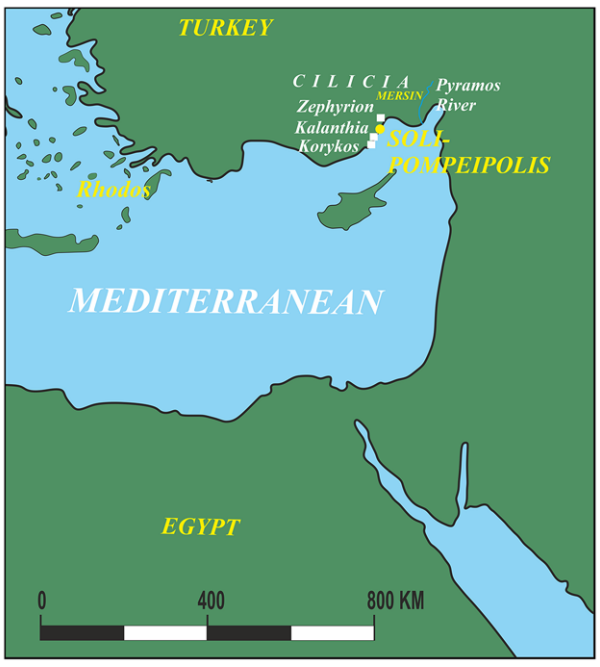

Figure 1. Location of Soli-Pompeiopolis.

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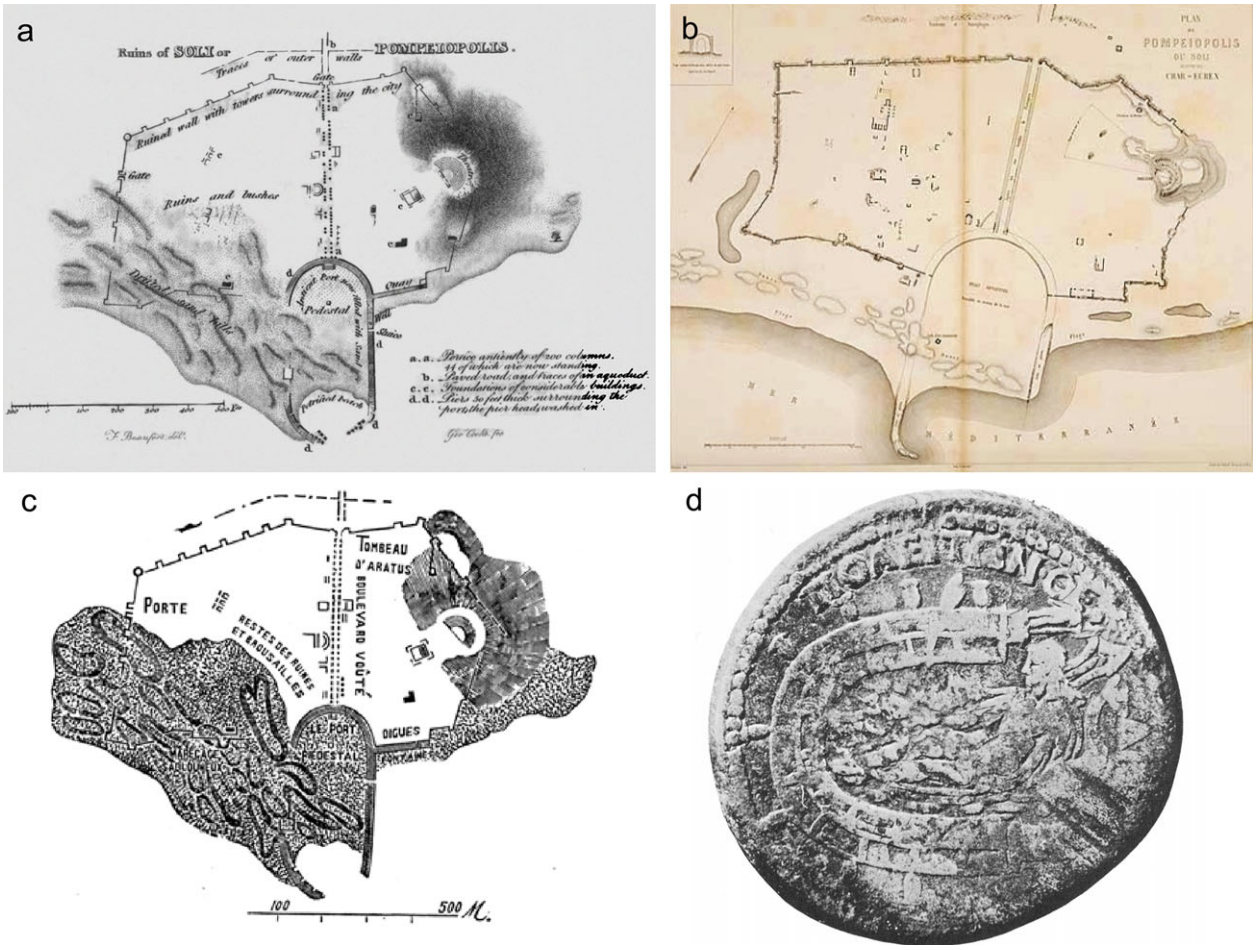

Figure 2. Plans of Soli-Pompeiopolis by *a)* Beaufort (1818: 249); *b)* Tremeaux (1858; Yıldırım, 2017: 91); *c)* Alishan (Alishan, 1899; Yıldırım, 2017: 92); *d)* coin of Antoninus Pius dated 143–145 AD depicting the harbour (Boyce, 1958: 67–78).

ruins at Soli and other cities of the region (Beaufort, 1818: 249–251). Beaufort's plan of the site shows a large oval harbour basin, marked 'Ancient Port now filled with sand' and 'petrified beach', with an opening to the sea to the south, a 'sluice' to the east, and a 'quay' marked east of the basin (Fig. 2a). Although a valuable source, it has been shown elsewhere that Beaufort's drawings are not always accurate and should be used with caution (Öniz, 2016b: 151).

French architect-photographer Pierre Tremeaux also worked in the area some years later. His city plan and harbour drawing of Soli were included in *Archaeological Research in Asia Minor,* published in Paris in 1858 (Fig. 2b). He shows the northern side of the oval basin, much like Beaufort, but only the western side of the southern half is shown and it is squarer in shape than Beaufort's rendition (Tremeaux, 1858; Yıldırım, 2017: 91).

In 1899, Armenian historical geographer Ghevond Alishan published *Sissouan ou l'Armenie Cicilian* in French, which also includes a plan of Soli (Fig. 2c) (Alishan, 1899, Yıldırım, 2017: 92). Alishan's drawing shows an oval basin but with a long western mole and a shorter wall to the east.

In 1958 Aline Boyce published an important article in the *American Journal of Archaeology* on the harbour works. It included a coin, dated to AD 143–145, of Antoninus Pius (138–161) (Fig. 2d) that Boyce suggested depicts Neptune (or the emperor) at the entrance to Soli harbour (1958: 69). Boyce also suggested that the statues depicted standing on the harbour wall on the coin might still be submerged waiting to be uncovered from the sand. This coin was also addressed by David Blackman alongside other coins showing the harbours at Zankle-Messina, Portus, Side, Patrae-Patras, and Cenchreae. He described it as showing a harbour wall that is a 'horseshoe-shaped structure, which is apparently two storeys high' (Blackman, 1982: 82).

Consequently, in 1993 a study was conducted at Soli as part of a wider research project on Cilician harbours by Robert L. Vann and his team (Vann, 1994: 68). The aim was carry out a survey of the visible harbour remains and compare them to the historical plans

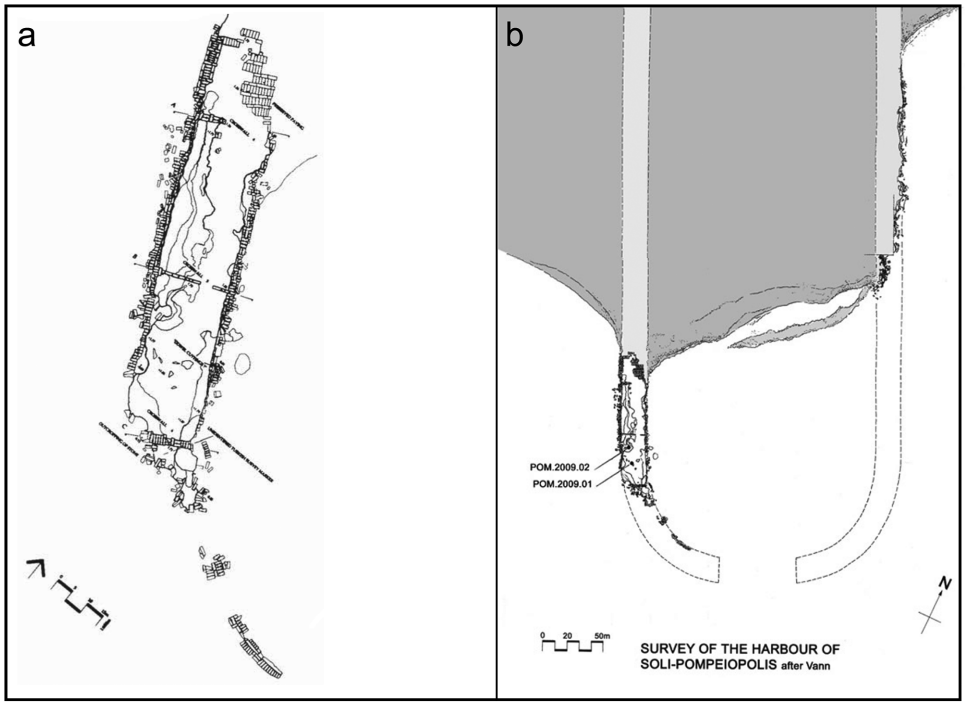

Figure 3. *a)* Plan of the western breakwater of Soli-Pompeiopolis by Vann (Vann, 1994: 69, fig. 2); *b)* Soli-Pompeiopolis harbour by Brandon *et al.* after Vann (Brandon *et al.*, 2010a: 396, fig. 9).

(Vann, 1995: 530). The visible architectural details of the western and eastern breakwaters were discussed, and the parts of the western breakwater visible above water were drawn (Fig. 3a). Both Beaufort and Vann recorded a harbour 500m in length; however; as there were no scuba diving permits, the submerged part of the harbour was not included in the study (Vann, 1993: 533) and conclusions were drawn by comparing the east and west breakwaters.

A variety of studies were conducted at Soli in 2009 within the Roman Maritime Concrete Study (ROMACONS) project carried out by C. Brandon and his team (Brandon *et al.*, 2010a: 390–399; Brandon *et al.*, 2010b: 195–198; Brandon *et al.*, 2014: 94–101). Brandon suggests the earliest settlement was probably a river harbour with alluvial deposits slowly pushing the shoreline to the south, and that the harbour was constructed in the Hellenistic period and revised by Romans (Brandon *et al.*, 2014: 94–95).

The aim of the ROMACONS project was to understand the hydraulic concrete composition applied in the Roman period and related harbour construction techniques. In the first phase of the work, core samples were taken and laboratory analyses were carried out to understand the concrete composition (Stanislao *et al.*, 2011: 471). This valuable work undoubtedly shed light on some aspects of harbour construction. The two curved moles are described as 320m long, each wall being *c.*23m wide and set 180m apart (Brandon *et al.*, 2010a: 391), which matches Vann's earlier plan of the harbour, with a total width of 227m (Fig. 3b). No underwater survey was carried out, Brandon noting simply that:

> The seaward ends of both breakwaters have disappeared into the sea, creating an incoherent rubble and block scatter that provides no clues as to the configuration of the terminus of either mole, or the width of the harbour's mouth (Brandon *et al.*, 2014: 96).

The reconstruction in the ROMACONS final publication portrays two symmetrical, curved moles of equal length with the entrance to the south (Brandon *et al.*, 2010a, 392, fig. 2; Brandon *et al.*, 2014: 96, fig. 4.44; 99, fig. 4.53).

An entrance towards the south, however, would have left the harbour exposed to the open sea and the dominant wind in the region that blows from the west-southwest (Fig. 4). These factors raised doubts over whether the Cilicians would have chosen this alignment for the breakwaters and orientation of the harbour mouth. Harbours have rarely been constructed facing the open sea and only due to natural necessity, such as the Antalya-Side harbour (Öniz, 2017: 84; Öniz, 2014: 60).

Recent work

Recent underwater and aerial survey results allow us to challenge Brandon's reconstruction of the harbour at Soli and provide a more accurate plan and measurements for the moles and harbour mouth. A team of 20 underwater archaeologists carried out

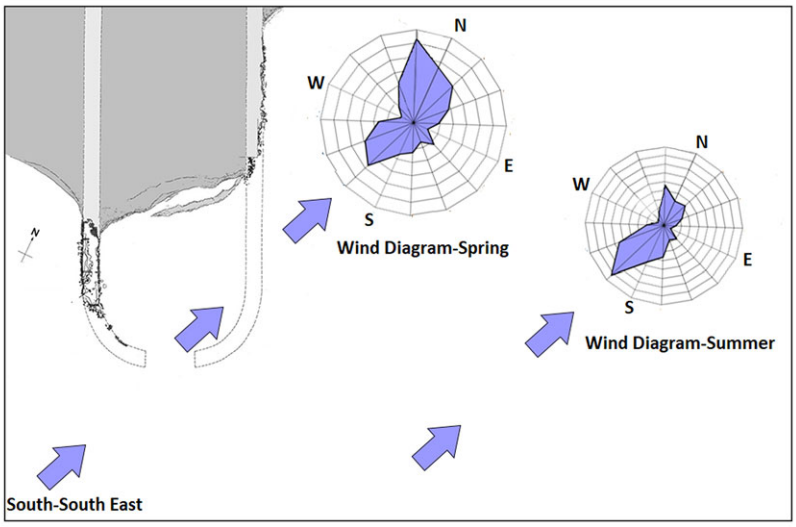

Figure 4. Harbour plan after Brandon/Vann (as Fig. 3) with the prevalent wind diagram (MGS, 2013: 76, fig. 27).

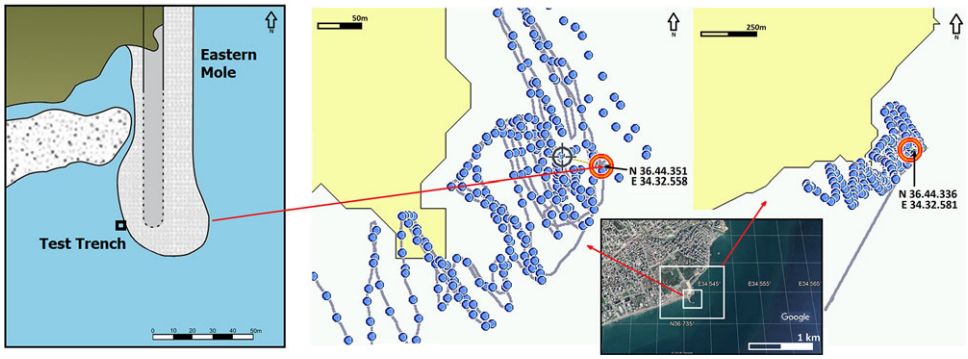

Figure 5. *a)* Position of the excavated test trench (drawing by Metehan Samet Gül); *b)* location of sonar surveys in and around of Soli-Pompeiopolis Harbour, points indicate a sonar reading (Imagery 2018 DigitalGlobe, Terrametrics, Map data 2018 Google).

research at Soli Harbour in July of 2017, using the fully equipped Selçuk 1 scientific research and excavation ship, with the aim of studying the natural site formation processes and the effects of earthquakes, and to map and further investigate the mole structures.

Four methods were applied: test excavation to examine the harbour sediments and underwater examination of the visible remains of the mole, both using scuba equipment; aerial photography using a drone; and sonar survey using sidescan sonar, dual beam sonar, and a Chirp sub-bottom profiler, along with a small boat for use close to the shore.

A test trench was excavated within the eastern breakwater (Fig. 5). Some 0.80m of the thick sediment that covers the strata dating to the period when the harbour was in use was excavated over an area 2.5 × 2.5m. From this layer about 50 amphora sherds were recovered and a marble building fragment was located and left *in situ*. The amphora sherds included locally produced Cilicia 6b-(LR1b) dated to the 5th–6th Century AD (Öniz, 2016a: 32). Poor visibility made drawing the submerged parts of the mole and examination of its base difficult.

Within the harbour, there is a rock formation that forms a barrier between the two breakwaters (Fig. 6a). This formation severely restricts passage into the harbour. Samples were taken and sent to the Geology Department of Ardahan University where Evren Erginal classified it as beachrock.

The combined use of aerial photography and sonar survey allowed the moles (Fig. 6b, 6c) to be accurately mapped. Together they show that the harbour mole is completely covered by silt emanating from the region's rivers.

Results

Rather than the symmetrical plan put forward by Vann and Brandon, the shorter eastern mole extends straight towards the open sea, while the western mole

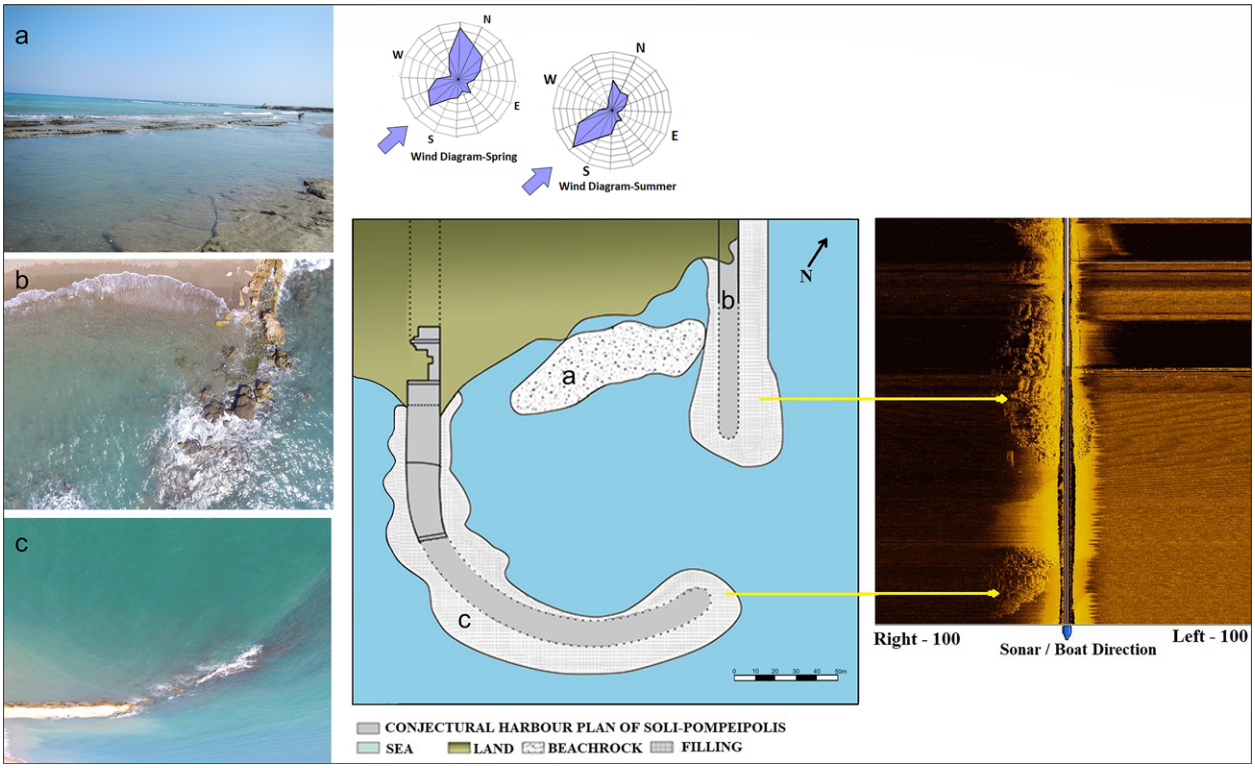

Figure 6. *a)* Beachrock formation in the harbour (photo: Ahmet Aydemir) *b)* east breakwater; *c)* west breakwater (drone photography: Günay Dönmez); centre: revised plan of Soli-Pompeiopolis harbour (drawing: Hazal Yazıcı, Metehan Samet Gül, Günay Dönmez); with sidescan sonar image and regional wind diagram (MGS, 2013: 76, fig. 27).

curves right around closing the harbour completely to the south, leaving a narrow entrance to the east (Fig. 6). Dimensions of the harbour taken during the current project and confirmed within the Turkish geoplotting system do not match those published earlier. The width of the western mole wall above water is *c.*15.5m; with a width of dumped material of *c.*30 m for each mole measured at the current seafloor; the distance between the interior walls of the two moles is *c.*127m; giving a total width of the harbour structure, of *c.*182m. The harbour was thus protected from dominant winds of the region. Based on Antoninus Pius' coin, this entrance may have had the addition of a lighthouse placed on top of the western breakwater to guide incoming ships to the east-facing harbour mouth.

Beachrock is a sedimentary rock formed as a result of the cementing of sand, gravel, and loose beach materials with a few degrees of inclination towards the sea, its formation is commonly dated between 3000 BC and 1000 AD (Erginal and Ertek, 2009: 1–2). Beachrock is formed relatively rapidly in flow-free environments (Mauz, 2015: 1–16). In Beaufort's plan, there is a small sluice-gate in the eastern breakwater. This gate was probably made to prevent siltation by allowing the circulation of water in the harbour basin (Brandon, 2010a: 396), and possibly as an entrance for small vessels. Over time, sand and the silt carried by the rivers closed this passage and the harbour began to be filled. As a result, water circulation in the harbour was decreased and the natural beachrock barrier formed over the past approximately 1500 years. Moreover, some examples of beachrock close to present sea level are recorded as younger than 1000 years (Çiner *et al.*, 2009: 260). Therefore, the beachrock barrier likely formed after the harbour went out of use and the sluice was no longer maintained.

Conclusions

Without underwater archaeological investigation, the studies of harbour cities cannot be regarded as complete. Today's modern technologies provide more accurate, measured results in this field. The submerged structures at Soli-Pompeiopolis have been waiting to provide information to complement the archaeological studies carried out on the land. The work done at the Soli-Pompeiopolis harbour is a step in this direction and undoubtedly, in the years to come, fuller excavation will reveal much more. The present scientific results show the existence of a harbour that was planned to reflect the local knowledge and culture of the Cilician seafarers.

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