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Report on Underwater Excavation at the Phoenician Harbour, Atlit, Israel

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Atlit is a small Phoenician settlement on the Carmel coast, with an artificial harbour, built during Iron Age II, before the Assyrian occupation, and used until the end of the Persian era. There are no remains of any later construction, in contrast to other Phoenician ports such as Sidon and Tyre. The study of Atlit harbour has therefore provided invaluable information on the positioning, planning and construction of Phoenician harbours in the Levant. This article is a summary of the most recent underwater excavation seasons at the harbour, and presents our conclusions on construction techniques and their historical implications.

Key words: Iron Age II, Phoenician harbour, Israel coast, Atlit, C14, pier-and-rubble.

The settlement at Atlit is a prime example of Phoenician presence in the southern Levant. It is situated about 20 km south of Haifa, on a sandstone ridge adjacent to Atlit Bay, the second-largest natural bay on the Israeli coast. Most of the ancient settlement is buried beneath the Crusader town and fortress, Chastel Pelerin. In the 1930s the site was excavated by C. N. Johns of the Department of Antiquities in Palestine (Johns, 1932; 1933; 1934; 1935; 1936; 1938). While the majority of this research was dedicated to the Crusader occupation, Johns discovered the Bronze Age tel and Iron Age/Persian period necropolis (1932; 1938). The harbour itself was only discovered in the 1960s by the Underwater Exploration Society of Israel (UESI). During the 1970s the harbour was surveyed by the Centre for Maritime Studies (CMS) of the University of Haifa, headed by Dr Linder and Professor Raban (Linder, 1967; Raban, 1997b). Underwater survey and excavation were renewed by the author and the late Avner Raban, and subsequently Professor Artzy, on behalf of the Institute for Maritime Studies of the University of Haifa.

The underwater excavations have focused around four areas: two at the northern mole (K1, L) and the other two at the south-eastern mole (M, M1). During the excavation we conducted radiocarbon analysis on several pieces of wood found inside the northern mole. These allowed dating of the artificial Phoenician harbour for the first time (Table 1) (Haggi, 2006: 51–2; table 1). The excavation further provided new data on the innovative Phoenician maritime construction techniques which enabled them to build protruding moles in what would become a typical Phoenician dry-land ‘pier-and-rubble’ construction, to create a deep and well-protected harbour (Haggi and Artzy, 2008: 83). Geological analyses of the pebbles show that most of them were basalts, ophiolites and gabbro. These stones are not local, but brought to Atlit from northern Syria and Cyprus (Haggi, 2006: 51).

Description of the harbour

The Phoenician harbour occupies a natural bay ideal for hosting an artificial harbour, and was built north and north-east of the promontory upon which stands the Crusader castle (Fig. 1). This enclosed area of water is protected from the dominant winds and swell from the south-west by the promontory cliff. To the west, protection is afforded by two rocky islets, which are part of the submerged Carmel coast sandstone ridge. To the east the bay extends to the mouth of Nahal Oren, a distance of *c*.800 m.

The Phoenician harbour at Atlit is divided into two similar sectors which are laid out symmetrically (Fig. 2). Each of these sectors consists of a mole (a protruding jetty) perpendicular to a quay, which together create a closed rectangular area of low energy-flow. The south-eastern section is connected to the coast at the foot of the ancient tel, just to the east of the Crusader moat. The quay, 38 m long, was constructed on the shore in typical Phoenician style, with the narrow side of the ashlars (headers) facing seawards (Raban, 1985: 31). An outward-projecting mole *c*.100 m long and *c*.10 m wide is attached to its eastern corner (Raban, 1985: 31). The mole consists of two parallel walls of ashlars filled with

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Table 1. *Radiocarbon dates for wood samples*

RT-RTA-RTP	Sample no.	Wood species	^{14}C Age ± 1σ year BP	Calibrated age	Collection Site	Sample ID	δ^{13}C PDB ‰	δ^{13}C PDB ‰
RT	4450	Olive	2790 ± 45	68.2% probability 1010BC (68.2%) 890BC. 95.4% Probability 1050BC (95.4%) 820BC.	Atlit. Area :K1, Locus: Wall 100, Basket 1	W 100	–25.8	–25.8
RT	4451	Cedar	2655 ± 45	68.2% probability 890BC (6.2%) 875BC 845BC (62.0%) 790BC. 95.4% probability 910BC (95.4%) 770BC	Atlit. Area :K1, Locus : 101/2	Locus 101/2	–25.0	–25.0
RT	4452	Olive	2710 ± 60	68.2% probability 905BC (68.2%) 805BC. 95.4% probability 1000BC (95.4%) 790BC.	Atlit. Area :K1, Locus:101, Basket 1	Locus 101/1	–25.7	–25.7

^{14}C ages are reported in conventional radiocarbon years (before present = 1950) in accordance with international convention (Stuiver and Polach, 1977: 255). Thus all calculated ^{14}C ages have been corrected for the fractionation so the results are equivalent with the standard δ^{13}C value of –25‰ (wood). Calibrated ages in calendar years have been obtained from the calibration tables in Stuiver *et al.* (1998) by means by means of the 1999 version OxCal v. 3.3 of Bronk Ramsey using the 10 yr terrestrial calibration curve.

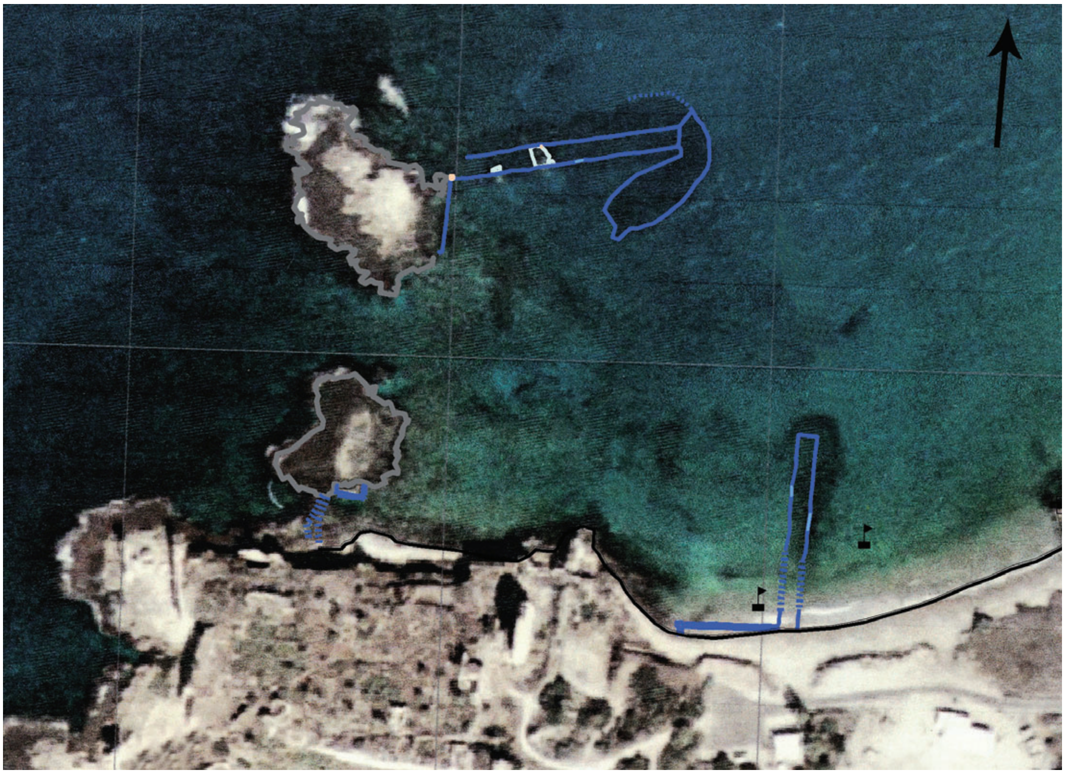

Figure 1. Satellite image of the harbour site, with line of walls indicated.

field-stones, a common Phoenician 'pier-and-rubble' style (Haggi and Artzy, 2008: 82). At the tip of the mole are remains of a tower-base measuring 20 × 12 m, possibly used as either a watch-tower or a lighthouse. The ashlars forming the mole were laid on a rubble fill to prevent the waves undercutting the construction (Raban, 1995: 156).

The north-western sector of the port is attached to two small sandstone islets. The surface of the smaller, southern islet was quarried and levelled, and remains of a structure are clearly discernable. Raban suggested that this structure was used as a warehouse (Raban, 1997b). The narrow passage between the islet and the main sandstone peninsula, which is today covered with

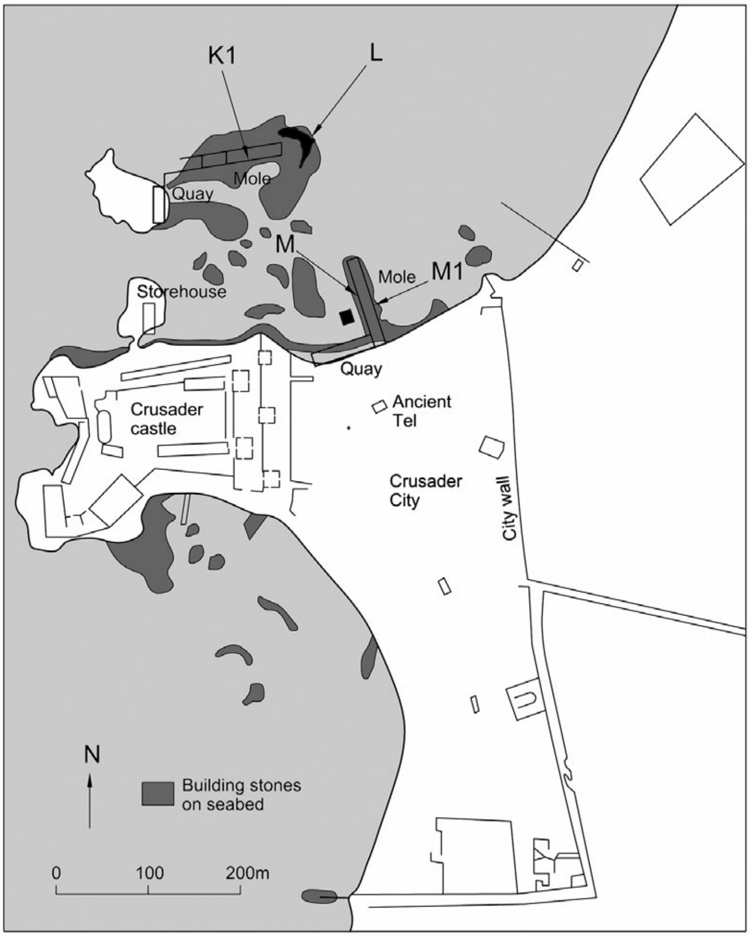

Figure 2. Plan of ancient Atlit and its harbour. (After a drawing by A. Raban)

the remains of the Crusader fortress, was bridged. The bridge probably provided access between the warehouse and the town, and also could have prevented the flow of water into that part of the harbour (Haggi, 2006: 49). On the larger, northern islet the eastern edge was levelled for construction of a quay which is *c*.43 m long, and comprises three courses of *in situ* ashlar headers. The average width of this quay is *c*.4 m, and it is well protected from westerly winds and waves by the natural rock islet which forms a sea-wall.

A mole *c*.130 m long by 10 m wide was built perpendicularly from the northern tip of the quay toward the east (Raban, 1985: 31). Its construction is similar to its southern counterpart, namely two parallel walls of headers filled with rubble (Haggi, 2006: 51). The mole ends to the east with a rampart formed of partly-worked sandstone ashlars laid, as in the other parts of the mole, on pebbles and broken pieces of sandstone, probably from the nearby quarry (Haggi, 2006: 51). The rampart is curved in shape and continues to the south-west into the harbour (Figs 1–2). To prevent the harbour basin from silting, the main entrance was from the east, the more sheltered part of the bay. On the western side of the harbour, between the two islets, a shallow gap of *c*.20 m was left untouched and never blocked. It is hypothesized that this gap served to keep the harbour basin free of silt (Raban, 1995: 156).

Excavation areas

Area K1

This area is located on the south side of the northern mole's inner wall, 50 m east of the northern islet (Fig. 2). The elevation of the top course of the wall, which was built in the 'header' method, was 2.2 m below mean sea-level. At the beginning of the excavation, the surface of the excavation area was 2.5 m^2. The ground surface was covered with ashlar stones that had fallen from the upper course of the mole wall, and fieldstones that had served as fill material for the space between the two mole walls. Most of the ashlar stones are $0.5 \times 0.5 \times 1$ m in size, while some are slightly thinner at 0.2–0.3 m thick and were probably used as covering tiles for the mole (Fig. 3).

Wooden wedges were discovered between the ashlar stones of the mole's southern wall. An archaeobotanical examination carried out by Nili Liphschitz of Tel Aviv University showed that the wooden wedges

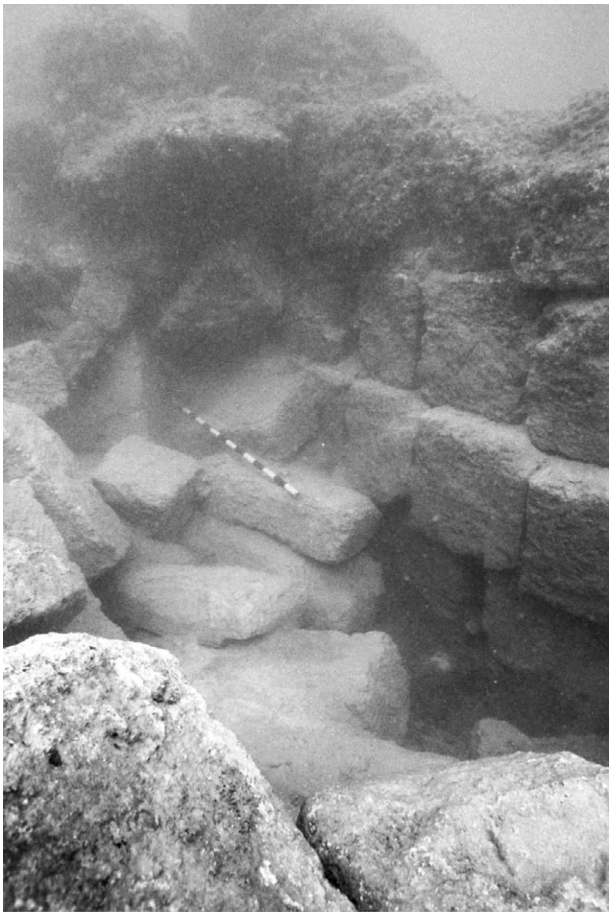

Figure 3. Ashlar stones in area K1. (S. Breitstein)

were of two species, *Cedrus libani* (Lebanese cedar), which grows only in Lebanon, and *Olea europea* (European olive), which grows throughout the Mediterranean. The wedges were most probably used in the construction of the harbour to level the stone courses and straighten the stones. The laying of the wedges and the underwater construction in general would have been carried out by divers. More signs of work carried out by divers are in the north-west corner of the northern mole, where the foundation layer of the mole rests on the submerged Carmel coast sandstone ridge, which exhibits signs of chiselling to shape the rock for construction of the mole (Haggi, 2006: 51–2).

The location of the wooden wedges inside the inner wall of the quay, deep between the ashlars, together with high-resolution laboratory analyses, has enabled us to date the construction of the mole and the establishment of the harbour. C^{14} tests carried out on three samples by Elisabetta Boaretto of the Weizmann Institute of Science suggest that they are all of the same period, Iron Age IIa (Table 1). When considering the radiocarbon results, the 'wood effect' should be taken into consideration, specifically, the possibility that the wood had been felled a number of years prior to use, as well as the possibility that the wooden wedges were in secondary use in the harbour mole. The findings point to the dating of the harbour as the late-9th or the beginning of the 8th century BC. This is supported by other findings such as the re-evaluation of ceramic remains previously extracted from cremation burials in the south-east corner of the Phoenician settlement (Haggi, 2006: 48–9).

Today, the remains of the mole wall in area K1 rise to four courses high (Fig. 3). The bottom course (4.2 m below MSL) rests on a foundation layer of flat, round river pebbles that were deposited on the sandy sea-bed. Geological analyses of the pebbles show that most of them were basalts, ophiolites and gabbro. These types of stone are not local, but were imported into Atlit from northern Syria or Cyprus. The pebbles appear to have been used initially as ballast-stones, and their large number attests to maritime commercial interaction between Atlit and northern Syria or Cyprus. Some of the foundation stones were pieces of *kurkar* that probably originated from local quarries used by the builders of the harbour. Remains of one of the quarries are visible today in the western part of the Crusader fortress. The foundation layer is only present in places where the sea-bed is sandy or muddy, and where moles were not laid. The role of this layer was to prevent waves undermining the mole walls. It covers the entire width of the quay with margins extending for at least *c*.5 m. in each direction. The western part of the northern quay was built on top of a submerged sandstone ridge which was levelled and straightened for that purpose (Raban, 1984: 251; Raban, 1995: 153–4).

Area L

Area L is located at the end of the eastern side of the northern mole, next to the harbour entrance. The depth at the base is between 6.5 and 5.5 m below sea-level. The sea-bed is covered with a thin layer of sand, shells, ceramic sherds and small fieldstones, underlain by clay, characteristic of the Nahal Oren estuary. Large ashlar stones of different sizes (max. $0.65 \times 0.65 \times 1.8$ m), weighing over 500 kg, are scattered on and in the sand (Fig. 4). Area L was selected for research because of the different technique used to build the eastern part of this mole. Fieldstones and semi-hewn stones were piled up into a rampart that rose to 2.7–3.5 m above the sea-bed. The bottom layer of the rampart is comprised of roughly-hewn stones placed on a foundation of river pebbles (Fig. 5). The rampart was connected to the end of the northern mole at its eastern side. At the top of the southern side of the rampart (the inner side of the harbour), are remains of a structure made of ashlar stones $0.65 \times 0.65 \times 1.8$ m in size, whose purpose is unknown.

Area M

Area M is located at the west (inner) side of the south-eastern mole. This area was chosen because of its proximity to the ancient city, and because it is located at the most protected part of the harbour, where ancient

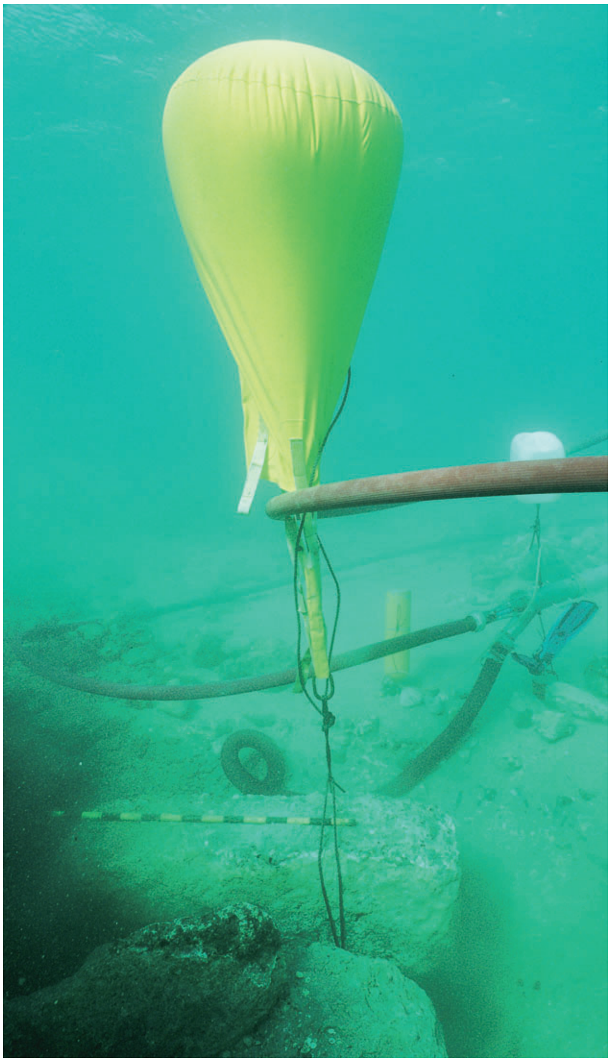

Figure 4. Ashlar stones scattered on the sandy bottom next to area L. (S. Breitstein)

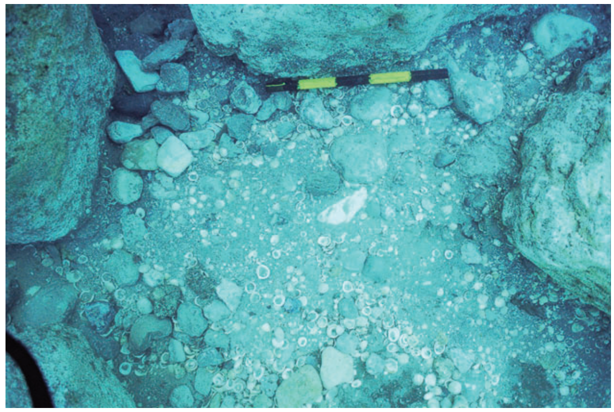

Figure 5. Roughly-hewn stones placed on a foundation of river pebbles in area L. (S. Breitstein)

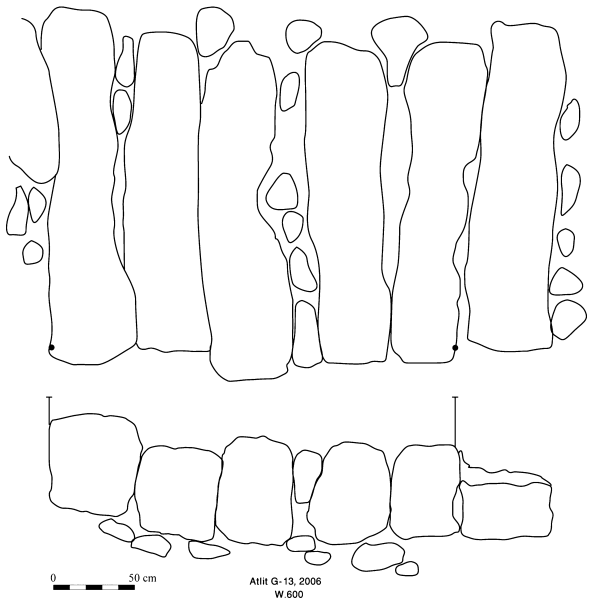

Figure 6. Drawing of wall 600 in area M. (Y. Artzy and N. Yoselevich)

seacraft probably anchored. The width of the area was limited to 2.5 m because of a number of large ashlars which had collapsed from the upper part of the mole. The upper layer in this area consists of sand of *c.*40–50 cm deep mixed with jar body-sherds from the Iron Age and the Persian period, as well as more modern waste such as plastic bags. As in areas K1 and L, the mole wall (wall 600) is built of 'headers' laid on a foundation layer containing imported river pebbles mixed with local sandstones (Fig. 6), spreading *c.*5 m west of the mole. These foundations were laid directly on a continental clay layer from the early Holocene era, before the area reached its maximum flooding surface (MFS) *c.*6000 BP (Marriner and Morhange, 2007: 175).

Area M1

Area M1 is located at the eastern (outer) side of the south-eastern mole (Fig. 2), where there is hardly any accumulation of sand as the mole prevents sand from moving to its eastern side. The sea-bed is covered with a thin layer of beach sediments which barely cover the foundation layer of the mole. During the excavation we uncovered *c.*10 m of the eastern mole wall (Wall 500), allowing us a clear view of the Phoenician harbour-building technique (Figs 7–8). As in area M the foundation layer sits directly on the continental clay layer (Fig. 8). No signs of other natural sediment were discovered under the eastern mole.

Discussion

The Phoenician harbour at Atlit was built in an ideal location: a natural bay providing well-protected shelter for seacraft. The natural bay was improved by the construction of two similar sectors, each consisting of a

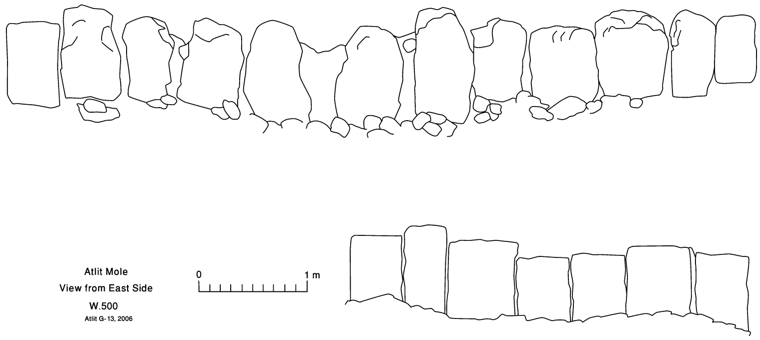

Figure 7. Drawing of wall 500 in area M1. (J. Tresman and Y. Artzy)

Figure 8. Pebbles placed under the eastern mole foundation for stability. (S. Breitstein)

mole perpendicular to a quay, together creating an enclosed rectangular area of low-energy water which served as the harbour basin. The moles were built of two parallel walls of ashlars filled with field stones (Raban, 1985: 31), a common Phoenician ‘pier-and-rubble’ technique, which was noted at Sarepta, in Lebanon, in a layer dating as early as the 11th century BC (Markoe, 2000: 30). This is a common construction method throughout the Phoenician northern Israel coast, and in royal centres in Israel such as Samaria, during Iron Age II (Sharon, 1987). Van Beek and Van Beek (1981) argued that this technique is Phoenician in origin and spread from late Bronze Age Phoenicia all over Israel, to the western Phoenician colonies, then to Greece, and to Roman North Africa, where it can be found as late as the 6th century AD.

Radiocarbon tests carried out on the wooden wedges from the northern mole indicate that the pier-and-rubble technique had been applied to maritime usage by Iron Age IIa (Haggi and Artzy, 2008: 83). The same kind of conception, harbour-planning and building techniques are demonstrated in other Phoenician harbours along the Levant dating from the Iron Age to the Roman period, such as Tyre (Poidebard, 1939; Frost 1969; 1971; 1972; Raban, 1997a; Marriner and Morhange, 2005; Marriner *et al.*, 2005; 2008), Sidon (Poidebard, and Lauffary, 1951; Frost, 1973; Blackman, 1982, fig. 9; Raban, 1995; Raban, 1997a; Frost, 1999; Frost, 2000; Carayon, 2003; Morhange *et al.*, 2003; Marriner *et al.*, 2006), Akko (Raban, 1986; 1991; 1995; 1997a), Arwad (Frost, 1966; 1970), Tabbat el-Hammam (Braidwood, 1940), the late-4th-century harbour at Amathus in Cyprus (Empereur and Verlinder, 1987) and the Roman quay at Sarepta (Pritchard, 1978).

Phoenician understanding of harbour engineering is well demonstrated in the drainage system in Atlit. At many Phoenician harbours, such as Tyre (Raban, 1997a) and Akko (Raban, 1986; 1991), several gaps were left along the moles to enable water to enter the harbour basin. At Sidon a system of three flushing-channels and a special pool to collect the sediments was built along the western reef (Blackman, 1982, fig. 9; Raban 1995, 162 fig. 34). In Atlit the builders used the natural westerly currents flowing into the harbour from the gap between the two western islets. Our surveys and underwater excavation at Atlit indicate that there is no accumulation of sediment on the harbour bottom.

Atlit harbour appears to have had maritime connections with northern Syria or Cyprus. This assumption is supported by the pebble fills used in the construction of the harbour, which originated from northern Syria or Cyprus, two prominent regions in the Phoenician economy during the 9th to 7th centuries BC (Markoe, 2000; Aubet, 2001). Atlit harbour was probably built as the result of a need to satisfy the growing demand for metals, which were imported from those regions by the Phoenicians (Aubet, 2001: 80–81) to the northern Kingdom of Israel in exchange for agricultural products. Israel was one of Tyre’s main sources for oil, grain and wine (Aubet, 2001: 76). Oil- and wine-producing settlements were also prevalent along the Carmel Ridge. In the town of Shiqmona, Atlit’s northern neighbour, industrial olive presses and warehouses were found in Layer X (beginning of the 8th century BC) (Elgavish, 1994: 64) The growth in oil and wine production is not a phenomenon unique to the Carmel. Various archaeological surveys show that in the first half of the 8th century the kingdom of Israel returned to a position of agricultural importance in the region. In the Samarian hills, many agricultural settlements have been discovered containing installations for the production of oil and wine (Broshi and Finkelstein, 1992). Atlit was thus in a good position to serve as the main harbour for maritime exports.

Conclusions

The C^{14} dates (Table 1) from the northern mole of Atlit harbour enable us to date a Phoenician harbour facility for the first time. The dating indicates that the harbour was built during Iron Age IIa or the beginning of Iron IIb. The 'pier-and-rubble' technique was used in Atlit to build protruding moles, in a location carefully chosen for its ability to provide shelter from the winds and the waves, and to prevent silting-up of the harbour basin. The application of typical Phoenician dry-land construction techniques to the sea took place during the first half of Iron Age II, the apogee of Phoenician maritime trade, before the Assyrian conquest of the Levant. It is suggested that Atlit harbour was built as an outcome of the co-operation between Tyre and the Kingdom of Israel.

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