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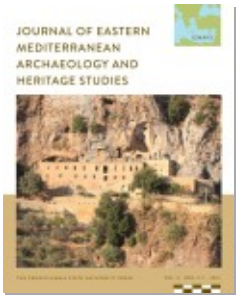

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THE MARITIME APPROACHES TO ANCIENT BYBLOS (LEBANON)

Martine Francis-Allouche and Nicolas Grimal

ABSTRACT

Maritime trade between Levantine coastal cities over the millennia is attested in numerous ancient sources. Information from these textual and iconographic works often describes the timber trade between Byblos and Egypt. However, no physical trace of a Bronze Age harbor has been discovered around ancient Byblos. After 17 years of field investigation, a harbor basin has finally been located at the southern foot of the ancient city. In 2011, the geo-archaeological research program Byblos and the Sea was launched to shed new light on the maritime approaches to Byblos. Several indications confirm the location of a silted-in harbor basin, most probably the harbor, which is so vividly described in the *Report of Wenamun*.

KEYWORDS: maritime timber trade, Lebanon, Byblos, Egypt, ancient sources, underwater archaeology, ancient harbors

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Research of Maritime Byblos

The Byblos and the Sea Project is the continuation of a long-term marine survey program that started in Byblos in the 1960s (and continued until the beginning of the Lebanese civil war) by Honor Frost, a pioneer in marine archaeology in Lebanon and the eastern Mediterranean. Frost began her study of coastal and maritime issues at a time when all archaeological investigations were exclusively land-based (Dunand 1939; Renan 1864; Montet 1962; Lauffray 2008). After the end of the civil war, Frost resumed her marine research in 1998 and continued until 2006. After her death in 2010, the marine research program resumed within the framework of the new Byblos and the Sea Project, under the joint directorship of Nicolas Grimal and Martine Francis-Allouche, who assisted Frost in her surveys of Byblos, beginning in 1998.

Since 2011, the Byblos and the Sea Project has conducted a multi-disciplinary field investigation in collaboration with foreign specialists and the Lebanese Directorate General of Antiquities. The main objectives of this investigation were: (a) to understand the archaeological man-made features of coastal Byblos; (b) to link the ancient city to its shore (which had remained *terra incognita* before Frost's survey); (c) to understand the near-shore maritime approaches to the city; and finally (d) to eventually locate the well-attested Bronze Age

harbor of Byblos, which was responsible for the economic growth of the city during antiquity.

Historical Sources

The ancient city of Byblos[1] ranks as one of the oldest settlements in the world and has been listed as a UNESCO World Heritage site since 1984. Located on the Lebanese seafront north of Beirut, the ancient city prides itself on its long exceptional history.

Around 6,000 BC, fishermen settled on the Byblian headland and lived in circular domestic houses. As a result of the economic growth from the trade and exchange of goods between Byblos and every part of the Mediterranean, a prosperous and rich Bronze Age city rose on the foundations of the older Neolithic settlement by the middle of the fourth millennium BC.

Toward the end of the third millennium BC, and more specifically in the second millennium BC, Byblos played an important role in the trade network of ancient Egypt (Breyer 2010: 67–100). Archaeological artifacts found in the excavations of Byblos provide evidence of the commercial connection the two shared: objects originating from the Nile Valley, local copies of Egyptian-style objects, and inscribed diplomatic gifts from the pharaohs, dated to the 4th Dynasty onward, to the Byblian kings (Grimal 2009).

Ancient Egyptians, unfamiliar with high-sea navigation, adopted Levantine ship building techniques in the third millennium BC. Archaeological excavations of ʻAyn al-Soukhna on the Red Sea yielded an entire harbor installation with ships described by ancient Egyptians as *kpny* "giblite," originating from *Gbl*-Jbayl (Tallet and Marouard 2012: 42). A second harbor installation, recently discovered at Wadi el-Jarf on the Red Sea, has also been described in ancient annals as "giblite" (Tallet 2012: 150). Both installations, discovered in Egypt, are models of what one may expect to have existed at ancient Byblos.

Textual and iconographic testimonies from Egypt, dated to the second millennium BC, are even more abundant. These sources attest to the exploits and conquests of the ruling powers over the Levant. Many describe the ancient sea trade, the ships, the traded goods, and, more particularly, the exploitation of forests of the hinterland and the export of timber from the Levant to the south, be it ancient Egypt, the kingdom of Israel, or the East, specifically the Assyrian and Neo-Babylonian Empires.

Early Egyptian indicators prove the important role played by the Levant in antiquity. Indeed, pharaohs of the Old and Middle Kingdoms imported wood from the region (mainly from the area of modern Lebanon) to use in the building of ships and furniture. Cedar was particularly prized for the construction of sacred vessels, and cedar resin was highly sought after for embalming in mummification.

The annals of Thutmose III (1490–1436 BC) contain, for example, a description of the land, as well as of the goods imported to Egypt, their shipping, and the missions to fetch them (Bardinet 2008: 120). The shipping and nature of the goods traded in the second millennium BC are represented on iconographic sources, such as those in the Qenamun Tomb, dated to the 18th Dynasty and depicting seagoing ships with Syro-Canaanite merchants unloading goods on Egyptian land (Davies 1963: pl. XV; Briquel-Chatonnet 2001) (Fig. 1).

Another important iconographic source is the bas-relief (dated to 1294–1279 BC) on the façade of the Temple of Seti I on the north wall of the Temple of Amun at Karnak. This wall relief shows dignitaries from Lebanon cutting wood to be offered to Seti I (Wreszinski 1934: 86–87, figs. 34–35; Briquel-Chatonnet 2001: 43) (Fig. 2). These iconographic representations testify to the commercial transactions between the Levant and Egypt.

The Voyage of Wenamun

The first-millennium BC *Report of Wenamun* is the most important text to confirm the existence of a harbor in ancient Byblos. Pushkin Papyrus 120 tells the story of Wenamun, an Egyptian high dignitary, who was sent to Byblos by Ramesses XI to buy wood to repair Amun's sacred vessel in the temple of Thebes (Lefebvre 1976: 234–64). This expedition, dated to 1076/1075 BC (Gardiner 1932: 138–69; Kees 1936: 3–4), is the most explicit and vivid piece of evidence in relation to the existence of a harbor installation in Byblos. More generally, it provides precise information on Levantine seamanship and sea trade during the second millennium BC.

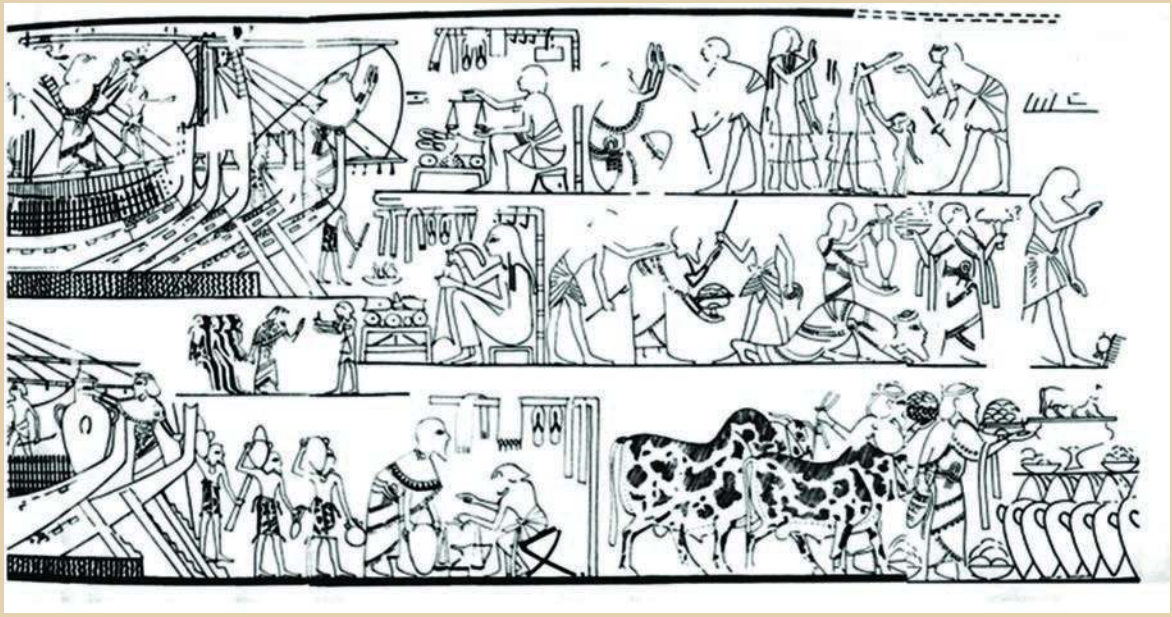


FIG. 1
Syro-Canaanite merchants unloading goods in Egypt, as depicted on the Tomb of Qenamun from the mid-second millennium BC. (Courtesy of N. Grimal.)

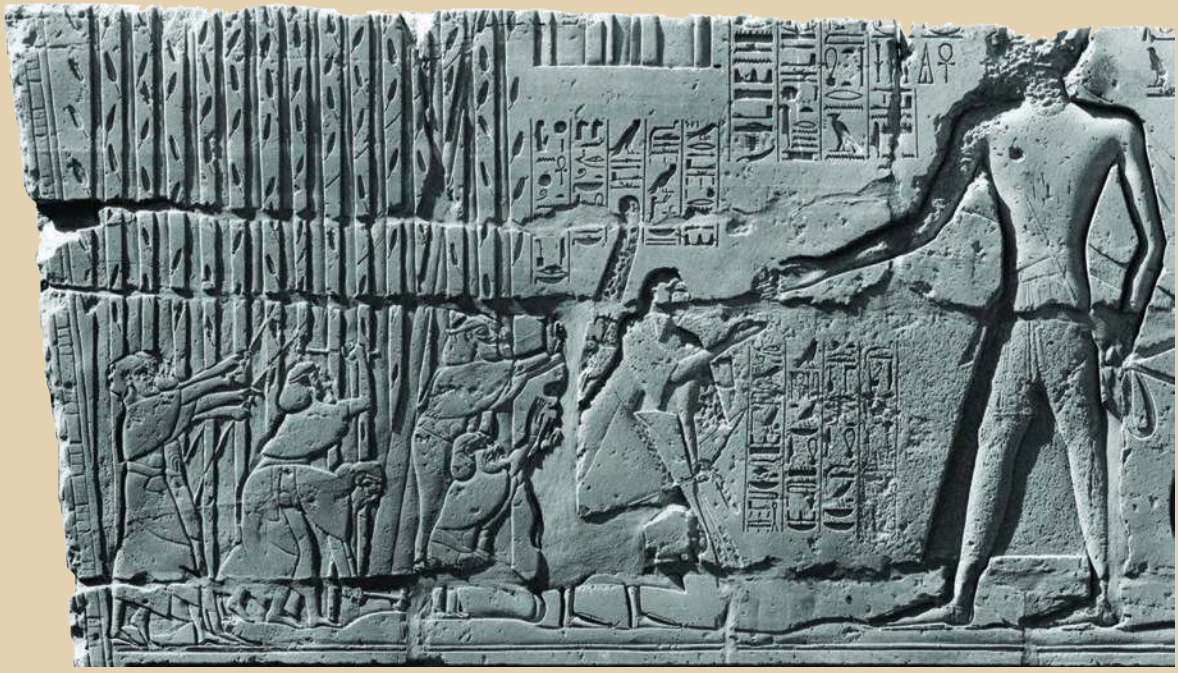


FIG. 2
The "chiefs of Lebanon" cutting trees for Seti I, as depicted on a bas-relief on the outer northern façade of the hypostyle room at the Temple of Amun in Karnak. (Photo by N. Grimal.)

After a difficult sea journey that led Wenamun from Tanis to Dor, then to Tyre, and finally to Byblos, the Egyptian envoy faced difficult negotiations with Tjekerbaal, the prince of Byblos, who eventually granted him an audience. The prince agreed to cut down trees and transport them to the harbor at Byblos, where ships would be loaded with the timber for transport back to Egypt.

Transportation Methods of Felled Cedar and Pine Logs: The two major tree species sought after by Egyptians (Bardinet 2008: 23, 121–34) are pine trees (*pinus pinea* or *pinus halepensis*) and cedar trees (*cedrus libani*), both of which still grow today in the hinterland of Byblos at different altitudes. Pine trees grow from the shoreline up to about 1,000 m in altitude, whereas the cedar tree needs higher elevations of no less than a 1,000 m and ideally 1,500 m. Two major areas in the hinterland areas closer to Byblos could have provided these species: the high plateau of Jaj (or Arz Jaj) and the Jabal Mar Moussa Forest, where an inscription by the Roman emperor Hadrian confirms this hypothesis (Fig. 3). This engraved inscription aimed to protect four species of evergreens, which still grow in these altitudes (Mouterde 1957: 230–34; Breton 1970: 69–72, 130–41; Abdul-Nour 2001: 66).

Timber exceeding 30 m in length could not be transported by land,[2] so logs were most likely moved by men and oxen from the felling areas to the river banks and thereon floated down the river to the sea. A survey conducted by Anne-Sophie Dalix and Anis Chaaya in 2004 in the upper course of the El-Fidar River, south of Byblos, identified man-made grooves cut into the river banks, which may have served to slow down the logs as they floated down (Dalix 2005: 37, 42–43).

Two modes of transportation are likely to have coexisted: The first method is known as "à bûches perdues" (Elayi 1988: 30–31), that is, the floating of loose timbers down the river. The second method is tying logs into rafts

FIG. 3
The main rivers that flow into the hinterland of Byblos, some of which were perfect for floating logs down to the sea. (Courtesy of the Byblos and the Sea Project.)

that are then steered down the river, as depicted in the bas-relief of the Palace of Sargon II, dated to 721–705 BC (Linder 1986: 271–74; Fontan 2001) (Fig. 4).

According to the "transportation" scenes, both methods may have been used simultaneously, either on rivers or at sea (Dalix and Chaaya 2007–2008: 244–48). It would have been easier for ships to tow floating rafts rather than loose logs once they reached the sea; however, the export of large quantities of timber from Byblos to the Egyptian Delta could only have happened by loading the wood onto ships.

The two main rivers reaching the high plateaus of the hinterland of Byblos are the seasonal river in the El-Fidar Valley and the Nahr Ibrahim River (see Fig. 3). Both have the two required attributes: (a) an elevation where cedar trees or other evergreens are prevalent; and (b) a depth and width of the riverbed to accommodate logs from the felling source to the sea. Of course, all rivers and streams in the area may have been used for the transport of different goods from the hinterland to the coast. However, only the streams south of ancient Byblos have been taken into consideration in the present study because the predominately southwestern sea currents allowed for the successful transport of the logs from the mouth of the river to the harbor facility, supposedly located in the direct vicinity of ancient Byblos (according to the *Report of Wenamun*).

FIG. 4
A bas-relief from the palace of the Assyrian king Sargon II at Dur Sharrukin (modern Khorsabad, Iraq), dating to ca. 716–713 BC and showing how logs were towed from the mouth of the river and then loaded onto ships. (Courtesy of Wikimedia Commons [http://creativecommons.org/licenses/by/4.0/legalcode].)

Forest Exploitation Processes in the *Report of Wenamun*: The Wenamun account gives a detailed description of different episodes of forest exploitation and the export of timber. The trade of timber was seasonal. The cutting of trees took place in winter (at least in 1075 BC) when growth was at a minimum. Timber was then kept on the ground over the winter, from December until February (*ỉw=w ỉr pr ỉm ḫ3 ʿ ỉr 3bd 3 šmw*) (2.44).[3] Transport of cut timber to the shore took place in spring when rivers were flooded from melting snow (precisely between the fifth of March and the sixth of April of the year 1074 BC [*ỉw=w ỉtḥ w <ḥr> spt <n> p3 ywm*] [2.243–44]), but the episode of transportation from the river mouth to the harbor facility is not described in the *Report of Wenamun*. Finally, timber was loaded onto ships and ready for export when sea conditions were convenient and predictable, usually at the end of summer. In fact, the messenger of Ramesses XI returned with the sum demanded by Tjekerbaal between the sixth of September and the fifth of October in 1075 BC (Year VI, Part I [Egberts 1991: 61]); however, the order was probably only shipped in 1076 BC.

Wenamun's account hints at the location where the timber was stored before it was loaded onto the ships: "I went to the seaside, where the timber logs had been piled up, and I saw 11 boats" (*ỉw=ỉ šỉ n=ỉ <ḥr> spr <n> p3 ywm r p3 nty n3 ḫt ỉm wẓḥ, ỉw=ỉ nw r 11 n br*) (2.62–63). The storage area seems to have been close to an important mooring basin, since Wenamun sees 11 boats (*br*).

Another conclusive indication of a harbor facility in the *Report of Wenamun* is the recurrent references to the word *mrỉt*, meaning "harbor" (Fig. 5)—that is, a space where ships are moored—which is differentiated from the word *spt*, which means "seashore," for example: "the

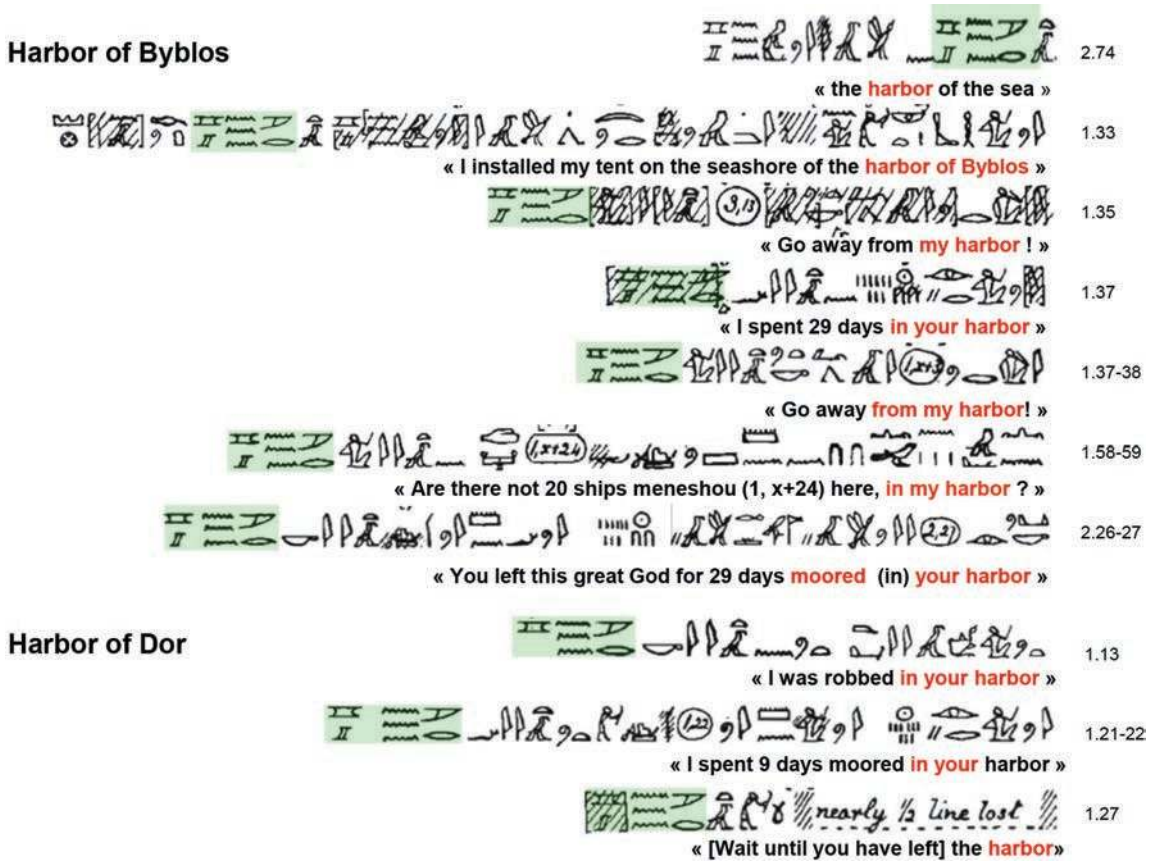


FIG. 5
The use of the word *mrỉt* for "harbor" (marked in green) in the *Report of Wenamun*. (Photo and translation by N. Grimal.)

harbor of the sea (*n p3 ywm*)" (2.74); " … the seashore of the harbor of Byblos" (1.33); and "Are there not 20 ships (*mnš*) here, in my harbor" (1.58–59). The terms are the same for the city of Dor, where the location of the harbor has been clearly identified (Carayon 2008: 1022–23). Wenamun mentions the harbor of Dor: "I was robbed in your harbor" (1.13); "I spent 9 days moored in your harbor" (1.21–22); and "[Wait until you have left] the harbor" (1.27). Thus, it is very clear that Byblos had a built harbor in the eleventh century BC with a dock, where at least 20 cargo ships could be moored simultaneously.

According to Wenamun's report, this harbor installation seems to have been located in the immediate vicinity of Byblos, itself nested on a 25 m-high promontory. When he reached Byblos, Wenamun set up a tent on the seashore of the harbor—probably meaning outside the mooring basin—waiting for the prince of Byblos to give him audience.

> When the morning came, he [the prince] sent someone to escort me to the top [to the city which laid on top of the promontory], leaving the statue of the God Amon in the tent where he had been at seashore. I found him [the prince] sitting at his desk, his back to the window: the waves of the large Syrian Sea were unfolding up to his neck [probably an optical illusion]. I tell him: "may Amon bless you!" He tells me: "How long has it been till today that you left the place of Amon's residence?" I tell him: "Five full months till today." (1.13–16)

The Wenamun report has been analyzed by many researchers. French Egyptologist Pierre Montet placed the Bronze Age harbor to the north of the archaeological tell of Byblos at the location of the medieval harbor, the actual fishermen's harbor of Byblos (Montet 1962). But was the medieval harbor basin really installed on the older Bronze Age harbor basin of Byblos? What does the field investigation reveal?

Field Investigation

Since 2011, in the framework of the Byblos and the Sea Project, all data from previous scientific research was gathered in an attempt to synthesize the different approaches of the past. The field study covered the entire rocky coastal strip of Byblos, from its northern part to its southern end (Fig. 6). The main aim of this investigation was to confirm or invalidate the five options previously suggested as possible locations for the Bronze Age harbor of Byblos: (1) the Saquiet Zaidane Bay; (2) the area of the medieval harbor; (3) the Chamiyeh Bay; (4) the open El-Skhyneh Bay; and (5) the Dahret Martine, Dahret Jbeil, and Al-Chakfi offshore anchorages, located at 2 km at large (Fig. 7).

The first field mission conducted in 2011 by the Byblos and the Sea Project completed a topographical survey of the coastal strip of Byblos, linking the archaeological tell to the sea. Ancient remains and archaeological installations found on the coast, such as a maritime quarry, a necropolis, and a series of reservoirs, were studied. Different zones of the coastal area were established, a much-needed basis to understand the functionality of the exploited areas, as well as potential harbor configurations. This first step resulted in an overall master plan of the land, which was later enlarged to cover the sea. A bathymetric mapping of the maritime area of Byblos was conducted in 2014 (see below) (see Fig. 7).

Re-Investigating the Potential Harbors in the Northern Part of Byblos

Five areas were contenders for the location of the ancient harbor.

1. The northerly Saquiet Zaidane Bay presents an open and straight pebble stretch, bordered by steep cliffs and exposed to major sea currents. This location was ruled out by Frost as a shelter for mooring boats, adding that it was also located outside the medieval city walls (Frost and Morhange 2000: 102).
2. The medieval harbor of Byblos was also rejected by Frost's investigation as it does not seem to have been used in antiquity, at least not for bigger cargo ships on which 26–30 m-long cedar logs were exported to the Egyptian Delta. In 2000, two auger core drillings in the harbor dock, performed in the framework of Project CEDRE, showed a shallow basin with very coarse sediments, which translate into an unprotected basin from the open-sea current (Stefaniuk et al. 2005: 23).

FIG. 6
An aerial view of the southern maritime approaches to Byblos. (Photo by C. Tannouri.)

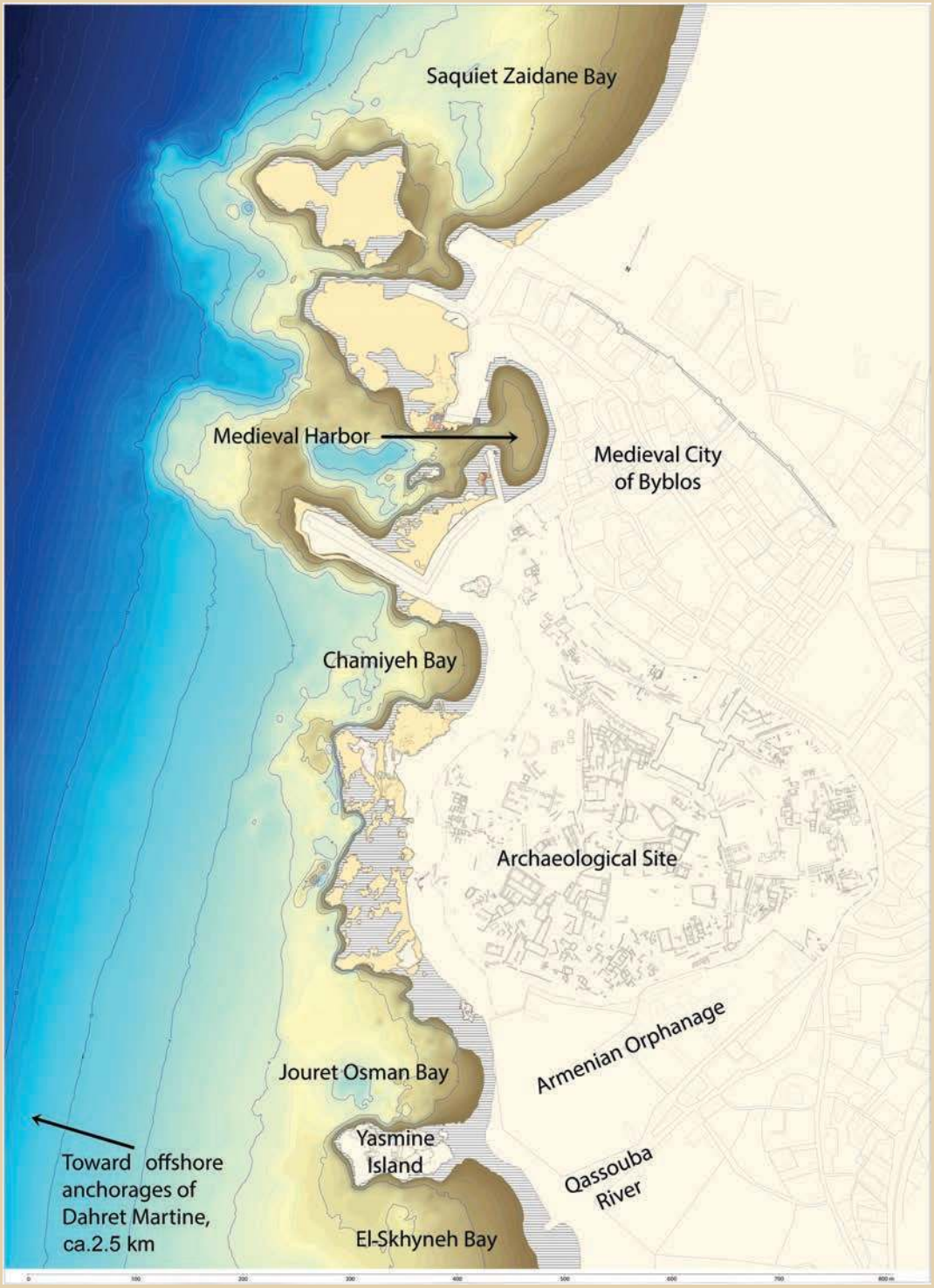


FIG. 7

Topographical plan of the coastal area of Byblos and bathymetric survey of the near shore area.
(Courtesy of the Byblos and the Sea Project.)

In 2011, the medieval basin was reinvestigated from the sea. Originally, the area was a much smaller size, which can be seen in a 1930s black-and-white photograph (Fig. 8). Since 1968, the basin has been deepened and enlarged to accommodate larger boats. Prior to these modern modifications, the medieval harbor basin presented rocky outcrops and erosion *trottoirs*, which are geological terraces at mean sea level inside the basin. The medieval basin seems to have been inserted between these geological terraces from the seaward side and a narrow *talweg* (the intersection line of two lateral slopes within a valley) on the eastern side, which must have had steep walls down to the cove. Today, rock-cut shaft tombs are present in the back of a restaurant bordering the harbor basin. The entrance of these tombs is 3 m above mean sea level (Figs. 9–10), suggesting an extremely steep and narrow topographical configuration prior to the 1968 excavations of the geological terraces and rocky outcrops. A dock was built all around the natural cove, as well as a jetty, which narrowed the entrance of the harbor mouth.

In 2014, an underwater bathymetric survey conducted within the framework of the Byblos and the Sea Project has revealed an unsuitable underwater configuration for mooring boats in the medieval harbor basin, confirming the auger coring results performed by Frost in 2000. Moreover, the bathymetric map showed a rocky and shallow maritime approach at the harbor mouth (Figs. 11–12). Frost's mention of the Jean de Palerne wreckage (dated to AD 1581) against the rocky outcrops at the entrance of the medieval harbor illustrates this well (Aurenche 1978; Frost and Morhange 2000: 102). It further confirms that larger vessels had to moor elsewhere.

FIG. 8

The medieval harbor of Byblos in the 1930s: a natural and shallow cove presenting geological outcrops (erosion *trottoirs*) at mean sea level inside the basin. (Courtesy of the Max Van Berchem Foundation.)

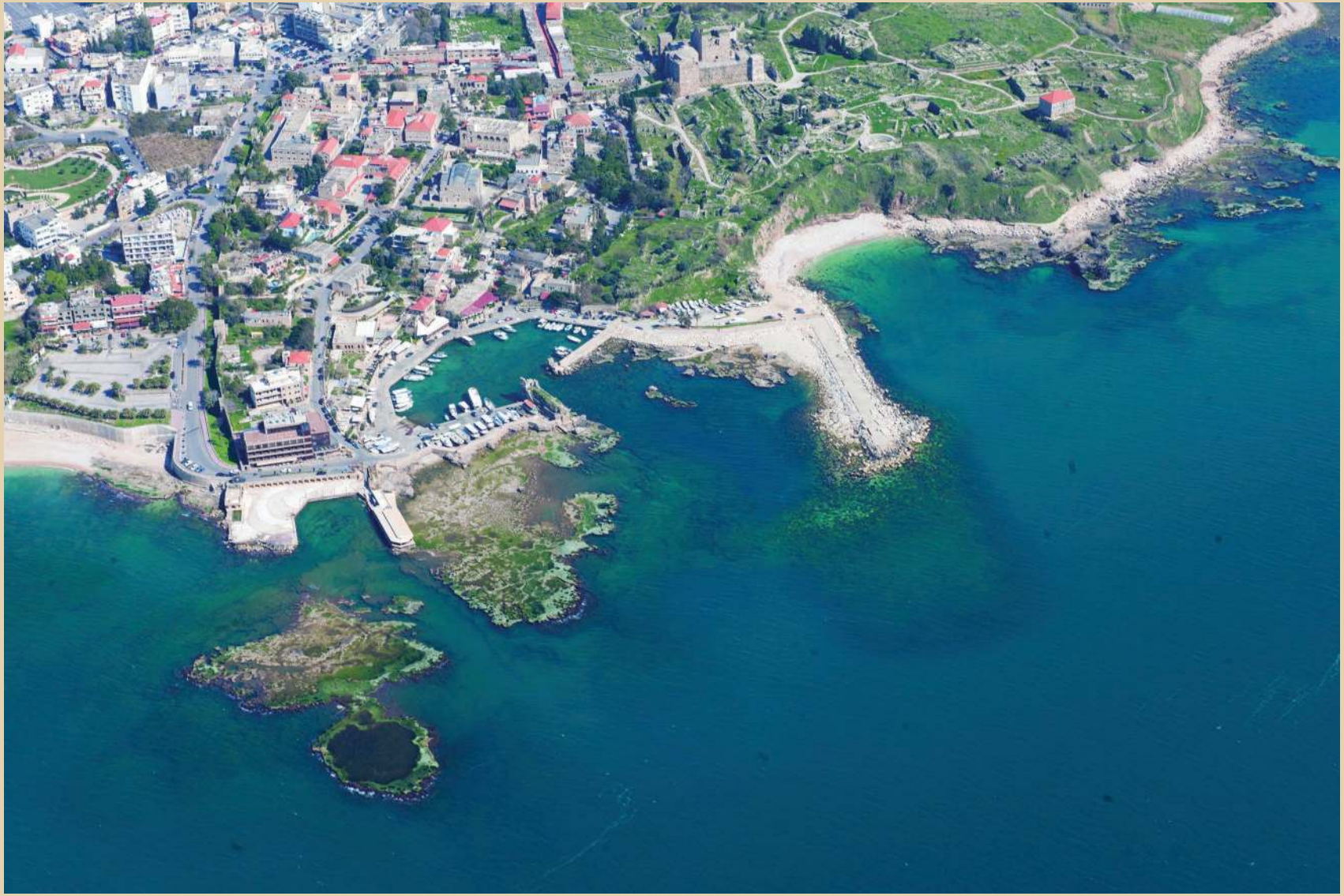


FIG. 9
An aerial view of the medieval harbor basin of Byblos. (Photo by C. Tannouri.)

FIG. 10
Shaft tombs cut into the bedrock overlooking the medieval harbor, from the east. (Photo by N. Grimal.)

Finally, a mooring basin for smaller ships may have been possible in the medieval harbor basin. The existence of fresh water wells around the harbor cove suggests that water was available for moored ships (Carayon 2012–2013: 22). However, no harbor installation prior to the medieval one can be confirmed to date at this northern location despite the fact that the northern city-gate of ancient Byblos was installed in the direction of a *talweg*, which leads to the harbor cove (Dunand 1939: 11–12, 423).

3. The Chamiyeh Bay, located south of the medieval harbor, presents the same intricate underwater configuration as the area inside and around the medieval harbor. Indeed, this third location is too rocky and shallow for the maneuvering of bigger cargo vessels in antiquity.

   Based on these indications, the hypothesis of an ancient anchorage in the northern zone of Byblos had to be ruled out, at least for the mooring of large cargo ships. This reasoning steered the field investigations to the south of the ancient city, to the sandy El-Skhyneh Bay (Fig. 13).

4. Within the framework of Project CEDRE, Frost and Morhange launched another session of auger core soundings in the southern area of Byblos in 2000, more precisely in the El-Skhyneh Bay, which stretches over 800 m and is 250 m wide. The southern and northern angles of this bay are protected from predominantly southwest currents, respectively by Cape Qartaboun and Yasmine Island. The inward side of the bay is enclosed by a strip of rocky cliffs, which is interrupted at its north and at its south by two seasonal rivers, the Qassouba and the Qartaboun.

   Two boreholes (BIV and BII) removed from the southern part of the bay (see Fig. 13) showed coarse sediments, indicating an open unprotected bay and ruling out this 800 m-long sandy stretch as a

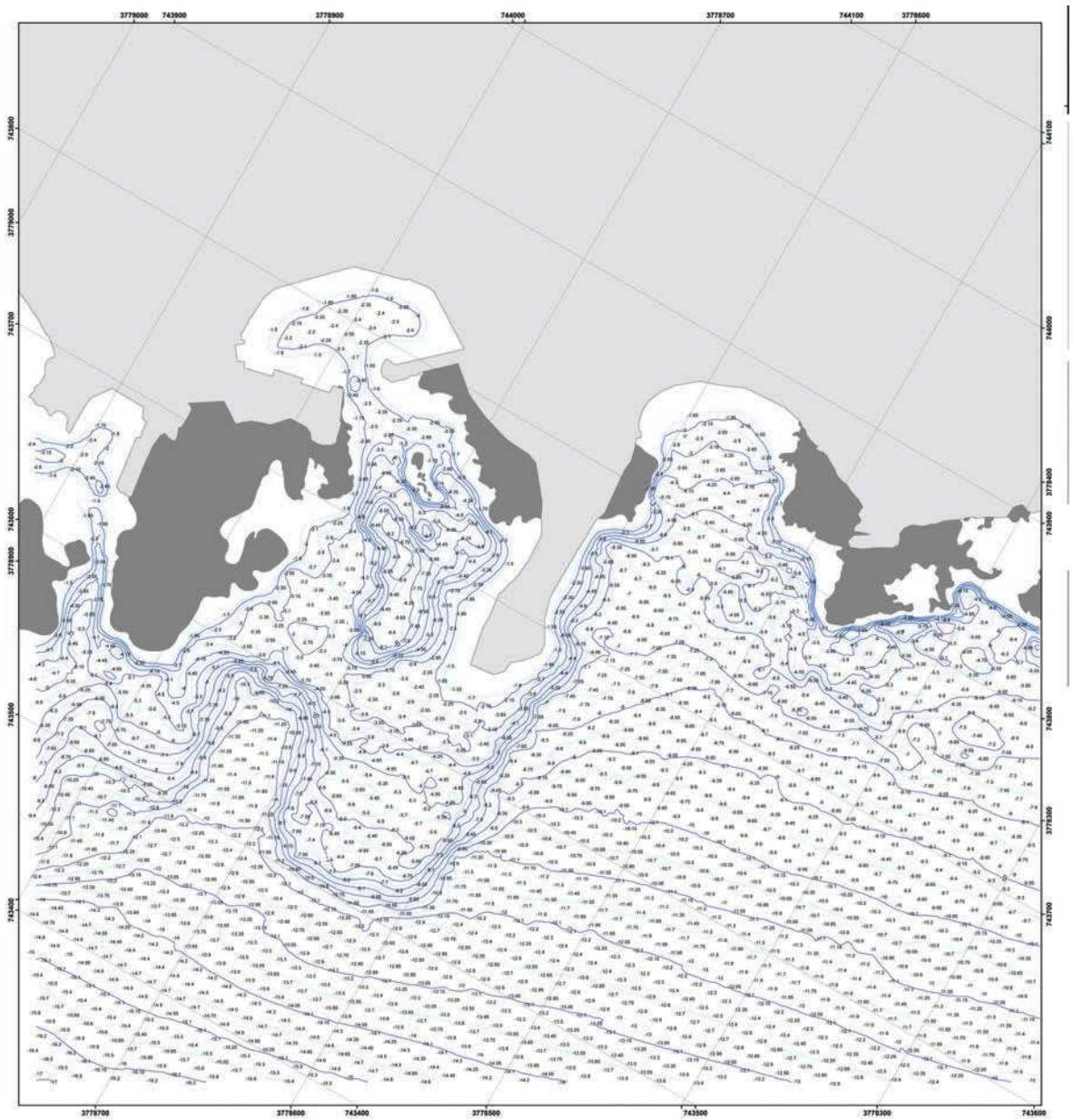


FIG. 11
Bathymetric survey of the medieval harbor area showing shallow and narrow seaward approaches in spite of the 1968 harbor enlargement. (Courtesy of the Byblos and the Sea Project.)

mooring facility, except, however, for lighter boats or service crafts, which may have beached on this stretch. A third borehole (BI) was taken from the northern part of the bay, south of the Armenian Orphanage lot, which may have once been the ancient mouth of the Qassouba River. Today, this river is almost dried up and barely trickles down to the sea (Fig. 14). The coring sediments included a large amount of river pebbles, flattened by erosion and indicating the existence of quite a large riverbed at the south of the city of Byblos during antiquity (Frost 2004: 341–42).

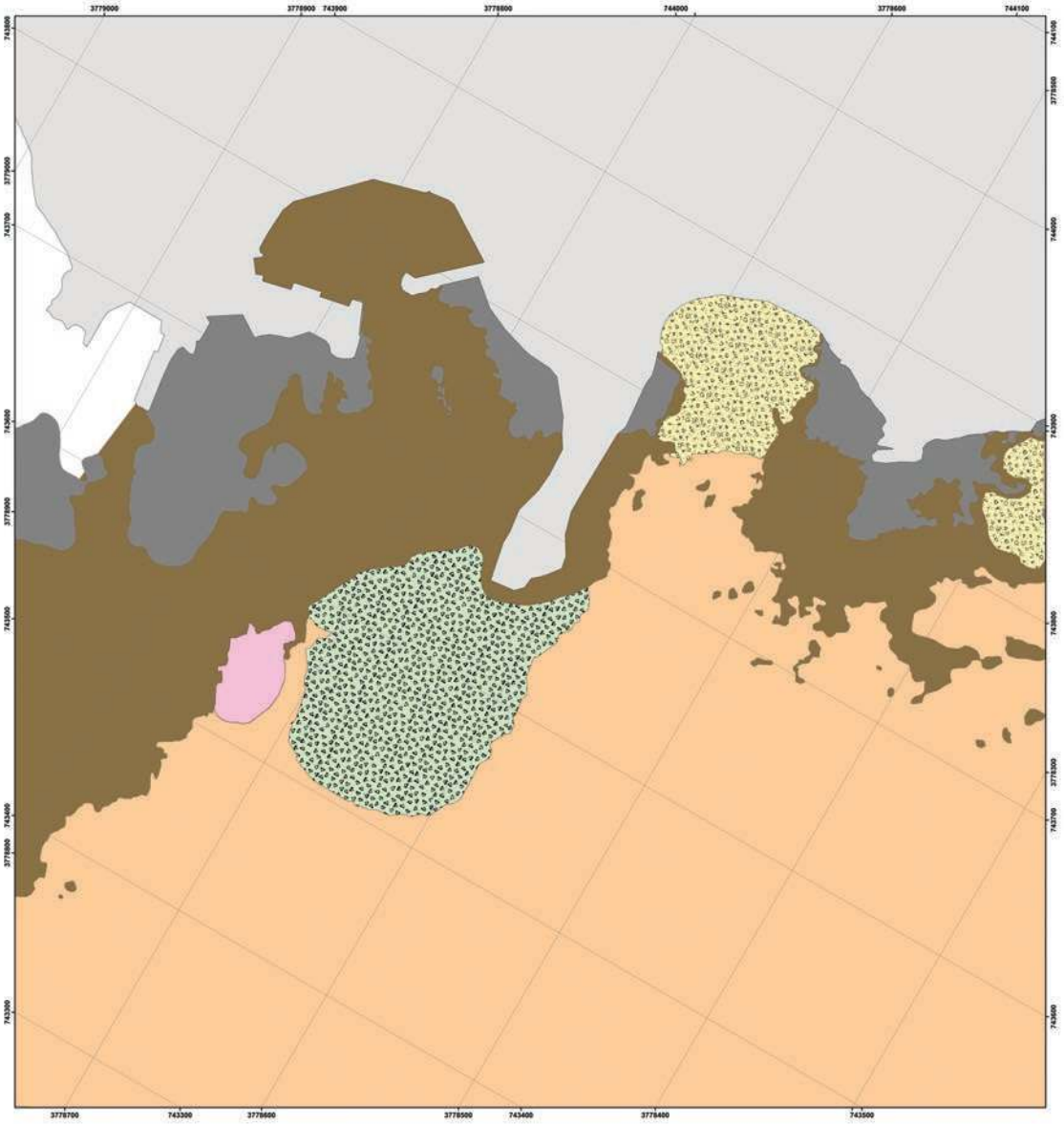


FIG. 12
Seabed composition in the medieval harbor area of Byblos showing the large and shallow rocky seabed (brown), the sandy area (beige), and loose rocks and cement blocks deposited for the modern jetty (green and yellow). Even today, the maritime approaches are rather difficult for larger boats. (Courtesy of the Byblos and the Sea Project.)

According to Frost, cedar logs and other conifers were floated down from the hinterland on the Qassouba River. Actual field investigation has proven otherwise: (a) the course of its riverbed is rather rough and bumpy, and also presents narrow elbows; and (b) the higher end of the Qassouba River only reaches 325 m in altitude, where cedar and juniper trees cannot grow (see Fig. 3). It was, thus, impossible to float timber down on the Qassouba River in antiquity. However, smaller-sized goods may have been transported on its course.[4]

FIG. 13
A view of the El-Skhyneh Bay, looking northwest. The ancient tell is visible in the background to the left. The locations of the four boreholes drilled during Project CEDRE are indicated by black arrows. (Photo by M. Francis-Allouche.)

One last coring session (BIII) took place at the foot of the ancient city in the so-called Armenian Orphanage lot, which lies in a location well protected between the promontory and the Qassouba River. There, Frost tried looking for a *cothon* (an artificially dug harbor) or any vestige of artificial harbor construction (Frost 1998–1999; Morhange 1998–1999). However, this coring did not yield any substantial results, due to the unfortunate loss of a large amount of sediments while pulling out the core itself (Stefaniuk 2001: 85–86). Therefore, it was commonly agreed at the time, based on the nature of the few sediments pulled out, that the area has always been an unprotected open bay, with a shoreline close to where it lays today.

The second criterion for elimination of this area as a possible harbor was the underwater configuration of the near shore in front of the Armenian Orphanage lot. The actual depth and configuration of the Jouret Osman Bay appears to be very shallow and rocky. One cannot help but eliminate this area as a harbor basin due to its topographical configuration.

5. Based on this evidence, Frost pulled away from her original thought, which was to place the ancient harbor in the northern corner of the southern El-Skhyneh Bay. Nevertheless, she explains the beaching of smaller boats (*kpnt*) on the open sandy bay and their commuting back and forth between the bay and large cargo ships, which would anchor on offshore reefs 2 km off the coast (Fig. 15). These boats (more commonly known as lighters) would tow logs from the shore to the cargo vessels at sea for transport to Egypt.

FIG. 14
The Qassouba River today, southeast of the buried harbor basin.
(Photo by M. Francis-Allouche.)

Hence, until then, no Bronze Age harbor installation had been found in the vicinity of ancient Byblos. Based on the field investigation, the five harbor possibilities on the coast were eliminated, and Frost adopted the theory of an offshore anchorage at more than 2 km off the coast of Byblos. However, given the exposure of these offshore anchorages to seasonal winds, whether southwesterly or northerly, the potential anchorage issues had to be revised. Mooring and loading harbor activities are not easy tasks to perform in general, specifically the uploading of long-sized timbers. A series of pierced stone anchors found on the middle anchorage, known as Dahret Martine, may nevertheless indicate a possible temporary anchorage for cargo ships, which waited to be moored in the harbor basin of ancient Byblos, as explicitly described in Wenamun's account.

Field Investigation in the Southern Area of Byblos

Based on the above results, the immediate southern vicinity of the ancient city of Byblos (Fig. 16) was reinvestigated by the Byblos and the Sea Project for the following reasons: (a) the proximity of the ancient city of Byblos; (b) the area at the foot of the ancient tell, presenting a deep inward golf prior to silting and construction; (c) the protection Yasmine Island offers to the area; (d) the location of two main rivers to the south of the area, enabling the southwesterly sea currents to drift towed logs or rafts naturally toward the north to the possible harbor location; and, last but not least, (e) the indications that the *Report of Wenamun*, more precisely the mention by Prince Tjekerbaal of 20 boats moored in the harbor which he (the prince) sees from his office on the headland, is quite a realistic description.

Geophysical Survey

Geophysical prospection is an essential tool prior to any "invasive" intervention at a given site. It provides a two-dimensional mapping or a three-dimensional image of the underground and allows a rough localization of silted-in harbor coves or land-filled bays and their paleo-shorelines, since these move over time. It may also detect possible buried archaeological structures. In the present case, a survey was conducted in October 2013 on the lower lot of the Armenian Orphanage in Byblos (Francis-Allouche and Grimal 2015: 54–59). The measurements of this electrical resistivity profiling survey were taken by geophysicists Tomasz Herbich and Dawid Swięch (Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw, Poland). The grid was set by topographer Damien Laisney (Maison de l'Orient, Lyon, France). The data were processed by Herbich.

The main objective of this geophysical survey was, of course, the localization of a possible ancient harbor beneath this lot in the immediate southern vicinity of the ancient city of Byblos. The results were quite astonishing: A two-dimensional image of a buried harbor basin was rendered, showing an old shoreline at about a 100 m inland from the current shoreline (Figs. 17–19). These geophysical readings allowed for the detection of

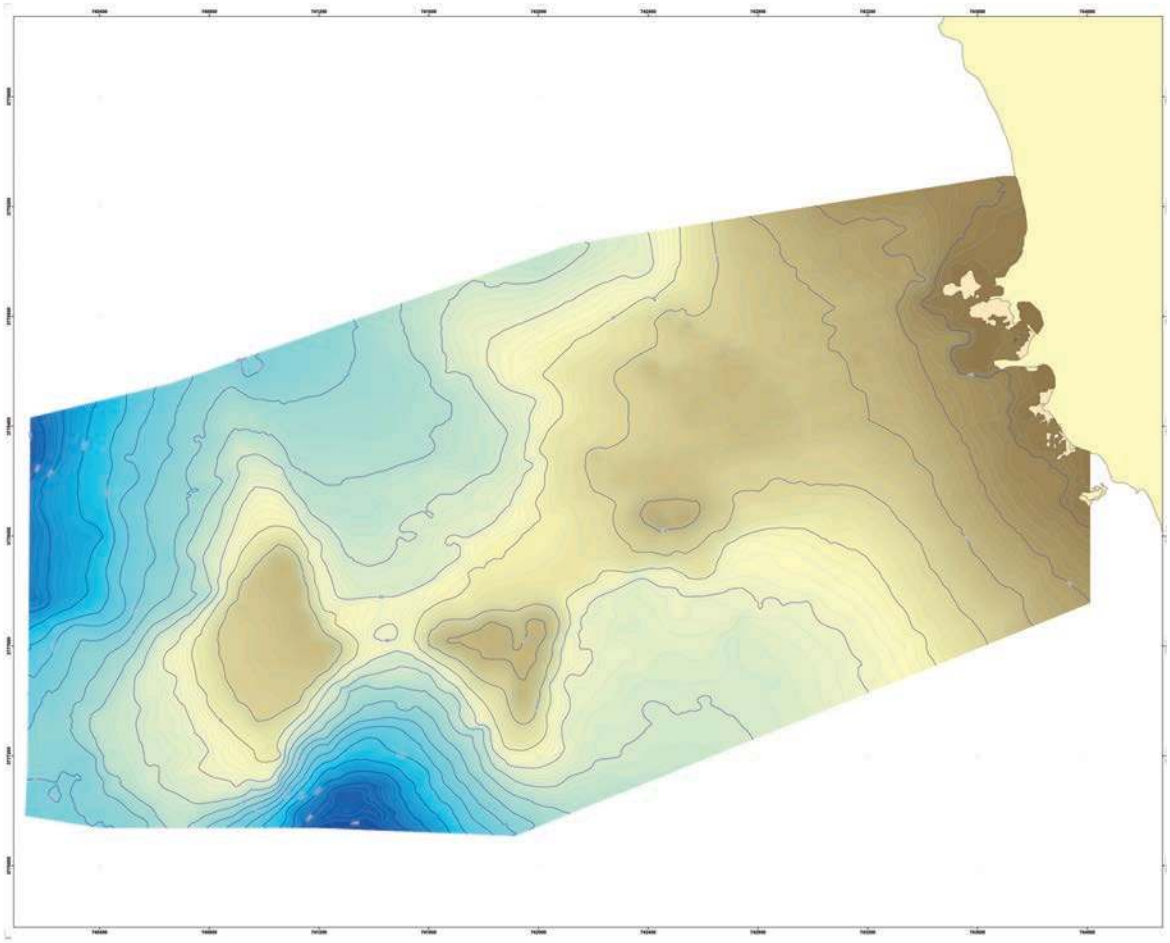


FIG. 15
The offshore anchorages ca. 2 km off the coast of Byblos. (Courtesy of the Byblos and the Sea Project.)

a silted-in basin, buried inland in the lower lot of the Armenian Orphanage. Results are presented as maps of the apparent resistivity changes, with blue corresponding to the lowest values of resistivity and brown corresponding to the highest ones (see Fig. 19). The result of the survey produced a good basis for further research; verification by auger coring was necessary at this point. This was performed along lines perpendicular to the boundary between high- and low-resistivity areas, both in the northern and the southern parts of the prospected area.

Auger Coring Survey: Based on the analyses of extracted sediments, one may understand the process of transformation from a "natural" coastal space to a "man-made" artificial installation. The process of the different phases can even be retraced, recreating the ancient harbor space. Once artificial harbor structures are built to protect a natural environment from sea currents, it transforms the nature of sediments from very coarse ones, exposed to strong currents, to very fine and silt sediments, trapped in the enclosed and protected area. Such changes appear very clearly, and they denote a protected harbor area (Carayon 2008; Goiran and Morhange 2001).

In 2014, an auger coring mission was conducted by sediment specialist, Nicolas Carayon (CNRS UMR 5140: Archéologie des sociétés méditerranéennes, Montpellier-Lattes, France) in the Armenian Orphanage lot (Carayon 2014). It completed a series of boreholes conducted in 2000 by Project CEDRE (Frost and Morhange 2000).

FIG. 16
The presumed location of the ancient harbor basin of Byblos. (Photo by M. Francis-Allouche.)

The main objective for this mission, however, was to verify the results of the 2013 geophysical survey readings. As a result, the existence of a body of water was confirmed, and a silted-in harbor cove was corroborated. The sediments filling this harbor cove were analyzed, and all 29 boreholes unanimously verified that this area, at the foot of the ancient city, was once a well-protected harbor basin.[5] According to the different layers found in the cores, this basin was wide enough (approximately 8,000 to 12,000 m²) and had deep enough waters (of 1.5 to 4 m) to accommodate a fleet of commercial boats, as described in ancient Egyptian annals and the *Report of Wenamun* (Figs. 20–22).

Several phases of seashore modification have been identified thanks to the auger cores: two paleo-shorelines were located, showing a progradation exceeding 100 m since the maximum rise in sea level (marine transgression), dated to around 6000 BC. In our case, silting could have been the outcome of the abandonment of harbor structures, which served as protection from swells and major winds. This abandonment caused rapid silting of the basin from the inland, leading to a quick progression of seashores. The phenomenon of ancient seashores being totally integrated into their urban surroundings has been noted, for instance, at: the Phoenician slipways of Minet el-Hosn in Beirut (ca. 100 m) (Francis-Allouche 2012: 7–10), the slipways of Kition-*Bamboula* in Larnaka, Cyprus (ca. 800 m) (Yon 2000; Yon and Sourisseau 2010), and the harbor of Yenikapı in Istanbul, Turkey (ca. 1,500 m) (Perinçek 2010).

Bathymetric Survey: An extensive marine remote sensing survey was conducted in the maritime approaches of Byblos, covering a total area of 8 km² with a total length of 250 km in track lines, from the medieval harbor of Byblos to the Nahr el-Fidar River canyon, and a width of 3 km (Papatheodorou et al. 2014) (Figs. 23–27). This marine prospection completes two preliminary underwater mappings previously

FIG. 17
Tomasz Herbich conducting an electrical resistivity profile survey in October 2013 on the Armenian Orphanage lot, south of the archaeological site of Byblos. (Photo by M. Francis-Allouche.)

FIG. 18
A close-up of Tomasz Herbich taking electrical resistivity profile measurements. (Courtesy of T. Herbich.)

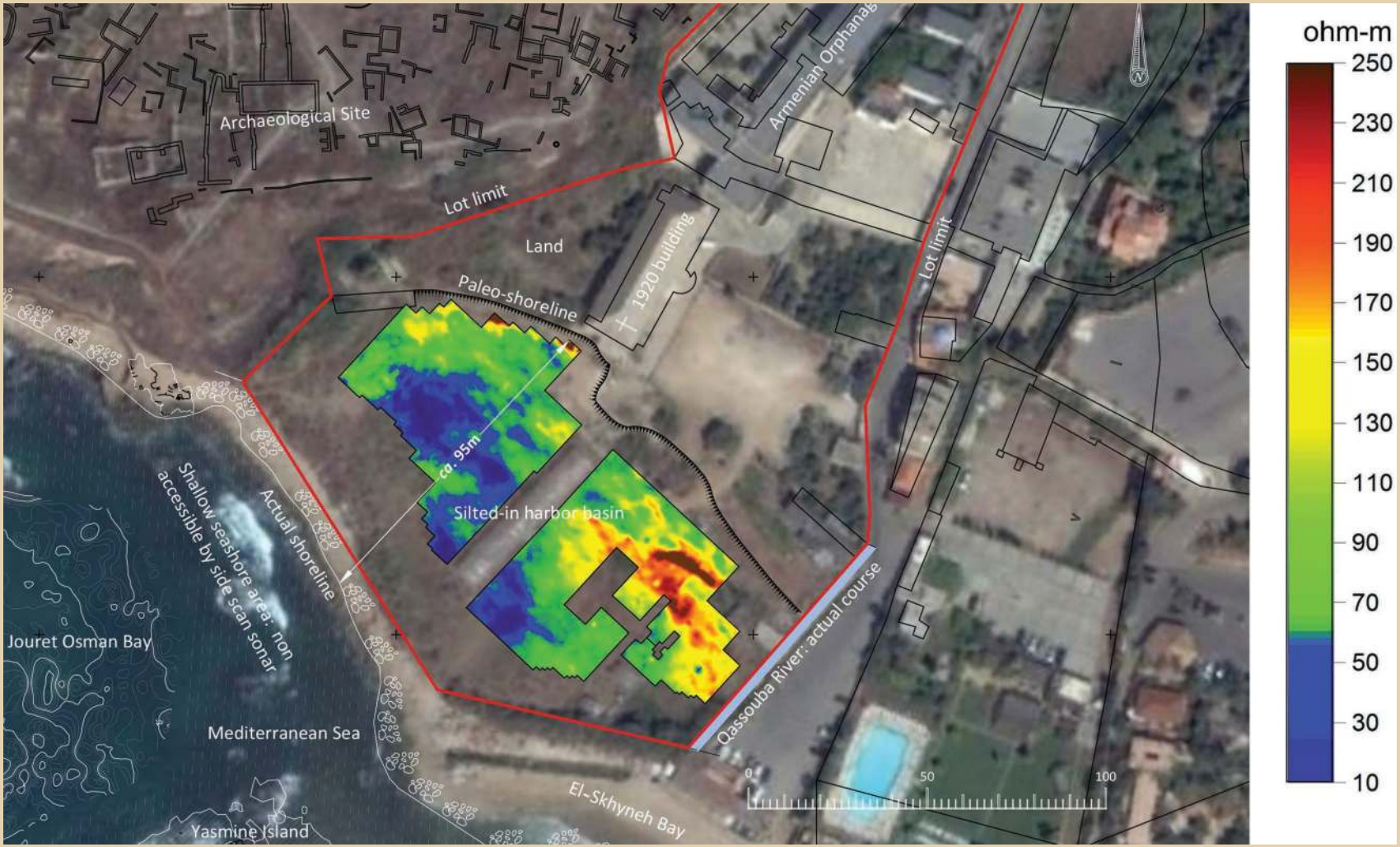


FIG. 19

A two-dimensional image of a buried body of water, showing an old shoreline at approximately 100 m inland from today's shoreline.

(Courtesy of the Byblos and the Sea Project.)

FIG. 20
Nicolas Carayon conducting auger coring in 2014 in the Armenian Orphanage lot.
(Photo by M. Francis-Allouche.)

FIG. 21
Assessing the 291 kg of sediments removed during coring, of which 80 kg were sampled, processed, and analyzed by UMR 5140: Archéologie des sociétés méditerranéennes of the Centre national de la recherche scientifique in Montpellier-Lattes, France. (Photo by N. Grimal.)

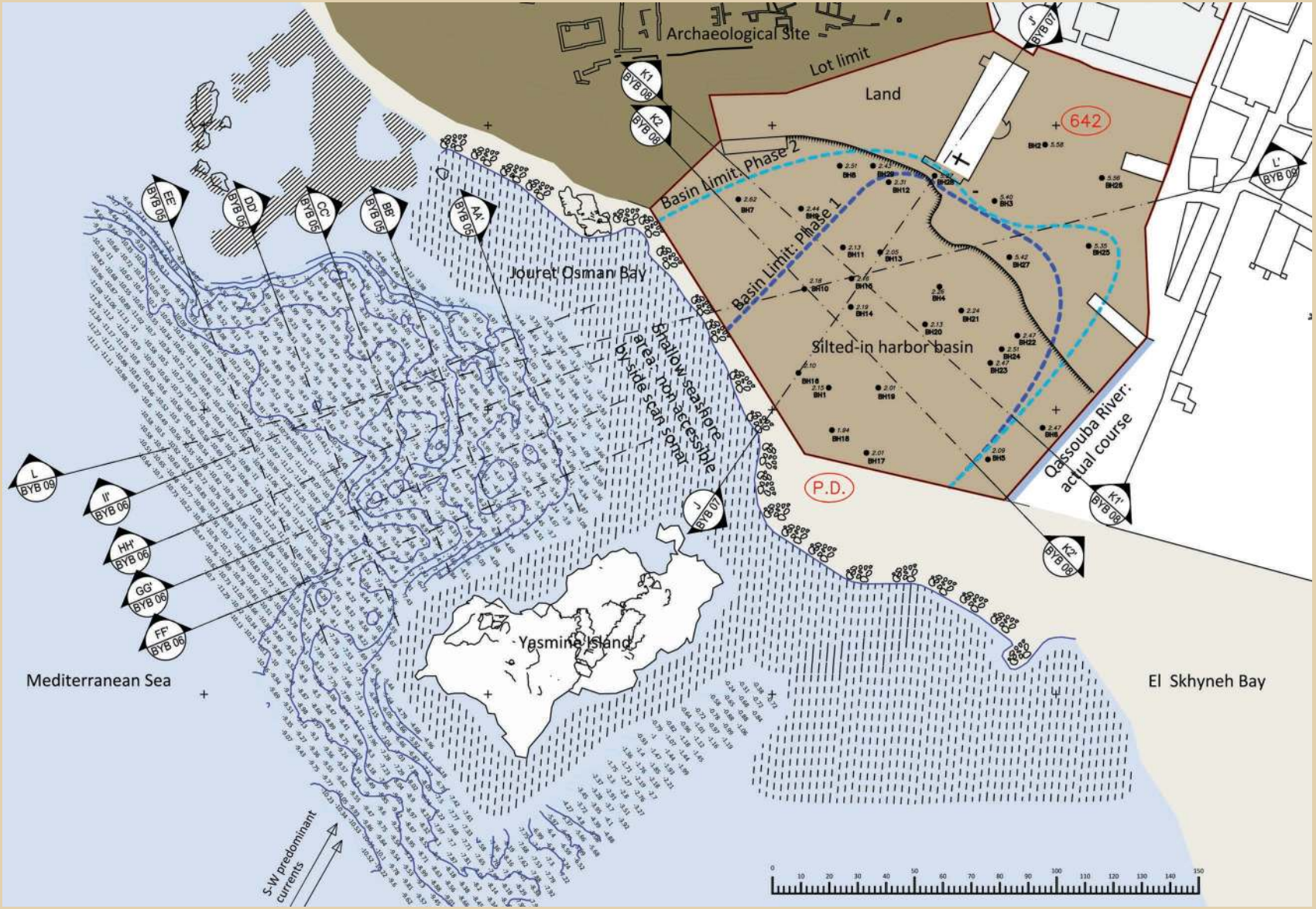


FIG. 22

A general plan showing the borehole survey on the Armenian Orphanage lot in Byblos: (a) the location of 29 auger cores (black dots); and (b) the limits of a two-phased silted-in harbor basin (8,000 m² and 12,000 m², respectively) (hatched blue lines). (Courtesy of the Byblos and the Sea Project.)

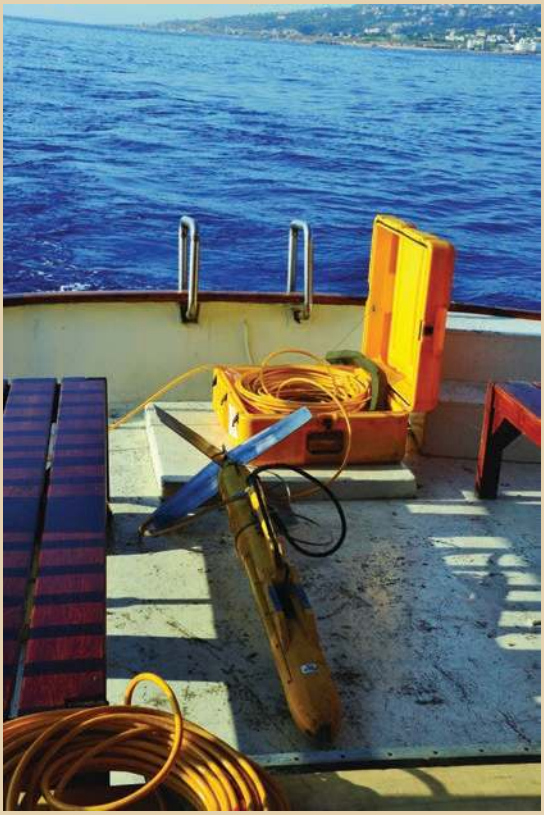
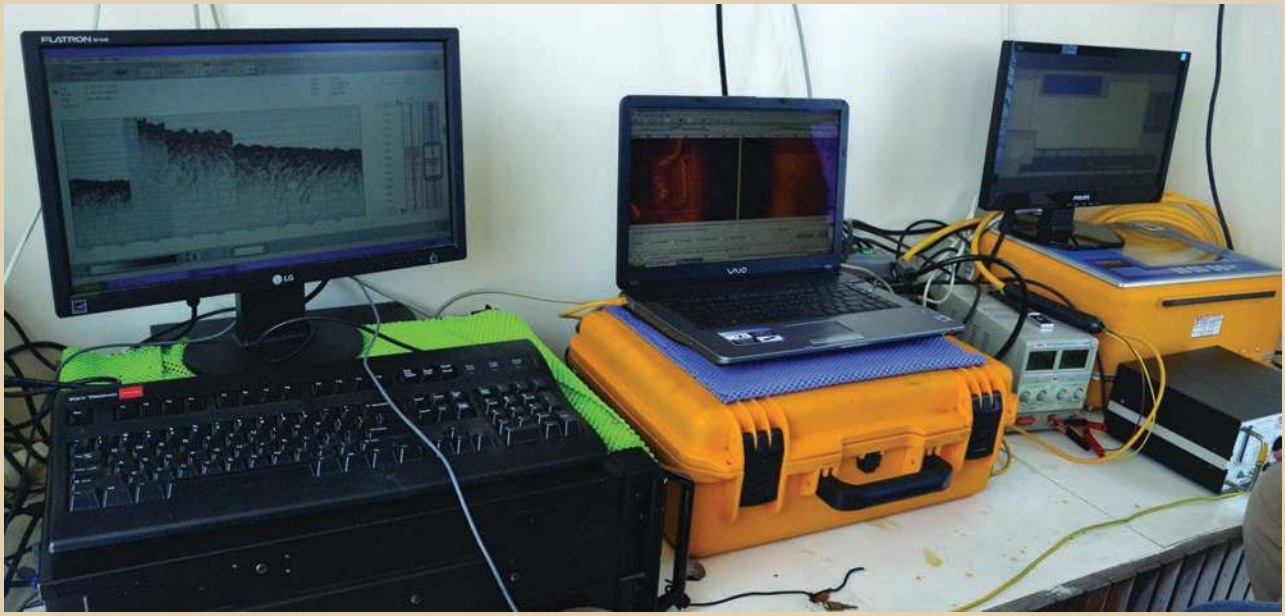


FIG. 23
A remote sensing survey conducted in the maritime approaches to Byblos in June 2014 under the direction of George Papatheodorou from the Laboratory of Marine Geology and Physical Oceanography at the University of Patras in Patras, Greece. (Photo by M. Francis-Allouche.)

FIG. 24
Deploying a wide side-scan sonar that is towed behind the ship and takes planimetric measurements of a wide seafloor area, resulting in geomorphological mapping and the detection of man-made features. (Photo by M. Francis-Allouche.)

FIG. 25
A sub-bottom profiler system provides a geological profile of the sub-bottom up to 50 m beneath the actual seabed. It evaluates the seismic stratigraphy of the seafloor and detects paleo-shorelines, buried seabeds, and structures. (Photo by M. Francis-Allouche.)

FIG. 26
The data acquisition system for all the marine remote sensing devices. (Photo by M. Francis-Allouche.)



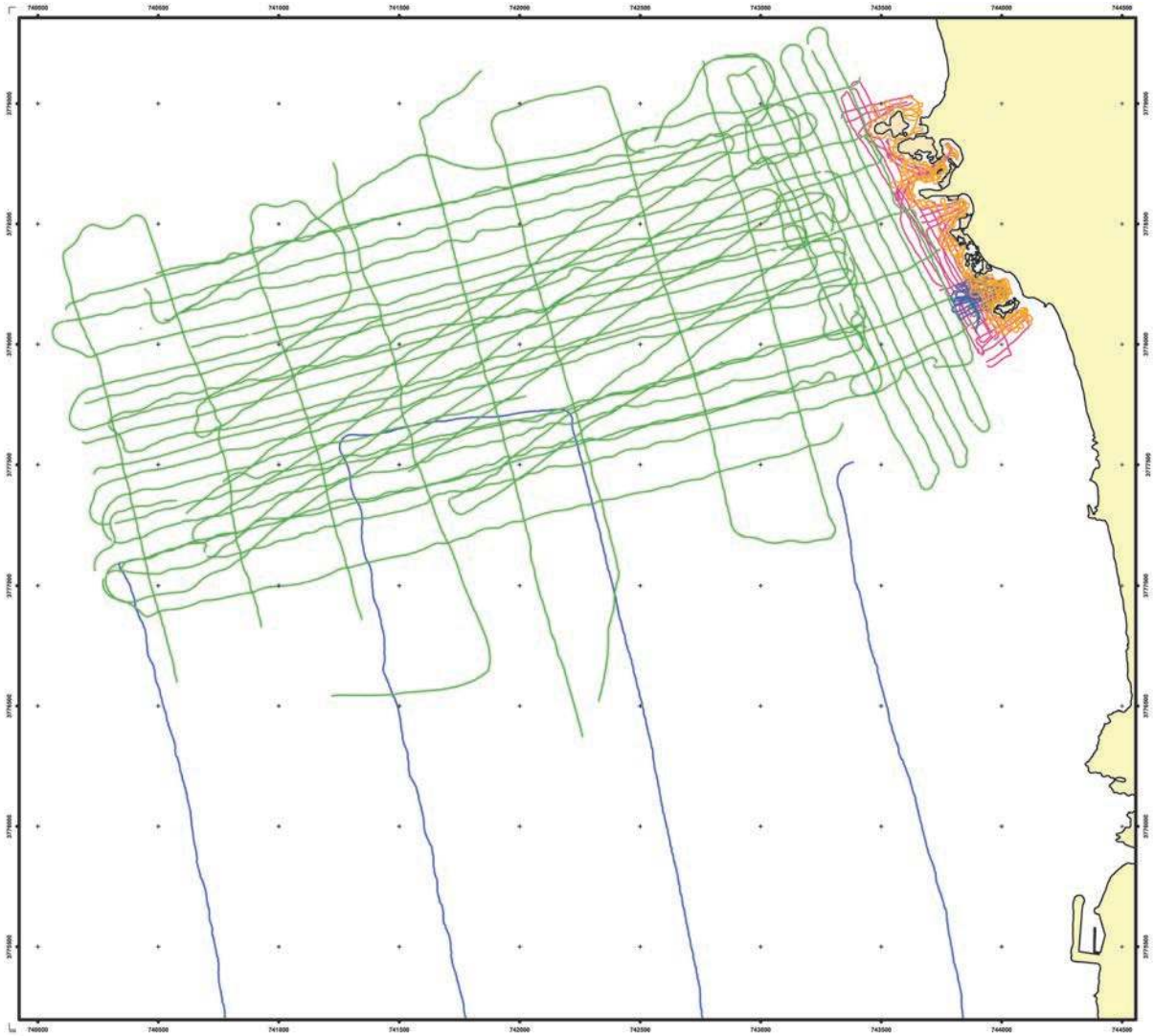


FIG. 27
Plan of the bathymetric sea surveying mission in Byblos covering a total area of 8 km² with a total length of 250 km in track lines. (Courtesy of the Byblos and the Sea Project.)

performed in Byblos (2002 [Frost 2002; Collina-Girard et al. 2002] and 2011 [Grimal and Francis-Allouche 2012]). The processed data of this survey resulted in: (a) a bathymetric map of the actual seabed; (b) a paleo-bathymetric map of a deeper laying seafloor; (c) a seafloor composition map; and (d) a man-made target map, spotting unusual man-made features.

In Jouret Osman Bay (Fig. 28), results of this bathymetric survey indicated an extremely shallow and rocky seabed with a shoreline practically linked to Yasmine Island and almost forming a headland. However, further investigations located a paleo-bathymetric level, that is, a deeper seabed, buried beneath the actual one. A 5 m-thick layer of loose sediments accumulated over the years and covers the deeper original seabed (Figs. 29–31). Moreover, the depth of this buried seabed perfectly matches the depth of the inland silted-in harbor basin on the Armenian Orphanage lot, meaning that the entire profile of the Qassouba Valley seems to have been much deeper and perfectly suited for mooring boats (Fig. 32).

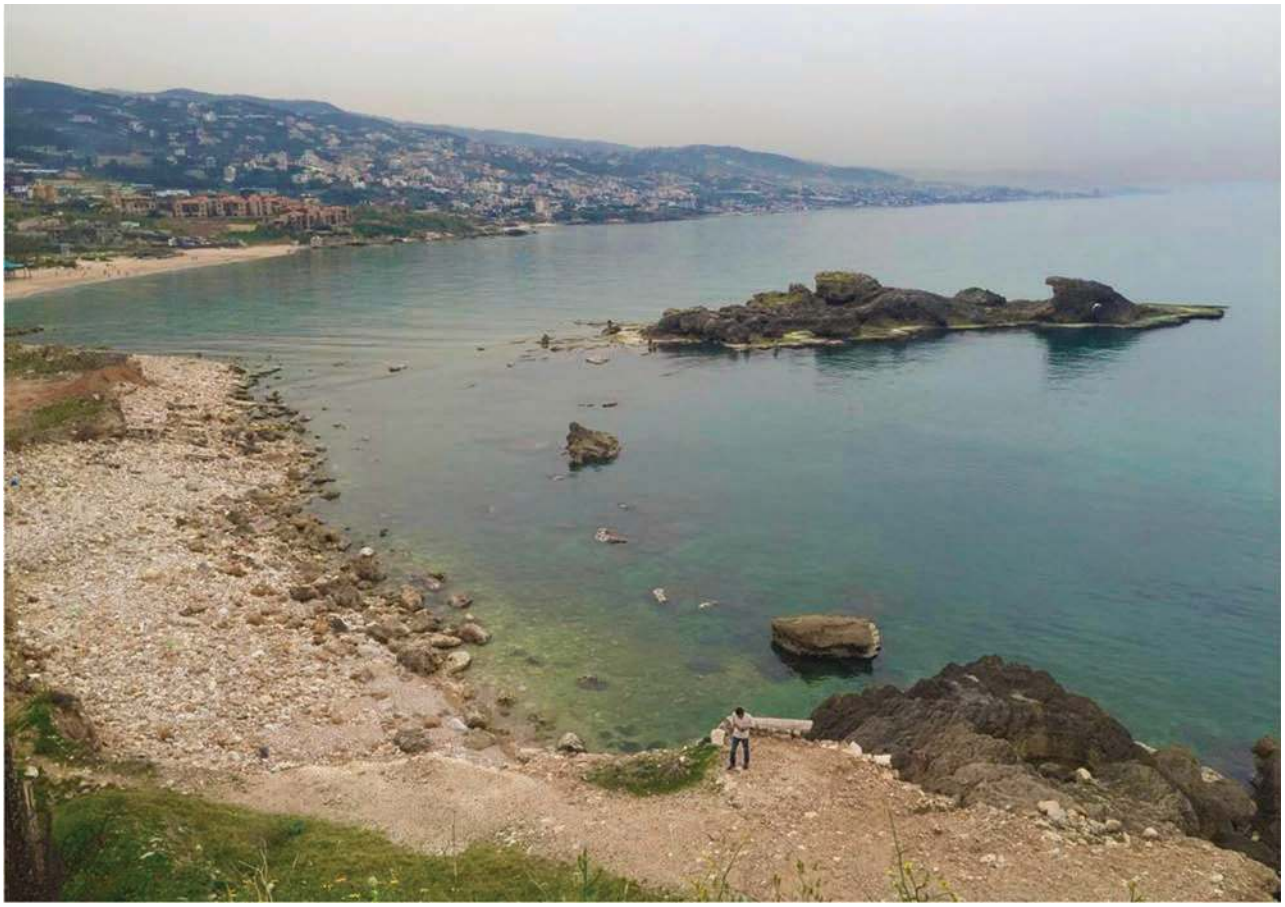


FIG. 28
The Jouret Osman Bay in front of the Armenian Orphanage lot in Byblos, showing Yasmine Island in the background.
(Photo by M. Francis-Allouche.)

Geophysical Survey

Within the framework of the Byblos and the Sea Project, a survey of geophysical readings was performed on the Armenian Orphanage lot in March 2015 by geophysicists Vivien Mathé and Adrien Camus (La Rochelle University, La Rochelle, Poitou-Charentes, France). The objectives of this mission were to: (a) survey the areas located outside the harbor basin lines; (b) fine tune previous results obtained by the geophysical resistivity survey; and (c) spot possible man-made structures, such as a mole, dock, or other harbor buildings.

This tomographic survey performed 13 parallel northeast–southwest and northwest–southeast pseudo-sections across the area, yielding results in section and elevation, whereas former resistivity results gave two-dimensional images or in plan. Both of these highly efficient and complementary techniques were used to optimize results by cross-referencing one another and resulted in a three-dimensional image of the harbor basin (Figs. 33–37).

Archaeological Soundings

Based on the results of the last geophysical survey, some archaeological soundings were conducted and trenches were dug in 2015 on the Armenian Orphanage lot to assess the archaeological importance of the site. A team of archaeologists confirmed the existence of a silted-in basin in the lower part of the lot. However, deeper archaeological layers were only reached in one of the soundings, confirming an

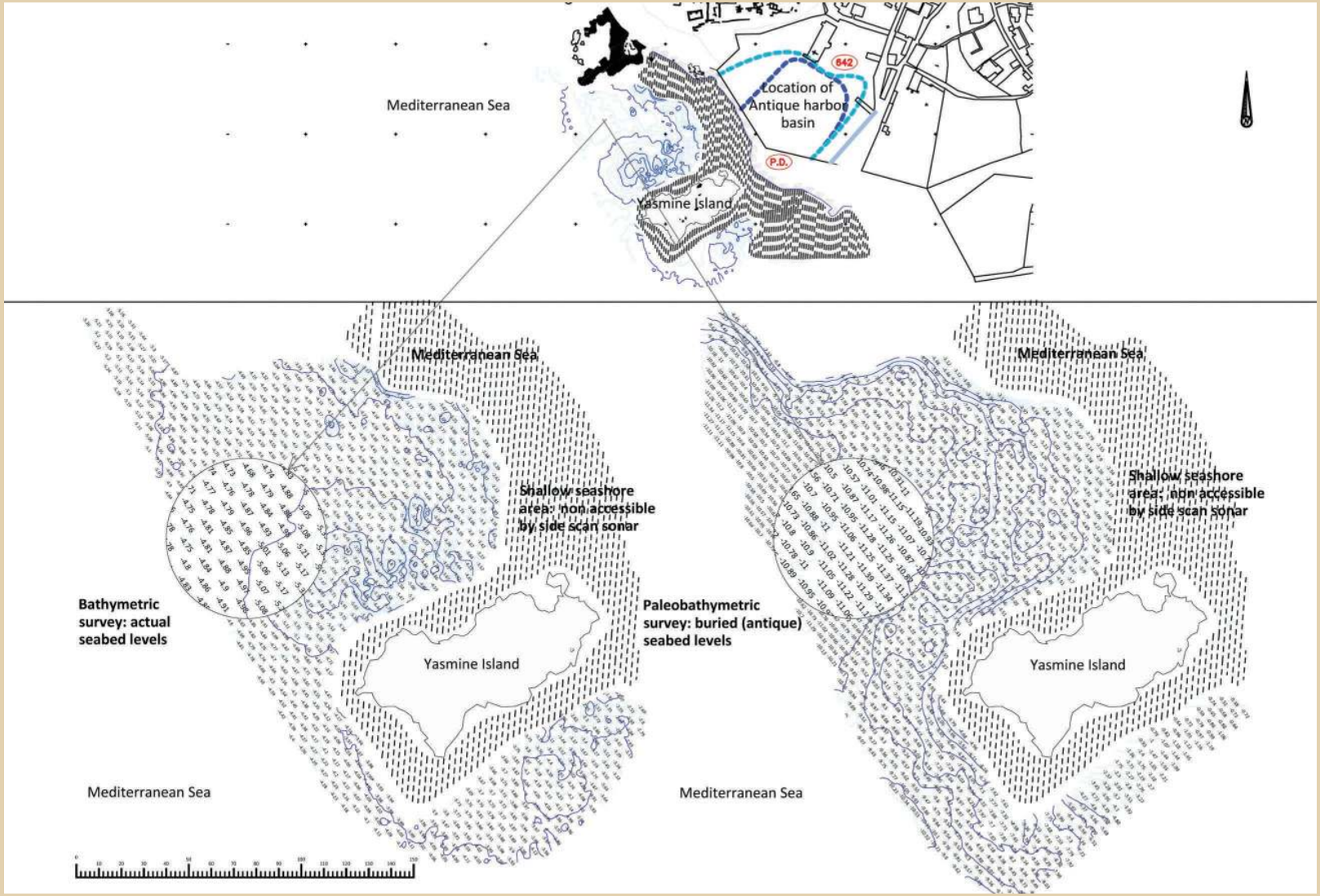


FIG. 29

A comparative plan showing actual bathymetric seabed levels (to the left) and buried paleo-bathymetric levels (to the right) of the same area in the Jouret Osman Bay. (Courtesy of the Byblos and the Sea Project.)

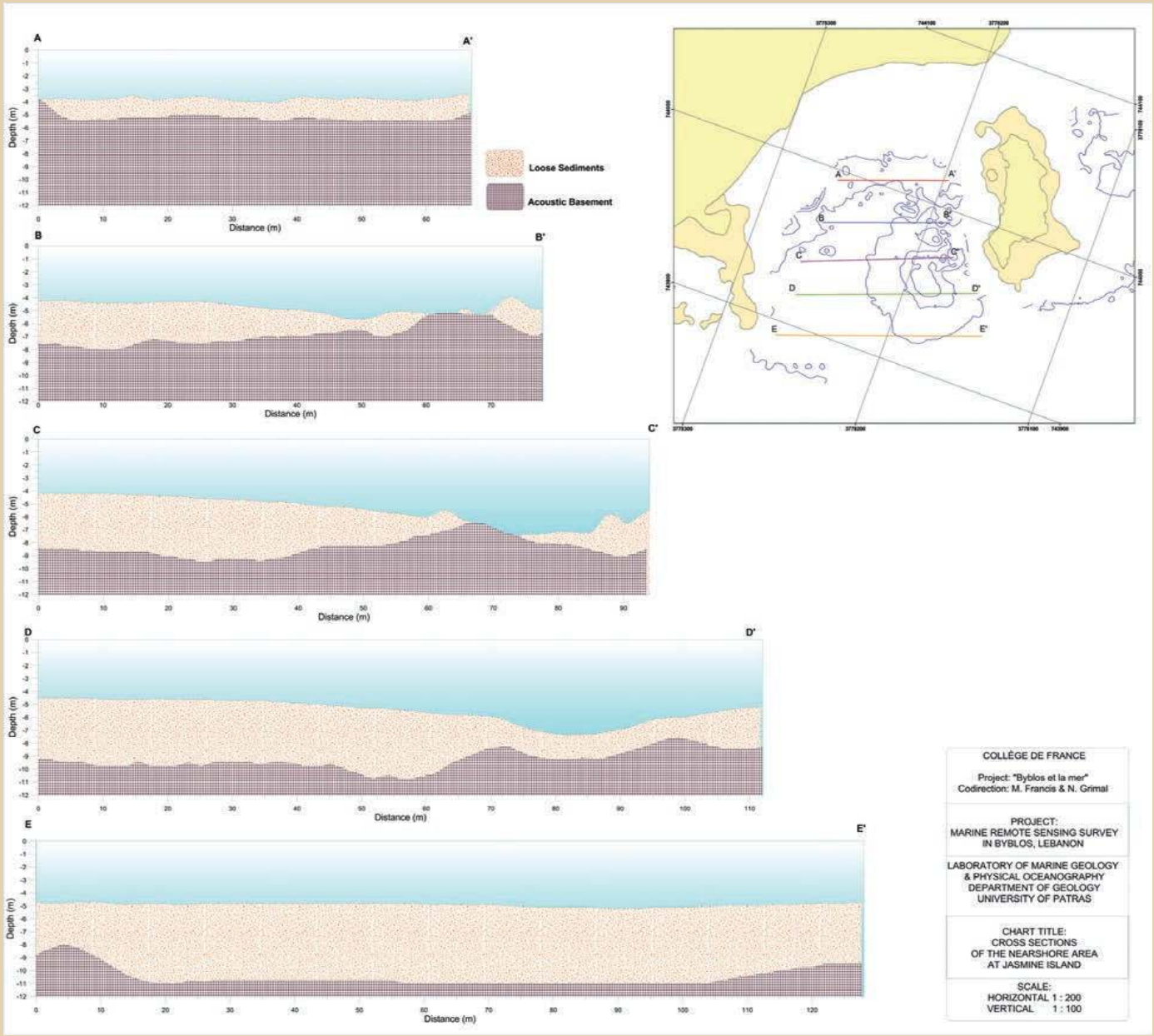


FIG. 30
Cross-sections of the near-shore area in the Jouret Osman Bay, showing a 5 m-thick layer of loose sediments covering a deeper seabed. (Courtesy of the Byblos and the Sea Project.)

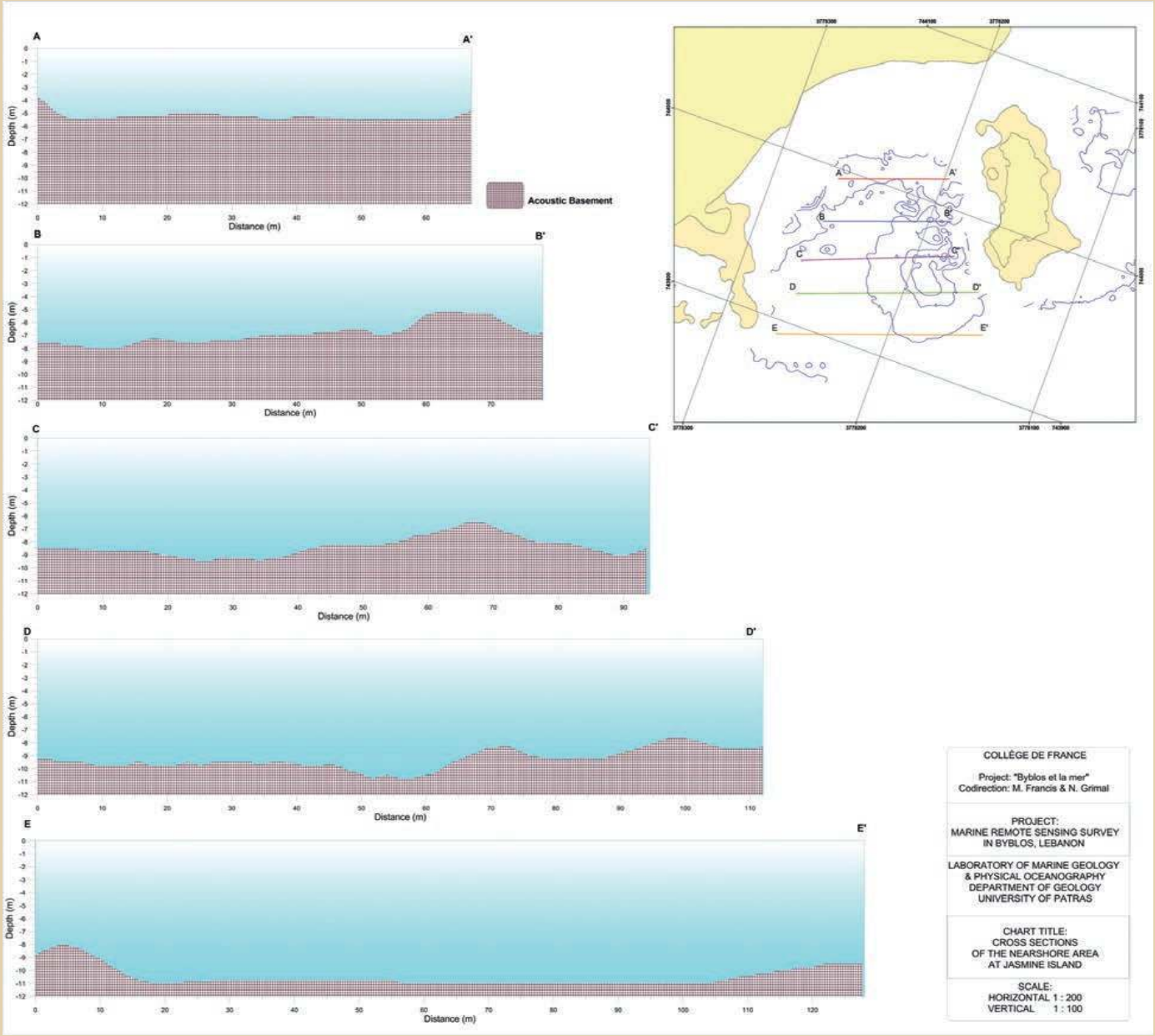


FIG. 31
Cross-sections of the near-shore area in the Jouret Osman Bay, showing the buried seabed level without the accumulated sediments layer. (Courtesy of the Byblos and the Sea Project.)

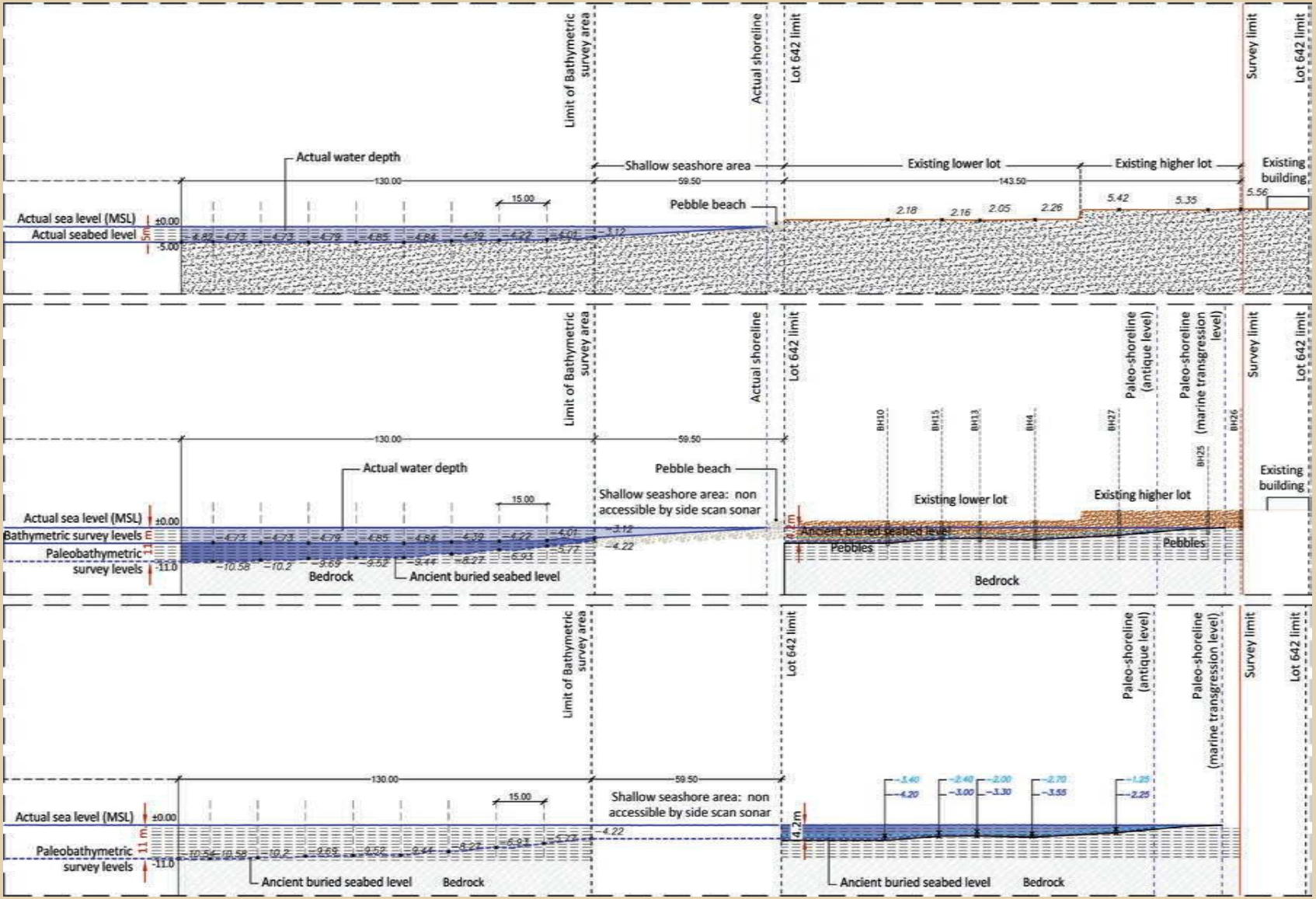


FIG. 32

Northeast–southwest general section, reconstituting the water depth of the ancient basin, buried in the Armenian Orphanage lot, and extending into the sea beneath the Jouret Osman Bay. From top to bottom: (a) actual configuration, (b) the prospection, and (c) the ancient configuration of the basin. (Courtesy of the Byblos and the Sea Project.)

FIG. 33
The tomography survey equipment used by Vivien Mathé and Adrien Camus in March 2015. (Photo by M. Francis-Allouche.)

FIG. 34
A tomographic pseudo-section across the Armenian Orphanage lot. (Photo by M. Francis-Allouche.)

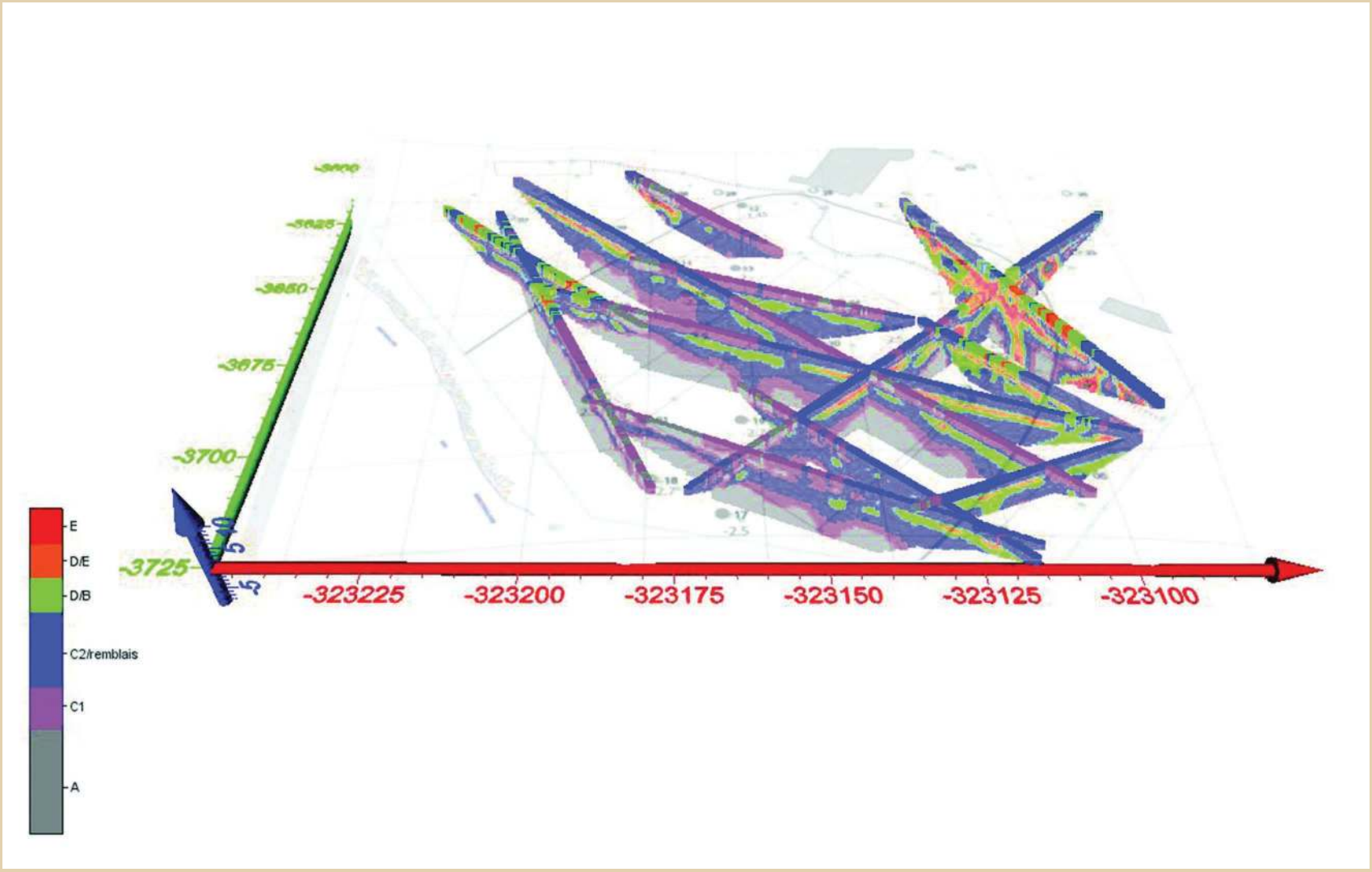


FIG. 35

Thirteen parallel northeast–southwest and northwest–southeast pseudo-sections resulting in a three-dimensional north–south view of the basin. The gray color represents the bedrock; the magenta and the blue represent the buried basin; and the red and orange represent possible structures. (Courtesy of the Byblos and the Sea Project.)

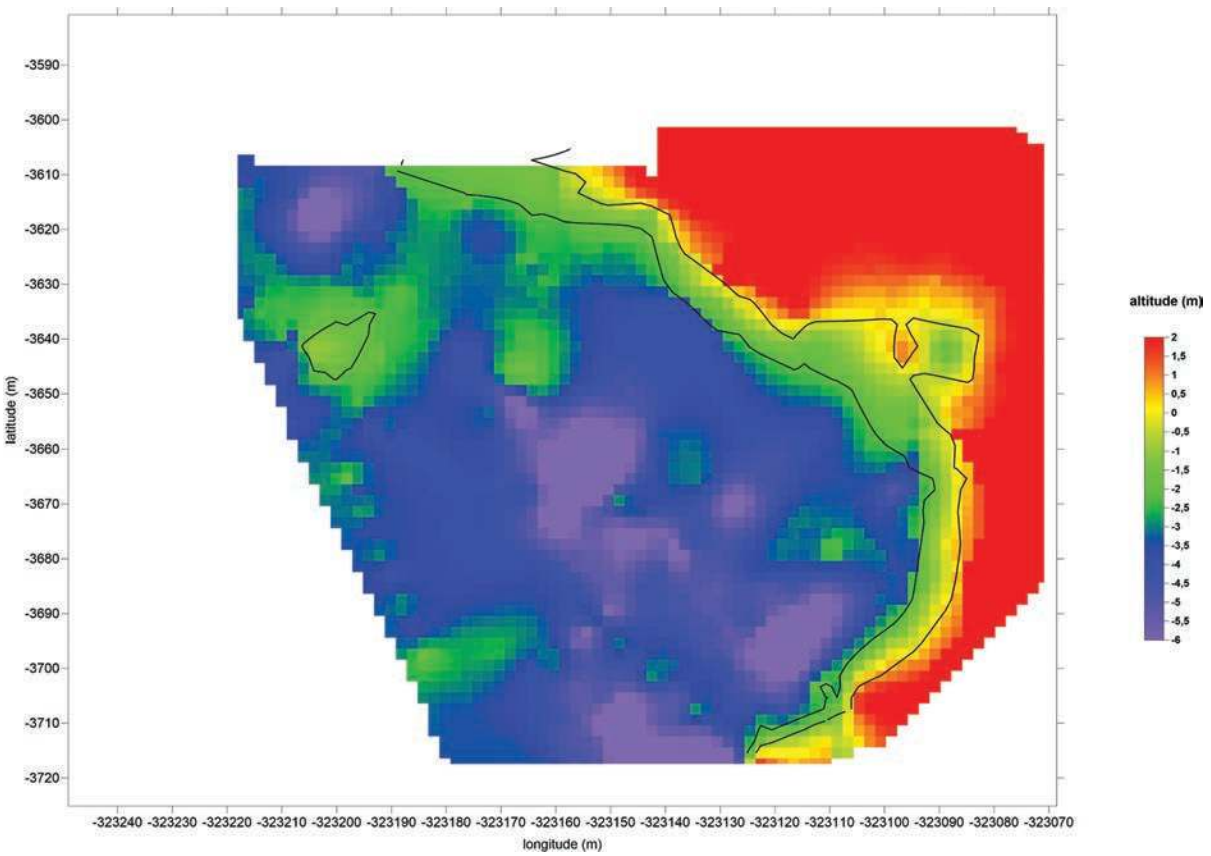


FIG. 36
Two-dimensional image of the silted-in harbor basin. (Courtesy of the Byblos and the Sea Project.)

old seashore line with material finds, such as a mooring weight and a series of typical copper ship nails. Anchors were also found in the harbor vicinity (Fig. 38).

In the upper area, excavated results validated the high-resistivity readings obtained by the tomography survey, unearthing a concentration of medieval and Roman structures. However, no older harbor structures have yet been unearthed. But what should we expect? Would these harbor structures be rather spectacular in scale, or should we expect a natural cove with more average ones?

Synthesis

The present study has confirmed through different scientific approaches the localization of the Bronze Age harbor of Byblos at the southern foot of the ancient city. Further archaeological investigations need to be conducted in order to better understand the harbor basin configuration and to unearth its possible structures. Moreover, it is important to note that the limits of the ancient city cannot be confined any longer to the promontory itself. These have to be extended to include the new harbor location, south of the city. As reported by ancient texts, the city of Byblos developed extensively during the middle of the third millennium BC due to its maritime trade, which was most probably conducted out of its southern harbor. This means that the natural border of the ancient city on the southeastern side coincides with the Qassouba Valley. The protected zone of the World Heritage site has to be widened to include not only its northern medieval harbor but also its newly located southern harbor, which seems to date to the Canaanite and Phoenician eras, based on the *Report of Wenamun*.

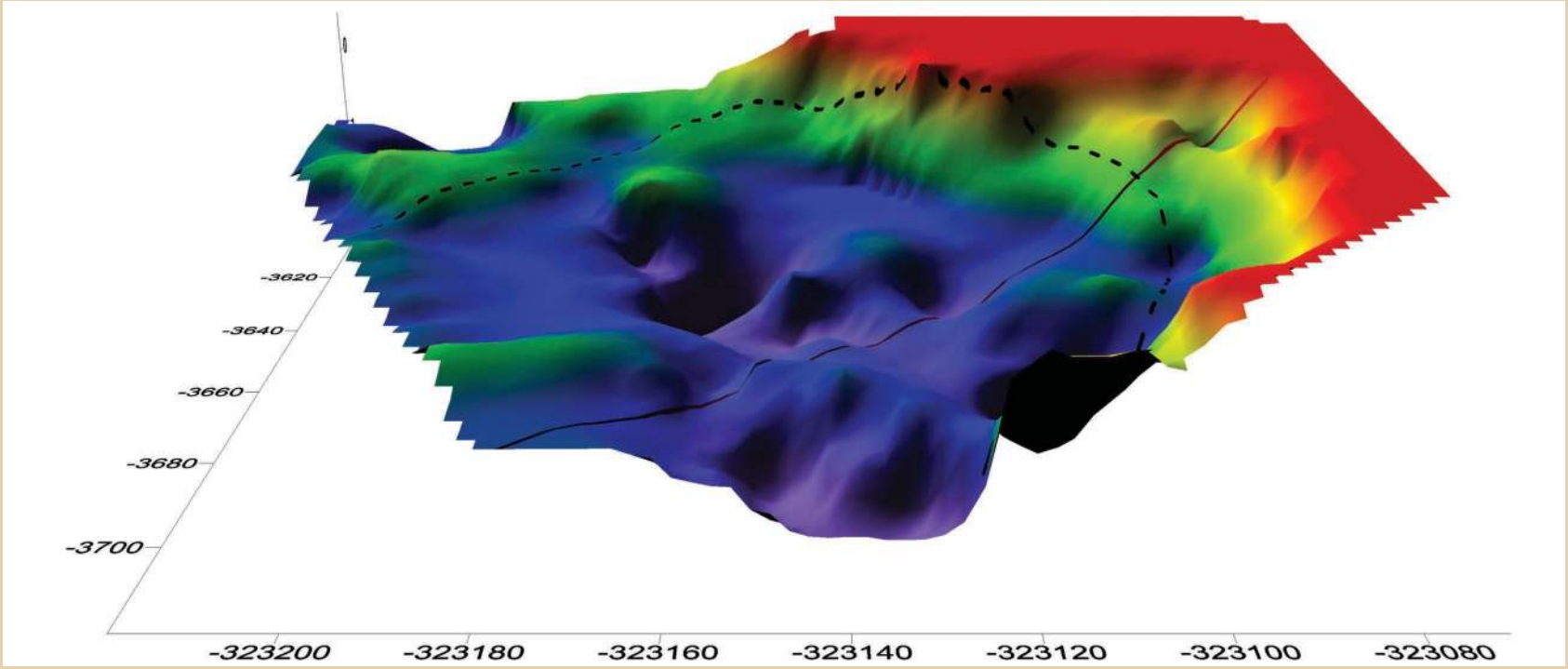


FIG. 37
Three-dimensional reconstruction of the harbor basin without the landfill. (Courtesy of the Byblos and the Sea Project.)

FIG. 38
An ancient stone anchor found in Jouret Osman Bay, the seaward side of the presumed ancient harbor of Byblos. (Photo by M. Francis-Allouche.)

Notes

1. Ancient Byblos was called *Gbl* in Phoenician, *Gubla* in Akkadian, and *kpn* in Egyptian (Jidejian 1971: 1–2).
2. This is known from the Cheops ship, uncovered in the Great Pyramid of Giza and dated to the third millennium BC.
3. All Egyptian transliterations and translations are by N. Grimal.
4. Although it may not have transported logs, the Qassouba River probably supplied fresh water to the harbor basin and, more generally, to the coastal area.
5. The sediments are currently undergoing ^{14}C analyses.

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