

Byblos & the Sea - an HFF funded Research Project

Summary report: Marine Remote Sensing and Sampling Survey / Mission 7 - Sept. 2016

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In the framework of the research program *Byblos and the Sea* a marine remote sensing and sampling survey was carried out in the coastal zone of Byblos in September 2016, in collaboration with the Laboratory of Marine Geology and Physical Oceanography of the University of Patras, under the scientific direction of George Papatheodorou. The investigation has been entirely funded by the Honor Frost Foundation.

After six years of research in the maritime approaches to Byblos and along the coastal area, the localization of the ancient harbor of the ancient city has been confirmed at the southern foot of the archaeological tell of Byblos, – a silted-in harbor cove of ca. 12.000m² with a depth of 1.5 to 4m of water column, has been roughly outlined. Further archaeological investigation was needed **on land** to understand the precise configuration of the basin buried under the Armenian Orphanage lot (Fig.1), to find the precise limits of its paleo-shoreline(s) and possibly unearthen piers, docks, storage facilities or other harbor buildings.



Figure 1. Aerial view of the nearshore area of Byblos : showing the main area of interest for minute marine survey around the Island of El-Yasmine (©Byblos & the Sea, 2016, Martine Francis-Allouche).

Sea Survey Mission 7 – Sept. 2016

At sea, the marine investigation conducted in September 2016 (mission no. 7), covered mainly the outer part of the basin area which remains submerged to this day in the Jouret Osman Bay, itself protected by the Island of El-Yasmine (Fig. 1).

The main objective of the marine survey in this near-shore maritime area was to deliver a detailed bathymetric and paleo-bathymetric map from the southeastern “Egyptian” approaches to the Island. When considering the entrance to the inner harbor basin, the Island may have played a role of a wave breaker against the majorly southwesterly currents, allowing ships to enter from the north-west into the harbor, i.e. through the Jouret Osman Bay (Fig.1). However, northerly or northwesterly currents do blow in winter season into the Jouret Osman Bay; therefore, even if seafaring may have been seasonal for international trade on longer routes (as related from ancient annals), local ships must have entered the harbor in winter season from its southeastern approaches, i.e. from the El-Skhyneh Bay (Fig.1). The investigation of this southern maritime area has therefore been set as a priority.

FIELD WORK:

The Profiling Survey

The survey at Byblos offshore area was carried out using a Chirp type GeoAcoustics GeoPulse Plus sub-bottom profiler. This profiler system provides a geological profile of the sub-bottom beneath the path over which the system is towed. Over 75 Chirp Subbottom profiler lines having a total length of 38.1 km were surveyed (Fig. 2).

Based on the 2014 survey results, this second bathymetric survey was carried out in the shallow nearshore area of Byblos, concentrating however on the maritime area around the Island of El-Yasmine. The collected subbottom profiles will be used for the reconstitution of the palaeogeography of coastal Byblos as well as for the detection of submerged palaeoshorelines, in conjunction with profiles collected by the survey expedition of 2014. For this purpose, more than 150 lines were conducted with a total length exceeding 63 km (Fig.2).

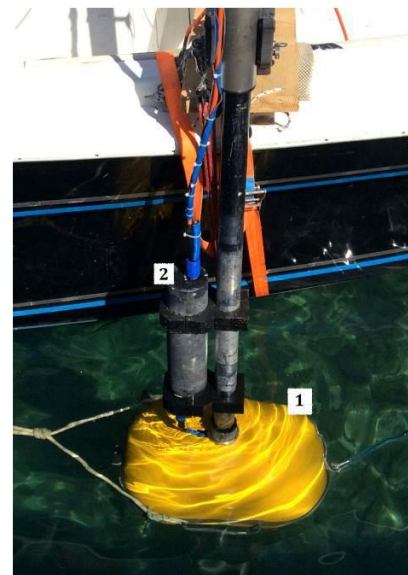
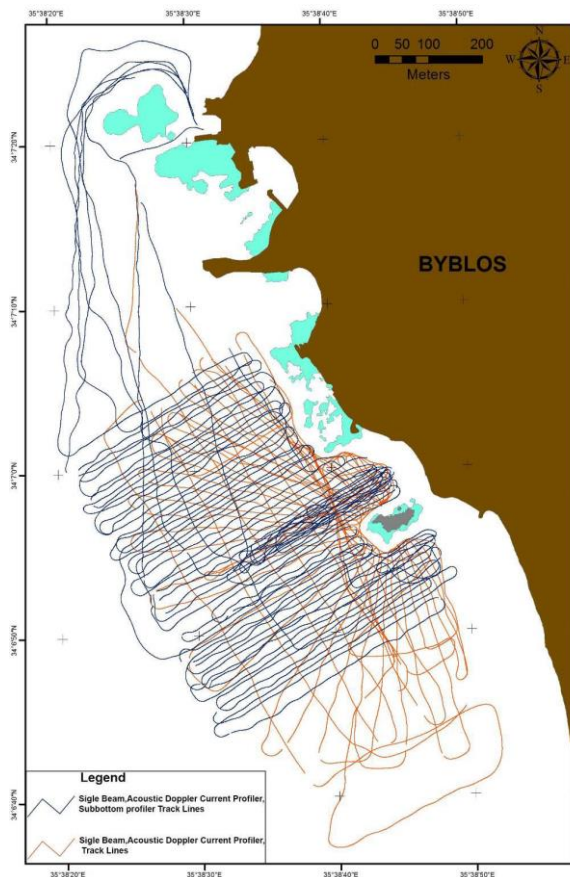


Figure 2. Map of the survey area showing the Single beam, ADCP and Chirp subbottom profiler tracklines (left); Bubble Model 132 over-the-side Transducer Mounting (1) and waterproof digital profiler electronics bottle (2) (right); (©Byblos & the Sea, 2016, G. Papatheodorou).

➤ **Acquired data:**

- A detailed bathymetry of the coastal zone of Byblos and the area of El-Yasmine Island,
- A definition of the subbottom stratigraphy of the recent sediment sequence,
- The tracing of the evolution of the coastline configuration at Byblos over the last 12000 years BP, based on the mapping of palaeoshorelines features,
- The detection of targets (surface and subsurface) of potential archaeological interest.

The sea currents measurement survey

The sea current measurement survey was carried out simultaneously with the Subbottom profile and bathymetric survey using a digital quad beam Acoustic Doppler Current Profiler (ADCP) Echosounder (Fig.3). The sea current survey was carried out in order to obtain detailed data about the hydrodynamic conditions of the coastal zone of Byblos which will also contribute to the reconstitution of the palaeoshoreline and the palaeobathymetry of the coastal Byblos.

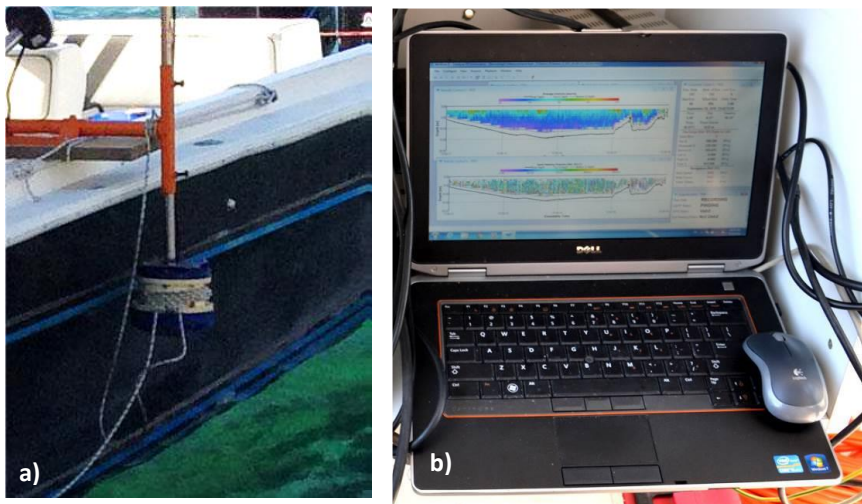
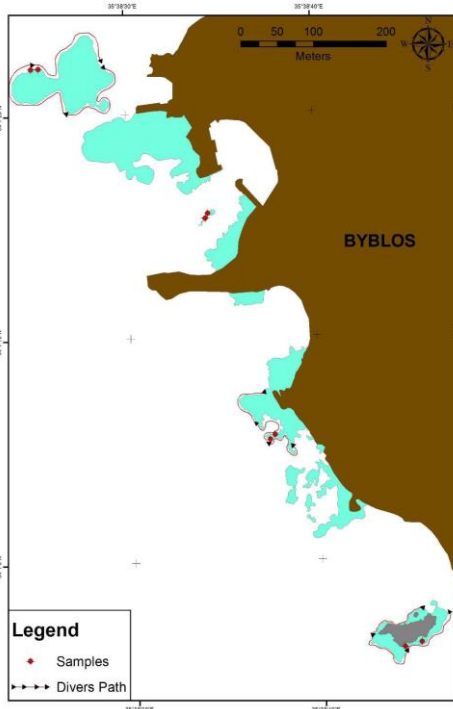


Figure 3. The transducers (a) of the ADCP and the digital recording unit (b) with a sea water current profile of the surveyed area; (©Byblos & the Sea, 2016, G. Papatheodorou).



The sampling session

During the sampling session, 10 samples were collected on specific locations (Fig.4) of the platforms of coastal Byblos. Eight of these were collected using a wet diamond core drill (Fig.5b) with a maximum penetration of 60cm into the rock, while two samples were extracted from the platform of El-Yasmine Island using hammer and chisel (Fig. 5c). The sampling session was conducted in order to acquire data through dating and analysis (Fig.6) on sea level changes. The acquired date may further help with the palaeogeographic reconstruction of the coastal zone of Byblos.

Figure 4. Map showing the samples locations (Red dots); (©Byblos & the Sea, 2016, G. Papatheodorou)



Figure 5. The sampling procedure on geological platforms (a): the wet diamond core drill (b) and the hammer & chisel technique (c); Photo M. Francis-Allouche).



Figure 6. Rock samples (Turoneun limestone covered by *Dendropoma Petraeum*) extracted from uplifted platforms for dating by Optically Stimulated Luminescence (OSL) and Carbon 14 (C14); (©Byblos & the Sea, 2016, G. Papatheodorou; Photo M. Francis-Allouche).

The dive session

The dive session was carried out by two divers, one moving on the seafloor and the other following the first at Mean Sea Level. A third surveyor was walking on the shore parallel to the divers and marking the route using a portable GPS. In total, three dives were conducted throughout the session along El-Yasmine Island and the shoreline of Byblos. The dives were conducted in order to identify submerged notches (Fig.7 Left) and geomorphological structures which indicate palaeoshorelines. Simultaneously with the dive session, another team identified and documented uplifted notches on the shoreline of Byblos and on El-Yasmine Island (Fig.7 Right).

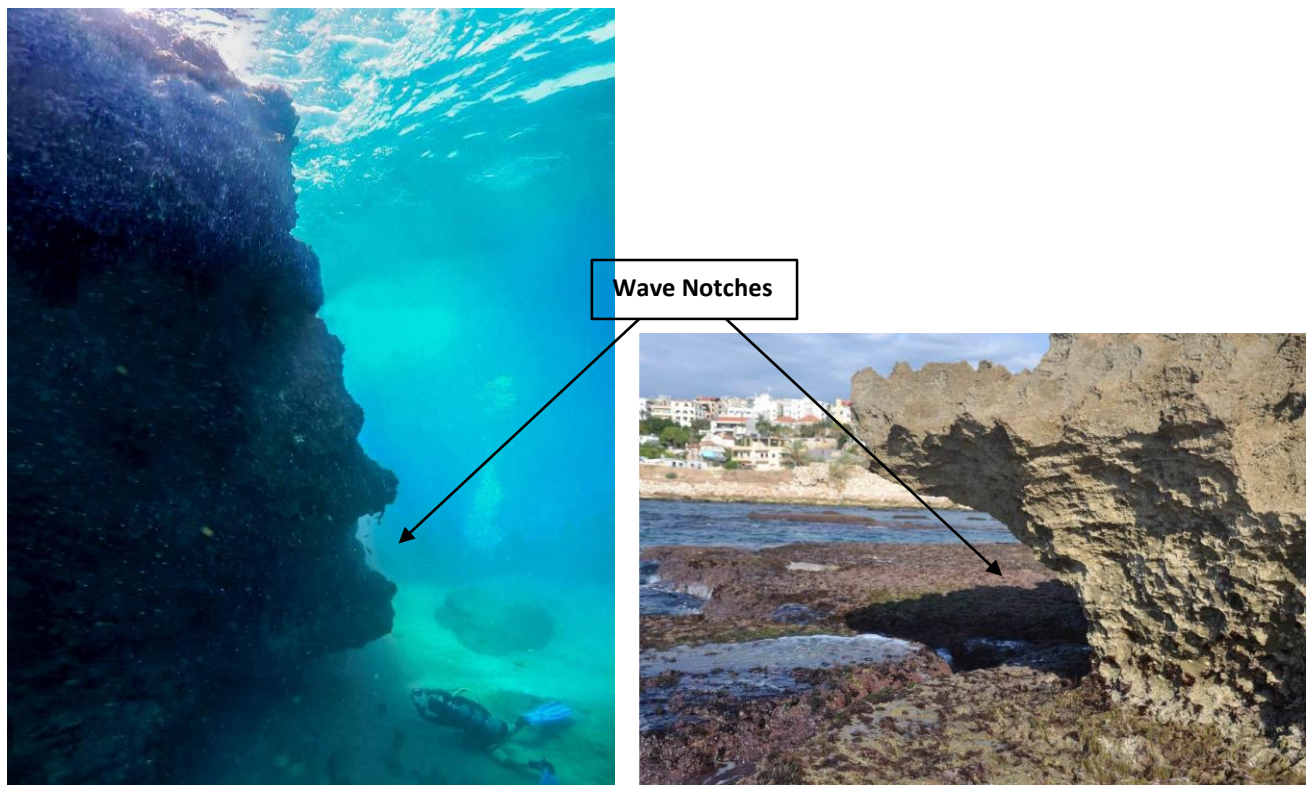


Figure 7. Left: Photo of submerged notches at El-Yasmine Island; Right: Photo of an uplifted notch on El Yasmine Island (©Byblos & the Sea, 2016, G. Papatheodorou).

Preliminary scientific results are published in the Bulletin d'Archéologie et d'Architecture Libanaises (Francis-Allouche, M. and Grimal, N. *et al.* 2017. "Byblos maritime : une installation portuaire au piémont sud de la ville antique", BAAL 17, p. 133-196).