



UNIVERSITY OF THE PELOPONNESE

DEMIRI EUGENIA
1012201502011

DIPLOMA THESIS:

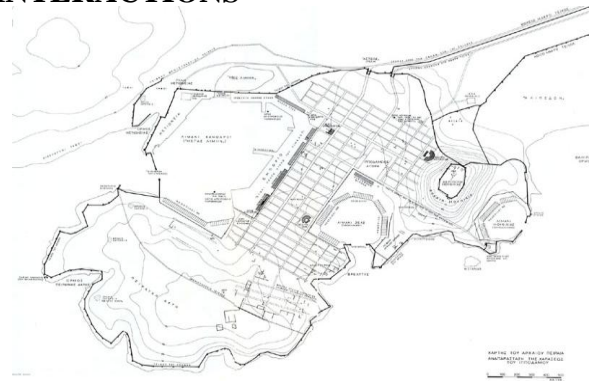
**FORMATION AND EVOLUTION OF HARBORS IN MAINLAND
GREECE AND THE ISLANDS: HUMAN, ENVIRONMENTAL, AND
BIOGEOGRAPHICAL INTERACTIONS**

SUPERVISING COMMITTEE:

- Assist. Prof. Zimi Eleni
- Assoc. Prof. Zacharias Nikos

EXAMINATION COMMITTEE:

- Assist. Prof. Zimi Eleni
- Assoc. Prof. Zacharias Nikos
- Assist. Prof. Xanthopoulou Maria



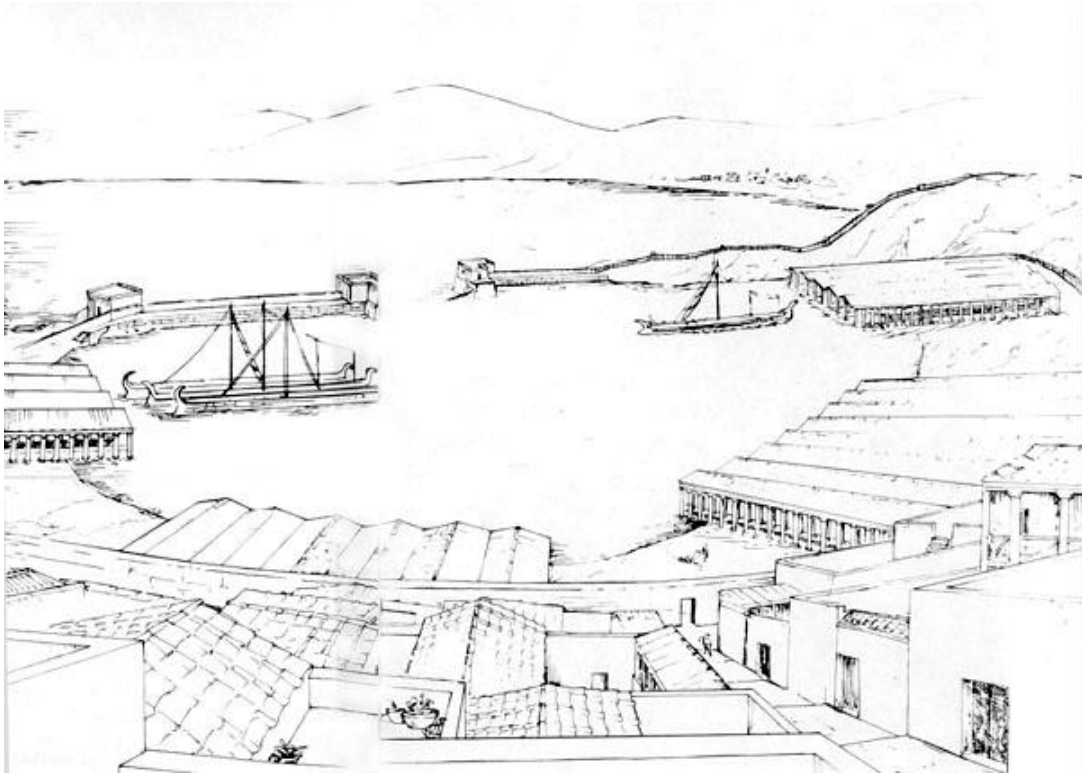
KAAAMATA, SEPTEMBER 2016

...in addition to this, you have harbors, without which it is not possible to enjoy naval power.

(Xenophon, *Hellenica* 7.1.3)

...πρὸς τούτοις δὲ λιμένας ἔχετε, ὧν ἄνευ οὐχ οἶόν τε ναυτικῇ δυνάμει χρῆσθαι.

(Ξενοφών, *Ελληνικά*, 7.1.3)



Foreword

This thesis entitled “Formation and Evolution of harbors in mainland Greece and the Islands: Human, Environmental, and Biogeographical Interactions” was produced as part of the program specification for the Master in Science in “Cultural Heritage Materials and Technologies” by the Department of History, Archaeology and Cultural Resources Management, Faculty of Humanities and Culture Studies, University of the Peloponnese. It is about a research study for the identification and recording of the ancient harbors in mainland Greece and the islands constructed from the Archaic to the Hellenistic period and an investigation of the evolution of their palaeo environment through time based on human, environmental, and biogeographical interactions.

This is because one of the difficulties encountered by anyone studying the ancient ports is the evolution of the landscape, a phenomenon observed particularly on the coasts. Coastal development is the result of the complex interplay between long-term forces. The ports have been built depending on the configuration of the coast of the period of their construction. Therefore, it is estimated that the overall level of the sea has been raised by 2.5m around since antiquity. In addition, the geological phenomena differ from region to region but also in relation to the location of the ports on the seismological map. An important role plays the position of the port in relation to the hydrological network of the region, which may lead a coast to move towards the sea or inland. Sedimentation can also be caused by anthropogenic interventions. Thus, the researcher in some cases detects the ancient ports sunken, embanked, or uplifted.

In fulfillment of this dissertation, I would like to thank, first, the supervisor of my thesis, Assistant Professor Zimi Eleni for the valuable assistance and guidance during my work. I am also grateful to the other members of the supervising and examination committee of my thesis, Associate Professor Zacharias Nikos and Assistant Professor Xanthopoulou Maria for cooperation and valuable contribution to its integration. Finally, I would like to express my sincere and heartfelt thanks to the facilities provided by the University of the Peloponnese, the the Laboratory of Archaeometry and MSc scientific, secretarial and support staff for the help and guidance during this academic year.

Contents

Foreword.....	3
Contents.....	5
Introduction.....	19
Chapter 1	
Ancient harbors and remains of port installations in mainland Greece and the islands. Overview of archaeological remains, references to ancient sources, underwater and coastal surveys.....	22
1. Peloponnese (from the west).....	26
1.1. Porto Cheli-Alieis.....	26
1.2. Corinth-Lechaeon.....	28
1.3. Arcadia.....	32
1.4. Kyllene.....	32
2. Central Greece.....	35
2.1. Piraeus	35
2.1.1. Kantharos.....	35
2.1.2. Munychia.....	38
2.1.3. Zea.....	40
2.2. Salamis- Ambelaki.....	42
2.3. Attica-Sounion.....	44
2.4. Aigina.....	46
2.5. Oiniadai.....	49
3. North Greece.....	51
3.1. Abdera.....	51
4. Crete.....	52
4.1. Phalasarna.....	52

4.2. Rethymnon.....	54
4.3. Matala.....	54
4.4. Sitea.....	55
4.5. Trypitos.....	55
5. Cyclades.....	56
5.1. Andros-Palaeopoli.....	56
5.2. Kea.....	58
5.2.1. Otzias bay.....	58
5.2.2. Poiessa.....	60
5.3. Kythnos-Mandraki bay.....	60
5.4. Delos.....	63
6. North eastern Aegean.....	64
6.1. Thasos.....	64
6.1.1. Commercial Harbor.....	64
6.1.2. Military Harbor.....	66
6.2. Lemnos.....	68
6.2.1. Agios Sotiras.....	68
6.2.2. Hefaistia.....	70
6.2.3. Neftina.....	71
6.2.4. Thanous bay Stvi.....	71
6.3. Lesvos.....	72
6.3.1. Mytilene North harbor.....	73
6.3.2. Mytilene South harbor.....	74
6.3.3. Antissa.....	76
6.3.4. Eresos.....	78
6.3.5. Kalo Limani.....	81
6.3.6. Pyrrha.....	82

6.3.7. Mithymna.....	85
6.3.8. Agios Fokas.....	86
6.4. Samos-Pythagoreion.....	87
7. Dodecanese.....	91
7.1. Rhodes-City ports.....	91
7.2. Kos City, Kos.....	93
7.3. Alimia.....	95

Chapter 2

Ancient harbor geoarchaeology.....	97
1. The Geoarchaeological study of ancient harbors.....	102
1.1. Global sea level.....	102
1.2. Tectonism.....	103
1.3. Climate.....	104
1.4. Sedimentation.....	105
2. Crece.....	106
3. Geoarchaeological context of ancient Greek harbors.....	107
3.1. Paleogeografhy of Southern Greece.....	107
3.2. Paleogeografhy of Central Greece.....	108
3.3. Paleogeografhy of Crete.....	110
3.4. Paleogeografhy of the Aegean.....	113
Valuation and comments.....	113
Gazetteer of Sites.....	116
Appendix of Maps.....	130
Appendix of Tables.....	132
Appendix of Figures.....	134
Bibliography.....	176

Appendix of Maps

1. Geographical distribution of the ancient Greek harbors in the Archaic period.....	16
2. Geographical distribution of the ancient Greek harbors in the Classical period.....	17
3. Geographical distribution of the ancient Greek harbors in the Hellenistic period.....	18
4. Map of the harbor area of Lechaeon with the visible remains.....	130
5. Map of Ambelaki bay of the Classical / Hellenistic harbor	130
6. Map of Cape Sounion with the ancient remains.....	131
7. Map of west Crete showing Phalasarna.....	131

Appendix of Tables

Table 1. Major Geoarchaeological surveys conducted in mainland Greece and the islands.....132

Appendix of Figures

Part A

1.	Plan of harbor area of Alieis.....	134
2.	Sketch of the remains at the harbor area of Alieis.....	134
3.	Reconstruction of the harbor area of Alieis.....	135
4.	Reconstruction of the boom mechanism at the harbor entrance.....	135
5.	The port of Lechaeon in 1907 according to Georgiades.....	136
6.	Aerial view of Lechaeon in 1960.....	136
7.	Lechaio: the occluded mouth.....	136
8.	The platform of the port next to the occluded mouth.....	137
9.	View of the channel guiding to the sea from the inner eastern basin.....	137
10.	View of the build up southern bank of the eastern basin.....	137
11.	View of the build southern bank of the eastern basin.....	137
12.	Vertical blocks at the build up northern bank of the eastern basin.....	138
13.	View of the technical islet in the western inner basin.....	138
14.	Lechaio: Top view of the sunken remnants of the input channel.....	138
15.	Overview of the Kyllene harbor site.....	139
16.	Visible remains of the ancient Kyllene harbor site.....	139
17.	Visible remains of the ancient Kyllene harbor site.....	140
18.	Plan of the ancient city of Piraeus.....	140
19.	Representation of the ancient city of Piraeus Representation	141
20.	Graphic representation of the Emporion at the Kantharos basin in the 5th c. B.C.....	141
21.	Plan of Kantharos harbor.....	141
22.	Beacon column on the south side of the mouth of Kantharos	142

23. Remains of beacon on the north side of the mouth of Kantharos.....	142
24. Graphic representation of the dockyard of Munychia.....	142
25. Munychia harbor as it was in early seventies.....	143
26. Drawings of the surviving structures in the dockyard of Munychia.....	143
27. Zea harbor according to the latest excavation results	144
28. Dorpfeld's plan of twelve shipsheds in the eastern part of Zea harbor.....	144
29. Representation of shipsheds of Zea at Piraeus Nautical Museum.....	144
30. Shipsheds' remains at Saggariou street from the eastern side of Zea basin.....	145
31. Shipsheds' remains in a basement at Saggariou Street	145
32. Submerged rock foundation trench dividing shipsheds of Zea	145
33. The location of the port of Zea, south of Munychia hill.....	146
34. Ancient harbor-works on the west side of Ambelaki bay from NW.....	146
35. Ancient harbor-works on the west side of Ambelaki bay from W.....	147
36. Ancient harbor-works on the west side of Ambelaki bay from SW.....	147
37. Mole remains on the south side of Ambelaki bay from SW.....	147
38. Mole remains on the north side of Ambelaki bay from N.....	148
39. Mole remains on the north side of Ambelaki bay from S.....	148
40. City wall remnants of the ancient city at Ambelaki.....	148
41. Representation of the structures of the walled site of Sounion.	149
42. Representation of harbor structures at the beach of Sounion bay	149
43. The military harbor of Aigina. Source: Book presentation " <i>Shipsheds of the Ancient Mediterranean</i> ". David Blackman, Kalliopi Baika and Jari Pakkanen present the book by themselves and B. Rankov, H. Gerding and J. McKenzie. An event co-organized with the Finnish Institute at Athens.....	150
44. The harbors of Aigina. Source: <i>ibid</i>	150
45. Aerial view of Oiniadai in Trikardos hill.....	151

46. Remains of shipsheds at Oiniadai. Source: Book presentation " <i>Shipsheds of the Ancient Mediterranean</i> ". David Blackman, Kalliopi Baika and Jari Pakkanen present the book by themselves and B. Rankov, H. Gerding and J. McKenzie. An event co-organized with the Finnish Institute at Athens.....	151
47. The shipsheds at Oiniadai. Source: <i>ibid.</i>	151
48. The location of the shipshed complex in Abdera. Source: <i>ibid.</i>	152
49. Plan of the harbor of Phalasarna	152
50. Defensive circular tower of the harbor.....	153
51. Part of a quay. A binding hole as well as a mooring stone are visible.....	153
52. Part of quay with binding holes and mooring stones.....	153
53. Quay with mooring stones	154
54. General view of Phalasarna harbor from the acropolis.....	154
55. Defending towers in Phalasarna harbor.....	155
56. The location of the single slipway in Trypitos.....	155
57. Satellite view of the remains of the harbor at Palaeopolis.....	156
58. Panoramic view of the archaeological site.....	156
59. View of the island of Kea and the cove Otzias.....	157
60. Top view of the port construction in the cove Otzias.....	157
61. View and section of the port construction in the cove Otzias.....	157
62. View of the quay of the port in the cove Otzias.....	158
63. View of the quay in bay Otzias	158
64. The location of the single slipway in Poiessa.....	158
65. General view of the Mandraki bay.....	159
66. Site plan of the ancient city of Kythnos.....	159
67. View of the wall at the northern side of the harbor.....	159
68. View of Skardanas Bay to the southwest.....	160
69. View of the foundation of the construction in Skardanas bay westward...	160

70. General plan of the ancient defended city of Thasos	160
71. Plan of the two harbors of ancient Thasos.....	161
72. General view of the two harbors of ancient Thasos	161
73. View of the submerged mole of the ancient commercial port.....	161
74. The military Harbor of Thasos. Source: Book presentation " <i>Shipheds of the Ancient Mediterranean</i> ". David Blackman, Kalliopi Baika and Jari Pakkanen present the book by themselves and B. Rankov, H. Gerding and J. McKenzie. An event co-organized with the Finnish Institute at Athens.....	162
75. Remains of a circular tower at the military harbor's southwest angle.....	162
76. Satellite image of Mytilene with the two ports.....	163
77. Lighthouse at mole edge of the eastern breakwater in gravure of the 18 th century.....	163
78. The surviving today right	163
79. A view of the remains of the north jetty in Kalamaris region.....	164
80. General view of the north port.....	164
81. Satellite image of Mytilene, showing the ancient basin of the southern port.....	165
82. View of the breakwater Lantern which coincides with the s/n breakwater of the ancient southern basin.....	165
83. Sketch of "Euripus".....	165
84. Ancient Antissa according to Robert Koldewey (1890).....	166
85. Antissa. At the background of the bay the remains of the jetty	166
86. The modern fishing shelter in Eresos and in its expansion the ancient cantilever / jetty.....	167
87. Underwater view of the south side of the cantilever /breakwater	167
88. View of the surviving section of the cantilever / jetty.....	167

89. Tsamour port.....	168
90. Pyrrha. View of the embanked North Bay.....	168
91. The end of the breakwater that was found south of traditional platforms..	168
92. The preserved part of the ancient waterfront on top of the eastern breakwater.....	169
93. Underwater view of the waterfront.....	169
94. The fishing shelter in Agios Fokas.....	169
95. General plan of the port of Pythagoreion, Samos.....	170
96. Aerial view of the ancient port of Samos.....	170
97. General view of the harbor of Samos.....	171
98. Relics of the Byzantine city wall.....	171
99. The harbors of the city of Rhodes.....	172
100. The harbor of Kos.....	173

Part B

- 101.** Palaeogeographical reconstruction of the coast of the foreharbor of ancient Lechaion. A: The sea level in Roman times was 0.90m lower than the present. B: After the abandonment of the foreharbor and the siltation of its facilities the sea level rose by 2.0m.....174
- 102.** Geomorphological map of the seafloor of the Gulf of Sounion.....174
- 103.** Palaeogeographic reconstruction of the coast during the historical period, when sea level was 2.15m lower than at present.....175



Map 1. Geographical distribution of the ancient Greek harbors in the Archaic period.



Map 2. Geographical distribution of the ancient Greek harbors in the Classical period.



Map 3. Geographical distribution of the ancient Greek harbors in the Hellenistic period.

Introduction

The present thesis investigates the archaeological remains of the ancient harbor works in mainland Greece and the islands during historical times, from the Archaic to the Hellenistic period, analyzing their formation and evolution processes over time incorporating human, environmental, and biogeographical interactions. The increasing amount of archaeological evidence for the ancient port installations has been encouraged by marine and underwater surveys complemented with geoarchaeological studies. Geoarchaeology is primarily a recent term. The main objective of geoarchaeology -in the context of multidisciplinary cooperation with archaeology- is the knowledge and representation of terrestrial and coastal palaeo relief, and the study of natural factors that shape it and are associated with the history of human habitation, with the use of analytical techniques. These findings help archaeologists both in ancient civilizations research as well as in solving individual excavation problems.

For the processing of literature were sought both primary (literary sources, excavation reports, archaeological and geoarchaeological studies, research articles, thesis) and secondary sources (review articles, bibliography, online portals).

The structure of the main body is composed of two chapters, which enclose the reasoning of the basic topic. In the first chapter, a comprehensive catalogue of the ancient historic Greek harbors is presented in geographical distribution according to the Greek territory. Information about archaeological remains, chronology, possible operation use, archaeological or geoarchaeological studies and current preservation state are displayed. Each site description will conclude with individual references and ancient sources. The

harbor identification was relied on published record and excavation data as well as references to ancient literature.

The second chapter is accompanied with paleoenvironmental information and references to the complex interplay between long-term forces, which are responsible for coastal development and regionally heterogeneous changes on the topography of the ancient harbor installations. Ancient harbor constructions are particularly interesting because they served as important economic, social and political centers for maritime navigation; they are excellent preservers of the material culture and finally they contain an abundance of source material for palaeoenvironmental reconstruction. Geoarchaeology researchers seek the correlation between human and natural eco-environment in a known place and time and try to understand and interpret the above factors and their interaction. Specific case studies are presented as characteristic examples for each area that reflect the same geoarchaeological conditions. In Greece, ancient ports are identified today precipitated (i.e. Piraeus, Kyllene, Thasos, Samos and port works in the Cyclades), embanked (i.e. Phalasarna) and in some cases have raised and lost all contact with the sea (i.e. Phalasarna), because of the continuous change of the coastline. Therefore, the ports are in the interest of many scientific fields including geoarchaeology. The geoarchaeological study of the port constructions can provide with valuable data on the socio-economic context of their creation, geostrategic, ancient technology, and general culture that turned a natural bay to a strong city-port. This approach concerns not only the investigation of their palaeo topography and fortification, but also the spatial organization and functionality of the ancient dockyards.

Finally, topographic and historical data of the cities in which the previously mentioned ports belong will be presented in a centralized unity named “Gazetteer of Sites” after the end of the second chapter.

Altogether, the purposes of this thesis it to set the ancient harbors of Greece in their historical context and to draw attention to the information available in ancient literary sources which complement the archaeological evidence; to evaluate all the evidence in order to gain a holistic understanding of how the harbors operated and what they were for and to present what is known about those sites, where harbor works have been identified or proposed. Additionally, to illustrate whether those harbor works have been investigated so far within a geoarchaeological context and in what processes is given more emphasis during those kind of studies and why.

Chapter 1

Ancient harbors and remains of port installations in mainland Greece and the islands

*Overview of archaeological remains, references to
ancient sources, underwater and coastal surveys*

In this unit, the recent published record of the excavated harbor installations in Greece during historic times is presented and catalogued by geographical distribution. The endless coastline of Greece forms closed inlets, natural harbors, deep bays, small and big islands which were exploited by the ancient Greeks already from the prehistoric times. The Greeks, more than any other people in the world, considered the sea a natural gateway, soon developed the seamanship and remained mariners during their very long history without interruption. The geographical position of Greece provided a great advantage; located approximately in the middle of the Ancient Mediterranean, between Asia and Italy, near Egypt and Libya to the south, and next to the other Balkan countries to the north, was on the crossroads of the most ancient shipping lanes. The analytical chapter is complemented by a full and detailed catalogue of documented archaeologically maritime infrastructures in the territory of Greece from the Archaic to Hellenistic period (7th B.C. to 31 B.C.), with plans for all the major sites.

The increasing amount of archaeological evidence for harbor installations in Greek coastal regions and the islands, especially in recent years, have made necessary the systematic involvement and their recording. It is expected that the presentation of the archaeological findings into ancient Greek port structures will provoke fruitful discussion among those that are immediately or indirectly interested in archaeological issues.

The archaeological remains of the ancient harbors provide information about the fortifications, the land-planning organization, the architecture, and the functionalism of these spaces, as well as answers in more specific questions as the hauling and the launching operations of ancient ships. The term port installations essentially includes findings about outer port structures, like moles and breakwaters, inner port foundations, like quays, piers, basins, canals as well

as land facilities, i.e. defense structures, temples, shipsheds, stoas, store buildings and lighthouses. Different types of harbors will be presented; the "cothon" type, inner artificial port connected to the sea via channels, was ideal for the establishment of military naval bases. Such examples have become known in the harbors of Phalasarna in Crete and in Lechaion in Corinth. Another invention in ancient harbor engineering was the "κλειστός λιμὴν" (closed port). The term defines a closed harbor, included in a fortification, usually an extension of the city walls, as at Aigina, Piraeus, Rhodes, and Thasos. It terminated in maritime towers, which often served as lighthouses, and fitted so that the mouth of the harbor could be closed by means of a chain or boom and reinforced with artillery. Trade and merchant harbors will also be presented. Those ports were open to the sea and often protected by a large breakwater. Thasos, Samos, and Aigina provide such examples. Finally, shipsheds, the main components of a naval arsenal, were the purpose-built installations for the accommodation of war fleets, when these were not in mission and were hauled out of the water for protection, dry-out, and maintenance. The first shipsheds are historically attested at 530 B.C. in Samos, while shipshed complexes have been revealed also in Abdera, Piraeus, Oiniade, Kos, Rhodes, and Alimnia.

It is important to mention that not all the Greek harbor works have been systematically studied. Some ports are partly excavated, i.e. the harbor installations in the island of Lemnos, Salamis (Ambelaki), the shipshed complexes in Kos, Sitea, Matala, and Rethymnon. Other sites require more research, like Kythnos (Mandraki Bay), Aigina, Delos, and shipshed complexes in Alimnia and Trypitos. In some cases, as in Arcadia, only optical observations have been made until now while in others, surveys are continued until today and new information will be presented in the future, i.e. in the case of Zea and Munychia (Zea Harbor Project) and Kyllene. Anyway, ancient harbor

establishments constitute a very interesting area of study, which is strongly related to the many Greek shores. Their existence is indicative for the commercial, military, and intercommunicational relationships of the ancient cities that developed during those times.

1. Peloponnese (from the west)

1.1. Porto Cheli – Alieis (5th B.C.-4th B.C)

The Port of Alieis was at north of the citadel into the bay of modern Porto Cheli. The archaeological remains consist of two circular towers, 9.2m diameter, of the walls of the city defining its entrance. The researchers identified their foundations at a depth of ~ 2m (Figure 1). From the north, the port was defined by a large pier, length of about 100m., on which went the city wall, ending in a circular tower in the edge of the breakwater. On the inner side of the wall, there was a dock, width 3m., monitored at a distance of approximately 90 meters from the tower to the east. A second structure that was interpreted by scholars as dock located after the south tower to the north. This construction reduces the opening space between the towers from 20 to 9 meters. The size of the basin has not been determined yet, but based on the archaeological data could be calculated at 4000m about. In the area of the end of the breakwater, notches on some stones interpreted by the excavators as sections of the port isolation system with wooden block. The building material is stone blocks (Jameson M. H., 1969:315) (Figures 2, 3, 4).

The port installation in Alieis dates to the 4th century BC probably or maybe 5th, in correspondence with the circular tower of the citadel that dated to the 4th century B.C. However, it is not excluded that these port constructions already existed and fortified after the construction of the citadel (Jameson M. H., 1969:337).

The use of the port is not exactly defined. The presence of the quay (inside the north wall and possibly a second in expansion after the south tower) and the reference to the occupation of the city by the Spartan Aneristos (Thucydides II.56.5, IV.45.2), who used a cargo ship (ολκάδα) full of soldiers,

probably shows commercial use of the port. On the other, the fortification of the piers in order to create a "closed port" rather suggests military use, probably small scale, due to the small size of the basin. Besides, the position of the Alieis, inside the large protected bay of Porto Cheli, consist a key naval station for both the Athenians and the Spartans in the midway distance between them. It should be noted that F. Frost (1985) questioned the identification of the location as a port, suggesting as an interpretation the agora of the city.

In the area of the ancient Porto Cheli, archaeological research was conducted from 1959 until 1967 by the University of Pennsylvania. In 1967 and 1968, the survey was conducted jointly with the University of Indiana under the auspices of the American School of Classical Studies in Athens. During that time, the port together with the flooded part of the town was investigated (Theodoulou Th., 2016).

Ancient Authors

Diodorus, *Historical Library* XI 78.1-2

Herodotus, *Histories* VII 137

Pausanias, *Greece Periegesis* II 36.1

Strabo, *Geography* VIII 6.11

Thucydides, *History*, VII 12.3-4, I 105.1; II 56.4, IV 45.2

Xenophon, *Greek* I 5.10

References

Frost J.F., (1985) The harbor at Halieis in Raban A., *Harbor Archaeology. Proceedings of the International Workshop on ancient Mediterranean harbours*,

Caesarea Maritima 24-28.6.83, University of Haifa, Bar International Series 257.

Jameson M. H., (1969) Excavations at Porto Cheli and Vicinity, Preliminary report, I: Halieis, 1962-1968, *Hesperia* 38, 311-342.

Theodoulou Theotokis (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Navis II Project, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200, B-1049 Brussels <http://www2.rgzm.de/Navis2/Home/Frames.htm>.

1.2. Corinth – Lechaeon (6th B.C. - 6th A.D.)

Lechaeon's inner basins are the earliest example of the "cothon" type harbor in the Aegean. The harbor was in use from the early 6th century B.C. to at least the 6th century A.D. (Πάλλας I. Δ., 1965:144). The visible archaeological remains include three or four inner dugout basins which were formed where a marsh once was situated in the region (Rothaus R., 1995:294) (Figure 14). The sand and pebbles of the prime and the following dredging of the harbor formed two hills, which hid it from the north (Πάλλας I. Δ., 1967:143). Between the two hills, a channel at the north-eastern of the basins was leading to the sea (Figure 7, 8). Both its sides were constructed by stone blocks. Another channel was also connecting the western with the eastern basins (Δροσογιάννη Φ. Α., 1969:201) (Figure 9). In several areas of the banks, remains of rows of stone blocks of a not defined construction are observed (maybe quays). At the northern side of the eastern basin, on a certain area of the structure, projecting vertical stones can be noticed, probably used for mooring

or berthing the ships (Figures 10, 11, 12). In the western basin, a rectangular construction made of stone blocks could possibly be a base for a statue or a lighthouse (Πάλλας Ι. Δ., 1963:169) (Figure 13). Two breakwaters at the beach, north of the inner basins with their northern ends still visible are preserved at the surface of the sea and constructed with stone blocks together with clamps, as it is evident from the relevant cuttings. The formation also of the western end of the breakwater suggests the existence of a tower or a lighthouse on it. The area between the two breakwaters, which was perhaps communicating with the inner west basin with a second channel, is considered as a "pro-limen" by some researchers (Georgiades A. S., Paris J.). An aerial view of 1960 (Θεοδούλου Θ., 2002) proves the existence of the so called "pro-limen" but not of the channel (Figure 6). East of the two breakwaters, a row of un-worked medium size stones is visible underwater. It could have been constructed there in order to prevent the main entrance channel or the "pro-limen" from silting or even as a border of a second "pro-limen" basin (Πάλλας Ι. Δ., 1965:139). At the broader area of the harbor are located several buildings necessary for the harbor's operation, like shipsheds, temples, villas and relics of walls that can be identified as remains of the city walls. Eastern of the entrance channel some conglomerated formations are considered remains of Roman caissons¹ (Stiros, S. et. al., 1998:253) (Map 4).

The harbor of Lechaeon definitely operated as key port for the expansion of the Corinthian colonies to the west during the archaic period and as an important navigation network towards Central Greece, the Ionian Sea and Italy, from the Archaic to Byzantine times.

1. A watertight chamber used in construction work underwater or as a foundation.

Thus, it is also certain that at some of its protected basins was docked part of the Corinthian fleet who had as "operational space" the Corinthian Bay and west. This note is supported by the existence of shipsheds (Rothaus R., 1995:294).

Primarily the American School of Classical Studies and the Hellenic Archaeological Service undertook excavation surveys in the ancient port of Lechaeon. The site, although it is characterized a protected archaeological zone, has not been surveyed by any official organization yet. A mapping of the area was undertaken by Georgiadis in 1907 (Figure 5), and several archaeological observations were made by Pallas concerning the harbor during the excavations of the Basilica of the Martyr Leonides (Πάλλας Ι. Δ., 1963). A concentrated reference text was published in the *Enalia* journal (Θεοδούλου Θ., 2002) (Theodoulou Th., In Navis II Project).

Ancient Authors

Diodorus, *Historical Library* XIV, 86, 2-4

Pausanias, *Corinthian-Lakonika* II.2.3

Plutarch, *Moralia* 2

Polybius, *Histories* V.18.9, 24.12, 25.5, 26.16, 28.4

Strabo, *Geography* VIII.20

Thucydides, *Histories* I.XIII.2

Xenophon, *Greek* IV.4.7-13

References

Rothaus R., (1995) Lechaeon, western port of Corinth, *Oxford Journal of Archaeology* 14 (1995), Blackwell Publishers, Oxford, pp. 293-306.

Stiros S. et al., (1998) On the date of construction of Lechaion, western harbor of ancient Corinth, Greece, *Geoarchaeology* 11.3, pp. 251 – 263.

Δροσογιάννη Φανή Α., (1968) Μεσαιωνικά μνημεία της Πελοποννήσου: Κορινθία: Αρχαία Κόρινθος, Χρονικά- Μέρος Β1, *Αρχαιολογική Εταιρεία* 23, σ. 195-202.

Θεοδούλου Θεοτόκης, (2002) Λέχαιο, το δυτικό τεχνητό λιμάνι της αρχαίας Κορίνθου, *Ενάλια* VI, Αθήνα, ΙΕΝΑΕ, σ. 83-99.

Πάλλας Ι. Δ., (1965) Ανασκαφαί εν Λεχαίω, *Πρακτικά Αρχαιολογικής Εταιρείας*, Αθήναι, σ. 136-166.

Πάλλας Ι.Δ., (1965) Ανασκαφή Βασιλικής Λεχαίου, *Πρακτικά Αρχαιολογικής Εταιρείας* 1959, Αθήναι, σ. 126-140.

Πάλλας Ι. Δ., (1967) Ανασκαφικές έρευνες στο Λέχαιο, *Πρακτικά Αρχαιολογικής Εταιρείας*, Τόμος 120, Αθήναι, σ. 137-166.

Πάλλας Ι. Δ., (1963) Ανασκαφαί Λεχαίου, *Αρχαιολογικόν Δελτίον* 17 (1961/2): Χρονικά, Αθήναι, σ. 69-78.

Navis II Project, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200, B-1049 Brussels <http://www2.rgzm.de/Navis2/Home/Frames.htm>.
<http://www.yppo.gr/0/gindex.jsp>.

1.3. Arcadia

In 1969, F. Cooper located two structures, on the bank of the Neda River, west of the city of Phifalia near the western coast of the Peloponnese that could be interpreted as possible shipsheds. If the roofed naval structures were built as ship shelters, they are the only material evidence in the Mediterranean of shipsheds built on a river. The buildings have not been excavated as yet. (Loven B. and Schaldemose M., 2011:27).

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbors of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

1.4. Kyllene

The harbor of Kyllene is located in the northwestern part of Peloponnese (Rankov B., Blackman D. J. et al., 2014:14) (Figure 15). From the archaeological remains, it is noticed that the harbor was separated into different basins. The existence of an inner basin can merely be expected from the present-day topography and swamp-like conditions in the lowland area between the acropolis of Glarentza and the recent coastline while an outer harbor is well defined by the remaining harbor installations. Visible remains of submerged walls, breakwaters, and tower foundations in the shallow water of the modern coastline are well preserved. In the northwestern harbor area, a massive breakwater runs vertical to the current beach, while narrower structures parallel

to the coastline form some kind of mid-harbor basin. No archaeological remains are visible in the central area of the inner harbor basin. Its maximum extension is merely defined by the rising terrain of the surrounding slopes. The outer harbor is mostly submerged while the present surface of the inner basin lies about 1m above sea level along the modern coast but slightly declines in landward direction (Hadler H., 2013:86) (Figures 16, 17).

The port had an important geostrategic location and strategic role in warfare and trade in Western Greece from classical antiquity until medieval times. Unlike other locations along the coastline of the western Peloponnese, the sheltered bay at Kyllene provides both a well defendable settlement site and a protected harbor (Hadler H., 2013:82).

A harbor survey initiated in 2007 until 2009 as collaboration between the Ephorate of Underwater Antiquities and the Finnish Institute at Athens with the co-operation of the Sixth Ephorate of Byzantine Antiquities at Patras. The “Kyllene Harbor Project” combined archaeological, topographical, and underwater geomorphological survey. The preliminary results show that the mouth from the north-east was blocked by destroying the towers on both sides of the entrance, matching with the literary descriptions of the destruction of the installations in 1431, while the maritime geomorphological study indicated the existence of the different port installations based on the spatial distribution of the underwater remains and the seafloor morphology (Pakkanen J. et al, 2007-2008).

Ancient Sources

Ammianus Marcellinus, *Res gestae* 26.10.15-19

Diodorus Siculus, 19.66.1/2,19.87.3

Homer, *Iliad* 15.515

Pausanias, *Description of Greece*, 3.8.5/6.26.4-5, 8.6.8

Polybius, *Histories*, 4.9.1, 5.3.1

Ptolemy, 3.14.30

Srtabo, *Geography*, 8.3.4/5

Thucydides, *Histories*, 1.30, 2.84/86, 3.69

Titus Livius, *the History of Rome*, 27.32

Xenofon, *Hellenica*, 3.2.30

References

Hadler Hanna, (2013) *Ancient Greek harbors used as geo-archives for palaeotsunami research - Case studies from Krane (Cefalonia), Lechaion (Gulf of Corinth) and Kyllini (Peloponnese)*, Dissertation, Johannes Gutenberg University.

Pakkanen Jari, Baika Kalliopi, Evangelistis Dionysios, Papatheodorou George, and Geraga Maria, (2014) Kyllene Harbor Project in <http://www.finninstitute.gr/en/kyllene>.

Rankov B., Blackman D.J. (Eds), *Shipheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

2. Central Greece

2.1. Piraeus

2.1.1. Kantharos (5th B.C. – 4th B.C.)

Kantharos is the largest of the three natural gulfs of Piraeus peninsula (the other two are Zea and Munychia) in the south Athenian coast and it was used by Athenians as their main trading port (Figures 18, 19). Visible remains of the ancient establishments are minimal, although testimonies for their existence are found in ancient sources (Frost H., 1987:181). "Megas Limin" or "Kantharos", a name derived most probably from the basin's shape that resembled the homonymous vessel, is located in the northwest of the Piraeus peninsula. It was the "εμπόριον" (the commercial harbor) of Piraeus (Casson L., 1995:365) (Figure 21) although the existence of shipsheds near the port's entrance indicates an additional military purpose. The emporion occupied the eastern coastal zone (area of about 1.5 km²) of the central port (Blackman D. J., 1987:41) (Figure 20). The exact location, the expanse and the form of this section of the Piraeus provides the modern to the foundation of the city system of the benchmarks "όποι", found in the last century in their original locations (Σταϊνχάουερ Γ., 1998:20). North of the shipsheds area was the main dock, separated by a pier. In the north-eastern cove a jetty has been observed, probably related with the long arcade that was located there. Four more stoaes were located in the eastern part of the harbor's basin, the most important of which is referred as "deigma" (sample's exhibition) (Σταϊνχάουερ Γ., 1998:20). The existence of lighthouses for the signification of the entrance is confirmed by the remnants that have been restored in two positions along the coast. The first one on the northwest (Figure 23), inside the area of today's fertilizer factory and the other to the south (Figure 22), in the area of the Maritime

Administration of the Aegean, beside the section that has been identified as the tomb of Themistocles (Σταϊνχάουερ Γ., 2000:79). The northwestern bay was a shallow marshy area mentioned in the written sources as the "κωφός λιμὴν" where probably should be sought the so called "δια μέσου χώμα" (earth in between). The north-western part of the basin was closing by the fortified promontory of Hiaetionia (Σταϊνχάουερ Γ., 1998:18).

The central harbor, Kantharos, served as the commercial port as well as the second largest dockyard of the Athenians, highlighting the socioeconomic power of the whole city – harbor. The other two ports were occupied only by the use of the dockyards (Vlachaki F., in Navis II Project).

Research on the harbors of Piraeus began at the early 19th century by foreign travelers, cartographers (Dodwell, 1801-1806, Leake, 1821) and researchers like, Curtius (1841), Ulrichs (1843) and topographers like Strantz (1861). Archaeological research began during the first period of the rapid construction of the modern city in the form of rescue excavations (by Dragatsis 1880-1920 and the recording by Doerpfeld of the shisheds), being the main option of research in the densely inhabited city of Piraeus, because of the severe interventions that the ancient harbor has undergone, due to the industrialization of its use (Vlachaki F., in Navis II Project).

Ancient Authors

Aristophanes, *Horsemen* 815, *Peace* 145

Aristotle, *Politics*, II 8, *Ath. State*, 19, 37, 38, 54, 24, 46, 49, 61

Dimosthenis, 34. 37, 19. 60, 19. 125

Diodorus, 11. 41, 12. 49, 14. 33, 14. 85, 18. 64, 18. 68, 20. 45

Pausanias, I. 1. 2, I. 1. 3, I. 1. 4, 2, 3, 25. 58. 10. 4

Plato, *Gorgias* 455

Pliny NH., 38. 1, 7. 37. 125
Plutarch, *Themistocles*, 32, 19. *Dimitrios* 8, *Kimón* 13, *Sillas* 14
Strabo, 9.1, 1. 15, 2, 395, I. 3
Thucydides, 1. 93, 93. 3, 107, 2. 13, 13. 8, 93, 94, 7. 11, 12. 4, 8. 90
Vitruvius, 7. 152. 12
Xenophon, *Greek*, 4. 10, 2, 2. 4, 4. 31, 4. 11, *Anabasis* 7, 1. 27.

References

Blackman D. J., (1987) Triremes and shipsheds, *Tropis II*, Athens (1990), pp. 35-52.

Casson Lionel, (1995) *Ships and seamanship in the ancient world*, London: Johns Hopkins University Press.

Frost H., (1987) Where did they build Ancient Warships in *Tropis II. Proceedings of the 2nd International Symposium on ship construction in antiquity*, Delphi 1987, Athens (1990), pp. 181-185.

Vlachaki Foteini, ‘Piraeus: Cantharus, Zea, Munichia’ in *Navis II Project*, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200 , B-1049 Brussels <http://www2.rgzm.de/Navis2/Home/Frames.htm>.

Παπαχατζής Νικόλαος, (1974) *Πανσανίου Ελλάδος περιήγησις* , Τόμος Ι, Αττικά, Αθήνα.

Σταϊνχάουερ Γιώργος, 2000, "*Αρχαίος Πειραιάς: Η πόλη του Θεμιστοκλή και του Ιππόδαμου*" στο Σταϊνχάουερ Γιώργος - Μαλικούτη Ματίνα -Τσοκόπουλος Βάσιας-Γκανιάτσας Βασίλης, Πειραιάς: Κέντρο ναυτιλίας και πολιτισμού, Αθήνα, σ. 9- 123.

Σταϊνχάουερ Γιώργος, (1998) *Τα μνημεία και το Αρχαιολογικό Μουσείο του Πειραιά*, Αθήνα.

2.1.2. Munychia (5th B.C. – 4th B.C.)

Munychia is the smallest of the three natural gulfs of Piraeus peninsula. Its modern name is Mikrolimano. The natural protected harbor inserted into the Munychia hill from which and took its name providing great protection in north, south and west winds (challenged only by south easterly winds that always are weak) (Πανάγος Χ.Θ, 1968:245, Παπαχατζής Ν., 1974:98,121) (Figure 24). It has an oval shape and is located on the east side of Piraeus overlooking the Saronic entrance (Figure 25). The visible remains include a north-eastern entrance formed by two promontories which were extended in two fortified breakwaters ending to towers and closed each time by a refloated chain. Remains of the foundations are still visible as well as remnants of the north-eastern breakwater with parts of the tower. The north-western breakwater was 190m long while the north-eastern one was 95m long. The latter one ended to a circular tower on tetragonal foundations with a side of 12m (Figure 26). At approximately the middle of its length exist recess that hosted a building (8.3x10.15m) most probably explained as a temple or a lighthouse. In the basin's perimeter, shipsheds have been located and possibly free space was available for repairs ("neorion") as well as more buildings, like docks, storehouses, arsenals etc (Δραγάτσης, Ι. - Αγγελόπουλος Η, 1899:37-41 και 1900:35-37).

The port was used as a naval base like the port of Zea. According to the written sources 82 shipsheds existed there during the 4th century B.C. Those shipsheds, who were around the port had length each 37 m and a width of 6.25

m, occupied by side waterfront length of 512 m (total length was about 600 m)
(Σταϊνχάουερ Γ., 1998:19).

Ancient Authors

Aristotle, *Athenian Constitution* 19

Demosthenes, *Peri Stefanou* 262

Diodorus, XIV, 33 - XVIII, 48 - XX 45

Euripides, *Hippolytus* 761

Herodotus, *Histories*, VIII, 76

Pausanias, *Periegesis* I, 25, 4 - II, 8, 5

Plutarch, *Demosthenes* 28, *Fokion* 27, 31, *Dimitrios* 8, 34, *Eroticos* 9

Strabo, *Geography* IX, I

Thucydides, *Xyngrafi II*, 13 - VIII, 92,5

Xenophon, *Ellinika* II, 4, 11, 37

References

Δραγάτσης, Ι. - Αγγελόπουλος Η., (1900) *Ανασκαφή εν Πειραιεί, Πρακτικά της εν Αθήναις Αρχαιολογικής Εταιρείας*, Αθήναι, σ. 33-37.

Σταϊνχάουερ Γιώργος, (1998) *Τα μνημεία και το Αρχαιολογικό Μουσείο του Πειραιά*, Αθήνα.

Πανάγος Χ.Θ., (1968) *Ο Πειραιεύς, Οικονομική και ιστορική έρευνα από των αρχαιοτάτων χρόνων μέχρι του τέλους της ρωμαϊκής αυτοκρατορίας*, Αθήνα (2η έκδοση με νεώτερα στοιχεία για την τοπογραφία και την οικονομική ζωή του Πειραιά από τον Έφορο Αρχαιοτήτων Γ. Σταϊνχάουερ, Αθήνα 1995), 240-250.

Παπαχατζής Νικόλαος, (1974) *Παυσανίου Ελλάδος περιήγησις*, Τόμος Ι, Αττικά, Αθήνα.

Navis II Project, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200, B-1049 Brussels <http://www2.rgzm.de/Navis2/Home/Frames.htm>.

2.1.3. Zea (5th B.C.- 4th B.C.)

The port of Zea or older Pasalimani, in the eastern coast of the Piraeus peninsula, is the second largest port of Piraeus with circular shape (Figure 33). The port of Zea was the main naval base of Athens fleet. The entrance to the basin of Zea was to the south, protected with two walled breakwaters spaced apart 96 meters from whom reloaded chain was brought so as to close the port, hence the "closed port" name. Alongside those towers were the so-called "heat sinks" where most likely must have been drying spaces for the sails and the ropes of the ships. In the eastern side, remains of shipsheds (196 are reported in radial arrangement on the beach), have been located, however most of them are not visible anymore, being covered by modern port installations. It is possible that such buildings extended to the whole perimeter of the harbor, except the area of the gulf's cove. The shipsheds of Zea were longer than those of Munychia (40m long and 6.5m wide). To the northwest, remains of the famous Philon's Arsenal ("Σκευοθήκη του Φίλωνος") have been found, where the removable parts of the triremes were stored (Theodoulou Th., 2016). In Zea the shipsheds, were divided into two groups, east, and west, along the coastline of the harbor (Figure 28). The existence of two rows of sheds is also supported by the fact that traces of them were found in the 19th century. From the shipshed of the western side of the harbor no traces have survived today, while from the eastern side a small part is preserved in the basement of an apartment building (on the corner of Akti Moutsopoulou and Sirangiou Street) (Loven B. and

Schaldemose M., 2011). Researchers discovered different constructing phases at the shipsheds. Evidence of similar grouping was apparently found in Munychia. (Παπαχατζής N., 1974:107) (Figures 27, 29, 30, 31, 32).

Archaeological researches in Zea have been conducted from the early 19th century by Gracer (1872), Milchofer (1881), Dragatsis and Dorpfeld (1885), Blackman (1968) and Danish Institute (2000-today), under the supervision of archaeologist P. Loven (Loven P., 2005).

Ancient Authors

Aristophanes, *Horsemen* 815, *Peace* 145

Aristotle, *Politics*, II 8, *Ath. State*, 19, 37, 38, 54, 24, 46, 49, 61

Dimosthenis, 34. 37, 19. 60, 19. 125

Diodorus, 11. 41, 12. 49, 14. 33, 14. 85, 18. 64, 18. 68, 20. 45

Herodotus, 6. 116, 8. 76, 77, 107, 92 5 93

Pausanias, 1. 1. 2 1 1. 3 1. 4, 2, 3, 25. 8. 10. 5 4

Plato, *Gorgias* 455

Pliny, *NH*. 38. 1 7. 37. 125

Plutarch, *Themistocles*, 32, 19., *Dimitrios* 8, *Kimón* 13, *Sillas* 14

Polyainos, *Strategic* I. 40. 3

Strabo, 9. 1, 1. 15, 2, 395, I. 3

Thucydides, 1. 93 93. 3 107 2. 13 13. 8 93 94 7. 11 12. 4 8. 90

Vitruvius, 7. 152. 12

Xenophon, *Greek*, 4. 10, 2, 2. 4, 4. 31, 4. 11 *Anabasis* 7 1. 27

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Loven P., (2002 and 2005) on the investigation of the Danish Institute articles, to be published in the *Tropis VIII & Tropis IX* (ed. Tzalas X.).

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Δραγάτσης, Ι., (1885) Έκθεσις περί των εν Πειραιεί ανασκαφών, *Πρακτικά της εν Αθήναις Αρχαιολογικής Εταιρείας*, Αθήναι, σ. 63-71, Πιν. 2, 3.

Παπαχατζής Νικόλαος, (1974) *Παυσανίου Ελλάδος περιήγησις*, Τόμος Ι, Αττικά, Αθήνα.

Navis II Project, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200, B-1049 Brussels <http://www2.rgzm.de/Navis2/Home/Frames.htm>.

http://www.zeaharbourproject.dk/4/4_01_01_03.htm.

<http://slideplayer.gr/slide/2939670/>.

2.2. Salamis Ambelaki (5th B.C.-3rd B.C.)

The remains of the Classical / Hellenistic capital of Salamis are placed at the area of Ambelaki bay, on the Pounta promontory, eastern of the island (Map 5). The construction and its operation are placed chronologically between the 5th and 3rd century B.C. The harbor establishments are observed underwater in the inner bay of the site (Lolos Y., 1995:292). The visible port

installations consist of remains of stone blocks, breakwaters and other structures. A partly submerged row of blocks running E-W is located on the western side of the bay dating probably to Classical / Hellenistic period. On the east, another elongate structure (probably breakwater) is noticed, running NE-SW 37.30m in length. North of the bay, exist third structure, made of stone blocks (1.2 to 1.30m long), probably in second use. It runs N-S for 54.50m, having a width of 1.4 to 1.6m (Figures 34, 35, 36, 37, 38, 39). Other structures such as foundations and wall parts seem to be related with the harbor and its function (Figure 40). Furthermore, the oral tradition refers to the existence of underwater platforms or corridors, which could resemble shipshed ramps (Lolos Y., 1995:294).

The harbor facilities at the Ambelaki bay were obviously the seaward gate of the Classical and Hellenistic city of Salamis to the Aegean and the east Mediterranean Sea, as the pottery collected from the wider area indicates. The mercantile and military installations of Salamis could have served the needs of the Athenian fleet due to its proximity with the nearby large urban centre and its central position on the straits controlling navigation from south (Lolos Y., 1995:293).

In the ancient port of Salamis has not been conducted extended archaeological research and therefore cannot be precisely defined any chronological data for the port's construction.

Ancient Authors

Pausanias, *Description of Greece*, I.53.3

Skylax, *Periplus*, 57

Strabo, *Geography*, IX.1.9

References

Lolos Y., (1995) Notes on Salaminian harbors, *Tropis III, 3rd International symposium on ship construction in antiquity*, Athens, 1989, pp. 291-308.

<http://www.ypai.gr/atlas/thesi.asp?idthesis=279>.

2.3. Attica – Sounion (5th B.C. - 1st A.D.)

The only visible remains preserved in Sounion are carvings and the ramps from a double shipshed, as well as a part of a wall, at the south-east of Sounion gulf (Map 6). The shipshed had probably a symmetrical two-slope roof, possibly in two levels (Kenny A.E.J., 1947:199). The two shipsheds (now underwater) are located on the western side of Cape Sounion, below the acropolis (Figure 42). The main rock-cut installation, (Sounion 1), which includes two rock-cut slipways, is situated on the north-west side of the promontory, well protected from the prevailing winds. There is a smaller rock-cut slipway (Sounion 2) on the same side of the promontory, a little further along the coast to the northeast. Several other rock-cuttings, visible at the water's edge and underwater along the rocky coast beyond the small slipway (Sounion 2), suggest the existence of several terrestrial installations, today partly submerged (Rankov B., Blackman D.J. et al. 2014:525).

Based on the port installations left and the existence of the shipsheds, the port of Sounion probably operated as a naval station and an observation post guarding the entrance of Saronic and Euboean gulf as well as watching over the nearby Lavrion mines and the wheat trade routes to Athens during the Peloponnesian war as Thucydides mentions (Hist. 8.4). The port mentioned by Pausanias (Attica I.1), should be regarded as the small bay west of the cape

where trade ships could have been hauled on the sandy beach and served by the improvised port constructions that left no traces, although some underwater remains in the bay could belong to regular port installations (Theodoulou Th., 2016) (Figure 41).

With the harbor remains dealt Oikonomos (1923) who completely excavated the shipsheds on land, but published no plans or information about the stratigraphy. Kenny (1935) published a site plan and sections of the terrestrial part of the shipsheds noting that the ramps continued into the sea. Goette discusses the shipsheds in his monograph on the site including observations on the chronology of the complex. Finally, Baika (2004 and 2006) investigated the shipsheds both on land and in the sea; these investigations have not yet been published (Loven B. and Schaldemose M., 2011:25).

Ancient Authors

Cicero, *Epistulae ad Atticum* 7.3.10

Dittenberger W. (ed.), 1913, *Inscriptiones Graecae*, (2nd ed.), Berlin, 1170, 1180

Herodotus, *Histories* 6.87-90, 8.121

Homer, *Odyssey* 3.278-283

Livy, *Ab Urbe Condita* 28.8.11, 32.17

Pausanias, *Attica* I.1

Strabo, *Geography* 390, 398

Thucydides, *Histories* 8.4

Xenophon, *Greek* 5.1.23

References

Kenny A.E.J., (1947) The ancient docks on the promontory of Sounion, *The Annual of the British School at Athens* Vol. 42, London, pp. 194-200.

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Rankov B., Blackman D.J. (Eds) (2014) *Shipsheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Παπαχατζής Νικόλαος, (1974) *Παυσανίου Ελλάδος περιήγησις*, Τόμος I, Αττικά, Αθήνα, σ. 78-90.

2.4. Aigina

There are documented two harbors south of Kolona; a naval fortified harbor known from the ancient sources as ‘Kryptos Limen’ meaning ‘hidden harbor’, centrally situated under the Classical acropolis (Kolona hill), (Figure 43) and the commercial harbor on the south (Rankov B., Blackman D. J. et al. 2014:191). They appear to have integrated fortification and possibly were communicating. The naval port is safeguarded from both north and south with great breakwaters made of unworked stones, the position of which appears to be related with the perimetric fortification of the ancient town. The west seafront of the harbor work is delimited by a long row of manmade reefs, which make the approach of enemy ships inaccessible. The south breakwater of the naval

harbor, either demolished or covered of the modern harbor, seems to have been connecting the military with the commercial harbor. This fact is related to small water basins observed in the early 19th century which had been interpreted as connection channel between the harbors and possibly a ship repair zone (Gerding H., 2014:284).

From 1964 to 1966 Knoblauch undertook major land and underwater surveys of the naval harbor of ancient Aegina, producing detailed plans and sections of six or perhaps seven possible shipsheds (Rankov B., Blackman D.J. et al. 2014:9). No remains of ramps have been recorded which is why the buildings are classified as possible shipsheds, although in this instance the buildings are most probably shipsheds based on their location in the northwestern side of the well-defined military harbor. Apart from the top of the back-wall, the possible shipsheds are presently underwater. Knoblauch calculates that since their construction, probably in the Classical period, there has been a sea level rise of ca 1.55m (as of 1966) (Loven B. and Schaldemose M., 2011:26). Earlier, in 1938, F.G. Welter reported submerged remains as shipsheds in Aegina's naval harbor. Along the northwest mole, Welter describes the presence of nine shipsheds and fifteen more that were adjacent to the southeast mole. The complex has not been excavated, nor have the lower parts been surveyed in detail (Loven B. and Schaldemose M., 2011:27).

The commercial port is prevented by the construction of the modern harbor facilities thus the visible remains are few and in more times suspected (Figure 44). It had possibly an oval shape. The south breakwater is mentioned as ancient, in a chart (UKHO) made by Graves (1838). The harbor was in use during the second Venetian rule (end of 17th century) testified by a tower built by Morosini at the end of the south mole, protecting its entrance and was demolished at the end of the 19th century. The construction of the commercial

harbor is according to Knoblauch contemporary to the naval, dated around 480 B.C. (Triantafillidis I. and Tselentis V., 2013:203).

The commercial port during its operation use, served Aegina for the processing of commercial activities. Aegina's decline in the middle of the 5th century by the Athenians, declares the end of its maritime supremacy and probably the destruction of the harbor facilities.

A third harbor protected by a large breakwater in the bay north of the Kolona hill belongs to an earlier period. It was probably rendered useless by a relative rise in sea level before the construction of the two previously mentioned harbors (Gerding H., 2014:284).

Ancient Authors

Pausanias, *Description of Greece*, II

References

Gerding Henrik "Aigina" in Rankov B., Blackman D.J. (Eds), (2014) *Shipheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Rankov B., Blackman D.J. (Eds), (2014) *Shipheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

Triantafillidis Ioannis and Tselentis Vassilis, Management of Underwater Archaeological Heritage: An Environmental Approach to the Protection and Preservation of the Harbour Complex of Aegina, *Proceedings of the 17th Symposium on Mediterranean Archaeology*, Moscow/ 25-27 April 2013, Oxford.

2.5. Oiniadai

The ancient naval station is located in the village of Oiniadai and was built around the 4th century B.C. about. The shipsheds are located at the southwest edge of the harbor fortifications. Today the area has stationary water, surrounded by land (Figure 45). The remaining archaeological evidence consist of the large metal rings, the bindings of the ancient ships and the ruins of the towers that protected the harbor basin. The ancient shipyard was carved on the rock surrounded by wall, which reached the 11 meters. In ancient times had roof coverage and the interior space was separated by five colonnades of 17 columns (Casson L., 1995) (Figures 46, 47). The harbor basin originally penetrated inland towards the city centre and must been the main commercial harbor of the city. The excavators dated the sheds to the third century B.C. at the latest, and probably earlier (Rankov B., Blackman D.J. et al. 2014:191).

The city of Oiniadai was located on a strategic position; placed near the mouth of Acheloos River was therefore suitable for construction of port and commercial activity. From that place controlled both the entrance to the Gulf of Patras and the sea artery between Acarnania and the islands Lefkada, Ithaca, and Cephalonia.

The harbor facilities were first excavated by J.M. Sears (1900 and 1901). L. Kolonas (in 1989, 1991, 1992, and 1995) fully excavated the terrestrial parts of the site, and the preliminary results were published in a report form. Both Kolonas and Sears terminated their excavation surveys at the groundwater level, leaving unexcavated what would have been the lower ends of the shipsheds. (Loven B. and Schaldemose M., 2011:25).

Ancient Authors

Apollod, 3.7.6

Herodotus, 2.10, 7.126

Pausanias, 1.28.3, 8.38.10

References

Casson Lionel, (1995) *Ships and seamanship in the ancient world*, London: Johns Hopkins University Press.

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens, 15*, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Rankov B., Blackman D.J. (Eds), (2014) *Shipsheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

<http://www.pentalofo.gr/axiotheata/oiniades.aspx>.

3. North Greece

3.1. Abdera

In the Thracian coastal city of Abdera, near the mouth of the Nestos River, Ch. Samiou-Lianou (1991) excavated an inclined colonnade of a possible shipshed, along with tiles belonging to a roof structure. As no remains of the ramp structure were located, the building cannot be securely identified as a shipshed. (Loven B. and Schaldemose M., 2011:28) (Figure 48). The existence of naval installation in Abdera is not excluded since the city was located in a highly strategic position; between the great road passages of Nestos River and through the mountains north of Xanthi, and the sea gateways leading to the Thracian and the Macedonian coast.

Ancient Sources

Herodotus VI 46-7

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens, 15*, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Rankov B., Blackman D.J. (Eds), (2014) *Shipsheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

4. Crete

4.1. Phalasarna (4th B.C. - 1st B.C.)

The ancient city of Phalasarna is located in the middle of the west coast of Crete (Map 7), at the tip of the Gramvousa cape. The visible archaeological facilities on land include temples, houses, defense structures and quarries while basins, canals and wharfs are identified as inner port structures. The port was established in a pre-existing basin, which was dredged and reshaped (Figure 49). A canal provided access to the open sea (the “entry canal”) and also functioned as a drainage work. It could be closed by walls and sealed by chain in order to form the "closed port". Another canal (the “cleaning canal”), which intersected the first one, discharged further north and was created probably for preventing siltation in the basin (Hadjidaki E., 1987:255). Remains of defending walls and towers are identified in the main basin (75x100m wide) (Figures 50, 55). In the inner side of the walls quays are observed probably equipped with mooring stones. A stone ladder was also discovered (Frost F.J., Hadjidaki E., 1990:517) (Figures 51, 52, 53, 54). In the middle of 2nd century B.C. a second port basin was created further north. Its entrance was made with material from the pre-existing fortification tower. A canal of small dimensions (50x50cm.) permits water circulation while the existing wall-quays served the ships mooring (Frost F.J., Hadjidaki E., 1990:524).

The port of Phalasarna, exploiting the city’s strategic position in-between the Aegean - Egypt and Western - Eastern Mediterranean sea crossroads, definitely operated as an important naval trading and warfare centre. In addition, the form of the internal closed harbor that the city acquired around the middle of the 4th century transformed it to a safe anchorage for the ships.

Excavation in the harbor of Phalasarna is taking place by the Ephorate of Underwater Antiquities. Excavations under Elpida Chatzidaki began in 1986 and continued until the summer of 1987 while further investigations in 1988-91 were directed by Elpida Chatzidaki in collaboration with Frank Frost (University of California, Santa Barbara) (Θεοδούλου Θ., 2015:37).

Ancient Authors

Pliny, *the Natural History*, 4.19

Polybius, *Histories*, 22.19

Skyllax

Strabo, *Geography*, 10.4

Titus Livius, *the History of Rome*, 42.51

References

Frost F.J., Hadjidaki E., (1990) Excavations at the Harbor of Phalasarna in Crete: The 1988 Season, *Hesperia* 59.3, pp. 513-527.

Hajidaki E., (1987) Excavations at the Classical/Hellenistic harbor of Phalasarna, Western Crete, Greece, *International Journal of Nautical Archaeology* Volume 16, Issue 3, pages 254–256.

Pirazzoli H.A. et. al., (1992) Historical Environmental Changes at Phalasarna Harbor, West Crete in Swiny, S., Hohlfelder, R.L., Swiny, H.W., (eds.) 1997, *Res Maritimae: Cyprus and the Eastern Mediterranean from Prehistory to late Antiquity*, Scholars Press Atlanta, pp. 371-92.

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Θεοδούλου Θεοτόκης, Σύνοψη της ενάλιας και παράκτιας αρχαιολογικής έρευνας στην Κρήτη μέχρι το 2014, *Κρητικά Χρονικά* ΛΕ' (2015), 31-52.

<http://www.ypai.gr/atlas/thesi.asp?idthesis=491>.

4.2. Rethymnon

N.C. Flemming and P. Pirazzoli briefly visited the site on the northern central coast of Crete in 1981 and located remains of at least three possible shipsheds. Few decades later, K. Baika surveyed the site in 2003 and 2005 (Loven B. and Schaldemose M., 2011:27).

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

4.3. Matala

J. Shaw located a possible slipway at Matala and Blackman (1970-1971) investigated and surveyed the site. K. Baika (2005) continued the investigations of the site including the underwater parts of the structure (Loven B. and Schaldemose M., 2011:27), but the rock cutting on land was mostly been filled in and covered. The site has not been excavated as yet (Rankov B., Blackman D.J. et al. 2014:9).

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Rankov B., Blackman D.J. (Eds), (2014) *Shipheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

4.4. Sitea

A Hellenistic rock-cut slipway was a chance find east of the northeastern Cretan town of Sitea. In 1967, K. Davaras excavated the landward part of the slipway site, but carried out no investigations in the sea. During a preliminary survey of the site in 2002, K. Baika found the continuation of the slipway into the sea; in 2005, she digitally surveyed the exposed structure on land and underwater. The submerged part of the structure has not been excavated as yet. (Loven B. and Schaldemose M., 2011:27).

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

4.5. Trypitos (Tripiti)

A single rock-cut slipway lies below the remains of a Hellenistic city, which has been under excavation since 1987, on the small peninsula of Trypitos (Tripiti), 3 km east of the modern harbor town of Setea in northeast Crete

(Figure 56). The slipway is located on the eastern side of the promontory of Trypitos. Its east-west orientation protects it from the strong northerly winds (Rankov B., Blackman D.J. et al. 2014: 518).

References

Rankov B., Blackman D.J. (Eds), (2014) *Shipheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

5. Cyclades

5.1. Andros – Palaeopoli

Ancient Andros city is located in the middle of the western coast of the island, where the village of Palaeopolis lays today (Ραουζαίου Π., 2003:40) (Figure 58). Today newest structures rest upon the old ones advocating in conducting more systematic excavations in the old city (Κοντολέων Ν., 1964:3). As depicted in the satellite image of the area (Figure 57), the port is guarded by two breakwaters. The windward breakwater with N-S orientation is about 170m long and afterwards bends in right angle to the SE for another 40m. Along the beach, a second construction can be observed, with an approximate length of 70m, regarded to be a lee breakwater (Παλαιοκρασσά-Κόπιτσα Λ, 1996a:235). At the genesis of the windward breakwater have been revealed remains of ancient Roman baths and at small distance buildings of the agora complex and remains of an early Christian Basilica have been excavated. The size of the port's basin is relatively small, possibly because that part of it has silted up with rubble; this is strengthened by the existence of a nearby stream that discharges

in the basin as well as the steep ground upon where the city has been build (Παλαιοκρασσά-Κόπιτσα Λ., 1996a:244).

The existence of a closed port in Andros is certainly relevant to the security of the city and the war fleet. This operation is mentioned in the ancient sources which refer to the hosting of warships in the bay of Gavrio and that a guard party was posted there. That's why it has been supported that this bay was the main harbor of Andros island. The function as a trading post (importation of grain, exportation of minerals) is given as Andros was in a central position among the Aegean islands and the eastern coasts of Anatolia (Theodoulou Th., 2016).

The harbor complex in Andros is investigated (2006-2008) as part of a geological study in the framework of collaboration between Athens University and the Greek Ephorate of Underwater Antiquities (Ministry of Culture - Greece) (Theodoulou Th., 2016).

Ancient Authors

Diodorus, *Historical Library* VIII.69, XX.37

Herodotus, *Histories* VIII.66, 121

Skylax, *Periplous* 58

Strabo, *Geography*, 10.5

Titus Livius, *the History of Rome*, 31.45

Xenophon, *Hellenica* I.4.21

References

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Κοντολέων Ν., (1964) *Αρχαιολογική Εφημερίς*, Χρονικά, σ. 1-5.

Παλαιοκρασσά-Κόπιτσα Λ., (1996) *Παλαιόπολις Άνδρου. Τα οικοδομικά από την προανασκαφική έρευνα*, Αθήνα.

Ραουζαίου Παυλίνα, (2003) *Η αρχαιολογία των κυκλαδικών πόλεων*, Μεταπτυχιακή διατριβή, Πανεπιστήμιο Θεσσαλίας, Βόλος.

<http://www.gosur.com/map/?satellite>.

http://androssimera.blogspot.gr/2013/06/blog-post_5.html.

5.2. Kea

5.2.1. Otzias bay

Despite being a deep bay, with length reaching approximately 1 km, the bay of Otzias is not a safe anchorage because it is exposed to the north wind (Figure 59). However, in its cove, below the church of Agios Sozon, remains of port constructions are preserved, probably from the Classical period (Whitelaw T.M., 1998: 231) (Figure 60). The archaeological remains consist of a quay of quadrilateral shape, which stands on earth stone scatter. It is made of natural stones of small dimensions (20x30x10cm.), while the platform is built from natural blocks of shale rock with dimensions 2x1x0.5m about. The masonry of the platform consists of natural stones slightly labored and resembles the ones used in the walls of Ioulida and Poiessa, dating from the 4th century B.C. They are the only evidence for dating the port installation. The earth stone scatter

continues at the southeast of the construction, possibly in order to protect the harbor from silting because of the stream that flows into the bay (Σπονδύλης Η., 1998: 699-712) (Figures 61, 62, 63). The foot of the earth stone scatter is -5.2m in the sandy bottom, its top -3.8m, and the top of the platform -1.4m. Because the platform maybe preserves on the top its original height and probably projected during its operation phase for around 0.5-1m, then the change in sea level can be calculated between 1.9-2.4m. The port construction provided enough space for two ships of a standard size of the Classical period (~50m) (Σπονδύλης Η., 1998: 699-712).

The port in Otzias bay does not seem to be a trade post serving a city, but it may have been used as a loading station for specific products, in this case, possibly metal or Miltos from the area of Paoura mines or Trypospilion (Whitelaw T.M., 1998: 233).

The harbor was identified and designed in a survey of the Ephorate of Underwater Antiquities, in 1987, after a request for performing modern port installations in the same location (Ραουζαίου Π., 2003:63).

Ancient Sources

Appian, *the Civil Wars*, 5.1

Demosthenes, *on the Crown*, 18.96

Herodotus, *Histories*, 4.35

Pliny, *the Natural History*, 2.94

References

Whitelaw T.M., (1998) Colonization and competition in the polis of Koressos: The development f settlement in north-west Keos from the archaic to the late

roman periods in Μενδώνη και Μαζαράκης – Αινιάν, *Κέα-Κύθνος: Ιστορία και Αρχαιολογία* (Μελετήματα 27). Αθήνα/ Παρίσι, 2 σ.27 – 257.

Ραουζαίου Παυλίνα, (2003) *Η αρχαιολογία των κυκλαδικών πόλεων*, Μεταπτυχιακή διατριβή, Πανεπιστήμιο Θεσσαλίας, Βόλος.

Σπονδύλης Η., (1998) Ένα βυθισμένο λιμενικό έργο στον Οτζιά Κέας στο Λ.Γ. Μενδώνη - Α.Ι. Μαζαράκης Αινιάν (επιμ.) *Κέα - Κύθνος: Ιστορία και Αρχαιολογία, Πρακτικά Διεθνούς Συμποσίου 22-25 Ιουνίου 1994*, Αθήνα 1998.

5.2.2. Poiessa

A single slipway is cut into the rock on the north side of the southern promontory where the ancient acropolis of Poiessa is located (Figure 64). The slipway is placed in the southern part of the Bay of Poiessa at the site known as Tarsanas (“shipbuilding yard”). As the bay was exposed to the north-west winds, it may not have been suitable for large vessels. Today the bay is partly silted by the alluvium of a river that ran down the valley behind the city in ancient times (Rankov B., Blackman D.J. et al. 2014: 489).

References

Rankov B., Blackman D.J. (Eds), (2014) *Shipheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

5.3. Kythnos - Madraki bay

In the area of Episkopi, on the northwest of Kythnos Island, was discovered and excavated by the University of Thessaly the settlement of ancient Kythnos. In the same area the small bay of Mandraki, in the south of

Episkopi, which is protected by the islet Vryokastro, seems to have been used as a mooring space (Figure 65). The basin is formed by the small bay of Mandraki and the opposite hill of Vryokastro (Figure 66) (Theodoulou Th., 2016). During the underwater archaeological excavations in the bay of Mandraki were located the sunken remains of the port of the ancient city of the island. The remains of a breakwater made of natural stone blocks length over of 100m was detected south of the bay. Nevertheless, the presence of the blocks around the structure perhaps suggests the existence of an internal wharf or quay. This construction protected the entrance and the basin from the south - southwesterly winds, which were the only ones who could challenge it. East of the bay, construction remains are preserved connecting the rocky beach with the hill of Vryokastro closing the basin from that side. In the cove of the bay, was located at a depth 2.20m, a strong wall, width 2.20m and length at least 15m, which goes parallel to the modern beach (Figure 67). The wall was likely to be part of the sunken fortification wall. Various structures in other parts of the basin are also mentioned which have not yet been studied (25/09/06 at: www.culture.gr).

Kythnos' excavation was carried out by the Sector of Archaeology of the Department of History, Archaeology and Social Anthropology (IAKA) of University of Thessaly initially, and up to 2011 with the cooperation, and from 2012 onwards with the supervision of KA Ephorate of Prehistoric and Classical Antiquities. Head of the research team of the University is Professor Alexander Mazarakis Ainian (Department of Underwater Antiquities, Kythnos: 389).

The research is still at an early stage that is not yet known further details about the port construction's function, which remains unspecified.

Ancient Authors

Herodotus, *Histories* VIII, 46

Polybius, *Histories*, 33.4

Strabo, *Geography*, 10.5

References

Department of Underwater Antiquities

<http://www.yppo.gr/0/anaskafes/pdfs/EEA.pdf>.

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities

(<http://limenoscope.ntua.gr/>).

Press Release 25/09/06 at: (www.culture.gr).

<http://extras.ha.uth.gr/kythnos/index.php?page=sites-town>.

5.4. Delos

Building walls in the shoreline along the beach of Skardana were identified during the research of the Ephorate of Underwater Antiquities in cooperation with the National Research Foundation, in underwater research at Delos (Figure 68, 69). The construction is interpreted as possible harbor installation, with the subjection of course of the excavation research, which will provide more and safer information. If, however, the identification is correct, then the experts speculate that the port as well as another one that had previously detected in the area of Stadiou were small commercial ports operating as auxiliary ports to the main port of the ancient island. In underwater exploratory autopsies performed in order to locate ancient shipwrecks between Delos and Rhenia, a total number of seven ancient merchant ships wrecks were found. This indicates that Delos had experienced a rapid growth after 167 B.C., when the Romans turned it into a commercial basis linking the eastern and western Mediterranean. (The channel between Delos and Rhenia is a key passage).

Ancient Sources

Strabo, *Geography*, 2.5, 6.2

References

<http://www.archaiologia.gr/>.

Press Release 28/06/16 at: (www.culture.gr).

6. North eastern Aegean

6.1. Thasos

6.1.1. Commercial Harbor (6th B.C.-2nd B.C.)

The city of Thasos is located in the northern part of the homonymous island, along the bay of Panagia in which two harbors were formed; an inner military harbor and a trade pier/breakwater. The merchant port was constructed northeast of the nautical base, in the port of Evreokastro area, protected to the north by a breakwater (Figures 70, 72) and from the outside by the city walls which were an extension of the naval base to the northeast (Figure 71). In ancient times, the port intercommunicated with the agora through gates (Theodoulou Th., 2016). The visible outer port structures consist of a single breakwater to the north. The construction was extended to E-W direction, with dimensions of 115m in length and 18-30m in width. The breakwater head is of circular shape (with a diameter of 20m), which may be explained by the existence of a tower. It was probably fortified in its exposed side with a wharf in the inner foot of the walls. Today the breakwater remains can be identified in an average depth of -1 to -2m below the sea level (Archontidou-Argyri A. et al., 1989:52) (Figure 73).

The island's strategic location, upon the trade networks from Aegean to Thrace and Black Sea, the metal-rich subsoil (gold, silver), the vineyards and the forests, enhanced the city's development to a significant naval and trade power. Every kind of the island's trade products were exported from this port and especially the famous Thasian wine in the distinguishable Thasian transport amphorae with the particular shape (Καραδήμα Χ., 2003).

The ports of Thasos were already known to the travellers of the 19th century (Perrot G., 1864, Conze A., 1860). Initially, during 1980-1984 carried

out small-scale excavations by the Department of Underwater Antiquities. Apart from that, a simultaneous mission of the Ephorate of Underwater Antiquities and the French Archaeological School in Athens conducted excavation of the closed military harbor in eight seasons (Theodoulou Th., 2016).

Ancient Authors

Herodotus, *Histories* VI.46

Pliny, *Naturalis Historia*, VII.209

Ploutarch, *Lives (Kimon)* 14.2

Pseudoskylax, *Periplous* 67

Thucydites, *History of the Peloponnesian War* I.101.1, I.200.2, 3.4.104-105, 8.64.2-4

Xenophon, *Hellenica* 12

References

Archontidou-Argyri A., Simossi A., Empereur J. -Y., (1989) The underwater excavation at the ancient port of Thasos, Greece, *International Journal of Nautical Archaeology*, 18.1, pp. 51-59.

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Navis II Project, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200, B-1049 Brussels <http://www2.rgzm.de/Navis2/Home/Frames.htm>.

Καραδήμα Χ., (2003) Τα κρασιά της Θάσου, 3-3-2003 <http://www.thassos-island.gr>.

6.1.2. Military Harbor (6th B.C. - 2nd B.C.)

The military harbor was formed at a quadrilateral shape and was located in front of the city's agora, intercommunicating by two gates. The north-easter side (A-B) was 148.6m long and then extended to southwest (B-C) for another 45m, as long as the length of the shipsheds was. The southern side (H-G) extended northeastern (G-F) for 31m. Right after this section, the contemporary harbor's entrance begins. The western sea-exposed side existed in the extension of this part (F-D), until the Early Byzantine period. The original entrance is presumed to have been located in between section D-C. The city walls were built upon the breakwaters. Their width was approximately 3m. They consisted of marble blocks in the exterior, while the interior was filled with un-worked stones (Archontidou-Argyri A. et al., 1989:58).

Possible remains of shipsheds were found in 1988 during the Greek-French underwater excavations in the northeastern side of the naval harbor of Thasos on the north coast of the island. As at Aigina, the structures were most probably shipsheds based on their location within a well-defined military harbor, but they were classified as possible shipsheds due to lack of a ramp structure. During dredging work in the western part of the harbor in 1983, two possible ramp blocks were found. The buildings are dated to the middle of the 5th century B.C. and therefore are the oldest remnants from structures of this use from the Classical period (Loven B. and Schaldemose M., 2011:28) (Figure 74).

Grounded in archaeological evidence, mainly ceramics and individual findings, along with certain structural features identified by the excavators,

there can be distinguished three main phases in the history of the military harbor; the fortification of the harbor dates back to the end of the 6th -early 5th century B.C., because of the similarity with the terrestrial fortifications. The shipsheds are dated around the middle of the 5th century. At the end of the 4th century the sea wall was reinforced with circular towers (Figure 75). From that period is dated the artificial beach on the west, outside the fortification wall. During the early Christian period (4th-7th century A.D.) a new section of the breakwater was constructed and the entrance of the port shifts. The port gets abandoned after the destruction of the city at the end of the 6th -early 7th A.D. and restarted to operate around the 10th century A.D. (Theodoulou Th., 2016).

The port was operated as a military base from the 6th century B.C. until the 2nd century B.C. After the renovations during the Early Byzantine period it was transformed to a commercial port and since the 10th century A.D. the establishments were used only for trading purposes (Theodoulou Th., 2016).

Ancient Authors

Pausanias, *Description of Greece*, 5.25

Strabo, *Geography*, 1.2

Xenophon, *Hellenica* 1.1

References

Archontidou-Argyri A., Simossi A., Empereur J. -Y., (1989) The underwater excavation at the ancient port of Thasos, Greece, *International Journal of Nautical Archaeology*, 18.1, pp. 51-59.

Loven Bjorn, Schaldemose Mette, (2011) *The ancient harbours of the Piraeus, Monographs of the Danish Institute at Athens, 15*, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Rankov B., Blackman D.J. (Eds), (2014) *Shipsheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

6.2. Lemnos

Lemnos, flourished from prehistoric times with cities like Poliochni, Koukonisi and Myrina, and maintained a strong presence in the historical development with settlements and places on the coast which testify the significance of the sea for its existence (Marangou C., 2002: 7). The implementation of its pastime occupation in ancient harbor works, although generally unexplored, is detected at the island's perimeter in the positions of Agios Sotiras, Neftina and Hephaestia at the bay of Pournia, in the position Stvi on the northwest side of the bay Thanous and probably in Myrina, which continues to be during the medieval and Ottoman years, the main port (Maragou C., 1995).

6.2.1. Agios Sotiras

At the north end of the bay of Pournia, at the promontory of Agios Sotiras remains of an ancient port is preserved, similar to the one in Neftina bay 3 km approximately southern. The visible remains include a curved breakwater, heading northeast - southeast, with a length of 400m about and 10 meters wide. The building material is un-worked stones mined from the promontory region.

Although part of the basin is silted up, it is maintained in a large enough area. The port is constructed with a similar way as the port constructions in Neftina and Hefaistia located a little southern. All the port installations in the island are attributed to the period of the presence of Persians in Lemnos (512-479 BC) (Αρχοντίδου-Αργύρη Α. και Κοκκινοφόρου Μ, 2004:31).

The port, in a key position to the navy street from the sea to the Hellespont and in close proximity to the coast of Troy, perhaps operated as a shelter or station for the near sail vessels, possibly in connection with the sanctuary of the Great Kabeirian Gods, protectors of sailors (Maragou C., 1995:312).

References

Maragou C., (1995) A rock engraving in Lemnos (Preliminary Study), *Tropis III -3rd International Symposium on Ship Construction in Antiquity, Athens 1989*, Athens, pp. 309-319.

Marangou C., (2002) Rocks and itineraries: Sea and Land Perspectives on an Aegean island. In W. H. Waldren, J. A. Ensenyat (eds.), *World Islands in Prehistory, International Insular investigations, V Deia International Conference of Prehistory*. BAR International Series 1095, Oxford: Archaeopress, pp. 7-18.

Αρχοντίδου-Αργύρη Α. και Κοκκινοφόρου Μ. (επιμ.), (2004) *Η Μύρινα της πρώιμης εποχής του Χαλκού, Λήμνος*.

6.2.2. Hefaistia

On the northwest side of the peninsula, where the city of Hephaestia developed, the remnants of a basin are preserved. They consist of a curved breakwater running from the north, bending to the west and ending to the south, where the entrance is shaped between the end of the breakwater and the coast. The construction has the same orientation with the jetties that form the ports in Agios Sotiras and Neftina and is made of natural stone blocks, but somewhat smaller. It seems to have been used for mooring boats as in the case with the deep bay in the east of the peninsula, although there are not any relevant port constructions been located there. Besides, the form of the ancient coastline has undergone silting since antiquity (512-479 B.C.) (Αρχοντίδου-Αργύρη Α. και Κοκκινοφόρου Μ, 2004:31).

The port construction in northwest operated, obviously, alternatively to the deep bay to the east, depending on the prevailing weather conditions. The bay is challenged by the northeastern winds, while the port in the west would, during its operation, be practically intact, as even from the entrance to the south there is no wide spread of sea in order to create intense ripple. As for the commercial or military use of the two ports, it is impossible to make estimates because of the absence of detail investigation (Theodoulou Th., 2016).

References

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Αρχοντίδου-Αργύρη Α. και Κοκκινοφόρου Μ. (επιμ.), (2004) *Η Μύρινα της πρώιμης εποχής του Χαλκού*, Λήμνος.

6.2.3. Neftina

On the north side of the bay of Neftina an elongated curved breakwater is preserved. It is about 420m long and 10-12m wide at sea surface, with direction from northeast to southeast. The breakwater is trapezoidal in cross-section and is made of un-worked stones. The major part of the basin is now embanked because of the streams that invaded inside it (Αγαλοπούλου Π. και Καλλιωντζής Ν., 1988:169). Due to the proximity of the port construction to the Kabeirio and the absence of adequate mooring space in the immediate vicinity of the sanctuary, which is approximately 1200m from the port's location, it is quite likely that this harbor construction was built to serve the needs of the religious center (Maragou C., 1995:312).

References

Maragou C., (1995) A rock engraving in Lemnos (Preliminary Study), *Tropis III -3rd International Symposium on Ship Construction in Antiquity, Athens 1989*, Athens, pp. 309-319.

Αγαλοπούλου Π. και Καλλιωντζής Ν., (1988) Τρία αρχαία λιμάνια της βόρειας Λήμνου, *Αρχαιολογική Εταιρεία*, σ. 169-174.

6.2.4. Thanous bay Stvi

On the northwest side of the bay Thanous, a curving earth stone scatter has been identified with direction northeast – southwest, creating a protected basin in the northwest. The construction consists of large natural blocks on the windward eastern side and smaller ones on the inner. Part of the surface stones reaches the level of the water while in both sides of the structure exists stacking of sand. Although in the autopsy of the Ephorate of Underwater Antiquities

(2008) there were no pottery finds, the earth stone scatter is anthropogenic, which makes its date impossible to define. In addition, the use of the port remains unknown (Theodoulou Th., 2016).

References

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

6.3. Lesvos

Lesvos stands throughout the Aegean with impressive harbor works that can be dated from the classical period and possibly earlier. The five cities Lesvos (Lesbian Pentapoli) of Classical period have achieved harbor remains with different degrees of conservation state. In Pyrrha and Antissa, the ports today are embanked. In Mithymna and Eresos, the ancient port remains are still visible and partly in use. At Mytilene, the northern port at Epano Skala, the Maloes Limin², remains the most impressive port construction of the Aegean antiquity, unlike southern trireme Port³, has disappeared entirely under the modern harbor installations (Theodoulou Th., 2010: 094).

2. The northern, commercial harbor of Mytilene is mentioned in the sources and as "Maloes Limin 'in honor of Maloentos Apollo, whose sanctuary was found in the area of Epano Skala in Mytilene (Theodoulou Th., 2010: 0102).

3. The southern port is mentioned by Strabo as «κλειστός τριηρικός ναυσί πενήκοντα» ("closed trireme with fifty ships") (ibid).

6.3.1. Mytilene North harbor (4th B.C. - 7th A.D.)

The northern port of Mytilene (Figure 76), called "Malois port", was the commercial port of the city (Figure 80). The visible outer port structures include two breakwaters, preserved in very good condition. The eastern breakwater has a length of 350m and a width of 7.60m and on its genesis exist tower of the Ottoman part of the castle of Mytilene (Figure 78). To the north, it leads to a reef, which is identified as the location of a lighthouse building seen on 18th century engravings, but not preserved today (Figure 77). The northwest breakwater has its origin on the beach, near the abandoned factory of Kalamaris and extends 150 meters east (Figure 79). Its width is 8.50m. Both jetties constructed with blocks, connected together by dovetail joints, as evidenced by their tenons. The initial construction is attributed to the late 5th century B.C. according to the testimony of Thucydides (C.1 and 3). However, third mole exists underwater, which follows the same direction as the east and bends in the west forming a small basin. This construction is probably an earlier port work. On the eastern breakwater and at regular distances of about 38m, are preserved pointed passageways for the entry and exit of the water in order to reduce the stress of the breakwater from the bottom stream and to renew the waters of the basin. The north port is not archaeologically documented. Although archaeological evidence is lacking for a secure dating of the ports of Lesbos, it is generally accepted that they were all initiated in the 4th century B.C. (Θεοδούλου Θ., 2010: 097).

The northern port was serving the commercial activity of the city and the communication with the opposite Asia Minor area of Mytilene as well as the rest of the Mediterranean. However, it cannot be excluded the existence of

some military installations providing more direct protection of the city from the north side also (Theodoulou Th., 2016).

In 2008, a project of mapping all of Lesvos ancient ports has been initiated by the Department of Underwater Antiquities (Theodoulou Th., 2016).

Ancient Authors

Diodorus, *Historical Library* XIII.77

Strabo, *Geography* XIII.2.2

Thucydides, *History* A.93, C.1-3, Z.23

References

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Θεοδούλου Θεοτόκης, (2010) Εφορεία Ενάλιων Αρχαιοτήτων -Υποβρύχια έρευνα στα αρχαία λιμάνια της Λέσβου στο *Αρχαιολογία και Τέχνες, Στήλες*, τεύχος 116, σ. 093-0102.

<http://www.ellinikiaktoploia.net/a-5/>.

<http://www.gosur.com/map/?satellite>.

6.3.2. Mytilene South harbor (4th B.C. - 7th A.D.)

The southern port (now internal) is the most protected one from the waves. The modern basin is equated with the ancient, although it is less extensive due to modern works (waterfront, road, silting) (Θεοδούλου Θ.,

2008:230) (Figure 81). From the ancient port constructions are still preserved some traces (blocks visible at the bottom) in the cantilever Fanari, which defines the entrance of the ancient harbor basin and at the base of the waterfront of the Christmas Street, which runs the south-western part of the basin (Θεοδούλου Θ., 2010: 097) (Figure 82). Part of the ancient port construction has been found during excavations in the Swimming Pool area, east of the southern basin of the modern port. It consists of a section of the fortification wall that protected the archaic and classical city, which ended up in a tower to the south, underwater, taking the form of a closed port breakwater. It was built with irregular isodomic system and the blocks were connected by dovetail joints. During the excavation it was revealed part of 33m (11m. the tower), which was eventually covered in order to erect the outbuildings of the Swimming Pool area (Θεοδούλου Θ., 2008) (Figure 83).

The southern port is regarded as the military port of Mytilene, which hosted, according to Strabo (XIII.2.2), fifty warships. Therefore, in this site anchored the fleet of Mytilene, not excluding the hospitality of at least part of the fleet in the northern port, in order to protect the city adequately (Θεοδούλου Θ. και Κουρτζέλλης Γ., 2011:136).

References

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Θεοδούλου Θεοτόκης, (2008) Διαχείριση παράκτιας ζώνης και ενάλια πολιτιστικά αγαθά - το παράδειγμα της Λέσβου στο *Πρακτικά του 4^{ου} Πανελλαδικού Συνεδρίου Διαχείρισης και Βελτίωσης Παρακτίων Ζωνών*,

Μυτιλήνη 23 με 27 Σεπτ. 2008, ΕΜΠ, Εργαστήριο Λιμενικών έργων, Αθήνα, σ. 223-232.

Θεοδούλου Θεοτόκης, (2010) Εφορεία Ενάλιων Αρχαιοτήτων -Υποβρύχια έρευνα στα αρχαία λιμάνια της Λέσβου στο *Αρχαιολογία και Τέχνες, Στήλες*, τεύχος 116, σ. 093-0102.

Θεοδούλου Θεοτόκης και Κουρτζέλλης Γιάννης, (2011) Λιμάνια και ναυτικοί δρόμοι στην αρχαία Λέσβο, *Λεσβιακό Ημερολόγιο,- Γράμματα- Τέχνες- Πολιτισμός*, εκδόσεις: Αιολίδα, σ. 129-300.

<http://www.gosur.com/map/?satellite>.

<http://www.blod.gr/lectures/Pages/viewlecture.aspx?LectureID=1396>.

6.3.3. Antissa (4th B.C.-2nd B.C.)

The artificial harbor of the town of Antissa (Figure 84) is located 270m from the eastern side of the peninsula, to the west of the necropolis (Παρασκευαΐδης Π., 2008). R. Koldewey (1890), outlining the direction of the wall, states that the port was outside the fortification walls, which would make it weak to sea attacks. The artificial port was built into a "Γ" or "Π" shape while the shoreline relocation does not fully illustrates the relationship between the basin with its silted part in the land. The preserved breakwater is oriented SW-SE with length of 170m and then turns SE at approximately 80m. The biggest part that starts from the beach is natural rocky formation while the rest is earth stone scatter of natural stones (Θεοδούλου Θ., 2010: 099) (Figure 85). The course of the two parts of the breakwater is identifiable, until today at the level of their foundations, while stone plinths, apparently coming from the platforms, are scattered in the shallow basin. The harbor entrance was located in the southeast. The technical construction of the platforms seems to be the same

with the other port constructions of Lesvos, the "emplekton masonry"⁴ with stone plinths on the outer edges and filling of smaller un-worked and semi-worked stones. For the port of Antissa, there are no historical data. It is generally accepted that the port developments in Lesvos stood together in the 4th century B.C. (Θεοδούλου Θ., 2008:230).

The port installation would obviously execute all kinds of imports and exports of the city. On whether the ancient port functioned as a naval base, there is insufficient evidence, although it would be quite reasonable. Instead, it has been suggested that Kalo (Tsamour) Limani functioned as a naval port of the city, in a distance of 2 km east (Θεοδούλου Θ. και Κουρτζέλλης Γ., 2011).

Ancient Authors

Claudius Ptolemy, *Yfigisis* 5.2.19

Diodorus, *Historical Library* XIV.94 and XVII.29

Livius, 45.31.13-14

P. Ovidius Naso, *Metamorphoses*, XV.287

Plinius, *Naturalis Historia*, V.39.139 and II.94

Skylax, *Periplus*, 97

Strabo, *Geography*, I.60 and XIII.618.25

Thucydides, *History* III.28

4. Refers to a building technique where two parallel walls are constructed with stone plinths and the core between them is filled with rubble or smaller un-worked and semi-worked stones, creating one thick wall (Vitruvius, II.8.7, *On Architecture*).

References

Παρασκευαΐδης Π., (2008) Περιδιάβαση στο λιμάνι της αρχαίας Άντισσας, μετέπειτα Αγίων Θεοδώρων στο *Πρακτικά 4ου Πανελληνίου Συνεδρίου Διαχείρισης και Βελτίωσης Παρακτίων Ζωνών*, Μυτιλήνη 23-27 Σεπτ. 2008, ΕΜΠ, Εργαστήριο Λιμενικών Έργων, Αθήνα, σ. 223-232.

Θεοδούλου Θεοτόκης, (2008) Διαχείριση παράκτιας ζώνης και ενάλια πολιτιστικά αγαθά - το παράδειγμα της Λέσβου στο *Πρακτικά του 4^{ου} Πανελλαδικού Συνεδρίου Διαχείρισης και Βελτίωσης Παρακτίων Ζωνών*, Μυτιλήνη 23 με 27 Σεπτ. 2008, ΕΜΠ, Εργαστήριο Λιμενικών έργων, Αθήνα, σ. 223-232.

Θεοδούλου Θεοτόκης, (2010) Εφορεία Ενάλιων Αρχαιοτήτων -Υποβρύχια έρευνα στα αρχαία λιμάνια της Λέσβου στο *Αρχαιολογία και Τέχνες, Στήλες*, τεύχος 116, σ. 093-0102.

Θεοδούλου Θεοτόκης και Κουρτζέλλης Γιάννης, (2011) Λιμάνια και ναυτικοί δρόμοι στην αρχαία Λέσβο, *Λεσβιακό Ημερολόγιο,- Γράμματα- Τέχνες- Πολιτισμός*, εκδόσεις: Αιολίδα, σ. 129-300.

6.3.4. Eresos (4th B.C.- 7th A.D.)

The ancient port of Eresos is located at the foot of the citadel, at the west of the ancient agora. The archaeological outer structures consist of a breakwater / cantilever length of 200-250m (depending on the coastline change) and a width of about 7.5m (Figures 87, 88). The construction connected the beach with a reef, which extends to the south, giving on the north side of the bay a "Γ" shape. The port was protected from the south by rocky formations. The large size of the basin and the southwest entrance resulted not to be considered by scholars as a harbor in the narrow sense. On the northern side of

the breakwater it is considered that stood the sea wall and in the inner side a wharf was shaped in sea surface height (Θεοδούλου Θ., 2010: 099). However, the shift of the beach has changed the picture given by ancient authors for the citadel, its relationship to the ancient shoreline and the original shape of the port, while the current fishing shelter has overlaid much of the ancient breakwater (Figure 86). Therefore, the exact form of the port will only occur after underwater exploration. It is possible, since there appears not to be a "closed port" in the classic sense, the breakwater to play the role of cantilever in both sides of which were anchored vessels depending on the prevailing winds (Θεοδούλου Θ. και Κουρτζέλλης Γ., 2011:142).

The design and construction technique of the port complex of Eresos shows, according to I. Kontis (1977), similarities with the piers of the port of Mytilene and the other cities of the island. On the other hand, Lehmann-Hartleben (1923, 76) argues that there was a second port in the northern of the first, an opinion that is not accepted by Kontis because in that case both ports would have been hit by strong winds. Finally, scholars argue that there was a repair in the central part of the breakwater made of medium and large stone plinths associated with plaster, in Roman times (Theodoulou Th., 2016).

The dating of the port installations can be placed, based on literary sources, in the 4th century B.C. by interpreting the words of Diodorus about the destruction of the fleet (23 galleys) of Thrasybulus in 389 B.C. (Diodorus 14.94) from the strong southern winds, which indicate that the port has not yet been built, or it was not so big to protect the fleet (Theodoulou Th., 2016).

Except for the two ports of Mytilene where specific uses have been defined (south and north ports), the other ports of Lesbos seem to have been used for a variety of activities, peaceful and martial, contacts and trade, including the import of agricultural products and the export of lesbian wine.

Specifically, Eresos was a big cereal producer. Taking into consideration Lesvos' contacts with Asia Minor coast, the port is likely to have served the cereals market. The mooring use for the city warships in a sheltered spot of the coastline should not, however, be excluded (Theodoulou Th., 2016).

Ancient Authors

Athenaeus, *Deipnosophistai* 1.29. b and 3.77

Diodorus, *Historical Library* 14.94

Galen, *On the drug composition in genera* 1.8 and 1.5, *About antidotes* 1.5

Strabo, *Geography* 13.2.4

Thucydides, *History* 3.18.3, 3.35.1 and 8.100.3

References

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Θεοδούλου Θεοτόκης, (2010) Εφορεία Ενάλιων Αρχαιοτήτων -Υποβρύχια έρευνα στα αρχαία λιμάνια της Λέσβου στο *Αρχαιολογία και Τέχνες, Στήλες*, τεύχος 116, σ. 093-0102.

Θεοδούλου Θεοτόκης και Κουρτζέλλης Γιάννης, (2011) Λιμάνια και ναυτικοί δρόμοι στην αρχαία Λέσβο, *Λεσβιακό Ημερολόγιο,- Γράμματα- Τέχνες- Πολιτισμός*, εκδόσεις: Αιολίδα, σ. 129-300.

6.3.5. Kalo Limani

Widespread attention and concern causes the interpretation of Kalo Limani, which has been assigned as a military port of ancient Antissa. The outer visible remains consist of earth stone scatter or of a breakwater platform, a technique unknown to the other port constructions of Lesvos cities of the ancient times. Chronology and identification as a military ancient port of ancient Antissa remain problematic. For the creation of the artificial harbor constructed a compact outer breakwater eastern of the bay, which closed the sea passage between the promontory "Island" and the opposite shore. Its length is about 300m and its width is estimated at 15m, size that clearly cannot be calculated without excavation because of the fallen stones. The breakwater is at a depth of -0.50m minimum and -5.50m maximum from the current sea level. The port entrance was on the west with opening about 20 to 25m in an area that now has silted up. Underwater investigation recovered pottery, mostly amphorae, dating to the Hellenistic era, Late Roman period, and post-Byzantine eras, revealing the continuing use of the site. The ancient earth stone scatter in the central part of the construction was destroyed with explosives in 1960 in order to construct an entrance into the already shallow port for boats of local fishermen (Θεοδούλου Θ. και Κουρτζέλλης Γ., 2011:141). Any date as early as the Hellenistic time is plausible for this port, which was in use until the post-Byzantine period.

Whether the ancient Tsamour port functioned as a naval base for the docking of warships of Antissa there is insufficient evidence or testimony in the ancient literature. The above opinion could be accurate if we consider defensive attention and care of Antissa towards the hostile town of Mythimna, which is

located 17 km from Kalo Limani (Θεοδούλου Θ. και Κουρτζέλλης Γ., 2011:141).

The ancient port construction discovered in 1994 by the Tax Office of Underwater Antiquities and mapped in 1995.

References

Παρασκευαΐδης Π., (2008) Περιδιάβαση στο λιμάνι της αρχαίας Αντισσας, μετέπειτα Αγίων Θεοδώρων στο *Πρακτικά 4ου Πανελληνίου Συνεδρίου Διαχείρισης και Βελτίωσης Παρακτίων Ζωνών*, Μυτιλήνη 23-27 Σεπτ. 2008, ΕΜΠ, Εργαστήριο Λιμενικών Έργων, Αθήνα, σ. 223-232.

Θεοδούλου Θεοτόκης, (2008) Διαχείριση παράκτιας ζώνης και ενάλια πολιτιστικά αγαθά - το παράδειγμα της Λέσβου στο *Πρακτικά του 4^{ου} Πανελλαδικού Συνεδρίου Διαχείρισης και Βελτίωσης Παρακτίων Ζωνών*, Μυτιλήνη 23 με 27 Σεπτ. 2008, ΕΜΠ, Εργαστήριο Λιμενικών έργων, Αθήνα, σ. 223-232.

Θεοδούλου Θεοτόκης και Κουρτζέλλης Γιάννης, (2011) Λιμάνια και ναυτικοί δρόμοι στην αρχαία Λέσβο, *Λεσβιακό Ημερολόγιο,- Γράμματα- Τέχνες- Πολιτισμός*, εκδόσεις: Αιολίδα, σ. 129-300.

http://vaspik.blogspot.gr/2013/01/blog-post_9798.html.

6.3.6. Pyrrha (4th B.C.-2nd B.C.)

The port of Pyrrha, which was in use during the classical period, was probably in the north side of the fortified town, in the area where the river Vouvaris flows today (Figure 90) (Θεοδούλου Θ., 2008). For the outer port remnants, Koldewey (1890) provides some evidence mainly on the existence of

two sets of rectangular stone plinths, parallel to each other, with an inclination towards the sea, length of 20m and width of 6.50m near the church of Agia Fotini. The structures were interpreted as shipsheds for the hauling and launching of warships (Θεοδούλου Θ., 2010: 099). The existence of shipsheds suggests the occurrence of an artificial military port, but the area has been heavily silted because of the presence of the river, which has transformed the ancient shoreline. After the destruction of the city by an earthquake, in 231 B.C., the northern port was most probably abandoned and the settlement was moved south of the hill, where the Suburb area⁵ is placed (Θεοδούλου Θ. και Κουρτζέλλης Γ., 2011:143). There, scholars mention the existence of a breakwater in the genesis of which are preserved various architectural remains. Koldewey (1890) also mentions little northern, remains of hauling ship facilities, which characterizes medieval, while Kontis (1977) dates them to the late antiquity. B. Petrakos partially cleaned these offshore structures and located a head of female figurine and a bronze coin of Constantine II (641-668 A.D.).

It has been suggested that the port of Pyrrha served the movement of the pilgrims to the adjacent Sanctuary of Messou. Additionally, as Pyrrha had the control of a large part of the Gulf of Kalloni, a bay rich in fish and shellfish, many of which were considered excellent food, definitely operated as a trade post for imports and exports of products of the city to the markets of Athens and to the opposite coasts of Asia Minor (Theodoulou Th., 2016).

The harbor of Pyrrha is not documented archaeologically and in fact has not been systematically studied,

5. After the devastating earthquake, Pyrrha continued to exist as a settlement in the south of the hill, as "the Suburb with port", according to Strabo.

except from the general mapping by the Ephorate of Underwater Antiquities (2008) of the total port establishments in the island of Lesvos.

Ancient Authors

Diodorus, *Historical Library* XII.105.5

Plinius, *Historia Naturalis* V.XXXIX.139

Plinius, *Historia Naturalis* II.XCIV.206

Skylax, *Periplus* 97

Strabo, *Geography* CHIII.2.4.618.

Theophrastus, *On Plant Histories* 3.9.5

References

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Θεοδούλου Θεοτόκης, (2008) Διαχείριση παράκτιας ζώνης και ενάλια πολιτιστικά αγαθά - το παράδειγμα της Λέσβου στο *Πρακτικά του 4^{ου} Πανελλαδικού Συνεδρίου Διαχείρισης και Βελτίωσης Παρακτίων Ζωνών*, Μυτιλήνη 23 με 27 Σεπτ. 2008, ΕΜΠ, Εργαστήριο Λιμενικών έργων, Αθήνα, σ. 223-232.

Θεοδούλου Θεοτόκης, (2010) Εφορεία Ενάλιων Αρχαιοτήτων -Υποβρύχια έρευνα στα αρχαία λιμάνια της Λέσβου στο *Αρχαιολογία και Τέχνες, Στήλες*, τεύχος 116, σ. 093-0102.

Θεοδούλου Θεοτόκης και Κουρτζέλλης Γιάννης, (2011) Λιμάνια και ναυτικοί δρόμοι στην αρχαία Λέσβο, *Λεσβιακό Ημερολόγιο,- Γράμματα- Τέχνες- Πολιτισμός*, εκδόσεις: Αιολίδα, σ. 129-300.

6.3.7. Mithymna

The picturesque fishing port of Molyvos -medieval name for ancient Mithymna- identified by R. Koldewey (1890) as the ancient war port of the city. In its perimeter is maintained the traditional platform, in several points covered by concrete, which remains on time undated, although it potentially could be estimated until the medieval times. In southwest of the platform exists underwater earth stone scatter which continues to a depth of 25m. Probably part of its core is natural formation, promontory, islet or reef, which artificially strengthened in order to accommodate the ancient quays that later succeeded the existing ones. Recent research has revealed southern of the platforms part remains of an end of a breakwater (6x2.5m about), built even way according to the “emplekton technique”, as the breakwaters in Mytilene (Figure 91). The end of the breakwater defines the entrance to the ancient harbor basin from the south, in different position and direction from the entrance of the current fishing shelter. On its southwest, abuts semi ruined later addendum of subordinate technique, which indicates a second chronological and building phase. From its front and after a distance, which probably coincides with the ancient entrance of the port, were identified underwater sections of agglomerated un-worked stones coming from the now extinct second breakwater, which defined the basin from northwest or the fortification wall that probably ran it. Its width (6 m) is such as to justify the existence of the wall in combination with a wharf (3 + 3 m). Under the light of new data, it seems that the fortification of the city of

Mithymna could organically include the military port forming a closed port. In the extended shoreline, southern of the city, were located in the bottom architectural remains indicating a different configuration of the coast in the ancient times. There probably should be sought the ancient commercial harbor (Θεοδούλου Θ., 2010:097).

References

Θεοδούλου Θεοτόκης, (2010) Εφορεία Ενάλιων Αρχαιοτήτων -Υποβρύχια έρευνα στα αρχαία λιμάνια της Λέσβου στο *Αρχαιολογία και Τέχνες, Στήλες*, τεύχος 116, σ. 093-0102.

6.3.8. Agios Fokas

On the west side of the promontory Agios Fokas, forms a safe basin with entrance from the northeast, which is used until today as a fishing shelter (Figure 94). On the top of the windward east breakwater of the fishing shelter are detected relics of an ancient waterfront, consisting of stone plinths, 25m approximately in length, preserved in two layers (Figures 92, 93). In the rest of the harbor's perimeter, the waterfront has disappeared, but the agglomerated filling that existed behind it is continued. On the outer side of the breakwater, which seemed like natural formation, it was determined from the recent research that is about an artificial level, which maintains foundations of ancient buildings. For the protection of those buildings from sea level rise and rippling, was constructed eastern from the windward breakwater another jetty. In the area

of the leeward northern breakwater were located the remains of an ancient earth stone scatter, which are preserved beneath the modern formations made of natural stones. Among them scattered ancient architectural parts were detected. The pottery from the basin of Agios Fokas indicates use since at least the 3rd century B.C. (Θεοδούλου Θ., 2010:0100).

References

Θεοδούλου Θεοτόκης, (2010) Εφορεία Ενάλιων Αρχαιοτήτων -Υποβρύχια έρευνα στα αρχαία λιμάνια της Λέσβου στο *Αρχαιολογία και Τέχνες, Στήλες*, τεύχος 116, σ. 093-0102.

6.4. Samos - Pythagoreion (6th B.C. – 5th B.C.)

The ancient city of Samos is located in the southeastern part of the homonymous island, in the place that today is the village of Pythagoreion. The city's port was in a natural bay, formed at the eastern edge of the ancient city, in the same location that operates the modern port of Pythagoreion (Σίμωνι Α., 2010:114) (Figure 97). The ancient port of Samos must have been bilateral, consisting of a walled basin, the earliest example of "closed port" (Figure 96), in which apparently were the shipsheds mentioned in sources (Hdt. III.45). A second basin, probably the cove to the east of the previous basin, protected from the southeast by the elongated breakwater of Polycrates, was used rather as commercial port (Figure 95). The visible archaeological remains found in the port area of Pythagoreion consist of: outwardly of the modern southern pier and

alongside towards him with direction NW - SE is preserved earth stone scatter, 480m in length about, turning to its southern edge to the east, beneath the modern pier. This earth stone scatter, made of clay bricks and blocks of secondary use, is at a depth of -2.75m northwest until -14m southeast. Its width is not specified because it is covered by sediments and fallen material from the adjacent modern pier (Simossi A., 1988:283). For this construction was supported the identification with the Polykrates "soil" (Σίμωσι A., 1993), the ancient breakwater, whom Herodotus mentions: "περί λιμένα χώμα εν θαλάσση, βάθος και είκοσι οργυιέων, μήκος δε του χώματος μέζον δύο σταδίων". A second earth stone scatter dimensions 170-190m in length and width 20m about, was located beneath the modern northern breakwater, at a depth of 2m and was considered identical with the foundation of the ancient quay / sea wall, which surrounded the eastern military port, following the inland city wall. In this hypothesis, advocates the identification of ancient building material, which was used in the breakwater of the 19th century. Remains of the corresponding western pier detected in the continuity of the Byzantine wall, part of which is today visible in the genesis of the modern southern pier (Figure 98). In the extension of this visible part, in the sea and to the east, at a depth of -1m was discovered that the Byzantine wall was constructed on a premier work. The structure is extended in length for 13m. It consists of two layers of seventeen limestone blocks arranged either as outbond or as cavity. The construction was considered the external view of the ancient wall, which went over the south pier creating the protected area of the "closed port" of Samos (Σίμωσι A., 2010:115). The remains were originally dated from the Hellenistic period onwards. However, the excavator subsequently proposed their identification with the works of Polycrates (6th century BC) (Σίμωσι A., 1993).

The port of Samos obviously operated with double role as a "closed" war harbor and as a trading port. The walled inner basin was used to guard the Samian fleet of "Samaina⁶". On the perimeter of the basin, below the quay of the 19th century and or the beach buildings, are probably the remains of the shipsheds for guarding the warships (Simossi A., 1988:289). Similarly, the commercial port was used for the processing of the island exchanges. Samos was known for its oil exports in a specific form of transport amphorae and was rich in other agricultural products (Σίμωσι Α., 2010:116). The port of Pythagoreion was located at a very crucial point in the commercial road that connected the Aegean with Anatolia and developed trade relations with the eastern Mediterranean, Cyprus and Egypt. The island also established a colonies network in the northern Aegean from Samothraki and Propontis (Perinthos, Ireon Wall, Bisanthi) to Cilicia (Nayis, Kelenderis). In addition, it is noteworthy that piracy events show the naval capabilities of Samos, but also the necessity of a trade and naval port. Finally, findings from the excavation of the temple of Hera imply that both the port of Pythagoreion and port remains near the Heraion show the importance of these ports to the "religious tourism"(Theodoulou Th., 2016).

Preliminary underwater survey carried out in the harbor establishments by the Department of Underwater Antiquities in 1988 and continued with two excavated seasons in 1993 and 1994 (Theodoulou Th., 2016).

6. Samaina was a distinctive type of ship, created by the tyrant Polycrates of Samos. It was a Bireme (two level ship) with boar headed shaped ram and covered by deck throughout its length. The only representation, which is believed to depict the bow of a Samaina, is the one reproduced on one side of the coins found in Zagkli (a Samian colony in Sicily) (Λάσκαρης Ν. Γ., 2006:39).

Ancient Authors

Herodotus, *Histories*, III.39, III.45, III.60

Pliny, *Natural History*, 7.209

Strabo, *Geography*, XIV.I.14

Thucydides, *History*, VIII, 79

References

Simossi A., (1988) Underwater excavation research in the ancient harbor of Samos: September - October 1988", *International Journal of Nautical Archaeology* 20.4, pp. 281-298.

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Λάσκαρης Νικόλαος Γ., (2006) Προσπάθεια αναπαραστάσεως της Σάμαινας, *Αρχαιολογία και Τέχνες*, Τεύχος 101, σ. 38-43.

Σίμωσι Α., (2010) Ο κλειστός πολεμικός λιμένας της αρχαία πόλης της Σάμου, *Αρχαιολογία και Τέχνες*, Τεύχος 114 σ. 114-116.

Σίμωσι Α., (1993) Σάμος. Αρχαίο λιμάνι Σάμου (δεύτερη περίοδος ανασκαφικής έρευνας), *Αρχαιολογικόν Δελτίον* 48, *Χρονικά* Β.2 1998, σ. 592-595.

Navis II Project, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200, B-1049 Brussels <http://www2.rgzm.de/Navis2/Home/Frames.htm>.
<http://www.gosur.com/satellite/>.

7. Dodecanese

7.1. Rhodes- City ports (Mandraki, Great Port, and Acadias)

The northernmost port, the "Little Port" (Mikros limen) currently Mandraki, was the military port, which closed with chains and was separated from the rest of the city. To its facilities was forbidden and punished with death penalty the entry of foreigners (Μανούσου-Ντέλλα Κ., 2012:22). Remains (or possible remains) of Hellenistic shipsheds have been identified in several places around Mandraki harbor, also known as the "Small" harbor or the "Military" harbor. Remains at two other sites on the west side of Mandraki have also been reported as possible shipsheds (at the Regina Hotel and Cairo Palace), but their identity remains less than certain. All of these sites are 100-200m from the present waterfront, which indicates that the harbor was originally much larger. It has been suggested that the shipsheds once occupied the entire west and south sides of the harbor, forming a right angle (Rankov B., Blackman D.J. et al. 2014: 509).

The upper parts of four shipsheds on the southeast side of Mandraki Harbor were excavated by an Italian expedition, in the city of Rhodes, in 1940-1942. The buildings were first identified as shipsheds by I.D. Kondis in 1953, and then subsequently mentioned by D. Bradford (in 1956) and by G Konstantinopoulos (in 1966). Blackman and P. Knoblauch (1971 and 1976) were able to identify as belonging to shipsheds some remains on the west side of the military harbor found earlier during rescue excavations by the Ephorate (Rankov, B., Blackman, D.J. et al. 2014:9). The final publication, which is one of the most comprehensive on shipshed sites to date, appeared in 1996. The

major part of these shipsheds, however, remains unexcavated (Loven B. and Schaldemose M., 2011:25-26).

Further south was the "Great Port", the largest and most organized port since ancient times until today, while more southern was the port "Acadias" as it was called in medieval times, which used as mooring place when was overcrowding in the other ports (Figure 99). In ancient times, the coast penetrated further inland than today and the port facilities spread out along it. Thus, the capacity of the ports was much larger than the current one (Μανούσου-Ντέλλα Κ., 2009:70).

The island's key position as gateway to the East, at an Aegean point where the crossing sea routes link Greece with Cyprus and Anatolia, Crete and Egypt, and the western Mediterranean, brought great wealth and turned the city of Rhodes one of the leading cities of the ancient Greek world (Μανούσου-Ντέλλα Κ., 2009).

Ancient Sources

Diodorus Siculus, *Library*, 14.79

Pliny, *the Natural History*, 4.23

Strabo, *Geography*, 3.4

Titus Livius, *the History of Rome*, 44.28

Xenophon, *Hellenica*, 4.8

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Rankov B., Blackman D.J. (Eds), (2014) *Shipsheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

Μανούσου-Ντέλλα Κατερίνα, (2009) Οι θαλάσσιες οχυρώσεις και τα λιμάνια της πόλης της Ρόδου, *Δελτίον της Χριστιανικής Αρχαιολογικής Εταιρείας*, Περίοδος Δ', Τόμος Λ' (2009), Αθήνα, σ. 67-80.

Μανούσου-Ντέλλα Κατερίνα, (2012) Μνημειακή τοπογραφία του βορείου άκρου της πόλης της Ρόδου, *Δελτίον της Χριστιανικής Αρχαιολογικής Εταιρείας*, Περίοδος Δ', Τόμος ΛΓ', Αθήνα 2012 σ. 21-36.

7.2. Kos City, Kos

The area of the agora and Kos port is located on the east side of the island. Kos port was one of the most important ports in the southeastern Aegean. According to the geographer Scylax, the ancient harbor of Kos was a “closed” (kleistos) harbor, possibly developed from the fourth century B.C., although there is no evidence for its size. A shipshed complex has been discovered on the south-west side of Mandraki harbor, which corresponds approximately to the ancient basin. The shipshed remains are located on Akti Koundouriotou, between P. Tsaldari and M. Alexandrou streets. The remains of the shipsheds are within the walled area of the harbor, west of the agora, parts of which date

to the end of the fourth century B.C. and the beginning of the third (Baika K., 2014: 362) (Figure 100).

The natural harbor of Kos was located in an ideal position on the main trade route between the Black Sea, Rhodes, and Egypt. The city must have had a permanent navy because of the detailed organization of the fleet, which is attested by inscriptions. Therefore, the harbor must have served as naval base and “port of call” on many occasions during the 3rd and 2nd centuries BC, when the island was under the domination of outside powers (social war, ally with Ptolemies, first Cretan war, second Macedonian war) (Baika K., 2014:362).

The archaeological site of the agora and the Kos port was excavated by the Italian Archaeological School after the 1933 earthquake that flattened the city (Laurenzi L. initially, Morricone L. later between 1935 and 1942). The excavation occupies the space located within the medieval fortifications (Μποσνάκης Δ. και Σκέρλου Ε., 2012). K. Kantzia (1987 and 1988) exposed parts of a shipshed and possible remains of two other shipsheds but was covered by modern structures and has not been excavated yet. In 2002, E. Brouskari and Blackman were entrusted with the final publication of the shipshed structures (Loven B. and Schaldemose M., 2011:28).

Ancient Sources

Apollodorus, *Epitome*, 5.6

Diodorus Siculus, *Library*, 15.76.2

Pliny, *the Natural History*, 5.29

Skylax, *Periplus*

Titus Livius, *the History of Rome*, 37.11

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens, 15*, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Baika Kalliopi, Kos, in Rankov B., Blackman D.J. (Eds), (2014) *Shipsheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

Μποσνάκης Δ. και Σκέρλου Ε., (2012) Υπουργείο Πολιτισμού και Αθλητισμού (http://odysseus.culture.gr/h/3/gh351.jsp?obj_id=5142).

7.3. Alimnia

Alimnia is a Greek Aegean island, located in the sea area between Rhodes and Halkis, in the Dodecanese. The two large bays of the island, Emporeio and Agios Georgios, on the east and west sides of the island are safe natural harbors. In 1980, A. Sampson surveyed two possible rock-cut slipway sites on the small island of Alimnia (Rankov B., Blackman D.J. et al. 2014:9). At Emporeio, on the eastern side of the island, he documented remains of eleven possible slipways. In the main harbor at Agios Georgios, on the western coast, remains of ten possible slipways were also located. Blackman briefly investigated the two sites in 1991 and verified Sampson's measurements. In 1997, A. Simossi and Blackman conducted limited terrestrial excavations at the site of Emporeio, and surveyed the site underwater. No definite remains of the possible slipways were, however, found in the sea. (Loven B. and Schaldemose M., 2011:27).

References

Loven Bjorn, Schaldemose Mette, (2011) The ancient harbours of the Piraeus, *Monographs of the Danish Institute at Athens, 15*, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Rankov B., Blackman D.J. (Eds), (2014) *Shipsheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

Chapter 2

Ancient harbor geoarchaeology

*Geoarchaeological study of ancient harbors, the
geoarchaeological context of Greek ports, relevant case
studies*

The science of geoarchaeology is now applied in combination with archaeology in order to give answers in serious questions about how landscape and environment changed and eventually shaped the archaeological evidence that we know today (Jardine W.G, 1984). With the help of geoarchaeologists, archaeologists are now able to understand archaeological sites, their environmental context, and particularly site formation processes and how the analysis of sedimentary records can enhance the understanding of human activity in Quaternary environments (Bintliff J., 1992:6). Environmental and landscape changes, such as shifting sea levels, fluctuating rainfall, uplifting land (from tectonic activity), and cooling temperatures, (Walsh K., 2013:57) demanded adjustments and adaptation on the part of individual people. The cycle of people effecting environment and environment restricting humans continues spiraling through time, leaving its traces on the landscape of today.

At the beginning of 1970 laid the foundations of the geoarchaeological research on ancient ports, where pioneering archaeological research carried out, which included the cooperation of many disciplines for the reconstruction of the palaeoenvironment of each survey area. Until now, the application of geoarchaeological studies and marine geophysical techniques have been widely used in underwater archaeological and geoarchaeological surveys focusing on the reconstruction of coastal palaeotopography at submerged sites of archaeological interest mainly by detecting and mapping the preserved palaeoshorelines and by studying the local stratigraphy and Late Quaternary geology (Marriner N., Morhange C., 2007:141). In Table 1, are demonstrated certain researches on ancient Greek ports studied by using geophysical methods and becomes clear that those kinds of studies are not an old field of research for archaeology. However, they are not systematically applied for the study of

harbor works of the historical period but only for individual cases for the big port constructions so far.

Ancient harbor works survived through many centuries of continuous usage carrying with them a long history. They are particularly interesting in geological and geoarchaeological studies as they allow us to understand how people engaged with them and adapted to the each environmental processes. Nowadays, most of the seaports are identified partly underwater, as in the case of the harbors of Mytilene or covered by the modern urban fabric, i.e. Piraeus and Aegina or are located far away from the current shoreline as in Phalasarua or silted up by near river mouths i.e. Oiniadai. All of the above situations are caused by several geological (tectonic movements), environmental (sea level rise, rivers, lakes) and climatic factors that if will be considered they will provide a more clear insight about their past formation.

A brief description of the geological environment of Greece's regions is presented including morphological features, climatic conditions, and seismic activity. Case studies involving underwater and geoarchaeological surveys together with palaeogeographical reconstruction, changes in sea level, shoreline evolution, tectonic uplifting, and subsidence events resulting in the formation and evolution of the ancient harbor works are displayed.

1. The Geoarchaeological study of ancient harbors

Nowadays, it is accepted that harbors should best studied within broader regional frameworks using a multidisciplinary methodology. In terms of geoarchaeology, there are a great variety in physical processes important in influencing harbor location and design as well as their long-term survival; geographical situation, site and local dynamics and navigation conditions imposed by the wind and wave climate (Morhange Ch. et al, 2015:251). The physical changes that occur in coastlines over time can be considerable, making once ideal harbors useless. This is why modern harbors are often poor indicators of suitable harbor locations some 3,000 to 5,000 years ago. Coastal development is the result of the complex interplay of eustatic, glacio-hydro-isostatic and tectonic processes. This combination results in regionally heterogeneous changes. Several other long-range forces may be responsible for changes in the configuration of coastlines. This unity comprises a brief overview of the most crucial natural processes and hazards that from the geoarchaeological perspective have affected these waterfront areas.

1.1. Global sea level

Global (eustatic) sea level has been rising since the subsidence of the continental ice sheets near the end of the Pleistocene geological epoch, ca. 14,000 years ago. Initially, the marine transgression was rapid and substantial (100 meters or more in some locations), but stabilized approximately 5,000 years ago, at the beginning of the Aegean Bronze Age - with a further rise on the order of five meters or less to the present (Marriner N. et al., 2010:22). It is known an eustatic sea level rise of around 0.50 m over the past 2000 years (estimations range from nil to more than 1.50 m). For example, for the Aegean,

it has been observed a eustatic rise of sea level from 2.5-2.8m over the last 2500 BP since the Classical period, and a rise of 1.7-2.2 since 2000 BP. This indicates that besides the glacio–hydro-isostatic effect (glacio-hydro-isostasy refers to the specific case of surface ice and water loads during glacial cycles) (Lambeck K., 2014), also the tectonic contribution can affect the relative sea level changes along the coastlines, since the last ~2.5 ka (Baika K., 2008:34). Worldwide changes in sea level over decades to centuries caused by the addition of water from the melting of glacial ice and/or thermal expansion of sea water due to global warming, which is crucial for the landscape (Walsh K., 2013:52). In Greece, the relative change in sea level is important since ancient times until today. As a result, most ancient ports of the naval forces of classical and Hellenistic era are now precipitated, e.g. the naval facilities in Piraeus, the ports of Thasos, Samos, port facilities in the Cyclades, the Ionian islands, etc. (Blackman D.J., 1982b, Μπάικα Κ., 2011:39).

1.2. Tectonism

Many processes and configurations of the different seas are directly affected by tectonic activity with geodynamic processes defining many coastlines. The effects of tectonism are more localized and more rapid; thus, they may be experienced on human temporal and spatial scales. Greece sits atop a subduction zone in which the African tectonic plate is moving north and sliding beneath the Eurasian plate (Walsh K., 2013:60). The predictable result is an arc of intense faulting, with following volcanism (the Aegean volcanic arc runs through the Cycladic islands and includes the famous island of Thera, much of which was eliminated in a volcanic destruction in the Late Bronze Age) and earthquake activity. This process is also responsible for creating the

mountains that form the backbone of the Greek landmass (Λυριτζής I., 2005:95). On a local scale, tectonic activity may take the form of localized uplift events, causing a change in relative sea level. The effects of these events can lead a coastline to complete submerging or raising a beach high and dry (Λυριτζής I., 2005:191). Another factor of alteration is seismic events inducing tsunamis, which devastated adjacent coastal plains (e.g. the Ionian Sea and the Gulf of Corinth) (Hadler H., 2013:5).

Ancient ports have been lifted because of forceful tectonic activity. The best examples come from the Aegean Sea. A typical example is the port of Phalasarna in western Crete and the roman port Aigeira (Stiros S.C., 1998). The lifting in Phalasarna was caused by the Early Byzantine Exacerbation according to Pirazzoli (1986), a strong tectonic event that shook the eastern Mediterranean sometime between the 4th and 6th B.C. century (Μπάικα Κ., 2011:42).

1.3. Climate

Climate is another significant factor affecting landscape's morphology and ecological productivity of the regional seas. Changes in sea temperature or even salinity would have influenced societies and economies, although such processes are difficult to identify (Walsh K., 2013:33). Greece is part of the Mediterranean Sea where the flow of the air takes place through gaps in the mountain ranges. In the summer, most Mediterranean winds come from the north. In addition, Greece has the benefit of the meltemi wind, which flows from north to northwest across the Aegean Sea. During a strong meltemi event, the trough may extend relatively far to the west and beyond Rhodes and even Crete, forming calm leeward wind in the Aegean islands (Λυριτζής I., 2005:22). From at least 1,000 B.C., the general meteorological situation appears to have

been such that the direction of the predominant wind was only slightly different from that of today, when it is generally north-west. (Mc Grail S., 2004:92). Tide should also be considered as an important parameter. From the Neolithic onwards, it has been observed that ancient tidal effects and currents would have been similar to today's. The Mediterranean is a near-tideless sea with a tidal range of about 28 centimetres. However, there are regions where restrictive channels cause significant tidal effects, like the Strait of Messina, the Strait of Evripou, the head of Adriatic and in the Gulf of Gabes (Mc Grail S., 2004:94).

1.4. Sedimentation

Sedimentation is a very important factor that affects the preservation of ancient harbors (Walsh K., 2014:57). River mouths usually tend to silt up, as rivers carry most of the materials that create coasts, and this explains why some ancient ports are now so far from the sea (e.g. Phalasarna) or just filled up with sand (e.g. the ports installations in Lemnos) (Walsh K., 2013:58). Harbors were therefore usually built at the opposite side of the delta and therefore safe from the river silt (Blackman D. J., 1982b:187). Sedimentation occurs when there is sediment (mud, silt, or sand) in the water column and the water movement is not strong enough to keep sediment moving (Smith E. et al., 2005). Beaches are subject to sedimentation and erosion by wave action, and the latter explains why some ancient ports were lost to the sea (e.g. in Tunisia). Another parameter including the element of water is daily storms of several hundred mm, which are common throughout northern Greece in winter. This characteristic proves the importance that a few daily events have on geomorphological evolution in these landscapes (González-Hidalgo J. C. et al., 2007:197). Finally, sedimentation can be caused by anthropogenic interventions (i.e. construction

of breakwaters, deforestation, cultivation which speed up soil erosion, the use of the basin as pit, etc.), which intensify the erosion rate (Μπάικα Κ., 2011:41).

These are key processes determining how changes in relative sea level, uplift and subsidence, erosion, shoreline evolution and sedimentary inputs can be studied on a given coastline. This is because ancient harbor works consist of both cultural and environmental contexts and their multidisciplinary approach combining archeological, geological and geoarchaeological methods will provide not only insights into the history of human occupation at a given site but also the mobility of its shorelines, in addition to the coastal processes and risks that have influenced these port constructions.

2. Greece

The history of ancient Greece is in many ways the story of how environment and geography shaped the ways that community and individuals interacted with each other. A changing climate could demand the adaptation of any particular region to those changes, either by forging human relations (e.g., trade/ exchange networks) or by provoking revolutions in technology. Another example in human response to environmental change is harbor dredging. Primitive harbor dredging began during the Bronze Age along the Nile, Euphrates, Tigris and Indus rivers. Societies then realized that had a significant role to play in coastal sedimentation, where ports act like artificial sinks accumulating thick sequences of fine-grained sediments over many millennia, being at the same time rich time-series of human-environment interaction since the Bronze Age (Morhange C., Marriner N., 2008:24).

Geography has always had a great influence on Greece and its inhabitants by either imposing restrictions or opening wider horizons. Three elements dominate; the sea, the mountains, and the lowland. Ancient Greeks

became a sea-going people due to the close proximity of the sea; Greece has the largest coastline in Europe (13,676 km). About eighty percent of Greece consists of mountains or hills, thus making Greece one of the most mountainous countries of Europe. About fifty percent of Greek land is covered by forests with rich varied vegetation while the climate consists of mild winters and long, hot and dry summers (Mediterranean climate). The ancient Greeks took advantage of their country's geography in which harmoniously adapted and formed their own identity (Καραλή Λ., 2005:65).

3. Geoarchaeological context of ancient Greek harbors

3.1. Paleogeography of Southern Greece

Peloponnese is the largest peninsula in Greece and constitutes the southernmost of Greek mainland. Was the centre of ancient Greek culture and it has been inhabited since the prehistoric times. The region of Peloponnese is mainly mountainous, covered by the mountain range of Mount Taygetos (Καραλή Λ., 2005:65).

North Peloponnese is an area of impressive Quaternary uplift; marine terraces 450,000 years old reach a height of 820m. The Gulf of Corinth is one of the most seismically active regions in the world, and this is why in early days of plate tectonics it was considered as a plate boundary (Papageorgiou S. et al., 1993:277).

Lechaion, the harbor of ancient Corinth, due to widespread fault systems characterizing the gulf, seismic activity is frequent and often associated to landslides or submarine mass movements. Thus, it is reported that the final abandonment of Roman Lechaion is connected to the destruction of ancient Corinth by a series of severe earthquakes in 521 or 551 A.D. (Crouch D. P.,

1996:237). The well-preserved Holocene shorelines above the present day sea level permit the estimation of an uplift rate of approximately 3 mm/year. Due to this elevation, rivers along the coast have been affected by gradual decrease of their hydraulic gradient. Road network development, sand extraction from riverbeds, sand-dunes destruction and extensive construction of dams and seawalls along the southeastern coast of the Gulf, have produced a deltaic environment that does not contribute adequate inland deposits to the coastal zone (Repousis E. G. et al, 2015).

A combined archaeological and geomorphological study together with the related palaeogeographical reconstruction was applied in the harbor of Lechaion by N.D. Mourtzas et al (2014), using mechanical methods. The results showed that the sea level during the Roman operation of the harbor was 0.90m lower than the present. During two successive tectonic subsidence co-seismic events, the sea level rose by 2.0m in total, 1.60m during the first event (in 362-375 A.D.) and 0.40m during the second (in 522-580 A.D.). A strong uplift tectonic event followed (in 1402, 1742-1756 and 1817-1858) and the sea level dropped by 1.10m. This regression of the sea was responsible for the present shoreline morphology (Figure 101) (Mourtzas N.D. et al., 2014:168).

3.2. Paleogeography of Central Greece

Central Greece covers about eighty-three percent of the country's total territory and is largely mountainous. Despite its rocky environment, ancient Greeks settled in coastal regions and constructed their naval bases either for commercial or military purposes (Καραλή Λ, 2005:65).

One significant ancient port town in central Greece and one of the most important towns of ancient Acarnania is ancient Oiniadai, located on the west bank of the river Acheloos. The ancient seaport of Oiniadai underwent during

historical times huge coastal change. The site once belonged to the Echinades Islands, most of which have been swallowed by sediments of the Acheloos river during the last 6,000 or so years. The present distance from the open sea is about 9 to 11 km. Andreas Vött et al. (2004) carried out a geoarchaeological study about Holocene landscape evolution around the ancient seaport of Oiniadai by applying sedimentological study in sedimentary units extracted from the Acheloos delta. The research team concluded with the following scenario for the different evolutionary steps in the development of the southwestern delta and alluvial plain. In the 5th millennium B.C. early delta progradation (seaward growth) and lateral drifting of sediments led to the formation of a large and long-lasting lagoonal complex north and east of the former island of Trikardo where ancient Oiniadai is situated. The delta in front of the Acheloos passed south of Trikardo and moved further south reaching the Ionian Sea. During the first millennium B.C., Trikardo's southern side remained under marine conditions whereas the northern lagoonal system was gradually reduced in size due to silting. From the 5th century BC until around 1 B.C., the lagoon of Oiniadai narrowed and stabilized at the northern side of the hill. Oiniadai's shipsheds were connected to the sea via this lagoonal system. The northern lagoon finally silted up by the 2nd century A.D. Further delta progradation in southwestern direction took place at least between the 8th and the 17th centuries (Vött A. et al., 2004:52).

The gulf of Sounion, southern Attica, Greece is of great archaeological importance since Cape Sounion served as a navigational post and a naval base protecting the networks towards of Athens and the silver mines of Lavreon during the Classical and Hellenistic periods. Parts of the coastal ancient installations are now preserved underwater. Marine geophysical survey was conducted by George Papatheodorou et al. (2014) in order to examine the sea

level change during the historic period. Underwater remote sensing survey using a subbottom profiler and a side scan sonar system were applied. Based on the preliminary results, the research team suggests that a relative sea level rise of at least 2.5-3.0m was experienced for the last 2500 years (Figure 102) (Papatheodorou G. et al., 2014:365-366).

3.3. Paleogeography of Crete

In Crete, apart from eustatic sea level change and tectonic movements it should be appreciated the horizontal displacement generating by natural or artificial mechanisms of silting and erosion. This phenomenon is particularly important for Crete, where typically coastal settlements are found in small or large plains, which form the mouths that run the intense mountainous terrain. The mouths of the rivers have many times been selected as sites for the establishment of port facilities. In these places is observed the largest river sediment deposition. Very often, the opposite process of deposition of the wave load at the mouth works by creating swamp and inland lagoons (Kraft J.C. et al., 1985).

The region of Crete (Greek Arc), meeting place of the African tectonic plate and Eurasia, is perhaps the most seismic zone of Europe, thus recorded on the island vertical differentiation from the Greco-Roman antiquity, which is around 9m lifting on the west and 2m submerge on the east (Flemming N.C., 1978). However, as the island is not a single plate, there is no consequence of submerge with lifting, so as rises on one side so to descend to the other (Flemming N.C., 1978: 421-422, Blackman D.J., 1973).

N.C. Flemming (1978:429) surveyed the eustatic sea level and earth movements in the western Mediterranean from 1960 to 1965 and the study

extended to the eastern in 1967. The applied field methods were direct observations, field mapping techniques, vertical measurements, and marine solution notches (Flemming N.C., 1978: 417-418). According to the results, in Rethymnon is recorded submersion of around 0.2m while the same confirmation makes K. Baika, studying the remains of the shipsheds to the west of the hill of the Fortezza of Rethymnon, by calculating the change in sea level in $\pm 0.1\text{m}$.

The identification and publication of shipsheds a little further east in the Bay of Sitea by K. Davaras, leads to a similar conclusion. The observed submersion does not exceed the 0.5m. (Davaras K., 1974: 89)

The bay of Matala, where the possibility of simultaneous elevation and subsidence takes place, controls accordingly the lifting limit on the west Crete (Flemming N.C., 1978: 422).

Best researched is the port of Phalasarna. All port facilities are currently embanked ashore in a distance of 100m about from the modern beach (Pirazzoli P.A. et al., 1992: 372). The site has been lifted by 6.6m probably because of the strong earthquake of 365 A.D., having already embanked by tsunami in the 1st century A.D. Although the port was mentioned during the Roman period, environmental and geoarchaeological study agrees that, the port was no longer in operation at this time (Pirazzoli P.A. et al., 1992: 390).

The ancient environment of the harbor reconstituted after interdisciplinary research based on archaeological, geomorphological, stratigraphic, and radiometric data (Pirazzoli P.A. et al., 1992). For example, geomorphological study calculated the sea level at different times through biological and radiocarbon indicators and showed that the harbor depth during the Hellenistic period is estimated in $1.1 + -0.1\text{m}$, while at 67 B.C. the depth was between 0.80-1.25m. The earthquakes that shook the region reflected

characteristically in the stratigraphy of the port (Pirazzoli P.A. et al., 1992: 386-387). The stratigraphic study that was conducted in the main port confirmed the existence of palaiotsunami phenomena, which followed the seismic movement in Crete in 66 A.D. Instead, the tsunami that followed the earthquake on July 21 365 and shook the central Mediterranean left few geomorphological residues at the port of Phalasarna (Pirazzoli P.A. et al., 1992: 375-382). The earthquake had probably epicenter the SW side of Crete and the tsunami that created greatly affected the Mediterranean at a wide range, reaching from the eastern coast of Sicily, to the Ionian islands, the Adriatic, the southern Peloponnese, the west coast of Crete and Alexandria in the Nile delta. According to Pirazzoli (1992:389-390), the fact that little remains of this tsunami have been found in Phalasarna can perhaps be explained only if the port was raised 6.6m a few minutes before hits the tidal wave, so probably this earthquake may be responsible for the lifting of the site (Μπάικα Κ., 2011:42). The archaeological excavations concluded the absence of any evidence of occupation of the harbor of Phalasarna during Roman Imperial times, in contradiction with several ancient texts. In addition, the stratigraphical and geomorphological data confirmed that the harbor was not in use during Roman times. This contradiction may be explained by either the existence of another Phalasarna closed harbor basin, the location of which has not yet been discovered, or, more likely, if the topographical situation of Phalasarna is considered, by the fact that some ancient writings may have been based on a corpus of earlier antiquated sources of information (Pirazzoli P.A. et al., 1992: 390).

3.4. Paleogeography of the Aegean

The current geomorphological condition of the Aegean is the result of three main features; tectonism, volcanic activity, and eustatism (i.e. the rise and fall of the sea level). Morphologically speaking, the Aegean constitutes a relatively shallow sea with many small and big bays, capes, and natural ports. The geographers and geologists have divided the Aegean Sea in North, Central, and South Aegean according to the morphology of the coasts, the position of the islands and the formation of the seabed (Trichas A., 2004:379).

Cyclades is a group of islands spreading from central to the southeastern Aegean, which essentially are peaks of submerged mountains (Σημιαϊάκης Σ., 2005:33). The Cycladic islands are mainly mountainous and semi-mountainous with a smaller percentage of lowland areas, while their extent varies considerably from Delos (one of the smaller islands) up to Naxos one of the largest (Σημιαϊάκης Σ., 2005:34). The Cycladic complex is characterized by great diversity of the landscape with several contrasts (steep and smoother areas) while, the coasts are usually steep and high (Σημιαϊάκης Σ., 2005:35).

Dodecanese, in southern east Aegean, is an insular complex consisting of 18 big islands, many smaller ones and numerous rocky islets. The terrain of the islands is infertile and rocky while many of the Dodecanese islands are volcanic (Σημιαϊάκης Σ., 2005:35). In northern Dodecanese, there was volcanic activity during the era of intense geological changes (i. e. the crater at Nisyros) (Σημιαϊάκης Σ., 2005:36).

The North Aegean islands are a number of scattered islands in the north Aegean Sea, also known as the Northeast Aegean islands due to close proximity to the coast of Asia Minor.

In the archaeologically rich Aegean region, sea levels rose more than 40m during the Neolithic and Bronze Age periods (10-3.2 ka BP), dramatically transforming the configuration of the coastlines (Lambeck K., 1996). Although the changes in shoreline positions during that period were less widespread, they would definitely have been an important environmental determinant in the harbor locations (Tartaron T.F. et al., 2006:455).

A palaeogeographical reconstruction of the seafront of the ancient city of Delos was conducted by N. D. Mourtzas (2012) in underwater survey in combination with analysis of archaeological, sedimentary, and geomorphological evidence recorded from depth. The results showed that after the end of the Hellenistic period, the coasts of Delos submerged initially by 1.35m, and then, further 0.80m, together with an older phase of 3.60m lower than today. This change in sea level dramatically affected the island's shores placing them a lot of meters above the sea (i.e. the sandy coast of Skardana by 29m) (Figure 103) (Mourtzas N. D., 2012:17).

Valuation and Comments

The comprehensive overview of the ancient Greek harbor works during historical times and the recent archaeological research across the Greek shores supplemented with the geoarchaeological context of the Greek territory has led to the following valuation of their identification and systematic study.

Despite its small surface area, Greece is gifted with a particularly rich and diversified natural environment, with unique geomorphology and intense contrasts that over the years shaped and transformed the environment among coastal harbor installations in Greek maritime regions. An understanding of maritime activity through the study of ancient harbor works is crucial to our comprehension of the Greek world. Ancient harbor contexts have emerged as particularly novel and original archives, shedding light on how humans have interacted and modified coastal zones since the Neolithic. It is clear that an appreciation of the harbor's location, configuration, operation, and construction provides an insight into the maritime elements of Greek society. Our sources for these works are becoming increasingly well documented, especially the archaeological evidence with the application of geophysics and the underwater and marine surveys. Taken as a whole, they offer a relatively clear view of Greek practices and an assessment of the general performance that these establishments were capable of as well as the marine technology and the rules of trade that these societies were aware of during the periods of their use.

The relation between the evolution of coastal palaeo environments and the dynamics of the societies is worth mentioned. This means that the duration of the harbor works indicates the difficulties involved in mastering a coast in

order to keep the port active by the societies, who gradually improved their technical knowledge in harbor dredging and artificial port constructions. This is more intense in the Roman period. Roman engineers improved upon older ideas and inventions to introduce a great number of innovations i.e. hydraulic concrete, building machines and improved harbor dredging works.

Cooperation between Archaeology and Geography is still uncommon, but recent research points out the steadily increasing interest in this topic. Geoarchaeology contributes substantially to the broad goals of archaeological research. Consequently, it is crucial that the close interaction between the geosciences and archaeology should continue to grow and that geoarchaeology should become an organized sub discipline within archaeology with its specialists fully integrated into archaeological research. Geoarchaeology is used to describe the application of geosciences to solve research problems in archaeology. The nature of archaeology has created the necessity for close collaboration between geologists and archaeologists in order to interpret the evidence. The skills of geomorphologists and sedimentologists have been essential to understanding the archaeological record. In other words, geosciences and archaeology have come to mutually support each other when the object of study is one.

Ancient coastal sites, harbors and coastal settlements can not be studied integrated but only with systematic interdisciplinary research, with aid from geology, physical oceanography, biology, archaeoseismology, etc., which mainly help in the study of the relative change in sea level, the reconstruction of the evolutionary dynamics of palaeocoasts and the reconstitution of palaiotopography of the ancient ports. Despite the fact that the importance of research of the ancient ports was not recognized but relatively recently, as underwater archeology is usually considered through the investigation of

shipwrecks. However, while the wrecks are excellent source of information, is nothing but static events in time and limited in space. In contrast, the ancient port basins can be seen as large tanks of information, where multi-scientific elements gathered over the centuries and reflect events and developments of the natural environment and of anthropogenic interventions.

Within this context, a multidisciplinary geoarchaeological approach can yield rapid results and aid planners in identifying and protecting the most important archaeological zones for future preservation, as the geology and geomorphology-based techniques are usually necessary to Cultural Resource Management investigations and are considered as an integral part (help the development of cultural resource management and evaluation strategies).

Gazetteer of Sites

Agina

The island of Aegina was inhabited since the Neolithic times. The prehistoric settlement of the island is located on its northwest part, at the coastal hill known as Kolona, north of the modern town of Aegina. After the 7th century B.C., the ancient town expanded east of Kolona hill. The first period of prosperity took place in the Bronze Age. As the settlement of that time is build next to the coast, it is possible that the bay north of Kolona would be used as an anchorage. In the Late Archaic and the Early Classical periods, Aegina accumulates great wealth from maritime activities that include relations to Italy, the Black Sea, and Egypt. At the beginning of the 5th century B.C., the town was being fortified and at the same time, the harbor installation was expanded (Triantafillidis I. and Tselentis V., 2013:202).

Andros

The city of Andros was built upon the steep slopes of a small plain in the neighboring bay, where remains of ancient harbor works are still visible. The area has been inhabited since the Prehistoric times and the island of Andros was able to establish four colonies in Halkidiki, during the 7th century B.C. (Stageira, Akanthos, Argilos, and Sani). In the classical period, the city was a

member of the Athenian League, however during the Peloponnesian war allied with Sparta only to return under Athenian influence short after. In the Hellenistic period, it was under Pergamos rule (Ραουζαίου Π., 2003:40). The city flourished during the Roman and early Byzantine periods and finally abandoned as many other settlements in the Aegean islands, around the 7th century A.D., due to the Arabian Raids (Κοντολέων Ν., 1964:3).

Delos

Delos was both an influential political force and an important religious centre in the Archaic and Classical periods. The island was also a major commercial and merchant centre in the 2nd and 1st centuries. It was first inhabited in the early Bronze Age, testified by the excavation of Mycenaean tombs dating from the late Bronze Age. Athens, under Pisistratus, took a greater interest in the island in the 6th century B.C. and attempted to purify the island by a 'catharsis' - removing and prohibiting burials on the island from 540 B.C. In 478 B.C. was chosen as the meeting place and treasury for the Delian League. Following the Chremonidean War (266-229 B.C.), Delos became an independent polis for the next 150 years and administered by a religious council of hieropoioi. The island's independence ended in 166 B.C. when the Romans gave control of Delos back to Athens (Cartwright M., 2013).

Kea - Otzias bay

The cove Otzias is situated on the northern coast of Kea and probably belonged to the territory of Ioulida, one of the four cities of Kea that flourished in ancient times (Ioulis, Korissia, Poiessa, Karthaia) (Whitelaw T.M., 1998).

Kea- Poiessa

The ancient city of Poiessa lays on the west coast of the island of Kea and lasted from the sixth century B.C. to the early Byzantine period. Poiessa's territory was extended in the valley between two hills, Tourkos and Phyra, north and south of the bay. The ancient acropolis was located on the southern hill of Pyrha (Panagia Sotira). The city must have spread around the acropolis and to the north, onto the hill of Tourkos (Baika K., 2014:489).

Kos

The town of Kos was inhabited continuously from the Early Helladic era (2300 B.C.) until today. In the Bronze Age, the settlement developed on the hill of Seragion (downtown). Findings of Geometric and Archaic period indicate the continuation of the occupation, although the capital was transferred to another - south- end of the island (Kos Astypalea). The first reference to the island is by Homer (Iliad 14.255 / 15.28 and 2676). Other ancient authors mention that the Dorians inhabitants must be descended from Epidaurus (Herodotus 7,99,2 and follows / Pausanias 3, 23, 6). The island belonged to the Dorian Pentapolis according to Herodotus (1.144). In the late 6th or early 5th century B.C., the Scythian tyrant with his son Cadmus dominated the island.

Later, however, the island was incorporated in the Delian League (Μποσνάκης Δ. και Σκέρλου Ε., 2012).

Kyllene

In the classical period, Kyllene was the principal outpost of ancient Elis and gathered a large number of participants and spectators of the Olympian Games. Thucydides (2.86.1, 3.69.1–2) mentions that during the Peloponnesian War (431–404 B.C.) Kyllene constituted the main naval station of Sparta against the Athenian military forces in western Peloponnese. In the Hellenistic period, the port remained a key strategic position for the war fleets of the Ptolemies and the Macedonians. The medieval fortifications and harbor installations are in many places constructed of re-used ancient blocks while Hellenistic and Roman pottery as well as coins have been documented in the medieval stratigraphy. At the end of the Fourth Crusade, after the decline of Constantinople, western Peloponnese (Morea) was conquered in 1205 A.D. by the Franks who held it for more than two centuries as the Principality of Achaia. The Villehardouins developed the coastal city of Kyllene, which was then known as Glarenza, as a significant strategic location. The city-harbor soon developed to one of the most notorious international centers of medieval Europe. Between 1407 and 1428 changed hands 5 times and in 1431, the Byzantine Konstantinos Palaiologos destroyed its walls to prevent a new conquest of the city and the harbor (J. Pakkanen et al., 2008-2009).

Kythnos - Madraki bay

Kythnos lies between Kea and Serifos in western Cyclades and was inhabited from the Mesolithic period, as evidenced by the settlement in Maroulas in the northeast of the island. Herodotus (VIII, 46) says that Kythnos participated in the Persian Wars with one trireme and one penteconter. With the settlement of Kythnos are related the remains of a double temple, whose sanctuary and depositor was found looted; the hundreds of finds date mainly from the 7th to the 5th century B.C. (Theodoulou Th., 2016).

Lechaeon

Lechaeon was the western harbor of Corinth. During the Classical times, the area of the Lechaeon harbor and the city of Corinth were connected with long walls, which are recorded in written sources and they have been partly excavated. The first harbor works in Lechaion are attributed to the tyrant of Corinth Periandros. The relics of the harbor, the written testimony and the pottery scattered around the area testify formations dating possibly from the Hellenistic period and definitely from the Roman times (Πάλλας I. Δ., 1965:140). During the middle of the 6th A.D. the basilica of Martyr Leonidis, which had been built near the western basin, was destroyed by an earthquake. This earthquake led to the decline of the suburb that existed around the port; although that does not necessary confirm the complete final abandonment of the harbor infrastructures (Πάλλας I. Δ., 1965:144).

Lemnos

The direct connection of Lemnos with the processing of metals, but the lacks in its subsoil, attested archaeologically and reflected in the myth

(Kabeiroi, Hephaestus), indicate the early occupation of Lemnos' people with navigation for the supply of raw materials. According to the myth, the son of Limnias Ipsipilis and Jason, that was called Evnios (εὐνώης) provided minerals from the opposite coast of Asia Minor (Iliad, H, 467-475), (Maragou C., 1995:310).

Lesvos- Mytilene

The island of Lesvos has been inhabited from the Early Bronze Age evidenced by the remains of settlements, as the Chalakies in the Gulf of Kalloni. The establishment of Mytilene is attributed to the 11th century B.C. and continues to be inhabited since then. During the Archaic period showed an intense colonizing activity, founding colonies in the region from Adramyttino Bay (Pitane, Elea, Aigai, Gryneion etc.) up to the entrance of the Hellespont (Sistus, Madytos) and North Sea (Enos). The part of the Asia Minor coast, across the town's east coast had been for a long time part of its territory, known as "Mytilene seashore" (Strabo XIII.1.49). The special relationship with the sea shows, beyond the colonies, the overseas relations with Egypt, Cyprus etc. The small island on which was the city of Mytilene was separated from the main body of Lesvos with "Euripus" until the end of the 5th century B.C. (Diodorus Sicily). "Euripus" was a width of 30m and 280m approximately in length, which united the two bays that were formed north and south. In these two bays were constructed the north and south ports of the city. The Euripus existed until the Middle Ages (15th century), so was embanked. Remains from bridges and breakwater edge (northwest) have been found in recent excavations of the Inspectorate of the Ministry of Culture (Θεοδούλου Θ., 2010: 096).

Lesvos- Antissa

The ancient Antissa is located 16 km southwest of Mithymna and is built on a peninsula, like the other cities of Lesvos. Its territory occupies including Eresos the northwestern part of the island. During its history, Antissa had friendly relations with Eresos unlike Mithymna (Θεοδούλου Θ. και Κουρτζέλλης Γ., 2011:139). The area has been inhabited since prehistoric times. The foundation of the city, according to the up to now known excavation data, goes back to the Proto Geometric era and its destruction was carried out by the Romans in 167 B.C. On the ruins of the ancient city was founded the "Castle of Agioi Theodoroi." in the Byzantine era. The current castle (Ovriokastro) is constructed by the Gatelouzi leaders of Lesvos (Παρασκευαΐδης Π, 2008). The ancient city occupied the area of the current medieval in the northern half of the peninsula. Inside the city have been identified housing remains and wall relics.

Lesvos- Eresos

The territory of Eresos is located at the southeast of Antissa and is defined in the north by Sigri and in the south by Apothika. One of the city merits that are mentioned is the fertile plain for growing grain; Arcestratus states as primary agricultural production of the city the barley (Athenaeus 3.77). Drawback of the city was the long beach, which made it vulnerable to sea attacks and essentially unprotected by the southern winds. However, the problem of safe grounding of ships actually never solved and long-term, in the post-Byzantine period, led to the abandonment of the position, the transfer of the village in the Midlands and the creation of Sigri by the Ottomans. In the Archaic period, the city was mentioned by Sappho, which came from Eresos,

but lived in the city of Mytilene, demonstrating the friendly relationship, and possibly the common origin of the aristocratic families of the two cities (Θεοδούλου Θ., 2010:099).

Lesvos- Kalo Limani

Two km approximately afar from ancient Antissa, was located, identified, and studied, the region of Kalo Limani or Tsamour Port, an additional port construction, which is unknown to the ancient sources (Θεοδούλου Θ., 2008:230). The Turkish name "Tsamour Port" means mudport, indicating that the basin had embanked and become shallower since the Turkish occupation. The name "Kalo Limani" was used after the liberation of Lesvos from the Ottomans and obviously was used euphemistically (Παρασκευαΐδης Π, 2008:209).

Lesvos- Pyrrha

The territory of Pyrrha occupied most of the Gulf of Kalloni (eastern and northern side) and bordered to the north with the territory of Mithymna and to the east with the territory of Mytilene (Θεοδούλου Θ., 2008:230). The city was founded along with the other cities of Lesvos in the late second millennium B.C., on a hill and later was fortified according to the "emplekton technique". The political and administrative history ended suddenly in the Hellenistic period and the territory was incorporated into that of Mytilene. Strabo, in the 1st century A.D., refers to the destruction of the city (Lat. 13.2.4) and Pliny the Elder (Hist. Nat. 5.39.139) says that Pyrrha was sank. (Θεοδούλου Θ., 2010:099). The reference of Pliny created many problems, as it is unlikely to be

sank a city that was built on a hill. Scholars believe that Pliny confused the sources for Pyrrha and likely consider the destruction of the city by an earthquake in 231 B.C. (Παρασκευαΐδης Π, 1963). Probably the sea level rose, the silting of the port facilities and the shift of the coastline mainly to the north hill, contributed to the preservation of the myth of the sunken city.

Oiniadai

Ancient Oiniadai lies in the western part of Acarnania at the strategically important entrance to the Corinthian Gulf. It was built on the north bank of the River Acheloos on a rocky hill, the Trikardo, which is overgrown with oaks. It was located at a strategic point and was well fortified. Oiniadai was one of the most important cities of Acarnania and was founded by the Corinthians in the 7th century B.C. (Loven B. and Schaldemose M., 2011:25). After the Peloponnesian war joined the Athenian alliance. Later, the city was conquered by the Macedonians and after the foundation of Nikopolis declined. According to Strabo its first name was Erysichi. Its current name in a version derives from the production of wine. However, some researchers argue that derives from the Aetolian king Eneas, who fought against Acarnanians.

Phalasarna

Pottery from the surrounding area proves that the city was already inhabited in the Middle Minoan period, while its development is depicted by the Archaic and Classical tombs discovered in the nearby area. The city was at its peak between the middle of the 4th century B.C. and the middle of the 1st century B.C. During this period, a walled harbor was constructed, coins were

issued, and naval trade and warfare was developed. The Romans destroyed the city in 67 B.C., most probably because of its turning to piracy (Pirazzoli H.A. et al. 1992:372). Total annihilation occurred during the 4th century A.D., probably in 365 A.D., when the whole area rose by about 6.6m due to a severe earthquake. The city and the port were buried irreversibly by tectonic action (Θεοδούλου Θ., 2015:37).

Piraeus- Kantharos- Munychia- Zea

Fishermen and farmers inhabited the Piraeus peninsula until the dawn of the 5th century B.C. In the meantime, Phaliro gulf was used as Athens harbor. The ports were constructed and walled after Themistokles urge, when he was elected as the "archon eponymous" in 493-492 B.C. Until the middle of the 5th century B.C., the entire Piraeus peninsula was fortified and connected to Athens with the so-called long walls. At the same time, the city of Piraeus kept growing. The importance of Piraeus ports is directly related to the development of the Athenian state, so Kantharos became the prominent trading port of the Mediterranean during the 5th century B.C. The crucial character of Kantharos for Athens is depicted by the integrated program for urban development (hypodamian system), the fortification works for which Athens spent tremendous wealth (Isocrates mentions 1000 ingots for shipsheds building) and the governors and economical officers appointed to the port to sustain its function. The ports of Piraeus among with Kantharos are included paid host to the Athenian war fleet, which allowed the development of the Athenian democracy and hegemony. Simultaneously, trade fleets accompanied by war vessels ensured a constant supply of imports like grain and raw materials and the export of the Athenian products like pottery, oil, honey, etc.

The history of the area of Munychia follows that of the Piraeus peninsula after the 5th century B.C. Munychia was fortified and transformed to a naval base. However, the protective walls were destroyed at the end of the 5th century B.C. and the harbor was re-included in the Konon's program of fortifications thus acquiring the character of an enclosed basin (Πανάγος Χ.Θ, 1968:245, Παπαχατζής Ν., 1974:98, 121). In this port were docked the ancient "sacred vessels" such as the Paralos, Salamis etc during the celebrations of Munychia. Also from this port were leaving the regarded enemies of the Athenian state and the political exiles including the orator Aeschines. Inscriptions and the written sources evident the existence of sanctuaries dedicated to Zeus Milichios, Zeus- Philios, Aesculapius, the goddess "Soteira ellimena" (Savior in the port) and the goddess Bendis from Thrace. Most known and confirmed by excavations is the temple of Artemis Munychia that is located in the hill where the Nautical Club stands today (Παπαχατζής Ν., 1974:103).

The third port of Piraeus was called by the ancient Athenians 'Zea', as identified by an inscription found in the cove of the port before the current Kanari square, and on which was the policy of "in Zea sideboard Atticus Naval Base." («εν Ζέα Σκευοθήκης του Αττικού Ναυστάθμου»). The port took its name from the little cereal. In particular, Hesychius delivers the following etymology: "Zea, Hecate despite Athinaiois and areas of ports in Piraeus so called from the fruit of zeias and has the Piraeus port three closed '. Herodotus (B 36) states that the Egyptians regarded the zeia as cereal superior to wheat and barley (Παπαχατζής Ν., 1974:107).

Portocheli

According to Herodotus, the city of Alieis was founded after the 479 B.C. by Tiryns refugees when the city was occupied by Argos. The city remains are located on the southwest side of the bay of Porto Cheli. The archaeological evidence shows that the city flourished in the 5th and 4th centuries B.C., while small installation continued to exist until the early Christian years (Jameson M. H., 1969:313).

Salamis Ambelaki

The existence of the harbor in Salamis is witnessed from the middle of 4th century B.C. by Skylax who laconically notes, "Salamis is an island, a city and a port" (Periplus, 57). In this small bay, the Athenian fleet was gathered before the famous naval battle in 480 B.C. (Lolos Y., 1995:292).

Samos-Pythagoreion

Remnants of the city of Pythagoreion testify its life from the Archaic to the Early Christian years. The island was inhabited in the 4th millennium B.C. and it was colonized by the Ionians in the early 1st millennium B.C. (Simossi A., 1988:281). During the years of the tyrant Polycrates, the large engineering projects were constructed, such as the "Tunnel of Efpalinos", the temple of Hera, the fortifications and the "soil in the sea", a remarkable breakwater, the first artificial port construction mentioned in the ancient sources (Hdt. III.60). In the 4th century B.C., the island became an Athenian colony, while in the Hellenistic period came under the Pergamon territory. In the Roman times belonged to the province of Asia, while archaeological remains testify its flourishing in the first Byzantine period. Polycrates organized such navy that

allowed him to control the Aegean and the opposite coast of Asia Minor (Simossi A., 1988:281). He also established contacts with Anatolia and Eastern Mediterranean (Cilicia, Syria, Cyprus, and Egypt). Maritime development of the Samian shows, the design of a special naval vessel, the "Samaina", as well as the fact that the Samian navigator Kollaios reported that arrived first at Tartessus (SW Spain) outside the Columns of Hercules (Gibraltar).

Sounion

The archaeological research depicts the existence of organized worship of Poseidon and Athena during the 7th century B.C. in Sounion, while certain evidence exists for installations in the area from the Prehistoric period. At the begging of the 5th century the construction of a temple dedicated to Poseidon began, which had been later destroyed by the Persians. After the victory of the Greeks, the temple of Poseidon was built as well as an equivalent of Athena. During the Peloponnesian war, the cape of Sounion was fortified in order to operate as an Attica fortress. Both sanctuaries declined and eventually abandoned in the first century A.D. (Παπαχατζής N., 1974:80).

Rhodes

In 408 B.C. with the settlement of the three cities of Lindos, Ialyssos and Kamiros was created in the northern part of the island, the city of Rhodes. After the campaign of Alexander the Great and the foundation of Alexandria in 331 B.C., the city - state of Rhodes, owing to its geographic location and the navy, became one of the most important commercial centers of the Mediterranean. The decisive factor for the selection of Rhode's City location was the existence of bays in the northeastern end of the island. On the east side,

opened three natural bays, which were transformed into fortified ports by the residents. Ancient Rhodes had a total number of seven ports; their position was such that they can be treated all weather conditions protecting the fleet and at the same time served as transport and trade roads from all directions (Μανούσου-Ντέλλα Κ., 2012:22).

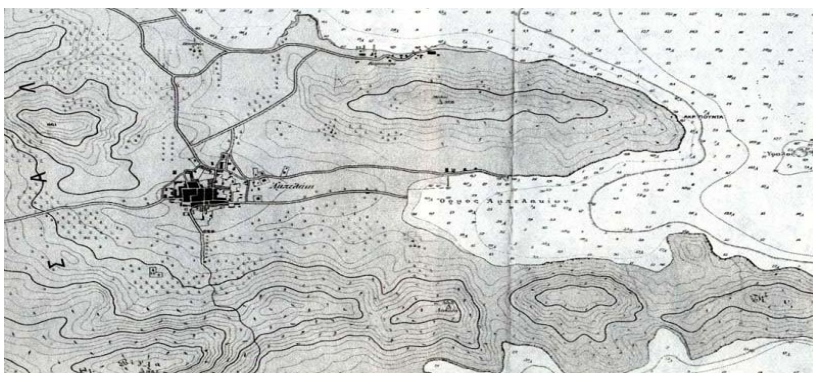
Thasos

Settlers from Paros inhabited Thasos around 680 B.C. Thasos was an important member of the Athenian alliance and functioned as an advanced naval base of Athens. Thasian coins have been found in Egypt and Syria, while the characteristic Thasian amphora has been located in the Mediterranean and the Black Sea. The city was at its peak until the Roman period, when a decline began, but it flourished again during the Early Byzantine period (Theodoulou Th., 2016).

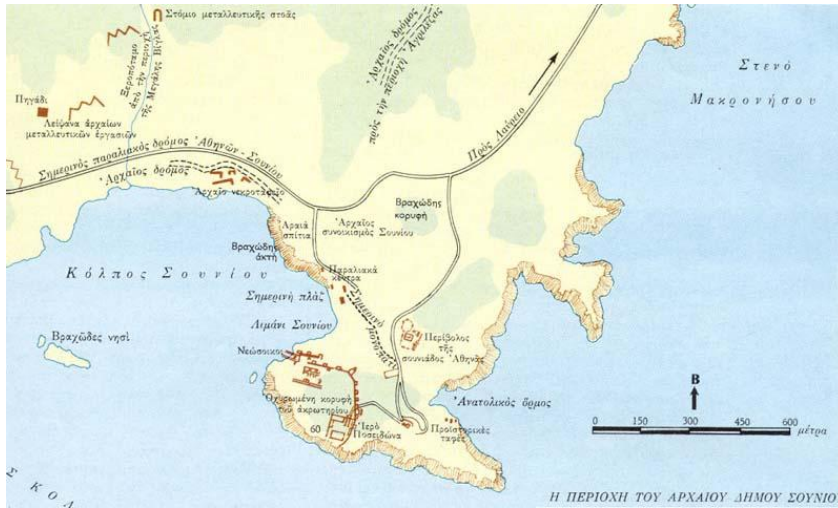
Appendix of Maps



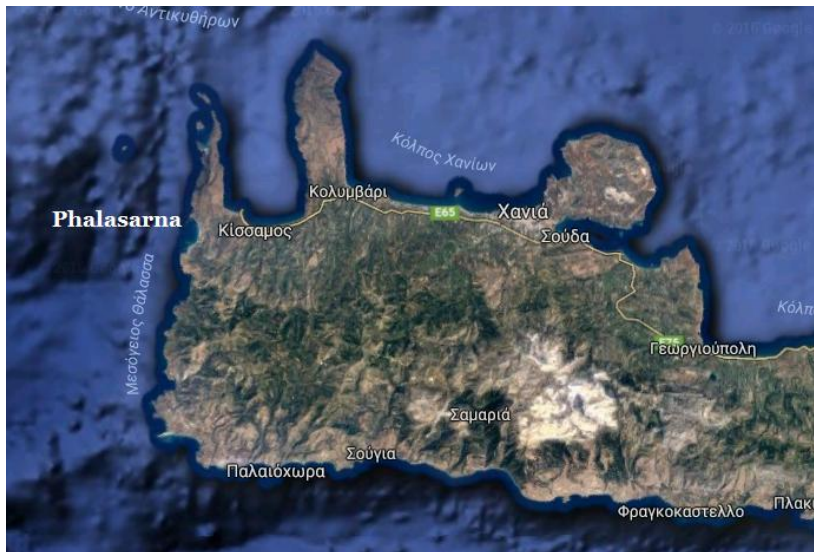
Map 4. Map of the harbor area of Lechaeon with the visible remains (Θεοδούλου Θ., 2002:85, Fig. 11).



Map 5. Map of Ambelaki bay of the Classical / Hellenistic harbor (Lolos Y., 1995:301, fig. 4).



Map 6. Map of Cape Sounion with the ancient remains (Παπαχατζής Ν., 1974:79, Fig. 11).



Map 7. Map of west Crete showing Phalasarna. Source: Google Earth.

Appendix of Tables

Area	Researcher/es	Surveys
East and south east coast of Peloponnese	Flemming N. C., 1968	Holocene Earth Movements and Eustatic Sea Level Change in the Peloponnese
Major archaeological sites around the Aegean Sea	John C. Kraft, Stanley E. Aschenbrenner, George Rapp, Jr., 1977	Paleogeographic Reconstructions of Coastal Aegean Archaeological Sites
Western Crete, Falasarna	Papamarinopoulos S. - Stamou T., 1988	Geophysical studies on West Crete and a detection of a harbor inland at Falasarna
Coasts and coastal areas in Lesbos	Katsikatsos G., Mataragas D, Migiros G., Triantafyllis M., 1993	Geological study on the island Lesbos
Ancient harbours of Zea and Munychia	Danish Institute at Athens and directed by Dr. Bjørn Lovén and supervised by the Ephorate of Underwater Antiquities and the 26th Ephorate of Prehistoric and Classical Antiquities, 2002	Zea Harbor Project
Akarnania, NW Greece, ancient Oiniadai	Vött, Andreas, 2007	Silting up Oiniadai's harbors (Acheloos River delta, NW Greece). Geoarchaeological implications of late Holocene landscape changes

Ancient Kyllene harbor and the Crusader's port of Kyllene/Glarentza in NW Peloponnese	Jari Pakkanen, Kalliopi Baika, Dionysios Evangelistis, George Papatheodorou and Maria Geraga, 2007-2009	Kyllene Harbor Project
Lechaion, Gulf of Corinth	Morhange, C., P. A. Pirazzoli, N. Evelpidou, N. Marriner, 2012	Late Holocene tectonic uplift and the silting up of Lechaion, the western harbor of ancient Corinth, Greece
Seafront of the ancient city of Delos	N.D. Mourtzas, 2012	A palaeogeographic reconstruction of the seafront of the ancient city of Delos in relation to Upper Holocene sea level changes in the central Cyclades
Aegina , Saronic Gulf, ancient harbor installations	Mourtzas, N.D. and Kolaiti, E., 2013	Historical coastal evolution of the ancient harbor of Aegina in relation to the Upper Holocene relative sea level changes in the Saronic Gulf, Greece
Gulf of Sounion, Southern Attica, Greece	George Papatheodorou, Maria Geraga, Dimitris Christodoulou, Margarita Iatrou, Elias Fakiris, Stuart Heath and Kalliopi Baika, 2014	A marine geoarchaeological survey, Cape Sounion, Greece: Preliminary Results
Rhodes island and particular remains of shipsheds in Mandraki Harbor	Stathis C. Stiros , David J. Blackman, 2014	Seismic coastal uplift and subsidence in Rhodes Island, Aegean Arc: Evidence from an uplifted ancient harbor

Table1. Major Geoarchaeological surveys conducted in mainland Greece and the islands.

Appendix of Figures

Part A

Peloponnese(from the west)

Portocheli – Alieis (5th B.C.-4th B.C)

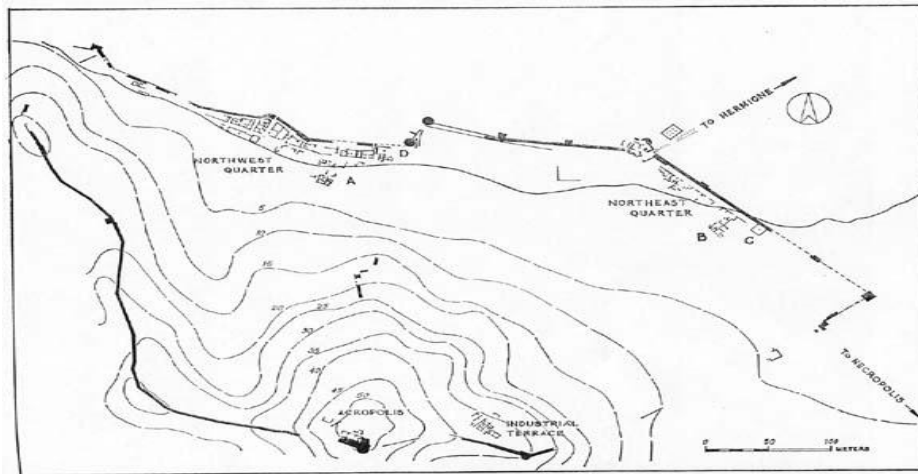


Figure 1. Plan of harbor area of Alieis (In Navis II, fig. 1).

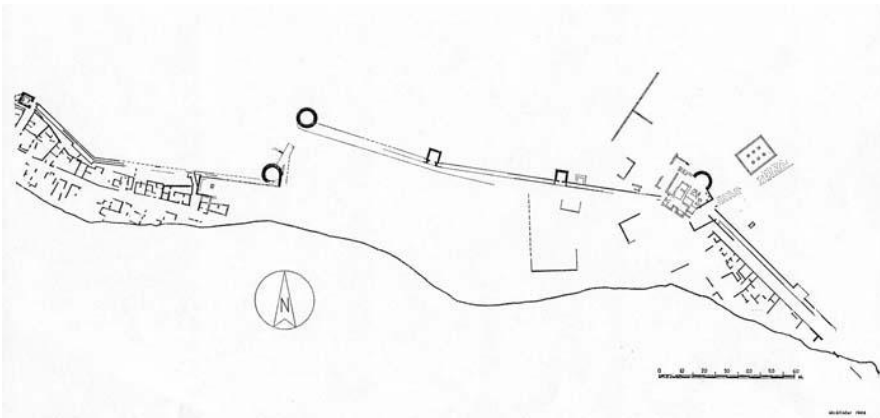


Figure 2. Sketch of the remains at the harbor area of Alieis (Jameson M. H., 1969:326 fig. 5).

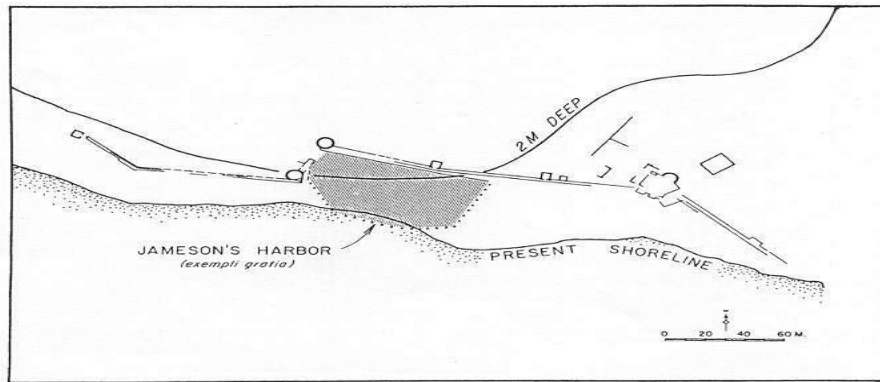


Figure 3.
Reconstruction
of the harbor
area of Alieis
(Frost J. F.,
1985:64, Fig. 2).

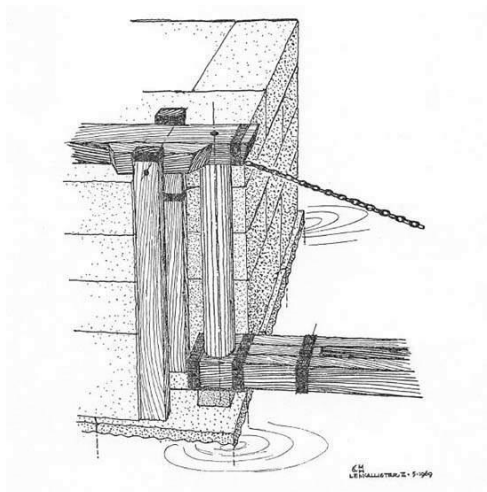


Figure 4. Reconstruction of the boom
mechanism at the harbor entrance
(Jameson M. H., 1969:328, Fig. 7a).

Lechaeon (6th B.C. - 6th A.D.)

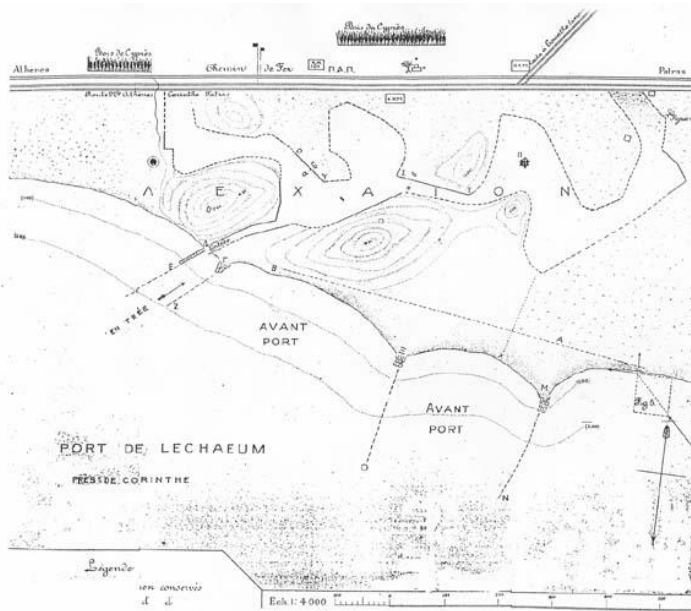


Figure 5. The port of Lechaeon in 1907 according to Georgiades (Navis II, Fig. 1).

Figure 6. Aerial view of Lechaeon in 1960 (Θεοδούλου Θ., 2002:73, Fig. 3).



Figure 7. Lechaio: the occluded mouth

(Δροσογιάννη Φ. Α., 1969: Πίνακας 153).





Figure 8. The platform of the port next to the occluded mouth (Δροσογιάννη Φ. Α., 1969: Πίνακας 154).

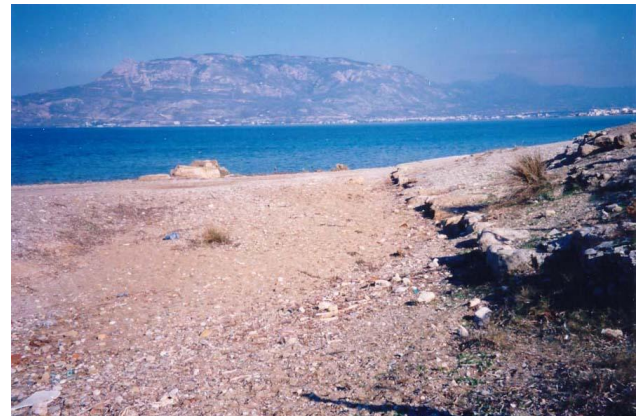


Figure 9. View of the channel guiding to the sea from the inner eastern basin (Θεοδούλου Θ., 2002:78, Fig. 8).



Figure 10. View of the build up southern bank of the eastern basin (Θεοδούλου Θ., 2002:77, Fig. 7).



Figure 11. View of the build southern bank of the eastern basin (Θεοδούλου Θ., 2002:76, Fig. 6).



Figure 12. Vertical blocks at the build up northern bank of the eastern basin (Θεοδούλου Θ., 2002:75, Fig. 5).



Figure 13. View of the technical islet in the western inner basin (Θεοδούλου Θ., 2002:81, Fig.10).



Figure 14. Lechaio: Top view of the sunken remnants of the input channel (fig. YPPOA).

Kyllene

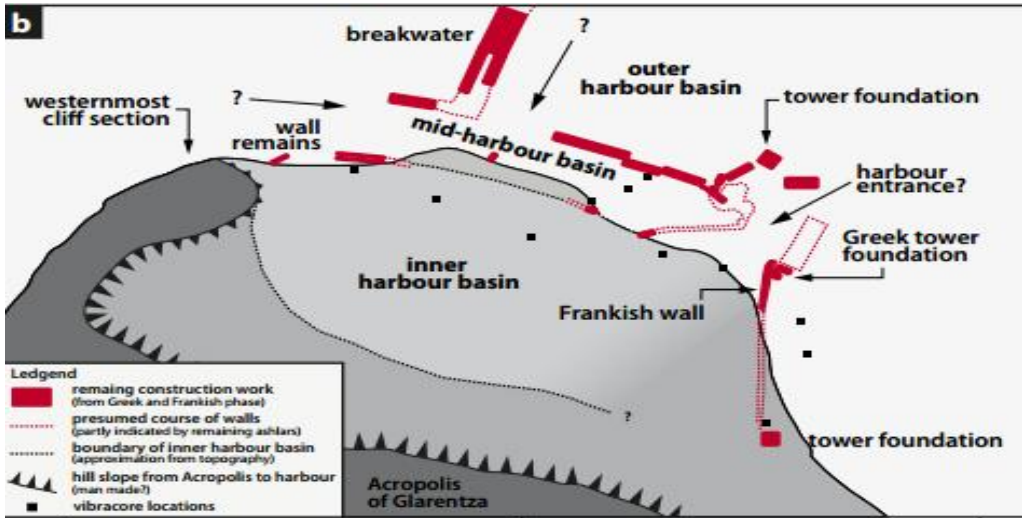


Figure 15. Overview of the Kyllene harbor site (Hadler H, 2013:83, Fig. 5.1).

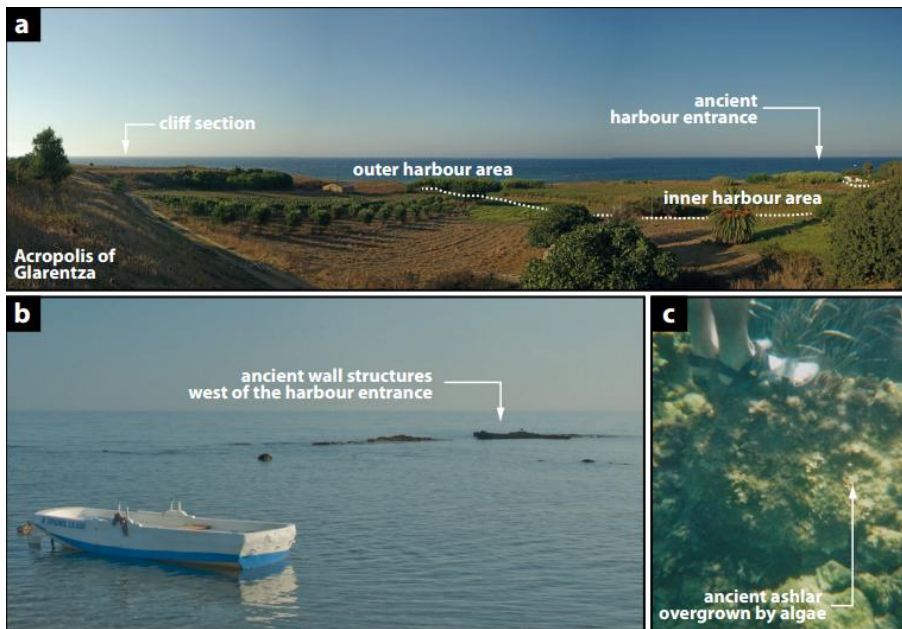


Figure 16. Visible remains of the ancient Kyllene harbor site (Hadler H, 2013:87, Fig. 5.3).

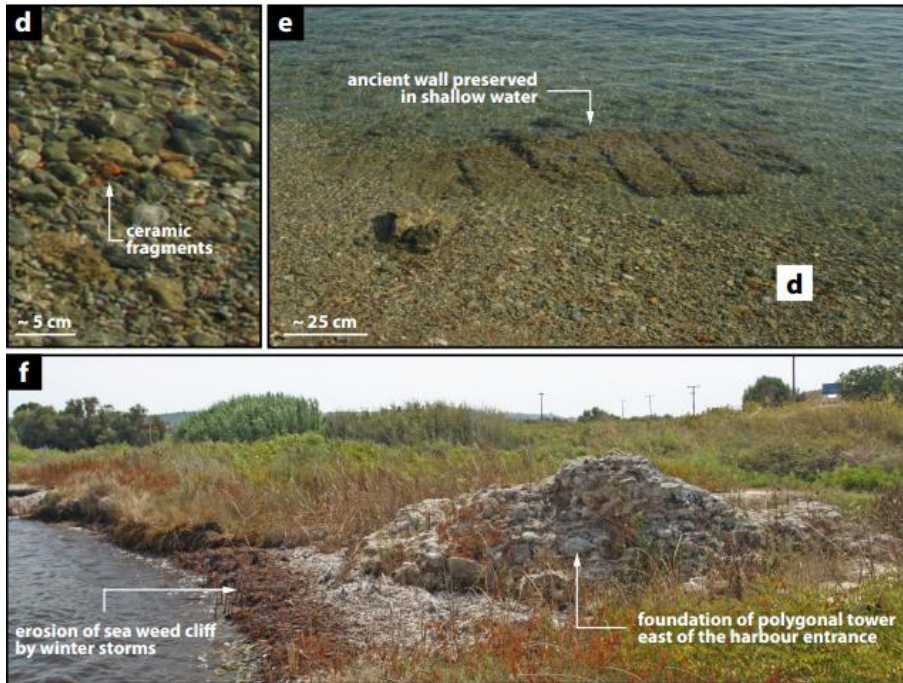


Figure 17. Visible remains of the ancient Kyllene harbor site (Hadler H, 2013:87, Fig. 5.3).

Central Greece

Piraeus- Kantharos (5th B.C. - 4th B.C.)

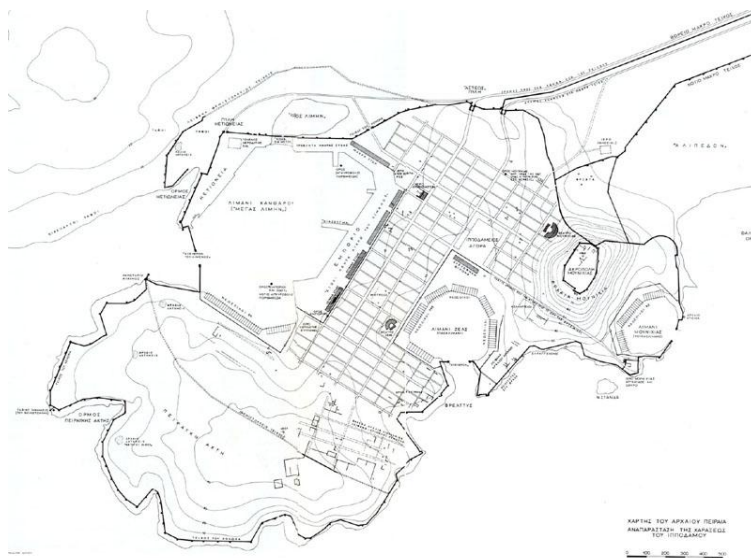


Figure 18. Plan of the ancient city of Piraeus (Παπαχατζής N., 1974:100-101, Fig. 25).



Figure 22. Beacon column on the south side of the mouth of Kantharos (Σταϊνγάουερ Γ., 2000:82).

Figure 23. Remains of beacon on the north side of the mouth of Kantharos (Σταϊνγάουερ Γ., 2000:81).



Piraeus – Munychia (5th B.C. - 4th B.C.)

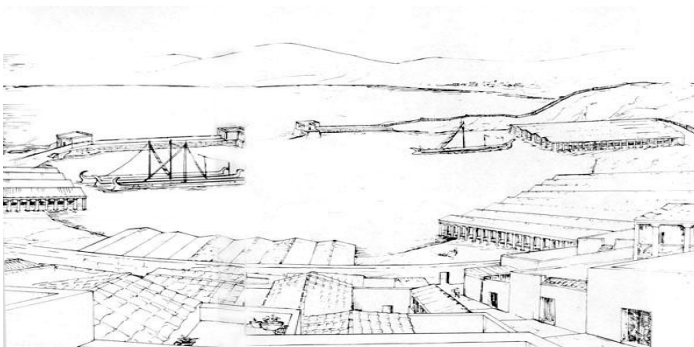


Figure 24. Graphic representation of the dockyard of Munychia (Navis II).



Figure 25. Munychia harbor as it was in early seventies (Παπαχατζής Ν., 1974:103, Fig. 26).

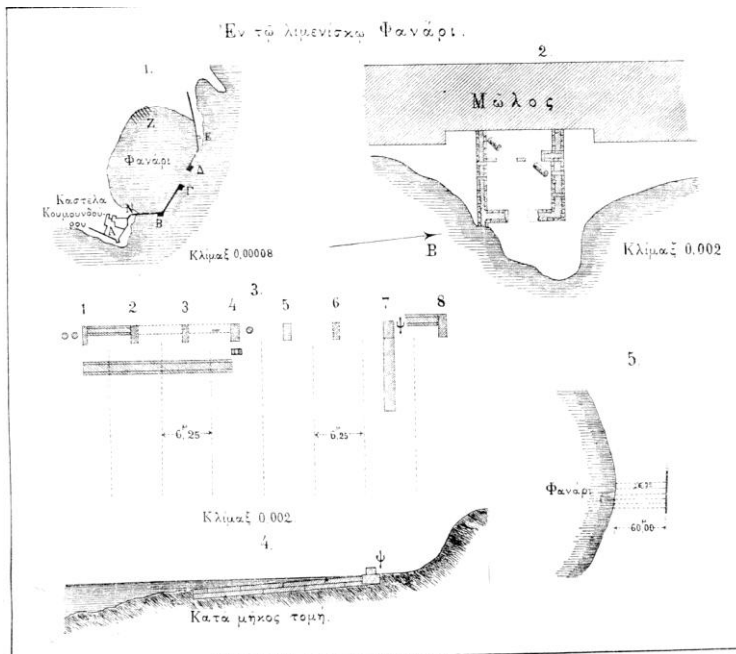


Figure 26. Drawings of the surviving structures in the dockyard of Munychia (Navis II).

Piraeus- Zea (5th B.C.-4th B.C.)

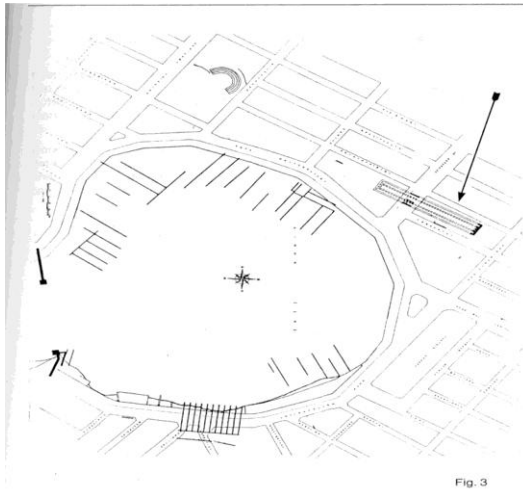


Fig. 3

Figure 27. Zea harbor according to the latest excavation results (Navis II).

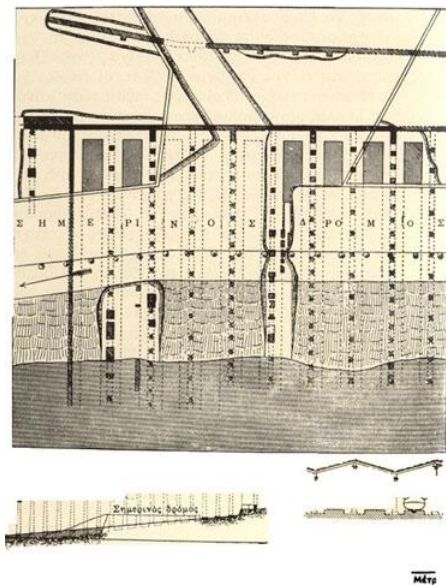


Figure 28. Dorpfeld's plan of twelve shipsheds in the eastern part of Zea harbor (Δραγάτης, I., 1885, Table 2).

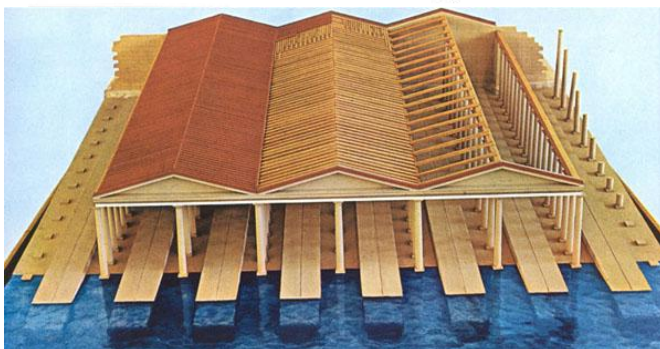


Figure 29. Representation of shipsheds of Zea at Piraeus Nautical Museum (Παπαχατζής N., 1974:107, Fig. 34).



Figure 30. Shipsheds' remains at Saggariou street from the eastern side of Zea basin (Παπαχατζής N., 1974:108, Fig. 35).



Figure 31. Shipsheds' remains in a basement at Saggariou street

(http://www.zeaharbourproject.dk/4/4_01_01_03.htm).

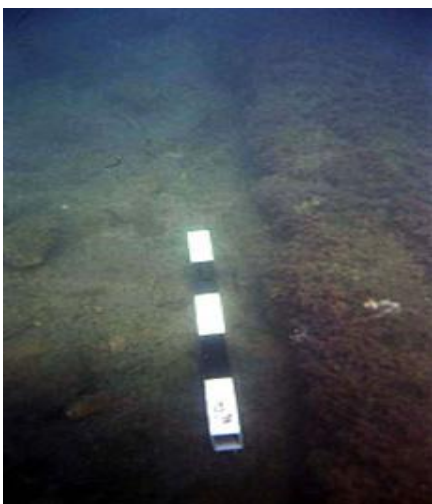
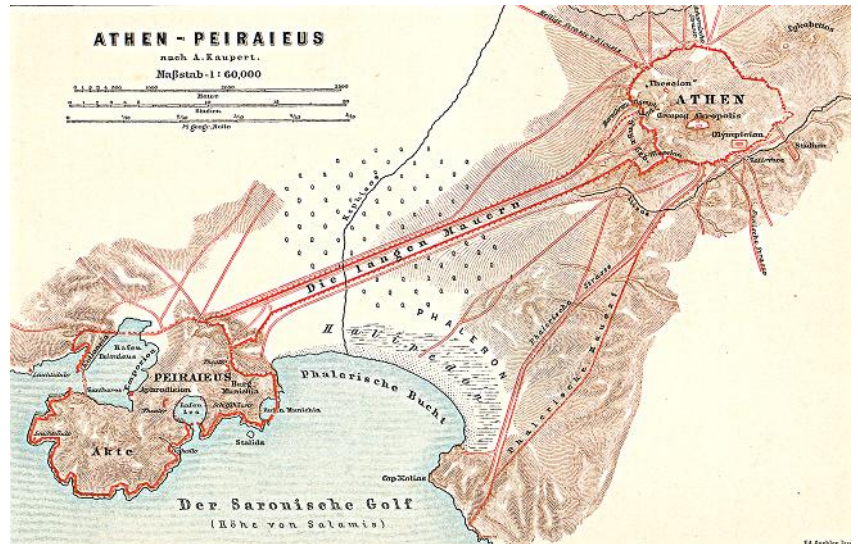


Figure 32. Submerged rock foundation trench dividing shipsheds of Zea (http://www.zeaharbourproject.dk/4/4_01_01_05.htm).

Figure 33. The location of the port of Zea, south of Munychia hill
(<http://slideplayer.gr/slide/2939670/>).



Salamis Ambelaki



Figure 34. Ancient harbor-works on the west side of Ambelaki bay from NW (Lolos Y., 1995:303, fig. 7).



Figure 35. Ancient harborworks on the west side of Ambelaki bay from W (Lolos Y., 1995:303, fig. 8).



Figure 36. Ancient harborworks on the west side of Ambelaki bay from SW (Lolos Y., 1995:304, fig. 9).



Figure 37. Mole remains on the south side of Ambelaki bay from SW (Lolos Y., 1995:304, fig. 10).



Figure 38. Mole remains on the north side of Ambelaki bay from N (Lolos Y., 1995:304, fig. 11).

Figure 39. Mole remains on the north side of Ambelaki bay from S (Lolos Y., 1995:305, fig. 12).

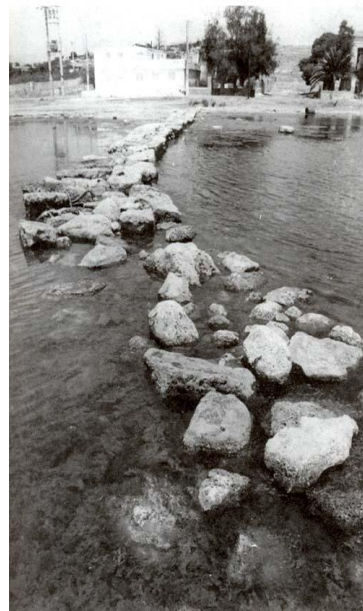


Figure 40. City wall remnants of the ancient city at Ambelaki.

(<http://www.ypai.gr/atlas/thesi.asp?idthesis=279>).

Attica – Sounion (5th B.C. - 1st A.D.)

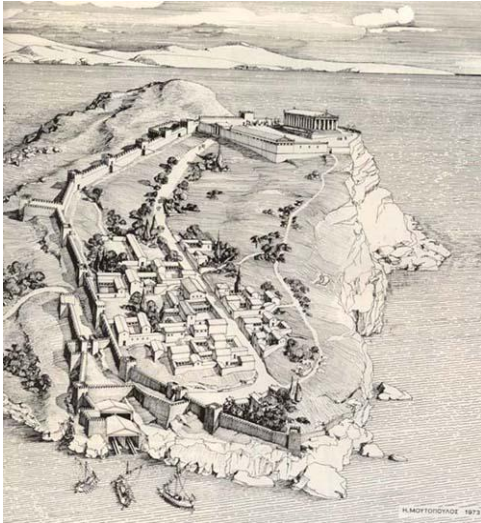


Figure 41. Representation of the structures of the walled site of Sounion (Παπαχατζής Ν., 1974: 90, Fig. 17).

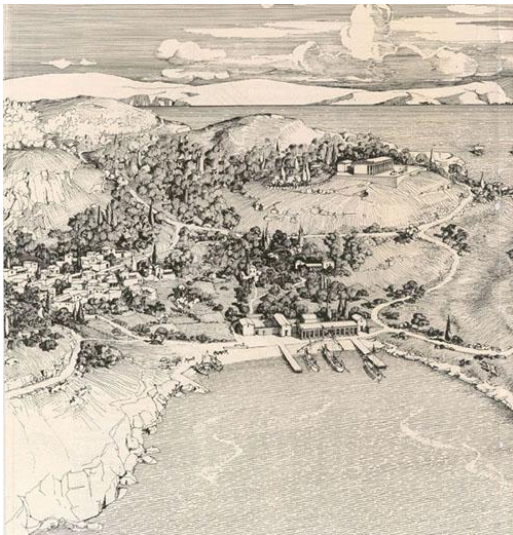


Figure 42. Representation of harbor structures at the beach of Sounion bay

(Παπαχατζής Ν., 1974: 89, Fig. 16).

Agina

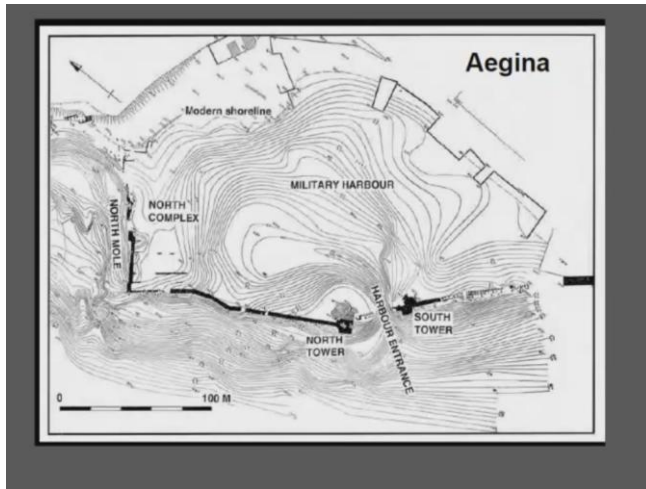


Figure 43. The military harbor of Agina.

Source: Book presentation "*Shipheds of the Ancient Mediterranean*". David Blackman, Kalliopi Baika and Jari Pakkanen present the book by themselves and B. Rankov, H. Gerding

and J. McKenzie. An event co-organized with the Finnish Institute at Athens (14-5-2014).



Figure 44. The harbors of Agina. Source: *ibid.*

Oiniadai



Figure 45. Aerial view of Oiniadai in Trikardos hill

(<http://www.pentalofo.gr/axiotheata/oiniades.aspx>).



Figure 46. Remains of shipsheds at Oiniadai. Source: Book presentation "*Shipsheds of the Ancient Mediterranean*". David Blackman, Kalliopi Baika and Jari Pakkanen present the book by themselves and B. Rankov, H. Gerding and J. McKenzie.

An event co-organized with the Finnish Institute at Athens (14-5-2014).



Figure 47. The shipsheds at Oiniadai. Source: *ibid.*

North Greece

Abdera

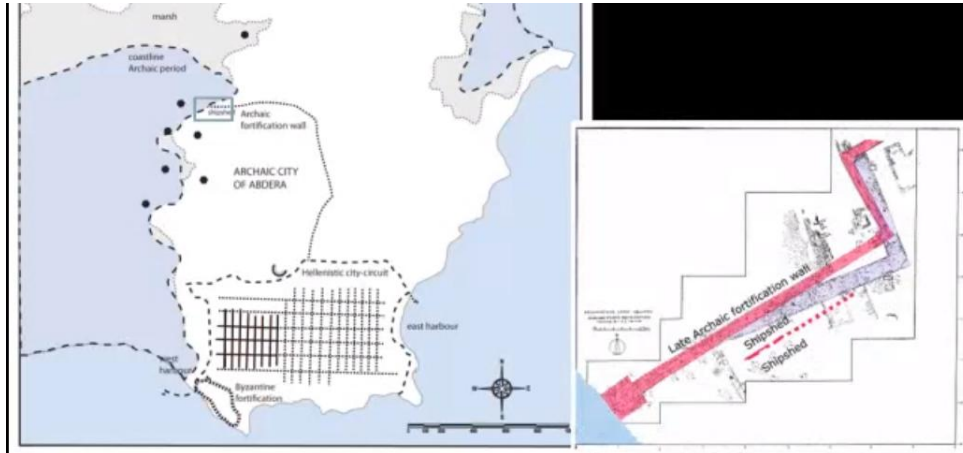


Figure 48. The location of the shipshed complex in Abdera. Source: *ibid.*

Crete

Phalasarna (4th B.C. - 1st B.C.)

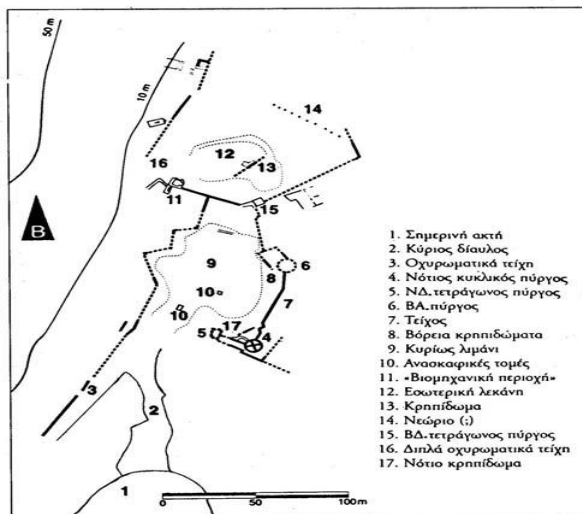


Figure 49. Plan of the harbor of Phalasarna

(<http://limenoscope.ntua.gr/>).



Figure 50. Defensive circular tower of the harbor.

(<http://www.ypai.gr/atlas/thesi.asp?idthesis=491>).

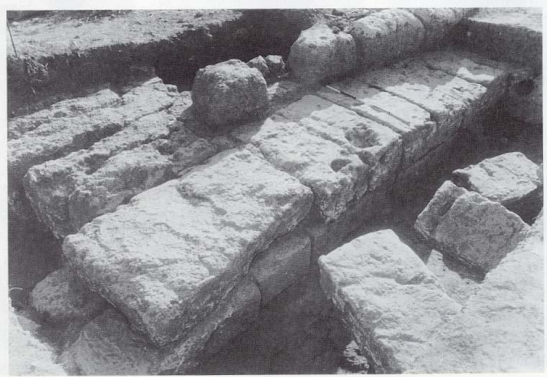


Figure 51. Part of quay under excavation. A binding hole is visible on an ashlar, as well as a mooring stone at the far end on the section of the excavation trench

(<http://limenoscope.ntua.gr/>).



Figure 52. Part of quay with binding holes and mooring stones

(<http://limenoscope.ntua.gr/>).

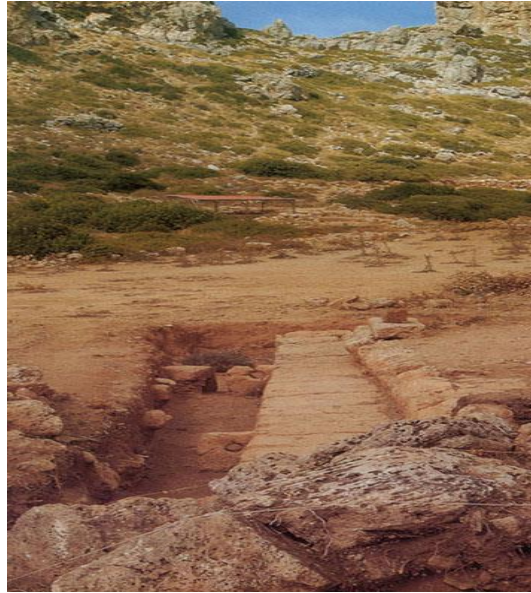


Figure 53. Quay with mooring stones (<http://limenoscope.ntua.gr/>).



Figure 54. General view of the Phalasarna harbor from the acropolis (<http://limenoscope.ntua.gr/>).



North tower from north



North tower before excavation, from southeast, double acropolis of Phalasarna in background



Steps descending from north tower, from southeast



North tower and gateway to right, from south

Figure 55. Defending towers in Phalasarna harbor (Frost F.J., Hadjidaki E., 1990, Plate 80).

Sitea

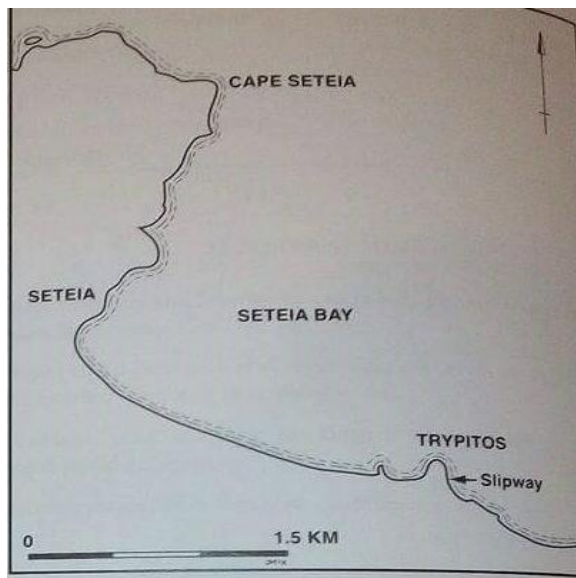


Figure 56. The location of the single slipway in Trypitos (Rankov, B., Blackman, D.J. et al. 2014: 518, Fig. B21.1a).

Cyclades

Andros – Palaeopoli



Figure 57. Satellite view of the remains of the harbor at Palaeopoli (Google Earth).



Figure 58. Panoramic view of the archaeological site.

Source:

http://androssimera.blogspot.gr/2013/06/blog-post_5.html.

Kea - Otzias bay

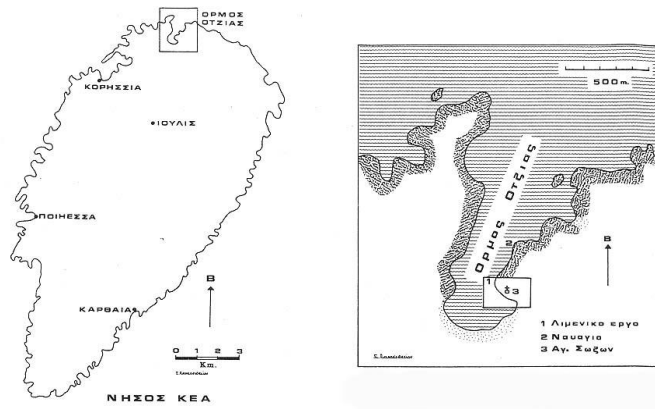


Figure 59. View of the island of Kea and the cove Otzias (Σπονδύλης Η., 1998, Fig. 1, 2).

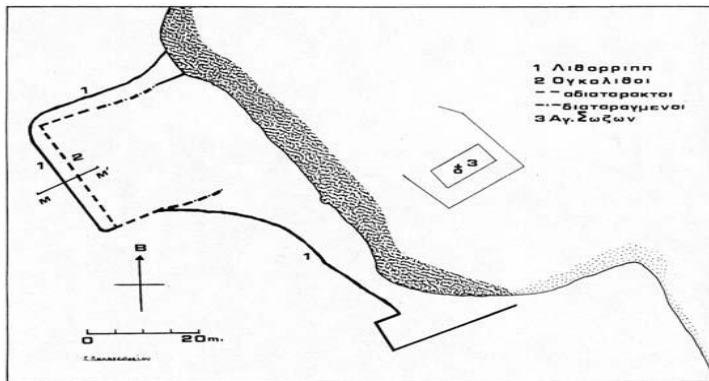


Figure 60. Top view of the port construction in the cove Otzias (Σπονδύλης Η., 1998, Fig. 8).

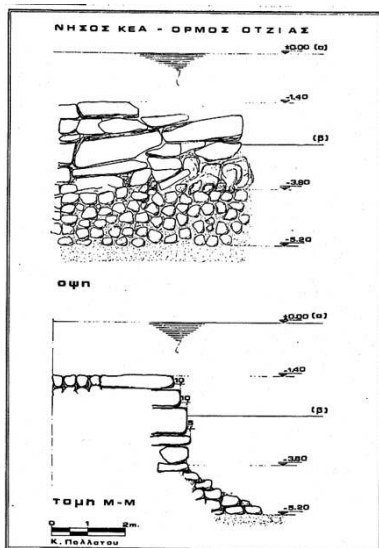


Figure 61. View and section of the port construction in the cove Otzias (Σπονδύλης Η., 1998, Fig. 10).

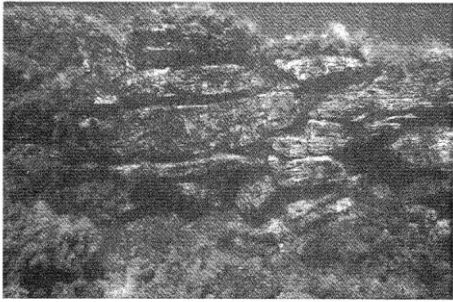


Figure 62. View of the quay of the port in the cove Otzias (Σπονδύλης Η., 1998, Fig. 11, 12, 13).

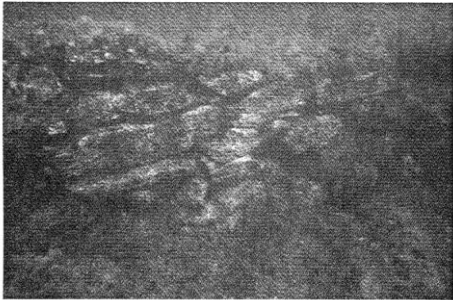
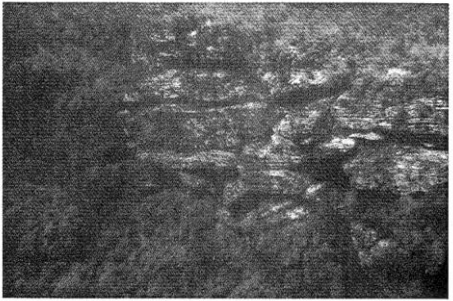
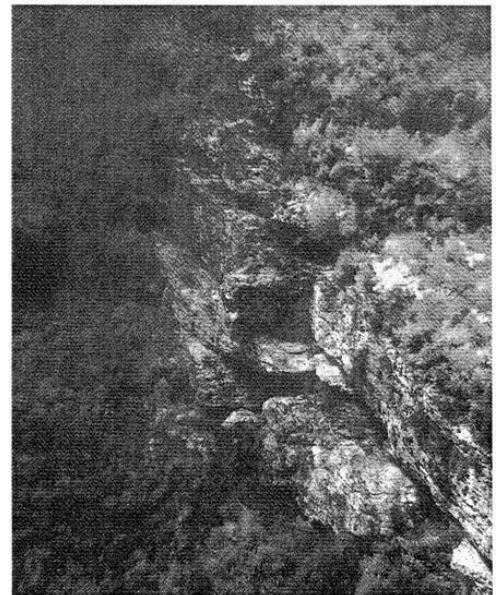


Figure 63. View of the quay in bay Otzias (Σπονδύλης Η., 1998, Fig. 14).



Kea- Poiessa

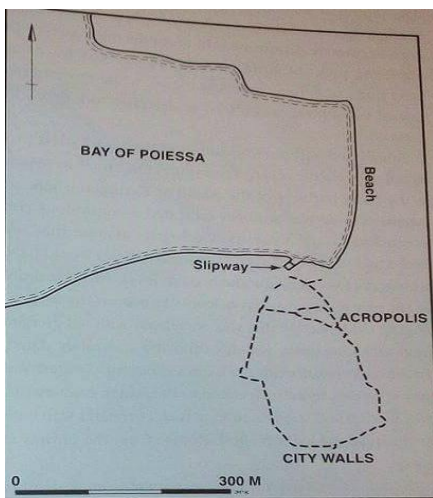


Figure 64. The location of the single slipway in Poiessa (Rankov B., Blackman D.J. et al. 2014: 489, Fig. B17.1).

Kythnos - Madraki bay



Figure 65. General view of the Madraki bay

(www.culture.gr).

Figure 66. Site plan of the ancient city of Kythnos (Fig. Gounaris A. based on the design of Chatzitheodorou Th. and Mazarakis A. Ainian). Source:

<http://extras.ha.uth.gr/kythnos/index.php?page=sites-town>

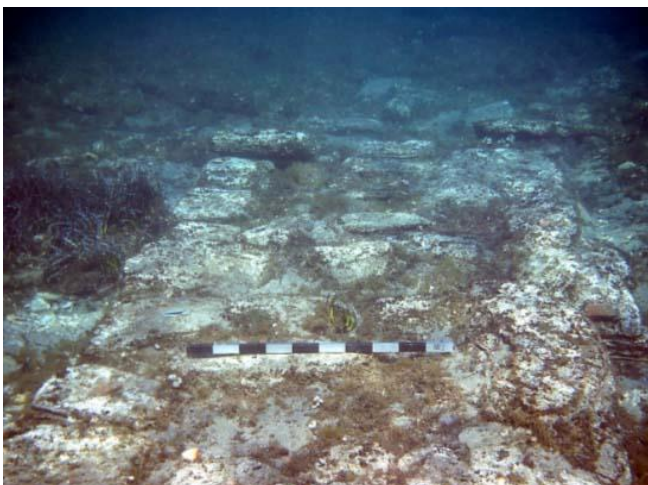
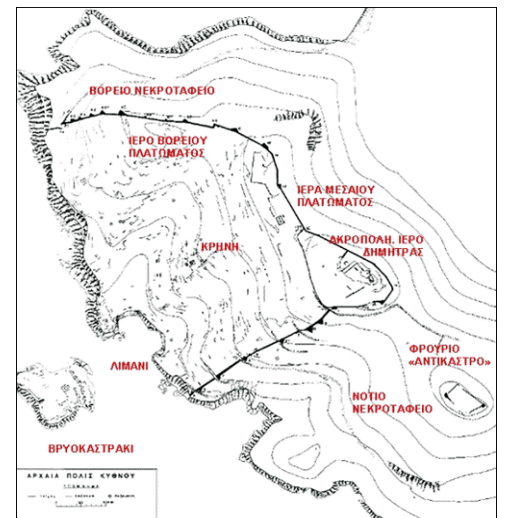


Figure 67. View of the wall at the northern side of the harbor

(www.culture.gr).

Delos



Figure 68. View of Skardanas Bay to the southwest

(www.culture.gr).



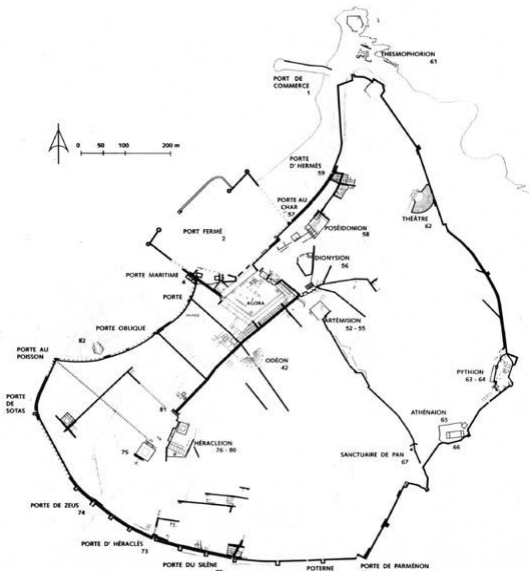
Figure 69. View of the foundation of the construction in Skardanas bay westward

(www.culture.gr).

North eastern Aegean

Thasos - Commercial Harbor (6th B.C.-2nd B.C.)

Figure 70. General plan of the ancient defended city of Thasos (Navis II).



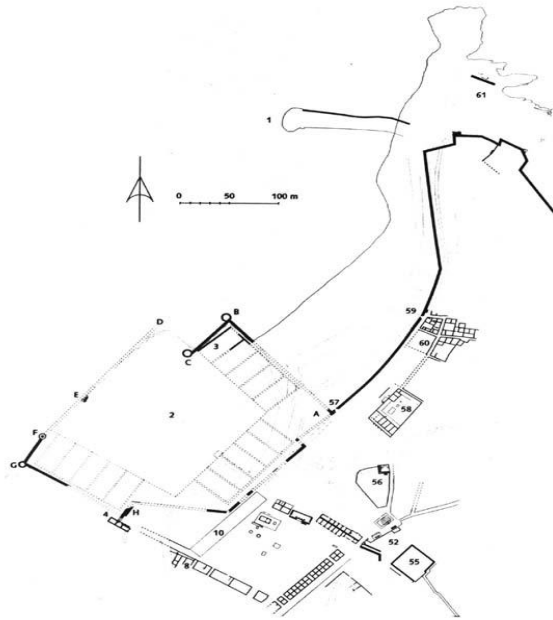


Figure 71. Plan of the two harbors of ancient Thasos (Navis II).

Figure 72. General view of the two harbors of ancient Thasos (<http://limenoscope.ntua.gr/>).



Figure 73. View of the submerged mole of the ancient commercial port (<http://limenoscope.ntua.gr/>).



Thasos - Military Harbor (6th B.C. - 2nd B.C.)

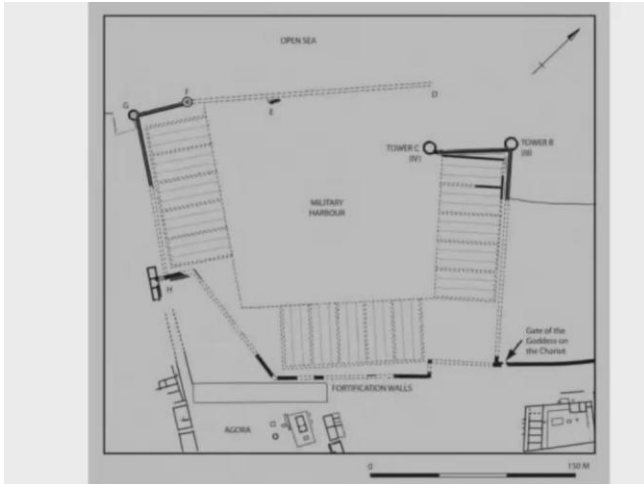


Figure 74. The military Harbor of Thasos. Source: Book presentation "*Shipsheeds of the Ancient Mediterranean*". David Blackman, Kalliopi Baika and Jari Pakkanen present the book by themselves and B. Rankov, H. Gerding and J. McKenzie. An event co-organized with the Finnish Institute at Athens (14-5-2014).



Figure 75. Remains of a circular tower at the military harbor's southwest angle

(<http://limenoscope.ntua.gr/>).

Lesvos - Mytilene (North harbor)

(4th B.C. - 7th A.D.)

Figure 76. Satellite image of Mytilene with the two ports (GoogleEarth).

<http://www.gosur.com/map/?satellite>.

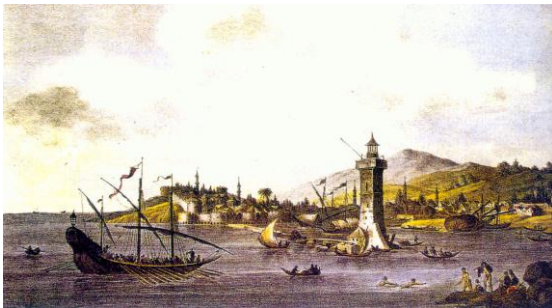


Figure 77. Lighthouse at mole edge of the eastern breakwater in gravure of the 18th century (<http://limenscope.ntua.gr/>).

Figure 78. The surviving today right pier.

Source: <http://www.ellinikiaktoploia.net/a-5/>





Figure 79. A view of the remains of the north jetty in Kalamaris region (<http://limenoscope.ntua.gr/>).



Figure 80. General view of the north port (Google Earth). <http://www.gosur.com/map/?satellite>.

Lesvos - Mytilene (South harbor) (4th B.C. - 7th A.D.)



Figure 81. Satellite image of Mytilene, showing the ancient basin of the southern port (Google Earth)

<http://www.gosur.com/map/?satellite>.



Figure 82. View of the breakwater Lantern which coincides with the s/n breakwater of the ancient southern basin

(<http://limenoscope.ntua.gr/>).

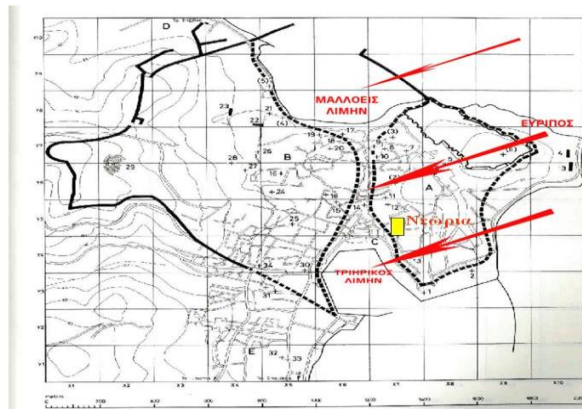


Figure 83. Sketch of "Euripus".

<http://www.blod.gr/lectures/Pages/viewlecture.aspx?LectureID=1396>.

17

Lesvos- Antissa (4th B.C.-2nd B.C.)

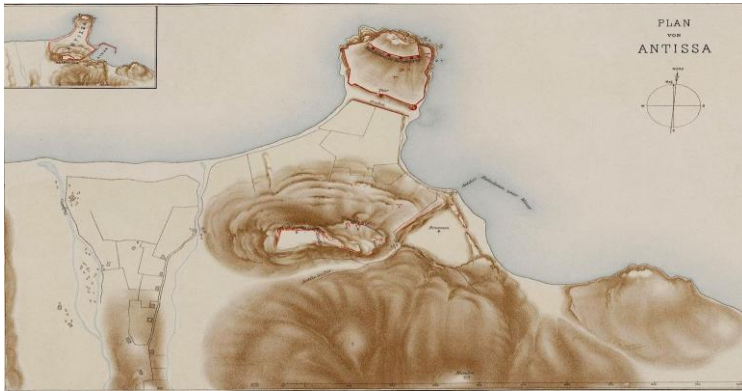


Figure 84. Ancient Antissa according to Robert Koldewey (1890) (Παρασκευαΐδης Π., 2008:223-232).



Figure 85. Antissa. At the background of the bay the remains of the jetty (Παρασκευαΐδης Π., 2008:223-232).

Lesvos Eresos



Figure 86. The modern fishing shelter in Eresos and in its expansion the ancient cantilever / jetty (Fig. Θεοδούλου Θ., © EEA-YPPOT).



Figure 87. Underwater view of the south side of the cantilever /breakwater (Fig. Μεντόγιαννης Β. © EEA-YPPOT).

Figure 88. View of the surviving section of the cantilever / jetty (Fig. Θεοδούλου Θ., © EEA-YPPOT).



Lesvos - Kalo Limani



Figure 89. Tsamour port.

Source: http://vaspik.blogspot.gr/2013/01/blog-post_9798.html

Lesvos – Pyrrha (4th B.C.-2nd B.C.)

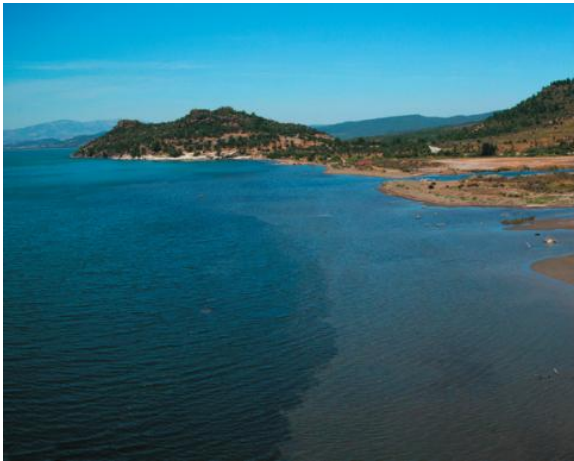


Figure 90. Pyrrha. View of the embanked North Bay (Fig. Θεοδούλου Θ., © EEA-YPPOT).

Lesvos-Mithymna



Figure 91. The end of the breakwater that was found south of traditional platforms (Fig. Θεοδούλου Θ., © EEA-YPPOT).

Lesvos-Agios Fokas



Figure 92. The preserved part of the ancient waterfront on top of the eastern breakwater (Θεοδούλου Θ., 2010:0100 Fig. 11).



Figure 93. Underwater view of the waterfront (Θεοδούλου Θ., 2010:0101 Fig. 12).



Figure 94. The fishing shelter in Agios Fokas (Θεοδούλου Θ., 2010:0102 Fig. 13).

Samos-Pythagoreion (6th B.C.-5th B.C.)

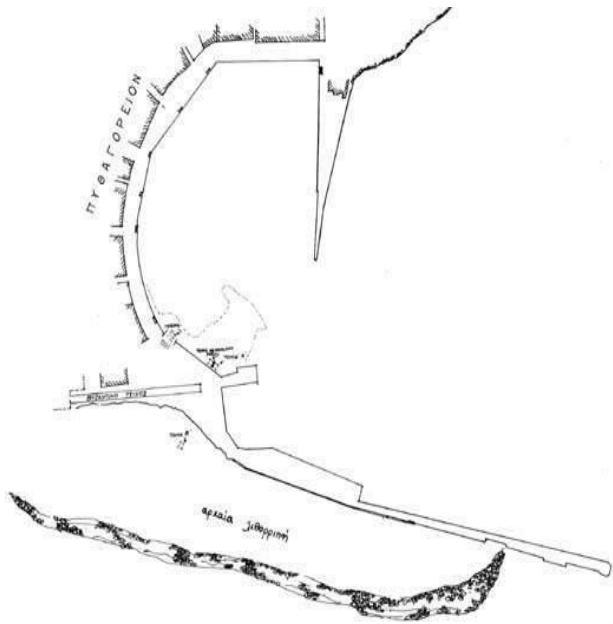


Figure 95. General plan of the port of Pythagoreion, Samos (Navis II)



Figure 96. Aerial view of the ancient port of Samos.

Source: Google Earth <http://www.gosur.com/satellite/>



Figure 97. General view of the harbor of Samos (<http://limenoscope.ntua.gr/>)



Figure 98. Relics of the Byzantine city wall (<http://limenoscope.ntua.gr/>)

Dodecanese

Rhodes

City ports (Mandraki, Great Port, and Acadias)

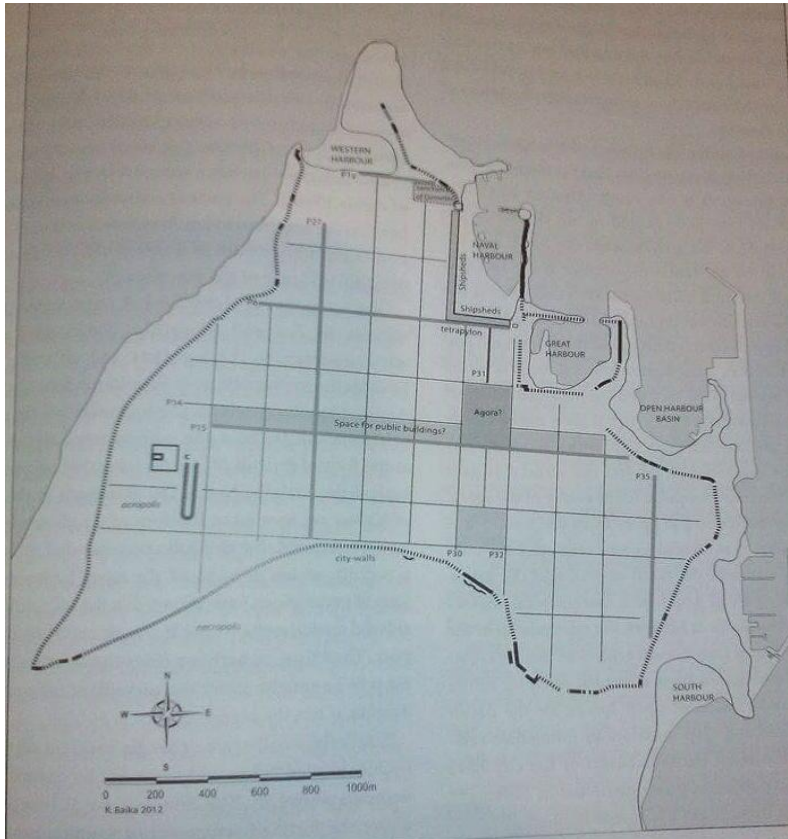


Figure 99. The harbors of the city of Rhodes

(Rankov B., Blackman D.J. et al. 2014: 201, Fig. A10.10).

Kos

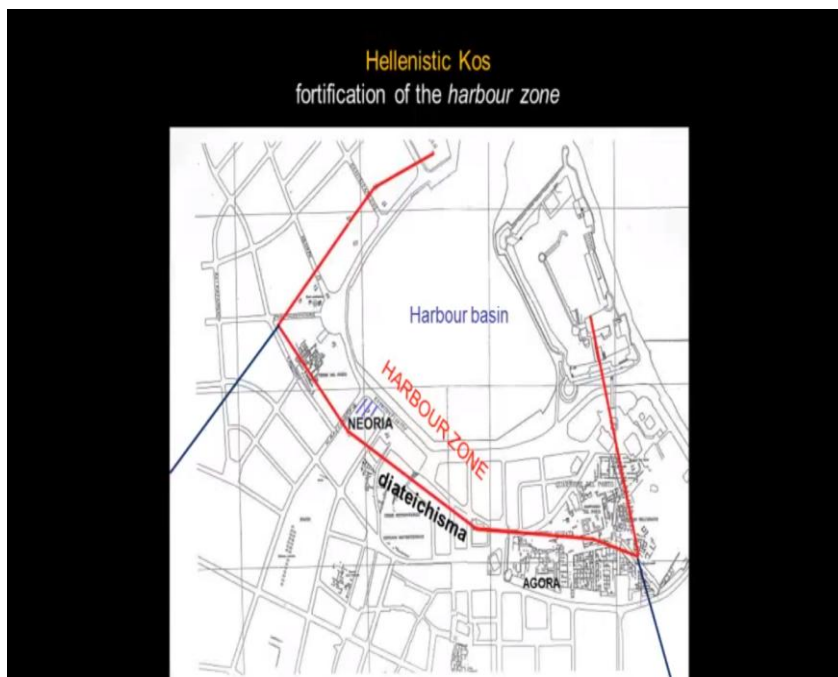


Figure 100. The harbor of Kos. Source: Book presentation "*Shipheds of the Ancient Mediterranean*". David Blackman, Kalliopi Baika, and Jari Pakkanen present the book by themselves and B. Rankov, H. Gerding and J. McKenzie. An event co-organized with the Finnish Institute at Athens (14-5-2014).

Part B

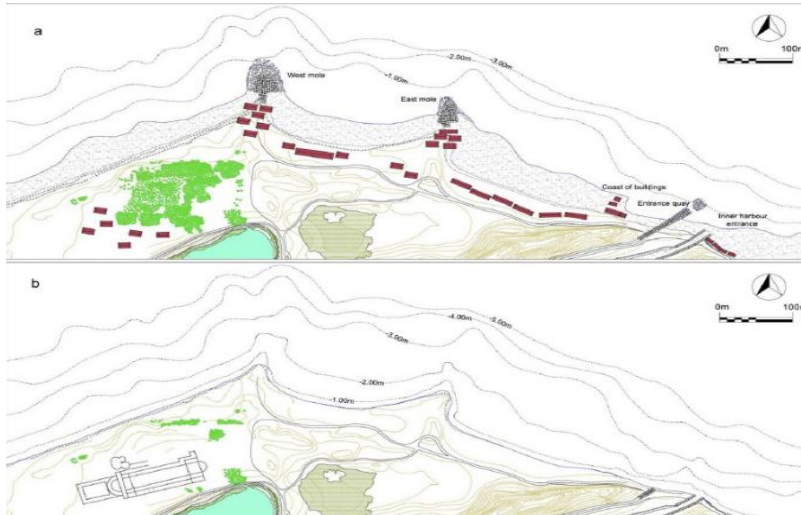


Figure 101. Palaeogeographical reconstruction of the coast of the foreharbor of ancient Lechaion. A: The sea level in Roman times was 0.90m lower than the present. B: After the abandonment of the foreharbor and the siltation of its facilities the sea level rose by 2.0m (Mourtzas N.D. et al., 2014:167, Fig. 9).

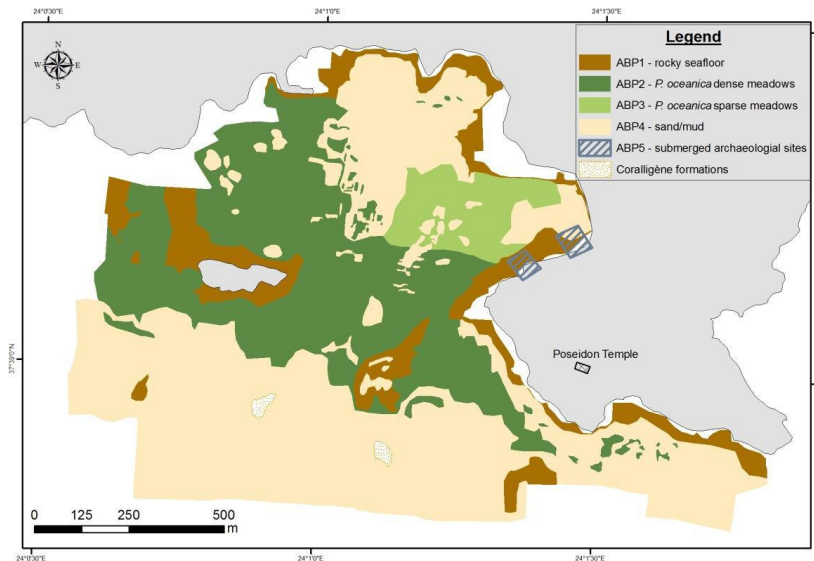


Figure 102. Geomorphological map of the seafloor of the Gulf of Sounion (Papatheodorou G. et al. 2014:362, Fig. 7).

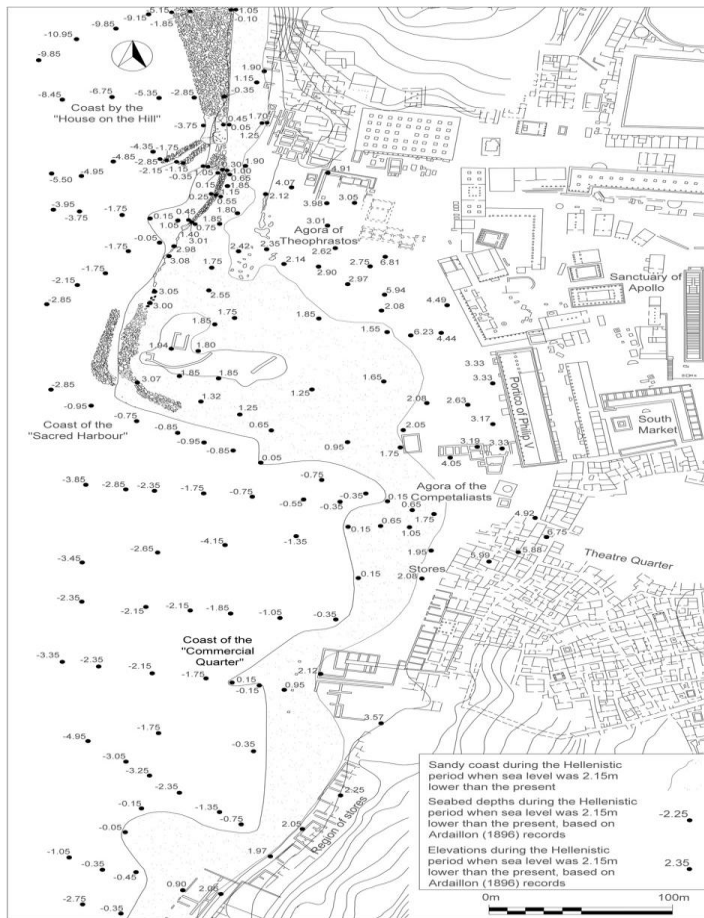


Figure 103. Palaeogeographic reconstruction of the coast during the historical period, when sea level was 2.15m lower than at present (Mourtzas N. D., 2012:16, Fig. 12).

Bibliography

Archontidou Argyri A., Simossi A., Empeur J. -Y., (1989) The underwater excavation at the ancient port of Thasos, Greece, *International Journal of Nautical Archaeology*, 18.1, pp. 51-59.

Baika Kalliopi, (2008) Archaeological indicators of relative sea-level changes in the Attico-Cycladic massif: preliminary results, *Bulletin of the Geological Society of Greece* vol. XLII/II-2008, pp. 33-48.

Bintliff J., (1992) Interaction between archaeological sites and geomorphology, *Cuaternario y Geomorfologia*, 6, pp 5-20.

Blackman D. J., (1973) The neosoikos at Matala in *Proceedings of the 3rd Cretological Congress* 1971, Athens, pp. 14-21.

Blackman D.J., (1982) Ancient harbors in the Mediterranean Part 2, the *International Journal of Nautical Archaeology and Underwater Exploration*, pp. 185-211.

Blackman D. J., (1987) Triremes and shipsheds, *Tropis II*, Athens (1990), pp. 35-52.

Casson Lionel, (1995) *Ships and seamanship in the ancient world*, London: Johns Hopkins University Press.

Crouch D. P., (1996) Environmental geology of ancient Greek cities, *Environmental Geology* 27, pp. 233-245.

Davaras C., (1974) Rock-Cut Fish Tanks in Eastern Crete, *Annual of the British School at Athens* 69, pp. 87-93.

Flemming N.C., (1978) Holocene eustatic changes and coastal tectonics in the Northeast Mediterranean: Implications for models of crustal consumption, *Philosophical Transactions of Royal Society*, A.289, pp. 405-458.

Frost J.F., (1985) The harbor at Halieis in Raban A., *Harbor Archaeology. Proceedings of the International Workshop on ancient Mediterranean harbours*, Caesarea Maritima 24-28.6.83, University of Haifa, Bar International Series 257.

Frost H., (1987) Where did they build Ancient Warships in *Tropis II. Proceedings of the 2nd International Symposium on ship construction in antiquity*, Delphi 1987, Athens (1990), pp. 181-185.

Frost F.J., Hadjidaki E., (1990) Excavations at the Harbor of Phalasarna in Crete: The 1988 Season, *Hesperia* 59.3, pp. 513-527.

Gepousis Elpidoforos G., Ziros, Athanasios G., Chondros Michalis K., Memos Constantine D., (2015) Efficient sediment management at the entrance of an

ancient harbor, *E-proceedings of the 36th IAHR World Congress*, 28 June – 3 July, The Hague, the Netherlands, pp. 1-10.

González-Hidalgo José Carlos, Peña-Monné José Luis and de Luis Martín, (2007) A review of daily soil erosion in Western Mediterranean areas, / *Catena* 71 (2007) pp. 193–199.

Hadler Hanna, (2013) *Ancient Greek harbours used as geo-archives for palaeotsunami research - Case studies from Krane (Cefalonia), Lechaion (Gulf of Corinth) and Kyllini (Peloponnese)*, Dissertation, Johannes Gutenberg University in Mainz.

Hajidaki E., (1987) Excavations at the Classical/Hellenistic harbor of Phalasarna, Western Crete, Greece, *International Journal of Nautical Archaeology* Volume 16, Issue 3, pages 254–256.

Jameson M. H., (1969) Excavations at Porto Cheli and Vicinity, Preliminary report, I: Halieis, 1962-1968, *Hesperia* 38, 311-342.

Jardine, W, (1984) The Role of Geomorphology or geology in archaeological studies: a synopsis, Published by *Academic Journal* Offprint from - Glasgow Archaeological Journal, Volume 11 Issue 11, pp. 1-11.

Kenny A.E.J., (1947) The ancient docks on the promontory of Sounion, *The Annual of the British School at Athens* Vol. 42, London, pp. 194-200.

Kraft J.C., et al., (1985) Geological studies of coastal change applied to archaeological settings in G. Rapp, J. and J.A. Gifford (eds.) *Archaeological Geology*, London, pp. 57-84.

Lambeck, K., (1996) Sea level change and shoreline evolution in Aegean Greece since Upper Palaeolithic time, *Antiquity* 70, pp. 588-610.

Lolos Y., (1995) Notes on Salaminian harbors, *Tropis III, 3rd International symposium on ship construction in antiquity*, Athens, 1989, pp. 291-308.

Loven P., (2002 and 2005) on the investigation of the Danish Institute articles, to be published in the *Tropis VIII & Tropis IX* (ed. Tzalas X.).

Loven Bjorn, Schaldemose Mette, (2011)The ancient harbors of the Piraeus, *Monographs of the Danish Institute at Athens*, 15, Volume I.1. The Zea shipsheds and slipways: architecture and topography.

Maragou C., (1995) A rock engraving in Lemnos (Preliminary Study), *Tropis III -3rd International Symposium on Ship Construction in Antiquity*, Athens 1989, pp.309-319.

Marangou C., (2002) Rocks and itineraries: Sea and Land Perspectives on an Aegean island. In W. H. Waldren, J. A. Ensenyat (eds.), *World Islands in Prehistory, International Insular investigations, V Deia International Conference of Prehistory*. BAR International Series 1095, Oxford: Archaeopress, pp. 7-18.

Marriner, N., Morhange, C., (2007) Geoscience of ancient Mediterranean harbors, *Earth-Science Reviews*, 80, pp. 137-194.

Marriner N., Morhange C., and Goiran J.P., (2010) Coastal and ancient harbor geoarchaeology, *Geology Today*, Vol. 26, No. 1, Blackwell Publishing Ltd, The Geologists' Association & The Geological Society of London pp. 21-27.

McGrail Sean, (2004) *Boats of the world: from the Stone Age to Medieval times*, New York: Oxford University Press.

Morhange Christophe, Marriner Nick, (2008) Mind the (stratigraphic) gap: Roman dredging in ancient Mediterranean harbors, *XVII International Congress of Classical Archaeology*, Session: Portus, Ostia, and the Ports of the Roman Mediterranean, pp. 23-32, Contributions from Archaeology and History.

Mourtzas N.D., (2012) A palaeogeographic reconstruction of the seafront of the ancient city of Delos in relation to Upper Holocene sea level changes in the central Cyclades, *Quaternary International* 250, pp. 3-18.

Mourtzas N.D., Kissas C. and Kolaiti E., (2014) Archaeological and geomorphological indicators of the historical sea level changes and the related palaeogeographical reconstruction of the ancient foreharbour of Lechaion, East Corinth Gulf (Greece), *Quaternary International* 332, pp. 151-171.

Papageorgiou Sophia, Arnold Maurice, Laborel Jacques, Stiros Stathis C., (1993) Seismic uplift of the harbor of ancient Aigeira, Central Greece, *The International Journal of Nautical Archaeology* 22.3, pp. 275-281.

Papathodorou George, Geraga Maria Christodoulou Dimitris, Iatrou Margarita, Fakiris Elias, Heath Stuart, and Baika Kalliopi, (2014) a marine geoarchaeological survey, Cape Sounion, Greece: preliminary results, *Mediterranean Archaeology and Archaeometry*, Vol. 14, No 1, pp. 357-371.

Pirazzoli P.A., Ausseil-Badie J., Giresse P., Hadjidaki E., Arnold M., (1992) Historical Environmental Changes at Phalasarna Harbor, West Crete in Swiny, S., Hohlfelder, R.L., Swiny, H.W., (eds.) 1997, *Res Maritimae: Cyprus and the Eastern Mediterranean from Prehistory to late Antiquity*, Scholars Press Atlanta, pp. 371-92.

Rankov B., Blackman D.J. (Eds), (2014) *Shipheds of the Ancient Mediterranean*, Cambridge: Cambridge University Press.

Rothaus R., (1995) Lechaeon, western port of Corinth, *Oxford Journal of Archaeology* 14 (1995), Blackwell Publishers, Oxford, pp. 293-306.

Simossi A., (1988) Underwater excavation research in the ancient harbor of Samos: September - October 1988, *International Journal of Nautical Archaeology* 20.4, pp.281-298.

Smith Eric and Headland John, (2005) Minimization of Sedimentation in Harbors and Marinas, *Second Annual Dredged Material Management Summit*.

Stiros S.C., (1998) Archaeological Evidence for Unusually Rapid Holocene Uplift Rates in an Active Normal Faulting Terrain: Roman Harbor of Aigeira, Gulf of Corinth, Greece *Geoarchaeology* 13.7, pp. 731-741.

Stiros S. et al., (1998) On the date of construction of Lechaion, western harbor of ancient Corinth, Greece, *Geoarchaeology* 11.3, pp. 251 – 263.

Tartaron T.F., Gregory T.E., Pullen D.J., Noller J.S., Rothaus R.M., Rifle J.L., Tzortzopoulou-Gregory L., Schon R., Caraher W.R., Pettegrew D.K., Nakassis D., (2006) The Eastern Korinthia Archaeological Survey - Integrated Methods for a Dynamic Landscape. *Hesperia* 75, pp. 453-523.

Triantafillidis Ioannis and Tselentis Vassilis, (2013) Management of Underwater Archaeological Heritage: An Environmental Approach to the Protection and Preservation of the Harbor Complex of Aegina, *Proceedings of the 17th Symposium on Mediterranean Archaeology*, Moscow/ 25-27 April, Oxford pp. 202-212.

Trichas A., (2004) Biogeography of the Aegean. At: *The nature of geography*, Supervisors: Efthimiopoulos, I., Modinos, M. Interdisciplinary Institute for Environmental Research.

Vött Andreas, Brückner Helmut, Schriever Armin, Handl Mathias, Besonen Mark & van der Borg Klaas, (2004) Holocene coastal evolution around the ancient seaport of Oiniadai, Acheloos alluvial plain, NW Greece, G. Schernewski und T. Dolch (Hrsg.): *Geographie der Meere und Küsten Coastline Reports 1*, pp 43-53.

Walsh Kevin, (2013) *the Archaeology of Mediterranean Landscapes Human-Environment Interaction from the Neolithic to the Roman Period*, Cambridge.

Whitelaw T.M., (1998) Colonisation and competition in the polis of Koressos: The development of settlement in north-west Keos from the archaic to the late roman periods in Μενδώνη και Μαζαράκης – Αινιάν, *Κέα-Κύθνος: Ιστορία και Αρχαιολογία* (Μελετήματα 27). Αθήνα/ Παρίσι, 2, σ. 27 – 257.

Αγαλοπούλου Π. και Καλλιοντζής Ν., (1988) Τρία αρχαία λιμάνια της βόρειας Λήμνου, *Αρχαιολογική Εταιρεία*, σ. 169-174.

Αρχοντίδου-Αργύρη Α. και Κοκκινοφόρου Μ. (επιμ.), (2004) *Η Μύρινα της πρώιμης εποχής του Χαλκού*, Λήμνος.

Δραγάτσης, Ι., (1885) Έκθεσις περί των εν Πειραιεί ανασκαφών, *Πρακτικά της εν Αθήναις Αρχαιολογικής Εταιρείας*, Αθήναι, σ. 63-71, Πιν. 2, 3.

Δραγάτσης, Ι. - Αγγελόπουλος Η., (1900), Ανασκαφή εν Πειραιεί , *Πρακτικά της εν Αθήναις Αρχαιολογικής Εταιρείας*, Αθήναι, σ. 33-37.

Δροσογιάννη Φανή Α., (1968) Μεσαιωνικά μνημεία της Πελοποννήσου: Κορινθία: Αρχαία Κόρινθος, Χρονικά- Μέρος Β1, *Αρχαιολογική Εταιρεία* 23, σ. 195-202.

Θεοδούλου Θεοτόκης, (2002) Λέχαιο, το δυτικό τεχνητό λιμάνι της αρχαίας Κορίνθου, *Ενάλια VI*, Αθήνα, Ινστιτούτο Εναλίων Αρχαιολογικών Ερευνών, σ. 83-99.

Θεοδούλου Θεοτόκης, (2008) Διαχείριση παράκτιας ζώνης και ενάλια πολιτιστικά αγαθά - το παράδειγμα της Λέσβου στο *Πρακτικά του 4^{ου}*

Πανελλαδικού Συνεδρίου Διαχείρισης και Βελτίωσης Παρακτίων Ζωνών,
Μυτιλήνη 23 με 27 Σεπτ. 2008, ΕΜΠ, Εργαστήριο Λιμενικών έργων, Αθήνα, σ.
223-232.

Θεοδούλου Θεοτόκης, (2010) Εφορεία Ενάλιων Αρχαιοτήτων -Υποβρύχια
έρευνα στα αρχαία λιμάνια της Λέσβου στο *Αρχαιολογία και Τέχνες*, Στήλες,
τεύχος 116, σ. 093-0102.

Θεοδούλου Θεοτόκης και Κουρτζέλλης Γιάννης, (2011) Λιμάνια και ναυτικοί
δρόμοι στην αρχαία Λέσβο, *Λεσβιακό Ημερολόγιο,- Γράμματα- Τέχνες-
Πολιτισμός*, εκδόσεις: Αιολίδα, σ. 129-300.

Θεοδούλου Θεοτόκης, (2015) Σύνοψη της ενάλιας και παράκτιας
αρχαιολογικής έρευνας στην Κρήτη μέχρι το 2014, *Κρητικά Χρονικά* ΛΕ΄, 31-
52.

Καραλή Λίλιαν, (2005) *Περιβαλλοντική αρχαιολογία*, Αθήνα: Ινστιτούτο του
βιβλίου- Καρδαμίτσα Α.

Κοντολέων Ν., (1964) *Αρχαιολογική Εφημερίς*, Χρονικά, σ. 1-5.

Λάσκαρης Νικόλαος Γ., (2006) Προσπάθεια αναπαραστάσεως της Σάμαινας,
Αρχαιολογία και Τέχνες, Τεύχος 101, σ. 38-43.

Λυριτζής Ιωάννης, (2005) *Αρχαιολογία και Περιβάλλον*, Αθήνα: Ινστιτούτο του
βιβλίου- Καρδαμίτσα Α.

Μανούσου-Ντέλλα Κατερίνα, (2009) Οι θαλάσσιες οχυρώσεις και τα λιμάνια της πόλης της Ρόδου, *Δελτίον της Χριστιανικής Αρχαιολογικής Εταιρείας*, Περίοδος Δ', Τόμος Λ', Αθήνα, σ. 67-80.

Μανούσου-Ντέλλα Κατερίνα, (2012) Μνημειακή τοπογραφία του βορείου άκρου της πόλης της Ρόδου, *Δελτίον της Χριστιανικής Αρχαιολογικής Εταιρείας*, Περίοδος Δ', Τόμος ΛΓ', Αθήνα, σ. 21-36.

Μπάικα Καλλιόπη, (2011) Γεωαρχαιολογία λιμένων και παράκτιων θέσεων: μεθοδολογικές προσεγγίσεις στο Αιγαίο και τη Μεσόγειο, στο Κίσαμος Θερινό σχολείο- *Υλικά δόμησης των αρχαίων. Γεωμορφολογική εξέλιξη της Δ. Κρήτης κατά τους προϊστορικούς και ιστορικούς χρόνους*, Τμήμα Γεωλογίας και Γεωπεριβάλλοντος, Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών, 25-29 / 8/2011, σ. 39-42.

Παλαιοκρασσά-Κόπιτσα Λ., (1996) *Παλαιόπολις Ανδρου. Τα οικοδομικά από την προανασκαφική έρευνα*, Αθήνα.

Πάλλας Ι. Δ., (1963) Ανασκαφαί Λεχαίου, *Αρχαιολογικόν Δελτίον* 17 (1961/2): Χρονικά, Αθήναι, 69-78.

Πάλλας Ι. Δ., (1965) Ανασκαφαί εν Λεχαίω, *Πρακτικά Αρχαιολογικής Εταιρείας*, Αθήναι, σ. 136-166.

Πάλλας Ι.Δ., (1965) Ανασκαφή Βασιλικής Λεχαιού, *Πρακτικά Αρχαιολογικής Εταιρείας* 1959, Αθήναι, σ. 126-140.

Πάλλας Ι. Δ., (1967) Ανασκαφικές έρευνες στο Λέχαιο, *Πρακτικά Αρχαιολογικής Εταιρείας*, Τόμος 120, Αθήναι, σ. 137-166.

Πανάγος Χ.Θ., (1968) *Ο Πειραιεύς, Οικονομική και ιστορική έρευνα από των αρχαιοτάτων χρόνων μέχρι του τέλους της ρωμαϊκής αυτοκρατορίας*, Αθήνα (2η έκδοση με νεότερα στοιχεία για την τοπογραφία και την οικονομική ζωή του Πειραιά από τον Έφορο Αρχαιοτήτων Γ. Σταϊνχάουερ, Αθήνα 1995).

Παπαχατζής Νικόλαος, (1974) *Παυσανίου Ελλάδος περιήγησις*, Τόμος Ι, Αττικά, Αθήνα.

Παρασκευαΐδης Π., (2008) Περιδιάβαση στο λιμάνι της αρχαίας Αντισσας, μετέπειτα Αγίων Θεοδώρων στο *Πρακτικά 4ου Πανελληνίου Συνεδρίου Διαχείρισης και Βελτίωσης Παρακτίων Ζωνών*, Μυτιλήνη 23-27 Σεπτ. 2008, ΕΜΠ, Εργαστήριο Λιμενικών Έργων, Αθήνα, σ. 223-232.

Ραουζαίου Παυλίνα, (2003) *Η αρχαιολογία των κυκλαδικών πόλεων*, Μεταπτυχιακή διατριβή, Πανεπιστήμιο Θεσσαλίας, Βόλος.

Σημαιοάκης Στυλιανός, (2005) *Συστηματική, βιογεωγραφία και στοιχεία οικολογίας των χειλοπόδων του νοτίου Αιγαίου*. Διδακτορική Διατριβή. Πανεπιστήμιο Κρήτης, Τμήμα Βιολογίας, Ηράκλειο, Κρήτη.

Σίμωνι Α., (1993) Σάμος. Αρχαίο λιμάνι Σάμου (δεύτερη περίοδος ανασκαφικής έρευνας), *Αρχαιολογικόν Δελτίον* 48, *Χρονικά* Β.2 1998, σ. 592-595.

Σίμωνι Α., (2010) Ο κλειστός πολεμικός λιμένας της αρχαία πόλης της Σάμου, *Αρχαιολογία και Τέχνες*, Τεύχος 114 σ. 114-116.

Σπονδύλης Η., (1998) Ένα βυθισμένο λιμενικό έργο στον Οτζιά Κέα στο Λ. Γ. Μενδώνη - Α.Ι. Μαζαράκης Αινιάν (επιμ.) *Κέα - Κύθνος: Ιστορία και Αρχαιολογία, Πρακτικά Διεθνούς Συμποσίου 22-25 Ιουνίου 1994*, Αθήνα 1998.

Σταϊνχάουερ Γιώργος, (1998) *Τα μνημεία και το Αρχαιολογικό Μουσείο του Πειραιά*, Αθήνα.

Σταϊνχάουερ Γιώργος, (2000) Αρχαίος Πειραιάς: Η πόλη του Θεμιστοκλή και του Ιππόδαμου στο Σταϊνχάουερ Γιώργος - Μαλικούτη Ματίνα - Τσοκόπουλος Βάσιας-Γκανιάτσας Βασίλης, *Πειραιάς: Κέντρο ναυτιλίας και πολιτισμού*, Αθήνα, σ. 9- 123.

Navis II Project, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200, B-1049 Brussels. Retrieved on July 10, 2016 from: <http://www2.rgzm.de/Navis2/Home/Frames.htm>.

Υπουργείο Πολιτισμού και Αθλητισμού. Retrieved on July 10, 2016 from: <http://www.yppo.gr/0/gindex.jsp>.

Zea Harbor Project. Retrieved on July 10, 2016 from: http://www.zeaharbourproject.dk/4/4_01_01_03.htm.

Νάρκης Νικόλας (2015), Εργασία με θέμα «τα Μακρά τείχη». Retrieved on July 16, 2016 from: <http://slideplayer.gr/slide/2939670/>.

Γενική Γραμματεία Αιγαίου και Νησιωτικής Πολιτικής. Retrieved on July 16, 2016 from: <http://www.ypai.gr/atlas/thesi.asp?idthesis=279>.

Πεντάλοφο- Ποδολοβίτσα. (2009-2016). Αρχαίος ιστορικός οικισμός δήμος Οινιάδων. Η ιστορική πορεία των 3.000 χρόνων. Retrieved on July 20, 2016 from: <http://www.pentalofo.gr/axiotheata/oiniades.aspx>.

Άνδρος σήμερα. (2013). Αρχαία Παλαιόπολη. Retrieved on July 20, 2016 from: http://androssimera.blogspot.gr/2013/06/blog-post_5.html.

Εφορεία Ενάλιων Αρχαιοτήτων. Ευρήματα και ανασκαφές σε συνεργασία με το Ινστιτούτο Εναλίων Αρχαιολογικών Ερευνών. Retrieved on July 10, 2016 from: <http://www.yppo.gr/0/anaskafes/pdfs/EEA.pdf> pp. 387-392.

Υπουργείο Πολιτισμού και Αθλητισμού. Δελτίο τύπου (25/09/06), Υποβρύχια αρχαιολογική έρευνα για την αποτύπωση του αρχαίου λιμένα της Κύθνου. Retrieved on July 14, 2016 from: www.culture.gr.

Kythnos Excavation Project (1990-2014). Kythnos- Vryokastro. The ancient polis of Kythnos. Retrieved on July 10, 2016 from: <http://extras.ha.uth.gr/kythnos/index.php?page=sites-town>.

Archaeology and Arts. (2016). Αρχαία ναύαγια εντοπίστηκαν στη Δήλο. Αποτελέσματα έρευνας-αποτύπωσης. Retrieved on September 09, 2016 from: <http://www.archaiologia.gr/>.

Υπουργείο Πολιτισμού και Αθλητισμού. Δελτίο τύπου (28/06/16), Αποτελέσματα έρευνας – αποτύπωσης στη Δήλο. Retrieved on September 09, 2016 from: www.culture.gr.

Καραδήμα Χ., (2003) Τα κρασιά της Θάσου. Retrieved on September 09, 2016 from: <http://www.thassos-island.gr>.

Σκούφης Κώστας, (2012), Βόρειο και νότιο λιμάνι Μυτιλήνης. Retrieved on September 09, 2016 from: <http://www.ellinikiaktoploia.net/a-5/>.

Map data (2016) Google. Retrieved on September 09 and 30 2016 from: <http://www.gosur.com/map/?satellite>.

Αρχοντίδου-Αργύρη Αγλαΐα (2014), Αρχαίοι λιμένες της Μυτιλήνης. Retrieved on July 07, 2016 from: <http://www.blod.gr/lectures/Pages/viewlecture.aspx?LectureID=1396>.

(2013) Αρχαία Άντισσα, Άγιοι Θεόδωροι, Οβριόκαστρο. Retrieved on September 13, 2016 from: http://vaspik.blogspot.gr/2013/01/blog-post_9798.html.

Μποσνάκης Δημήτριος και Σκέρλου Ελπίδα (2012) Υπουργείο Πολιτισμού και Αθλητισμού. Αγορά - Λιμένας Κω. Ιστορικό. Retrieved on September 13, 2016 from: (http://odysseus.culture.gr/h/3/gh351.jsp?obj_id=5142).

Cartwright Mark, (2013) Ancient History Encyclopedia. Delos. Retrieved on October 06, 2016 from: <http://www.ancient.eu/delos/>.

Theodoulou Theotokis, (2016) in National Technical University of Athens, School of Civil Engineering (limenoscope), Ephorate of Underwater Antiquities (<http://limenoscope.ntua.gr/>).

Pakkanen Jari, Baika Kalliopi, Evangelistis Dionysios, Papatheodorou George, and Geraga Maria, Kyllene Harbor Project in <http://www.finninstitute.gr/en/kyllene>.

Vlachaki Foteini, Piraeus: Cantharus, Zea, Munichia in *Navis II Project*, European Commission Directorate General X, Information, Communication, Culture, Audiovisual Culture and Audiovisual Policy, Rue de la Loi 200 , B-1049 Brussels <http://www2.rgzm.de/Navis2/Home/Frames.htm>.