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Peter Ettel · Ursula Warnke (eds)

HARBOURS AS OBJECTS OF INTERDISCIPLINARY RESEARCH – ARCHAEOLOGY + HISTORY + GEOSCIENCES

International Conference »Harbours as objects of interdisciplinary research – Archaeology + History + Geosciences« at the Christian-Albrechts-University in Kiel, 30.9.-3.10.2015, within the framework of the Special Research Programme (DFG-SPP 1630) »Harbours from the Roman Period to the Middle Ages«

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CONTENTS

Inland Navigation

FOREWORD

The Priority Programme 1630 »Harbours from the Roman Period to the Middle Ages« funded by the German Research Foundation (Deutsche Forschungsgemeinschaft) in the years 2011-2018 has made it its priority to unite and connect multidimensional approaches to harbour research within the vast research area of the North Atlantic to the Mediterranean. Modern research of the last three to four decades has particularly shown how the integration of geophysical and geoarchaeological methods has brought new insights into interdisciplinary and interpretational approaches. Thus the logical consequence was to dedicate the first international conference on the framework of the Priority Programme to this approach and its wide discussion. It took place from 30 September to 3 October 2015 with the title »Harbours as objects of interdisciplinary research – Archaeology + History + Geosciences«. About 130 participants from 15 nations with 70 lectures presented their work approaches and results within the five sections of the conference: »Plenum keynote-lectures«, »Geophysics and Field Research: Developing methods«, »Geoarchaeology: Changing Harbour Environments«, »Archaeological Features: Harbour Facilities and Infrastructure«, »Written and Iconographic Sources: Complementing the Material Evidence«. The ceremonial address of the evening was given by Sabine Ladstätter (Vienna) on the harbour of Ephesos. On the last day of the conference the participants visited the Viking Museum Haithabu as well as exhibitions at the Schleswig-Holsteinisches Landesmuseum Schloss Gottorf in Schleswig.

Subsequent to the conference in Kiel, the initiators of the Priority Programme decided on what at first glance appears to be an unusual publication strategy in which the predominantly archaeologically and historically oriented papers are being published in the present volume, whereas some mainly geophysical and geoarchaeological papers will be published in Quaternary International Special Issue »Integrated geophysical and (geo)archaeological explorations in wetlands« (guest editors: Christoph Zielhofer, Wolfgang Rabbel, Stefanie Berg-Hobohm, Tina Wunderlich), thereby reaching different milieus, which are, however, interconnected by their interdisciplinary research on harbours. Consequently, the thematic structure of the present volume will differ from the actual conference and the submitted contributions are arranged regionally as well as topically.

Our thanks go especially to Ilka E. Rau, who was both responsible for organising the conference as well as for the editorial responsibilities of this volume. Moreover, our thanks go to the editorial team of the RGZM in Mainz.

The initiators of the SPP 1630 »Harbours from the Roman Period to the Middle Ages«
Claus von Carnap-Bornheim
Falko Daim
Peter Ettel
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ALKIVIADIS GINALIS

EMPEROR OR BISHOP?

SKIATHOS AND THE BYZANTINE HARBOUR ARCHITECTURE IN THE 6TH CENTURY AD

As part of the study of Byzantine harbour infrastructures of the Aegean, a joint coastal and underwater archaeological project on the coastal infrastructures and maritime heritage of Skiathos was initiated in 2011 by the present author as external scientific partner of the Greek Ephorate for Underwater Antiquities (EEA) in cooperation with the former 13th Greek Ephorate for Prehistoric and Classical Antiquities and the 7th Greek Ephorate for Byzantine Antiquities (now Greek Ephorate for Antiquities of Magnesia).

The island of Skiathos belongs to the Thessalian archipelago of the Northern Sporades, also called Skopeloi or Magnesian islands, situated in the north-western Aegean Sea. Due to the island's crucial strategic position, lying off the northern entrance to the Euboean and Pagasetic Gulf, together with the favourable geographical and physical conditions of its broad harbour bay[1], Skiathos functioned as an important regional and supraregional station for the trading routes and shipping lanes of the Aegean from classical antiquity[2]. Accordingly, since 2012 a number of sites, including harbour installations and other coastal infrastructures such as *villae maritimae*, as well as more than ten wreck sites of the classical to Byzantine periods have been detected and documented around the island under the auspices of the Ephorate for Underwater Antiquities[3]. The main area of investigation, however, is the harbour bay of the homonymous town of Skiathos, located on the eastern side of the island (**fig. 1, 1**). A Venetian harbour fortification, the so-called Bourtzi, located on a rocky islet off the town, divides the broad harbour bay into an eastern and southern harbour area (**fig. 1, 2**).

Particularly the southern or so-called Old Harbour is currently the subject of intensive studies the first preliminary results of which will be presented here. It is defined by a rocky slope towards the acropolis of the town on its western side and the Venetian harbour fortification of Bourtzi on its eastern side, forming a harbour basin of approximately 2.4 ha (**fig. 2**). In the course of investigations, several harbour features consisting of two breakwaters and a quay with a central jetty could be documented (**fig. 3**). The most prominent one constitutes the harbour's western breakwater (**fig. 4**).

THE WESTERN BREAKWATER

The existence of this quite conspicuous breakwater has been known and used by local fishermen for centuries[4] until it was officially reported by the German Professor H. N. Ulrichs in 1863[5]. However, apart from a brief five-line description by Fragkoulas in 1995[6], it has never been the subject of detailed study prior to the present investigation. Despite the fact that in modern times the breakwater has been frequently used for anchoring fishing boats, its structure is almost entirely preserved. It has an east-west orientation, starting from a group of rocks protruding from the water surface and limiting the harbour to the west. With a total length of around 47 m, it closes approximately one third of the harbour entrance from the west. Its width of 50 m, however, lends the structure a more uniform symmetry. The breakwater has a current height of 1.4 m at its western starting point and reaches a height of 5 m at its eastern end. It consists of two different construction parts: an internal and an external. The internal core section is built of a mixture of quarry

1

2

Fig. 1 **1** the harbour bay of Skiathos. – **2** division of harbour area. – (Photos Greek Ephorate for Underwater Antiquities; graphics A. Ginalis).

rubbish and small stones, while its external part consists mainly of huge raw rock boulders (**fig. 5, 1**). The breakwater is currently situated 0.5 m below the present water level. Despite the change in sea level since antiquity[7], the breakwater probably did not protrude a lot from the sea even at the time of its construction. Nonetheless, the breakwater can be identified as of type »Mound Breakwater«[8]. The grade of the slope differs between its northern, southern and eastern ends. While the northern end drops quite abruptly with a steep angle, the angle of the slope becomes slightly flatter at the eastern end and increasingly towards its southern end. The gentle inclination of the breakwater towards the south starts nearly from the middle of the structure, which thus gives the construction a high stability against the strong southern winds and absorbs the force of the waves from the open sea. Simultaneously, this would have allowed the waves to break over, creating currents within the harbour basin in order to prevent siltation. The whole inner side of the breakwater from the central area up to its northern end possesses an approximately 35-40 m long and

Fig. 2 Southern harbour basin. – (Photo Greek Ephorate for Underwater Antiquities; graphics A. Ginalis).

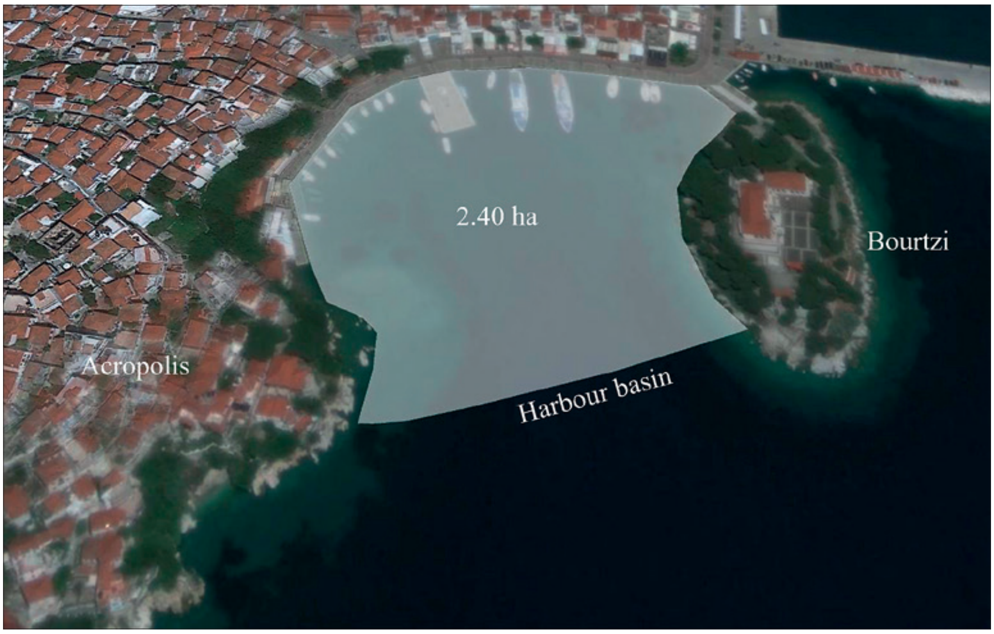
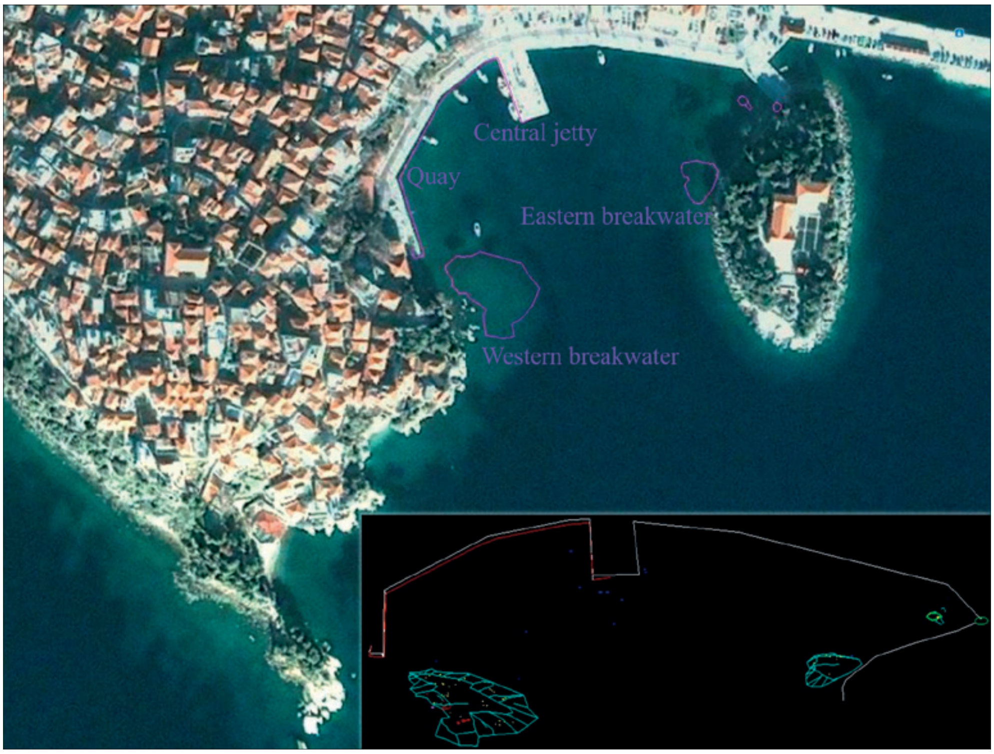


Fig. 3 Harbour infrastructure. – (Photo Greek Ephorate for Underwater Antiquities; graphics A. Ginalis).



28-30m wide flat surface. Big parts of that surface show residues of mortar, encrusted with the rubble filling of the breakwater's core, which acted as binding material for blocks. This suggests the possible existence of a mole construction of an estimated length of 27-35m and an estimated width of 26-28m. In fact, at the southern end of the surface as well as on the southern slope, structural remains bedded into mortar could be verified. Although partly fallen off the slope, these still form the southern line of the mole. Big concrete blocks at the bottom of the breakwater's eastern end (**fig. 5, 2**) indeed attest the former construction of a mole[9], which probably broke off and fell down from the surface of the breakwater. The concrete blocks of the mole were bound to the breakwater by the use of mortar as well as with additionally fixed metal rods bored through the blocks. Thus the mole architecture provided strength and resistance against the forces

Fig. 4 Western breakwater. – (Photo A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

of nature. No signs of a harbour fortification could be found. This shows that apart from acting against siltation, the main purpose of the breakwater was to support a mole construction for commercial and travel-orientated activities. Consequently, based on its architectural and functional characteristics, a *terminus post quem* of the Roman imperial period and especially the time of the *Pax Romana* can be suggested.

Additionally, on a protruding rock forming the western beginning of the breakwater, an early Byzantine rock inscription (**fig. 6**) is located. Reading Ο ΑΓΙΩΤΑΤΟϹ ΚΕ ΜΑΚΑΡΙΩΤΑΤΟϹ ΑΙΠΙϹΚΟΠΟϹ ϹΤΡΑΤΩΝ ΑΙΚ ΤΩΝ ΙΔΙΩΝ ΑΙΚΤΙϹΕ ΤΟΝ ΜΩΛΟΝ, which is to be translated as »The most saintly and blessed Bishop Straton built the mole from his own resources«[10], finally verifies the existence of a mole and eventually the main purpose of the breakwater. Although the inscription was first noted together with the breakwater by Ulrichs in 1863, it was initially published by Fredrich and Wace in 1906[11]. Only about 30 years later, Fragkoulas provided a first critical edition and short analysis of its impact on the church history of the island[12]. It seems that the fairly eroded front face has probably been partly cut and roughly polished, just to leave enough space for the writing. However, anomalies of the surface suggest that either the space has not been calculated well or the work had initially been planned differently and finally finished by using the rough limited space which goes below the present water surface. Unfortunately, the lines of the text which constantly lie under water are not preserved anymore. As such, the surviving writing starts from the present water surface and contains nine of at least ten initial lines of capital Greek letters.

Although the date of the inscription is missing[13], based on the characteristics of the letters a rough date between the 6th and 8th century AD has been suggested. This is supported by the fact that the inscription refers to the involvement of the church by mentioning a so far unknown bishop called Straton. According to the island's church history, while a *terminus post quem* is set by the first bishop of Skiathos, Demetrios, mentioned in 530 AD, the existence of an independent diocese of Skiathos sets a *terminus ante quem* of the anti-iconoclast revolt of the Theme of Hellas in 726/727 AD[14].

The question of its precise date is in fact also closely related to the question of how the dedicative inscription is to be interpreted. Did the bishop really construct the mole or just repair it? And if it had indeed been constructed by the bishop, is the construction of the breakwater also to be associated with it or does its superstructure constitute a later addition? Surrounding archaeological material (**fig. 7**), including an ornamental

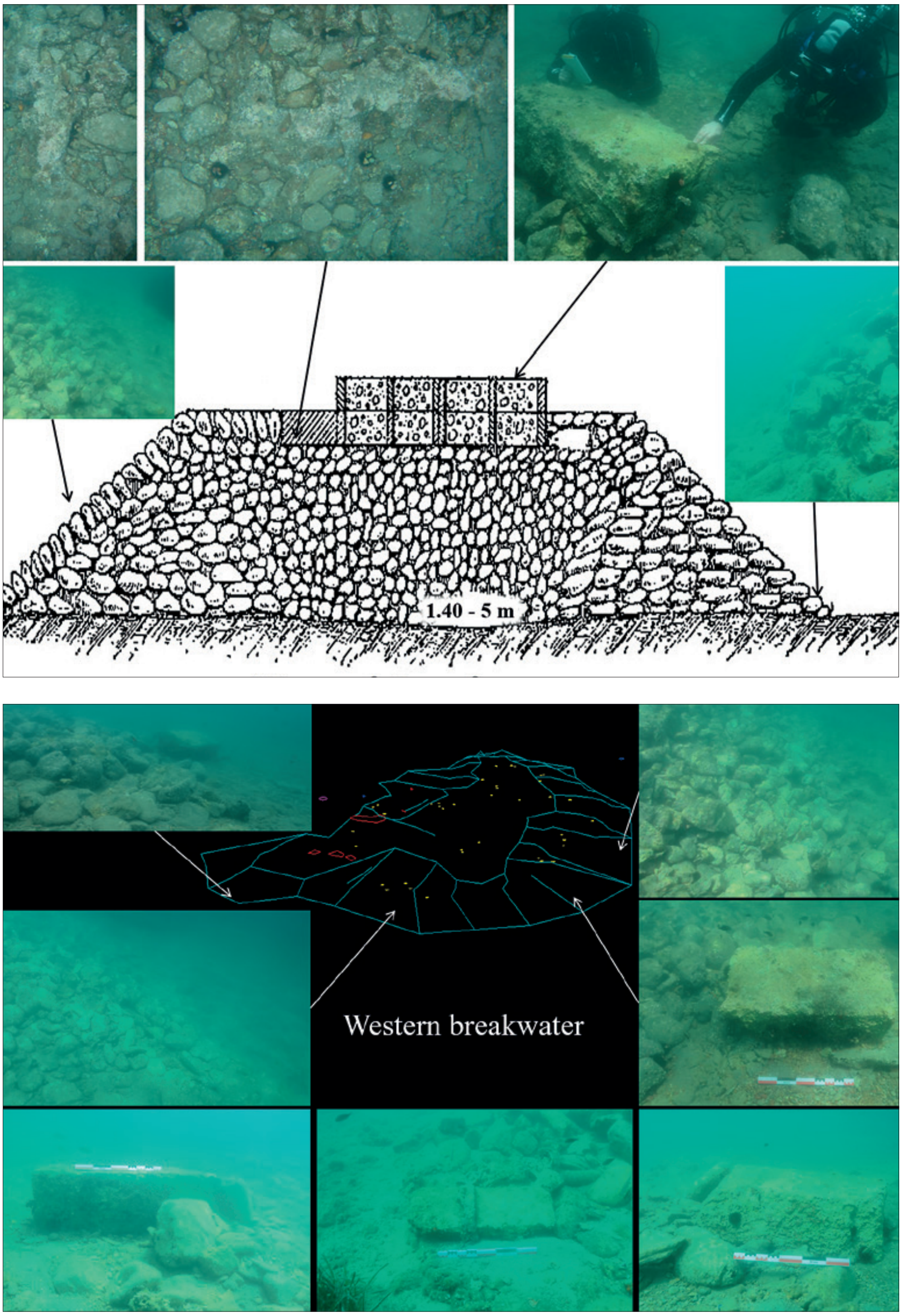


Fig. 5 **1** western Breakwater composition. – **2** mole construction blocks. – (1 modified figure after Cornick 1958-1962, 119 fig. 11, 3; photo A. Ginalis; 2 photos/graphics A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

marble object at the western end, a circular crushing stone of a lever and drum or screw type oil press on the inner side, as well as scattered ceramics such as late Roman 1 and late Roman 2 amphorae[15], all suggest a date between the 6th and 7th century AD for the use of the mole. As such, supported also by numerous dedicative inscriptions from the reign of Justinian I[16], a date to the 6th century AD and particularly the reign of Justinian I seem likely. As for the breakwater, its architectural characteristics may indicate that in its initial phase the breakwater simply may have been built for the protection of the harbour and prevention of siltation. However, even though mound breakwaters had been common since the Roman imperial period[17], its relation to the sea level in conjunction with the mole construction, as well as its close connection to the

Fig. 6 Rock inscription. – (Photos/graphics A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

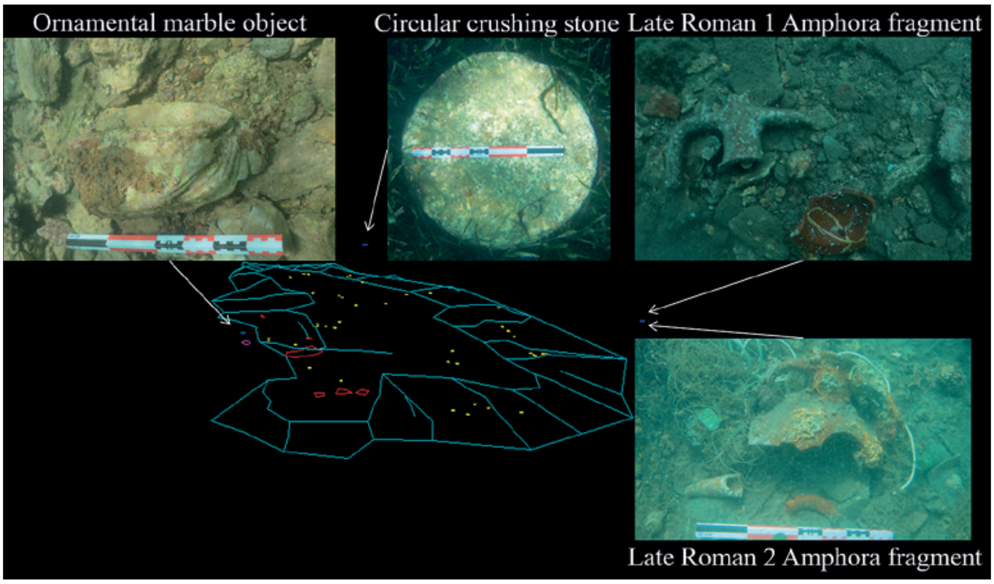


Fig. 7 Archaeological material surrounding the western breakwater. – (Photos/graphics A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

quay and the central jetty (see below), rather suggests an association with its superstructure. Consequently, it can be assumed that both features were constructed together as a »private« dedication or donation to the contemporaneous imperial works, probably as part of a church-backed initiative.

THE QUAY

Following the western breakwater towards the north, a quay facility running along the western and northern coastline of the harbour bay is preserved beneath modern superstructures (**fig. 8**). Although the original

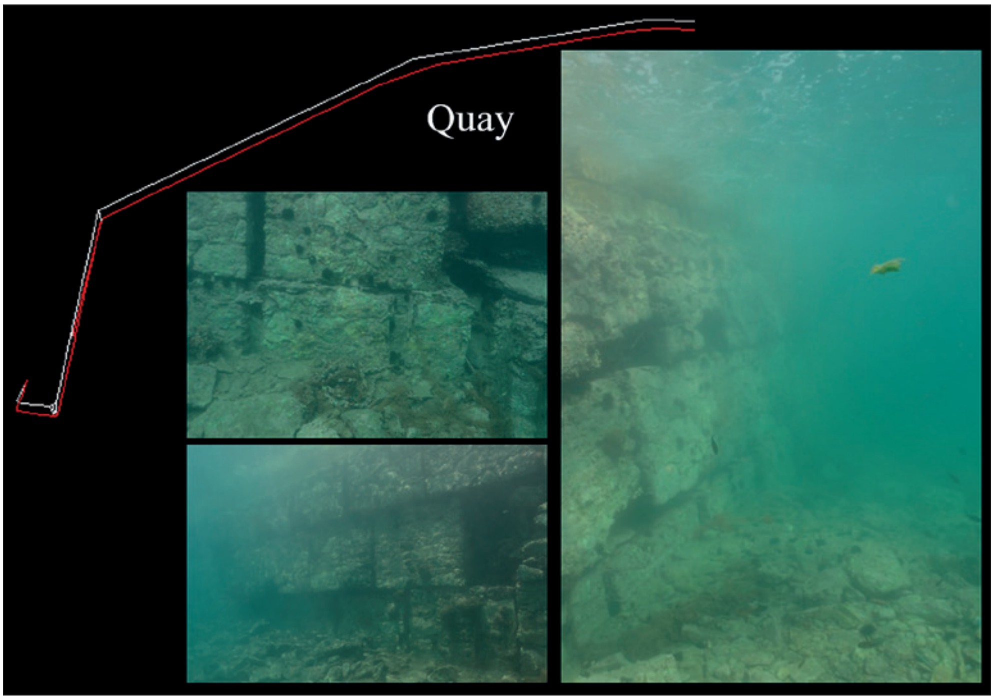


Fig. 8 Quay construction. – (Photos/graphics A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

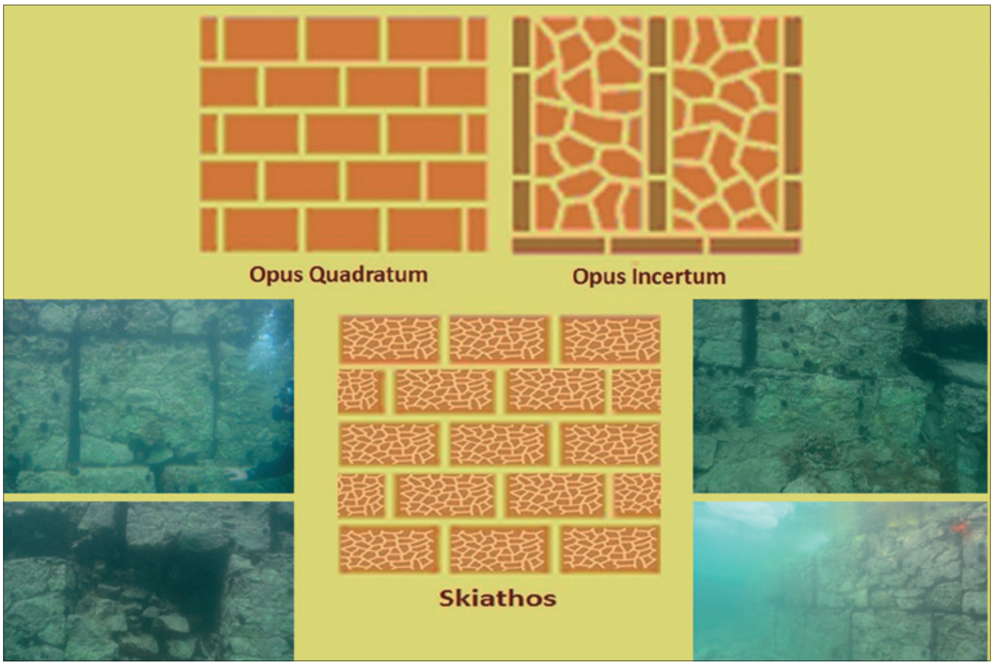


Fig. 9 Quay masonry. – (Photos/graphics A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

quay line is limited to the western harbour basin by a central jetty (**fig. 3**), it shows a considerable length of around 137 m and an estimated width of 5.5 m, forming five sides of a hendecagon.

The quay is built of huge blocks of broken rubble stones. The shape of these blocks, consisting of a mixture of quarry stones and mortar, vary mostly between rectangular and almost cuboid with average lengths of 1 m and heights of 0.6 m. Despite the use of irregularly shaped and randomly placed uncut rubble stones, the quay does clearly not consist of rubble masonry forming a so-called *opus incertum* or *opus antiquum*, since the stones are set into a core of mortar forming regularly shaped blocks. However, in contrast to sites such as Leptis Magna or Cenchreae[18], it does not consist of ashlar masonry forming a so-called *opus quadratum* either, since the blocks are formed from quarry stones and mortar (**fig. 9**). Additionally, the blocks

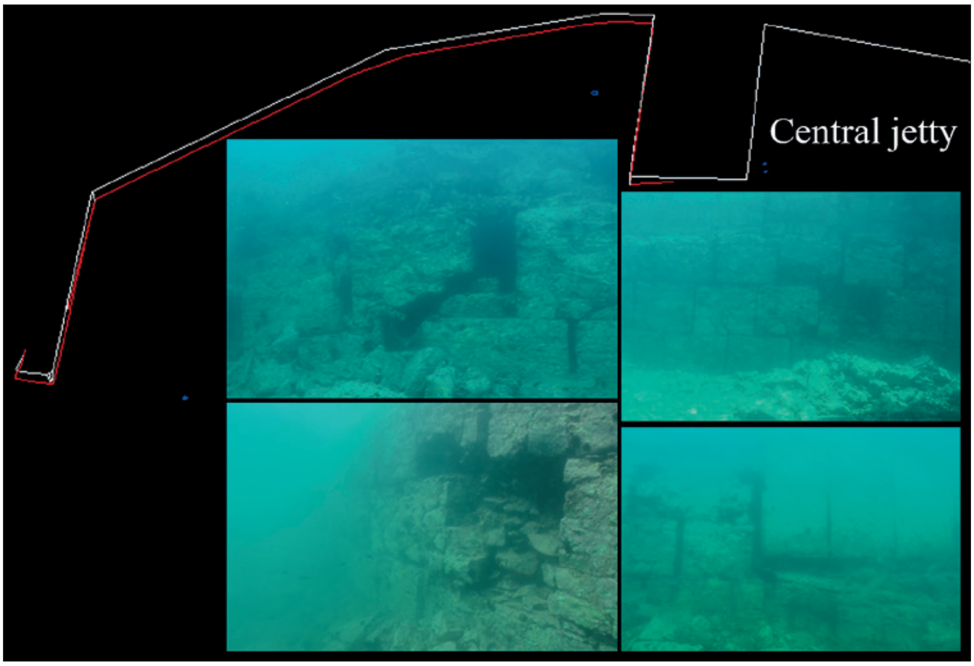


Fig. 10 Central jetty masonry. – (Photos / graphics A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

show extremely smooth surfaces. As such, similar to hydraulic concrete structures described by the Roman architect and engineer Vitruvius Pollio and later by the Byzantine scholar and historian Procopius of Caesarea as *opus caementicium*[19], these suggest that the blocks of rubble-mortar mixture were produced by using timber formworks. However, compared to harbour features of other sites such as the jetties and mole structures at the Theodosian harbour at Constantinople, the Herodian harbour of Sebastos at Caesarea Maritima or Portus[20], no sinking of the block's wooden formworks prior to their filling with the rubble-mortar mixture had been practised. In fact, it rather seems that the blocks had been produced individually in uniform wooden formworks on land and subsequently used for the construction of the quay by putting them on top of each other in a slightly displaced order. This consequently shows an entirely new approach to and nature of the so far known *opera caementicia*, by using a mixture of various masonry techniques: the *opus quadratum* as a basic form, added to with blocks of *opus incertum*. Despite the resistance and high consistency of the masonry, parts of the mortar got washed out, causing the breaking away of the rubble stones, particularly at the corners. Finally, due to modern superstructures, unfortunately it is impossible to investigate and reconstruct the interior composition and architectural characteristics of the original quay. As such, it remains unclear whether the quay was built entirely of those rubble-mortar blocks or if it possessed transversal walls as retainers for non-consolidated fillings, such as at other harbour sites like Thessalian Thebes, Larymna, Aegina or Anthedon[21].

THE CENTRAL JETTY

The centrally located jetty (**fig. 3**) protrudes from the quay into the harbour basin, dividing the old harbour into a western and an eastern basin. Simultaneously, it forms the eastern end of the Byzantine harbour, limiting latter to the western basin. Similar to the quay, the jetty is covered by modern superstructures and only partly preserved, providing the original phase exclusively at its western side. However, its remains reveal that the dimensions of both the length and the width of the original phase of the jetty were much smaller than the modern slightly trapezoid superstructure. While the original jetty is only fully preserved up to a length

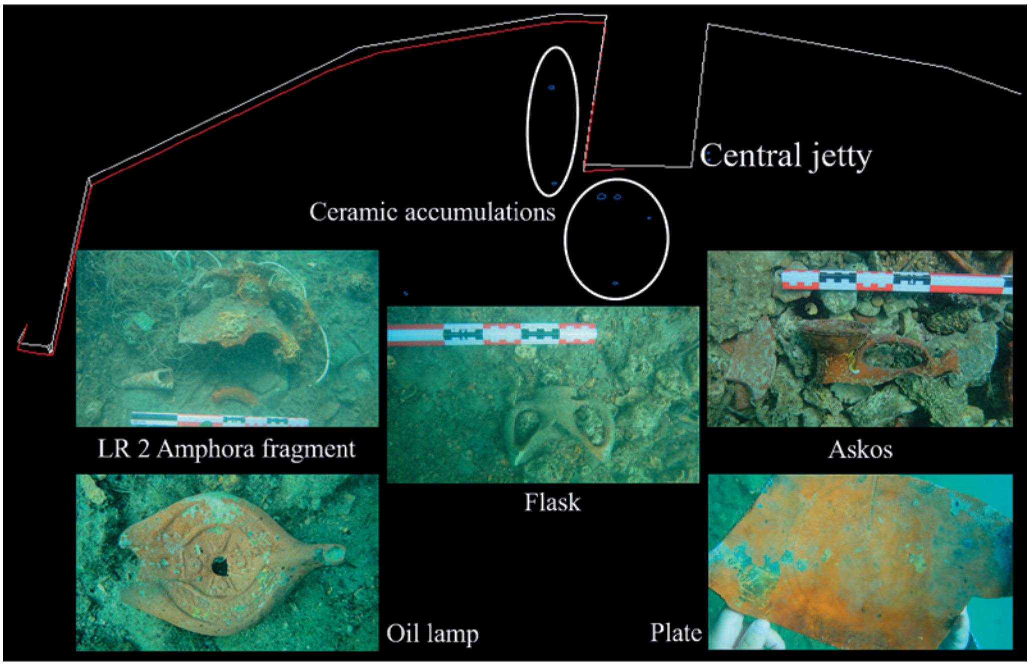


Fig. 11 Ceramic accumulations in the western harbour basin. – (Photos/graphics A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

of 15 m, it possesses a total and partly preserved length of 30 m, as well as a width of 12 m. Nevertheless, as the jetty continues into the harbour basin to a depth of more than 5 m, the original structural remains still consist of one to two rows of blocks, so that the modern concrete blocks are actually just set on top of the ancient remains, using them as a substructure and base. Concerning its composition, the jetty is built of huge blocks. The material of the blocks is identical with that of the quay, consisting of broken rubble stones mixed with mortar (**fig. 10**). The blocks of the jetty are roughly shaped cubes with average lengths of 0.90 m and heights of 0.72 m. In contrast to the quay facade, due to its enlargement by the modern superstructure, major parts of the jetty are heavily damaged, resulting in entire blocks breaking away. However, the identical material and uniform construction method used for both the quay and the jetty suggest that both features can be seen as a homogeneous harbour installation and therefore without doubt constructed together.

As for the dating of this homogeneous harbour feature, high quantities of ceramic material were found scattered over the bottom of the entire western harbour basin. Among the jumble of fragmentary material such as jugs, jars, plates and amphorae, along the western side of the jetty two main ceramic accumulations, one at the end of the jetty and one towards the corner of the quay, have been able to be distinguished and documented so far. Apart from mainly globular late Roman 2 and 3 amphora types, these include a plate, an askos and flasks of type African Red Slip ware (**fig. 11**). Together with further late Roman 2 amphorae and a North African oil lamp at the southern end of the jetty, these can be dated roughly between the 6th and 7th centuries AD[22]. Consequently, similar to the breakwater and the mole, a 6th century AD date seems possible again.

Concerning the features' architectural characteristics, even though the quay and jetty structures show a similar construction technique of *opus caementicium*, the method of use is totally different. Instead of the »classical« way of constructing hydraulic concrete features, the formwork was used for the production of individual stone blocks on land. Furthermore, the filling consists of raw quarry stones, which may be waste material originating from a quarry on the mainland, possibly from the nearby Pelion Peninsula. Looking at Procopius' descriptions of harbour construction techniques in Byzantium, some kind of a continuation of Roman tradition is attested until the 6th century AD. However, in his account, Procopius merely describes the construction of breakwaters and moles, similar to earlier works such as Caesarea Maritima. Constructing

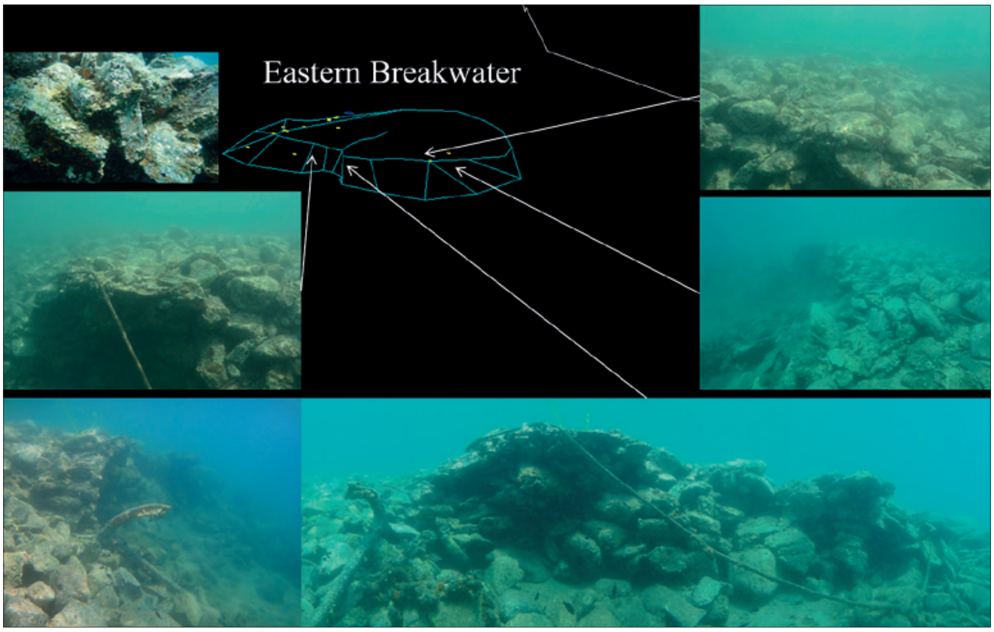


Fig. 12 Eastern breakwater composition. – (Photos/graphics A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

hydraulic concrete features along the coastline such as a quay may not indeed have required the sinking of a timber formwork. On the contrary, the construction of a uniform hydraulic concrete jetty into a harbour basin with a depth of more than 5 m would have required some kind of caisson. This is attested by jetties both at major imperial sites such as the Theodosian harbour in Constantinople and local sites such as a private villa estate on Skiathos, the so-called Villa Maritima of Lazareta[23]. However, both are of earlier date[24]. As such, the »classical« way of constructing hydraulic concrete jetties up to the 4th-5th centuries AD, as shown above, sets a *terminus post quem* for the quay and the central jetty at the old harbour. Considering the fact that the quay and the jetty did not have to provide the same high stability against the forces of the open sea as did the mole structure, the above-described equally efficient, but faster and lower-priced way of »mass production« using local waste material was suddenly enhanced. Consequently, we may see a transition period here, reflecting a continuing Roman tradition, but a different adaption for harbour architecture, at least for harbour internal installations such as the quay and the jetty. This can be explained by a period of crisis and geopolitical instability such as in the 6th century AD. The architecture of the present installation may therefore be rather associated with the inevitability of an extensive building programme carried out under Emperor Justinian I.

THE EASTERN BREAKWATER

Finally, at the eastern harbour basin, another breakwater, located at the western side of the Venetian fortification of Bourtzi just opposite the western breakwater, could be verified and documented (**fig. 3**). Like the western one, the eastern breakwater has an east-west orientation, consequently closing the harbour entrance from the east. Although the breakwater is not completely preserved, similar to its western counterpart the remains suggest a uniform symmetric structure. The breakwater is currently situated 1.5 m below the present water level and has a current maximum height of 2.9 m at its western end. It shows the same type of construction as the western breakwater, consisting of two different parts: an internal and an external part. Similarly, the internal part or core section is built of a mixture of quarry rubbish and small stones, which is subsequently covered by large rock boulders (**fig. 12**). Furthermore, similar to the western breakwater, the grade of the slope differs between its northern and southern end. While the northern end drops abruptly with a relatively steep angle, the southern end slopes at a slight angle. The gentle inclination of the breakwater towards the south gives the construction high stability against the strong southern winds and additionally absorbs the force of the waves of the open sea. However, in contrast to the western breakwater, much bigger parts of the surface show residues of hydraulic concrete-like mortar, heavily encrusted with the rubble filling of the breakwater's core. The eastern breakwater also demonstrates a thicker concrete composition, both at the breaking point and at another part of the breakwater, which broke off the western front and currently forms a separate chunk of that solid rubble-mortar composition. Additionally, with a current depth of 1.5 m, the eastern breakwater is set around 1 m lower than its western counterpart. So, taking into account the change of the water level, this rubble mound construction did not protrude from the sea. Consequently, the eastern breakwater seems not to represent a »mound breakwater«, but is rather to be identified as of type »composite breakwater«[25]. While composite breakwaters were built mainly in regions with a wide tidal range, often economic reasons or architectural restrictions had been further determining factors, especially when the depth of water was too big and consequently the required quantity of rubble stones had been too large to realize the construction of the mound type. In that case the rubble mound would have formed only a substructure as a kind of foundation for vertical walls or a mole built on top of it. However, although similarly to the western breakwater, a sharp linear northern edge towards its inner side as well as ceramic fragments scattered on its surface would imply the construction of a mole; no signs of any kind of superstructure could be detected. As such, it can be assumed that in contrast to the western breakwater, the eastern one probably just acted as a protection for the eastern harbour basin by simply allowing the waves to break over in order to create currents within the harbour basin for the prevention of siltation. This is further supported by the fact that the eastern breakwater is not attached to any other harbour feature such as a quay, which would have been necessary for an additional mole construction.

Concerning the dating of the breakwater, unfortunately neither its architectural and functional characteristics nor the ceramic material could provide any precise dating evidence. So far, merely a comparison with its western counterpart allows a first attempt to place the eastern breakwater in time. In contrast to the western breakwater, the eastern one shows a thicker and totally different concrete composition, pointing to a much rougher construction method. As a result, it definitely has to be placed into a different time period than the early to middle Byzantine era. But was it constructed later or earlier? In contrast to the western harbour basin, the eastern basin revealed, apart from a series of fragmentary pieces of late Roman 2, 4, 5 and Günsenin type 3 amphorae on the surface, mainly material of the classical to Roman periods, suggesting a much earlier date. Among a jumble of broken pieces of Dressel 1B amphorae and *dolia* dating to the Augustan period of the late 1st century BC to early 1st century AD, black-glazed jars of the 4th century BC, as well as *terra sigillata* and eastern *sigillata* bowls of the 1st-2nd and 3rd-4th centuries AD have been documented together with further domestic ware and an architectural stone fragment of the Roman imperial period (fig. 13)[26]. Despite the large time span from the earliest attested material of the 4th century BC to the main corpus dating to the Roman times, both its architectural characteristics as composite breakwater and the use of hydraulic concrete support a dating to the Roman imperial period at the earliest. However, the use of a different breakwater type with much weaker architectural characteristics compared to the western breakwater does not seem reasonable for a dating to the Roman imperial period. In fact, it can be assumed that the Romans rather continued to use the classical eastern harbour of Skiathos. As such, taking into account its location adjacent to the rocky islet and consequently close relation to the Venetian fortification of Bourtzi, a construction phase of the 13th century AD in order to protect the fortification's entrance against its southern exposure seems more likely.

Fig. 13 Archaeological material in the eastern harbour basin. – (Photos A. Ginalis with permission by the Greek Ephorate for Underwater Antiquities).

CONCLUSIONS

The tiny island of Skiathos at first may appear to be a rather insignificant local production site for the regional distribution of commodities and consequently be considered as an unimportant example when it comes to the general study of harbour infrastructures. On the contrary, due to its geographical position, sitting on a historically strategically important sea route, it actually played a quite significant role in the wider Aegean Sea trade and maritime connectivity particularly from and towards Constantinople. As such, based on the concept of hinterland and foreland as the matrix of exchange and part of the network systems based on coastal navigation, Skiathos formed a port of call for merchants within the Aegean system of tramping and cabotage trade[27]. Besides numerous wreck sites in the area and around the island[28], this is first and foremost shown by major harbour construction works and extensive port activities during the Byzantine era. Connected with the shift and retreat of the residential area towards the acropolis during the early Byzantine period, the town's main harbour facilities moved from the eastern towards the southern harbour area. However, while the eastern basin of the southern harbour revealed material as early as the classical period, so far the western basin shows signs of use only starting in Byzantine times. Suggesting a general date of the 6th century AD for the harbour features analysed above, an association with the extensive building activities in central Greece under Emperor Justinian I may be considered. This is further supported by the extensive ceramic finds of amphorae and tableware, which reveal a strong connection to the new North African markets as a result of its annexation to the Byzantine Empire in the 530s. If that is the case, Justinian's building programme not only included the improvement of fortifications and water supplies or the construction of churches but also the construction of Byzantine harbour sites.

Beyond the physical awareness of the extent of harbour works in Byzantine times and particularly the 6th century AD, Skiathos also reveals an actual development status of architectural characteristics and traditions of certain harbour features for the first time. Looking at Vitruvius' and Procopius' descriptions of

Roman and Byzantine harbour construction techniques up to the 6^{th} century AD, a change of implementation reflected by a continuation of Roman tradition but different adaption for a faster and lower-priced but equally efficient »mass production« is evident. Taking into account the next stage of development of the 7^{th}-8^{th} centuries AD, shown for example by the southern harbour of Demetrias and the outer harbour of Thessalian Thebes[29], the 6^{th} century AD therefore forms a crucial transition period in harbour traditions, with Skiathos as an important representative. The apparent need for this harbour installation with a new quay line and central jetty is based on sudden heightened commercial activities. Together with the construction of the mole, which allowed and resulted in a further increase in mooring space within the harbour basin for the loading and unloading of trade commodities, a flourishing trade from the 6^{th} to at least the 8^{th} century and later from the 10^{th} to the 13^{th} century AD is observable. Wreck sites as well as pottery remains and the circular crushing stone of an olive oil or wine press situated at the breakwater's inner side, signify the role of Skiathos as an important production area for agricultural goods, as well as its involvement in Thessaly's regional and supraregional trade relations.

Concerning the question of its initiative, interestingly Skiathos provides, apart from imperial central activities, also an example of a contemporaneous »private« order as a dedication or donation, a so-called *philotimia*, to the imperial works. Since Skiathos constituted a decisive junction in the Aegean, the bishop of the island apparently became involved in the island's commercial activities. As representatives and instruments of the church, clergymen often acted both as an important part of the church apparatus and as private entrepreneurs[30], shipping agricultural products of and to the various church properties. The same can be observed for Skiathos. However, here the role of the bishop and his influence on the island's commercial activities is primarily reflected by building activities, shown by the rock inscription on the western breakwater. Whether the direct impact on maritime trade as well as the influence on the construction of Skiathos' harbour facilities was commissioned by the church or privately on behalf of the bishop remains unknown. Yet, among the archaeological material in the western harbour basin artefacts such as the flasks and other African Red Slip ware or the ornamental marble fragment[31] further show a strong ecclesiastical connection which in turn indicates a general influence of the church in maritime trade activities particularly during the 6^{th}-7^{th} centuries AD. As a result, although a high amount of imperial building activities, including the construction of harbour sites, can still be observed for the 6^{th} century AD and particularly under the reign of Justinian I, the constantly increasing power and influence of the church on maritime trade, with its clergymen such as the Bishop Straton as executives, becomes obvious.

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Notes

1) Physical conditions are mainly defined by the consistence and configuration of a specific coastline, affected among many other aspects by the waves, currents, tides and winds, whereas geographical conditions characterize the location itself and its close relationship to the surrounding area. Both conditions vary quite often in the course of time, being the »primum mobile« for the survival or even success of certain coastal structures. For further information see Karmon 1985, 1-6. – Ginalis 2014, 9 ff.

2) Ginalis 2011; 2014, 75-90; forthcoming.

3) For further information see Ginalis 2014, 90-139. 147-159.

4) Numerous modern anchors, particularly along the northern slope of the breakwater, attest that latter provided good and sheltered anchorage for the western quayside even in modern times.

5) Ulrichs 1863, 239.

6) Fragkoulas 1995, 13.

7) Blackman 1973, 115-139.

8) For Mound Breakwater see Cornick 1958-1962, II, 116. 118 ff. – Ginalis 2014, 27 f.

9) For a definition and the understanding of moles see Ginalis 2014, 26. 30 f.

10) Translation by the author.

11) Fredrich/Wace 1906, 106. – Ulrichs 1863, 239.

12) Fragkoulas 1935, 111 f.; 1995, 13 f. – Further see Avramea 1989, 833. – Evangelides 1913, 36.

13) If it ever existed, it probably would have been given in the lost last lines of the inscription.

14) Fragkoulas 1935, 111 f. – Ginalis 2014, 86. 145. 153.

15) Ginalis 2014, 96 f. 102 ff.

16) Avramea 1989, 830-834. – Feissel 1989, 820-823.

17) Blackman 2008, 467 f.

18) Blackman 2008, 645.

19) Vitruvius Pollio, De Architectura, V. 12. 3-6. – Procopius Caesariensis, De aedificiis, I. 11. 18-20. – For the use of wooden formworks in context with the technology of harbour architecture see Blackman 2008, 645-647. – Gotti et al. 2008, 578-590. – Hohlfelder/Brandon/Oleson 2005, 123-137. – Olesonet al. 2004, 199-229.

20) For more information on these harbours see Blackman 2008, 649. – Ercan 2010, 121-126. 163 fig. III, 10-11. 46. – Raban 1989, 64 ff.

21) Knoblauch 1969, 104-116; 1972, 50-85. – Raban et al. 2009, 65 f. – Schäfer 1967, 531-535 figs 7. 10. – Schläger/Blackman/Schläger 1968, 52-64.

22) For further information on the ceramic material see Ginalis 2014, 103-107.

23) For the jetties at the Theodosian harbour and the use of hydraulic concrete for the construction of the substructures see Ercan 2010, 121-126 fig. III. 10-11. 46-48. – For the Villa Maritima of Lazareta on Skiathos see Ginalis 2014, 126 ff.

24) According to P. I. Kuniholm the jetty at the Theodosian harbour is of the 4th-5th century AD as is that of the jetty of the Villa Maritima of Lazareta: Ginalis 2014, 127 f. – Pearson et al. 2012, 3402-3414.

25) On composite breakwater see Cornick 1958-1962, II, 116. 118 ff. – Ginalis 2014, 27 ff.

26) Ginalis 2014, 110-116.

27) For the interpretation of physical and geographical conditions as well as that of the model of »Hinterland and Foreland« see Karmon 1985, 1-6. – For the definition and analysis of trading systems see Arnaud 2001, 61-80. – Gianfrotta et al. 1997, 154-159. – Horden/Purcell 2000, 140 ff. – Schörle 2001, 93.

28) Ginalis 2008, 115-122; 2011, 291 f.; 2014, 116-123. 133-138.

29) Ginalis 2014, 171-178. 189-193.

30) This is demonstrated by numerous written sources such as the report of the pilgrim Saewulf or that of Patriarch Leontios about a monk being synchronously a sea trader, dating to the 12th century AD: Huygens 1994, 60 f. 76 f. – Goudelis/Tsougarakis 1993, 98 ff. – Kingsley 2004, 5 f. – Kislinger 2010, 170.

31) Reminiscent of the late 6th century AD Marzamemi B shipwreck, shipping Proconnesian church marble and the Thessalian stone »verde antico« from Constantinople, the Marmara Sea and central Greece for the construction of a basilica or another episcopal building either in Sicily or Northern Africa indicates building and shipping activities by the church in the 6th century AD. For the Marzamemi or so-called church wreck see Bohne 1998, 6-17. – Kapitän 1969, 122-133. – Parker 1992, 267.

References

Arnaud 2001: P. Arnaud, Ancient sailing-routes and trade-patterns: the impact of human factors. In: D. Robinson / A. Wilson (eds), Maritime Archaeology and Ancient Trade in the Mediterranean. Oxford Centre for Maritime Archaeology 6 (Oxford 2011) 61-80.

Avramea 1989: A. Avramea, Les Constructions profanes de l'Éveque d'après l'Épigraphie et les textes d'Orient. In: F. Baritel / N. Duval / Ph. Pergola (eds), Actes du XIe Congrès International d'Archéologie Chrétienne, I. Collection de l'École française de Rome 123, Lyon, Vienne, Grenoble, Genève et Aoste 1986 (Rome 1989) 829-835.

Blackman 1973: D. J. Blackman, Evidence of sea level change in ancient harbours and coastal installations. In: D. J. Blackman (ed.), Marine Archaeology, Proceeding of the Twenty-third Symposium of the Colston Research Society. Colston Papers 23, Bristol 1971 (London 1973) 115-139.

2008: D. J. Blackman, Sea Transport, Part 2: Harbors. In: J. P. Oleson (ed.), Oxford Handbook of Engineering and Technology in the Classical World (New York 2008) 638-670.

Bohne 1998: A. Bohne, Das Kirchenwrack von Marzamemi. Handel mit Architekturteilen in frühbyzantinischer Zeit. Skyllis 1/1, 1998, 6-17.

Cornick 1958-1962: H. F. Cornick, Dock and Harbour Engineering I-IV (London 1958-1962).

Ercan 2010: A. Ercan, Yenikapı, A late antique and Byzantine harbor in Constantinople: A historical, archaeological and architectural study of the newly discovered remains [M.A. thesis Koç Univ. Istanbul 2010].

Evangelides 1913: T. E. Evangelides, Η ΝΗΣΟΣ ΣΚΙΑΘΟΣ και αι περί αυτήν νησίδες. Μελέτη τοπογραφικό-ιστορική μετά χάρτου τῆς Νήσου καί εικόνων (Athens 1913).

Feissel 1989: D. Feissel, L'Éveque, titres et fonctions d'après les Inscriptions Greques Jusqu'au VII[e] Siècle. In: F. Baritel / N. Duval / P. Pergola (eds), Actes du XI[e] Congrès International d'Archéologie Chrétienne, I. Collection de l'École française de Rome 123, Lyon, Vienne, Grenoble, Genève et Aoste 1986 (Rome 1989) 801-828.

Fragkoulas 1935: I. N. Fragkoulas, Η ΕΠΙΣΚΟΠΗ ΣΚΙΑΘΟΥ ΔΙΑ ΜΕΣΟΥ ΤΩΝ ΑΙΩΝΩΝ. Epetiris Etaireias Byzantinon Spoudon 11, 1935, 105-119.

1995: I. N. Fragkoulas, ΑΞΙΟΛΟΓΕΣ ΤΟΠΟΘΕΣΙΕΣ ΣΤΟ ΝΗΣΙ ΤΟΥ ΠΑΠΑΔΙΑΜΑΝΤΗ (Skiathos 1995).

Fredrich/Wace 1906: C. Fredrich / A. J. B. Wace, Skiathos und Peparethos. Mitteilungen des Kaiserlich Deutschen Archäologischen Instituts, Athenische Abteilung 31, 1906, 99-133.

Gianfrotta et al. 1997: P. A. Gianfrotta / X. Nieto / P. Pomey / A. Tchernia, La navigation dans l'Antiquité (Paris 1997).

Ginalis 2008: A. Ginalis, Materielle Zeugnisse der byzantinischen Seefahrt unter besonderer Beachtung der Unterwasserarchäologie [M.A. thesis Univ. Vienna 2010].

2011: A. Ginalis, The Northern Sporades from Late Antiquity to the end of Medieval times. An important junction of the Aegean trading routes. Graeco-Arabica 11, 2011, 279-294.

2014: A. Ginalis, Byzantine Ports. Central Greece as a link between the Mediterranean and the Black Sea [unpubl. Ph.D. thesis Univ. Oxford 2014].

forthcoming: A. Ginalis, Insularity and Identity in the Northern Sporades Islands: the question of Roman policy in central Greece. In: A. Kouremenos (ed.), Insularity and Identity in the Roman Mediterranean, Oxford (forthcoming).

Gotti et al. 2008: E. Gotti / J. P. Oleson / L. Bottalico / C. Brandon / R. Cucitore / R. L. Hohlfelder, A comparison of the chemical and engineering characteristics of ancient Roman hydraulic concrete with a modern reproduction of Vitruvian hydraulic concrete. Archaeometry 50/4, 2008, 576-590.

Goudelis/Tsougarakis 1993: Th. Goudelis / D. Tsougarakis, The life of Leontios, Patriarch of Jerusalem. Text, translation and commentary. The Medieval Mediterranean 2 (Leiden 1993).

Hohlfelder/Brandon/Oleson 2005: R. L. Hohlfelder / C. Brandon / J. P. Oleson, Building a Roman *Pila* in the Sea – Experimental Archaeology at Brindisi, Italy, September 2004. International Journal of Nautical Archaeology 34/1, 2005, 123-137.

Horden/Purcell 2000: P. Horden / N. Purcell, The Corrupting Sea: a Study of Mediterranean History (Oxford 2000).

Huygens 1994: R. B. C. Huygens (ed.), Peregrinationes tres. Saewulf, John of Würzburg, Theodoricus. Corpus Christianorum Continuatio Mediaevalis 139 (Turnholt 1994).

Kapitän 1969: G. Kapitän, The Church Wreck off Marzamemi. Archaeology 22, 1969, 122-133.

Karmon 1985: Y. Karmon, Geographical Components in the Study of Ancient Mediterranean Ports. In: A. Raban (ed.), Harbour Archaeology. Proceedings of the first international Workshop on ancient Mediterranean harbours Caesarea Maritima, Haifa 1983. British Archaeological Reports International Series 257 (Oxford 1985) 1-6.

Kingsley 2004: S. A. Kingsley (ed.), Barbarian Seas. Late Rome to Islam. Encyclopedia of Underwater Archaeology 4 (London 2004).

Kislinger 2010: E. Kislinger, Verkehrsrouten zur See im byzantinischen Raum. In: E. Kislinger / J. Koder / A. Külzer (eds), Handelsgüter und Verkehrswege: Aspekte der Warenversorgung im östlichen Mittelmeerraum (4. bis 15. Jahrhundert). Akten des internationalen Symposions Wien, 19.-22. Oktober 2005 (Wien 2010) 149-174.

Knoblauch 1969: P. Knoblauch, Neuere Untersuchungen an den Hafen von Ägina. Bonner Jahrbücher 169, 1969, 104-116.

1972: P. Knoblauch, Die Hafenanlagen der Stadt Ägina. Archaiologikon Deltion 27A, 1972, 50-85.

Parker 1992: A. J. Parker, Ancient Shipwrecks of the Mediterranean & the Roman Provinces. British Archaeological Reports International Series 580 (Oxford 1992).

Pearson et al. 2012: Ch. L. Pearson / C. B. Griggs / P. I. Kuniholm / P. W. Brewer / T. Wazny / L. A. Canady, Dendroarchaeology of the mid-first millennium AD in Constantinople. Journal of Archaeological Science 39/11, 2012, 3402-3414.

Oleson et al. 2004: J. P. Oleson / C. Brandon / S. M. Cramer / R. C. Gotti / M. Gotti / R. L. Hohlfelder, The ROMACONS Project: a Contribution to the Historical and Engineering Analysis of Hydraulic Concrete in Roman Maritime Structures. International Journal of Nautical Archaeology 33/2, 2004, 199-229.

Raban 1989: A. Raban, The Harbours of Caesarea Maritima. Results of the Caesarea Ancient Harbour Excavation Project, 1980-1985, I. British Archaeological Reports International Series 491 (Oxford 1989).

Raban et al. 2009: A. Raban / M. Artzy / B. Goodman / Z. Gal, The Harbour of Sebastos (Caesarea Maritima) in its Roman Mediterranean Context. British Archaeological Reports International Series 1930 (Oxford 2009).

Schäfer 1967: J. Schäfer, Beobachtungen zu den seeseitigen Mauern von Larymna in der Lokris. Archäologischer Anzeiger 82/4, 1967, 527-545.

Schläger/Blackman/Schläger 1968: H. Schläger / D. J. Blackman / J. Schläger, Der Hafen von Anthedon mit Beiträgen zur Topographie und Geschichte der Stadt. Archäologischer Anzeiger 85, 1968, 21-102 (Sonderdruck).

Schörle 2011: K. Schörle, Constructing port hierarchies: harbours of the central Tyrrhenian coast. In: D. Robinson / A. Wilson (eds), Maritime Archaeology and Ancient Trade in the Mediterranean. Oxford Centre for Maritime Archaeology 6 (Oxford 2011) 93-106.

Ulrichs 1863: H. N. Ulrichs, Reisen und Forschungen in Griechenland 11 (Berlin 1863).

Summary

Central Greece and in particular Thessaly constitutes not only an ideal region to gain equal information for the study of Byzantine ports, harbours and other coastal installations of the Early to Late Byzantine periods, but also to compare independent regional and imperial central building activities. As such, a joint coastal and underwater archaeological project on the coastal infrastructures and maritime heritage of Skiathos was initiated in 2011 by the Greek Ephorate for Underwater Antiquities (EEA) in cooperation with the Greek Ephorate for Antiquities of Magnesia. Reflecting Thessaly's maritime network through time, the investigation revealed that especially one period stands out in terms of harbour constructions compared to previous as well as following periods: the 6th century AD and especially the reign of emperor Justinian. Associated with his extensive building programme described by Procopius' De Aedificiis (Περί κτισμάτων), besides the region's primary port-cities such as Demetrias and Thessalian Thebes, particularly strategic coastal areas such as the island of Skiathos had been subject of imperial commissioned activities in order to secure control over the passing shipping lanes and trading routes. So far it is thought that Justinian's building programme is affecting primarily the erection of a chain of fortifications. However, confronting the latter with the construction of harbour facilities, it can be observed that they are closely linked. Consequently, Justinian's building programme not only enhanced certain existing harbour installations but even resulted in the foundation of new secondary harbour infrastructures and regional staple markets, respectively.
The question of its initiative, however, seems to be more complicated. Apart from imperial central activities, Skiathos even shows first »private« orders initiated by the church as a newly emerging independent entrepreneur from the 6th century AD onwards.

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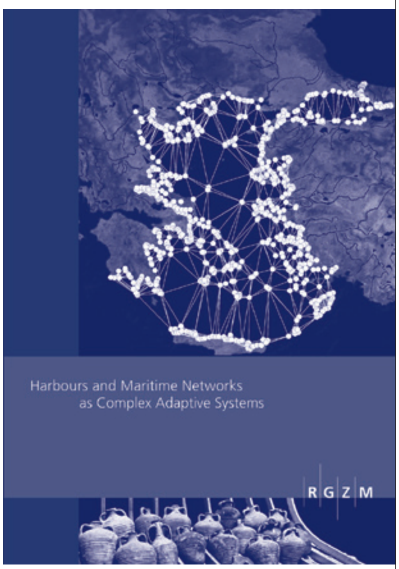

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