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Leibniz-Forschungsinstitut für Archäologie

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INTERDISZIPLINÄRE FORSCHUNGEN
zu den Häfen von der Römischen Kaiserzeit bis zum Mittelalter in Europa Band 5

Herausgegeben von Claus von Carnap-Bornheim, Falko Daim, Peter Ettel und Ursula Warnke

Claus von Carnap-Bornheim · Falko Daim
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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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
Ursula Warnke

VALENTINA CAMINNECI · VINCENZO CUCCHIARA · GIUSEPPE PRESTI

GEOARCHAEOLOGY AT THE ANCIENT HARBOUR OF AGRIGENTO

The research on the ancient harbour of Agrigento, which is still in progress, aims to clarify its topography, foremost through the archaeological investigations useful to define the chronology and through the geological study by defining the environmental change.

The current research is located a few hundred metres to the north of the mouth of the River Akragas, today called San Leone, which arises from the confluence of the two rivers Akragas and Hypsas (today called San Biagio and Drago) surrounding the city from the east and west (**fig. 1a-c**). The aggressive construction of buildings in this area since the 1950s, the erosion of the riverbanks as well as the sudden and continuous changes in the coastline, also stressed by breakwater barriers along the seaward side, hugely influenced the development and the results of the ongoing study. The archaeological evidence in this unstable and continuously threatened environment harms the reading of the stratigraphic relationships, although the investigations were temporally and spatially discontinuous due only to the needs of law protection, often limited by a few days, and forced into the tight spaces between a building and a summer home. The mapping of the area by a specific cartography and the zoning of the archaeological contexts are mandatory in order to illustrate the harbour topography, while the geological study of the area aims to define the coastal morphodynamic processes.

Literary sources, such as Diodorus, Polybius, Livy and Ptolemy, give information about the ancient harbour of the Greek polis, which later became the Roman and Byzantine city. Strabo remembered the *epineion* as a separate entity besides Akragas, one of the surviving sites along the west coast of Sicily during the 1st century BC[1]. A hagiography of the life of Bishop Gregory from Agrigento, written in the 8th century AD, mentioned the *emporion* near the river's mouth several times, with the ships leaving and arriving there[2].

The remains of the ancient neighbourhood near the harbour were initially identified by the archaeological excavations carried out in the 1920s on the left bank of the River Akragas, just near its mouth[3]. In the 1940s a Greek necropolis was investigated on the right bank contemporaneous with the early settlement of the Geloan *coloni*, which founded the polis and dates to the beginning of the 6th century BC.

The archaeological evidence found on the left bank mostly relates to the later inhabited phase of the ancient harbour, between the 4th and the 7th centuries AD (**fig. 2a-c**). Some rectangular storage buildings divided into square rooms and, moreover, four groups of tombs have been identified. Burials were found in chests of stone slabs, in pits covered by slabs and *enchytrismoi* in African amphorae[4]. The topography of this quarter is very difficult to understand; it is assumed that the necropolis was very close to the civil buildings. These archaeological data allow us to discover a glimpse of a late Roman landscape even if only piece by piece, together with the appearance of the settlement in which the life of the harbour took place. The direct relationship with the North African coast emerges from the prevalence of the findings produced in the workshops of the Gulf of Hammamet, especially in Nabeul[5].

Considering the distribution of goods, it is possible that the harbour of Agrigento played an important role in the relationship between the coast and inland. A cabotage along the west coast of Sicily, still active during the Norman period, probably linked small anchorages, originating in late antiquity near the river's mouth, to the biggest harbours, Agrigento and Lilibeo, which managed the transmarine markets, especially

a

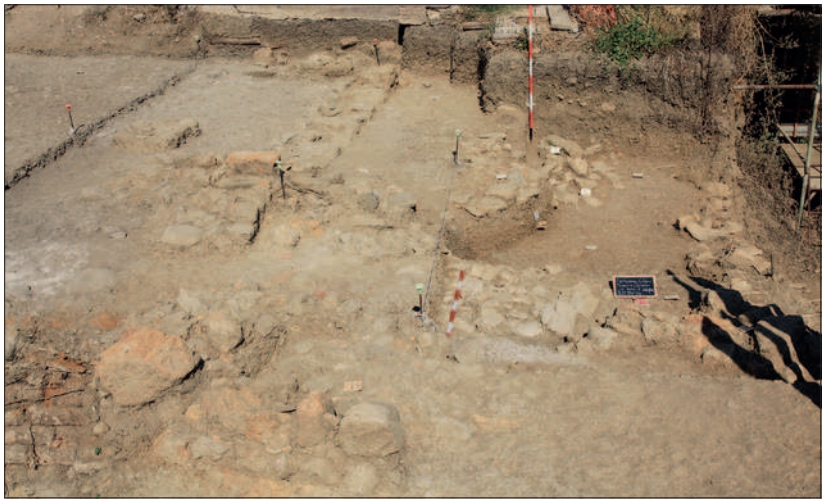
b

c

Fig. 1 **a-c** Agrigento's coast and the mouth of the Akragas River. – (Photos V. Caminneci).

Fig. 2 **a-c** Late Roman contexts near the Akragas River's mouth: storage buildings (?) and *enchytrismoi*. – (Photos V. Cucchiara / M. Nocito / A. Pitrone).

a



b

c


Hypothesis about
Agrigento's Emporion
Legend:
Greek necropolis
Schubring's hypothesis
Schmiedt's hypothesis
The shoreline on an aerial photo in 1973
New hypothesis about the Emporion topography
Archaeological excavations

a


New hypothesis about
the Emporion topography
Schmiedt's hypothesis

b

with North Africa[6]. The same sea routes through the Mediterranean have been attested by the journeys of the Agrigentine bishop. The young Gregory left the Emporion to arrive in Carthage after three days, while travelling from Palermo to Agrigento, sailing along the coast.
Recent archaeological research documents a widespread and intensive occupation of the Agrigento hinterland during the late Roman period, due to rural activities and the mining of sulphur. In this period an oil or wine amphora type was produced in Agrigento and in its hinterland, as attested by some workshops[7], while the sulphur exploitation is testified by an exceptional epigraphic document, the *tegulae sulphuris*, bearing the trademark to be imprinted on the sulphur loaves. These clay tablets, seal of the legality of the extraction, were most likely produced in Agrigentum, where, presumably, the refined mineral arrived in order to be exported from the harbour[8]. *V. Ca.*

HYPOTHESIS ABOUT THE LOCATION OF THE ANCIENT HARBOUR

The analysis, which is still in progress, was held on the basis of the preliminary knowledge of the site through a survey of the coast just near the mouth and by obtaining information from the cartographic, iconographic and photographic archives, especially ancient maps and satellite images[9]. The evolutionary progress was determined by comparing the shorelines relating to different periods. We are in the presence of an estuary, where the actions of waves and currents redistribute sediments before they are accumulated significantly in a sedimentary body. The results of the research have been achieved by integrating the results of the morphological survey with the archaeological data and by using satellite photographs and a digital elevation model. The study focused on a sample area, where the investigated coast runs from the river's mouth to Casa Cucchiara. A digital map of archaeological evidence has also been elaborated, even if archaeological remains cannot be used to reconstruct the sea level changes.
The study proceeded from the two main hypotheses about the harbour's identification.
The first theory was proposed by Julius Schubring at the end of the 19th century AD, who collocated the ancient harbour in a small bay on the right of the river's mouth[10]. Then, for the first time, in 1958, Schmiedt supposed, based on the geological observation of the river's course and on the evaluation of aerial photography, that an inner basin a few metres to the south of the confluence of the two main rivers Drago and San Biagio existed, surrounding the city from the eastern and western sides[11]. According to this hypothesis, the shoreline had to bend inward in ancient times, creating an inlet where ships could take shelter more safely than in the area of the river mouth.
Starting from Schmiedt's theory, our research has identified a more appropriate site for the harbour's location. An ancient map of Agrigento's coast drawn by Smyth in 1822, showing a much wider and deeper course of the river than today, testifies that probably a few metres to the north of the mouth a basin surely existed[12]. Furthermore, observing the altitude profile of this area, it seems that the ancient harbour could be in the site near Casa Cucchiara (**fig. 3a-b**).
While the methodology of analysis has offered the advantage of comparing the data of surveys carried out in different periods, the heterogeneity of the representations forced a somewhat laborious process to make these data homogeneous. It has been necessary to make a geometrical correction in order to compare this data and to eliminate the obvious distortions and to adjust projection systems adopted by IGM for the preparation of the maps. Finally, we developed a digital terrain model or DTM in GIS on the basis of the geomorphological analysis (**fig. 4**).

Fig. 3 **a** hypothesis about Agrigento's Emporion. – **b** Schmiedt's hypothesis and new hypothesis about the Emporion topography. – (Elaboration V. Cucchiara).

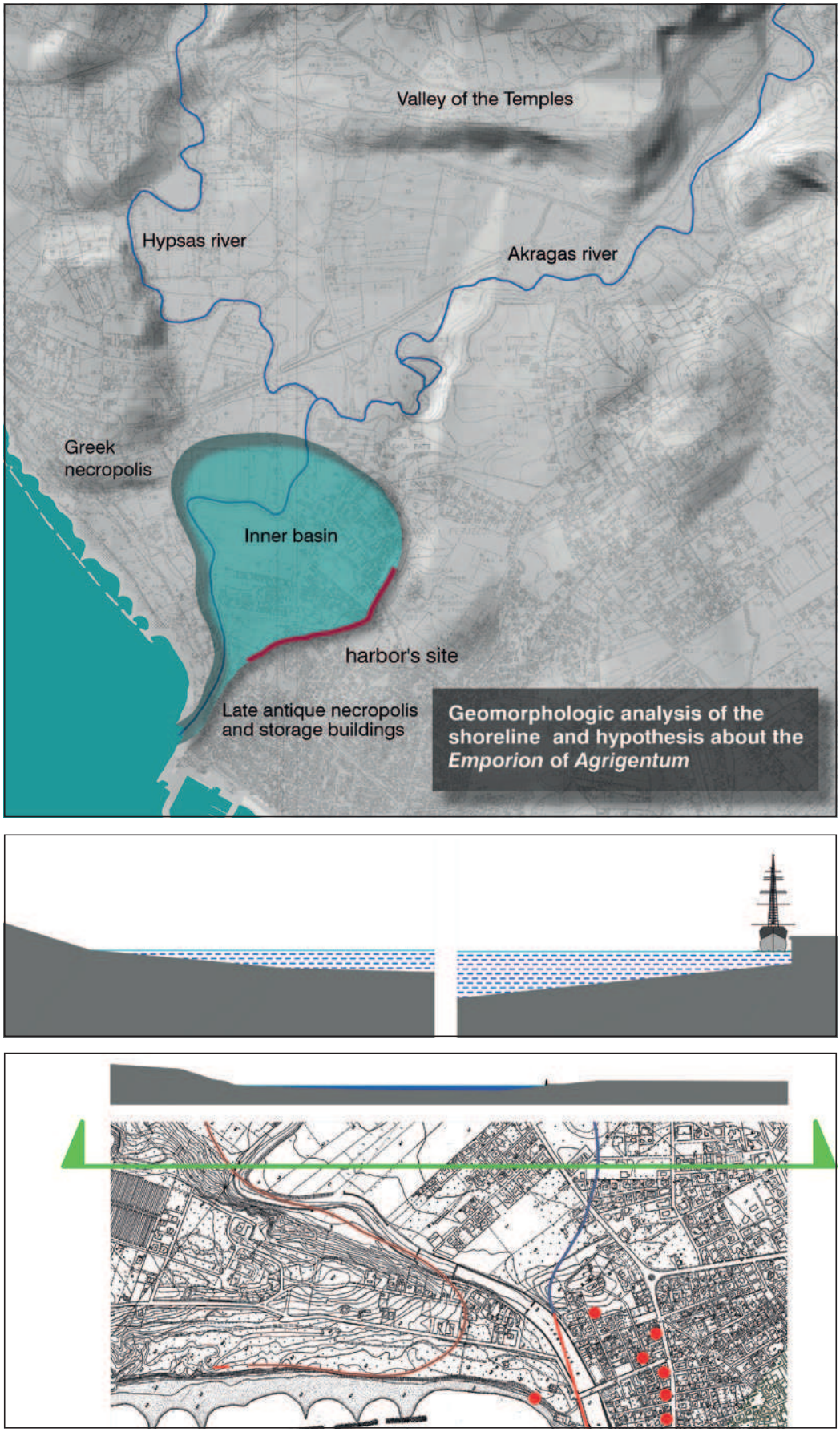


Fig. 4 DTM map of the mouth of the river and hypothesis about the harbour site. – (Elaboration V. Cucchiara).

Only multidisciplinary work will allow us to establish the precise functional depth in relation to the present sea level. Mostly sedimentological analyses of the samples taken inside the speculated harbour area will yield information about the shoreline of the past and the environmental evolution[13]. *V. Cu.*

THE GEOLOGICAL RESEARCH

The overall study area has a flat morphology or sub-flat, with morphological heights represented by hills that reach altitudes of up to 70.0 m above sea level, located to the hydraulic right and left of the San Leone (fig. 5a-e).

Our territory can be divided into three areas morphologically distinct from a genetic point of view:

The terraced areas in Contradas Maddalusa-Cavaleri; the mid-range that runs along the main waterways; the coastal strip located on the side of the mouth of San Leone.

The terraced areas of the Maddalusa-Cavaleri are located at an altitude higher than 50.0 m above sea level, and are probably of Tyrrhenian age. They most probably correspond to the level of the oldest Mediterranean's stations. These terraced areas, produced by the combined action of erosion and marine currents, compared with the stratigraphic sequence of the present land immediately around the mouth, also originating mainly from the marine movement, allow us to describe the subsequent fluctuations in the level of the Mediterranean Sea, and consequently the ancient landscapes of the coastal area of Agrigento surrounding the mouth of San Leone. In the middle is the floodplain, where alluvial processes linked to the surface water have prevailed especially in the Pleistocene. The morphology of this band is flat and occupied by Pleistocene alluvial deposits that continuously follow the progress of the two main waterways (the Drago and the San Biagio). They are made up of sediment gravel pebbles and coarse sand particles with intercalations of clayey silts and sandy silts from the typical lenticular geometry. The deposits have a thickness of about 8.0 to 10.0 m measured in accordance with some surveys carried out in the vicinity of the area of the confluence. The river deposits, often arranged on terraced areas, go as far as the modern street SS 115 at the foot of the Hill of the Temples, and are based on the grey-blue clays of the Monte Narbone Formation. The coastal strip next to the river mouth, finally, is characterized by a coast with cliffs alternating with sandy or pebbly dunes, in which the dynamic coastal morphological element is dominant (although at the mouth the significant influence of the river dynamics is noticeable). Both lithofacies, gravelly and sandy ones, are based on the grey-blue clays of the Monte Narbone Formation.

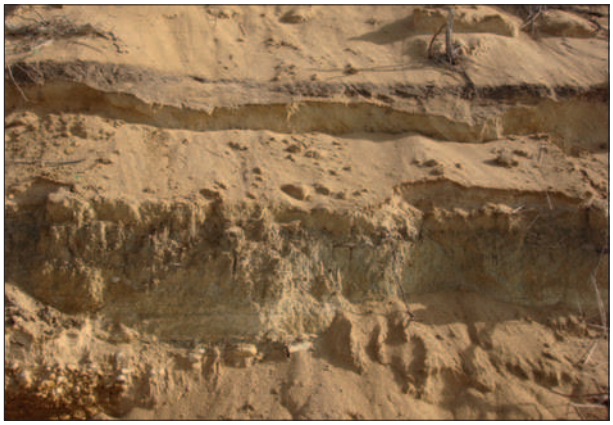
The observations regarding the mouth were entered on a base map with a scale of 1:2000. During the field trips, particular sequences of lithofacies were observed which were interspersed in the sandy dunes at various levels and located at the mouth to the right of the hydraulic action; these represent a key aspect of the morphological changes, more or less recent, to the coastline and are a result of the immediate hinterland of the estuary.

In the area to the right of the hydraulic action, almost exclusively lithological units emerge which are related to the Quaternary, resting above the sublayer of a clay marl of the Monte Narbone Formation. The coastal strip, for some hundreds of metres, is characterized by a gravelly-sandy beach with a width of some tens of metres, oriented in a NW-SE direction and ending with a morphological step of roughly 2.0 m. At the base of the step and 2.0 m above sea level, a level conglomerates a little with a 0.50 m thick cemented area, passing on to an alternation of sandstones and yellowish sands of medium-fine grains, moderately cemented with a thickness 0.85 m and interbedded within a silt clay characterized by nodules of calcinelli, and loops up to yellowish sands forming a dune belt in our area.

a

b

c



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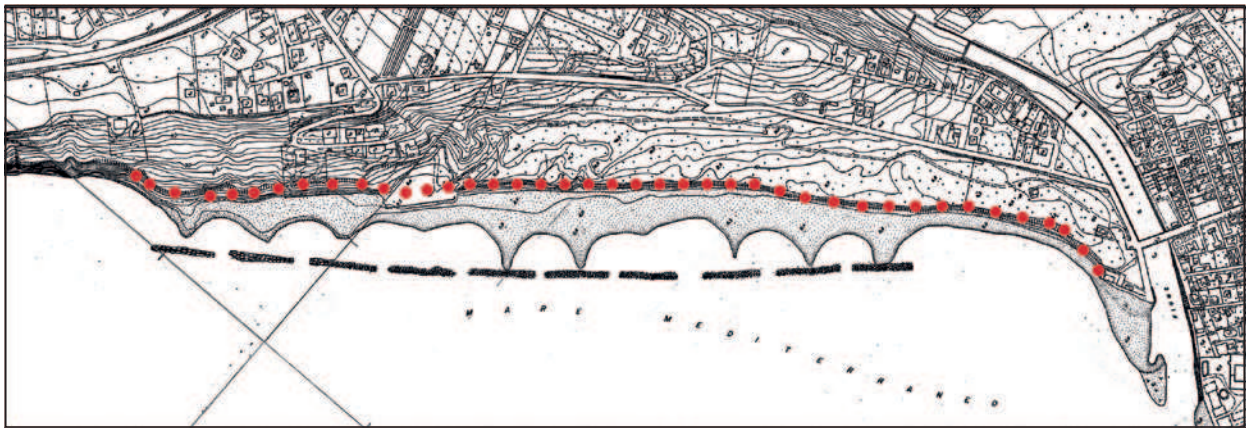

e

Fig. 5 **a** the sand dune on the right of the river's mouth. – **b** stratigraphic section on the sand dune near the river's mouth. – **c-d** palaeosoils. – **e** the sand dune along the coast on the right of the river mouth. – (Photos and elaboration V. Cucchiara).

In the body of the sand dune, a total thickness of about 8.0 to 9.0 m is measured in which two levels of palaeosoils were found, the first at a height of 3.35 m above sea level with a thickness of about 0.25-0.30 m, and the second at a height of 4.65 m above sea level with a thickness of a few decimetres. The palaeosoils in question have a development of a few hundred metres towards Beach Babbaluciara (**fig. 3**).
The units described above are the product of a fluvial marine sedimentation, apart from the two levels of palaeosoils. The palaeoland looks quite mature in terms of its development and has a lateral continuity which extends along the stretch of the mouth and the beach called Babbaluciara, or to the last breakwater in a westerly direction. The second palaeosoil, less evolved than the one below, however, has a lesser lateral extent of only several tens of metres.
The palaeosoils are vital regarding the reconstruction of the palaeoenvironment of our region, which is the reason we are going to date them, allowing us to establish the variation in the level of the Mediterranean in historical times, and consequently to define the configuration of the palaeogeographic immediately to the inland of the estuary. At present, however, starting with the younger units in the older palaeosoil, it is represented by the sequence sand dune, palaeosoils, moderately cemented sands and basal gravels; and, applying the principle of stratigraphic succession of a vertical terrain, it must be acknowledged that within a given time of the evolutionary history of our area, in terms of the palaeogeographic, fluvial-marine environments that have given rise to the dune deposits, they have been marked by two episodes that make up basically continental environments which led to the formation and evolution of the palaeosoils' strong organic component, very likely due to the contributions of sediments from marsh and/or lake. Of the two palaeosoils, it must be considered that the most complete is the one that originated from a continental environment of a longer duration than the palaeo-II ground. The above-mentioned environmental conditions of continentality have very likely affected the long stretch of the coast that extends from the mouth to the Beach Babbaluciara; beyond this area, in fact, as already mentioned, the palaeosoils disappear because they are interspersed within the body of the sand dunes.
The coast is characterized by a long coastline with cliffs of active facies of grey-blue clays of the Monte Narbone Formation, with a height of 50.0 m, above which lies the vast area of the marine terrace of the Tyrrhenian Contrada Maddalusa marking the oldest and highest level of the Mediterranean in our area. Therefore, starting from the Tyrrhenian and given the tectonic stability of this part of Sicily, a gradual overall reduction in the average level of the Mediterranean can be witnessed, while at the mouth of the San Leone and other waterways like the River Naro, we register the succession of fluvial-marine depositional environments that have given rise to the present system of dunes in the hinterland of the mouth of San Leone, characterized by the two moments of continentality that certainly also led to a different conformation of the coastline.
The large areas of marine terraces continuously occupy the high ground of the flow direction of the two main rivers, overlooking the underlying Plio-Pleistocene clays, and determine the conditions for the existence of water sources along the contact zone. From these areas, therefore, it is presumable that over the underlying esplanade of San Leone consistent rates of freshwater wetlands have contributed to more or less extensive floodplains, particularly at the immediate hinterland of the waterway. On the other hand it is very likely that the masses of water which were channelled through the Drago and the San Biagio during seasonal flooding have mainly released their load of sediments in the areas closest to the ancient shoreline, shifting it in a relatively short time. In our case, therefore, in order to obtain a reliable picture of the hydrogeomorphological configuration of the area where you can place the Emporion of Agrigento, the research will be conducted by determining the age of the sediments sampled during the excavations and soil samples taken from the palaeosoils incorporated into the coastal dune in order to obtain data relating to the eustatic lifting and sedimentation rate and reliably indicate the coastline from 10,000 years ago.

CONCLUSION

Archaeology and geology together lead to preliminary conclusions. The first question that this integrated approach can help to answer concerns the location of the ancient harbour, which cannot reliably be answered yet. The second issue to which we should be able to give some answers is the chronology. For how long was the harbour working? Archaeological evidence dates it to the 7th century AD, the same period in which, according to some of his scholars, Bishop Gregory lived. The problem is to understand when and why the harbour was moved a few kilometres away, near the modern Porto Empedocle, probably because of the filling of the estuary. The Arab El Idrisi in the Book of King Roger tells about Girgenti, a blooming and rich city where big ships could carry big loads much greater than their own size. Idrisi mentions Girgenti between the harbours listed along the coastal path, nine miles from Monte Rossello, alluding, perhaps, to the new city harbour. Three miles away, on the same route, he evidenced the next stop, at the mouth of the River Akragas. This probably means the coexistence of the two harbours in that period. Archive documents of the 13th century attest vineyards in the *contrata* San Leone, the bishop's property, bordered by the river and by a *strata puplica*, probably the same that connected the city to the coast in the past[14]. *V. Ca.*

Notes

1) Polybius, Histories IX, 27. – Titus Livius, Ab urbe condita libri XXVI, 40, 8-1.1 – Diodorus Siculus, Bibliotheca historica XIII, 81.4. – Strabo, Geography VI, 2, c. 272.5.
2) Berger 1994.
3) Caminneci 2014a.
4) Caminneci 2012a; 2012b; 2015.
5) Malfitana/Bonifay 2016.
6) Caminneci 2014b.
7) Rizzo 2014.
8) Zambito 2014.
9) Caminneci/Cucchiara/Presti 2016.
10) Schubring 1887.
11) Schmiedt/Griffo 1958.
12) Plan of the city environs and anchorage of Girgenti by Captain W. H. Smyth, R. M. Knight of S. T. Ferdinand E Merit. Document n.13.1822
13) Morhange/Marriner/Carayon 2015, 249 f.
14) Collura 1961, 194 ff.

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Summary

This paper focuses on the new geoarchaeological research in the area of ancient Agrigento's harbour, near the mouth of the River Akragas, where nowadays there is a modern suburb of summer homes.
The exact location of the port and the evolution of the coastline in ancient times are still open question. According to our hypothesis, based on the observation of depth and altitude profile of the area behind the mouth of the river, there was in antiquity an inner natural basin, used as a harbour. The scientific debate focuses also on the topography of the quarter born in ancient times near the harbour, not only through the review of the archaeological findings but also through observation of the geological characteristics of the site.
Habitation levels dated from the 5th to the 7th century AD, found during some excavations near the mouth of the River Akragas, relate to some storage buildings and burials. Our research aims to define the paleoenvironmental evolution of the coastline, using a multidisciplinary approach. In fact, the reconstruction of the human settlement along the coast cannot be separated from the surveying of the coastal landscape. Furthermore, we intend to identify the palaeosoils through a geological survey and some laboratory tests carried out on a sand dune still preserved near the river mouth.

AUS DER REIHE / FURTHER READING

Thomas Schmidts · Martin Marko Vučetič (Hrsg.)

Häfen im 1. Millennium AD

Bauliche Konzepte, herrschaftliche und religiöse Einflüsse

Interdisziplinäre Forschungen zu den Häfen von der Römischen Kaiserzeit bis zum Mittelalter in Europa, Band 1

Das DFG-Schwerpunktprogramm »Häfen von der Römischen Kaiserzeit bis zum Mittelalter – Zur Archäologie und Geschichte regionaler und überregionaler Verkehrssysteme« (SPP 1630) widmet sich unter verschiedensten Aspekten der Erforschung von Häfen als Schnittstellen zwischen Wasser- und Landweg.
19 Beiträge, die auf einer Plenartagung 2014 gehalten wurden, füllen einen geographisch weit gespannten Rahmen, der vom Nordatlantik bis in den östlichen Mittelmeerraum reicht. Breiten Raum nehmen dabei Ergebnisse der häufig in enger Zusammenarbeit mit naturwissenschaftlichen Disziplinen angelegten Feldforschungen ein. Eine Besonderheit liegt in der Zusammenschau von Arbeiten aus unterschiedlichen historischen, archäologischen und naturwissenschaftlichen Disziplinen.

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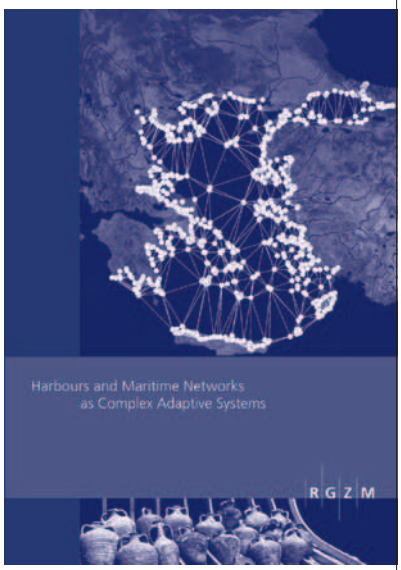

Johannes Preiser-Kapeller · Falko Daim (eds)

Harbours and Maritime Networks as Complex Adaptive Systems

Interdisziplinäre Forschungen zu den Häfen von der Römischen Kaiserzeit bis zum Mittelalter in Europa, Band 2

The concept of complex systems allows for a better understanding of the interplay between social and environmental factors for the emergence and maintenance of maritime infrastructure and route systems in the ancient and medieval period.
Complexity theory and network analysis provide an analytical framework to describe social configurations (cities, maritime communities, polities) and environmental phenomena (hydrosphere, climate) as complex systems, entangled via mechanisms of feedbacks, adaptation or disruption. In this volume, this approach is applied on various phenomena of maritime history as discussed within the DFG-funded Special Research Programme (SPP 1630) »Harbours from the Roman Period to the Middle Ages« (www.spp-haefen.de).

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Sven Kalmring · Lukas Werther (Hrsg.)

Häfen im 1. Millennium AD

Standortbedingungen, Entwicklungsmodelle und ökonomische Vernetzung

Interdisziplinäre Forschungen zu den Häfen von der Römischen Kaiserzeit bis zum Mittelalter in Europa, Band 3

Das DFG-Schwerpunktprogramm »Häfen der Römischen Kaiserzeit bis zum Mittelalter – Zur Archäologie und Geschichte regionaler und überregionaler Verkehrssysteme« (SPP 1630) widmet sich der Erforschung von Häfen als Schnittstellen zwischen dem Wasser- und Landweg unter verschiedensten Aspekten.
Der Band versammelt 13 Beiträge, die 2015 im Rahmen einer Plenartagung gehalten wurden. Der geographisch weit gespannte Rahmen reicht vom Nordatlantik bis in den östlichen Mittelmeerraum. Thematisiert werden See- und Binnenhäfen sowie künstliche Wasserstraßen. Der Band vereint Ergebnisse interdisziplinärer (geo-)archäologischer und geophysikalischer Feldforschungen, schriftquellenbasierter Untersuchungen und überregionaler Studien.

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