



Portuslimen: Rome's Mediterranean Ports (RoMP)

Workshop 3 - 26th and 27th January 2017



Programme

26 January 2017

AM/PM

Open Public Meeting

9.00-9.10: **Introduction:** Professor Christopher Smith, Director BSR

9.10-9.30: **Project overview:** S. Keay University of Southampton/BSR

Project Field-results 2016: Chaired by S. Keay

9.30-9.55: **New Geophysical Research in the Claudian Harbour at Portus: the Northern Mole**

S. Hay, University of Southampton, S. Kay, British School at Rome, S. Keay, University of Southampton, K. Strutt, University of Southampton & R. Sebastiani, SSCOL

The seaward trajectory of the northern mole of the Claudian harbour at Portus would appear to be indicated by the standing structures excavated in 1957 at its eastern end. Whilst 800m of the mole is visible, its full length has never been explored, in part due to the north-south runway of Leonardo Di Vinci airport constructed between 1958-61. In 2007, the then *Soprintendenza per i Beni Archeologici di Ostia* conducted a programme of deep cores in the area of Pesce Luna, immediately to the west of viale Coccia di Morte. An analysis of this material indicated the northern mole turned southwest towards the conjectured area of the Claudian lighthouse.

As part of the Portuslimen ERC-funded research, in April 2016 a large scale ground penetrating-radar (GPR) survey was conducted, with the aim of mapping anomalies in the north-western area inside the Claudian harbour. The earlier cores (Morelli *et al*, 2011) had indicated an overlying accumulation of approximately 6m, therefore the survey was conducted using a 200MHz frequency GSSI antenna towed by a quad bike or pulled by hand in constricted areas. Despite the known restriction of a possible high water table in the area that could adversely affect the permittivity of the radar signal (RDP), the survey mapped a

number of anomalies which appear to suggest the structure differed at its western extent. The GPR data did not record a single continuous anomaly as had been hypothesised, but rather a series of interspersed concentrations, suggesting the possibility of later spoliation or a different form of structure.

Morelli, C., Marinucci, A. and Arnoldus-Huyzendveld, A. 2011. Il Porto di Claudio: Nuove Scoperte, in S.Keay and L.Paroli (eds.) *Portus and its Hinterland, Archaeological Monographs of the British School at Rome* 18. pp47-65.



GPR Survey at Portus 2016

9.55-10.20: **Rome's Urban Story Inferred from Lead-contaminated Waters Trapped in its Ancient Harbour Basins**

H. Delile, CNRS, D. Keenan-Jones, University of Glasgow, J.-P. Goiran, CNRS, J. Blichert-Toft, CNRS, F. Albarède, Ecole Normale Supérieure de Lyon

Heavy metals from urban run-off preserved in sedimentary deposits record a city's long-term economic and industrial development via the expansion and contraction of its infrastructure. Lead concentrations and isotopic compositions measured in the sediments of the first harbor basin of Rome located at Ostia show that lead pipes used in the water supply networks of Rome and Ostia were the only source of radiogenic Pb, which, in geologically young Central Italy, is the hallmark of urban pollution. High-resolution geochemical analyses and radiocarbon dating of a sedimentary core from the harbor basin of Ostia allowed us to date the commissioning of the Roman water distribution system to the early 2nd c. B.C., two centuries before the earliest archaeological evidence. Even more significantly, the isotopic record of Pb pollution proves to be an unparalleled proxy for tracking the urban

development of ancient Rome, providing the first semi-quantitative, high-resolution record of the early phases of the lead pipe water distribution system: 1) its initial expansion during the 2nd c. BC; 2) its neglect during the civil wars of the 1st c. BC and 3) its growth to its maximum extent during the stability of the early Imperial period. The record of the last two centuries BC fills the gap in our understanding of the first, Republican phase of ancient Rome's water supply, before the appearance of literary and inscriptional evidence from the late 1st c. BC onwards. The cores also preserve evidence of the changes in the pollution dynamics of the Tiber River system that accompanied the construction of Rome's artificial port, Portus, during the 1st and 2nd c. AD.



The remains of the Aqua Marcia incorporated into the Acqua Felice (foreground), with the Anio Novus and Aqua Claudia in the background, at Roma Vecchia.



The extension of the Aqua Claudia that supplied the Palatine hill at Rome.

10.20-11.05: Il Vicus Lartidianus di Puteoli tra Terra e Mare: Ricerche Geofisiche e Archeologiche sulla Facciata Marittima di Puteoli e del Porto Iulio

C. Gialanella, Soprintendenza Archeologia della Campania, S. Keay, University of Southampton, F. Salomon, University of Southampton, N. Carayon, University of Southampton, K. Strutt, University of Southampton, M. di Vito and D. di Barra

In the context of the ERC-funded Roman Mediterranean Ports (RoMP) project, an international collaboration between the University of Southampton, the Soprintendenza di Napoli – Ufficio di Pozzuoli, the Istituto Nazionale di Geofisica e Vulcanologia, and the Università degli Studi di Napoli Federico II and Université Lyon 2 – CNRS, initiated a new study of the Ripa Puteolana in the Bay of Pozzuoli. The research at Pozzuoli focuses upon the reconstruction of the full length of the Roman maritime façade, with geophysical surveys and four cores drilled at selected points between the site of the Macellum at Pozzuoli and the largely submerged portscape of the Portus Iulius. The paleogeographic reconstruction involves the identification of new archaeological structures by geophysical surveys and an understanding of the coastal dynamics in terms of sedimentation/erosion and underground variations using sedimentary cores. In parallel, the Soprintendenza led new excavations in a key area located between Puteoli and Portus Iulius, at vicus Lartidianus.

Coffee 11.05-11.25

11.00-11.25: Baelo (*Baetica, Hispania*)

D. Bernal-Casasola, Universidad de Cádiz, N. Carayon, University of Southampton, K. Strutt, University of Southampton, F. Salomon, University of Southampton, J. J. Díaz-Rodríguez, Universidad de Cádiz and J. A. Expósito-Álvarez, Conjunto Arqueológico de Baelo Claudia. Junta de Andalucía.

Within the framework of the Portus-Limen project, the Roman city of *Baelo Claudia* has been selected as the preferred area for analysis of its port structures in the southern area of *Baetica* (*Fretum Gaditanum*). The exceptional conservation conditions and the absence of reoccupation after Late Roman times at Baelo, unlike at other port cities of greater importance in the area such as *Colonia Latina Libertinorum - Carteia* or *Gadir / Gades* which present greater difficulty for field research (Bernal, 2010 and 2012), facilitate the application of different geophysical and geoarchaeological techniques.

During 2016 a field campaign was carried out with three research objectives; a review of existing published and archive material, a geomorphological survey of the dune area and Bolonia bay, and a geophysical survey of the southern extent of the ancient town and beach.

From an archaeological point of view, all existing documentation on the port of this Baetican city was reviewed, including all of the unpublished finds. Among these was the recent discovery of a mooring stone on the maritime façade, associated with a possible harbour building. Also, a series of walls have been documented that start from the southern wall of the city, projecting perpendicularly towards the beach: in the so-called Southern Building XIII and in front of the fish-salting quarter (figure 1). Also the findings of work in the western *suburbium* of the city, in the area of Maritime Baths, are discussed, specifically structures for

the possible regularization of the riverside from the late-republican period onwards (Bernal *et al.*, ed., 2016).

The team conducted a new geomorphological survey of the Bolonia bay following the work of previous teams led by L. Ménanteau, C. Alonso and J. Gracia respectively. In total, 23 new geoarchaeological cores were drilled using a mechanical percussion auger (figure 2). A cross-section of 12 cores along the coast in front of the city will help us to reconstruct the evolution of the maritime façade of *Baelo Claudia*, and to identify the location of the Roman harbour. Additionally, in order to identify the role of the river dynamics in the coastal area, 11 cores were collected in the lower courses of the streams that surrounded the city outside of the wall ("Arroyo de la Chorrera" to the east and "Arroyo de las Villas" to the west), and in a western palaeochannel. Palaeoenvironmental analyses are currently in progress in order to provide a chronological framework and a reconstruction of the fluvio-coastal landscape evolution. Finally a geophysical survey was carried out in the lower part of the city, from the *decumanus maximus* to the beach, using various techniques (GPR and magnetometry), having identified various anomalies, both in the interior of the Roman city and in the area of the beach, that contribute to the general interpretation of the port system of *Baelo Claudia* in Antiquity. Preliminary results of this work will be presented.

References

Bernal, D. (2010): "Arqueología de los puertos romanos del Fretum Gaditanum. Nuevos datos, nuevas perspectivas", in *Proceedings of the XVII International Congress of Classical Archaeology (Roma, 2008)*, *Bollettino di Archeologia on line*, AIAC, Rome, pp. 69-82.

Bernal, D. (2012): "El puerto romano de Gades. Novedades arqueológicas", *Rome, Portus and the Mediterranean*, British School at Rome, S. Keay, ed., British School at Rome. *Archaeological Monographs*, 21, Rome, pp. 225-244.

Bernal, D., Expósito, J.A., Díaz, J.J. & Muñoz, A. (2016 eds.): *The Maritime Baths and the Doryphoros of Baelo Claudia*, Cádiz.

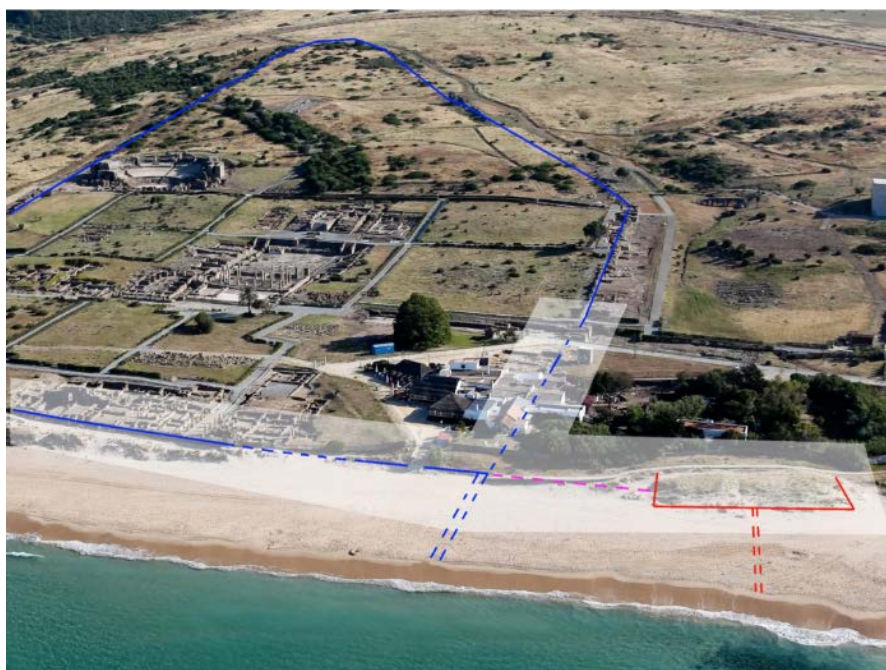


Figure 1. Aerial image of the city from the south, with the walls projecting towards the beach, perpendicular to the southern wall of the city of *Baelo Claudia*.

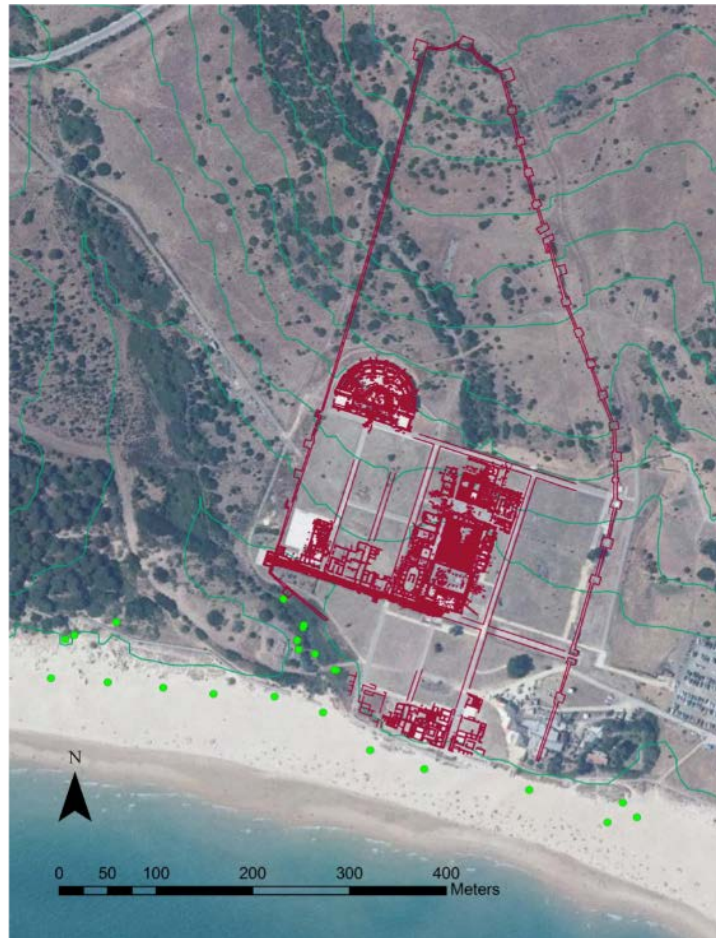


Figure 2. Aerial view of the city with indication of the geoarchaeological boreholes (green points).



Figure 3. Detail of the geophysical anomalies identified by magnetometry in the area of the beach of Bolonia.

11.45-12.00: **Survey at the Port of Narbonne**

N. Carayon, University of Southampton, K. Strutt, University of Southampton, C. Sanchez, CNRS and V. Mathé, Université de La Rochelle

The urban port of Narbonne is still mostly unknown. Recently, excavations lead by Corinne Sanchez has uncovered the remains of the most southern end of the canal which linked the city of Narbonne to the lagoon and the sea. Geophysical survey undertook by V. Mathé has followed the course of this canal between its southern end and the edge of the urban area. In May 2016, thanks to a partnership between the Collective Project of Research “Les ports antiques de Narbonne” and the ERC RoMP project, a team of geophysicists and archaeologists of the University of Southampton and the ERC RoMP project investigates the urban area of the theatre of Narbonne where a bank of the ancient canal which crossed the city has been uncovered in the 90's. This presentation aims to replace the preliminary results of the geophysical survey within the broader context of the ancient port of the *Colonia Narbo Martius* in order to better understand the harbour system of the colony.



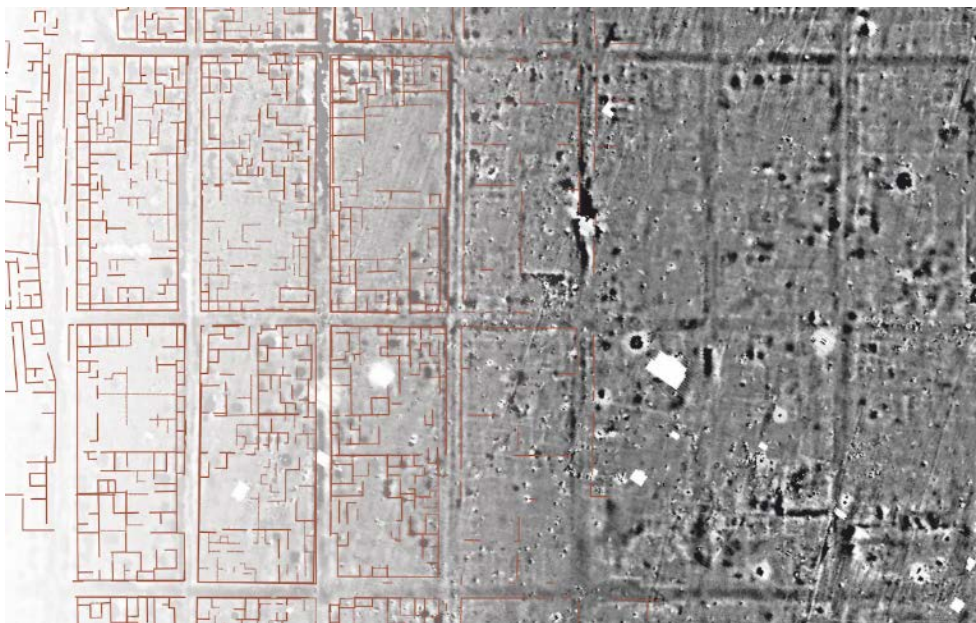
Fig. ERT at the theatre of Narbonne

12.00-12.25: **Uncovering Utica: A Geophysical Survey of the Roman Port Town**

S. Hay, University of Southampton, M. Dabas, Ecole Normale Supérieure de Lyon, L. Fentress, University of Oxford, S. Kay, British School at Rome, S. Keay, University of Southampton, E. Maw, British School at Rome, and A. Wilson, University of Oxford

The overall plan of the ancient port and city of Utica, Tunisia, has long been understood from the results of a few detailed excavations carried out in the early and mid-20th century of the monumental centre of the city and a number of adjacent *insulae*. Without an extensive systematic survey of the site the conclusions drawn from this work about the nature of the settlement could only be at best speculative.

The Portuslimen ERC research project in collaboration with the INP–Oxford Utica Project has undertaken a large-scale gradiometer survey that, together with the addition of more recent work carried out by a French team from Geocarta, covers about 35 hectares of the site. When compared to Alexandre Lézine’s projected hypothesis of the extent of the urban development, the geophysics survey results revealed that the orthogonal layout of the city covered a notably larger area. Whilst broad analysis of the results may provide clues as to the chronological development of the city, detailed interpretation has provided insights as to the nature of the layout of each *insula* block and identified possible production areas as well as other land use patterns within the urbanscape.



Detail of the gradiometry results from Utica showing the *insulae* with wall interpretation overlay

12.25-12.50: New Research Results on the Harbours of Ephesos

H. Schwaiger, Österreichisches Archäologisches Institut, S. Ladstätter, Österreichisches Archäologisches Institut and K. Strutt, University of Southampton,

With the new Hellenistic foundation of Ephesos-Arsinoeia in 294 B.C., the old, heterogeneous settlement layout was abandoned, and an urban structure was created in keeping with the functional requirements of a Hellenistic polis. The expansion of the bay between the Bülbüldağ in the south and the Panayırdağ in the north, which had been used since the Archaic period as a mooring place and which, probably after the Classical period, functioned as a naval port, was part of the town planning concept and integrated the harbour landscape into the architecture of the city, increasingly protected by fortifications,

which now lay directly on the coast. After the early 3rd century B.C., a sort of "window of opportunity" of perfect parameters presented itself, which in the first place made the rise of Ephesos possible. The economy profited not only due to the increased trade activities transacted through the port, but in addition due to systematic land exploitation and an intensification of wine and oil production, due to the influx of craftsmen as well as due to a service sector which was becoming increasingly important. The city developed into a communication hub and an administrative centre with high geo-strategic significance.

Already in the 19th century, a Hellenistic city harbour - nevertheless modest in size - was assumed, near the Theatre beneath the Imperial-period Halls of Verulanus. The interdisciplinary research carried out in recent years led not only to an evidence-based substantiation of this scenario, but also, in certain areas, to a striking revision of former hypotheses. The course of the coastline in the 3rd century B.C. can to a great extent be securely reconstructed on the basis of archaeological evidence and new geo-archaeological knowledge; nevertheless it deviates substantially from earlier reconstructions.

Accordingly, in the Hellenistic period the city of Ephesos was not equipped with an architectonically conceived harbour as such, but rather, a large marine bay whose coast lay approximately 500 m further to the east than the Roman harbour erected later; this natural harbour offered an extent of 2,500 metres for the mooring of ships. A 14.7 x 22.2 m large prostyle temple formed the north-west termination of the harbour bay; in the scholarship, this temple has been named the so-called rock-crevice temple, and according to the latest



Ephesos Harbour from the air

research is to be understood as a Temple of Aphrodite.

During the Roman-Syrian war Ephesos was viewed as difficult to capture due to its lagoon situation, yet it nevertheless found itself confronted with attempts to conquer it both from the water and from the land. An analysis of the archaeological evidence leaves no doubt that the naval port in Ephesos should be sought in the northern area of the bay. The trade

harbour, in contrast, is to be reconstructed as an open bay with numerous docking facilities; this bay extended from the city centre along the coast around the Bülbüldağ.

In order to maintain the functioning of the harbour of Ephesos in the 2nd century B.C., both for the Pergamene fleet and for trade shipping, countermeasures needed to be taken against the advancing progression of the delta and the associated silting up of the harbour. Following the Attalid measures for reorganising the harbour of Ephesos, in the early Roman imperial period the harbour was relocated to the west, an artificial harbour basin was laid out, and an access route, controlled by a canal, was created. In addition, 1.5 million m³ of earth were deposited (measured by an average depth of 4 metres), thereby enabling an expansion of the civic building ground by ca. 35 ha.

Questions and Discussion 12.50-13.00

Lunch 13.00-14.20

14.20-14.45: **Geomorphology and Geoarchaeology of the Ancient Harbours of Piraeus**

J.Ph. Goiran, CNRS, A. Chabrol, École Française d'Athènes, K. Pavlopoulos, Paris-Sorbonne University Abu Dhabi, E. Fouache, Paris-Sorbonne University Abu Dhabi, B. Loven, Danish Institute at Athens



Offshore coring in the harbour basin of Zea, Piraeus, Greece (© CNRS - UMR 5133 / J-Ph Goiran)

In the first century AD, the Greek geographer Strabo hypothesized that the rocky hill of Piraeus had once been an island. Located approximately seven kilometers south west of Athens, this vast rocky hill was home to the three ancient ports of the Greek capital, Zea,

Mounichia and Cantharos. During the fifth century BC, this strategic place was connected to Athens by a road protected by the 'Long Walls'. To put Strabo's intuition to the test, 10 geological cores, over 20 meters deep, have been drilled in what is today the Cephissus (Kifisos) plain located between Piraeus and Athens. The stratigraphical study enabled the observed four main stages in the evolution of coastal landscapes in the Piraeus region. (1) During the first stage, 6 700 – 5 500 BC, sea levels in the Mediterranean were considerably lower than today. The hill of Piraeus was not an island and was geographically connected to the mainland. (2) Then from 4 800 – 3 400 BC, sea levels rose, and Piraeus became an island. (3) During the third stage, from 2 800 BC to 1500 BC, sea level rose more slowly, while at the same time massive amounts of sediment were carried down by rivers in the region. This dual phenomenon caused sediments to build up on the Cephissus plain, which led to the establishment of a lagoon environment. (4) Finally, in the fifth century BC, the lagoons were still present. To build the Long Walls, the engineers of the time were therefore forced to fill in these wetlands.

Recently, thanks to the Danish Institute at Athens, l'Ecole française d'Athènes, the CNRS, the Paris-Sorbonne University Abu Dhabi and Harokopio University, a scientific program started on the ancient harbours of Piraeus.

During the 5th c. BC, Greek engineers built 3 mains harbours around the Piraeus rocky hill: Zea, Mounichia and Kantharos. Off shore cores have been carried out in Zea and Mounichia in order to understand the geoarchaeology of these military basins. Radiocarbon dating and multidisciplinary analyses are in process. They will bring 3 main results: (1) the depth of the harbour basins, (2) any dredging phases, (3) sedimentary rate and spanlife.

- (1) CNRS – UMR 5133 Archéorient, Maison de l'Orient et de la Méditerranée, 69007 Lyon
- (2) École française d'Athènes – 6 rue Didotou – GR 10680 Athènes
- (3) Paris-Sorbonne University Abu Dhabi, 38044 Abu Dhabi, UAE
- (4) Danish Institute at Athens, Director of Zea Harbour Project

Project Field Results in Context of Understanding of Extant Projects at Ports

14.45-15.10: Pergamon and its Maritime Façade: Some Thoughts on the Relations between Cities, Micro-regions and the Sea

S. Feuser, Kiel University and F. Pirson, Deutsches Archäologisches Institut

The “Kane Regional Harbour Survey”-Project as well as the Elaia-Project offer the chance to study a coastal micro-region, with a hierarchy of major and minor ports and bays suitable for cabotage and their relationship to Pergamon in a diachronic perspective. Furthermore, this region is also a good example to investigate the obvious changes in the importance and frequentation of harbour sites during the Roman period compared to the Greek.

On a macro level, this paper is concentrated on the different functions of Elaia, Pitane and Kane both within their micro-region as well as in relationship to Pergamon. Important questions are the sizes of the catchment area of the different harbours, the functional differentiation within the settlements as well as the military relevance of these maritime settlements for the city of Pergamon. On a micro level we take a fresh look at the urban maritime façades of both Kane and Elaia at the transition from the Greek to the Roman period. Key questions are how and with what kind of buildings the shore was incorporated

into the urban fabric, how this might have changed through time and how the inhabitants of



The closed harbour of Elaia. Overview from the top of the Akropolis hill (photo: F. Pirson)

both cities reacted to the fragile environment of the shore.

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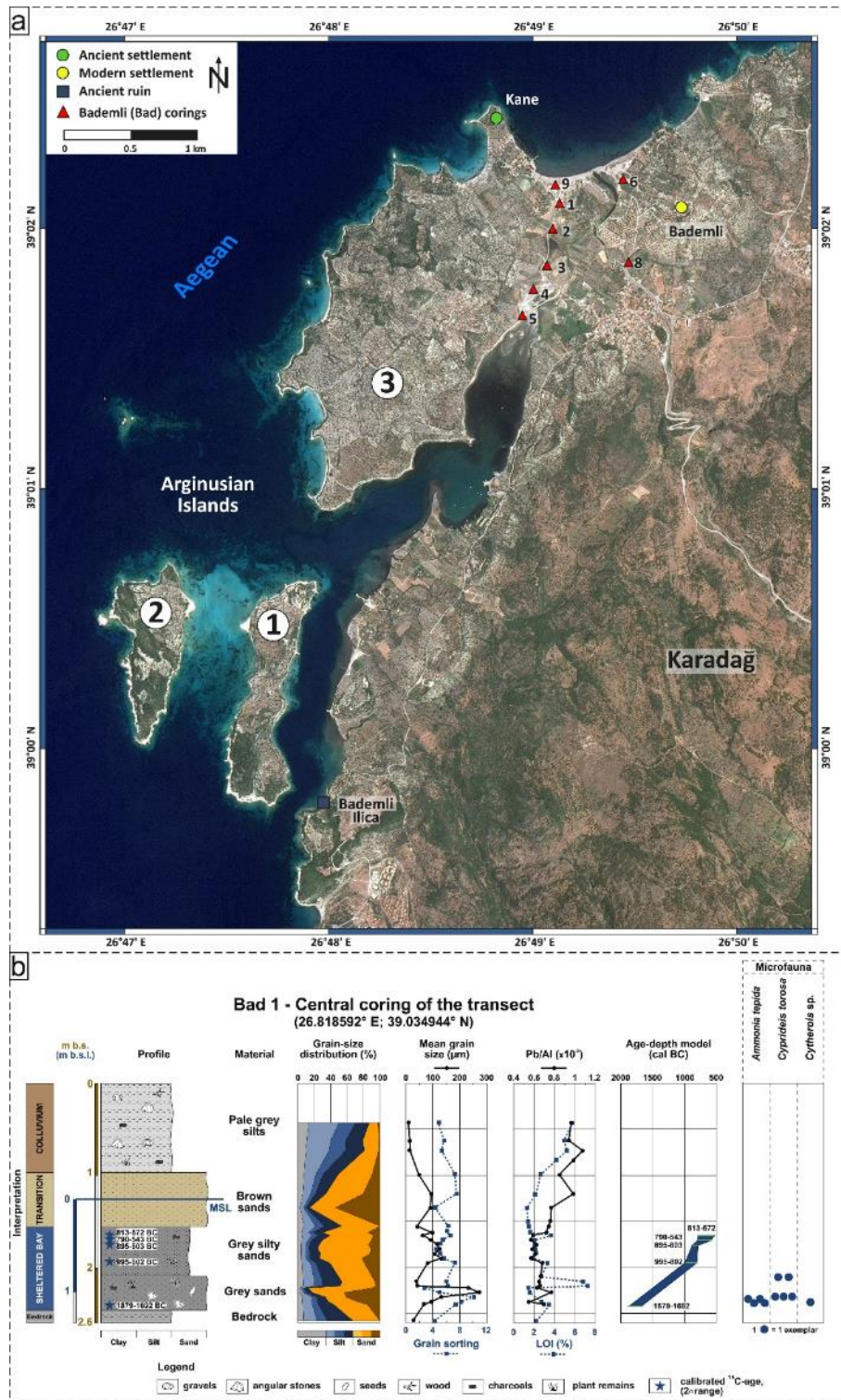
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15.10-15.35: **Geoarchaeological Research on Kane Peninsula**

Martin Seeliger & Helmut Brückner, Institute of Geography, University of Cologne, Albertus-Magnus-Platz, 50923 Germany

Under the umbrella of the ROMP project, geoarchaeological research was carried out on Kane Peninsula in September 2015. The fieldwork focussed on the surroundings of the ancient city of Kane near the modern village of Bademli, including UAV (unmanned aerial vehicle) surveys and sediment corings. This was later supplemented by various laboratory analyses.

During antiquity, literary sources mention three islands (Fig. 1a) off the modern Dikili peninsula. The so-called Arginusae were the site of the naval in 406 BC, when an Athenian fleet defeated a Spartan fleet. Many centuries later, the famous map of the Ottoman admiral Piri Reis from AD 1513 shows only two islands, the modern Garip islands. Using evidence from sediment cores, we tried to rediscover the “lost” third island, which may be the one where



(a) The investigation area in the north-western part of the Karadağ peninsula. Pléiades 1

satellite image; 23.05.2015; RGB- composite based on canals 3, 2, 1).

(b) Stratigraphical record and facies distribution of Bad 1, the central coring of the former sound (26.818592° E, 39.034944° N; ground level: 1.28 m above sea level).

the ruins of the ancient city of Kane are located.

Coring Bad 1 (Fig. 1b) was gained at the highest point of the former sound and acts as the neuralgic spot of the whole transect. If this area was water covered during the prime of Kane (Classical to Hellenistic times), the same has to be assumed for the rest of the transect. In summary coring BAD 1 indicates the following evolution: From the onset of the 2nd millennium onwards until 600 BC the location of Bad 1 was – if at all – only covered by shallow water. The water depth was shallower than 0.5 m. Around 600 BC men started to consolidate the terrain to create dry land and to enter the island on which ancient Kane was situated by feet. This is backed by the findings of a weathered limestone at 1.55 m below surface and rising contents of lead. Both findings correlates well with the settlement period of Kane in Classical and Hellenistic times. The investigation of corings Bad 2, 3 and 9 (Fig. 1a) will bear witness of the shape of the former sound and the width of the pathway. It is to be assumed, that the sound was already partly silted up during the prime of Kane.

15.35-16.00: The Harbour of Tarraco: New Results

J. M. Macias, ICAC, F. Salomon, University of Southampton and K. Strutt, University of Southampton

At the end of 2015 a geophysical and geoarchaeological survey was undertaken at the city of Tarragona, Hispania Tarraconensis coast, in Catalonia, Spain. All this activity was carried out in an active urban area and with an intense traffic. The current port area is superimposed ancient *portus* area in about 3 meters and, to date, the urban archaeology of Tarragona has not been able to accurately identify the line of the Roman quay. But many excavations have documented both intense commercial and urban activity between 6th century BC and 8th century AD.

The first goal was obtained new urban information from the Ground Penetrating Radar (GPR) survey of the modern streets of the harbour's town, and Electrical Resistivity Tomography (ERT) on paved area, to locate remains of the Roman port. Two geoarchaeological cores were also carried out in the interior of the port, with the objective of determining the depth of its basin.

The results of the geophysical survey at Tarragona highlight a number of key areas of the ancient port, showing remains of structures continuing under the modern streets. In the vicinity of the Roman theatre, baths and the Visigothic port, a large number of structures are visible in the results. A hypothetical line for the edge of the Roman harbour can be given on the basis of the results, although the exact location of the eastern Roman mole remains difficult.

Afternoon Tea 16.00-16.30

16.30-16.55: Excavation at Port-la-Nautique (Narbonne, France)

C. Sanchez, CNRS, ASM and C. Carrato, ASM

Port La Nautique is located 4 kilometers south of Narbonne, on the northern shore of the Bages and Sigean lagoon. It is one of the main piers of Narbonne's roman port system. The excavations undertaken since the beginning of the twentieth century, both on land and underwater, have shown that the site was occupied for a century, between 30 BC and 70 AD. Despite this relatively short interval the site shows signs of complex evolution, with luxurious residential areas (*Lac de Capelles*, *Villa*) and storage facilities.

Recent investigations carried out at Port-la-Nautique have shown the presence of big warehouses for the storage of *dolia*. The buildings are estimated to be around 150 m long and 16 m wide. This discovery proves that during the 1st century AD Narbonne was a harbour where bulk wine could be stored. The presence of pottery kilns and of a large dump filled with shells provides evidence for other activities in the port area.

These excavations have helped us understand the internal organization of this specific area in the harbour system. The roman site of Port La Nautique extends over 18 hectares, some of it being urbanized today. The digs were concentrated on a limited part of this site, and were coupled with geophysical surveys and small localized trenches in an attempt at reconstructing the Roman topography.



Port-la-Nautique, Narbonne

Other Ports and Sites

16.55-17.20: Investigations of the Port at Dreamers Bay, Akrotiri, Cyprus

S. James, University of Leicester, F. Salomon, University of Southampton, L. Blue, University of Southampton, H. Farr, University of Southampton, C. Hazell, Northumbria University, C. Vittori, University of Strasbourg, M. Pound, Northumbria University, E. Hocking, Northumbria University, M. Polidorou, University of Athens

At the southernmost tip of Cyprus, in Dreamers Bay on the seaward coast of the Akrotiri peninsula inside what is currently a UK Royal Air Force airbase, lie submerged remains of an ancient harbour. These comprise a masonry breakwater possibly of Hellenistic date, and a scatter of ancient anchors and ceramic concentrations believed to attest wrecks. On the top of the cliffs overlooking the harbour are extensive stone quarries, and rock-cut cemeteries of apparently Roman date.

Immediately to the west of the bay, on the only area of low ground anywhere on the southern coast of the peninsula, for 0.5km the shoreline is dotted with the remains of masonry buildings, exposed by winter wave action. Known for several decades and initially investigated in the 1990s, these were thought to be late Roman warehouses. The port as a whole must bear some relationship to the known settlement pattern of the peninsula, which comprises a number of apparent late Roman/early Byzantine 'village' sites, including Katalymata ton Plakaton, where a massive early Byzantine ecclesiastical centre is under excavation. It also likely relates to the major city of Kourion, c.13km to the northwest. Understanding all these relationships is dependent on establishing the currently-uncertain chronology of formation of the double tombolo beaches which, apparently around the general period, turned Akrotiri from an island to a peninsula.

Currently collaborative research undertaken by the Universities of Leicester and Southampton is seeking to address these questions. The Leicester team has conducted two seasons of shoreline excavation at Dreamers Bay, to determine the nature, extent and chronology of the apparent harbour facilities. Colleagues from Southampton have been conducting initial geomorphological work on the peninsula, and in September 2016 drilled cores in the salt lake which now exists between the former Akrotiri island and Cyprus proper. It is hoped that examination of these cores will provide much finer-grained dating information for when the peninsula formed, vital for understanding the purpose, functioning and chronology of the Dreamers Bay harbour.

17.20-17.45: Fossae Mariana Project

S. Fontaine, Department of Underwater Archaeological Research, French Ministry of Culture, K. Strutt, University of Southampton, N. Carayon, University of Southampton, F. Marty and M. El-Amouri, Ipso Facto

Fos-sur-Mer has been identified with the ancient Fossae Mariannae and one of the maritime ports of Arles (ancient Arelate). Underwater excavations undertaken by the DRASSM and the University of Marseille/Aix-en-Provence since 2012 in the gulf of Fos have uncovered several substantial structures related to the ancient harbour system. Within the framework of the new Collective Project of Research "*Fossae Mariannae*" and thanks to a partnership with the

ERC RoMP project, a team from the University of Southampton undertook a geophysical survey on several beaches around the Fos-sur-Mer peninsula. We aim to present the preliminary results of the underwater excavations and of the geophysical survey undertaken in 2016. As well we will present the 2017 campaign of fieldwork.



GPR at Fos-sur-Mer

Questions and Discussion: 17.45-18.30

Rinfresco 19.00

Dinner at BSR 20.00

27 January 2017

Thematic Studies

9.30-10.00: Introduction and Overview: P. Arnaud

10.00-10.25: **Geo-archaeological Work in the Bay of Pozzuoli**

M. A. Di Vito, INGV, Naples (IT), mauro.divito@ingv.it and V. Acocella, G. Aiello, D. Barra, M. Battaglia, A. Carandente, C. Del Gaudio, S. de Vita, G. P. Ricciardi, C. Ricco, R. Scandone, F. Terrasi.

Defining and understanding the shallow transfer of magma at volcanoes is crucial to forecast eruptions, possibly the ultimate goal of volcanology. This is particularly challenging at felsic calderas experiencing unrest, which typically includes significant changes in seismicity,

deformation and degassing rates. In fact, caldera unrest is particularly frequent, affects wide areas and often does not culminate in an eruption.

The Campi Flegrei caldera (CFC), in the densely inhabited metropolitan area of Naples (Italy), is commonly considered one of the most dangerous active volcanic systems. CFC is a ~12 km wide depression hosting two nested calderas formed during the eruptions of the Campanian Ignimbrite (~39 ka) and the Neapolitan Yellow Tuff (~15 ka). In the last ~5 ka, resurgence, with uplift of ca. 60 m close to the central part of the caldera, was accompanied by volcanism between ~4.8 and ~3.8 ka. After ~3 ka of quiescence, increasing seismicity and uplift preceded the last eruption at Monte Nuovo in 1538 for several decades. The most recent activity culminated in four unrest episodes between 1950-1952, 1969-1972, 1982-1984 and 2005-Present, with a cumulative uplift at Pozzuoli of ~4.5 m; the present unrest episode has been interpreted as being magma-driven. These unrest episodes are considered the most evident expression of a longer-term (centuries or more) restless activity. The post-1980 deformation largely results from a magmatic oblate or sill-like source at ~4 km depth below Pozzuoli. Despite the restless activity of CFC, the recent unrest episodes did not culminate in eruption, so that any possibility to define the pre-eruptive shallow transfer of magma remains elusive. Indeed, this definition is a crucial step in order to identify and understand pre-eruptive processes, and thus to make any forecast. To fill this gap, we focused on the last eruption of 1538, reconstructing its pre-eruptive deformation pattern. For this, we exploited the unique *historical, archaeological, geological and long-term geodetic records* of the caldera to carefully determine the height variations (and related errors) of 20 selected sites along its coastline in the last 2 ka. The integration of this large archeological, geological historical archive permitted us to obtain the first reconstruction of pre-eruptive short- and long-term ground deformation of the CFC and to model the magma transfer before the Monte Nuovo eruption. The model corroborates the existence of a stationary oblate source, below the caldera centre, that was feeding lateral eruptions for the last ~5 ka. Our results suggest: 1) repeated emplacement of magma through intrusions below the caldera centre; 2) occasional lateral transfer of magma feeding non-central eruptions within the caldera. Comparison with historical unrest at calderas worldwide suggests that this behavior is common.

Port Systems

10.25-10.50: Ports, Harbours and Anchorages: Working towards a Definition of the Concept of Port Systems

N. Carayon, University of Southampton

A port is an interface between land and water which acts as a node of connection between centres of population in its hinterland and other ports overseas. They are sites that are usually thought of as dots on the map or nodes in network analyses of inter-site connectivity. In reality, however, they are much more complex. Within the same micro-region, what is usually termed as simply a "port" in fact acts as an interface of connectivity that is perhaps better conceived of as a cluster of port facilities and sites of harbour-related potential. These "port-systems" include ports, harbours and anchorages and take the form of façade maritimes of differing degrees of development. The aim of this paper is to present the ongoing work of the ERC Portuslimen (RoMP) project about the definition of the concept of "port systems".

Coffee 10.50-11.10

11.10-11.35: Promoting the Understanding of Roman Ports: Computational Approaches to Port Systems

M.C. Moreno Escobar, BSR, University of Southampton

The ERC-funded “Rome’s Mediterranean Ports” (RoMP) Portuslimen Project is promoting an inter-disciplinary approach to the study of Roman Mediterranean ports, which moves away from views focused on ports as isolated entities towards a holistic and nuanced understanding of port systems. As part of the Project’s multi-disciplinary strategy on Roman ports, emphasis has been placed on their contextualisation within the landscape (both terrestrial and maritime) during the Early Imperial period, seeking to explore the changing relationships established between ports and their hinterlands. Such exploration (currently under development) relies heavily on the construction of computational models within the wider framework of archaeological spatial analysis, paying special attention to the issues of visibility and connectivity within port systems. Taking three case studies (*Hispalis*, Sevilla, Spain; *Narbo Martius*, Narbonne, France; and *Tarraco*, Tarragona, Spain), this paper will introduce the theoretical and methodological questions the Project is addressing in terms of the spatial complexity of port systems, with the aim of promoting a discussion about their territorial understanding and their development through time.



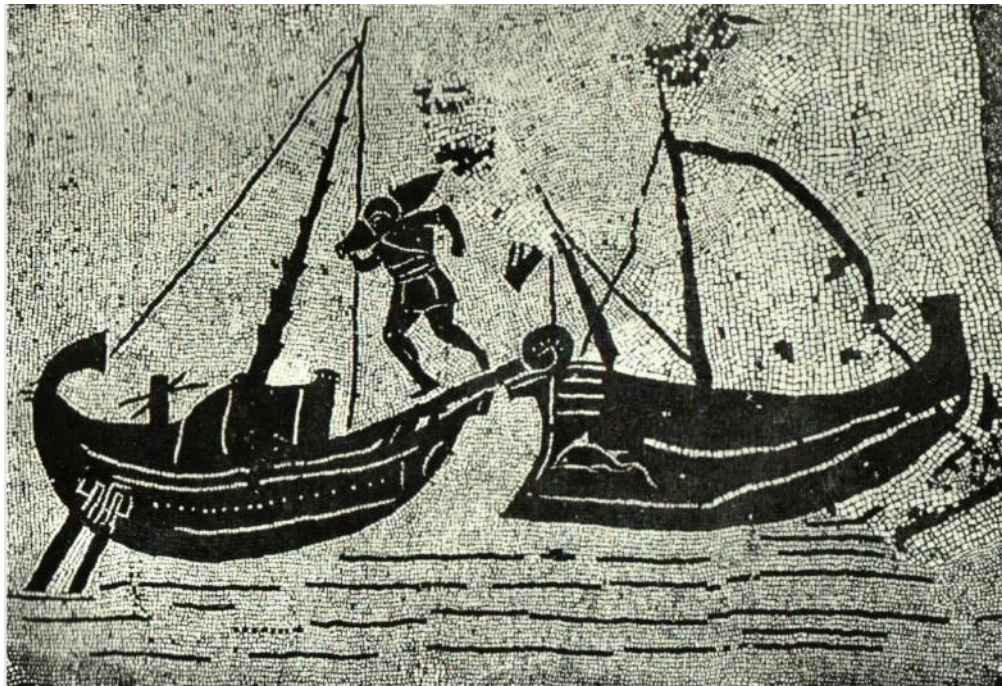
Location of the ports under discussion in this paper (Source: the author)

11.35-11.55: Roman Commercial Procedures in the Context of Mediterranean Ports

E. Mataix Ferrandiz

Although archaeologists have recovered many Roman-era port structures, trade in the ancient world is still poorly understood. What can inscriptions written on everyday stuff such as pots or barrels tell us about commerce in the Roman Empire? One way to approach this material is through the prism of Roman law. Like trade itself, Roman law was an integrating element in a Mediterranean world consisting of radically different cultures. The topic of study is the epigraphy of merchandize, and targets inscriptions which we have labelled as *scripta commercii*. This term refers to the inscriptions on artefacts reflecting the commercialization procedures in which the object is involved.

This presentation will show how patterns in mercantile inscriptions suggest a special commercial language, which fostered connections between different cultures and consist on the material expression of the procedures employed in trade. Understanding the cycle of procedures through the study of *scripta commercii* and other material evidence, provides a unitary focus to understand how trade was performed at the different Mediterranean ports. We will see a model of procedures taking place on different areas, protected by the Roman authorities through the framework of law, and how Roman jurists encouraged common-sense solutions to the constant challenges of trade and travel in a dangerous world.



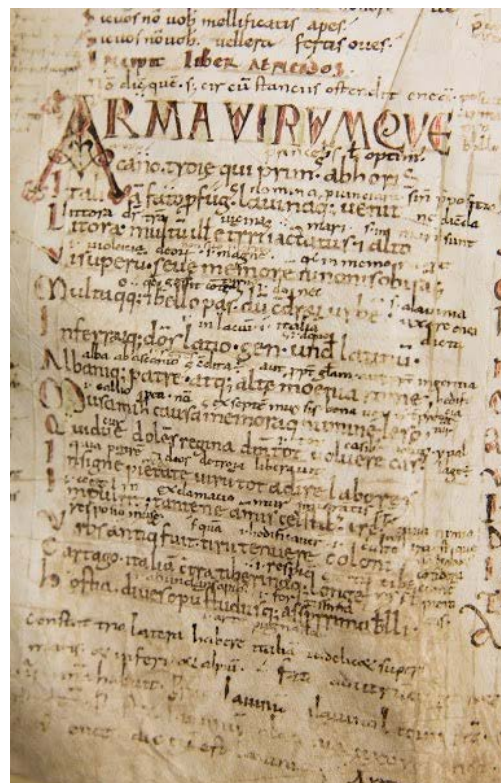
Mosaic, Statio 25, Piazzale del Corporazione, Ostia

11.55-12.15 What *portus* look like: Latin literary texts on geomorphology and climate

N. Garcia Casacuberta

As a member of the Portus Limen Project, my task consists of the analysis of the literary sources. This detailed analysis of large quantities of texts will allow for a more accurate description of ancient ports, further deepening our theoretical and contextual knowledge in contrast to the more concise attempts that have previously been carried out.

For this paper, I will present a brief sample of my work focusing on the Latin term *portus*, which is the standard word to designate a harbour. Firstly, I will present some statistical data that offers a general introduction to the textual sources available for my study. Secondly, I will discuss specific texts providing details about the characteristics of harbours from the eyes of Latin writers, focusing on the types of natural formations that provide shelter for vessels, and what they offer shelter from (wind in particular).



Detail from the beginning of the Aeneid, 11th century (ABEV ms 197 folio 25v)

Port Iconography

12.15-12.35: Visualised Port Landscapes in Roman Art: from the Reality to the Symbols

S. Mailleur-Aldbiyat

Our knowledge of port architecture under the Roman Empire is very unclear as it is not usually well preserved. Therefore, use of other types of sources like iconography is

fundamental. Port images are indeed quite abundant during the Imperial period and decorate various media (coins, ceramics, mosaics, paintings etc.). They make an important contribution to the study of the architectural appearance of the main ports of the Mediterranean Sea, showing us what no longer exists, such as the elevations of ports buildings. Use of iconographic sources is nevertheless quite limited because of their lack of reliability - the image is an interpretation of the reality by the artist. The main issue with this work is that artists appear to make representations according to artistic conventions rather than recording reality. In this paper, we will examine the distance between reality and the idealisation of port images. Additionally, we will study where these idealised port landscapes spring from and what is their purpose. Moreover, we will focus on examples depicted on the Nero's *sestertii* representing Portus in order to evaluate the degree of realism and symbolism of these images. We will show to what extent, beyond the representation, a port image can convey an ideological message and serve the Imperial propaganda.



Painting from Pompeii with maritime landscape (Italy, Naples, Museo Archeologico Nazionale, inv. 9484).

Questions and Discussion: 12.35-13.00

Lunch 13.00-14.20

Invited Papers

14.20-14.45: **From Amphora to TEU: Journey of a container. An Engineer's Perspective**

A. De Graauw

Coastal Engineering & Shiphandling

Grenoble, France

This presentation aims to compare aspects of ancient and modern maritime logistics such as stowage on board ships, loading & unloading, exporting & importing of goods, and merchant ships & sailing. A few major nodal points are known to have formed a network for trade in the Mediterranean area (Rome, Alexandria, Baetica, Proconsular Africa), and many smaller nodes created imbricated networks. The number of ships sailing the oceans has increased by

a factor of ten and large ship sizes have increased from 40-50 m in length to 300-400 m, but the number of shipwrecks per year has remained fairly steady, showing that ancient sailing was more dangerous than modern sailing. Sailing routes on the Mediterranean Sea and on the Red Sea are analysed briefly and show that sailing to windward was required, probably with a partially brailed sail as seen on the Kelenderis mosaic. The value of cargo on each ship, based on an exchange rate of 1 sesterce = 6.50 euro, has also increased by a factor of ten. It can hence be concluded that today's maritime logistics were already in use more than 2000 years ago, but in ancient times, today's "time is money" was less important than "have a safe trip back home".

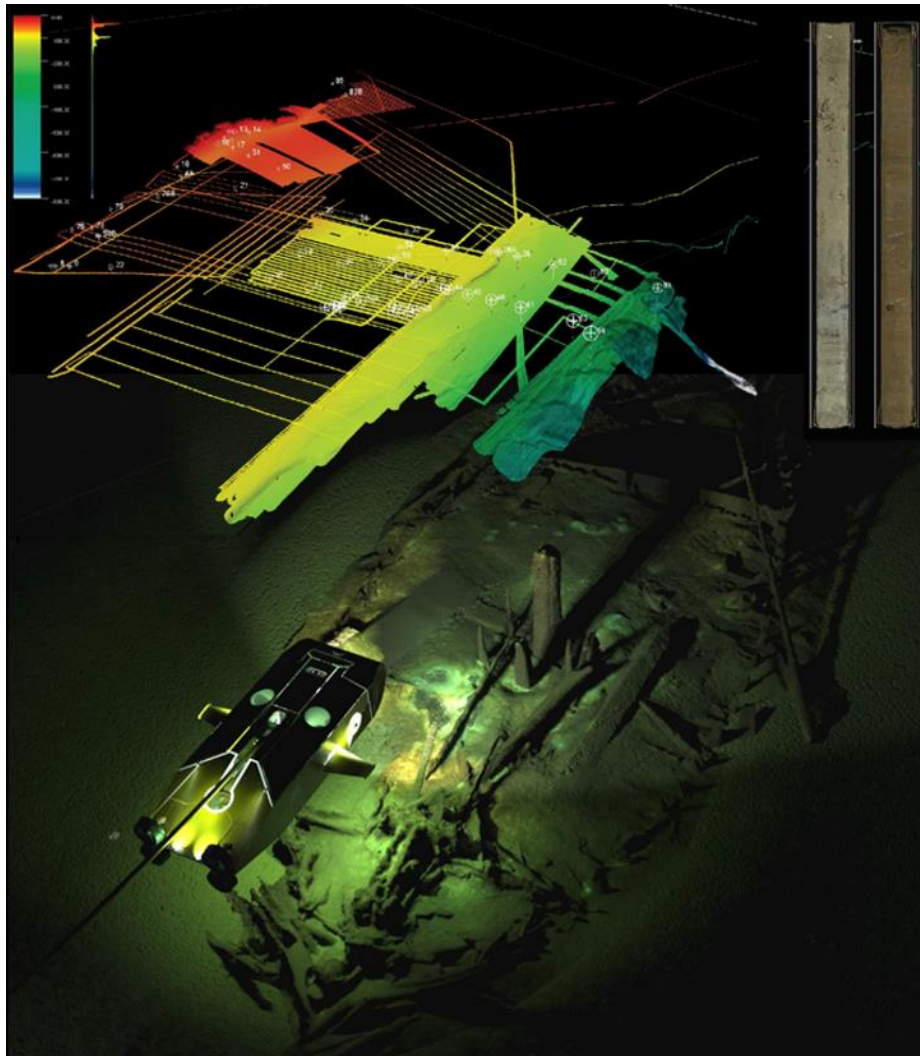


Display of amphora loading, Musée Archéologique d'Antibes

14.45-15.10: **The Black Sea Maritime Archaeology Project: From Palaeolandscapes to Port Networks**

J. Adams, University of Southampton

Abstract to follow



Composite image of wreck, ROV, surveyed seabed and cores

Final Questions and Discussion: 15.10 – 15.30

Closed Project Meeting: 15.30 – 18.00

- a. Overview
- b. Methodological Issues
- c. Future Perspectives
- d. Port Resource
- e. Publication Strategy