density of the port's activity during the Early Empire, the layout of Fossae Marianae, the topography of the harbour sector and the ancient settlement, the dating and the functionality of the facilities are still not well defined. Paradoxically, the harbour sector is very little studied given its archaeological and historical importance and its potential in comparative studies with contemporary large-scale harbour systems.
The underwater archaeological excavations, as well as the marine geophysical prospections undertaken since 2012 have revealed extensive facilities preserved in situ. At present, the entire Gulf of Fos and the Fossae Mariannae are studied in the framework of a large-scale Research Project, conducted by a multidisciplinary team, with main objective interconnected studies between the harbour sector, the coastal settlements and the Marius Channel.

10:30 - 10:30
The harbour system of Narbo Martius (Narbonne, France) and its facilities during Antiquity
Nicolas Carayon, Simon Keay, Pascal Arnaud, Corinne Sanchez

The actual city of Narbonne in south of France was the capital of the Roman province of Gallia Narbonensis and a city-port located at the crossroad of the Via Domitia which linked Italy to Spain and the Via Aquitania which linked the Mediterranean Sea to the Atlantic Ocean. Its port, the “emporion of all Gaul” in the words of Strabo was in fact a vast system of hundreds of occupation sites organised around a huge natural water area into a local internal network.
Within the framework of the ERC funded project Rome’s Mediterranean Ports – Portus Limen and thanks to a partnership with the Collective Project of Research: Les ports antiques de Narbonne (CNRS, UMR 5140 Archéologie des sociétés méditerranéennes), it has been possible to precisely define what was the harbour system of the Colonia Narbo Martius since its foundation in 118 BC until the late antiquity.
This paper aims to reconstruct the evolution of this harbour system taking into account the major transformation of the landscape, the human occupation of the area and the artificial development of the harbour activities. The recent archaeological discoveries allow new interpretations about the functioning of one of the most important Roman port of the western Mediterranean. The integration of all the data available into a GIS and into an interdisciplinary database allows visualizing the harbour system and its evolution over five centuries.

Session Geoarchaeology I (Lecture Hall A) – Chair: Steffen Schneider

9:00 – 9:30
Geoarchaeology of Magdala harbour and Tel Akko (Israel)
Christophe Morhange, Michal Artzy, Matthieu Giaime, Veronica Rossi, Giovanni Sarti

With the support of the MISTRALS-ENVIMED-GEOSISRAEL program and A*MIDEX GEOMED project, we have been able to reconstruct the palaeo-environmental evolution of two ancient harbours in Israel. Harbour geoarchaeology was mainly developed in Israel by the late Avner Raban, founding member of the RIMS multidisciplinary research unit in 1972 at Haifa University. Since these pionneering years, a series of geoarchaeological projects have focused on different ancient harbours, mainly at Caesarea, Dor, and Atlit. Paradoxically, landscape evolution of the major harbour sites of Magdala and Tel Akko have been neglected until two comprehensive multidisciplinary archaeological projects were recently started.
Recent excavations undertaken in the ancient city of Magdala, located on the western shore of the Sea of Galilee, have unearthed a harbour structure extending for more than 100 m, dating from the late Hellenistic (167-63 BC) to the middle Roman (70-270 AD) periods, with well-preserved quays and mooring stones. An integrated (geomorphological, sedimentological, micropalaeontological and archaeological) study of the sedimentary succession buried beneath the ancient harbour area reveals the harbour’s main evolutionary stages, shedding new light on the natural versus anthropogenic controls on sedimentation. Three sedimentary sequences reflect the recent palaeoenvironmental evolution of Magdala. These include: 1) a pre-harbour foundation sequence; 2) a harbour sequence from the 3rd-2nd centuries BC to the first half of the 1st century AD. The substantial increase of ostracod species (Pseudocandona albicans) preferring calm waters and fine-grained facies point to the establishment of a protected, shallow and organic-rich setting. The increase in sodium and potassium concentrations is accompanied by the sudden appearance of Heterocypris salina, a brackish-tolerant species, and by the dominance of noded valves of Cyprideis torosa ; and 3) a harbour abandonment sequence dated ca. 270-350 years AD.
Archaeological excavations at Tel Akko, east of the present city, revealed imported artifacts and evidence for maritime trade from the Middle Bronze Age (2200–1500 years BC) onwards. The findings strongly indicated that

a harbour had been developed on this site even though its exact location and associated facilities were still to be determined. Sedimentological and paleontological analyses together with 14C dating of cores provide new palaeo-environmental information allowing for the reconstruction of shoreline changes over the last 4000 years. Firstly, we propose that the southern face of the tell constituted the harbor environment,with lagoonal-marine characteristics until ca. 2800 years BP; and that the site was protected by a natural rocky breakwater and a spit which were eventually silted up and transformed into a continental marsh. This environment might have been used as a harbour by inhabitants before the archaic period. Secondly, it seems that the west side of the tell was lined by a sandy coast that had prograded offering an open anchorage until the Persian period. These results must be cross-validated by future archaeological excavations aimed at more accurately locating the ancient harbour structures.

9:30 – 10:00

Effect of The Holocene sea level change on geomorphology and geoarchaeology of ancient harbours sites in Ras El Hekma area, NW coast of Egypt

Magdy Torab, Samah Moustafa

Leuke, Hermaeis, Phoenicus or phénikountos and Pnigea are four of ancient harbours in Ras El Hekma area as a part of the NW coast of Egypt. Some geoarchaeological remains were discovered by the authors during their field surveying in the eastern side of Ras El Hekma triangle shape coastline on the NW coast of Egypt, west of Alexandria city of about 200 km., in the same location of the above ancient harbours were described by early writers.

The location of phénikountos Greek and Roman harbours have been identified with the ruins that lie on the coast in the gulf, near Bir el Gènèfis. (Fourtau, 1914, p. 108). There are twin islets, below which is the anchorage, with sufficient depth for large ships; water is to be found in a cistern in the neighboring valley. (Ball, 1942, P. 131). The geomorphological characteristics were studied for both locations but we must bear in our mind that the coastline were changed from the Roman period up to recent time by coastal erosion and other geomorphic processes in addition to the Holocene sea level change.

The study area is occupied by alternating Quaternary limestones as a part of eroded carbonate coastal ridge. Some geomorphic coastal landforms formed by The Holocene relative sea level were observed on the shoreline such as multi-level marine notches, platforms and caves in addition to some solution micro landforms formed by sea water on carbonate rocks such as solution holes, channel, pits and residual pinnacles.

The objective of current study is to define the geomorphological and geoarchaelological characteristics of some ancient harbours sites in Ras El Hekma area and to study effect of The Holocene sea level change on its geomorphology, based on detailed field geoarchaelogical and geomorphological surveying, mapping and collect some sedimentary samples by coring and dating, as well as multi dates historical maps and RS images to measure erosion rate of the coastline during last century by using GIS techniques.

References:

1. Ball, J. (1942), Egypt in the Classical Geographers, Ministry of Finance of Egypt, Government Press, Bulaq, Cairo.

2. Donald, M. & Bailey, D.M. (1996), Archaeological research in Roman Egypt , Journal of Roman Archaeology Supplementary , (19): 61- 81 .

3. Fourtau, R. (1914), La côte de la Marmarique d'après les anciens géographes grecs, Bulletin de l'Institut d'Egypte (8): 100-126.

10:30 - 10:30

Harbour of Elaia: Land-sea-human interactions during the last 7,500 years

Lyudmila Shumilovskikh, Martin Seeliger, Anna Pint, Stefan Feuser, Felix Pirson, Helmut Brückner

As part of the geoarchaeological research about Elaia, the harbour city of ancient Pergamum (W-Turkey), palynological studies were carried at a sediment core from the silted-up closed harbour basin of Elaia (core Ela70, 9 m long), in order to reconstruct the vegetation and environmental history. In addition to standard pollen analysis, non-pollen palynomorphs helped to detect environmental changes. An age-depth model based on 11 calibrated radiocarbon ages, starting from ~5500 BC, provides the basis for a high resolution chronostratigraphy.

The lower part of the pollen diagram is characterized by high percentages of deciduous oaks and pines, suggesting the dominance of open forests close to the coring site. While visible deforestation occurred around 5,000 BC and later 3,770 – 2,300 BC, the change from oak forests to anthropogenic landscapes with olive, pistachio, walnut, and grape definitely starts around 850 BC, reaching a maximum between 170 BC and AD 180, and continued up to ~AD 800. Afterwards the landscape got reforested by pines, while salt marches developed in the surroundings of the coring site. Elaia's heyday is characterized by increased fire activity, indicated by high charcoal concentrations, and the enhanced amount of eggs of intestine parasites Trichuris and Ascaris,