

MSM 16-3, PHAETON

1. Weekly report

22.10.-28.10.2010

MSM 16-3 was designed to study the Pleistocene to Holocene shallow to deep shelf and slope sedimentary system of Mauritania. It integrates the study of shallow-water carbonates, clastic sedimentary patterns, and deep water reefs. In addition, the eolian dust input and the hydrography are being studied.

The study area stretches along the shelf of Mauritania from South of Nouakchott to Cap Blanc in the North of Golfe d'Arguin (17-21°N). The study area is under influence of upwelling as is reflected in the cool and productive waters along the NW-African shelf. However in the Golfe d'Arguin the widening shelf allows the waters to warm up and thus gives rise to the development of a eutrophic tropical ecosystem additionally fertilized by Saharan dust. The dust settling in the wide gulf are winnowed and later deposited in depocenters at the precipitous morphological break off the shallow so-called Banc d'Arguin. These depocenters provide high-resolution climate records of the Holocene. In the canyons off this gulf and further south on the shelf slope, deep-water coral reefs have developed. Located within a major oceanic upwelling cell and at the border between Sahara and Sahel, this shelf is climatically and oceanographically exceptionally sensitive and offers the opportunity to put a variety of environmental parameters into a chronologic and causal context.

The scientific goals of the cruise are:

- gaining a better understanding of one of the rare modern occurrences of eutrophic tropical carbonates
- reconstructing Holocene climate as recorded in the fine-grained sediment off Banc d'Arguin („green Sahara“)
- learning about the ecology and status of the southernmost known deep-water coral reefs in the eastern North Atlantic.

Thu 14.10.2010

R/V Maria S. Merian left the port of Bremerhaven at 8:45 headed towards Las Palmas. The vibrocorer has been mounted on deck already on 13.10. in the port. Two scientists, Stephen Schilling and Hermann Kudrass, participate in the transect to Las Palmas in order to prepare parasound, multibeam, and innoMar operations. The other scientists flew to Las Palmas on 21.10.

Fri 22.10.2010

R/V Maria S. Merian left the port of Las Palmas at 9:00 in sunny weather. Later the wind caught up and the sky was cloudy. The transit to the study area off Mauritania took some 40 h. During the morning of 22.10., the scientists received an introduction into safety issues. Afterwards the containers were opened and the laboratory were prepared for the cruise. The dust collector was installed. An operational meeting between scientists and crew took place in order to prepare the ROV and Zodiac operations.

Sat 23.10.2010

Approaching the study area, the number of sea-birds and of trawlers increased around Maria S. Merian. Weather conditions were moderate (wind speed of 6, cloudy sky). Further preparatory meetings took place; a scientists' meeting to coordinate the work, and a meeting between scientists and crew where the first presented their research goals. Thanks to winds from aft, the transit time was shorter than first expected. The first station at 22.40h was a CTD profile combined with a test run for the Posidonia transponders needed for the ROV. During the remaining night a parasound profile was acquired on the outer shelf of northernmost Mauritania where incised valleys were detected.

Sun 24.10.2010

The weather improved during the course of the day. The area mapped the night before off the northern Golfe d'Arguin was sampled with the box, gravity and vibro-corers. In particular incised valley fills were cored. The sediment is extremely rich in whole and broken bivalves, the carbonate content is extremely high. The recovery was high for the box corer, however as a result of the sediment composition moderate for the other corers.

The night was spent on continuing the parasound and multibeam mapping to the shelf off the central Banc d'Arguin where a wedge of fine-grained sediment has accumulated. CTDs were cast in the seaward positions on the profiles.

Mon 25.10.2010

During ever-improving weather, core locations defined on the basis of the parasound mapping were visited. The box corer, gravity corer, and vibro-corer were employed for coring the prograding sediment sheet of the fine-grained wedge. Due to technical difficulties with the coring devices, only a limited number of stations were run.

During the night, the parasound and multibeam mapping continued on the central shelf off central Banc d'Arguin, CTDs were cast.

Tue 26.10.2010

Maria S. Merian approached the shallow southern Banc d'Arguin to a water depth of 30 m, where the zodiac was deployed with additional Second Officer Jan Philipp Günther to allow for studying the shallow bank that here features less than 10 m water depth. During a first zodiac trip, the sedimentary architecture was studied by employing a small parasound device (Innomar). An assumably erosional surface was detected that is overlain by a thick sandy horizon, assumably the Holocene carbonate sediment produced on Banc d'Arguin. During a second zodiac trip, a hand-held CTD allowed for measuring temperature and salinity, and samples were taken with a small grab sampler. The sediment samples confirmed the assumption that the sediment on the shallow bank

is coarse carbonate sand dominated by bivalves. Immediately off the bank, fine-grained silt-dominated sediment is thought to represent the eolian fines that have been winnowed off the bank. This type of fine-grained sediment was also found in the grab samples taken from Maria S. Merian at the same time immediately adjacent to the sampling area of the zodiac team in water depths around 30 m. The abrupt lateral facies contrast to the shallow bank is striking.

During the night, the mud wedge off the southern Banc d'Arguin was mapped by parasound and multibeam, several CTD casts were run.

Wed 27.10.2010

The zodiac was deployed a second time on a position a few miles south of the previous deployment position – the first one is located to the north of the assumed major outlet of the current off the Banc d'Arguin, the second one to the south in the depositional shade of Tidra Island. First, the transition to the shallow bank was mapped with the small parasound device. The parasound signal indicated a coarser sediment on top of the reflector than on the day before. This was confirmed by the samples taken by the sediment sampling team that afterwards took the zodiac to explore the outer Banc d'Arguin. In addition it was confirmed by the samples taken from Maria S. Merian during the zodiac excursions that was less rich in siliciclastic silt and much richer in well preserved tropical gastropods (*Marginellids* etc.) in addition to the dominant bivalves. In the finer-grained offbank sediment, large numbers of the bivalve *Pinna* are present. It appears that the Banc d'Arguin is the highly productive carbonate factory we expected. The presence of sea-grass was not only indicated indirectly by epiphytic foraminifers in the sediment but also directly proven by floating sea-grass leaves in the waters. Floating sea-grass was sampled in order to study the epiphytes and their role in carbonate production.

During the night, canyons in the area mapped during the night 25/26.10 were mapped in detail in order to provide the bathymetric information for the first ROV run planned for the next day. The vessel was accompanied by a school of dolphins for a while.

Thu 28.10.2010

On the 28th, the ROV was deployed for the first time during this expedition. The crew of Maria S. Merian had prepared all the arrangements needed to connect the ROV of University of Gothenborg to the positioning system. The ROV station aimed at studying a canyon system. In addition, a structure that is elevated some 35 m above the side of the canyon thalweg was mapped in 500 m waterdepth. The assumption that this structure could represent a multipeak coral mound was confirmed by means of the ROV. The mound peaks are composed of fossil coral framework infilled by silty-sandy sediment. The flanks are colonized uncommonly densely by tube-building polychaets. High abundances of fish and high concentration of suspended matter in all levels of the water column are conspicuous.

During the night, the multibeam- and parasound-mapping in the canyon area was continued and a yet unstudied canyon directly off Cap Timiris was mapped.

Fri 29.10.2010

The day was exceptionally calm, and in the focus of zodiac-based examinations was a shoal marked in the seemap south of Cap Timiris. Mapping with the innomar device, however, showed, that this shoal does not exist. The zodiac work therefore was discontinued, and the only sample taken was that of floating sea-grass *Zostera* for the study of epiphytes. Afterwards, a series of sediment samples were taken along the 30 m isobath of the southernmost Banc d'Arguin to complete the sample set along the break of Banc d'Arguin. In the late afternoon, the canyon off Cap Timiris that had been mapped the night before, was reached again and mapping was completed.

In the evening, at a station in a widening of the canyon, a 6m gravity core was taken. The sediment is extremely fine-grained and organic-rich. A school of dolphins accompanied the work. During the remaining night, coral mound in the canyon area have been mapped.

Sat 30.11.2010

After three CTD casts in the canyons, the ROV was deployed on one of the spurs that are characteristic for the flanks of the canyon in water depths of 300-600 m. The ROV landed in a spectacular setting amidst of actively growing *Lophelia* bioherms. Individual coral galleries reach thicknesses of 1 m and continue down to depths of some 400 m. The prominent bivalve *Acesta excavata* with sizes of 10-20 cm form thick clusters at the current-facing side of the coral framework. This scenery reminded Tomas Lundälv, our Swedish ROV pilot, of the underwater world of Sweden. At 400 m water depth, the heavily calcified *Lophelia* corals changed to small fragile colonies, and sponges increased significantly in abundance. The benthos community changed to a Mediterranean character. With this ROV dive, current models of the occurrence of live cold-water corals were heavily shaken. Another highlight of this dive were live specimens of the deep sea oyster (*Neopycnodonte zibrowii*), the southernmost occurrence of which thus was proven. This oyster has a live span of up to 500 years and therefore provides an important historical environmental archive. The coral group on board is already impatient to present the new findings on the underwater world to the scientific community.

After some 8h of ROV work, Maria S. Merian over night transited to the Baie du Lévrier in the northernmost part of the Golfe d'Arguin to enter the bight the next morning.

So. 31.10.2010

On Sunday morning we entered the Baie du Lévrier. The panorama of the peninsula of Cap Blanc was glowing in the morning sun. The zodiac was deployed from a position east of the port of Nouadhibou. The parasound measurements revealed a clear undulating disconformity underlying some 10 m of ?Holocene sediment. Sediment sampling from the boat revealed that clean carbonate sediment occurs only on the shallowest shoals, whereas in deeper areas (>10 m) dark mud dominates. The coarse carbonate sediment consists of reworked material. For the moment it remains unclear where the main carbonate factory is located.

Sediment sampling from board of Maria S. Merian recovered fine-grained organic-rich sediment with live chemosynthetic bivalves. Two 5 m-cores were recovered.

Thus, during the first week already all three subprojects obtained tightly interconnected first data and sample sets. The atmosphere on board the vessel is very good, the work is progressing very well.

Prof. Dr. Hildegard Westphal
Chief Scientist on Maria S. Merian



R/V Maria S. Merian on her way to Mauritanian waters (Photo: Nereo Preto)



The Zodiac with the second 2. Officer Jan Philipp Günther and able seaman Karsten Peters. (Photo: Nereo Preto)



Studying box cores on the aftdeck: Claudia Wienberg, Guillem Mateu, Corinna Schollenberg, Marco Taviani (Photo: Nereo Preto)



Gastropods from about 30m water depth off Banc d'Arguin. (Photo: Nereo Preto)



ROV-Team at work: Tomas Lundälv and Lydia Beuck. (Photo: Nereo Preto)



ROV of Tomas Lundälv, University of Gothenburg. (Photo: Steffen Hetzinger)