

Short Cruise Report

RV METEOR: Cruise M69/1

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University of Hamburg**

**Las Palmas / Gran Canaria to Cartagena / Spain
August 8 to August 28, 2006**

Participants

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Scientific Program

In areas protected from siliciclastic input, western Mediterranean shelves are characterized by a cool- or temperate-water neritic carbonate sedimentation. This type of carbonate production differs from the extensively documented tropical systems by its dominance of heterotrophic organisms which predominantly produce calcitic carbonate. Especially the knowledge about the sediment dynamics and sequence stratigraphy of such systems is still incomplete. During the last decade, a series of cool-water carbonate depositional models were particularly developed for the South Australian Shelf, which is subjected to an oceanic wave regime with a deep-lying wave base. The western Mediterranean Sea, however, is a more enclosed basin with a considerably lower swell. Therefore the goal of the research cruise is to develop depositional models of the cool- and temperate water carbonates which may serve as a better example than the high-energetic South Australian Shelf to understand such carbonate in the rock record, especially in Cenozoic deposits. Western Mediterranean shelves are located in a compressive regime controlled by the movements of Eurasia and Africa. Earthquake locations follow major strike slip faults and tectonic structures control location of carbonate depocentres in a region mainly characterized by siliciclastic sediments.

Furthermore, the micropalaeontology sub-project aims at the investigation of the deep-sea benthic foraminifers. The occurrence of benthic foraminifers in the Mediterranean Sea clearly trace the regional trophic gradients between the eastern and western Mediterranean sub basins. The aim of the Tübingen research group is to collect new material for characterization of ecological preferences and genetic variability of benthic and planktic foraminifera in the NE Atlantic and the Mediterranean. Water sampling was carried out in order to isolate and analyse dissolved organic matter (DOM) in terms of provenance and diagenesis.

Narrative

RV Meteor left Gran Canaria harbour on August 9 2006. The first leg of the 69th cruise started with some hours of testing of the hydro-acoustic systems. In the late afternoon Meteor started sailing on north-east bound course. During the transit to the Morocco Atlantic margin a vast amount of instruments were installed in the laboratories and on the working deck. The most important task during the transit was the search and recovery of two lander systems deployed by IfM-Geomar during MERIAN-cruise MSM01/3. A long-term observatory (DOS Lander) for the monitoring of abiotic and biotic control parameters of a coral bioherm, had been deployed at Renard Ridge in the Gulf of Cadiz and a PWPL tool to better understand the dynamics of dewatering features of mud diapirs and mud volcanoes and to monitor variations in fluid expulsion had been deployed farther away from the coast. Since the ARGOS satellite monitoring system received signals from one of the lander early July, there was reason to assume that the DOS-lander had already popped up. For this reason the Argos- and VHF-receivers were monitored during the entire transit. Indeed DOS-lander did not react to the hydroacoustic signals giving evidence that the lander was not grounded any longer. After numerous trials we had to terminate the search and left this area heading north-east. The PWPL-lander could be recovered from the Captain Arutyunov mud volcano. The instruments like CTD, current meter and pore water lance were undamaged, however, frame and instrument housings were partly corroded. The upper part of the PWPL-lander was covered by a thin and grey-green veneer of anastomizing mucilage strings, on which planctic foraminifera and lithoclasts were attached. The settlement proofs the hydrodynamic

environment of the lander position. Benthic foraminifera like the *Vulvulina pennatula* had a diameter of 0,350 mm and were still not in the adult stadium. This particular species is well adapted to strong bottom currents and settled 130 cm above the seafloor. Only two living examples of this foraminifera has been described for the Gulf of Cadiz yet. This finding corroborates the need of deep sea observatories for biological-geological experiments.

On August 12 we reached the working area between the Strait of Gibraltar and Cape Trafalgar. The geophysical working program was designed to investigate offshore prolongations of active faults in the hinterland. In the years 50 and 400 AC the Roman village Baelo Claudia close to the modern city of Tarifa had been destroyed by earthquakes. Source and epicentre are still uncertain. A possible seismogenic source is a fault that was assumed to prolong into the Gulf of Cadiz close to the Cabo de Gracia. The pre-processed seismic reflection revealed the expected offshore prolongations of the fault system. The Pliocene sediment succession is strongly affected by the faults which indicates younger tectonic activity. The strong surface currents of > 6 kn represented an extraordinary burden for the seismic gear and made it difficult to navigate. The geological program aimed on the development of depositional models of cool- and temperate water carbonates. Based on the seismic and hydroacoustic survey sediment sampling was carried out with grab sampler, box- and gravity corer. The samples included mainly sandy sediments with red algae, sponges, bryozoans or molluscs. The sampling of corals was unexpected since they were never reported from this area.

We passed the Strait of Gibraltar during the night to August 14. In spite of strong currents plankton net and water sampler stations were planned, since the Strait of Gibraltar represents a key area for the water exchange between Atlantic Ocean and the Mediterranean Sea. The strait is only a few kilometres wide and is a suitable location to investigate plankton and chemical transport. The multiple-opening-closing plankton net haul caught well preserved and rarely sampled foraminifera. Later on, molecular genetic analyses will be used to investigate the spatial distribution of genetic types and their affinity to oceanographic properties.

After arrival in the working area around the Alboran basement ridge an extensive seismic survey started the same day in order to map tectonic lineaments and its Pliocene-Pleistocene sedimentary cover, as well as to select appropriate sites for geological sampling. As predicted from bathymetric maps, we found a giant contour drift on the northern slope of the Alboran ridge. The drift evidences vortexes within the Levantine intermediate water, which transports water from the Levantine Basin through the Gibraltar sill into the Atlantic. On August 16 the geological sampling started. In this area protected from siliciclastic input, the Alboran ridge is characterized by cool- or temperate-water neritic carbonate sedimentation. This type of carbonate production differs from the extensively documented tropical systems by its dominance of heterotrophic organisms which predominantly produce calcitic carbonate. For the first time the vibro-corer has been used aboard Meteor. Cores of up to 5,5 m length could be taken in water depth between 40 and 65 m. The micropalaeontology group sampled deep-sea benthic foraminifers with a multi-corer. Within this group of protists, certain taxa are used as depth indicators. It has, however, recently been shown that distribution of benthic deep-sea foraminifers is largely controlled by the type and amount of available nutrients and the oxygen concentration. Thus the occurrence of benthic foraminifers in the Mediterranean Sea clearly trace the regional trophic gradients between the eastern and western Mediterranean sub basins.

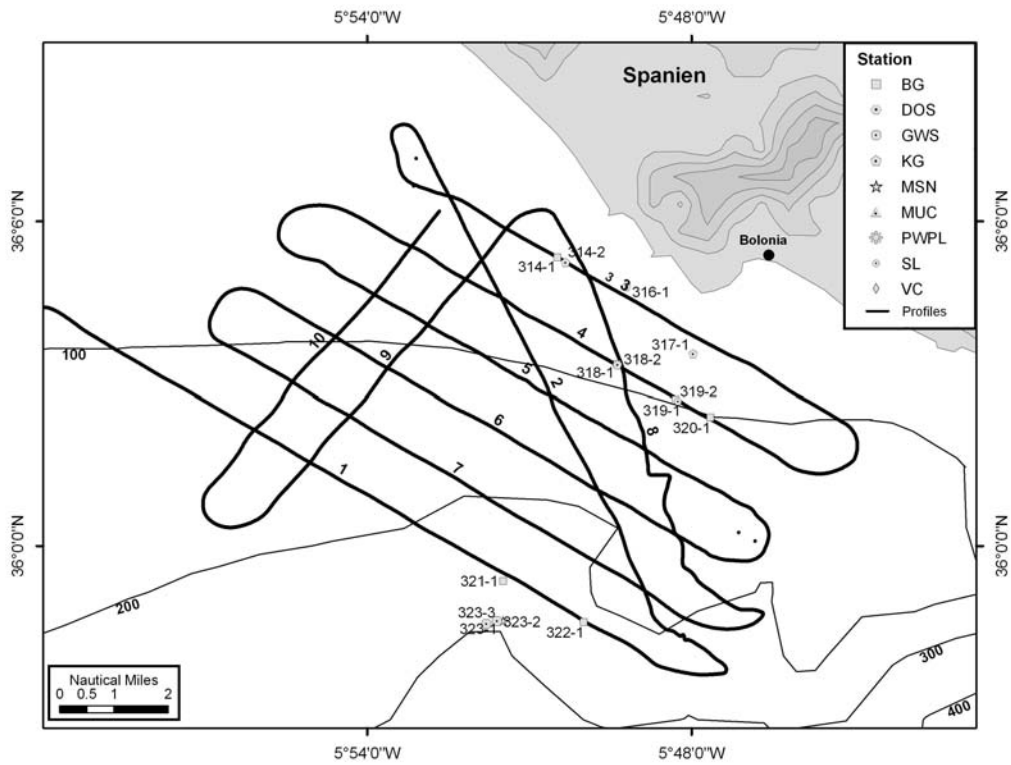
The next samples were taken close to the Carboneras fault, which has also an onshore segment. Previous studies had shown that this fault is highly active. Historical traditions reported an earthquake with subsequent tsunamis destroying cities in the hinterland. The offshore segment of the Carboneras fault had been

investigated by Spanish cooperation partners. From their data optimum core sites were determined and taken in order to reveal age models for fault activity.

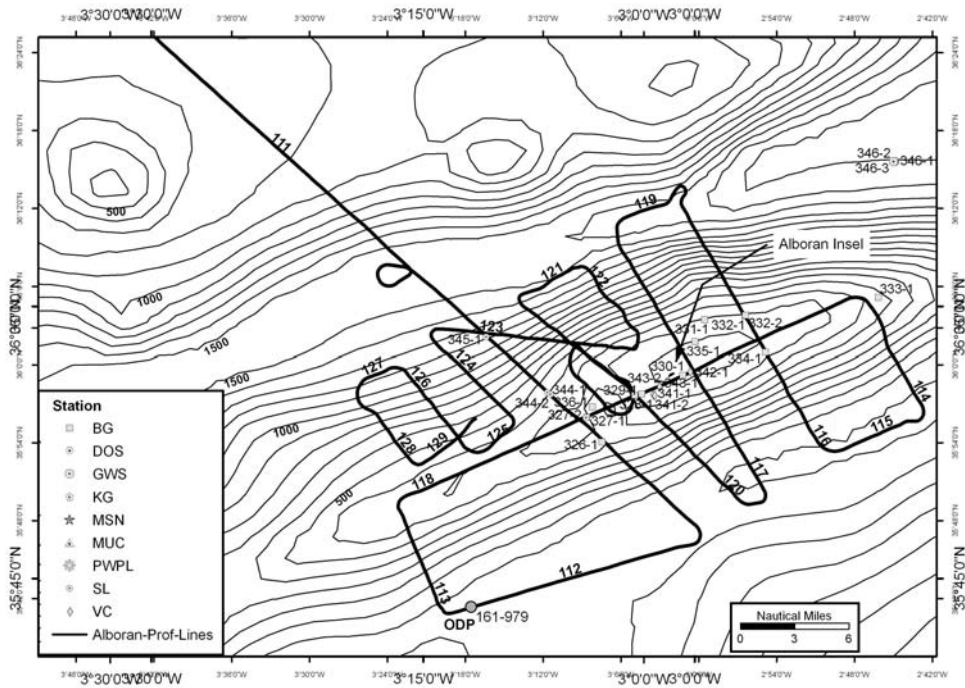
After a short transit to the Algerian coast on the 18th working continued with a geophysical survey of the Bay of Oran. The outer shelf was considered to represent an optimum depositional surface for cool-water carbonate production. Geological sample were taken along several transects. The spatial distribution of carbonates was surprisingly heterogeneous, obviously several depo-centers are presently active. The carbonate production is dominated by red algae. The substratum and base of the Holocene, respectively, was reached by the vibrocorer several times and therefore the cores will allow the reconstruction for the entire Holocene.

During the transit to Mallorca several water samples were taken in water depth of 150, 500, and 1500 m, in which the Modified Atlantic Water, the Levantine Intermediate Water, and the West Mediterranean Deep Water are present. The last water sample was collected at 1800 m water depth south of Mallorca. The so called dissolved organic matter (DOM) will be isolated and analysed later on in terms of provenance and diagenesis.

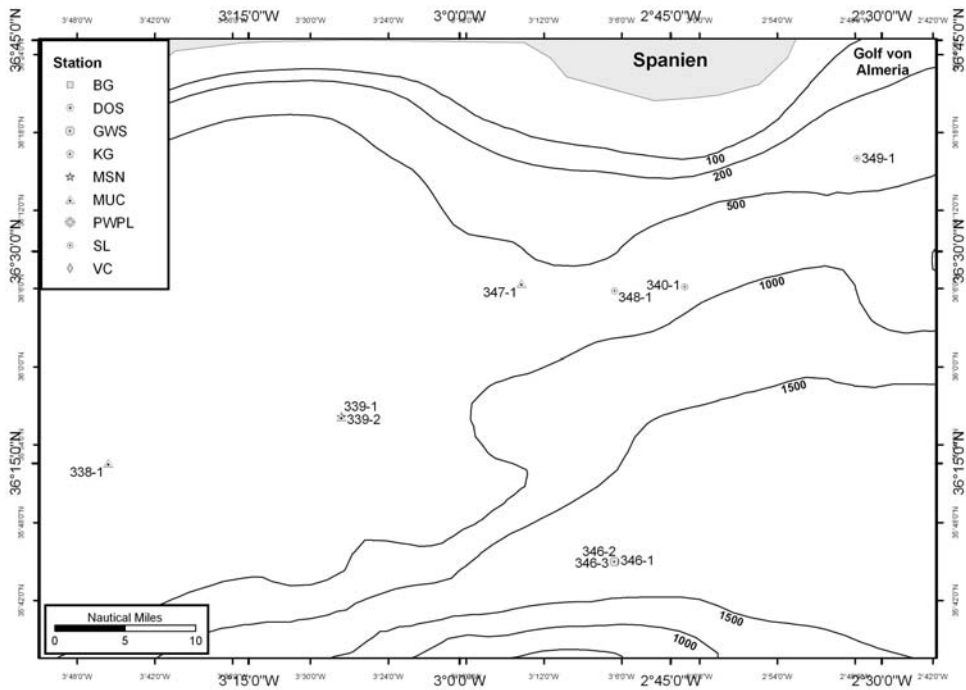
The third and final week of the cruise started with the geophysical profiling south-west of Mallorca Island. The seismic data documented the presence of a giant drift deposit in water depth beneath 200 m. Several sequences of drift deposits directly overlie the Messinian unconformity. It can be concluded that the contour current was active after the reflooding of the Mediterranean. An unexpected result was the detection of wide areas of gas beneath the unconformity. The gas seeps at near vertical faults and penetrates the Pliocene-Pleistocene sediment cover. Close to the shelf, the gas reaches the seafloor and no seismic signal penetration is possible. Similar to the Bay of Oran the geological sampling was carried out along several transects which were determined by means of Parasound data. After a final transit of 24 h we reached Cartagena / Spain where the successful cruise finished on August 28.



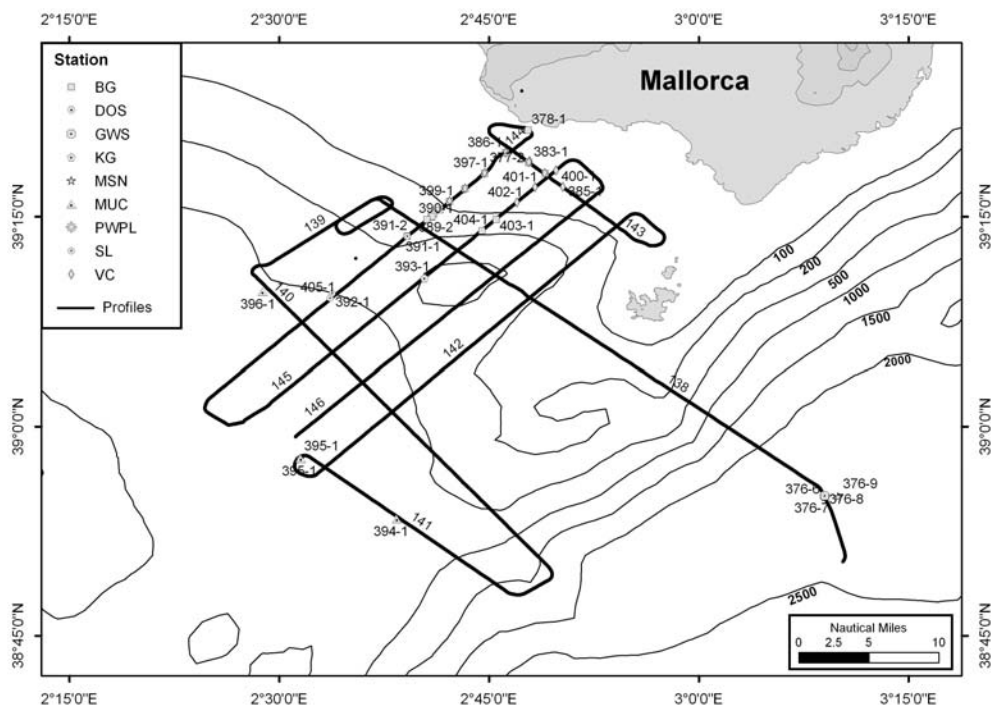
Profile and station map of working area "SW-Spain"



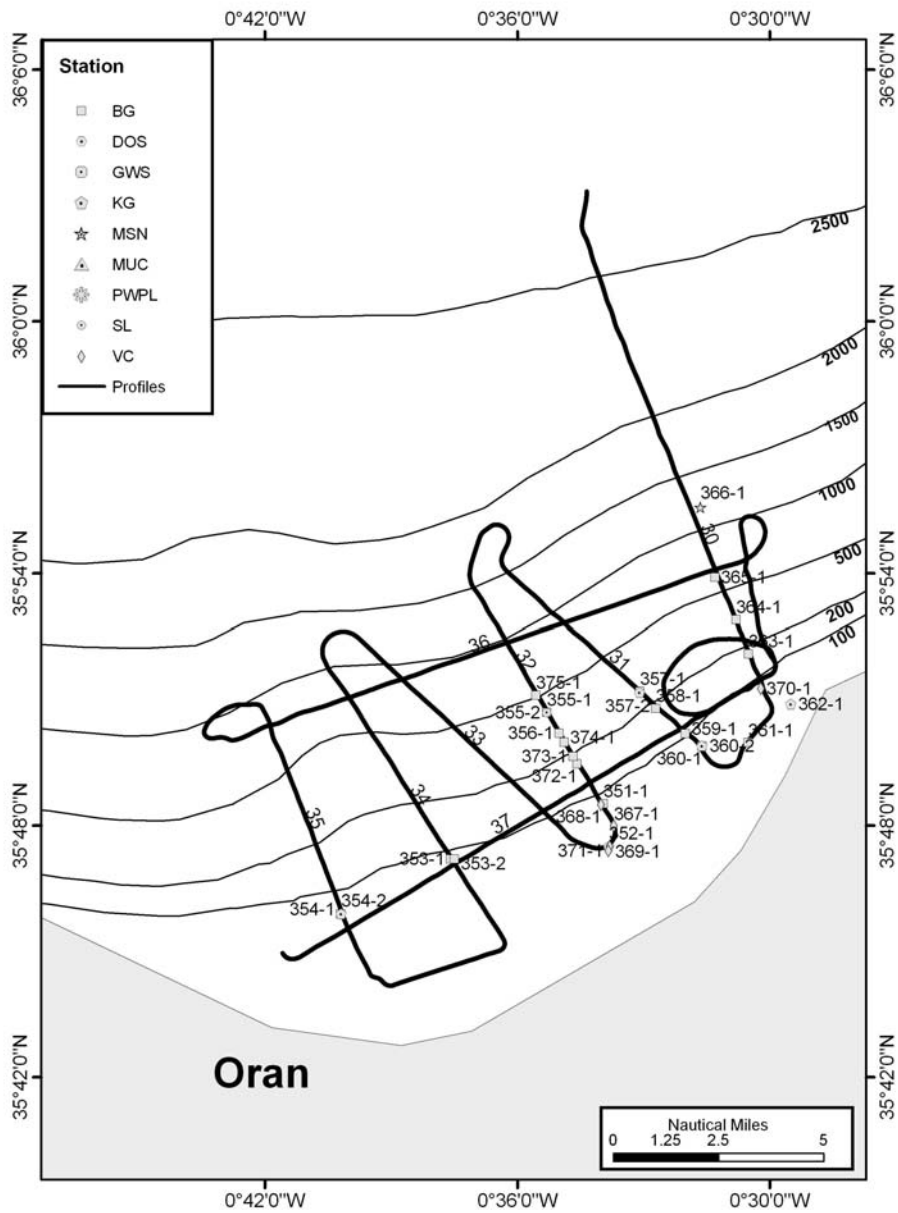
Profile and station map of working area "Alboran Ridge"



Station map of working area "Cabo de Gata"



Profile and station map of working area "Mallorca"



Profile and station map of working area "Oran"