Short Cruise Report of Leg M64/1 with RV METEOR

2.4.2005, Mindelo – 3.5.2005, Fortaleza

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Abbreviations:

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Research Program

Mid-ocean ridges are unique features of the Earth where energy and material is exchanged between the Earth's interior and the surface. This cruise is part of a DFG Priority Programme "From Mantle to Ocean: Energy, material and life cycles on spreading axes" designed to obtain a four-dimensional picture of the processes operating at mid-ocean ridges. In this context the overall goals of the planned investigations are as follows: (1) to determine the volcanic and tectonic dynamics operating at mid-ocean ridges as well as the geochemical and biological processes occurring at active hydrothermal vent areas shall be characterised in detail as a function of space and time and (2) to link the hydrothermal processes to the volcanic activity on the axis. The target area of Leg 64/1 is one of the two key areas of the Priority Programme 1144 on the Mid-Atlantic-Ridge (MAR) planned to be investigated by petrologists, biologists, chemists, geochemists, geophysists and oceanographers. It is situated between 7 and 12°S along the MAR south of the Ascension fracture zone (Figure M64/1-1). This section of the MAR is highly variable in morphology, crustal thickness, and magma composition and is thus an ideal region to study the diversity of magma transport and volcanic eruption processes and their influence on the formation and evolution of hydrothermal vents and associated biological processes. Leg M64/1 is a follow-up cruise of Leg M62/5 during which the foundation for this cruise – a detailed geologic and tectonic map of the seafloor and the position of hydrothermal plumes – has been obtained by using a TOBI combination of deep towed sidescan and nephelometry and a Remotely Operated Vehicle (ROV) and a CTD/Rosette. Based on this data our research group will select hydrothermally active sites

and characterise them volcanologically, geochemically and biologically by taking and analysing rock samples, samples of hydrothermal fluids, samples of the micro- and macro fauna and samples of the water column in the vicinity of those vent areas.

Narrative of the cruise

The cruise started in Mindelo with some minor problems with the transport of crew members and with the successful loading of the heavy ROV containers with an ancient swimming crane. In the morning of April 2nd FS METEOR left the port of Mindelo and steamed southwards to the first working area on the Mid-Atlantic Ridge (MAR) near 5°S (Figure 1). Throughout the cruise we had warm and calm weather and only for a couple of days the wind rose to a strength of 6 and the swell increased to about 3 m. In the evening of April 7th we arrived in the first working area at the location of the Turtle Pits hydrothermal field at about 4°48`S on the MAR (Figure 2) which was discovered only weeks before by a British-American cruise and the location of which was kindly forwarded to us by C. German and T. Shank. During the night the area was mapped with Hydrosweep after we had one CTD/rosette station outside of the ridge area in order to determine the background water composition. Unfortunately, the CTD failed and no water samples were recovered. On the morning of April 8th we performed the first dive (#36, station 108) with the MARUM QUEST ROV and after a few technical problems the ROV reached the seafloor at around noon. Towards the end of the dive we found two inactive balck smokers and deployed a sonar buoy. During the night two TV grab and several wax corer stations recovered basaltic lava and CTD/rosette stations were carried out to determine the location of the hydrothermal plume. MAPRs were also deployed with each wax corer and TV grab in order to study the areal extent of the plume. On April 9th the second ROV (#37, station 114) dive found the active chimneys situated in a north-south running depression and we started photographing, sampling and measuring the different structures. Between April 9th and April 15th five dives with the ROV were performed mostly during the day with CTD, wax corer and TV grab stations during the night. In most dives we studied the Turtle Pits field but one dive (#39, station 125) led to the Wideawake mussel field for geological, biological and fluid sampling. On April 16th a very long dive (#42, station 146) was performed starting south of the Turtle Pits field and ending at the Red Lion hydrothermal field where one active smoker had been reported by our British-American colleagues. While diving at this location we found four active smokers and numerous inactive structures with a peculiar fauna consisting of impressive numbers of shrimps. After this long dive we had a 24 h transit to the working area at 8°50´S on the MAR.

Work in the 8°50`S area (Figure 2) started with a detailed bathymetric survey of the large volcanic field on segment A2. After that the lavas of the volcanic field were sampled using the wax corer and the ROV during two dives in order to study the volcanology and geology of the area. Surprisingly, much of the volcanic field was covered by sediments althought the sidescan maps showed a very high reflectivity. CTD and MAPR stations in the area of the volcanic field did not show any hydrothermal signal and we concluded that the southern part of segment A2 is probably both volcanically and hydrothermally inactive. After three days of work on segment A2 (April 18th to 21st) we continued hydrothermal exploration on segment A3 using wax corers with MAPRs and CTD/rosettes. 186 CTD station showed a strong methane anomaly but the nephelometers did not record any anomalies in the water column. On April 23rd and 24th we performed two dives on the shallowest part of segment A3 near the near-axis seamounts in order to study the volcanology and sample lavas. On the night from April 24th to the 25th five CTD stations defined the location of a potential hydrothermal vent to be within the area between 9°32.5´S and 9°33.0´S (Figure 3). Studying the bathymetric and sidescan maps indicated that the most likely location of a vent would be the neovolcanic zone with a narrow cleft. On the morning of the 25th the ROV dive led us from one of the CTD stations with an anomaly to the east toward the neovolcanic zone. At about 12 o´clock we found the first hydrothermal sediments and mussel shells and at 15:55 we discovered the active low-temperature Lilliput hydrothermal field. The name was given because of the overabundance of small baby mussels. Biological, geological and fluid samples were taken. During the night two TV grab stations recovered more hydrothermal sediment, lava and biology from this field. On the next morning the ROV started the dive but technical problems required to retrieve the ROV after 2 hours from the water. The final stations of cruise M64/1 consisted of CTD, wax corer, and TV grab stations and one camera sledge tow across the neovolcanic zone. On the 27th at 15:00 we finished our work and RV METEOR started its voyage to Fortaleza. The ROV team was busy repairing the damage in the high voltage unit of the ROV and was successful so that by the time of arrival in Fortaleza most of the damage was repaired. Early in the morning on May 3rd METEOR arrived in Fortaleza after a very successful cruise.

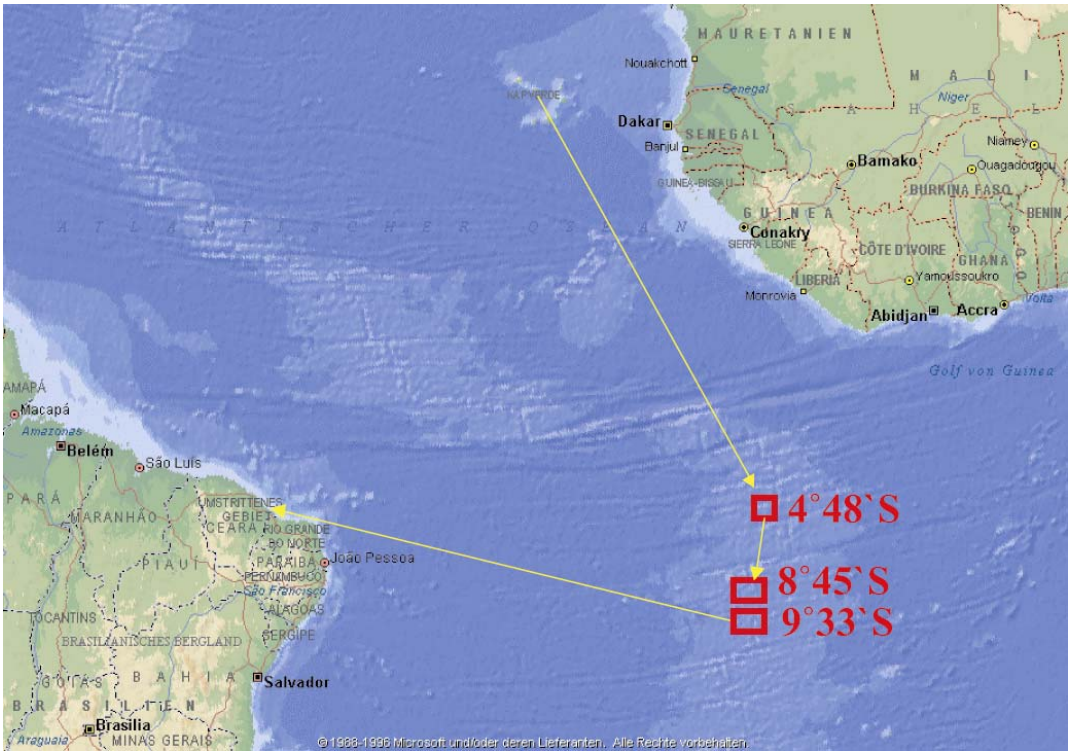

Figure 1. Overview of the track of RV Meteor during the cruise M64/1 and the three working areas.

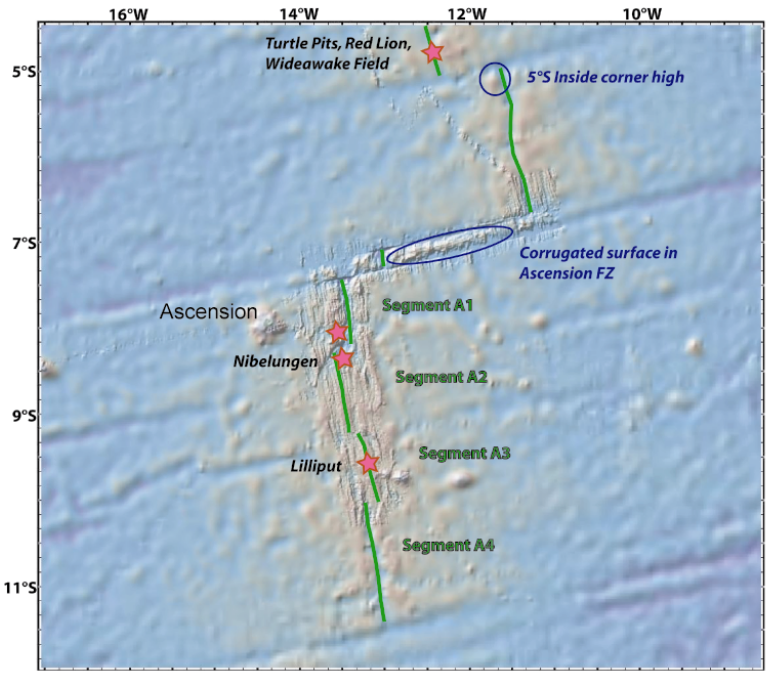

Figure 2. Enlarged map of the working area showing the location of the Turtle Pits, Red Lion and Wideawake hydrothermal fields (area 1), area 2 on Segment A2 and the Liliput hydrothermal field on Segment A3 (area 3).