Short Cruise Report
RV METEOR cruise M75/3

Dates:	March 03 to April 06, 2008
Port calls:	Durban (South Africa) – Cape Town (Namibia)
Chief scientist:	Prof. Dr. Ralph Schneider
Participating Institutions:	Institut fuer Geowissenschaften, Christian-Albrechts Universitaet, Kiel, Germany Fachbereich Geowissenschaften, Universitaet Bremen, Bremen, Germany Geoforschungszentrum (GFZ) Postsdam, Potsdam, Germany Institut de Ciència i Tecnologia Ambientals, Edifici Ciències, Universitat Autónoma de Barcelona, Spain School of Earth, Ocean and Planetary Sciences, Cardiff University, Cardiff, UK Instituto Nacional de Hidrografia e Navegacao, Maputo, Mocambique

Summary of the cruise

METEOR 75/3 was the last leg out of four of RV METEOR expedition M75 to the western Indian Ocean. Main objective of leg 75/3 was to obtain bathymetric and survey data as well as plankton, water and geological sample material from the shelves and continental slopes of Northwest-Madagascar, Mozambique, and South Africa. The hydroacoustic data and geological sampling material will provide important information on paleoclimatological and paleoceanographic changes that occurred in the southwestern Indian Ocean, particularly for the Mozambique and Agulhas Currents, and over adjacent continents during the late Quaternary. In addition to these surface processes, late Quaternary variations in intermediate and deep water masses will be investigated, remote from the Antarctic and Atlantic circulation patterns. During the 33-day cruise a work program was carried out for collection of water samples, surface sediments and sediment cores. Seven different working areas off the Sambezi, Limpopo, Mahajanga and Bonbetoka rivers, in the deep Mozambique Strait, and in the Natal Valley and Cape Basin were covered (see cruise map at the end of this report). Geophysical surveys, including bathymetric mapping by multi-beam echosounding and multichannel seismics, were carried out to identify geological sampling sites. A second priority was given to sample locations identified for a deep-sea drilling proposal submitted to the International Ocean Drilling Program (IODP) for drilling several hundred meters into Neogene sediment sequences along the pathway of the Agulhas Current and the area of Agulhas Ring formation and spawning into the South Atlantic. Furthermore, the Neogene sediments should provide geochemical parameters for the reconstruction of climatic changes on the African continent, which then can be compared with continental climate records and the evolution of human evolution over millions of years.

After two days of uploading and storage of scientific and technical equipment, RV METEOR left Durban at March, with 26 scientists from Germany, Spain and the United Kingdom onboard. We took heading towards our first working area off the Limpopo River, which was reached by Wednesday, March 5. We began our geological sampling program on the outer Mozambique continental margin, deploying multicorer, gravity corer, plankton nets, and water bottle sampler at about 900 m water depth at 25°30 S / 36°30 E (Box A1 in cruise map). The cruise program was continued with a bathymetric, sediment echosounder, and

seismic survey towards the shelf near the Bay of Maputo. On Friday, March 7, we took the scientific observer from the Mozambique National Institute of Hydrography and Navigations, Maputo onboard RV METEOR and proceeded with our geological and seismic sampling program on the shelf close to Limpopo river mouth. From the sediment acoustic and seismic data it became obvious that large part of the river sediment load is transported by currents immediately to the east and deposited on the upper margin in water depths deeper than 300 m, where it forms large bodies of drift deposits while no large Limpopo fan exists. On Sunday, March 9, we interrupted our sampling program in the Limpopo working area and sailed northward along the coast towards the Sambezi mouth in order to safely pass by the western rim of cyclone JOKWE that was heading southwards through the Mozambique.

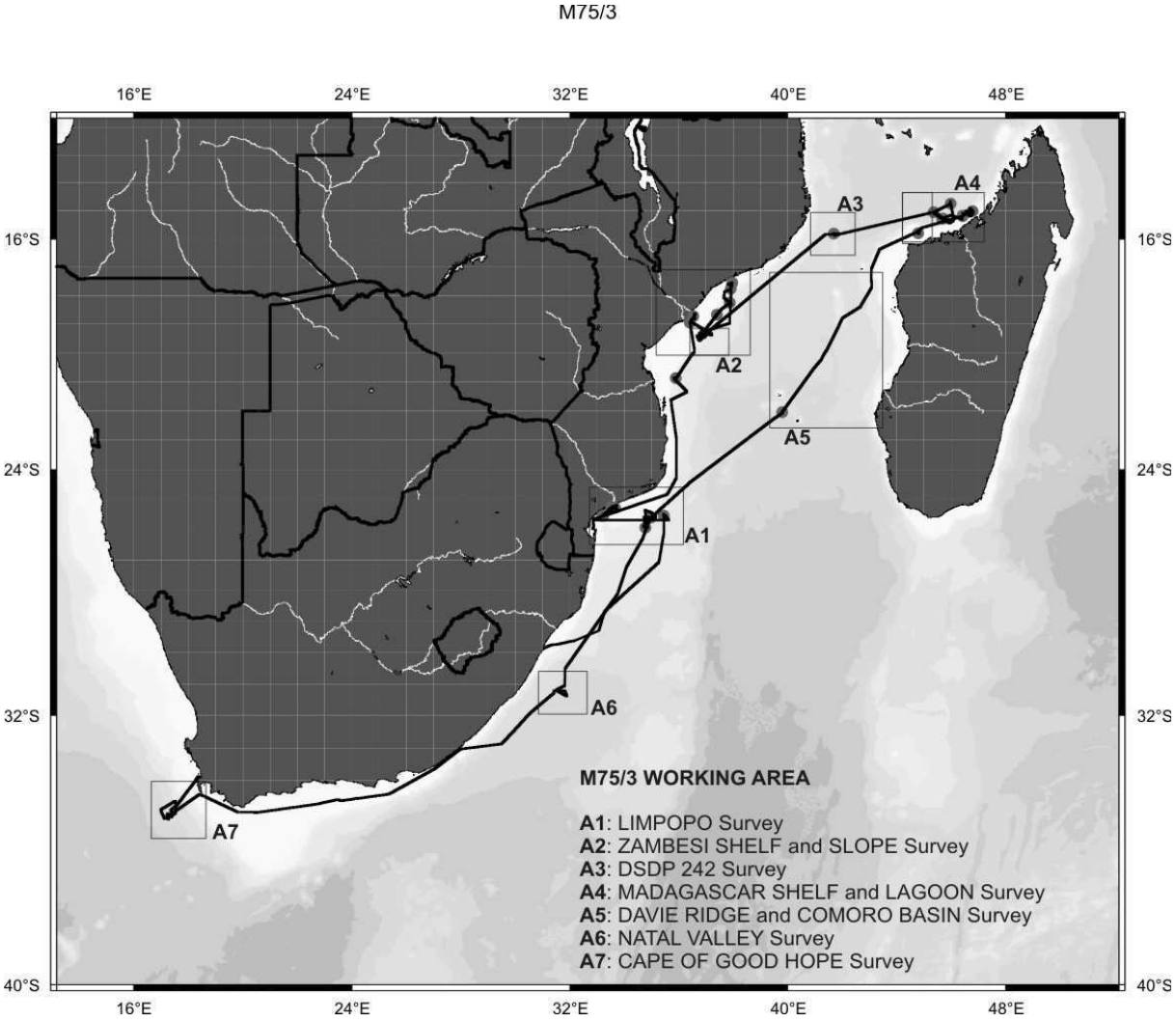
During the second week of the cruise we performed an extensive geological sampling program on the shelf in water depths of 20 to 50 m, directly off the Sambezi estuary and in the Holocene mud belt south of Pebane where smaller rivers drain their sediment load onto the shelf. The sampling should allow the reconstruction of late Holocene variability in river discharge and sediment deposition on the wide central Mosambique shelf region. The work program in the Sambezi region was finished by Sunday, March 16, with a small scale bathymetric survey of shelf break terraces and a drowned atoll at about 17°45 S / 38°00 E and a detailed seismic grid at the outer shelf and uppermost slope off the Sambezi mouth for the IODP drill site proposal in that region (Box A2 in cruise map).

Having finished the investigation in the Sambezi region we headed towards the northwestern margin of Madagascar, passing the Davie Ridge west to east at 15°50 S across the former DSDP drill site 242. Here we took sediment and water samples under open ocean conditions in the northern entrance of the Mosambique Strait (Box A3 in cruise map). The geological sampling retrieved pelagic carbonate oozes of Pleistocene age and was followed by a short, 10 hours, seismic survey, shooting a cross-profile over the DSDP site 242. Afterwards we continued our eastward transit to the Madagascar margin, which was reached Thursday, March 20 at about 15°05 S / 45°20 E. The work programme in the vicinity of the Bombetoka and Mahajamba Rivers, consisted of a 4 days bathymetric, sediment echosounder, and seismic survey with 4 transects from the lower slope in about 3000 m water depth to the shelf break, and in one case onto the shelf (55 m water depth) near Pointe Ambarata. The seismic survey was interrupted at sites suitable for coring continuous sediment sequences of Holocene and Pleistocene hemipelagic muds below 2000 m which should allow reconstruction of ocean circulation changes at the northern end of the Mozambique Strait and river runoff from NW-Madagascar. Also water samples were taken to manifest the influence of freshwater outflow by the rivers on the shelf. The work program off NW-Madagascar (Box A4 in cruise map) was finished by Monday, March, 24, on the shelf near Kap St. Andre. Here, shelf sediments consisted of reworked silts and sands, which prevented the sampling with the gravity corer.

During the fourth week of leg M75/3 we sailed back to the Mosambique Margin near the Limpopo mouth to continue the geological sampling and seismic survey program in the contourite-shaped sediment bodies which represent the so-called Limpopo cone (Box A1 in cruise map). Before, on the transit from Madagascar to the Limpopo, we crossed the Mozambique channel at about 19°00 S / 42°00 E with southwesterly heading and surveying the sea floor with bathymetric mapping, sediment echosounder and, only across the Davie Ridge, with shallow high resolution seismic profiling (Box A5 in cruise map). Between the islands Europe and Bahia de India we performed a deep-water geological sampling station, which provided pelagic calcareous ooze of Pleistocene age. The geological sampling program of M75/3 was finished by Sunday, March, 30 by coring the top of the drift bodies in 400 to 600 m water depths at 35°25 S / 34°58 E. The sediments retrieved were silty to sandy muds, which hampered penetration of the gravity corer. As for the other working areas at the shelf break off the Sambezi and Madagascar rivers a prominent sediment plume could be detected in the acoustic data (PARASOUND and ADCP) extending from the sea floor at shelf break

into the water column between water depths of 200 to 400 m. This provides evidence for strong fine particle sediment transport with shelf cutting eddies on the upper margin, where the drift deposits form. Finally, a seismic survey for the IODP site selection to drill Neogene Limpopo sediment sequences was executed in Box A1.

After the successful accomplishment of the working program in the vicinity of the large Mozambique and Madagascar rivers, RV METEOR headed southward to the southern tip of Africa. During this last week of the cruise, another two potential locations for IODP drill sites to retrieve Neogene sediments from the South African continental margin were surveyed with the seismic, echosounder and bathymetric mapping systems in boxes A6 and A7 along the path of the Agulhas Current into the South Atlantic. Only with such a detailed surveying we were able to identify sediment sequences of more than hundred meter in thickness, which seem to be continuous throughout the Neogene and not heavily disturbed by sediment waves or hiatuses, as is the case for most parts of the South African margin. This survey also contained a coast-parallel bathymetric survey across subaquatic Pleistocene dunes on the shelf between East London and Port Elizabeth at water depths between 500 and 80 m. The cruise ended on Sunday morning, April 6, with arriving at Cape Town harbour with demobilisation of the equipment and disembarkation of the scientific crew until Wednesday, 9.



Map of M75/3 cruise track

In total we achieved geological sampling at 23, water bottle at 13 and zooplankton net sampling at 8 stations. CTD casts were run at 18 stations. ADCP profiles amount to 1280 nm, Multichannel seismic reflection lines to 1460 nm, and swath bathymetry as well as sediment echosounder surveys to 5370 nm. The detailed meta information about cruise tracks, sampling devices and sampling stations will be published in the cruise report one year after the cruise and archived on the WDC MARE (PANGAEA, www.pangaea.de) data bank.

Kiel, 26. July 2008

Dr. Ralph Schneider (chief scientist)