SHORT CRUISE REPORT METEOR 74-1a

Dates: August 31 - September 18, 2007

Chief Scientist: Dr. Niko Lahajnar, Universität Hamburg

Institutions: **IfBM**: Institut für Biogeochemie und Meereschemie,
Universität Hamburg, Germany
Lahajnar, Niko
Nagel, Birgit

ZMT: Zentrum für Marine Tropenökologie, Bremen, Germany
Baum, Antje
Birkicht, Matthias
Kovacs, Csilla
Mintrop, Ludger

IfG: Institut für Geowissenschaften, Universität Tübingen, Germany
Aurahs, Ralf
Bayer, Margret
Marten, Roman

NIOF: National Institute of Oceanography and Fisheries, Egypt
Farha, Osama
El Azab, Hany (Military Observer)

Objectives:

The expedition METEOR M 74-1 was split in two sub-legs M 74-1a and M 74-1b due to the long transit time. M 74-1a was mainly dedicated to the transfer of the ship from the Mediterranean Sea to the prospective area of investigations in the Indian Ocean between September and December 2007. Nonetheless, four of five major scientific and political goals have been accomplished during M 74-1a: (1) retrieval of sediment trap mooring MID-03 off Crete, deployed during M 71-3 in January 2007; (2) contribution to the German Egyptian Year of Science and Technology with an open-ship-day in Port Said (Egypt); (3) plankton sampling at two stations in Egyptian waters of the Red Sea; and (4) deployment of an sediment trap mooring at station WAST (Western Arabian Sea Trap) at the former JGOFS site in the Indian Ocean. Unfortunately, the attempt to dredge an inactive sediment trap mooring close to station WAST failed due to technical problems with the ship's own winch.

Cruise narrative:

RV METEOR left - one day earlier as scheduled - the port in Iraklion (Crete) on August 31 at 21:00 local time since fine tuning of the navigational system was necessary to be performed by two technicians of KONGSBERG. Already 12 hours later after having left Iraklion, RV METEOR reached the first major station: sediment trap mooring MID-03 in the Ierapetra deep off Crete, deployed during M 71-3 in January 2007. The mooring is part of the project "Marine Ecosystem Response to Fertilization - MERF" funded by the European Science

Foundation and EuroCLIMATE. The main objective is to study environmental changes in the eastern Mediterranean Sea.
At 09:00 contact was tried to be established with the acoustic release in 3600 m water depth; however, the fist attempts failed due to apparent problems with the deck unit or hydrophone. Fortunately, a spare unit had been sent with the equipment so that a second chance was possible - and successful. The mooring was released and the top float seen close to the ship 30 min afterwards. Retrieval of the 2.2 km long mooring back on board was finished at 11:50. Both sediment traps (1 McLane Mark 7 and 1 Kiel Trap K/MT 234) and two Aanderaa RCM-8 current meters completed their schedules over the period of deployment so that the gained data sets will provide new and valuable insights into the biogeochemistry of the Eastern Mediterranean Sea.

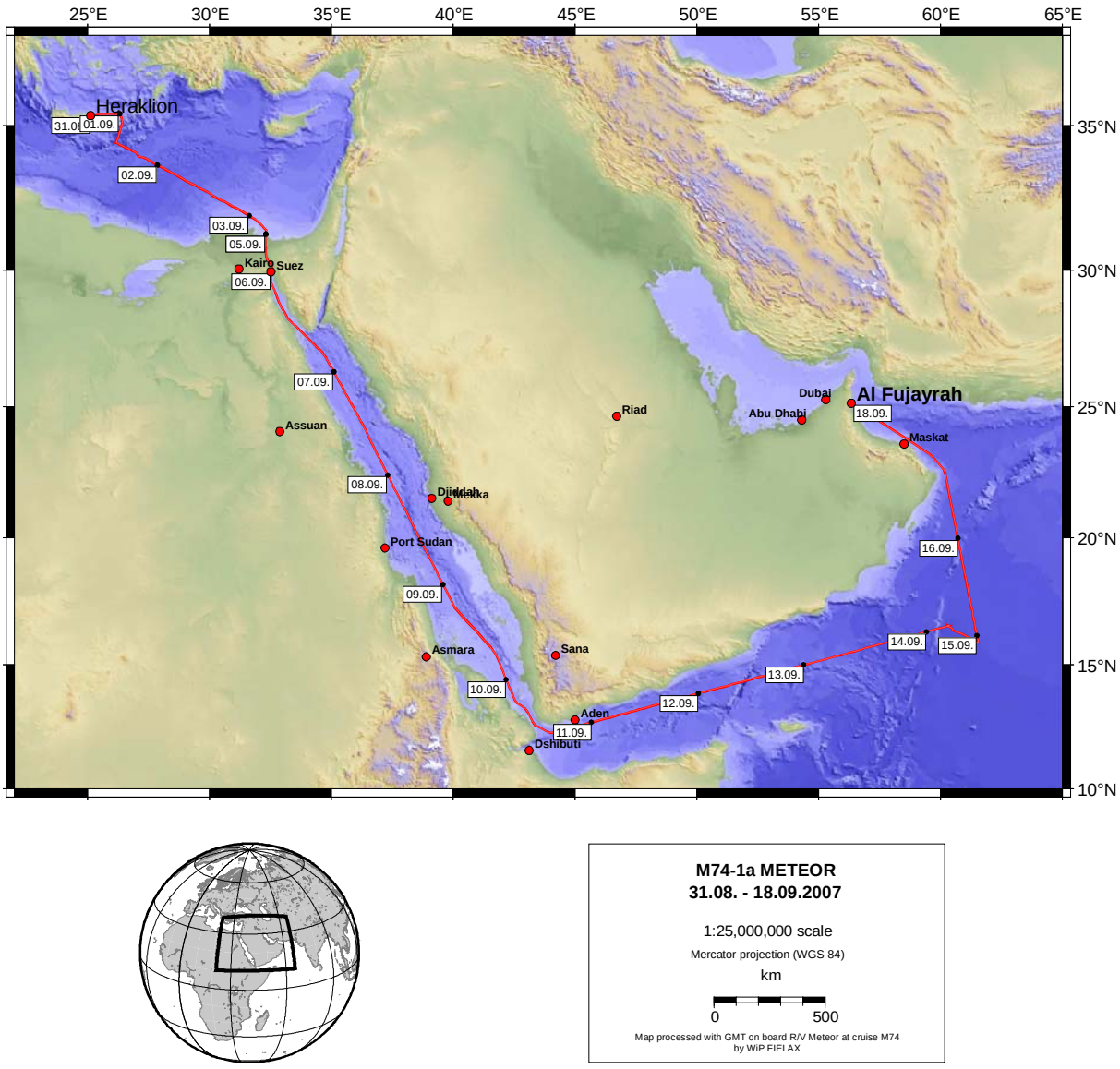
RV METEOR headed on to Port Said, the northern inlet of the Suez-Channel. The ship stopped at the passengers' terminal in order to celebrate and contribute to the German Egyptian Year of Science and Technology 2007. In the morning of September 04 various groups from Egyptian schools and universities visited the ship and showed genuine interest in how marine science is carried out on board. In the early afternoon TV and radio stations looked behind the scenes of a research vessel and performed interviews with the scientists and crew members on board. During the afternoon an international work shop took place in the conference room with four talks about topics in marine sciences. In the late afternoon a delegation lead by the Egyptian minister for Science and Technology, Prof. Hany Helal, and his Sudanese colleague, Prof. Mubarak M. Ali Magzoub, visited RV METEOR. They were accompanied on a guided tour through the ship and expressed their interests in extending the bilateral cooperation with scientific and research institutions in Germany. During a buffet on deck informal talks rounded off this day; and authorities from all countries expressed their gratitude for the performance and efforts of the ship's crew and scientists.

The cruise was continued on September 5, leaving the Suez-Channel. Two plankton stations were conducted in Egyptian waters of the Red Sea. Scientists from Tübingen University sampled living foraminifera by using a multi-closing net. They aimed for reference material for sediment cores of that region, probing with their nets from 700 m water depth to the surface.
From first observation of net-samples, the most abundant species are *Globigerinoides ruber* and *Globigerinita glutinata*. The planktonic foraminifera were most abundant in the upper 100 m of the water column with a higher number of foraminifera at the southern station TÜB-2 than at the northern station TÜB-1. Further analyses of the sampling material at land will bring more detail to previous results.

RV METEOR steamed another 1,800 nautical miles to the next station located in the Arabian Sea. At station WAST a mooring of 2.1 km total length and equipped with two sediment traps and one current meter was deployed at the former JGOFS and BIGSET station from the 1990s. It is intended to document changes in the quantity and quality of settling particles compared to the results from the 90s as there are indications that the biogeochemistry of the Arabian Sea has recently changed. As a pre-phase of an international cooperation this mooring also serves as a start-up for a new research campaign in the Arabian Sea area. On September 14 the anchor hit the seafloor at 16°32.70'N 060°18.29'E at 4110 m water depth and will measure the vertical particle flux until November 2008.

The last major goal of M 74-1a was to dredge an already inactive mooring - WAST-15 - at about 60 nm distance from WAST-16. The mooring had been deployed in 2001 but due to some political reasons it was not possible until this cruise to get a vessel for recovery. After more than six years the batteries of the acoustic release were completely discharged so that the intention was to dredge the mooring. However, already at the very beginning stage of the attempt to dredge, the hydraulic system of the winch did not work properly. It turned out that continuing with releasing wire and equipment would have resulted in a total loss of the material and, even more important, a severe thread to the personnel on deck could not have been excluded. It was decided to stop the dredging and to abandon station work under these conditions.

RV METEOR set course to its final destination and reached Fujairah port on September 18 and could dock at 07:00 local time.



SHORT CRUISE REPORT METEOR 74-1b
The Nitrogen Cycle in the Northern Indian Ocean

Dates: September 19 – October 4, 2007

Chief Scientist: Dr. Birgit Gaye, Universität Hamburg

List of Participants:

1.	Gaye, Birgit	*Chief Scientist*	IfBM
2.	Dähnke, Kirstin	W*ater chemistry*	IfBM
3.	Langenberg, Frauke	*Biogeochemistry*	IfBM
4.	Metzke, Marc	*CTD*	IfBM
5.	Möbius, Jürgen	*Geology*	IfBM
6.	Serna, Alexandra	*Biogeochemistry*	IfBM
7.	Wratsch, Liesa	*Water chemistry*	IfBM
8.	Hübner, Udo	*CTD*	IfM-HH
9.	Schmiedl, Gerhard	*Geology*	GPI-HH
10.	Baum, Antje	*Water chemistry*	ZMT
11.	Birkicht, Matthias	*Water chemistry*	ZMT
12.	Kovacs, Csilla	*Water chemistry*	ZMT
13.	Rixen, Tim	*Water chemistry*	ZMT
14.	Darling, Kate	*Foraminifera*	UE
15.	Schulz, Hartmut	*Geology*	IFG-TÜ
16.	Siccha, Michael	*Plankton tow*	IFG-TÜ
17.	Trommer, Gabriele	*Plankton tow*	IFG-TÜ
18.	Methar, Anand	*Sediment traps*	NIO-Goa
19.	Ramaswamy, Venkitasubramani	*Geology*	NIO-Goa
20.	Vijayan, Fernando	*Sediment traps*	NIO-Goa
21.	Jensen, Marlene	*Biogeochemistry*	MPI-Bremen
22.	Klockgether, Gabriele	*Biogeochemistry*	MPI-Bremen
23.	Kuijpers, Marcel	*Biogeochemistry*	MPI-Bremen
24.	Lam, Phillis	*Biogeochemistry*	MPI-Bremen
25.	Kock, Annette	*Gas analysis*	IFM-Geomar
26.	Müller, Eugen	*Meteorology*	DWD
27.	Ochsenhirt, Wolf-Thilo	*Meteorology*	DWD

Institutions:
IfBM: Institut für Biogeochemie und Meereschemie, Universität Hamburg, Germany
IfM: Institut für Meereskunde, Universität Hamburg, Germany
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ZMT: Zentrum für Marine Tropenökologie, Bremen, Germany
UE : School of Geoscience, University of Edinburgh, UK
IfG: Institut für Geowissenschaften, Universität Tübingen, Germany
NIO: National Institute of Oceanography, Goa, India
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Objectives

The seasonally changing monsoons lead to extreme seasonality of the circulation, upwelling and productivity in the Arabian Sea. The monsoonal upwelling along the Arabian Peninsula is the main reason for Arabian Sea high primary productivity and, together with the reduced ventilation of the intermediate water layers, leads to suboxic conditions between about 100 m and 1000 m water depth. Nitrogen deficiency in the core of the oxygen minimum suggests that nitrogen reduction is taking place. The Arabian Sea is thus one of the major oceanic nitrogen sinks.

The combined nitrogen and oxygen cycles of the Arabian Sea are extremely sensibly balanced. Small changes in oxygen concentrations in the intermediate water layers can lead to a shift from oxygenated conditions, normal for the global ocean, to suboxic or even anoxic conditions. Due to this sensitivity, small changes in the monsoon related biological production and oceanographic circulation can influence the nitrogen cycle of the Arabian Sea. Paleoceanographic investigations show that the extreme North Atlantic climatic variations of the last ice age directly influence the monsoon area as well as the nitrogen cycle of the Arabian Sea. It is comparatively more difficult to obtain a consistent picture of Holocene climatic variations. Although there are increasing numbers of direct climate monitoring during the last 150 years, the reaction of the monsoon to global climatic change is not being understood. Satellite observations of the upwelling imply an enhancement of the monsoon since 1997 which is, however, not or not yet reflected in enhanced rainfall over India. The long-term investigation of sinking particles in the upwelling areas also shows no clear trend.

The aim of the work in the Arabian Sea is a detailed investigation of the processes determining nitrogen cycling in the oxygen minimum zone and to study its susceptibility to global change and variations during the recent geological history (paleo-nitrogen-cycle). With this aim the sampling of sinking particles in the upwelling areas of the western Arabian Sea was taken up in cooperation with the National Institute of Oceanography, Goa, India, and complemented by a second station in the centre of the oxygen minimum in the eastern Arabian Sea. Sediment cores were taken in the Oman Basin and on the Oman continental margin. These studies will be used (i) to tune paleoceanographic proxies, (ii) to investigate the monsoonal variations and the Oman upwelling in more detail using sediment cores, and (iii) to find out whether global change has already led to changes in the nitrogen cycle by comparing the data to earlier process studies.

Cruise Narrative

Due to a delayed container the cruise started from Fujairah on 19.09. 07 at 13:00 hrs about one day behind schedule. The first coring station on the continental margin was reached after steaming for 240 nm. Gravity cores and multicorer samples were taken at four locations on the Oman continental margin at water depths of 400-700 m between September 20th and 23rd. Gravity core lengths were between 2 m and 5 m.

Water sampling and CTD profiling were carried out at 16 stations including three of the coring stations and all stations along the cruise track until October 1st. A special oxygen sensor (STOX) measuring down to 20 µmol was attached to the rosette and used at six stations. Nutrients, pCO_2, alkalinity and nitrous oxide were measured on board. Incubations and N-fixation experiments were carried out to study bacterial processes. Samples were taken for the genetic identification of anammox bacteria, identification of nitrogen fixing bacteria, stable nitrogen isotope measurements on nitrate and nitrite, DOC, methane and hydroxylamine measurements as well as the determination of oxygen isotope ratios of water. Suspended matter samples were obtained by large volume filtration from four water depths. Plankton tows were taken at 15 of the water stations and planktic foraminifera were identified on board and picked for genetic analyses.

The cruise started during the late SW monsoon when the upwelling off the Arabian Peninsula was still active. Measurable nitrate and phosphate concentrations even in surface waters, a shallow thermocline, a near surface chlorophyll maximum and diatom blooms revealed that upwelling was still taking place. The profile along the Arabian Peninsula showed the patchiness of upwelling with patches of cold water (< 24°C) as well as warm non-upwelling water (>26°C). Temperature changes were associated with fluctuations in pCO_2 concentrations in surface waters. On the way to the eastern Arabian Sea this pattern slowly changed. A deep chlorophyll maximum at about 40 m water depth, nutrient free surface waters, a deep mixed layer and much lower phytoplankton concentrations showed typical intermonsoon conditions with much lower amounts of plankton. The first station with nutrient free surface waters had no living plankton in the water column. On the east-west profile of the cruise the situation was similar implying that the upwelling had come to an end. Oxygen concentrations were lower in the eastern than in the western Arabian Sea with a pronounced nitrite maximum in the oxygen minimum of the eastern Arabian Sea.

A sediment trap system with three traps and a current meter was deployed on September 29th in the eastern Arabian Sea near an oceanographic monitoring station of the NIO, Goa.

A multicore and two gravity cores were taken on October 2nd on the Murray Ridge at 1800 m water depth. The last gravity core was taken on October 3rd on the continental slope off Oman at the first coring station in order to obtain a longer core of 6 m length. The cruise ended on October 4th at 08:00 hrs in Fujairah.