

Short Cruise Report RV METEOR cruise M77/2

Dates: November 24 to December 21, 2008
Port calls: Callao (Peru) – Guayaquil (Ecuador)

Chief scientist: Prof. Dr. Ralph Schneider

**Participating
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Summary of the cruise

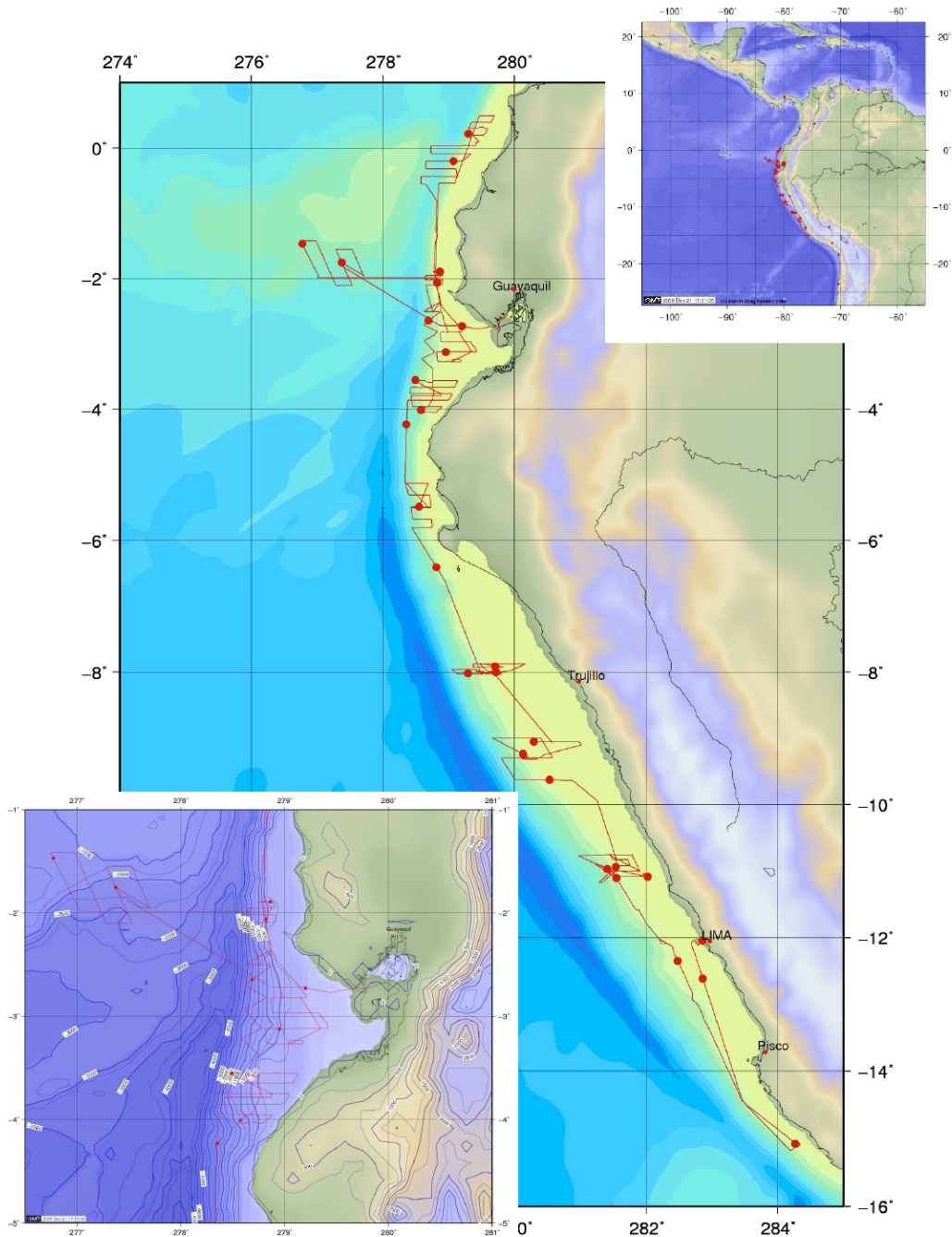
Main research topic of cruise M77-2 was the investigation of the oxygen minimum zone (OMZ) in the coastal upwelling areas off Peru and off Ecuador. The research cruise was carried out in the context of a new special collaborative research project (SFB 754) at the University of Kiel, "Climate – Biogeochemistry Interactions in the Tropical Ocean". The major focus of M77-2 was the investigation of past changes in eastern tropical Pacific surface and deep-water circulation during the late Pleistocene and the Holocene based on sedimentary records retrieved from the Peru and Ecuador continental margins as well as from the eastern flank of the Carnegie Ridge. The research project aims to unravel the role of climate change in the ocean on the biochemical processes within and outside the oxygen minimum zone (OMZ) off Peru and Ecuador. For this purpose a multi-corer and an up to 20 m long piston corer for surface and subsurface sediment sampling were deployed together with water and plankton sampling with hand nets, CTD and water bottle samplers at selected stations in 10 working areas at water depths between 200 and 2600 m. All sampling stations were selected after extensive hydro-acoustic surveys with ship mounted sediment echo-sounder (PARASOUND) and multi-beam swath bathymetry (KONGSBERG EM120, EM710) systems for areas with gentle slopes, thickest Holocene to Late Pleistocene soft sediment sections, and apparently void of sediment winnowing or erosion by bottom current activity or gravitational flow. The cruise track, survey lines and geological stations are given on the map below.

Furthermore, in situ measurements of turnover and fluxes of nitrogen compounds, nutrients, trace metals, phosphate and iron across the sediment-water interface at variable oxygen concentrations of the bottom and interstitial waters were carried out on the Peruvian upper slope, within and at the lower limit of the OMZ. For these sea-floor geobiochemical measurements bottom lander systems and video surveys with an ocean floor observing system (OFOS) were deployed in water depths between 250 and 800 m from inside the OMZ and below. Parallel to these measurements of the natural environment, the effects of variable oxygen availability (thresholds) in the bottom water on N-speciation and release of nutrients were determined by additional in situ experiments. Further activities of this leg comprised biological investigations of

benthic bacterial and foraminiferal communities, and the geochemistry of surface sediments related to the extension of the OMZ.

After two days of uploading and storage of scientific and technical equipment, RV METEOR left Callao at November 24 with 28 scientists from Ecuador, Germany, France, and Peru onboard. After bunkering fuel during the night we took heading southward to our first working area at about 15°05'S off Peru. We began our geological sampling program on a geological station to retrieve sediment cores within the OMZ, at November 26 and then turned to the North again executing a second station within the OMZ at about 12°06'S. November 28 we reached the lander and OFOS transect at 11°00'S where we continued the bottom video surveying of benthic life communities and the benthic boundary layer experiments within and below the OMZ already started during the cruise M77-1 before. The lander program was accompanied by several hydro-acoustic surveys for the selection of 3 geological stations in water depths between 200 and 2000 m at a latitudinal range from 11°05'S to 10°45'S. After completion of the 11°S transect December 2, we continued December 3 with another 3 geological stations in the working area between 9°18'S and 9°03'S where 2 long piston cores were taken in water depths of 1100 and 430 m. The attempt to take a short gravity corer at 115 m water depth above the OMZ failed. December 4 we started the second suite of lander experiments and OFOS surveys at about 8°00'S in water depths between 420 and 710 m water depth. Contrary to the 11° S transect, the lander operations turned out to be more difficult and partly insufficient at shallow depths because of the lack of a veneer of soft muds on top of sandy and indurated sediments which would allow for smooth penetration of the lander gears into the uppermost surface sediments. Nonetheless, also the second lander transect could be successfully completed and was followed again by 3 geological stations taking long piston cores and associated sampling devices at water depths between 1010 and 360 m water depth. The 8° S sampling transect was finished December 8 and we headed further northward to accomplish another 2 working areas off Peru at about 5°29'S and 3°45'S. After extensive hydro-acoustic surveying in each area we identified 3 geological stations in water depths between 2600 and 300 m water depth at 5°29'S and 3 more between 1000 and 350 m water depth at 3°45'S. At December 12 the sampling program in Peruvian waters was finished and we entered the Ecuadorian waters by surveying the sediments west of the shelf of the Gulf of Guayaquil. 3 geological stations were performed at water depths between 1700 and 200 m on a latitudinal transect between 2°30'S and 1°54'S. With this last coring transect at about 1°55'S we finished December 14 our sampling program on the shelves and upper slopes of Peru and Ecuador dedicated to region of the strong OMZ. We retrieved sediment and water as well as plankton samples within, above and below the OMZ. Particularly, the long piston cores with several sections of laminated sediments, indicating climate periods of very strong oxygen minimum conditions, make the M77-2 sediment core archive an unprecedented one. The final week of the cruise from December 15 to December 20 was oriented towards geological sampling stations outside the area of strong oxygen minimum conditions. The first was the eastern flank of the Carnegie Ridge where we performed a geological station at about 1°45'S / 82°38'W with a water depth of 2080 m. Afterwards we sampled 4 geological stations in the Gulf of Guayaquil at water depths between 440 and 60 m. These stations were planned to retrieve sediment and water samples that allow for the investigation of the river Guayas sediment suspension load and discharge variability. The very final part of cruise M77-2 in Ecuadorian waters brought us to the upper slope and shelf between 0°32'S and 0°30'N where an extensive hydro-acoustic survey was needed to identify 2

geological sampling stations with undisturbed sediment sequences in water depths between 1400 and 290 m. The samples from this working area will be used to investigate the plankton, water and sediment composition in the tropical water sphere of the eastern Pacific at the northern rim of the OMZ. The M77-2 sampling and survey program terminated December 20 on the way back to the harbour of Guayaquil where the cruise ended at December 21, with disembarkation of the scientists, the retrieved sample material and the equipment until December 23.



Map of M77/2 cruise track with hydroacoustic survey lines and long piston corer sampling stations

In total we achieved geological sampling at 27, water bottle at 28 and plankton net sampling at 27 stations. CTD casts were run at 33 stations. Swath bathymetry and sediment echo-sounder surveys amount to 4040 nm in total. In-situ sea-floor measurements with bottom lander systems were performed at 7 stations accompanied by the same number of OFOS video surveys of the benthic life communities within and below the OMZ. 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) and/or the SFB /54 data archives.

I would like to thank all the authorities and the Leitstelle METEOR involved in the planning and execution of the cruise, as well as the crew of RV METEOR for their strong engagement and support, which has made cruise M77-2 to become a very successful scientific enterprise.

Kiel, 18. March 2009

A handwritten signature in black ink, appearing to read 'Ralph Schneider', written in a cursive style.

Prof. Dr. Ralph Schneider (chief scientist)