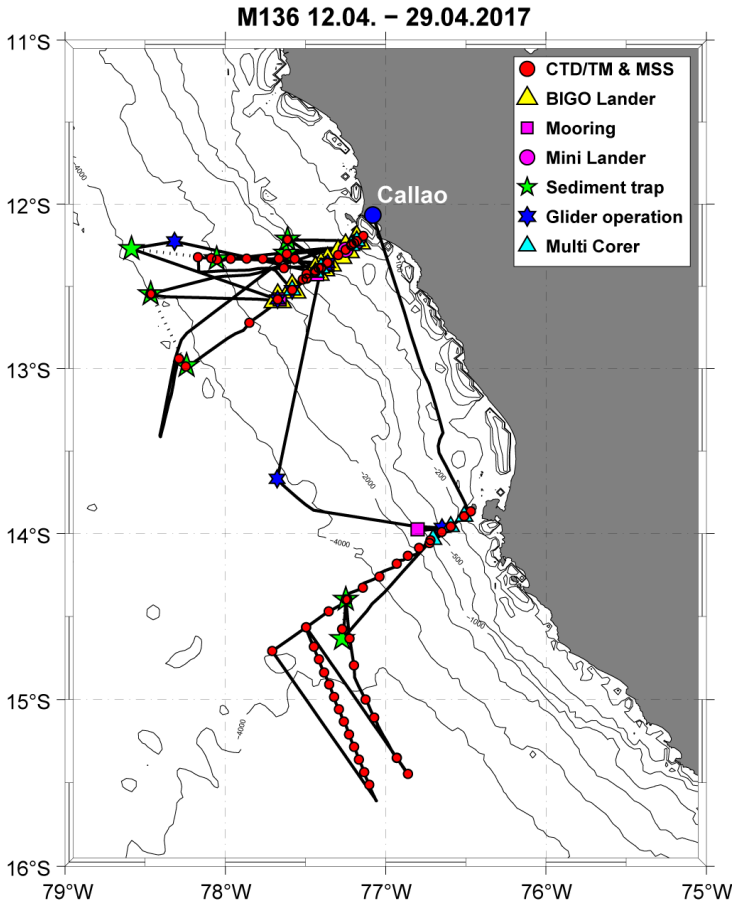
M136

(11.04. – 3.05.2017)

3rd Weekly Report April 30th, 2017

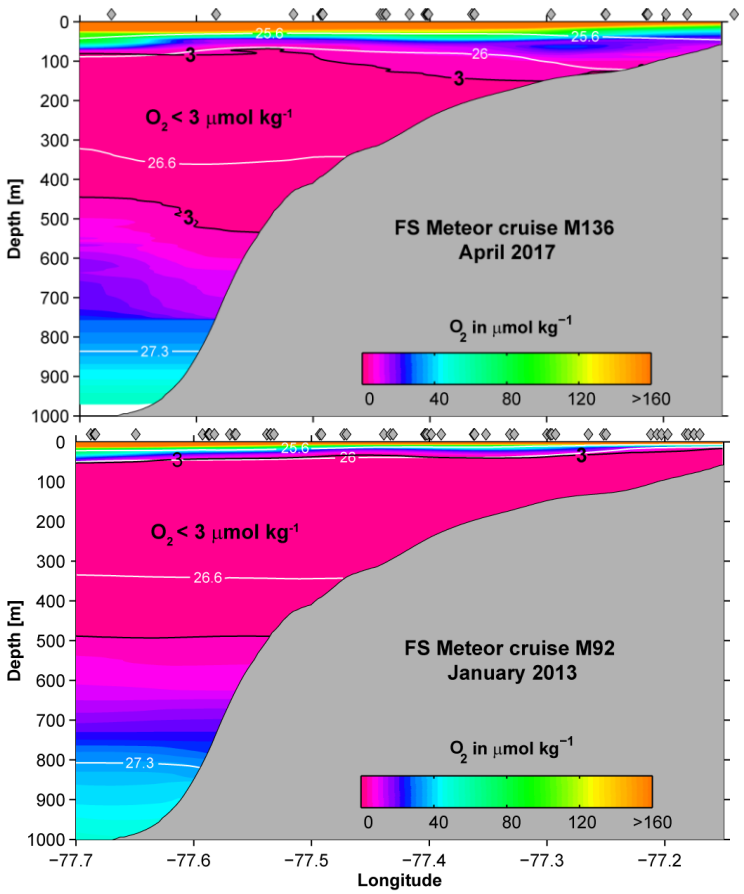
During the third week we were able to successfully complete a major part of our working program at 12°S. To date, more than 250 stations were sampled using a set of different state of the art observatories. More than 90 CTD profiles and 17 Trace Metal CTD profiles were taken to sample the oxygen and hydrographic distribution and to collect water samples for nutrient analysis and for the analysis of numerous other biogeochemical parameters. During 40 microstructure stations, upper ocean turbulence was sampled. All of the 8 planned BIGO lander deployments measuring natural solute fluxes between the sediments and the water column above were successfully completed. For biogeochemical analysis, 9 additional sediment cores were taken by a multi corer. All of the 4 drifting sediment traps returned excellent samples for the analysis of the export of organic particles from the upper ocean. For determining longer-term export fluxes, we additionally measured Thorium concentrations using in situ pumps deployed during 8 stations. 6 moorings equipped with velocity profilers and temperature, salinity and oxygen loggers were deployed along the continental slope. They will be used to determine the transport of solutes in the water column and will be recovered during METEOR cruise M138 by our colleagues. With the last glider deployment scheduled for tomorrow there will be 4 gliders carrying additional turbulence and nitrate sensors will be sampling the variability in the northern survey area. For the analysis of fronts and filaments, 1200 upper-ocean CTD profiles were collected with the Rapid



Map of completed stations of M136 until April 29th.

Cast system. Additionally, 9 Snow Catcher stations were performed to collect organic particles and we used a bottom water sampler on 4 stations to retrieve water samples from close to the sediments. During the last two days at sea, we will close the last data gaps.

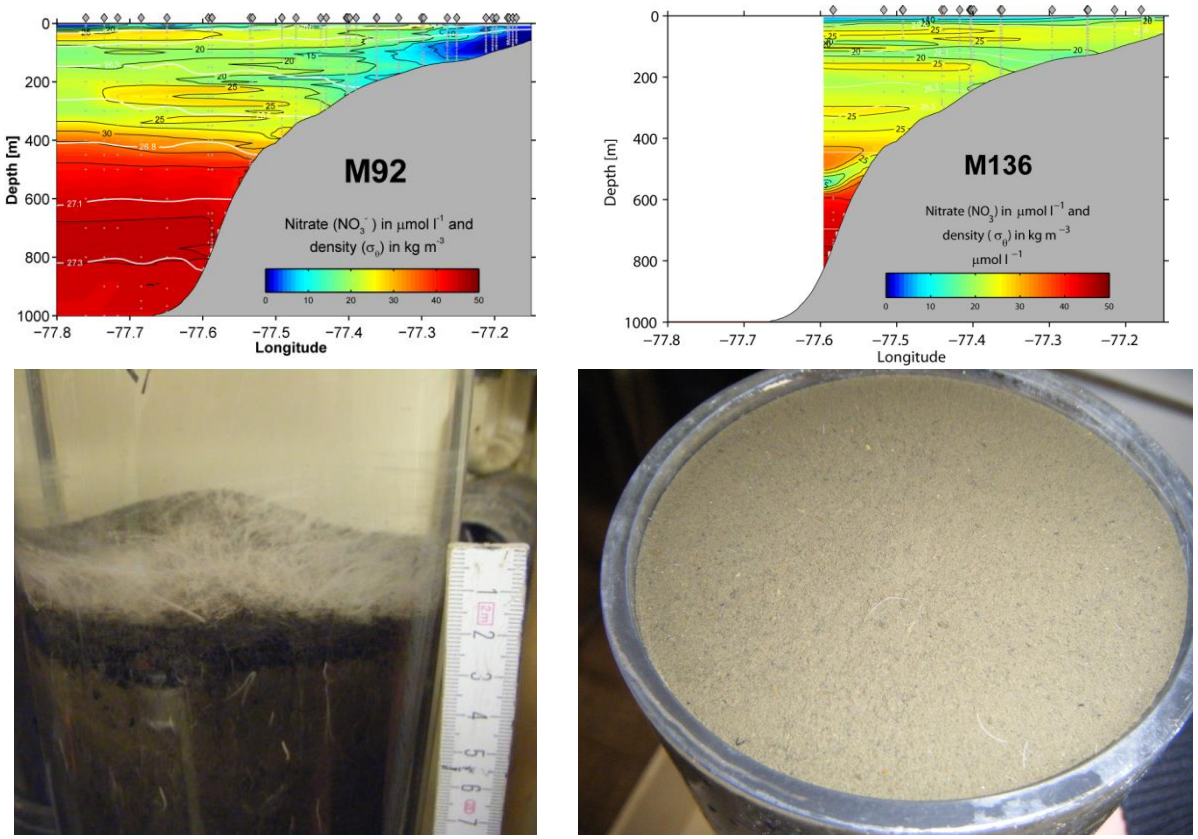
During Meteor cruise M92 and M93 conducted in austral summer 2013, the 12°S section was intensively sampled. The major aim for repeating the sampling along the section during the present austral fall is to quantify the variability of solute fluxes and solute turnover rates. We were particularly fascinated by the differences in oxygen and nutrient distributions we observed in comparison to the previous cruises. The preliminary calibrated data sets show that large parts of the upper continental slope and the shelf are occupied by oxygen-rich and warm water masses that are advected southward as indicated by the ship-board velocity profile measurements. Different to the situation found in austral summer 2013, anoxic regions in the water column are limited to depth below 100m. In January 2013, anoxic waters were present on the continental slope and the shelf in depths below 40m. The origin of these warm and oxygen-rich water masses is not fully understood, but we hypothize that they originate from near the equator where larger volumes of waters with similar characteristics were observed previously. It may also be possible that the poleward advection of these warm waters is associated with the strong El Nino event in 2015/2016.



Oxygen distribution (colors) and isopycnals (white solid lines, in kgm^{-3}) along the 12°S section during M136 (upper) and during M92 conducted in January 2013.

The ventilated water on the shelf also has important implications for benthic biogeochemistry. During M92, the shelf bottom waters were anoxic and the surface sediments were covered with mats of the filamentous bacteria *Marithioploca* that form dense white bundles visible to the naked eye (left image). These bacteria, which are typically abundant all over the shelf down to ca. 300 m, store nitrate within their cells

to detoxify sulfide in the sediment porewaters, preventing it from escaping the sediment. In stark contrast, the bacteria are apparently absent during this cruise (right image) and large changes in porewater chemistry were observed compared to M92. Simultaneous flux measurements of dissolved constituents using benthic landers will help to understand the role which these bacteria play in modulating the exchange of sulfide and nutrients between the sediments and the bottom waters.



Distribution of nitrate along 12°S in January 2013 (upper left) and during M136 (upper right). Sediment samples from a multi corer from 74m depth collected in January 2013 (lower left) and during M136 (lower right). (upper graphs J. Luedke, Photos: A. Dale)

Additionally, first results from incubations suggest that the production of bacterial biomass and the activity of enzymes in the water column are correlated with oxygen concentration. Additionally, elevated bacterial activity was found in the water masses above the upper continental slope and the shelf.

Wissenschaftliche Teilnehmer der M136

On Wednesday morning METEOR will enter the port of Callao. A very successful and work-intensive cruise will then be completed. We are grateful to Capitan Schubert and his crew for the excellent collaboration and the pleasant working atmosphere during the cruise. The crew of FS METEOR greatly contributed to the success of the cruise. Likewise, I am grateful to the dedication and commitment of the scientists and technical staff who equally contributed to the success of this cruise.

About half of the scientific crew of M136 will participate on the follow up cruise M137. The research goals of both cruises are closely related.

Best regards from the tropical South Pacific,

Marcus Dengler and the participants of M136