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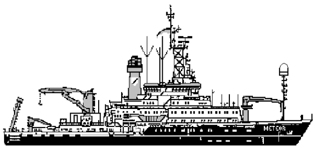
METEOR Cruise 77/1

Talcahuano (Chile) – Callao (Peru)

Weekly Report No. 4: 10. - 16. 11. 08

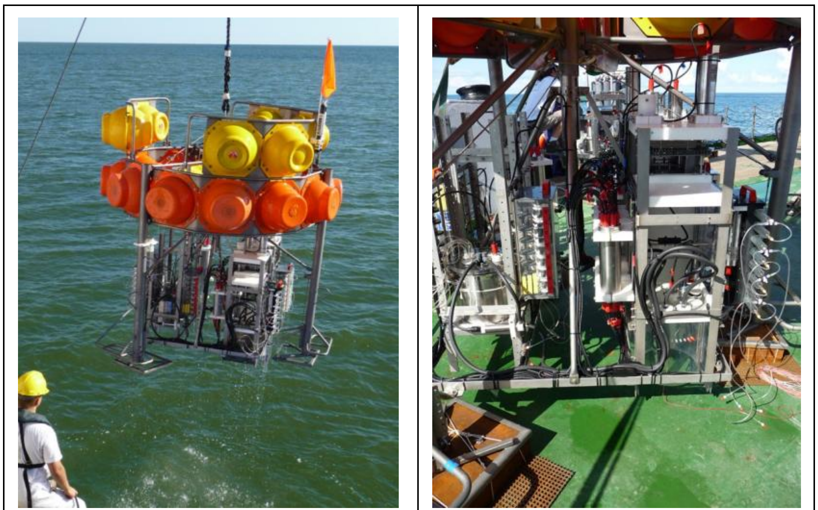


FS METEOR

Olaf Pfannkuche

Our activities during the last week were again partly dedicated to station work at the 11°S-transect. We also expanded our radius to two smaller transects 40nm north and 20nm south of the 11°-S transect. Both transect lines were mapped with the multi-beam. They extend about 25 miles each and cover a depth gradient of 200m to 1000m. Station work at the new transects was restricted to CTD/RO casts, OFOS-surveys and multi- corer sampling at key depths within and out site the core of the OMZ, whereas at the 11°-transect we concentrated to lander deployments and filled in some gaps of benthic sampling and CTD/Ro casts. By repeated CTD/RO surveys at the 300m-Station we could demonstrate the occurrence of temporal oxygen intrusion into the OMZ. In total we deployed 14 landers along the 11°S-transect line covering a depth range of 85m-1000m. The majority of landers deployed were of the BIGO-type (Biogeochemical Laboratory). The BIGO contains two benthic mesocosms to measure sediment water interface fluxes of oxidants, N-compounds and nutrients (Fig. 1). A modified version the BIGO-T (BIGO+THETYS) was deployed with one mesocosm unit replaced by the THETYS in situ mass spectrometer.

Fig. 1: Left - retrieval of BIGO after a successful deployment; **right** - a cylindrical benthic mesocosm with syringe water samplers. The mesocosm is connected to an oxistat which regulates the oxygen regime in the mesocosm (ca. 5µM accuracy) via the black hoses.

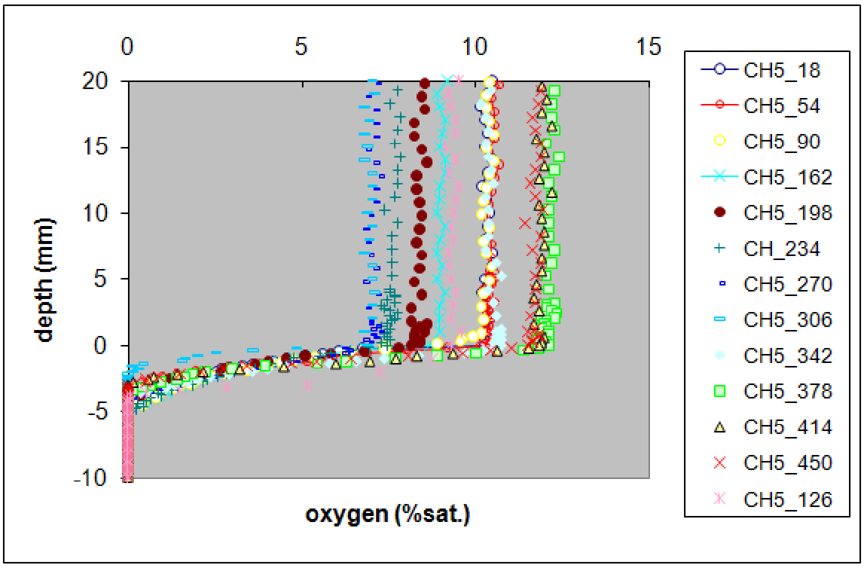


A new micro-electrode sediment profiler which was developed at IFM-GEOMAR in cooperation with Unisense (Arhus,DK) was successfully deployed down to 1000m integrated into a GEOMAR Modular Lander (Fig. 2). The profiler module can also be placed with a ROV on the sea floor. The new profiler has unlike its predecessors the capability to measure in three dimensions (x/y/z). The profiler unit carries four micro-electrodes which can measure oxygen, H_2S and pH.

Fig. 2: Left - deployment of a GEOMAR Modular Lander carrying the micro-electrode profiler module; **right -** the profiler is programmed for deployment.

A new concept of integrating a miniaturized amplifier, which hitherto was housed in a large pressure vessel, directly onto the micro-sensors allows to operate the sensors in three dimensions. Figure 3 shows a series of oxygen micro-profiles along the x axis (430mm) at 1000m water depth outside the OMZ. The maximum oxygen penetration depth was approximately 3-4 mm. The profiles were taken during a time interval of about 14 hours, the changing bottom water oxygen concentrations indicate internal periodicity (e.g. tides).

Fig. 3: Oxygen micro-profiles measured along the 430mm wide x-axis. The sediment surface (at 0mm) is indicated by a strong drop of the oxygen concentration in the bottom water close to the sediment surface.



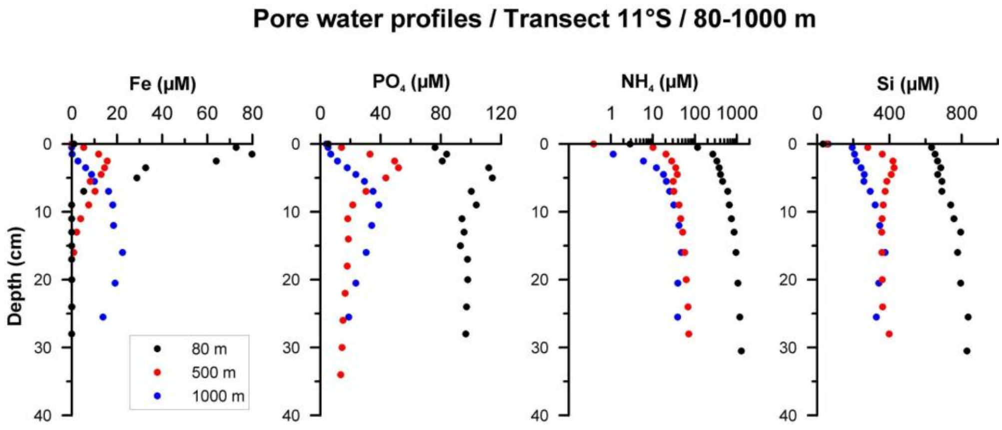
One aim of this cruise is to contribute to our understanding of the benthic-pelagic coupling in the ocean by examining key geochemical species, whose chemical behaviour and distribution are altered via changes in redox potential. It is well known that essential nutrients like phosphate and iron are preferentially released from sediments under anoxic conditions. However, the magnitude of this recycling flux, the relative importance of key control parameters, and the coupling to carbon and sulphur cycles are largely unconstrained. In order to overcome this lack of knowledge we performed geochemical analyses of pore water from surface sediments that were retrieved by multi-corer and by the benthic mesocosms of the BIGO Lander.

Based on CTD/RO casts the exact location of the oxygen minimum zone had already been characterized in detail along the 11°S-transect, so that sediment sampling could be directed to positions with varying degrees of bottom water oxygenation. In general, the sediments are rich in organic material and contain high amounts of biogenic opal (diatom ooze) and carbonate. At a number of locations diagenetic crusts and phosphorites (Fig. 4) could be observed.

Fig. 4: Large phosphorite concretions sampled with the gravity corer.

Selected pore water profiles from 3 stations at 80m, 500m and 1000m water depth (Fig. 5) illustrate differences in mineralization intensity and related benthic fluxes. Phosphate and ammonia are released into pore water by organic matter breakdown, whereas the sub-seafloor increase of silicon indicates the dissolution of diatom tests. The profiles reflect the decrease of organic matter input with increasing water depth. High subsurface peaks of dissolved iron at 500m and particularly at 80m depth further indicate the lack of oxygen and the instantaneous use of metal oxides for organic matter mineralization right below the sediment-water interface. The zone of Fe-release is shifted further downward as soon as oxygen becomes available at greater water depths (1000 m). A detailed examination of the data will help us to quantify diagenetic turnover in the sediments and hence, the quantification of benthic exchange fluxes. At present a second transect is sampled and a third one is planned for the upcoming days in order to extend the available data base and record spatial variability.

Fig. 5: Selected pore water profiles of iron, phosphate, ammonia and silicon at 11°S.



On behalf of the science party and Meteor crew, our very best regards.

Olaf Pfannkuche