

SO268/1
5th weekly report

18.-24.03.2019



We started the last week of station work with an intense and successful sediment sampling program with multi-, box- and gravity corers during the nights and the deployment of both elevators loaded with benthic chambers and profilers, 2 stand-alone cameras and amphipod traps in the Belgian contract area. Here, the first video-guided deployment of elevator 2 on March 15 had shown already that the sediment surface is more densely covered by larger nodules compared to the German area. Whereas the first deployment went smoothly, the subsequent deployment of elevator 1 became a free fall deployment by an unexpected activation of the electromagnetic release disconnecting the lander from the launcher when the telemetry was switched on at 71 m water depth. Fortunately, the elevator was found in 4507 m water depth by the ROV pilots on a subsequent dive (9) very close to its deployment position and the dive plan using the freight of both elevators could be continued almost as scheduled. However, the presence of the ROV proved to be very helpful again since the acoustic releasers on both elevators failed. After both elevators were recovered and since weather was favorable, we decided to deploy the large Molab Master lander. This lander was equipped with a sediment trap, a downward-looking still camera and Aquadopp profiler, 2 ADCPs, a CTD with various turbidity sensors and an acoustic modem. Together with the launcher it weighs about 2.6 tons in air and with its 2.4m long legs used as bottom weights it is designed to monitor the water column above and the bottom water underneath the floatation unit. So far, it has been deployed only 2-times before in shallow water in Norwegian fjords.



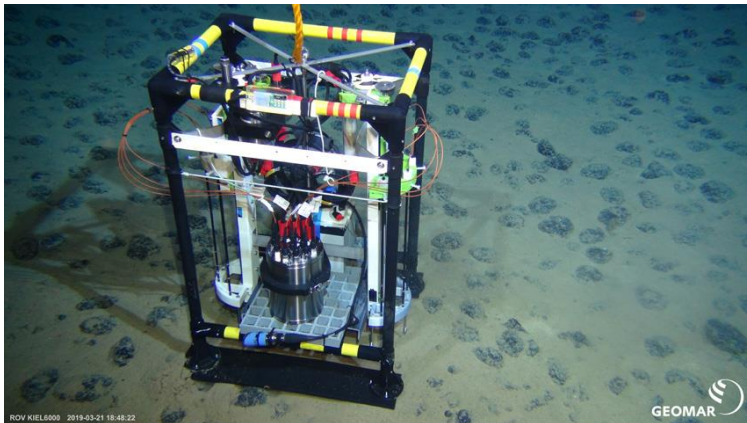
Molab Master lander ready for deployment.



Successful recovery by ROV in a 2-wire operation.

The first deployment in the deep sea proved to be a real challenge: first to bring it intact into the water and to the seafloor – during the first trial the legs were lost already on the surface when the lander hit the vessel in the swell and during the second trial at 1800 m water depth when the legs detached spontaneously. To make a long and tedious story short: When the wire was heaved back in, we had to notice that the attachment part of the launcher had been ripped off and the lander with launcher on top was slowly descending to the seafloor. Luckily, the signal of the transponder provided the position, but it took us 2 subsequent ROV dives (11 & 12) to recover on March 20 the upside down lander with launcher by a 2-wire operation back on deck. After this and after a last unsuccessful AUV-test, we decided that both instruments need substantial improvements/maintenance. The AUV-system will be returned to Kiel from Manzanillo to analyze the problems in greater detail.

With the last dive of the ROV, an experiment feeding holothurians with labelled algae was started and the team from the Max Planck Institute for Marine Microbiology (MPI) concluded its activities to measure oxygen fluxes directly at the seafloor. During a number of dives, the ROV positioned and started several self-contained measuring modules at the seafloor in 3 different working areas in the German and Belgian areas. These included microprofilers that drive very thin oxygen sensors into the seafloor and benthic chambers that enclose a small patch of sediment to measure its oxygen uptake.

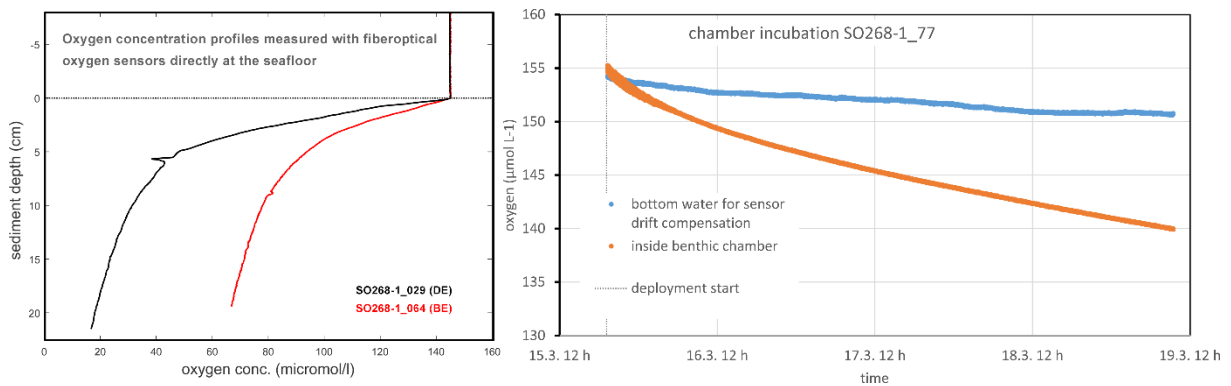


Both instruments use approaches that are well-established in deep-sea science. However, some technological modifications were necessary to cope with the low benthic activities and deep oxygen penetration expected in this part of the oceans and the dense coverage with nodules. For this reason, MPI brought profilers that use fiberoptical oxygen sensors (see

picture above) that are sturdier than the glass electrodes typically used and can penetrate deeper into the seafloor to also address the contribution of deeper sediment layers to the total oxygen demand. However, without the skills of GEOMAR's ROV team to position the measuring modules within the tiny nodule-poor spots, studies wouldn't have been successful.

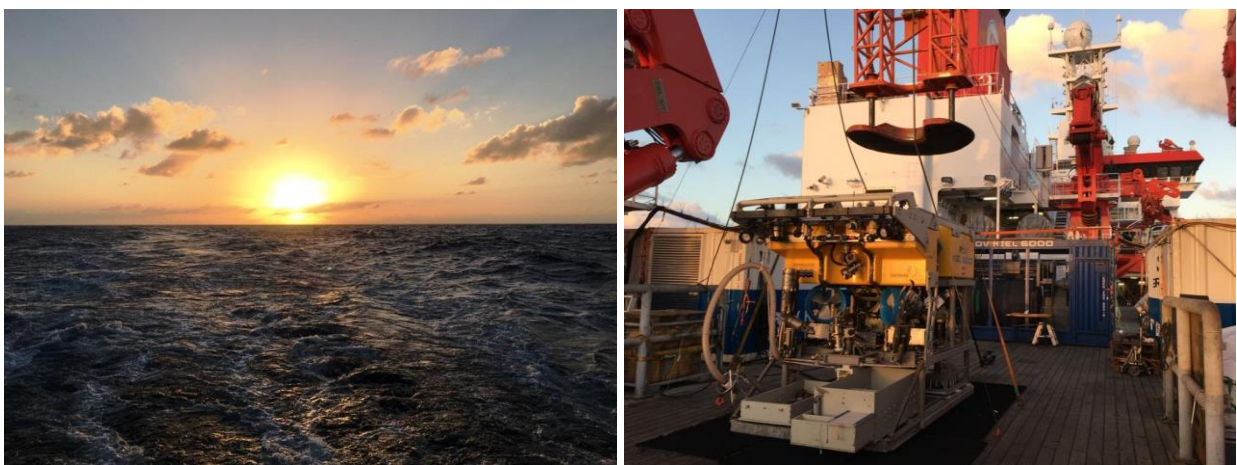
Seafloor oxygen flux measurements during this first leg aimed to quantify the activity of the organisms living in the pristine, undisturbed seafloor. As microorganisms provide most of the biomass in abyssal plains, the observed oxygen uptake rates mainly reflect the demand of these smallest – but abundant – members of benthic communities. However, forming the base of the food web, the well-being of the microorganisms is a prerequisite also for larger organisms feeding at or in the seafloor. Hence, biomass production by an active community of microorganisms is necessary to sustain benthic biodiversity and to allow for recovery and recolonization of ecosystems after impacts associated with deep-sea mining. So far, measurements of oxygen fluxes are not included in the contractor's monitoring obligations. The work carried out during this cruise will help to clarify the feasibility of such measurements to assess the general status of seafloor ecosystems, the severity of impacts, and the subsequent recovery of ecosystem functions. Any investigations of impacts require a good knowledge of conditions before ecosystems are disturbed. This so-called 'baseline study' was

the main task of MPI on this leg and is laying the foundation for studying impacts in follow-up investigations. Oxygen uptake measurements are combined with investigations of the microbial community composition and its metabolic activity carried out by MPI and colleagues from the University of Ancona based on sediment analyses and shipboard incubations.



A preliminary analysis of the oxygen profiles obtained with microprofilers shows pronounced differences between the two investigated areas (see left panel of the above figure). Higher oxygen concentrations deep in the sediments in the Belgian area are indicative of deeper oxygen penetration and lower rates of oxygen uptake and microbial activity. Luckily, the deep profiles obtained in both areas include the strongly curved upper part of the profiles, where most of the oxygen uptake is taking place. Profile-based flux data will be combined with oxygen uptake measurements derived from oxygen time series in the benthic chambers (right panel of above figure). In order to get the full picture, the data will be combined with oxygen measurements down to several meters sediment depth that are performed in the ship's lab by project partners from the Alfred Wegener Institute (AWI) using cores collected with the multi- and gravity corer. Oxygen uptake data will further be used for biogeochemical and foodweb modeling by GEOMAR and Utrecht University / NIOZ for integrated assessments of ecosystem function and energy and element flows in the benthic communities.

After a final test of our acoustic releasers on the CTD/water sampler carousel we terminated our demanding work program on March 22 and are now on our way back to Manzanillo.



Many greetings on behalf of the scientific party of SO268/1 - all healthy and well,

Peter Linke