METEOR Cruise M157

Mindelo (Cape Verde) – Walvis Bay (Namibia); 04. August – 16. Spetember 2019

4. Weekly Report; 01. September 2019

As previously planned, the investigations at the beginning of the expedition focused on the latitude section at 23°S. In the past few days, almost all the equipment on board was successfully deployed at a total of 16 stations with water depths between 42m and 2,070m. In addition, a long-term mooring could be recovered and re-deployed. However, due to the constraints of the individual missions (e.g. no sediment work if the water column is to be sampled), the shallow water depth at most of the stations and the comparatively short distances between the stations, all instruments could only be used at two of the three so-called main stations planned. Unfortunately, the first failures of this expedition were primarily due to the sometimes relatively high swell. Fortunately, the cable connections of the Pump-CTD and the Scanfish were damaged only after successful missions. However, both devices are currently being repaired on board, so hopefully their use in the last two weeks is not endangered. In the night of Thursday 29 August, the work at 23°S was almost completed. On Friday morning the investigations began shortly before the Angolan border (at approx. 17.5°S). The mainly biological and oceanographic work will continue into the late evening of September 1st. Afterwards a longer transit back to the south will take place.

The central questions on this expedition and thus of the EVAR research project are i.) how benthic communities (bacteria, meiofauna and macrobenthos) react to fluctuating redox conditions in bottom water, which are characterized by the availability of oxygen (O_2) and nitrate (NO_3^-); ii.) how is this reflected in the benthic turnover and fluxes of O_2, the greenhouse gases methane and carbon dioxide and dissolved inorganic carbon, nutrients, sulphide, silicate and iron with regard to threshold values, time and strength in the upwelling system off Namibia; and iii.) can information on the history of upwelling be derived from the sediment deposits? In order to approach these questions, one of the working groups on board (biogeochemistry) is pursuing an experimental approach in which the availability of O_2 and NO_3^- in bottom water is manipulated directly at the seafloor. Two identical BIGO lander (Biogeochemical Observatory) are used for this purpose, which incubate the seabed and bottom water in two chambers for approx. 36 hours each, independently of the ship (Fig. 1).

Initial investigations of the seabed along the 23rd southern latitude with a towed camera system quickly made it clear that sampling the extremely soft, aqueous seabed would be a challenge. Nevertheless, two stations, one inside the mud belt (M157-16) and one at its western edge (M157-12) could each be sampled twice. At station M157-16, whose highly active sediments are interspersed with sulfide-oxidizing sulfur bacteria, O_2 and NO_3^- are consumed after a short time. The degradation of organic material mainly takes place by bacterial sulfate respiration. This releases enormous amounts of highly toxic sulphide for aerobically living organisms, which is also released into the bottom water. Furthermore, these sediments show extremely high release rates of the nutrients phosphate and ammonium in comparison to earlier measurements in this region as well as in comparison to other oxygen minimum zones.

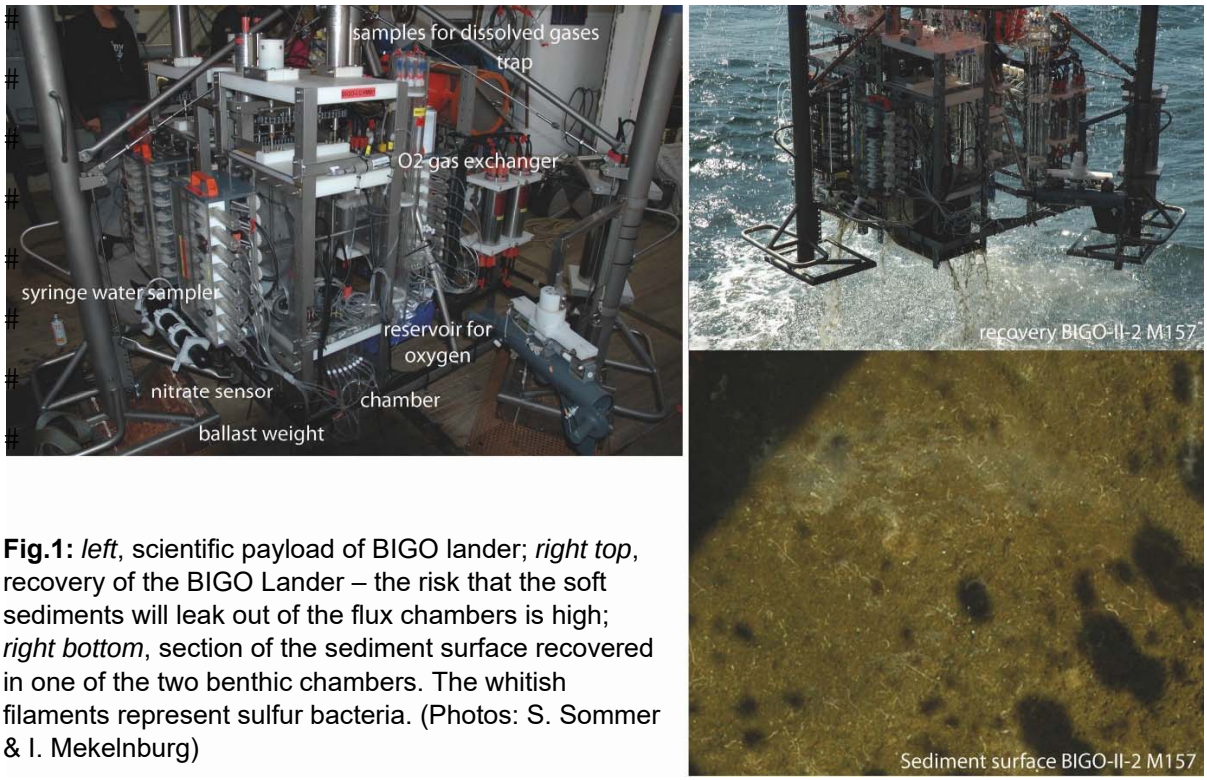

Fig.1: *left*, scientific payload of BIGO lander; *right top*, recovery of the BIGO Lander – the risk that the soft sediments will leak out of the flux chambers is high; *right bottom*, section of the sediment surface recovered in one of the two benthic chambers. The whitish filaments represent sulfur bacteria. (Photos: S. Sommer & I. Mekelnburg)

In the sediments of station M157-12, on the other hand, despite their location at the edge of the mud lens, the degradation of organic material is essentially carried by the respiration of O_2 and NO_3^-, which are consumed only slowly. Ammonium, which is formed during the degradation of organic matter, is only released in the course of incubation when the availability of O_2 and NO_3^- decreases. Phosphate, however, remains bound in the sediment or is absorbed from the bottom water. Sulfide could not be measured at this station. In cooperation with other working groups of the EVAR project, investigations on micro-, meio- and macrobenthos and gas release are carried out at these stations.

Due to the already mentioned nature of the sediments in the area of the coastal mud belt, we initially had great difficulties with their sampling. It was only after various "modifications" of the multicorer (Fig. 2) that the success was achieved, which has lasted until now.

Fig.2: Multicorer with various wooden attachments that prevent the instrument from sinking too deeply but also ensure that it closes. (Photo: M. Zabel)

With wave heights up to 4.5 m, the sea has unfortunately not made it easy for us in the past days. If we leave the current working area in a southerly direction, the swell should be slightly reduced to freshen up in the next working area (25°S). In spite of the predominant sunshine, the daily maximum temperatures do not rise above the usual 15-16°C for this season and this sea area.

All the boats are doing very well. After the exhausting first half of this expedition we are also looking forward to the two-day transit without station work.

In the name of the M157 Team,

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