RV SONNE Expedition SO317
MANGAN 2026

28.12.2025 – 19.02.2026
San Diego – San Diego (USA)
5th weekly report (26.01.2026 – 01.02.2026)

During the past week, which represents the fourth week of work in the BGR contract area, we have continued working in the Reference Site adjacent to the Patania II collector Trial Site (around 8 kilometres away). The Reference Site provides data and information on the natural environment, including spatial and temporal variability, against which the data from the impacted sites (Patania II collector impact and plume impact) can be assessed. In addition, we completed our sampling of the newly defined Trial Site for a potential future test of Impossible Metals' autonomous AUV collector Eureka III, which is envisaged to make use of the same Reference Site as described above. Both areas are characterised by high abundances of medium-sized to large nodules (23-25 kg/m^2 wet wt.), and we could verify that the chosen site for the Eureka III test is suitable for its purpose.

The week was dominated by three long ROV dives with intensive use of the subsea baskets ("lifts") to transport equipment to and from the seafloor in parallel to ROV operations. In total, the ROV Odysseus spent around 80 hours in the water, of which 67 hours represent seafloor bottom time during which we continued our work with multiple deployments of oxygen micro-profilers, benthic chambers, ecotoxicity chambers and baited amphipod traps, amongst others. In between deployment, relocation and activation of equipment on the seafloor, push cores were regularly taken for biogeochemical and biological analyses, and specific megafauna was sampled for genetic and baseline ecotoxicological studies. With the ROV's 4K camera, excellent close-up video imagery could be obtained of larger and smaller benthic and bathypelagic animals and their symbionts on and close to the seafloor, which will serve both scientific and public outreach purposes. After every dive, biologists scrambled to retrieve their samples and specimens from the ROV's bio-boxes and samplers to immediately photograph, preserve in ethanol or freeze them at -20°C to -80°C for further analytical work once back in the home laboratories.

Our ROV-supported, *in situ* research on benthic biogeochemical processes in all working areas is being carried out by Dr. Duygu Sevilgen and Dr. Felix Janssen from the Alfred Wegener Institute in Bremerhaven (AWI), as well as M.Sc. Lukas Damm from the University of Kaiserslautern. The main emphasis of their work is on pore water oxygen distributions in the upper 30 cm of the sediments, as well as oxygen fluxes across the sediment-water interface. Oxygen uptake is a key proxy for the activity of seafloor organisms and a measure of the rates of organic matter consumption. It is important to understand both the baseline conditions, including spatial variability thereof, and potential effects of deep-sea mining on benthic processes. Different aspects of benthic oxygen dynamics are addressed in both

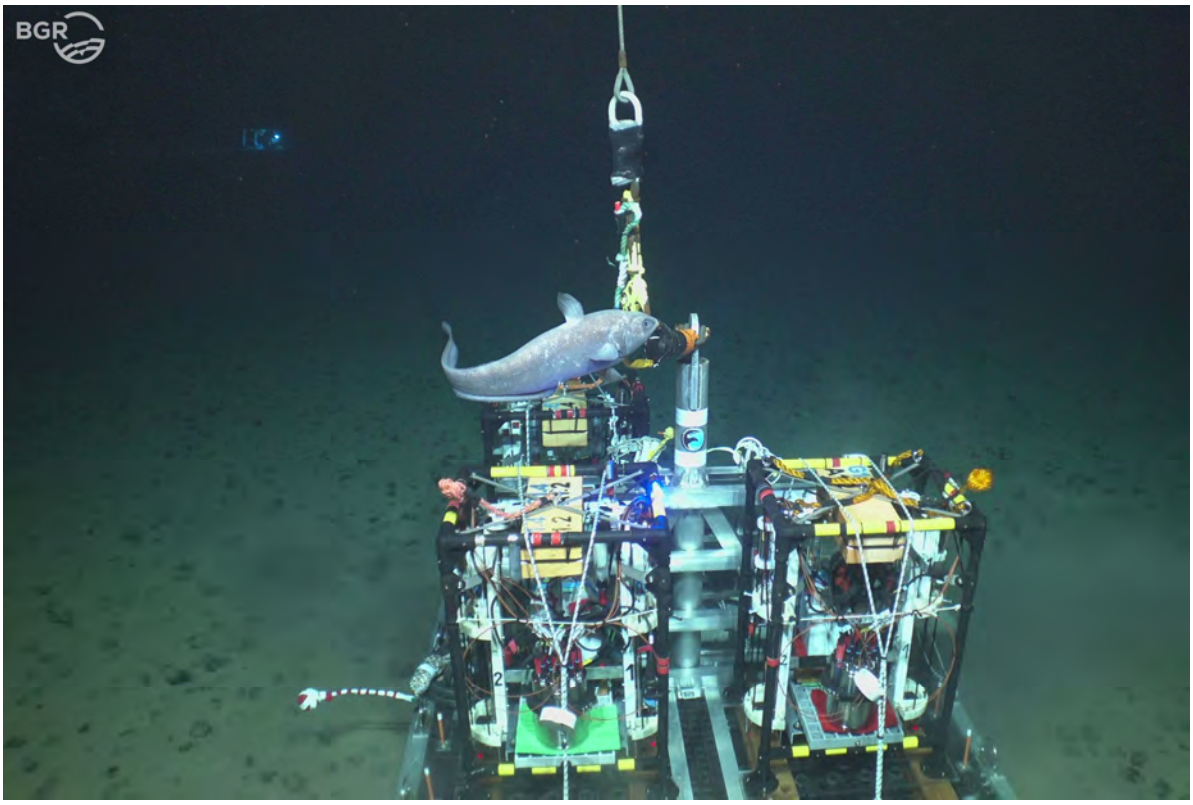
impacted and pristine areas using three complementary approaches. Benthic chambers quantify the total oxygen uptake of the sediments with 20-cm-wide plastic cylinders that enclose a small area of the seafloor together with some overlying water. Oxygen in the overlying water is monitored throughout ca. 2 days to quantify the total oxygen uptake by respiration of the microorganisms and fauna living in the sediments and nodules. In addition, samples are taken to investigate trace metal fluxes. Microsensor profilers are used to collect vertical profiles of oxygen concentration in the top 30 cm of sediment. Wherever gaps between nodules allow a penetration of sensors into the sediments, the method allows for the characterisation of seafloor oxygen conditions and the quantification of respiration rates of sediment microbes. In collaboration with Dr. Karl Attard from Odense University, an Eddy Covariance System is deployed as the third method to address benthic oxygen dynamics. By simultaneous measurements of fluctuations in currents and oxygen concentrations in the bottom waters directly above the seafloor, total oxygen uptake of the sediments can be quantified over an area that is typically several square meters in size. The clear waters and low oxygen uptake rates prevailing in nodule areas challenge this efficient method that holds great potential for benthic activity monitoring in the context of deep-sea mining.

Time in between ROV dives was mostly spent taking seafloor sediment multicores and box cores, as well as full water depth (trace metal clean) CTD/rosette profiles and samples. Two short moorings, each equipped with a 600 kHz ADCP and a 2 MHz Aanderaa RCM, were deployed in the Eureka III Trial Site to record hourly current speeds and directions close to the seafloor throughout the next ~1.5 years. They have been placed at locations from which we have already obtained several years of similar data between 2013 and 2016.

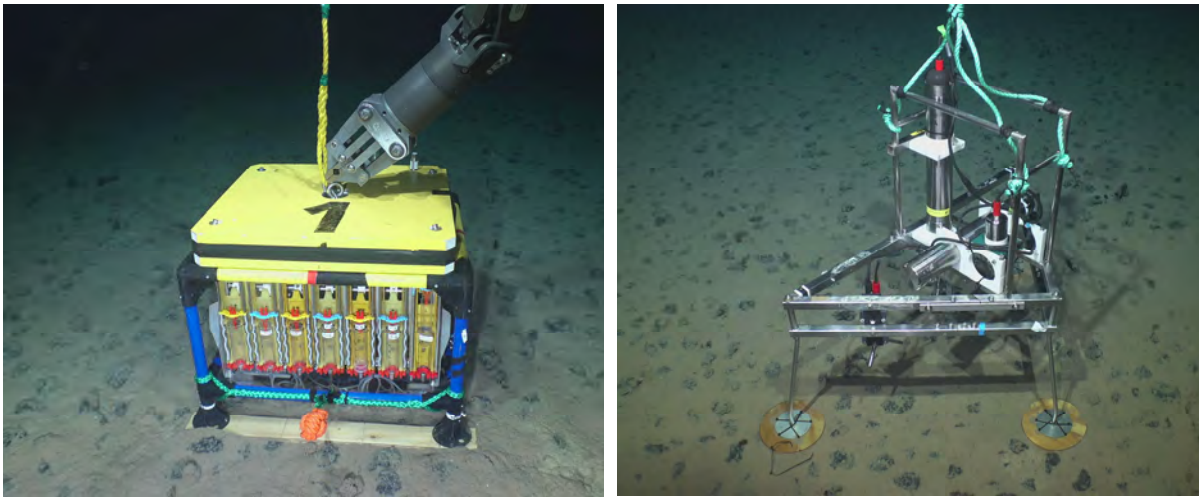
Early in the morning of Saturday, 31st January, we started a 17-hour transit to the north-western part of the contract area, which is one of the rare areas in which multibeam backscatter predicts no nodules on the flat abyssal seafloor, despite its lack of conspicuous topography. Nodule-free areas in the abyssal plains are only estimated to cover ca. 2% of the total contract area, and are interesting from a biogeochemical and biological perspective as they represent a deep-sea habitat with potentially differing benthic dynamics. Furthermore, they may provide valuable information on biological and ecosystem characteristics in a sedimentary environment that mimics conditions of thick plume sedimentation after a mining activity. We will carry out a full sampling programme here throughout the next 4 days before moving on to an area with small nodule coverage in the central contract area afterwards.

Despite an increase in wind speed, wave heights and unpredictable currents and undercurrents throughout the middle of last week, we have been able to deploy the ROV and our sampling equipment without constraints or delays. At the moment we are enjoying low swell and sunny weather – optimal conditions for our further work programme. All participants are doing well and send warm tropical greetings,

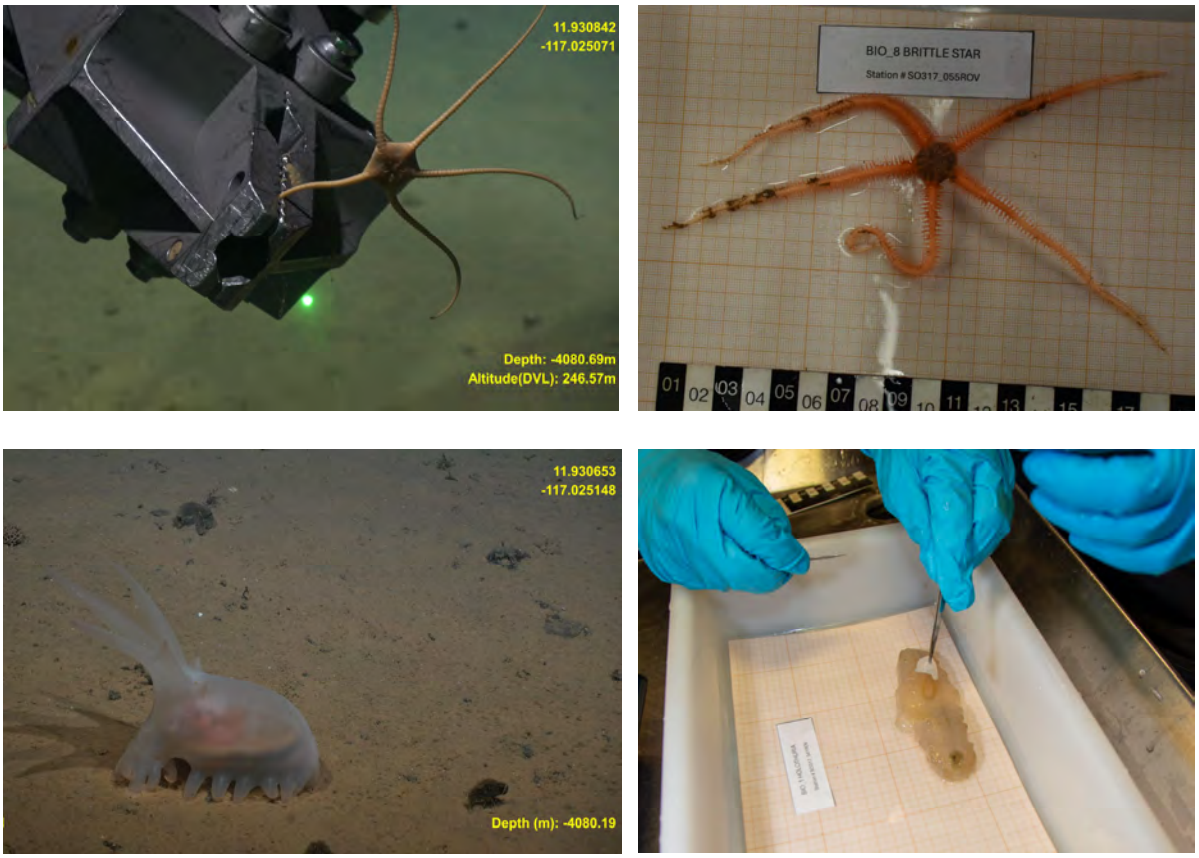
Annemiek Vink
(Chief Scientist SO317)



A subsea basket (lift) with three oxygen micro-profilers is brought down to the seafloor by ship's cable, where the ROV detaches it. A curious fish inspects the intrusion into its realm. A baited camera lander takes pictures of the seafloor and its fauna in the background.



A benthic chamber (left) and the eddy covariance system (right) measure oxygen uptake rates in and on the seafloor, respectively.



Brittle stars (top) and sea cucumbers (bottom) are sampled by ROV and consecutively photographed and sampled on board for genetic and ecotoxicological analyses.