FS METEOR
Cruise M200
22.03.2024 – 09.04.2024
Rostock – Rostock

MnION
Elemental coupling of manganese cycling
across redoxclines of the Baltic Sea

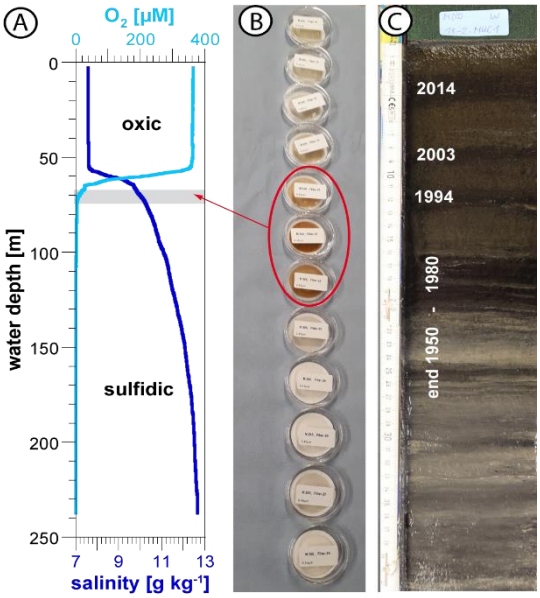
2nd Weekly Report
26.03. – 31.03.2024

At the beginning of the week, we reached our main working area in the eastern Gotland Basin. On Monday, we began station work in the Gotland Deep in pleasant weather. Our most important devices here are the CTD probe with the rosette water sampler, the so-called Pump CTD and the microstructure probe. They enable us to perform the extensive sampling program necessary for our project and to record high-resolution vertical profiles of hydrographic and biogeochemical parameters.
The Baltic Sea continues to be plagued by annual blooms of colony-forming cyanobacteria, which contribute to oxygen depletion as the biomass sinks. The blooms are also easily recognizable from satellites when the sky is cloudless, and their extent can therefore be easily recorded. Their abundance remains high as they obtain the phosphate nutrient they need from deep and oxygen-free but phosphate-rich water layers. They cover their nitrogen requirements through their special ability to fix molecular nitrogen. In total, they contribute as much nitrogen to the central Baltic Sea as all Baltic Sea tributaries combined.
Other bacteria that live in water depths below the light-flooded zone and can also fix nitrogen have hardly been studied. Although their occurrence has been described, little is known about their overall activity. On the M200 cruise, we are therefore taking samples from the anoxic water column and measuring their fixation rates by adding stable isotopes of nitrogen. After incubation, the samples are filtered (see Photo below).

Left: filtration of nitrogen fixation experiment in the cold room of RV METEOR. Right: preservation of samples from the pump CTD

In this way, we hope to find out how high their share of the nitrogen supply is - a quantity that is currently completely unknown.

Another focus of our work at sea is the oxygen supply and the processes that consume this oxygen. We are testing a new method for the first time in the Baltic Sea by taking samples to measure the stable isotopes of dissolved oxygen. We hope that this will provide us with two types of information: firstly, about the spread of the salt water that has entered the Baltic from the North Sea and the processes that consume this oxygen along the way. Secondly, the samples from the Pump CTD will provide a high-resolution profile of oxygen depletion and thus resolve consumption and mixing in the vertical.
Another research focus during the recent week was investigations of redox-sensitive trace metal cycling within stratified basins of the Baltic Sea. These studies, carried out by two geochemists from the Leibniz Institute for Baltic Sea Research Warnemünde and the University of Bern, aim to identify the processes and conditions affecting stable metal isotope signatures in the redox-stratified water column and corresponding sediments from the deeper basins of the Baltic Sea. In particular, the impact of intense manganese shuttling on the so far understudied trace metals antimony and tungsten forms a central focus. Both metals and especially their isotopic composition are considered as potentially promising new proxies for the global long-term redox conditions in the ancient oceans. However, for reliable reconstructions, a holistic understanding of the transfer and burial processes from the water column to the sediment forms an indispensable prerequisite, which can be studied in modern redox-stratified aquatic systems. Therefore, dissolved and particulate trace metals from the water column as well as from sediments and porewaters were sampled in the central Gotland Basin currently subjected to a sharp redoxcline separating the upper oxygenated water column from the deeper sulfidic waters below at ca. 70 m water depth (A).



From station 18 in the Gotland Basin: A) salinity and O2 concentration in the water column with the approx. position of the redoxcline (grey bar), B) suspended particulate matter in water samples and C) a lengthwise halved short core.

The water column sample selection could be easily controlled visually by brownish colored filters due to elevated accumulation of particulate manganese oxides causing substantial metal isotope fractionation (B). A lengthwise halved short core from the same station, which was obtained by a multi corer device, clearly reflects fundamental redox-shifts in the Gotland

Basin during the last ca. 150 years including, e.g., major Baltic inflows in 2014, 2003, 1994 and within the late 1970 – 50s (C).
After completing the work in the Gotland Deep, we switched to our second main station in the Faro Deep. The weather remained good and we were able to complete the work there on Saturday afternoon. After recovering a drifter near our station, we began the transit to our next station in the Landsort Deep between Gotland and the Swedish coast.
We used the short break from scientific work to celebrate the 200th voyage of Meteor 3 and the 100th anniversary of the commissioning of Meteor 1.

The atmosphere on board is still very good. The cooperation between the individual groups and the crew is excellent. We are satisfied that we have been able to successfully carry out all the planned measurements and sampling so far.

Best wishes on behalf of all participants,

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