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Highly dynamic oxygen conditions and increased denitrification in Crimean Shelf sediments (Black Sea)

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In the world largest anoxic basin, the Black Sea, a well described chemocline separates oxygenated surface waters from anoxic deep waters. Along with the oxycline a prominent nitrate peak is usually found at similar depths. At the continental shelf, oxycline and nitrate peak meet the sea floor thus providing an ideal study site to investigate the effect of hypoxic and anoxic condition on benthic life and sedimentary N-cycle.
During an expedition with the German research vessel MARIA S. MERIAN, oxygen dynamics and sediment biogeochemistry at the NW Crimean shelf was studied at depths of 100m to 200m, where the oxycline intersects with the sediment. Along two cross shore transects, 3 moorings equipped with CTD, oxygen sensors and current meters were deployed for 6-8 days. In parallel, nutrient and sulphide samples were collected using a CTD-Rosette and a Bottom Water Sampler. Sediment cores were retrieved to measure porewater nutrients as well as N2 production from 15N incubation experiments.
In the bottom water, variations in oxygen and nitrate concentrations correlated with density variations, thus concentration-time series could be calculated from the density-time series of the moorings. At all depths, a strong temporal variability of bottom water oxygen was observed. Below 130m depth, oxygen variability was strongest. Periods of rapid oxygen decrease (150μM/h) and anoxia were followed by periods of slow re-oxygenation of the bottom water. The affected sea floor area was up to 15km wide in the cross shore direction. Video surveying showed no signs of benthic macro-fauna at these depths. Oxygen uptake measured with chamber incubations, oxygen microprofiles and eddy correlation was low ranging between 1.5 -6.5 mmol m-2 d-1.
Nitrate was constantly present in the bottom water. Although the nitrate concentrations were moderate at around 4μM, sediment incubations with 15N-labelled nitrate revealed high capacities of denitrification. Considering low and strong fluctuating oxygen concentrations we speculate that nitrate reduction pathways become more favorable in these environments, as nitrate storage might allow many organisms to survive recurrent anoxic conditions.

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