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Element transformation rates and fluxes across the sediment-water interface of the Baltic Sea

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Organic matter is mineralized in brackish-marine sediments by microbial activity using predominantly oxygen, sulfate, and metal oxides as electron acceptors. This leads to a reflux of carbon dioxide into the bottom waters. Under anoxic bottom water conditions, sulfate reduction dominates. Under specific conditions, shallow methane may be oxidized. Pore water profiles reflect biogeochemical processes, transformation rates and fluxes of dissolved species across the sediment-water interface. They are controlled by different factors like microbial activity, bottom water redox conditions, and availability of electron acceptors/donors. Microbial activity in the sediment leads to changes in redox conditions, formation of metabolites and may lead to the formation of authigenic minerals. As an example, organic matter mineralization and reduction of iron oxyhydroxides both may lead to the liberation of dissolved phosphate thereby leading to a reflux into the bottom waters. Hypoxic conditions will enhance this process. We present the results of a detailed biogeochemical investigation of interstitial waters from shallow sediments to study the biogeochemical processes in recent sediments and associated element fluxes at the sediment-water-interface in different areas of the Baltic Sea.

Pore water and sediment samples were retrieved from short sediment cores that were collected with multi-coring devices in key regions of the Baltic Sea. Pore waters were taken in sufficient depth resolution and analyzed for main and trace element concentrations (e.g., Mn, SO4, HS, PO4, DIC) to allow a modelling of steady-state transformation volumetric rates and element fluxes. A quantitative interpretation of vertical concentration profiles in the pore waters was performed using a diffusion-based modelling approach. Element fluxes across the sediment-water interface show for the Baltic Sea a dependence from bottom water redox conditions, sedimentology, organic contents, and formation conditions (e.g., accumulation rates). In selected anoxic basins, gross anaerobic mineralization rates were additionally obtained from core incubations using a S-35 radiotracer. Highest SRR were found here in the top 5-10 cm.
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