Phosphorus geochemistry and export production across the polar front zone in the southeastern Atlantic Ocean

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Understanding how productivity and export production in the Southern Ocean has varied on glacial/interglacial time scales is important because of the potential influence the biological C pump has on atmospheric carbon dioxide. This paper presents results using sediment geochemical proxies for export production across the Polar Front Zone (PFZ), along a north-south transect between 41° S and 53° S in the southeastern Atlantic Ocean from cores recovered during ODP Leg 177 over the last 1 Ma. Because phosphorus (P) is an important nutrient element, we are using P geochemical records (total reactive P concentrations and accumulation rates) as well as bulk sediment geochemical records (P/Ti ratios) as indicators of changes in export production. Previously, it has been reported that productivity was higher north of the Polar Front and was lower south of the Polar Front during glacial intervals, based on changes in opal accumulation rates, radionuclide records, and stable isotope data. However, results from the sediment geochemical proxies of export production from this study appear to show similarities through time across the PFZ, with some increases during glacial intervals, indicating that regions north and south of the PFZ are more alike in terms of productivity and export production than previously suspected. Furthermore, maxima in export production frequently occur during glacial terminations, suggesting Southern Ocean biological productivity is more of a response to climate conditions rather than a significant factor modulating atmospheric carbon dioxide.

Redox driven cycling of uranium between sediment and water in a seasonal anoxic and sulfidic lake

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We determined the geochemical behaviour of uranium in an eutrophic and seasonally stratified lake. Uranium is a redox-sensitive trace element, with complementary redox-behaviour to manganese and iron. Under anoxic conditions U is immobile, while reduced Mn and Fe are dissolved in pore-water of sediments. Lake Willersinnweiher (Ludwigshafen/ Germany) is a strong eutrophic disused quarry pond with high bioproductivity and organic rich sediments (up to 7% TOC). Sedimentation rates are about 1.5 cm/y. It has a seasonal sulfidic hypolimnion in summer, in which strong precipitation and accumulation of Fe-sulfides occurs.

The measurement of both, total and dissolved U and Fe concentrations of lakewater, shows that despite the SO_4^{2-} reducing conditions and about 50% of the iron in particulate form (amorphous FeS), no significant amount of particulate uranium could be found. Nevertheless, we assume a permanent small flux of particulate U to the top of the sediment to explain the observed enrichment of U in the deeper parts (10 cm below water-sediment interface) of the sediment column.

Porewater data in summer (sulfidic bottom water) shows a diffusive flux into the upper 4-5 cm of the sediment and precipitation there. However, this diffusive flux is about one order of magnitude smaller than required for the observed uranium enrichment. In periods of ventilated bottom water (fall, winter and spring) oxygen diffuses in sediments, causes burn down of organic matter and a release of deposited U to porewater with concentrations about 7 times higher than lake water content. Uranium diffuses along concentration gradients in both directions: into bottom water and into deeper parts of the sediment. Below the redoxcline (under sulfate reducing conditions) at a depth of 8 - 10 cm U gets precipitated.

Altogether the net U balance of the sediment is positive and so the organic rich sediments are an important sink for uranium in this lake.