

Linking the micronutrient-driven biological pump and CO₂ drawdown in the Southern Ocean: Diatoms as a recorder of surface ocean trace metals

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The expansive Southern Ocean controls global climate by drawing down atmospheric carbon dioxide (CO₂) into the ocean's interior via primary production within the so called 'biological pump'. The efficiency of this process is limited by trace metal micronutrients such as iron (Fe) and zinc (Zn), but past-climate records are instead based on traditional macronutrient tracers (nitrate and phosphate) that are not ideally suited to the Southern Ocean. Therefore, sedimentary records of trace metal micronutrient tracers are needed to reliably reconstruct the efficiency of the past biological pump and improve the predictive performance of future-climate projections. South of the subtropical frontal zone, diatoms dominate the biogenic part of the sediment and provide a valuable record of surface Southern Ocean biogeochemistry (e.g. nutrient regime, temperature, ocean circulation). Our study is focused on diatom-based reconstructions of micronutrient availability and demand by primary producers during climate and CO₂ reorganisations across the last glacial-interglacial cycle (140 ka – present) at site TAN1302-96, just south of the Polar Front in the Pacific sector of the Southern Ocean. Our approach is based on downcore records of micronutrient concentrations and stable isotope systems, using a protocol modified from [1] to extract trace metal clean diatoms from the bulk sediments of the core. These micronutrient-focused records, combined with selected macronutrient tracers, will provide a new understanding of how trace metal micronutrients regulate marine primary productivity, the efficiency of the biological pump and the ability of the Southern Ocean to regulate atmospheric CO₂ levels.

[1] Andersen et al. (2011), *Earth Planet. Sci. Lett.* 301, 137-145.