Sources and sinks of Fe during the early austral spring offshore from the western Antarctic Peninsula

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The marine ecosystem is diverse and its many interdependent life forms significantly impact both regional and global climate. Importantly, phytoplankton, that form the base of the marine food web, consume CO_2 and influence global carbon and climate cycles. These microorganisms require major nutrients and micronutrients to satisfy their growth requirements. A critically important micronutrient is iron (Fe), which acts as a primary electron contributor and acceptor during photosynthesis and as a cofactor in enzymes that enable N-fixation from the atmosphere.

The concentration of Fe and its availability to microorganisms can limit productivity in some of the world oceans, especially in high-nutrient, low-chlorophyl (HNLC) regions. This includes waters adjacent to the western Antarctic Peninsula, which have high major nutrient concentrations, but low availability of light and micro-nutrients. However, during the austral spring and summer, the availability of light increases and sea-ice melts, possibly introducing micronutrients, including Fe, into the surface ocean.

Using techniques in trace metal pre-concentration and sector-field ICP-MS, we report the distribution of Fe in waters from the Bellingshausen Sea, offshore from the western Antarctic Peninsula, that were collected during the Phantastic II GEOTRACES cruise in November, 2014. In this oceanic region, the concentration and distribution of Fe should be relatively high at the beginning of spring due to deep mixing in the preceding winter, ice melt, and low consumption during autumn and winter. However, our results show that dissolved Fe concentrations were elevated over the continental shelf only, with the highest values of up to ~5 nmol/kg closer to the continent and very low values down to ~0.02 nmol/kg further offshore.

The comparison between the concentrations and distributions of Fe and various source tracers can be used to unravel different Fe sources and their relative contribution to the Fe budget in this region. Source tracers include Ti and 'Rare Earth Elements' (Sc, Y and La) as indicators of lithogenic sources such as glacial input, Mn as a tracer of reductive dissolution from sediments, and oxygen isotopes ($\delta^{18}O$) as a tracer of sea-ice melt or meteoric meltwater. Using this multi-tracer approach, we aim to improve understanding of the biogeochemical cycling of Fe in this HNLC oceanic region.