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Cracking the code: iron isotopes as source tracers in the Antarctic

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The often iron-limited Southern Ocean plays a disproportionally large role in global carbon cycling, accounting for around a quarter of oceanic CO_2 uptake in just one tenth of the global ocean's surface area. Dissolved iron (Fe) supply from sediments and cryospheric processes, whether near the Antarctic shelf, near Southern Ocean islands, or within coastal polynyas, thus plays a key role in determining both the location and magnitude of phytoplankton blooms (and resultant carbon uptake). In the last two decades, much work has demonstrated the importance of benthic sediments in supplying dissolved Fe to local waters in Antarctic marginal seas, off the West Antarctic Peninsula, and even potentially offshore into the Fe-limited surface waters of the Antarctic Circumpolar Current. However, questions remain over the transport, longevity, and speciation of this dissolved Fe. Recently, application of the stable isotope ratio of Fe (δ^{56}Fe) to in these settings by a handful of studies has provided further insights into the source, transport, and nature of dissolved Fe emanating from both benthic sediments and cryospheric processes to the water column in the region. In this talk we will summarize the current state of knowledge for the use of Fe isotope ratios as a source tracer around coastal Antarctica and the wider Southern Ocean. Several recent process studies in the Weddell and Amundsen Seas show both local insights for Fe cycling in Antarctic coastal regions and polynyas but also inform our understanding of processes that influence δ^{56}Fe globally. For example, conserved δ^{56}Fe signatures across a dFe concentration gradient over the Weddell Sea shelf lend support for δ^{56}Fe as a robust tracer of shelf-derived Fe out into the open ocean, while Fe isotope mass-balance calculations in the Amundsen Sea inform that both reductive and non-reductive flux mechanisms from benthic sediments must be active.