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Continental sources of Fe and Nd isotopes to the Antarctic shelf systems of the Amundsen Sea and Western Antarctic Peninsula

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The shelf systems of western Antarctica differ from those of the Arctic Ocean in several aspects. One is that they are bordered to the north by Fe-limited surface waters of the open Antarctic Circumpolar Current (ACC), which flows west to east just off the shelf break of the Amundsen Sea and the Western Peninsula. In contrast to the ACC, these productive shelf systems must therefore benefit from natural Fe fertilization. Here, we compare sources of Fe in the two Antarctic shelf systems, using dissolved and particulate trace metal data collected on the Palmer LTER grid and in the Amundsen polynya, and discuss their possible modification by current climate change. There are several candidate Fe sources fuelling primary production in these macro-nutrient rich regions, including atmospheric dust, sea ice, glacial ice and icebergs, and sedimentary inputs. The Amundsen polynya, the most productive polynya in Antarctica, is bordered in spring- summer by retreating and melting sea ice to the north and west, ice shelves fed by rapidly flowing glaciers to the south, and a phalanx of grounded icebergs and fast ice to the east. In contrast, much of the western Peninsula shelf system is sea-ice free by early summer, and while it experiences glacial runoff, is not strongly impacted by melting ice shelves. Preliminary results suggest that bioavailable Fe is supplied by modified Circumpolar Deep Water circulating under the ice shelves bordering the Amundsen polynya, subsequently upwelling to depths where wind event mixing may introduce Fe to the euphotic zone; particulate Fe is >100nM locally. Sea ice and iceberg melting can supply additional Fe, especially at the borders of the polynya. On the western Antarctic Peninsula, dissolved Fe concentrations are near 0.1nM in surface waters over the outer shelf, consistent with levels found in surface waters of the Fe-limited open ACC. Concentrations closer to the continent approach 1.0nM, suggesting that lateral inputs from continental sources or coastal upwelling of uCDW may dominate Fe supplies to the region. The continental source signature can be traced in both systems using Nd isotopes, which show more radiogenic values with proximity to the continent, consistent with the young rocks that dominate regional lithology. Isotope ratios vary from $\varepsilon_{Nd}(0)$ = -9 at a station 200km north of the Amundsen shelf break (consistent with literature values for the open ACC) to -5 (unfiltered) in close proximity to the Dotson Ice Shelf. Off the northern Antarctic Peninsula, inner shelf surface values of -6.5 increase to -8.2 at 100km off the shelf break, suggesting that continental influence extends well beyond the point where dissolved Fe is drawn down to minimal concentrations. The continental radiogenic component thus may influence the isotopic composition of Nd in the SO through exchange of shelf and open ACC water. If so, the importance of this input may have varied with Antarctic glacial and sea ice extent, potentially varying the SO endmember $\varepsilon_{Nd}(0)$ on glacial-interglacial cycles.