Fe sources and sinks along the southern Alaska margin inferred from time-series observations

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The subarctic Pacific is one of the largest iron-limited regions of the ocean, yet we lack a quantitative understanding of iron sources. Time series observations can help identify iron sources and sinks. Our time series observations from the southern Alaskan margin extended from the Copper River to ~50 km beyond the shelf break. Sampling before any depletion of surface-water nitrate reveals conditions at the start of spring blooms, and points to shelf sediment resuspension as an important winter/spring iron source through multiple lines of evidence: 1) satellite images reveal resuspended sediment in surface waters over most of the shelf; 2) concentrations of total dissolvable iron (TDFe; unfiltered, acidified to pH =1.7) are high and relatively constant over the shelf; 3) concentrations of dissolved iron (dFe; passes through a 0.45 um filter) are nearly uniform (~3 nmol kg^{-1}) over the shelf, decreasing beyond the shelf break. This is consistent with dFe supply via non-reductive dissolution of sediment. These dFe data can be described by a simple model that invokes a source from shelf sediments, horizontal mixing, and removal by first-order chemical scavenging. In the summer there is also a large dFe flux over the shelf, although the source is glacial meltwater, evidenced by the co-occurrence of high dFe concentrations with reduced surface-water salinity.

Interestingly, we see little evidence of redox-induced dFe release from margin sediments. This is indicated by the summer concentrations of Mn, Al and Fe, which all reveal near-bottom maxima, suggestive of sediment resuspension, and surface-water maxima from glacial meltwater, suggested by their co-occurence with reduced salinity.

By contrast, inferences derived from published dust flux estimates, and from published dFe profiles at Ocean Station Papa (50N, 145W), suggest dust dominates dFe inputs to surface waters of the central subarctic north Pacific.