Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20769

Investigating the lability and carbon complexation of glacially-derived iron particulates at the West Antarctic Peninsula

RHIANNON JONES[1], JON HAWKINGS[2], TOHRU ARAKI[3], MAJID KAZEMIAN[3], BURKHARD KAULICH[3], MAEVE LOHAN[1] AND AMBER ANNETT[1]

[1]University of Southampton
[2]University of Pennsylvania
[3]Diamond Light Source

Presenting Author: R.L.C.Jones@soton.ac.uk

Iron (Fe) is a limiting nutrient for primary production in large areas of the global ocean, including much of the Southern Ocean. However, high-Fe waters are found along the West Antarctic Peninsula. Here, iron (Fe) is delivered to the water column by Fe-rich glacial meltwaters and coastal shelf sediments. The bioavailability of Fe is partly dictated by its speciation; Fe^{2+} is largely more bioavailable than Fe^{3+}, but has a very short half-life in oxygenated seawater. The presence of organic carbon can stabilise Fe^{2+} in the water column, potentially enabling utilisation and export offshore. Using Fe L-edge (700-730eV) and Carbon K-edge (280-320 eV) NEXAFS (Near Edge X-ray Absorption Fine Structure) spectroscopy and STXM (Scanning Transmission X-ray Microscopy) at the Diamond Light Source Ltd., we determine the Fe speciation and potential organic carbon co-association of particles sampled from surface waters in three bays along the West Antarctic Peninsula, each influenced by meltwater from marine and/or land-terminating glaciers.

The acquired Fe spectra demonstrate heterogeneity in the oxidation state of Fe in particulates both between each bay, and between the glacier-proximal and glacier-distal sites at each bay. At two bays, Marian Cove and Borgen Bay, a higher abundance of Fe(II) at the glacier-proximal site correlates with higher dissolved Fe concentrations and meltwater contributions. Notably, the highest proportion of Fe(II) in particulates was observed proximal to the land-terminating Fourcade Glacier in Marian Cove, King George Island. Here too, the strongest evidence for organic carbon complexation of these Fe(II)-rich particles was observed. In contrast, surface waters in Sheldon Cove, Ryder Bay, indicated a lower dissolved Fe concentration, lower abundance of Fe-rich particulates, and a higher proportion of Fe(III)-bearing particulates proximal to the glacier.

The observed difference in Fe speciation and carbon co-association proximal to a land-terminating glacier and a marine-terminating glacier likely has implications for the bioavailability and transport of Fe supplied to the euphotic zone across the Antarctic Peninsula as glaciers continue to retreat. Stabilised particulates, rich in Fe(II) and exported offshore, may have an impact upon the delivery of bioavailable dissolved Fe to the Fe-limited Southern Ocean.