Increased bioavailability of iron in frozen environments

Iron is an essential micronutrient for the growth of living organism on Earth. The bio-availability of iron has been regarded as a crucial limiting factor for the phytoplankton productivity and involved in the sequestration of atmospheric carbon di-oxide(CO_2), especially in HNLC(High Nutrients Low Chlorophyll) regions such as Southern Ocean. Although the bioavailability and fate of iron in aquatic environments has been intensively investigated, those in frozen environments have rarely studied. In this study, the generation of dissolved iron from particulate iron oxides in ice phase was investigated both in the absence and presence of irradiation. The dissolution of iron oxides in frozen sample was significantly accelerated compared to those in aqueous solution. The outdoor experiments carried out under ambient solar radiation of Ny-lesund (Svalbard, 78 55'N) and King George Island (62°13′S 58°47′W, sea level) also confirmed that the production of bio-available iron species is enhanced when iron oxides are trapped in ice. We speculated that the freeze concentration of iron oxide particles, protons, and organic ligands in ice grain-boundaries could be the plausible reason for the enhanced dissolution of iron oxides in ice phase. These results imply that the iron oxides particles trapped in frozen environments (snow, glacier, ice-cloud particles, permafrost) provide more bio-available iron to the environments when it melt.

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