An evaluation of iron bioavailability and speciation in western Lake Superior with the use of combined physical, chemical, and biological assessment

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ABSTRACT: An iron-dependent cyanobacterial bioreporter (*Synechococcus* strain KAS101) was used in unison with size-fractionated iron content (>0.45, <0.45, <0.02 µm), and chemical characterization of iron complexation (C18 resin column) to elucidate the bioavailable forms of iron present in Lake Superior during periods of inverse thermal stratification (May) and strong thermal stratification (September) of the water column. The results provide evidence of organic complexation of iron in Lake Superior waters. Iron in most sampled water was complexed by organic compounds that behaved like fulvic acids, whereas some samples showed evidence for the presence of siderophore-like compounds. The presence of dissolved organic matter suppressed the cellular luminescence of the bioreporter, indicating an increased iron bioavailability. This effect could result either from the presence of siderophores forming iron complexes that are bioavailable to the bioreporter, or from more indirect effects because of the presence of other organic compounds, such as fulvic acids or polysaccharides. Model ligand additions, iron bioaccumulation, and photo-oxidation of dissolved organic matter were used to assess the bioavailability of organically complexed iron to the bioreporter. A significant fraction of the iron (40-100%) was bioavailable to the bioreporter. Iron bioavailability was high enough for the bioreporter not to be iron limited in the water collected from Lake Superior. This measure of bioavailability to picocyanobacteria is relevant because picoplankton accounted for the majority of chlorophyll a in Lake Superior during this study.

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