



Iron uptake and physiological response of phytoplankton during a mesoscale Southern Ocean iron enrichment

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ABSTRACT: Iron supply is thought to regulate primary production in high nitrate, low chlorophyll (HNLC) regions of the sea in both the past and the present. A critical aspect of this relationship is acquisition of iron (Fe) by phytoplankton, which occurs through a complex series of extracellular reactions that are influenced by Fe chemistry and speciation. During the first in situ mesoscale Fe-enrichment experiment in the Southern Ocean (Southern Ocean iron release experiment [SOIREE]), we monitored the uptake of Fe by three size classes of plankton and their ensuing physiological response to the Fe enrichment. Rates of Fe uptake from both inorganic Fe (Fe³⁺) and organic Fe complexes (FeL) were initially fast, indicative of Fe-limitation. After Fe enrichment phytoplankton down-regulated Fe uptake and optimized physiological performance, but by day 12 they had greatly increased their capacity to acquire Fe from FeL. The increase in Fe uptake from FeL coincided with a sixfold decrease in Fe³⁺ that followed the production of Fe-binding organic ligands. Phytoplankton were able to use organically bound Fe at rates sufficient to maintain net growth for more than 42 d. Adaptation to such shifts in Fe chemistry may contribute to bloom longevity in these polar HNLC waters.

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