Influences of organic Fe-binding ligands on natural phytoplankton growth in the western subarctic Pacific

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The influence of organic ligands on natural phytoplankton growth was investigated in high-nitrate low chlorophyll (HNLC) waters and during a phytoplankton bloom induced by a mesoscale iron enrichment experiment (SEEDS II) in the western subarctic Pacific. The growth responses of the phytoplankton in the treatments with iron complexed with model ligand were compared with those with inorganic iron or a control. Desferrioxamine B and protoporphyrin IX were used as models for hydroxamate-type siderophore and tetrapyrrole-type cell breakdown ligand, respectively. In the HNLC water, iron associated with protoporphyrin IX especially stimulated smaller phytoplankton (<10 μm) growth, 1.5-fold more than did inorganic iron, suggesting that these cell breakdown ligands might be more bioavailable for them. The protoporphyrin IX's stimulatory effect on small phytoplankton was also observed during bloom initiation and development phases, whereas not observed during steady and decline phases. The growth of phytoplankton was inhibited in the treatment with desferrioxamine B-complexed iron, suggesting its low bioavailability for the natural phytoplankton community. Its inhibitory effects were particularly pronounced in pico-eukaryotic phytoplankton. During the iron-induced bloom, the phytoplankton's iron-stress response gradually increased with the desferrioxamine B concentration, suggesting that the competition for iron complexation between natural ligands and desferrioxamine B affected phytoplankton growth. However, the nano-eukaryotes and cryptophytes did seem better able to utilize the desferrioxamine B-complexed iron during the bloom-developing phase. These results indicate that the iron bioavailability for phytoplankton differs between bloom-developing and bloom-decline phases.

Keywords: Organic ligand, Iron, Phytoplankton, Western subarctic Pacific, Desferrioxamine B, Protoporphyrin IX

