Copper requirements for iron acquisition and growth of coastal and oceanic diatoms

Peers, Graham, Sarah-Ann Quesnel, Neil M. Price

Limnol. Oceanogr., 50(4), 2005, 1149-1158 | DOI: 10.4319/lo.2005.50.4.1149

ABSTRACT: Centric diatoms isolated from open ocean environments require higher concentrations of Cu for growth than their coastal counterparts. In artificial seawater medium containing <1 nmol L^{-1} Cu, three coastal species maintained near maximum rates of growth, but the oceanic clones were unable to survive. Copper limitation was more severe in the diatoms grown in low- than in high-Fe seawater, suggesting that Cu and Fe were interacting essential resources. The interactive effect was in part the result of a Cu requirement for Fe transport. *Thalassiosira weissflogii* and *Thalassiosira oceanica* had lower Fe quotas and slower rates of Fe uptake when [Cu] was reduced in the medium. Brief exposure of Cu-limited cells to 10 nmol L^{-1} Cu increased the instantaneous Fe uptake rate by 1.5 times in *T. oceanica*. Steady-state uptake rates of both species at high, growth-saturating concentrations of Fe were also Cu dependent. Oceanic species appeared to have an additional Cu requirement that was independent of Fe acquisition and likely responsible for their higher requirements compared to coastal species. Evidence for the importance of Cu in natural communities of phytoplankton was obtained from an incubation experiment performed in the Fe-limited basin of the Bering Sea. Addition of 2 nmol L^{-1} Cu doubled the phytoplankton net growth rate compared to the untreated controls and, in the presence of extra Fe, increased the growth rate compared to the samples amended with Fe alone. The results suggest that Cu may be an important micronutrient for phytoplankton growth in low-Fe regions of the sea because of its role in Fe acquisition. Paradoxically, oceanic diatoms may be more susceptible to the effects of low Cu concentrations than coastal species.

Article Links

Download Full-text PDF

Return to Table of Contents