Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33370

Interdependent Effects of Cell Size and Copper Speciation on Growth of Cu-limited Phytoplankton

MEIZHEN LI AND NEIL PRICE

McGill University

We grew five species of marine phytoplankton ranging in diameter from 0.9 to 13 µm under Cu-limiting conditions to test the bioavailability of synthetic organic Cu complexes (Cu-L) and inorganic Cu species (Cu'). Growth rates (µ) were constrained by the rate of diffusion of Cu' to the cell surface relative to the cellular Cu requirements for growth and varied with cell size according to theoretical predictions. Large cells were relatively more Cu-limited than small cells in low Cu medium (0.5 nM Cu) and compensated by upregulating a reduction-based, high affinity Cu uptake system that enabled direct use of the Cu-organic complexes. When [Cu'] was insufficient, growth rates of the species were hyperbolic functions of [Cu-L], with half saturation constants in the low nanomolar range that varied directly with cell volume. Increasing [Cu'] also increased the growth rates of the species, so that both Cu-L and Cu' were bioavailable. The expression levels of the CTR and FRE genes involved in the Cu uptake pathway were strongly inversely correlated with the species relative growth rates (μ/μ_{max}) under Cu-limitation ($p < 0.05$), implying that use of Cu-L was enhanced by increasing Cu deficiency and regulated in a similar way in all the phytoplankton species. Our results suggest that cell size could affect the use of different Cu chemical species in the ocean with larger species relying disproportionally on Cu-organic complexes for growth.