Iron requirements of the pennate diatom Pseudo-nitzschia: Comparison of oceanic (high-nitrate, low-chlorophyll waters) and coastal species

Marchetti, Adrian, Maria T. Maldonado, Erin S. Lane, Paul J. Harrison

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ABSTRACT: We quantified and compared physiological parameters and iron requirements of several oceanic *Pseudonitzschia* spp., newly isolated from the high-nitrate, low-chlorophyll waters of the northeast subarctic Pacific, with coastal *Pseudo-nitzschia* spp. and the oceanic centric diatom *Thalassiosira oceanica* at a range of iron concentrations. In iron-replete conditions, the iron (Fe) : carbon (C) ratios in the six Pseudo-nitzschia isolates ranged from 157 µmol Fe mol C^{-1} to 248 µmol Fe mol C^{-1}, with no apparent differences between oceanic and coastal isolates. In low iron conditions, all *Pseudo-nitzschia* spp. exhibited marked reductions in photosynthetic efficiency, whereas the extent of the reductions in specific growth rates varied among species. When iron-limited, the Fe :C ratios decreased significantly in all oceanic *Pseudo-nitzschia* species, with the lowest ratios ranging from 2.8 µmol Fe mol C^{-1} to 3.7 µmol Fe mol C^{-1}. Combined with faster growth rates, lower Fe :C ratios in oceanic isolates of *Pseudo-nitzschia* resulted in significantly higher iron-use efficiencies relative to their coastal congeners and *T. oceanica*. The wide range between iron-replete (Fe-Q_{high}) and iron-limited (Fe-Q_{low}) quotas indicates that oceanic *Pseudo-nitzschia* spp. have an extensive plasticity in iron contents relative to other diatoms grown at similar iron concentrations reported in the literature; the Fe-Q_{high} : Fe-Q_{low} ratios for oceanic species were 46 to 67, whereas for coastal *Pseudo-nitzschia* species they were 16 and 43. We suggest that the ability of oceanic *Pseudo-nitzschia* species to exhibit an extensive growth response to iron enrichment events may, in part, be a result of their extraordinary capacity to accumulate and potentially store large amounts of intracellular iron when iron concentrations are high, yet substantially reduce their iron requirements to sustain fast growth rates well after external iron concentrations are depleted.