Growth rates, half saturation constants, and silicate, nitrate, and phosphate depletion in relation to iron availability of four large open-ocean diatoms from the Southern Ocean

Timmermans, Klaas R., Bas van der Wagt, Hein J. W. de Baar

Limnol. Oceanogr., 49(6), 2004, 2141-2151 | DOI: 10.4319/lo.2004.49.6.2141

ABSTRACT: Four large, open-ocean diatoms from the Southern Ocean (*Actinocyclus* sp., *Thalassiosira* sp., *Fragilariopsis kerguelensis*, and *Corethron pennatum*) were grown in natural (low iron) Southern ocean seawater with increasing Fe concentrations. With increasing dissolved iron (Fe_{diss}) concentrations, the growth rates increased three- to sixfold. The species with the smallest cells had the highest growth rates. The half-saturation constants (Km) for growth were low (0.19-1.14 nmol L^{-1} Fe_{diss}), and close to the ambient Fe_{diss} concentrations of 0.2 nmol L^{-1}. The range in K_m with respect to Fe_{diss} also varied with the size of the diatoms: the smallest species had the lowest K_m and the largest species had the highest K_m. As Fe_{diss} concentrations decreased, silicate consumption per cell increased, but nitrate consumption per cell decreased. Phosphate consumption per cell varied without clear relation to the dissolved iron concentrations. The differences in nutrient consumption per cell resulted in marked differences in elemental depletion ratios in relation to Fe_{diss}concentrations, with the depletion ratios being most affected by iron limitation in the largest cells. These experimental findings are in agreement with previous laboratory and field studies, showing the relatively high requirements of large diatoms for Fe. The size-dependent response of the diatoms with respect to nutrient depletion is a good illustration of the effects of Fe on silicate, nitrate, and phosphate metabolism.