A general kinetic model for iron acquisition by eukaryotic phytoplankton

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ABSTRACT: The conventional model of iron uptake in marine eukaryotic phytoplankton□the Fe' model□suggests a dependency of uptake rate on the concentration of unchelated iron species (Fe'), and not the concentration of total iron or iron chelated with organic ligands. However, iron in seawater is bound by strong organic ligands that buffer such low Fe' concentrations that they should not support phytoplankton growth. Studies that show uptake and extracellular reduction of siderophore-bound iron by diatoms and provide indications that the iron uptake system of phytoplankton may be similar to that of yeast in which extracellular reduction is a prerequisite for uptake, call for revisions of the Fe' model. In this paper we propose a new model for iron uptake by diatoms in which extracellular reduction of all Fe species is a necessary step for iron acquisition. Experiments verifying the predictions of the model are presented. In particular we show data supporting the fact that Fe(II) is formed as an intermediate during Fe uptake from all experimental media, including those buffered by Fe(III)EDTA. This model reconciles the standing Fe' model with new data and concepts on reduction of iron chelates and provides a convenient framework for designing and interpreting iron uptake experiments in a variety of natural and artificial media.