Impact of algal exudate on iron redox transformations

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Algae are known to secret organic ligands to their surrounding environment in order to obtain essential micronutrients by conversion of the nutrient into a bioavailable form. Iron is an example of an essential element whose bioavailability may be increased via interaction with algal exudate.

In this study, the impact of exudate from *Microcystis aeruginosa* on iron speciation in the dark at pH 8 was investigated. In order to avoid the background influence of organics and iron, the culture at stationary phase was resuspended in ligand and iron free medium for 2 days with this period being long enough for release of exudate yet avoidance of cell lysis. Experimental results revealed the production of long-lived reductants capable of reductively dissolving amorphous ferric oxide in ligand-free medium at neutral pH which promoted iron uptake by Fe-deficient algae. In addition to the presence of a reductant, an additional ligand was found to be present which accelerated the rate of oxidation of Fe(II). A mathematic model based on these two-ligand types was established in order to describe the interaction between iron and the algal exudate. Cyclic voltametric methods revealed that the redox behavior of the algal-derived exudate similar to quinone or quinone-like substances. The use of high performance liquid chromatography (HPLC) and nuclear magnetic resonance (NMR) allowed the identification of functional groups present in these algal exudate.