

Superoxide-mediated reduction of ferric iron in natural aquatic systems

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Superoxide, the one-electron reduced form of oxygen, is generated in aquatic systems either by the action of light on natural organic matter [1] or by action of oxidoreductase enzymes in the outer cell-membrane of aquatic and terrestrial plants [2,3]. This reactive oxygen species is an effective reductant of Fe(III) and, as such, can induce both the reduction of organically complexed Fe(III) to the ferrous form [4] and, in some instances, the reductive dissolution of amorphous ferric oxyhydroxides [5].

In this presentation, both the extent of superoxide production by both biotic and abiotic (photochemical) processes in natural systems will be described as will the kinetics and mechanism of ferric iron reduction under various conditions of geochemical interest. Additionally, consideration will be given to the potential environmental significance of superoxide production in natural systems with regard particularly to the impact on iron bioavailability and the mobilisation of both contaminants and nutrients adsorbed to particulate iron oxyhydroxides.

References

- [1] Rose, A.L., Waite, T.D. (2006) Role of superoxide in the photochemical reduction of iron in seawater *GCA* 70 (in press).
- [2] Oguchi, K., Tanaka, N., Komatsu, S. And Akao, S. (2004) Characterisation of NADPH-dependent oxidoreductase induced by auxin in rice *Physiol. Plant.* 121, 124-131.
- [3] Rose, A.L., Salmon, T.P., Lukondeh, T., Neilan, B.A. and Waite, T.D. (2005). Use of superoxide as an electron shuttle for iron acquisition by the marine cyanobacterium *Lyngbya majuscula*. *Environ. Sci. Technol.* 39, 3708-3715.
- [4] Rose, A.L. and Waite, T.D. (2005). Reduction of organically complexed ferric iron by superoxide in a simulated natural water. *Environ. Sci. Technol.* 39, 2645-2650.
- [5] Fujii, M., Rose, A.L., Waite, T.D. and Omura, T. (2006) Superoxide-mediated reductive dissolution of amorphous ferric oxyhydroxide in seawater. *Environ. Sci. Technol.* 40, 880-887.