Biotic acquisition of iron: A role for catalytic reduction of Fe(III) minerals by Fe(II)

ANNALEISE R KLEIN[1]*, DARREN S BALDWIN[2], EWEN SILVESTER[1]

[1]Department of Ecology, Environment, and Evolution (DEEE), La Trobe University, Albury-Wodonga Campus, Victoria, Australia, 3690 (*correspondence: a.klein@latrobe.edu.au)

2The Murray Darling Freshwater Research Centre (MDFRC), CSIRO Land and Water, La Trobe University, Albury-Wodonga Campus, Victoria, Australia, 3690

Microorganisms have developed two main strategies for gaining iron: ligand production (siderophores), and redox cycling (reductive iron uptake) [1]. In light of recent studies showing the highly dynamic nature of iron oxides in the presence of Fe(II) (conveyor belt mechanism) [2], we investigated how this process may couple with the redox cycling of iron to overcome barriers for Fe-dissolution and subsequent microorganism uptake of Fe. To do this we explored the interaction of Fe(II) with iron oxide (hydrous ferric oxide; HFO) in the presence of an iron complexing ligand (EDTA group), taking into account the influence of the addition sequence, Fe(II) concentration, pH, and Fe(III)-ligand binding strength.

We show that Fe(III) is released into solution at a much faster rate in the presence of Fe(II) when compared with direct ligand-promoted dissolution (in the absence of Fe(II)). The total concentration of Fe(III) released is similar to that in control experiments, indicating that Fe(II) only influences the rate of dissolution, and not the equilibrium position. Most significantly, only relatively small amounts of Fe(II) are required to enhance the dissolutin rate, suggesting a catalytic mechanism.

We propose that the observed rate enhancement most likely occurs via the conveyor belt recrystallisation of the HFO substrate and represents a pathway by which aquatic biota could rapidly acquire iron from Fe-mineral substrates under neutral pH conditions. Conditions suitable for this mechanism to operate would occur at redox boundaries (e.g. biofilms) and may represent an extemely important part of Fe acquisition under Fe-limiting conditions.

[1] Lis *et al*. (2015) *Life* **5**, 841-860. [2] Handler *et al*. (2009) *Environ. Sci. Technol*. **43**, 1102-1107.