

Effect of DFOB and SRFA on Fe(III) release and Cr(III) desorption from goethite

ANGELA G. STEWART^{1,2}, KAREN A. HUDSON-EDWARDS¹
AND WILLIAM E. DUBBIN^{2*}

¹Department of Earth and Planetary Science, Birkbeck,
University of London, Malet St., London WC1E 7X, UK

²Earth Sciences Department, Natural History Museum,
Cromwell Road, London SW7 5BD, UK

(*Correspondence: b.dubbin@nhm.ac.uk)

Desferrioxamine B (DFOB) is an hydroxamate siderophore secreted by micro-organisms in response to Fe stress. DFOB shows considerable affinity not only for Fe(III) [$K_{\text{Fe}}^{(\text{III})}_{\text{HDFOB}^+} = 10^{32.0}$] [1] but also for Cr(III) [$K_{\text{Cr}}^{(\text{III})}_{\text{HDFOB}^+} = 10^{33.0}$] [2]. Thus, in Cr(III) contaminated soils and sediments, DFOB may figure prominently in the mobilisation of Cr(III). Furthermore, the ubiquitous presence of fulvic acid may influence DFOB activity. The experimental objective was to determine the mechanisms and rates of Cr(III) desorption and Fe(III) release from Cr(III)-treated synthetic goethite as influenced by DFOB, by SRFA (Suwannee River), and by the two organic compounds in combination.

Our data show (i) Fe(III) release from Cr(III)-treated goethite is significantly lower than that from untreated synthetic goethite; (ii) the presence of either DFOB or SRFA alone increased the solubilisation of both Cr(III) and Fe(III); (iii) DFOB together with SRFA act synergistically to mobilise Cr(III) and Fe(III). We propose a model whereby adsorbed SRFA lowers the goethite surface charge thus increasing DFOB surface excess and its subsequent chelation of Fe(III) and Cr(III). This model is supported by FTIR data which show that, during complexation of Fe(III) and Cr(III) by DFOB at the goethite surface, the Fe(III) and Cr(III) share the hydroxamate group. Frequency bands of hydroxamate C=O, 1568 cm^{-1} Fe-DFOB and 1600 cm^{-1} Cr-DFOB were observed. This study elucidates the role of DFOB and SRFA on desorption of Cr(III) and dissolution of Fe(III) in Cr(III) contaminated environments.

[1] Krufft et al. (2013) *Journal of Inorganic Biochemistry* **129**, 150-161. [2] Duckworth et al. (2014) *Environ. Sci. Processes Impacts* **16**, 1348-1359.