Environmental Science & Technology Letters, 1(10), 387-392

Ubiquitous Presence of Fe(II) in Aquatic Colloids and Its Association with Organic Carbon

Bjorn P. von der Heyden,*,† Emily J. Hauser,‡ Bhoopesh Mishra,§ Gustavo A. Martinez,‖ Andrew R. Bowie,⊥,# Tolek Tyliszczak,@ Thato N. Mtshali,∇ Alakendra N. Roychoudhury,† and Satish C. B. Myneni‡

† Department of Earth Sciences, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa

‡ Department of Geosciences, Princeton University, Princeton, New Jersey 08544, United States

§ Physics Department, Illinois Institute of Technology, Chicago, Illinois 60616, United States

‖ Crops and Agroenvironmental Department, College of Agricultural Sciences, University of Puerto Rico, Mayagü ez, Puerto Rico

⊥Antarctic Climate and Ecosystems CRC, Private Bag 80, Hobart, Tasmania 7001, Australia

Institute of Marine and Antarctic Studies, University of Tasmania, Private Bag 129, Hobart, Tasmania 7001, Australia

@Advanced Light Source, Lawrence Berkeley National Laboratory, University of California, Berkeley, California 94720, United States

∇Council for Scientific and Industrial Research, P.O. Box 320, Stellenbosch 7600, South Africa

Abstract

Despite being thermodynamically less stable, small ferrous colloids (60 nm to 3 μm in diameter) remain an important component of the biogeochemical cycle at the Earth's surface, yet their composition and structure and the reasons for their persistence are still poorly understood. Here we use X-ray-based Fe L-edge and carbon K-edge spectromicroscopy to address the speciation and organic–mineral associations of ferrous, ferric, and Fe-poor particles collected from sampling sites in both marine and freshwater environments. We show that Fe(II)-rich phases are prevalent throughout different aquatic regimes yet exhibit a high degree of chemical heterogeneity. Furthermore, we show that Fe-rich particles show strong associations with organic carbon. The observed association of Fe(II) particles with carboxamide functional groups suggests a possible microbial role in the preservation of Fe(II). These finding have significant implications for the behavior of Fe(II) colloids in oxygenated waters, and their role in different aquatic biogeochemical processes.