

Existence, formation, and role of soluble organic-Fe(III) complexes in the biogeochemical cycling of iron in sediments

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The rate of hydrolysis of Fe(III) is so high at circumneutral pH that Fe(III) is generally assumed to be under the form of Fe(III) oxides in most aquatic environments. The solubility of Fe(III), however, is enhanced by complexation with organic ligands, and organic-Fe(III) complexes have been detected in a variety of freshwater and coastal marine sediments even several centimeters below the maximum oxygen penetration depth. In this study, the existence of these complexes in deep-sea sediments is confirmed, suggesting that they may be ubiquitous in iron-rich environments. These complexes may be formed by a variety of mechanisms, including aerobic oxidation, non-reductive dissolution of Fe(III) oxides, and aggregation of nanoparticulate material in the presence of organic ligands. A general mechanism for the chemical formation of these complexes and their reactivity will be proposed based on experiments performed in the laboratory. Finally, the role of these complexes in sediment biogeochemistry will be demonstrated using examples from field and laboratory studies.