

Dissolution of Goethite by Catechol: Adsorption and Surface Complexes

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The growth of marine phytoplankton is limited by a lack of dissolved iron. Iron is stable as ferric hydroxides in the ocean where iron have extremely low solubility. Micro-organisms living in iron deficient aquatic environments excrete ferric specific organic ligands, called siderophore. Dissolution of iron hydroxides by siderophore have not been studied very much, while uptake of ferric-siderophore complexes by micro-organisms have been studied extensively. Characteristics of iron (hydr)oxides dissolution by organic ligands, for example pH dependence of dissolution rates, is important in biogeochemistry and mineral surface chemistry. In this study, dissolution of goethite by catechol which is one of specific organic ligands for siderophore was examined. Dissolution of goethite by catechol increased from 1.2×10^{-8} to 2.2×10^{-8} (mol/hr/m²) as pH

increased from 5 to 9. Adsorption density of catechol on goethite for batch adsorption experiments during 3 hours increased from 3.1×10^{-7} to 7.0×10^{-7} (mol/ m²) as pH values increased from 5 to 8. Attenuated Total Reflection (ATR)-Fourier transform infrared spectroscopy (FTIR) was used to analyse adsorbed catechol on goethite in aqueous condition. ATR-IR spectra of adsorbed catechol at $5 < \text{pH} < 9$ did not have C-O-H bending mode which was similar to that of tris(ferric)catecholate complex (pH=9.9), indicating adsorption of catechol goethite surface in the bidentate form. Zeta-potential of goethite was lowered at $5 < \text{pH} < 9$ when catechol adsorbed on its surface. We suggest that the pH dependence on dissolution rates of goethite by catechol is mainly affected by adsorption density, and not by difference of surface complex species.