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Kinetics and Mechanisms of Nickel Sorption/Dissolution at Soil Mineral Surfaces Employing Atomic Force Microscopy
Cinétique et mécanismes de l'adsorption et de la dissolution du nickel sur les surfaces minérales des sols par l'AFM

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Surface precipitation of metals an mineral surfaces as a sorption mechanism has recently become an area of great interest in soil and environmental sciences. A definitive understanding of surface precipitate formation and dissolution mechanisms on natural materials is necessary to accurately predict the fate of metals in the environment. To conclusively ascertain these mechanisms, it is imperative that in-situ molecular approaches be employed. X-ray absorption fine structure (XAFS) spectroscopic studies have extensively shown that polynuclear Ni/Al complexes form on the surfaces of clay minerals and metal oxides. It appears that the mechanim for this phenomenon is related to metal promoted dissolution of Al from the mineral surfaces. However, this mechanism needs further confirmation. Additionally, it has been observed that mononuclear surface precipitates form on surfaces (i.e., quartz) that do not contain potentially hydrolyzable trivalent cations. Very limited research has been done to observe the dissolution mechanisms of polynuclear complexes. This study will employ a nondestructive, in-situ method, scanning force microscopy (SFM), and batch studies to examine the formation and dissolution of Ni(II) precipitates on pyrophyllite (Al2Si4O10(OH)2, talc (Mg3Si4O10(OH)2 and quartz (alpha-SiO2). Scanning force microscopy operates by placing a chemically etched probe near a surface and monitoring the attractive and repulsive forces applied to the probe to generate 3-D computer images of the surface. The sorption kinetics will be conducted at surface loadings well below monolayer coverage and at pH ranges below which one would expect the formation of Ni(OH)2(s) according to its thermodynamic solubility product. The dissolution kinetics will employ a variety of dissolution agents (EDTA, HNO3, low molecular weight organic acids, and acetylacetone) to observe the mechanisms and rates of Ni(II) removal from the mineral surfaces.

Keywords : AFM, kinetics, dissolution, surface precipitation, Ni, metals
Mots clés : AFM, cinétique, dissolution, précipitation de surface, Ni, métaux