

XPS and XAS investigation of Sb(V) reduction on mackinawite: Effect of pH and surface loading

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Sb exists in nature in a wide range of oxidation states and can be a potential hazardous contaminant depending on its speciation and reactivity. In this study we employed cryogenic-XPS and XAS techniques in order to understand the reduction of Sb^V at the surface of mackinawite (FeS) as a function of pH and surface loading.

Experimental Conditions

Nanoparticulate, Mackinawite samples were prepared and stored as suspensions under strictly anoxic conditions (~ 1 ppmv O₂) in a Jacomex glovebox. Sorption experiments at pH 5 and pH 8 with increasing Sb concentrations (0.1, 0.3, 0.6, 0.8 mM) were also conducted in the same glovebox under anoxic conditions [1, 2]. X-ray Photoelectron Spectroscopy (XPS) and X-ray Absorption Spectroscopy (XAS) measurements were conducted on frozen wet pastes of reacted mackinawite samples.

Results and Discussion

Sb3d XPS spectra of reacted sample series at pH 5 revealed presence of increasing amounts of Sb^{III} at the surface suggesting that the rate of reduction of Sb^V was directly proportional to surface loading. Corresponding Fe 2p and S 2p spectra of the same samples showed significant increase in the proportion of Fe^{III} species and presence of S⁰ at the surface. However, the proportion of S⁰ remained constant suggesting that Fe is the dominant redox partner in this system. At pH 8, presence of Sb^{III} was only observed at higher surface loadings indicating that adsorption and redox processes both occur at much slower rate compared to that at pH 5. In addition, increased contribution of surface monosulfide group at pH 5 suggest that Sb is most likely bound to S atoms at the surface, which was confirmed by Sb K-edge EXAFS spectra. In contrast, at pH 8, such increase in surface monosulfide contributions are absent, suggesting Sb is most likely bound to O atoms at the surface.

[1] Scheinost, *et al.* (2008) *J. Contam. Hydrol.* **102**, 228–245.

[2] Kirsch, *et al.* (2008) *Mineral. Mag.* **72**, 185–189.

An oxygen isotopic study of the lac cinquante Uranium deposit, Nunavut, Canada: Implications for mineralization and exploration

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The Lac Cinquante uranium deposit is located in the Kivalliq district of Nunavut, Canada, approximately 350 km west of Rankin Inlet. The deposit is hosted in Archean greenstones that are unconformably overlain by the northeast trending Angikuni sub-basin in the Western Churchill Province. In this study we present results from whole-rock oxygen stable isotopes in silicates and the implications for alteration and mineralization of the main ore zone at Lac Cinquante.

Oxygen isotope analyses are combined with bulk rock major- and trace-element geochemistry, thin section petrography and powder bulk-rock mineralogy. This comprehensive multi-technique approach of geochemical and mineralogical techniques aid in defining an alteration halo around the main zone of mineralization in the deposit and additionally provide signatures that may be unique to mineralized zones.

The extent, cause, and timing of alteration can be utilised as an exploration vector by identification of the alteration halo in drill core that may be proximal to the ore zone. This is expected to help refine future drill targets. Additionally, the alteration halo characteristics can be used to test historic drill core and identify sections of high-grade zones that were previously intersected. This technique can also be used to test drill core from holes that are associated with geophysical targets in the region not directly associated with the main zone of mineralization.