

Use of X-ray Absorption Spectroscopy to Distinguish Between Inner And Outer-sphere Pb Adsorption Complexes on Montmorillonite

D. G. Strawn

Adsorption behavior of Pb on montmorillonite as a function of pH was highly dependent on ionic strength. At $I = 0.1\ M$ the removal of Pb from solution increased from $\sim 40\%$ to $\sim 80\%$ at $\text{pH} = 6$ and $\text{pH} = 7$, respectively. This pH dependent behavior suggests inner-sphere complexation on the functional groups at the edges of the montmorillonite. At $I = 0.002\ M$ Pb adsorption was less dependent on solution pH, with $\sim 97\%$ removed from solution at $\text{pH} = 4$ and nearly 99% removed from solution at $\text{pH} = 7$. The lack of pH dependence at $I = 0.002\ M$ suggests that adsorption is primarily via an outer-sphere mechanism. The XANES spectrum of Pb sorbed on montmorillonite at $\text{pH} = 4.40$ ($I = 0.002\ M$) was similar to the XANES spectrum of a Pb^{2+} (aq) sample, suggesting that the adsorbed Pb is coordinated by water molecules. At $\text{pH} = 6.40$ ($I = 0.002\ M$ and $I = 0.1\ M$) the XANES spectra for Pb sorbed on montmorillonite are similar to a Pb solution containing predominantly $[\text{Pb}_4(\text{OH})_4]^{4+}$ complexes, indicating that sorbed Pb is predominantly coordinated by OH^- ligands.