28 - Spectroscopic evidence of mixed divalent metal layered double hydroxide phase formation from the co-sorption of Fe(II) and Zn with Al-bearing mineral substrates

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Layered double hydroxide (LDH) precipitates form from reactions between divalent metals (e.g. Ni, Co, Fe, and Zn) and Al-bearing substrates, and are naturally occurring. Mixed divalent metal LDH phases have also been found in natural environments. The objective of the study was to examine sorption kinetics and product speciation of co-sorption reactions of Fe(II) and Zn(II) with Al-bearing substrates using X-ray absorption spectroscopy (XAS) to determine if mixed divalent metal LDH phases form. XAS can examine element-specific structural information for reactions between metals (e.g. Fe and Zn) and mineral substrates at the mineral-water interface and can distinguish oxidation states. Batch reactions were performed under strictly anoxic conditions between 0.8 mM Zn and 3 mM Fe and either 10 g/L pyrophyllite or 7.5 g/L γ-Al_2O_3 at pH 7.5. The Fe K-edge χ data (Figure 1) show the formation of green rust and Fe(II)-Al(III)-LDH from Fe(II)/Zn co-sorption reactions with pyrophyllite and γ-Al_2O_3, respectively. The presence of structural Fe(III) impurities within the pyrophyllite resulted in the formation of a green rust, rather than a Fe(II)-Al(III)-LDH. The Zn K-edge χ data (Figure 1) show the formation Zn(II)-Al(III)-LDH in all reactions. The results suggest that a mixed divalent metal LDH forms from co-sorption reactions between Fe(II), Zn, and Al-bearing substrates. This study is important in understanding, modeling, and predicting the trace metals' fate in environmental systems, and in developing remediation strategies.

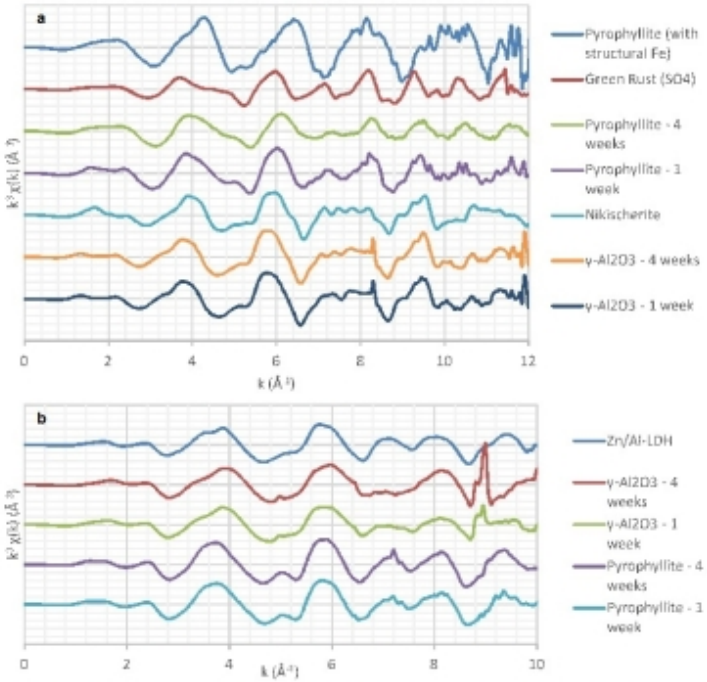

Figure 1: Fe K-edge (a) and Zn K-edge (b) χ data for co-sorption reactions of 3 mM Fe and 0.8 mM Zn with γ-Al_2O_3 or pyrophyllite for reaction times of 1 week and 4 weeks. The Fe standards pyrophyllite, nikischerite, and green rust (SO_4) and the Zn standard synthetic Zn(II)-Al(III)-LDH are also provided.

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