The influence of chloride and sulfate on Cu and Zn adsorption on goethite

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Metal mobility in natural environments is controlled by aqueous speciation of metals, dissolution and precipitation reactions, and/or metal adsorption onto mineral and organic surfaces, and well controlled experiments in simplified chemical systems are necessary to understand more complex natural environments. We measured the adsorption of Cu^{II} and Zn^{II} in 0.1-5 *m* NaCl and 0.001-1 *m* Na_2SO_4 with batch experiments at 25°C and pH 2-9.5. Cu and Zn adsorption was greater in NaCl solutions when compared to Na_2SO_4 solutions at pH < 7.5 (Figure 1). For example, at 0.5 *m* NaCl and pH 6.5, all dissolved Cu^{II} was adsorbed on goethite, whereas approximately 20% less was adsorbed in 0.01 *m* Na_2SO_4 at the same pH. In contrast, zinc adsorption was greater in Na_2SO_4 solutions than NaCl ones at pH < 7.5. Metal-chloride surface complexes such as $\equiv SOCuCl^0$ and $\equiv SOZnCl_2^-$ (where ≡SO represents the underlying goethite surface) are predicted to dominate over aqueous chloride complexes and are responsible for the enhanced adsorption of copper and zinc in NaCl solutions, whereas in Na_2SO_4 solutions, copper and zinc sulfate aqueous complexes suppress adsorption. Results of our experiments indicate that increased NaCl is likely to decrease the dispersion of copper and zinc during weathering, whereas high sulfate concentrations, such as those present in acid sulfate soils and acid rock drainage, will increase the dispersion of these metals. Fitted thermodynamic properties for the adsorption reactions can be used to predict the transport of dissolved Cu and Zn in oxidised regolith and other environments.

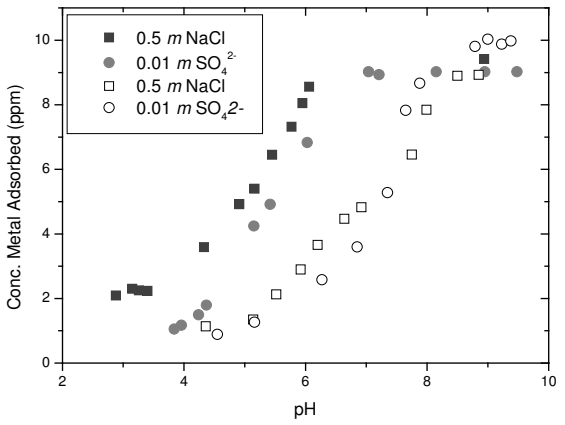

Figure 1: Adsorption of Cu^{II} (solid symbols) and Zn^{II} (hollow symbols) onto synthetic goethite in NaCl and Na_2SO_4 solutions at 25°C.