

# **From fresh to saltwater: the influence of salinity on the adsorption and retention of heavy metals to iron oxyhydroxide nanoparticles**

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Historic mining of gold and other precious metals in California has contributed to a legacy of toxic metal pollution that poses significant potential health and environmental risks. Long after many mines have ceased operations, acid mine drainage (AMD) events still mobilize highly acidic and heavy metal-rich waters into freshwater ecosystems. Naturally occurring nanoparticles are ubiquitous in these aquatic environments and play significant roles in the cycling of trace metals and metalloids. Iron oxyhydroxides, specifically goethite ( $\alpha$ -FeOOH), are of particular interest as they form readily in AMD environments. Past studies have found that salinity plays an important role in nanoparticle metal sorption and retention capabilities and is particularly relevant in understanding the fate of sorbed metals when transferred downstream from contaminated sites to marine waters [1].

In this study, the influence of artificial seawater on the adsorption and retention of dissolved metal ions to iron oxyhydroxide nanoparticles is investigated. Macroscopic batch uptake experiments were conducted with some of the most common toxic metals found in California acid mine drainage (Cd, Cu, Pb, Zn). Metals were adsorbed to goethite at a pH of 7.0 to model maximum sorption in circumneutral waters. Following this adsorption step, artificial seawater was added to the metal-sorbed goethite suspensions in concentrations ranging from 0-70 g/L, representing between 0-200% of the average salinity of seawater. Metal ion desorption was then induced by lowering the pH to 5.0 to serve as an assay for quantifying the fraction of adsorbed metal that remained strongly retained at the mineral-water interface. Supernatants were analyzed using inductively coupled plasma optical emission spectrometry (ICP-OES) for their dissolved metal concentrations. Extended X-ray absorption fine structure (EXAFS) spectroscopy was applied to select samples to determine changes in metal coordination environment under the increased salinity conditions. This combination of methods can provide insight into metal ion fate and transport across the freshwater-seawater continuum.

[1] Chesne, R.B. & Kim, C.S. (2014), *Geochem Trans* 15, 6.