

# Metal attenuation processes in an aquifer: Laboratory tests and reactive transport modeling

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Laboratory reaction tests and reactive transport modeling were conducted to evaluate geochemical interactions between a mine seepage water and an aquifer, primarily focusing on metal attenuation processes in the aquifer. The results for the reaction tests, in which the mine seepage water was reacted with the aquifer materials, showed the increases in pH, alkalinity, Ca, and Mg and the decreases in Fe, SO<sub>4</sub>, and metals (i.e., Al, Cd, Co, Cr, Cu, Mn, Ni, and Zn), suggesting dissolution of carbonate minerals and precipitation of secondary minerals containing metals.

The reaction mechanisms governing geochemical interactions between the mine seepage water and the aquifer, which were suggested from the reaction tests, include acid neutralization, mineralogical control on major ions, and control on trace metal mobility by secondary mineral precipitation and sorption. These conceptual reaction networks were incorporated into the multi-component reactive transport model MIN3P [1, 2]. The data collected at the mine site were used to constrain the initial chemistry of the seepage and groundwater and the mineralogical composition of the aquifer materials.

The simulation results showed that the pH in the aquifer was primarily controlled by dissolution of a series of carbonate and hydroxide minerals, as shown in Jurjovec *et al.* [3], and most metals in the seepage water were decreased to non-detectable levels by precipitation of secondary hydroxides, carbonates, and sulfides. After 100 years of simulation time, all of the important geochemical changes occurred within the 180 m distance from the point where infiltration intersects the groundwater table. Thus, the results indicate that the aquifer has a high buffering capacity due to the existence of carbonate minerals (calcite and ankerite) and the natural attenuation processes could be significant. This study provides a comprehensive understanding of reactive transport processes of heavy metals derived from acid mine drainage.

[1] Mayer *et al.* (2002) *Water Resour. Res.* **38**, 1174. [2] Jeen *et al.* (2013) *J. Contam. Hydrol.* **144**, 108-121. [3] Jurjovec *et al.* (2002) *Geochim. Cosmochim. Acta* **66**, 1511-1523.