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# Effects of Saturation Index, Ion Competition, and Salinity on As and Cr Coprecipitation into Barite ($BaSO_4$)

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Engineered systems, e.g., oil and gas operations and geothermal energy power plants, often produce saline wastewaters rich in $Ba^{2+}$ and other hazardous metals. One proposed treatment method involves adding $Na_2SO_4$ to produce barite ($BaSO_4$) solid solutions that coprecipitate with the hazardous ions. Here, we examine coprecipitation of toxic As and Cr anions into barite. We conducted experiments with varying saturation indices (SI) of $BaSO_4$, $BaHAsO_4$, and $BaCrO_4$, ranging from 0.37 to 3.27, -2.22 to 0.18, and –2.94 to 2.74, respectively. Experiments were conducted with no NaCl and at 1.0 M NaCl. As, Ba, and Cr concentrations were measured using inductively coupled plasma-atomic absorption spectroscopy (ICP-AES).

Experiments showed that higher $SIBaSO_4$ produced more solids that removed fewer trace ions. Low $SIBaSO_4$ resulted in greater total As and Cr removal, suggesting slower nucleation and growth may cause inclusion of more trace elements into the solid. When comparing As and Cr trace ion coprecipitation into solid solution, the less soluble solid $BaCrO_4$, incorporated more readily into $BaSO_4$ solid solution than the more soluble $BaHAsO_4$ phase. Removal of As increased with the product of the individual mineral saturation indices, $SIBaHAsO_4$ with $SIBaSO_4$, suggesting dependence on both saturation indices. Similarly, Cr removal increased with the product of SIBaCrO4 and $SIBaSO_4$ when $SIBaCrO_4$ was low. At higher $SIBaCrO_4$, Cr removal decreased with the product of $SIBaCrO_4$ and $SIBaSO_4$. Furthermore, high salinity conditions favored coprecipitation of trace elements into $BaSO_4$.