

Uptake of $\text{Pb}^{2+}_{(\text{aq})}$ by baryte-celestine solid-solution crystals: implications for the uptake of Ra^{2+}

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The interaction of dissolved toxic metals with minerals frequently leads to dissolution-coprecipitation processes in which the metal ion incorporates into the solid phase substituting for the major ion in lattice positions. The fact that the solubility of a minor constituent in a solid solution is smaller than the solubility of its equivalent pure solid explains the environmental relevance of these reactions. Interaction studies are typically carried out by using stoichiometric minerals as host phases. However, in most cases the effectiveness of this removal mechanism could be significantly increased using suitable solid-solutions instead of pure minerals. In this work we study the interaction of Pb-bearing aqueous solutions with baryte (BaSO_4), celestine (SrSO_4) and intermediate members of the $(\text{Sr},\text{Ba})\text{SO}_4$ solid solution (20%, 36% and 88% molar Sr).

Compositionally homogeneous crystals of the solid solution were obtained by precipitation & aging in a closed reactor at 90°C. The obtained precipitates were checked for compositional homogeneity by considering the full width at half maximum intensity values (FWHM) of some selected reflections of the XRD patterns. The precipitate compositions were determined by analyzing the remaining solutions by ICP-AES and the precipitates by SEM-EDS.

The interaction experiments were carried out in closed reactors at 25°C. The aqueous composition was analyzed repeated times during the experiments, which lasted one month. In the case of the interaction with strontian baryte, lead incorporates into the solid phase while some barium and a large proportion of strontium incorporate to the aqueous solution. As result the aqueous solution becomes depleted in lead at a significantly greater extent than during the interaction with pure baryte or celestite. The effect of adding different concentrations of Pb^{2+} (0.05, 0.1 and 0.2 mM) and varying amounts of solid (0.1, 0.2, 0.4 g) was reported.

Future work will deal with the implementation of an equilibrium model for the $(\text{Pb},\text{Sr},\text{Ba})\text{SO}_4\text{-H}_2\text{O}$ system. An added implication is related to the effectiveness of Sr-bearing baryte as a sequestering phase for radium. The interaction with baryte leads to a significant removal of dissolved Ra^{2+} , but the depletion could be considerably greater using strontian baryte.