Partitioning of Fission Products (Cs, Sr and I) into Salt Phases

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The Waste Isolation Pilot Project (WIPP) is a nuclear waste repository located in SE New Mexico, USA. The repository is hosting TRU waste and future disposal in similar sites may accept waste containing fission products (FPs). Should groundwater intrude such a repository and mobilize FPs, the transport of Cs, Sr and I may be limited by partitioning into salt phases, such as carnallite [$KMgCl_3 \cdot 6H_2O$], langbeinite [$K_2Mg_2(SO_4)_3$], leonite [$K_2Mg(SO4)_2 \cdot 4H_2O$], polyhalite [$K_2Ca_2Mg(SO_4)_4 \cdot 2H_2O$], gypsum [$CaSO_4 \cdot 2H_2O$], and sylvite [KCl]. We report experimentally determined partitioning of non-radioactive isotopes of Cs, Sr and I between salt phases and solution as a function of temperature and concentration of target elements.

Experiments were carried out at temperatures from 28 to 90°C. Saturated solutions were evaporated to induce mineral growth. Concentrations of Cs, Sr and I were added to solution between 100 to 1,000 ppm, except for sylvite experiments, in which concentrations of 1,000 and 5,000 ppm were required. Concentrations (ppm) of major, minor and trace elements were determined by ICP-MS, -AES and IC (SO_4^{2-} and I^-). Concentrations of Cs, Sr and I (ppm) in crystals were determined by electron microprobe analysis (EMPA) and the distribution of these elements in solids imaged by time-of-flight secondary ion mass spectrometry (ToF-SIMS).

Previous investigations [1, 2] quantified partitioning of Cs into carnallite and sylvite. Our results are consistent with previous work with distribution coefficients for Cs between carnallite and solution between 0.5 and 1.5. The distribution of I between carnallite and solution correlates inversely with temperature with values between 0.05 and 0.3. Partioning of Cs and I between sylvite and solution is ≤ 0.05 and ~0.20, respectively. The distribution of Cs between leonite and solution is ~1.0.

[1] Schock & Puchelt (1971) *Geochim. Cosmochim. Acta* **35**, 307-317. [2] Schock (1966) *Contrib. Min. Petrol.* **13**, 161-180. This research is funded by WIPP programs administered by the Office of Environmental Management (EM) of the U.S Department of Energy. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. This research was supported by the Salt R&D Programs administrated by the Office of Nuclear Energy, U.S. Department of Energy.