Chemistry of Water Collected from an Unventilated Drift, Yucca Mountain, Nevada

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The chemical composition of water that may be present in the emplacement drifts is a key issue for the isolation of high-level radioactive waste in a proposed mined geologic repository at Yucca Mountain, Nevada. Chemical constituents in water that may contact waste containers may affect rates of corrosion of the container materials. Long-term simulations of the in-drift chemical environment rely on ambient water chemistry, heat perturbations, and the interaction of ambient water with the engineered barriers (e.g. waste containers) and other introduced materials (e.g. rock bolts). In an attempt to induce seepage in the Enhanced Characterization of the Repository Block Cross Drift, bulkheads were constructed to isolate part of the 2.7-km-long drift from active ventilation. The bulkheads were closed and active ventilation ceased for periods up to 454 days. After opening the bulkheads, water was observed in small puddles on plastic sheets and on rubber conveyor belt surfaces; droplets of water were observed on many surfaces of various construction-related introduced materials. Mold or fungal colonies also were present. The puddles of water were sampled seven times from January 2003 to June 2005; most samples appeared yellow to brown. The water samples were analyzed for major and trace constituents by using ion chromatography and inductively-coupled plasma mass spectrometry. Total dissolved solids (TDS) in the puddle-water samples

ranged from 195 to 22,000 milligrams per liter (mg/L) and pH ranged from 4.2 to 8.9; these values are different from ambient pore-water samples extracted from adjacent rock (TDS < 1,400 mg/L and pH from 6.7 to 8.2). The chemical composition of the puddle-water samples is dominated by sodium and chloride, also different from the pore-water samples, which are dominated by sodium, calcium, and bicarbonate. Zinc concentrations ranged from 0.5 to 3,100 mg/L, substantially greater than the less than 0.1 mg/L values measured in pore water. Some of the chemical constituents measured in the puddle-water samples can be traced to interaction with the construction-related introduced materials. The isotopic composition of strontium in the puddle-water samples also indicates a source from introduced materials. Understanding the origin of the unusual chemistry of the puddle waters will facilitate the selection of materials for use in emplacement drifts, and will enhance predictability of the in-drift chemical environment during the post-closure time period. This study was done by the U.S. Geological Survey, in cooperation with the U.S. Department of Energy, under Interagency Agreement DE-AI28-02RW12167.