Strontium Isotopes in Pore Water as an Indicator of Water Flux At the Proposed High-Level Radioactive Waste Repository, Yucca Mountain, Nevada

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The proposed high-level radioactive waste repository at Yucca Mountain, Nevada, would be constructed in the high-silica rhyolite (Tptp) member of the Miocene-age Topopah Spring Tuff, a mostly welded ash-flow tuff in the ~500-m-thick unsaturated zone. Strontium isotope compositions have been measured in pore water centrifuged from preserved core samples and in leachates of pore-water salts from dried core samples, both from boreholes in the Tptp. Strontium isotope ratios ($^{87}Sr/^{86}Sr$) vary systematically with depth in the surface-based boreholes. Ratios in pore water near the surface (0.7114 to 0.7124) reflect the range of ratios in soil carbonate (0.7112 to 0.7125) collected near the boreholes, but ratios in the Tptp (0.7122 to 0.7127) at depths of 150 to 370 m have a narrower range and are more radiogenic due to interaction with the volcanic rocks (primarily non-welded tuffs) above the Tptp. An advection-reaction model relates the rate of strontium dissolution from the rocks with flow velocity. The model results agree with the low transport velocity (~2 cm per year) calculated from carbon-14 data by I.C. Yang (2002, App. Geochem., v. 17, no. 6, p. 807-817). Strontium isotope ratios in pore water from Tptp samples from horizontal boreholes collared in tunnels at the proposed repository horizon have a similar range (0.7121 to 0.7127), also indicating a low transport velocity.

Strontium isotope compositions of pore water below the proposed repository in core samples from boreholes drilled vertically downward from tunnel floors are more

varied, ranging from 0.7112 to 0.7127. The lower ratios (<0.7121) indicate that some of the pore water in these boreholes was replaced by tunnel construction water, which had an $^{87}Sr/^{86}Sr$ of 0.7115. Ratios lower than 0.7115 likely reflect interaction of construction water with concrete in the tunnel inverts, which had an $^{87}Sr/^{86}Sr < 0.709$. These low Sr ratios indicate penetration of construction water to depths of ~20 m below the tunnels within three years after construction, a transport velocity of ~7 m per year. These studies show that construction activities locally may alter the characteristics of the ambient hydrologic system at Yucca Mountain. This work was performed in cooperation with the U.S. Department of Energy.