Geochemistry of Natural Components in the Near-Field Environment, Yucca Mountain, Nevada

Zell E. Peterman[1] and Thomas A. Oliver[2]

[1]U.S. Geological Survey, Denver, Colorado
[2]S.M. Stoller Corporation, c/o U.S. Geological Survey, Denver, Colorado

The natural near-field environment in and around the emplacement drifts of the proposed nuclear waste repository at Yucca Mountain, Nevada, includes the host rock, dust, seepage water, and pore water. The chemical compositions of these components have been analyzed to provide a basis for assessing possible chemical and mineralogical reactions that may occur in and around the emplacement drifts during the heating and cooling cycle. The crystal-poor rhyolite of the Topopah Spring Tuff of Miocene age with an average silica (SiO_2) content of 76 percent will host the proposed repository. Samples of the rhyolite are relatively uniform in chemical composition as shown by an average coefficient of variation (CV) of 8.6 percent for major elements. The major component of underground dust is comminuted tuff generated during construction of the tunnel. Average CVs for major elements of dust samples collected from the main tunnel (Exploratory Studies Facility, ESF) and a cross drift (Enhanced Characterization of the Repository Block, ECRB) are 25 and 28 percent, respectively. This increased variability is due to a variable amount of dust derived from trachyte with SiO_2 contents as low as 66 percent (from overlying crystal-rich members) and from surface dust with an even lower average SiO_2 content of 60 percent (from the abundance of trachyte in outcrop and carbonate dust derived from nearby ranges). The composition of the water-soluble fraction of dust is of interest with regard to possible salt deliquescence on waste canisters. The nitrate-to-chloride (NO_3^-/Cl^-) ratio (weight) is used to assess the potential corrosive nature of the salts because an excess of NO_3^- over Cl^- may inhibit the formation of the more corrosive calcium chloride brines in deliquescing salts. The soluble fractions of dust samples typically have NO_3^-/Cl^- ratios between 1 and 10. About 30

samples of seepage into the south ramp of the ECRB have an average NO_3^-/Cl^- of 0.62. Pore water extracted from core samples of the repository host rock has lower NO_3^-/Cl^- ratios with an average value of 0.28 and a range over two orders of magnitude. Of all the components of the natural system, pore water has the largest compositional variability with an average CV of 62 percent, and thus, is the most difficult to characterize. Because pore water is extracted from dry-drilled core, its solute content may have been increased by evaporation during drilling, handling, storage, and extraction by ultracentrifugation. Further, microbial activity in the core during storage may reduce the concentration of NO_3^- thus decreasing the NO_3^-/Cl^- ratio. Therefore, the more dilute pore water samples might be considered the most representative of native pore water with NO_3^-/Cl^- ratios close to unity or greater.