

## ANALYSIS OF YUCCA MOUNTAIN PORE-WATER CHEMICAL DATA

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### RESEARCH OBJECTIVES

Distribution of chemical constituents in the unsaturated zone (UZ) system of Yucca Mountain, Nevada, depends on many factors, such as hydrological and geochemical processes of surface precipitation, evapotranspiration, the water-fracture-matrix interactions, large-scale mixing via lateral flow and transport, and history of climate changes. This study analyzes the pore-water chemical concentration data and models the transport processes. The model results are then used to calibrate the UZ model, particularly, to refine the bounds on infiltration rates and percolation fluxes to the potential repository.

### APPROACH

Major chemical data used in this study were pore-water chloride (Cl) concentrations and  $^{36}\text{Cl}/\text{Cl}$  isotopic ratios in pore waters. The sensitivity of these conservative tracers to infiltration rate is well known. These constituents were directly incorporated into a three-dimensional dual-permeability flow model. Chemical transport properties, such as molecular diffusion, mechanical dispersion and radioactive decay were taken into account. The boundary condition of the chemical was given by its surface flux. The flux was determined by the total amount of precipitation reaching the surface and chemical concentrations in the precipitation. The entire flow system was divided into domains based on the distribution of pore-water chemical data, infiltration data and hydrogeological and hydrostructural features. Model calibration proceeded by adjusting the site-scale infiltration map to reach a satisfying agreement between the simulated subsurface chemical distribution and measured chemical data in each region. An analytical solution of convection-diffusion was also applied for qualitative analysis and model validation.

### ACCOMPLISHMENTS

The model results of pore-water chemical distribution are compared with the measured data. The results using the calibrated infiltration map are more favorable than those using the one without calibration. The analytical solution was also able to capture major Cl and background  $^{36}\text{Cl}/\text{Cl}$  trends under conditions of transient Cl input. Although close on average, the infiltration map calibrated by pore-water chemical data indicates less spatial variation and a smoother distribution of infiltration rates than the one without calibration. Figure 1 shows the model results of pore-water Cl concentrations, by both 3-D simulation and analytical solution, against the measured data at the ECRB (Enhanced Characterization of the Repository Block) station. The simulation results using the infiltration map without calibration are also shown in the same figure for comparison.

### SIGNIFICANCE OF FINDINGS

The percolation flux at the potential high-level nuclear waste repository is one of the main issues in the UZ study. The long-term performance of the repository is determined in part by the timing of subsurface fluid percolation. Percolation flux strongly depends on the infiltration rates and their spatial and temporal distributions. This refined infiltration data is therefore

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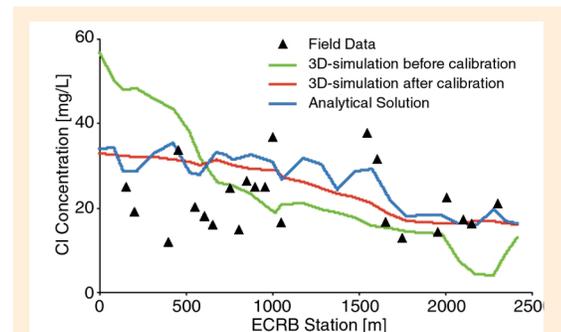


Figure 1. Observed and simulated chloride (Cl) values in the cross drift.

useful for further study of percolation flux, flow pathways and transport time, and can also be important for future integrated repository assessment.

### RELATED PUBLICATIONS

Liu, J., Analysis and modeling of pore-water chemical data, Analysis/Model Report "UZ Models and Flow Models," Section 6.4, MDL-NBS-HS-000006, Lawrence Berkeley National Laboratory, 2000.

### ACKNOWLEDGEMENTS

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