

## Deliquescence relative humidity of salt mixtures: An experimental and thermodynamic study

ROBERTO T. PABALAN AND LIETAI YANG

Center for Nuclear Waste Regulatory Analyses, San Antonio, Texas, USA (rpabalan@swri.org; ltyang@swri.org)

Evaporation of water seeping into the drift of a proposed geologic repository at Yucca Mountain, Nevada, and deposition of aerosol and dust from ventilation air may lead to the accumulation of multicomponent salt deposits on the surfaces of drip shields, waste packages, and ground support materials (e.g., rock bolts, wire mesh, and steel sets). Inorganic salts are generally hygroscopic and will deliquesce, i.e., absorb moisture from humid air, if the relative humidity in the environment reaches the deliquescence relative humidity (DRH) of the salt or salt mixture. Salt deliquescence would generate small volumes of brines that are potentially corrosive to the metallic materials. The deliquescence behavior of multicomponent salts is complicated and depends on temperature and mixture composition, but experimental data are sparse. In this study, the DRHs of salt mixtures in the system Na-K-Ca-Mg-Cl-NO<sub>3</sub> were measured as a function of temperature (20 to 85°C). Two measurement methods were employed, one using a hygrometer and the other using conductivity cells inside a controlled temperature/humidity chamber. To facilitate the calculation of the DRHs of multicomponent mixtures, a thermodynamic approach based on the Pitzer ion interaction model was used, with model parameters derived from the literature or from the experimental data. The DRHs of single salts and salt mixtures were calculated and compared with experimental data. A comparison of preliminary experimental data and calculated values for some single salts is shown in Figure 1. The results of the study will be used to evaluate the chemistry of water contacting the drip shields, waste packages, and ground support materials in the proposed Yucca Mountain repository and the time and temperature during which corrosion of the metallic materials initiates.

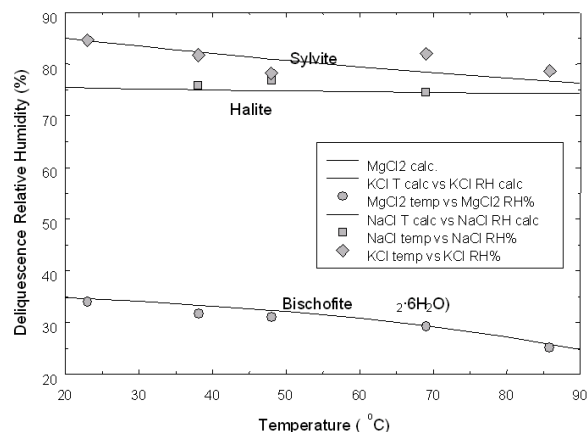


Figure 1. Measured (symbols) and calculated (lines) deliquescence relative humidity of single salts.

## Influence of the saturation state on the rates of plagioclase weathering

F.A.L. PACHECO<sup>1</sup> AND C.H. VAN DER WEIJDEN<sup>2</sup>

<sup>1</sup>Geology Department, Trás-os-Montes and Alto Douro University, 5000 Vila Real, Portugal

<sup>2</sup>Department of Geochemistry, Faculty of Earth Sciences, Utrecht University, P.O. Box 80.021, 3508 TA Utrecht, The Netherlands.

### Objective

The objective of this work is to investigate the influence of solute concentrations originated from sources such as atmospheric salts or farmland fertilizers on the rates of plagioclase weathering.

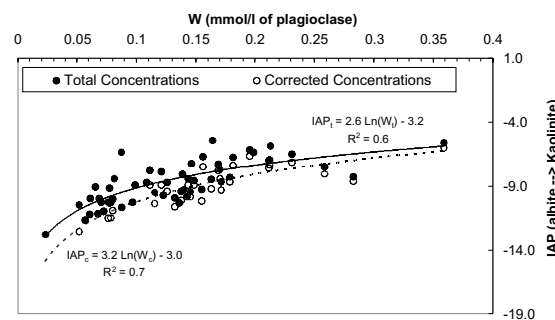
### Study Area, Data and Model Approach

In the Vouga river hydrographic basin (central Portugal), a number of spring waters have been collected from granite environment and analysed for their major inorganic constituents (Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>, HCO<sub>3</sub><sup>-</sup>, Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup> and H<sub>4</sub>SiO<sub>4</sub>). Regarding the cations, 60% of the concentrations may on average be attributed to sources other than mineral weathering.

Using the SiB model (Pacheco and Van der Weijden 1996), we associated the chemistries of the springs mostly with the alteration of albite into kaolinite.

### Results and Discussion

The Ion Activity Products (IAP) of the springs for the weathering of albite into kaolinite were calculated twice, considering the total and the corrected for contamination concentrations. The relations between the IAPs and the calculated by the SiB model plagioclase mole fractions (*W*) are shown below and have been fitted to logarithmic functions.



The figure suggests that for the same saturation state, the *W* values are higher when corrected concentrations are used. In the present case, when combining the two IAP equations in the figure, the following relation between *W<sub>t</sub>* (total concentrations used) and *W<sub>c</sub>* (corrected concentrations used) is obtained:

$$W_c \sim W_t^{1.23}$$

### Reference

Pacheco, F.A.L. & Van der Weijden, C.H. (1996). *Water Resour Res*, 30, 3553-3570.