

## Isotopic compositions of aqueous fluid inclusions in calcite from Yucca Mountain, NV, USA

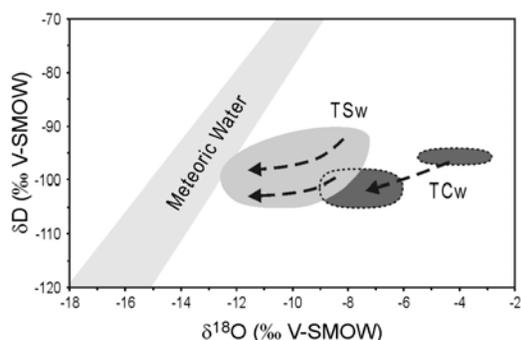
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Calcite in open cavities in the vadose zone of Yucca Mountain, Nevada, USA, has been interpreted as the result of meteoric infiltration over the last 10 Ma [1]. If correct, primary fluid inclusions in this calcite represent natural samples of the Late Miocene to Pleistocene meteoric waters.

Aqueous inclusions from 6 samples from two hydrologic units and different depositional settings were studied using a continuous-flow IRMS technique [2]. In each sample, inclusions were analyzed from 2 to 3 growth zones (2-4 aliquots each). Fluid inclusion homogenization temperatures ( $T_h$ ) were also determined. The  $\delta D$  values were measured, and the  $\delta^{18}O$  values were both measured and calculated from  $\delta^{18}O_{cat}$  and  $T_h$ . All  $\delta D$  values measured in this study fall within the -105 to -90 ‰ interval. The paired  $\delta^{18}O$ - $\delta D$  values exhibit a strong, 2 to 10 ‰, positive  $^{18}O$ -shift away from the meteoric water line (Figure 1). The shift was greater for a sample from shallow hydrologic unit (TCw), and smaller for samples from deeper unit (TSw). The data require high-temperature isotopic water-rock exchange, and are inconsistent with the presumed meteoric (direct infiltration) origin of the Yucca Mountain calcite [1].



**Figure 1:** Isotope compositions of water trapped in fluid inclusions in calcite from shallow (TCw) and deep (TSw) hydrologic units of Yucca Mountain. Arrows show temporal trends. The TSw field is from 4 samples.

[1] Whelan *et al.* (2008) *Appl. Geoch.* **23**, 1041–1075.

[2] Dublyansky & Spötl (2009) *EGU2009-7971-1*.

## Nickel sorption on chlorite: Batch experiments and modeling

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Modeling and predicting the sorption behavior of radionuclides under repository conditions is important for safety analysis of a final repository for nuclear waste. Geochemical retention of radionuclides in the bedrock is commonly quantified by the empirical  $K_d$  approach. A process based quantification would be better suited to demonstrate conceptual understanding of the retention, and for predictive modeling of sorption properties at various geochemical conditions.

Sorption of nickel onto chlorite is considered here. Nickel, present as an activation product, will contribute to the radiotoxicity of the nuclear waste. Chlorite is a dominant fracture filling material within the bedrock in which the Swedish final repository is planned to be built.

In this study, batch experiments using two different chlorites, from Karlsborg, Västergötland, and Taberg, Värmland, Sweden, at pH 6.0, 7.4, and 8.3 for different nickel concentrations ( $10^{-9}$  –  $10^{-7}$  M) were carried out. A surface complexation model was adopted from the literature [1], tested and modified using the experimental data of the two chlorites, with different chemical composition and specific surface area. We propose that the model can be applied to predict sorption on other, similar chlorites.

[1] Zazzi, Jakobsson & Wold (2009) Nickel(II) sorption on natural chlorite (submitted).