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Na- and Cs-exchange in a clinoptilolite-rich rock: Analysis of the outgoing cations in solution

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ABSTRACT

Batch cation-exchange experiments were performed by placing 4 g of clinoptilolite-rich rock into 100 mL of 1 *M* concentrations of NaCl or CsCl solution for differing times and temperatures. The solutions were analyzed for the outgoing cations Na, K, Ca, and Mg by ICP-AES. The goal of these experiments was to determine the behavior (i.e., effect of temperature, release rate, and time) of Na, K, Ca, and Mg exchanging out of the solid and into the liquid in either NaCl or CsCl solutions. For the Na-exchanged samples, the concentration of the outgoing divalent cations increased with time and increased temperature, with the majority of the exchange occurring in the first 10 h. Potassium behaved in a different manner, with approximately 20% exchange occurring within 0.5 h. With increased exchange time, K concentrations actually decreased slightly, indicating some re-exchange back into the solid from the liquid. After 24 h, samples in the four storage conditions averaged approximately 20% K, 80% Ca, and 50% Mg exchange out of the sample and into the liquid. For the Cs-exchanged samples, the concentration of the outgoing divalent cations increased with time and increased temperature, with the majority of the exchange occurring in the first 10 h. The outgoing monovalent cations behaved in a different, and somewhat unpredictable, manner. The majority of the exchange for both Na and K occurred within the first 0.5 h. Increased time had little effect on exchange; in fact, both exhibited some re-exchange back into the liquid. Also, more exchange occurred at lower than higher temperatures. With increased exchange time, K concentrations decreased slightly, indicating some re-exchange back into the solid from the liquid. After 24 h, samples in the four storage conditions averaged approximately 85% Na, 50% K, 80% Ca, and 40% Mg exchange out of the sample and into the liquid.