

Controls of Copper Isotope Fractionation

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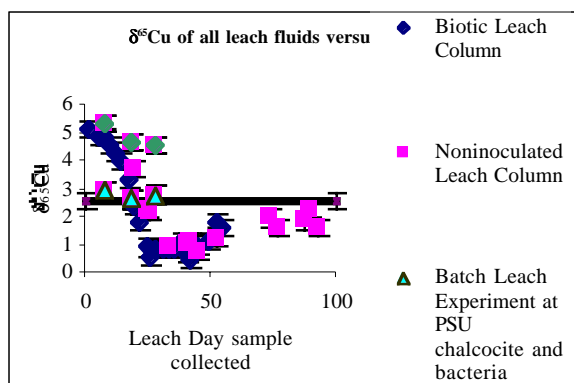
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Studies of copper isotope variations show that naturally occurring copper sulfides have variations of up to seven permil, which is a much larger variation than that shown for iron isotopes in natural systems. As with most, if not all, stable isotope systems in nature, the variations in isotope ratios are probably caused by inorganic processes as well as

biologically aided reactions. In order to determine the magnitude of isotope fractionation caused by organic versus inorganic processes, we have measured the isotope fractionation in experiments with and without bacteria and in benchtop to leach-pad scale. Our results indicate that inorganic process produce large positive shifts in copper isotopes. These reactions are controlled by the copper phase that is in equilibrium with the fluid. These large shifts are not observed in iron isotopes because there are fewer iron phases than copper phases in natural systems. to heavier copper in the eluted fluids. Biologically aided fractionation produces negative shifts in the copper isotopes during dissolution of sulfides.



Adsorption of ⁹⁰Sr and ¹³⁷Cs under elevated temperature and pressure conditions

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Introduction

Sorption and desorption kinetics have been studied in batch experiments conducted with radioactive acid (pH ≈ 3) solutions (containing ⁹⁰Sr and ¹³⁷Cs) under different temperature (T)/pressure (P) conditions (T=20 and 70 °C, and P=Patm and 3 MPa). Rock-samples were selected from a radioactively contaminated site associated with deep-well injection of the radioactive waste.

Results and discussion

The results showed a kinetic effect in the dissolution of carbonate minerals which influenced the radionuclide adsorption/desorption. A mathematical model was developed which explains the anomalous or unexpected character of the kinetic breakthrough (Figure 1). A possible reason for the presence of a concentration minimum is the competition of two reactions. During the first stage of the experiment, the rock adsorbs radionuclides actively, and hence a drop in the concentration function C(t) is observed. Later, the dissolution of the minerals leads to a saturation of the solution by the competing cation (e.g. Ca²⁺), which begins to displace the previously adsorbed radionuclide from the rock: its concentration in the solution begins to increase.

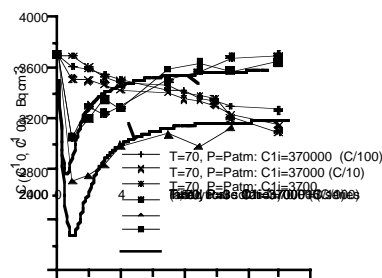


Figure 1: Adsorption of radiostrontium.

Conclusions

The studied problem deals with one of the most acute problems of environmental hydrogeology, namely a problem of a preferential flow through macropores of the subsurface, combined with a "fast transport" of radiostrontium.