Abstract

Halogens are powerful tracers of fluid sources in the crust, as different halogen reservoirs, such as evaporites, residual bittern brines, and magmatic fluids have distinct halogen ratios. However, being volatile elements, measuring halogens is challenging, especially in the absence of reliable fluid inclusions. Scapolite-group minerals, which are common metamorphic rock-forming minerals, have been recognized as useful archives of Cl, Br, and I, and importantly, experiments have shown that $D_{\text{fluid-mineral}}$ for the above halogens is ~1.

In this study we performed exchange experiments of Cl-Br partitioning in scapolite at lower brine concentrations (total brine concentration [mole fraction, X] ~0.2, ~0.3, ~0.4, ~0.5) than in previous experiments (~0.66) to test if $D_{\text{fluid-mineral}}$ remains ~1 during less "salty" fluid-mineral interactions. The experiments were run for 96h at 800˚C and 15kbar and ~10wt.% calcite was added to stabilize the meionite component in the scapolite. Scapolite, with minor calcite ± grossular, was found to be stable in all of the experiments that were run at the above conditions. For these experiments, we used scapolite with known compositions, including absolute CO_2 and halogen concentrations, in order to confidently distinguish reacted from non-reacted scapolite after the treatment. EPMA results show that new scapolite zones formed likely via dissolution-reprecipitation rather than via diffusion, given the sharp reaction interface between the parent and product phase. Cl-Br distribution coefficients will be presented and discussed as well as other compositional changes between the parent and product phases in order to determine if halogen ratios in scapolite are reliable fluid tracers under a broad range of fluid compositions.

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