

## **Strontium and magnesium isotope fractionation during hydrothermal seawater-basalt interaction**

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Fluid-rock interactions in hydrothermal systems at or near mid-oceanic ridges (MOR) play a major role in determining the composition of the oceanic crust and seawater. Our understanding of the rate and nature of these reactions is limited, however, by the paucity of natural samples. To help quantify the processes that govern cation exchange in these environments we have experimentally studied the isotopic evolution of  $^{87}\text{Sr}/^{86}\text{Sr}$ ,  $\delta^{88/86}\text{Sr}$  and  $\delta^{26/24}\text{Mg}$  in the fluid phase during seawater-basalt interaction at 250 and 290 °C.

Our results indicate that seawater Sr was incorporated into anhydrite during the early stages of seawater-basalt interaction. Fluid  $^{87}\text{Sr}/^{86}\text{Sr}$  values decreased towards the basaltic signature reflecting the interplay between fast Sr incorporation into secondary sulfates and the slow and continuous Sr liberation from basalt dissolution. This observation could partly explain previously identified discrepancies between MOR heat budget constraints and the marine  $^{87}\text{Sr}/^{86}\text{Sr}$  budget. Late-stage anhydrite re-dissolution is observed, likely caused by the fluid phase becoming more reducing through further basalt dissolution and by quenching of the experiments. This represents a potential explanation for the low amounts of anhydrite found in naturally altered oceanic basalt. A slight preference of anhydrite for isotopically heavy Sr suggests that changes in MOR spreading rates and Sr removal could be recorded in the isotope compositions of authigenic, sedimentary Sr phases.

The fluid  $\delta^{26/24}\text{Mg}$  composition mainly decreased during the experiments, with mass balance constraints indicating that isotopically heavy Mg was preferentially incorporated into clay minerals such as smectite. The direction and magnitude of this fractionation is similar to previously estimated values. Calculations suggest that the influence of clay formation on Mg isotopic signatures in marine hydrothermal systems is small compared to carbonate precipitation, in accord with previous estimates of marine Mg isotope fluxes.