

The impact of seafloor alteration on $\delta^{18}\text{O}$ and $\delta^{34}\text{S}$ of sulfates in the oceanic crust

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Sulfate (SO_4) is the major sulfur species in seawater with $\delta^{34}\text{S}$ of +21.24‰ [1]. Along mid-ocean ridges seawater SO_4 infiltrates the oceanic crust, whereas fluid emissions from hydrothermal vents in these settings mainly contain H_2S with $\delta^{34}\text{S}$ much lower than seawater [2]. The fate of seawater SO_4 within the oceanic crust is still highly debated [3,4] highlighting the need of a careful investigation.

This study aims to constrain the processes affecting the chemical and isotopic composition of sulfates (anhydrite) in the oceanic crust upon seafloor alteration. The sample set comprises anhydrite from seawater-dominated low- (~60-130°C, Surtsey, S Iceland) and high-temperature (~150-200°C, Reykjanes, SW Iceland) hydrothermal systems. The chemical composition, $\delta^{18}\text{O}$ and $\delta^{34}\text{S}$ of anhydrite was measured *in-situ* using EMPA and SIMS, respectively.

Geochemical isotope modelling was used to assess the major sources of sulphur (seawater, rock, gas) to the system and the processes affecting isotope systematics of anhydrite at various temperatures and upon fluid-rock interaction. Comparison of model results with our dataset reveals that deviations in $\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ of anhydrite from the original isotope composition of seawater SO_4 can be attributed to equilibrium isotope fractionation upon progressive seafloor alteration. Reduction of SO_4 to sulfide is limited at low temperature [5], whereas it is a significant source of sulfur at high temperatures. Sulfate reduction at high temperature and seawater-rock interaction may be significant sources of sulfur and greatly contribute to the modification of $\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ of the altered oceanic crust. Remelting of such modified crust within subduction zones could especially affect $\delta^{34}\text{S}$ of melts, volcanic gases and geothermal fluids in those settings.

[1] Tostevin *et al.* (2014), *EPSL* **396**. [2] Von Damm *et al.* (1985), *GCA* **49**. [3] Teagle *et al.* (1998), *EPSL* **155**. [4] Barker *et al.* (2010), *Chem Geol* **275**. [5] Gunnarsson-Robin *et al.* (2017), *JVGR* **346**.