Boron isotope behavior in ultramafic-hosted hydrothermal systems: nature vs. experiment

C.T. HANSEN[1*], L.E.M. SCHLICHT[1], E. P. REEVES[2], A. MEIXNER[1,3], S.A. KASEMANN[1,3], W. BACH[1]

[1]Faculty of Geosciences, University of Bremen, Germany (*correspondence: c.hansen@uni-bremen.de)

[2]Department of Earth Science & K.G. Jebsen Centre for Deep Sea Research, University of Bergen, Norway

[3]MARUM – Center for Marine Environmental Sciences, University of Bremen, Germany

We present the first boron isotope study of fluid samples collected from four natural hydrothermal vent sites along the Mid-Atlantic Ridge between the 15´20°N and the Marathon Fracture Zones (Logatchev, Ashadze II, Irinovskoe and Semenov-2), hosted in ultramafic crust. In addition, we present data of a batch experiment conducted at temperatures representative of high-T serpentinization (300 °C; 40 MPa), to determine B partitioning and isotope fractionation.

Serpentinization plays a key role in the B geochemical cycle in slow and ultra-slow spreading ridge settings, where detachment faulting exposes ultramafic rocks at the seafloor after they were hydrated by infiltrating seawater. Boron released upon the destruction of serpentinite in subduction zones also significantly affects the element cycle [1]. Serpentinization leads to strong B enrichment in the oceanic lithosphere. Considerable B enrichment in batch experiments (100 °C; 200 °C) showed that B partitioning and isotope fractionation are strongly controlled by temperature, pH, B coordination, water-rock-ratio, type of secondary minerals and B speciation in saline solutions [2,3].

The end-member fluids of all four vent sites are significantly depleted in B compared to bottom seawater, indicative of uptake by secondary minerals formed by serpentinization. The B isotopic composition of the fluids is lighter than bottom seawater, pointing to a preferred incorporation of the heavier isotope by secondary mineral phases. While B uptake is consistent with the experimental findings throughout, the observed isotope fractionation of the natural fluids deviates from earlier low-T serpentinization experiments [2] and will be discussed in light of the new high-T experimental data. Deeper understanding of B and B isotope uptake and fractionation processes is key to make better constraints on the impact of serpentinization on global mass fluxes.

[1] Hoog & Savov (2017) In: Marschall & Foster, *Springer*. [2] Hansen et al. (2017) *GCA* **217**, 51-79. [3] Pokrovski et al. (1995) *Chem. Geol.* **124**, 253-265.