High $\delta^{11}B$ secondary olivine suggests greater contribution from serpentinites to subduction zone dehydration fluids

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Seafloor serpentinites carry large volumes of water (~13 wt%) and fluid-mobile elements like B and Li into the mantle at subduction zones. Release of these fluids at depth during serpentine breakdown plays an important role in generating arc volcanism and volatile recycling. Boron isotopes are a powerful tracer of this process due to the large difference between mantle rock ($\delta^{11}B$ = -7‰), altered oceanic crust ($\delta^{11}B \approx$ -10 to +5‰) and serpentinite ($\delta^{11}B \approx$ +7 to +20‰). Here we report in situ SIMS data (Cameca 1270, calibrated using komatiite glass (for olivine) and serpentine standards) in serpentinites from HP ophiolites from the Alps and Spain, that show high but variable B (3.6-16.3 ppm) and $\delta^{11}B$ (+10.5 to +25.3 ‰) in metamorphic olivine formed by breakdown of antigorite (2.9-17.9 ppm B, $\delta^{11}B$ -0.3 to +28.5‰). In localities where $B_{ol} \geq B_{srp}$, $\Delta^{11}B_{ol-srp}$ = 0 to -12‰ (Monviso, Almirez, Voltri). The B excess in olivine is contrary to expectation[1] and is evidence of open system behaviour during serpentinite dehydration with low-$\delta^{11}B$ fluids sourced externally (from meta-sediments, oceanic crust or other serpentinites) occuring close to the subduction interface. In contrast, the one locality with $B_{ol} < B_{srp}$ (Zermatt-Saas) has $\Delta^{11}B_{ol-srp}$ = +12 ± 0.7‰. We conclude that this locality most closely approaches closed-system serpentine breakdown. The observed B isotope fractionation during serpentine breakdown is likely due to B coordination differences between olivine (trigonal) and serpentine (tetragonal)[2]. These results imply that serpentinite dehydration fluids will have lower B and $\delta^{11}B$ values than previously assumed, and thus a greater serpentinite contribution to magma sources is needed to create the B and $\delta^{11}B$ values observed in arc lavas.

[1] Tenthorey and Hermann (2004) *Geol.* **32**, 865–868; [2] Ingrin et al. (2014) *Am Mineral* **99**, 2138-2141