Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28032

Serpentinite dehydration in the subducted lithosphere produces no B isotopic fractionation

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Boron is a relatively fluid-mobile element, which is enriched in serpentinites, and its isotopes are a powerful tracer of fluid processes such as fluid production upon dehydration and subsequent fluid transfer. The $\delta^{11}B$ values of ocean floor and subducted serpentinites are mostly variably positive, whereas mantle wedge serpentinites show an isotopically lighter range of compositions, which has been attributed to serpentinisation by fluids derived from the subducting slab.

To contribute to a better understanding of the B isotopic fractionation upon serpentinite dehydration in the subducted lithosphere, we present *in situ* $\delta^{11}B$ analyses of antigorite and olivine from high pressure serpentinites from the Western Alps (Zermatt-Saas and Erro-Tobbio units). The different isotopic compositions of antigorite in different parts of the units ($\delta^{11}B$ of −5 to +10 ‰ and +13 to +19 ‰ for Zermatt-Saas, and $\delta^{11}B$ of up to +26 ‰ for Erro-Tobbio) are inherited from variable serpentinisation conditions on the sea floor. Bulk rock Sr isotope analyses indicate that sediment derived fluids cannot explain the variation seen in B isotopes.

Serpentinite dehydration via the brucite-out reaction during subduction produces metamorphic olivine in O isotopic equilibrium with antigorite. This olivine shows near zero B isotopic fractionation with coexisting antigorite ($\Delta^{11}B_{Ol\text{-}Atg}$ of −0.7 ± 3.4 ‰), which implies little B isotopic fractionation during serpentinite dehydration. Our results are supported by *ab initio* calculations considering serpentine and olivine with similar B coordination under subduction zone conditions. In contrast, significant B isotopic disequilibrium ($\Delta^{11}B_{Ol\text{-}Atg}$ of +25 ‰) is found between antigorite and olivine formed in shear bands, shear zones and veins, indicating channelled transfer of external fluids, including serpentinite-derived fluids, from a protolith with a different isotopic composition.

These finding implies that the $\delta^{11}B$ of the fluids from subducted serpentinites is comparable to that of the input oceanic floor serpentinites, and that generally positive $\delta^{11}B$ values are transferred to the mantle wedge.