Mantle metasomatism in subduction zones: insight from in-situ B isotopes

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The sources of fluid responsible for mantle metasomatism are difficult to identify, but likely can be inferred based on B isotopes and B content of serpentinites. Hence, serpentinites have been selected worldwide to better constrain the B isotopic signature of the different fluid sources affecting the mantle. The $\delta^{11}B$ of serpentinites coming from ophiolite (Cuba, Iran) range from +1 to +18‰, whereas samples from suture zones display contrasted values. Samples coming from the deep mantle wedge (Iran) have significantly negative to moderately positive $\delta^{11}B$ (-7 to +8‰), whereas samples from forearc (Nicaragua and Japan) have intermediate values (0 to +13‰). Sample coming from the mantle underneath the slab (Corsica and Alps) have significantly positive $\delta^{11}B$, ranging from +14 to +34‰. By comparing these values obtained in-situ with published whole-rock values, both on subduction-related serpentinites and on current seafloor serpentinites, it appears that the ophiolitic serpentinites measured in this study are in agreement with values published on Oman, and the fluids responsible for metasomatism is a mixture of seawater and low-grade metamorphic fluids. For suture zones serpentinites, the negative values are only encountered in serpentinites from deep mantle wedge (Iran), and are in good agreement with metamorphic fluids released from metabasites sampled next to these serpentinites. Such negative values have already been observed in mantle wedge samples from Guatemala. Intermediate $\delta^{11}B$ observed in Japan and Nicaragua represent serpentinization by low-grade metamorphic fluid occurring in the forearc (i.e. at shallow depths) during subduction. This hypothesis is also supported by the $\delta^{11}B$ of low-grade metabasites and metasediments in contact with these serpentinites, which are in agreement with the release of a fluid with a moderately positive $\delta^{11}B$. Finally, serpentinites from the mantle underneath the slab (Corsica and Alps) display strongly positive $\delta^{11}B$, in the same range of what is observed for current seafloor serpentinites, indicating that serpentinization occurred during seafloor residency, and that the seawater-derived signature is preserved through subduction event.