The metamorphic record of Lithium and Boron isotope fractionation in subduction zones

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High-pressure metamorphic (H*P*M) rocks can provide a record of various stages of the subduction process rather than just one final product, provided the history can be disentangled An important example is the Aegean island of Syros (Greece) which displays a mélange composed of rigid H*P*M blocks within a schistose mafic-ultramafic matrix. Most of the blocks preserved their peak-metamorphic mineral and chemical composition, while contacts between blocks and matrix display reaction zones (*blackwalls*) formed by fluid influx during exhumation.

Most blackwalls show strong enrichments in Li and B, manifest by abundant tourmaline and Li-rich omphacite and chlorite. Blackwall tourmaline include the heaviest B isotopic compositions so far reported for tourmaline, ranging from $\delta^{11}B$ = +18 to +28 ‰ [1], which strongly contrasts with metamorphic tourmaline from the internal parts of the H*P*M blocks ($\delta^{11}B \approx 0$ ‰ [2]). Similarly, whole-rock Li isotopic compositions of the H*P*M blocks ($\delta^{7}Li \approx$ -4.8 to +3.6 ‰) are lower than MORB and overlap with compositions of Alpine eclogites reported by [3], whilst enrichment of Li in the blackwalls (up to 80 µg/g) is accompanied by a strong increase in $\delta^{7}Li$ to values between +4.4 and +11.2 ‰.

The low $\delta^{7}Li$ and $\delta^{11}B$ values in the H*P*M blocks are interpreted to record isotopic fractionation of Li and B isotopes during prograde dehydration. The release of the complementary isotopically heavy fluids from the slab into the mélange at shallower depths result in the very high $\delta^{7}Li$ and $\delta^{11}B$ values in rehydrated zones.

In summary, this study supports the hypothesis of a dehydrated slab with an isotopically light Li isotope composition overlain by a high-$\delta^{7}Li$ hydrated mantle, proposed earlier [3, 4]. This work also confirms the similarity of the Li and B isotope systems during subduction zone metasomatic processes.

References

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