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Heavy boron isotopes in secondary olivine from the HP Voltri Massif: implications for the boron cycle in subduction zones

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The Erro-Tobbio peridotite (Voltri Massif, Ligurian Alps, Italy) contains high-pressure rocks that have been subducted to peak conditions close to the upper stability limit of serpentine (650°C at 25 kbar; [1]). Secondary olivine occurs in partially dehydrated serpentinites in association with Ti-clinohumite (Ti-Chu). It has high Mg# (Fo86-87), MnO (0.3-0.4 wt%) and NiO (0.2-0.3 wt%) and contains magnetite inclusions attesting to its secondary origin. Olivine has variable but very high H_2O (up to 0.7 wt%) which correlates with high TiO_2 (up to 0.85 wt%) and F contents (5-51 ppm). FTIR spectroscopy indicates a high proportion of Ti-Chu-like defects in the olivine as the cause of high H_2O, F and TiO_2. Olivine also has very high B (8-20 ppm) and Li (3-70 ppm) contents, but these are not correlated with H_2O contents. Antigorite from the same sample has lower B (8-10 ppm) and Li (0.1 ppm) contents than olivine while F contents are comparable (15-47 ppm).

In-situ boron isotope analysis (Cameca 1270 SIMS) shows that olivine is enriched in heavy B ($\delta^{11}B_{SRM951}$ = +17 to +23‰). No difference exists between Ti-rich and Ti-poor olivine. These high values are nearly identical to those of whole-rock high-pressure serpentinites from the same area ($\delta^{11}B$ = +17 to +24‰; [2]). This indicates that little B isotope fractionation occurs during subduction dehydration of serpentine. Moreover, the high B and F contents of secondary olivine imply that these elements remain in the rock during serpentine dehydration. Hence, subduction of ultramafic rocks may introduce significant B isotope anomalies and fluorine into the deeper mantle.

[1] Scambelluri *et al.* (1995) *Geology* **23**, 459-462. [2] Scambelluri and Tonarini (2012) *Geology* **40**, 907-910.