Experimental study on tourmaline stability in subducting crust: Behavior of B through subduction-zone processes

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High-pressure experiments with a multi-anvil apparatus were performed at 700 to 1000 deg.C and 3 to 8 GPa, determining pressure-temperature stabilities of dravitic tourmaline in a natural pelitic system, in order to understand the behavior of B in crustal materials processed through subduction zones. Most experiments produced garnet, omphacitic clinopyroxene, phengite, kyanite, coesite, and probably unquenchable fluid; a significant amount of melt was observed at 3 GPa, 900 deg.C. Abundant tourmaline seeds survived at conditions less than 4.5 GPa and 850 deg.C. No tourmaline was confirmed at conditions over 5.0 GPa at lower than 800 deg.C, and over 4.0 GPa at over 900 deg.C.

Experimental results indicate that there is little pressure-dependence on the high-pressure stability limit of tourmaline in the natural pelitic system. It suggests that subducting crust would release B-rich fluids upon reaching 150 km depth even in cold subduction zones. Whereas in hot subduction zones, liberated B from tourmaline would be incorporated with a slab-derived melt. The across- and along-arc variations in B-concentration of arc lavas from the Kamchatka to the northeastern Japan arcs are likely caused by most of B in subducting crust being released to overlying mantle wedge upon reaching certain depths, depending on subduction zone geotherms; age of subducting plate.