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Boron loss and isotopic fractionation as a result of sediment dehydration during subduction from seafloor to sub-arc in SW Japan

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The active SW Japan subduction zone is a site of extensive geologic, seismic, hydrologic, and volcanic research to date. Material input comprises both sediments and altered oceanic crust (AOC) as evidenced by cores obtained from seafloor drilling sites, ultimately resurfacing as arc lavas. However, mass balance of fluids in and out of the system between the time of subduction and arc magmatism remain poorly constrained. Boron can be a useful hydraulic tracer due to its solubility and high concentrations in subducted sediments relative to the overlying mantle wedge. Under lower PT conditions, diagenetic processes drive fluid loss. At higher PT, the predominant driver transitions to metamorphic dehydration, or breakdown of hydrous mineral phases. Using B concentration and $\delta^{11}B$ values as a proxy to quantify fluid loss, we hope to detail the geochemical evolution from when sediments first enter to the system, undergo metamorphism at depth, and resurface.

Preliminary [B] and $\delta^{11}B$ data have been collected from (meta)sediments along a SE-NW transect across Shikoku Island from the Nankai trough, through the Shimanto belt, to the Sanbagawa metamorphic belt. The data show decreasing [B] and $\delta^{11}B$ with increasing temperature, covering range of ~25-500°C. This suggests progressive fluid loss with increasing metamorphic grade due to slab dehydration, with ^{11}B being preferentially incorporated into the fluid.

In contrast to $\delta^{11}B$ which undergoes mass-dependent fractionation during dehydration, radiogenic $^{87}Sr/^{86}Sr$ can be used as a tracer of provenance for both sediments and AOC. $^{87}Sr/^{86}Sr$ data have been obtained for a sample set from the Shikoku transect including clays, shales, schists, and basalts. Mafic schists and altered basalts have $^{87}Sr/^{86}Sr$ values (0.705-0.709) intermediate to typical values for unaltered MORB and the low-end value for collected shales and pelitic schists. Five of the seven schist samples have $^{87}Sr/^{86}Sr$ values ranging between 0.709-0.715, which largely fall within the range for Nankai Trough clays (0.710-0.715) and Shimanto shales (0.710-0.717). This overlap suggests shared input sources, or more importantly, a viable analog of a continuous sedimentary suite. Applying this assessment of initial homogeneity establishes a strong base for interpretation of boron cycling in global subduction zones.