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Local vs. long-distance transport in subducted metasedimentary units: Insight from fluid-mobile elements and δ^7Li isotopes

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To evaluate fluid-rock interaction in subducted sediments buried down to seismogenic depths (250-330℃), we studied changes in fluid-mobile elements (FME) budget and δ^7Li of the matrix and fluid inclusions (FI) in metapelites from paleo-accretionary complexes of Kodiak accretionary complex, USA, and Shimanto belt, Japan.

The FME (Li, B, Rb, Sr, Cs, Ba) in Kodiak and Shimanto show contrasting behavior between 250 and 350°C. The FME whole-rock concentrations from 250 to 330℃ are preserved in Kodiak, whereas they decrease in Shimanto. The main FME-carrier minerals are chlorite and illite. The lithium concentrations in chlorite remains statistically identical between 250℃ and 330℃ at Kodiak (∼240 ppm), whereas in Shimanto the concentration decreases from ∼320 ppm at 250℃ to ∼120 ppm at 330℃. In parallel, FI in Shimanto show an enrichment in FME as temperature increases for elements lost from the matrix.

The fluid δ^7Li obtained by crush-leaching of quartz from veins also point to a difference between the two localities (Kodiak: +8.1 to +17.07‰; Shimanto: +2.53 to +10.39‰). The fluid δ^7Li are clearly different from seawater signature. Such variations may result from fluid-sediment interactions and isotopic exchanges. The higher δ^7Li of fluids in Kodiak is explained by the chlorite formation as it preferentially consumes ^{6}Li and the fluid remains enriched in ^{7}Li. Conversely, fluids from Shimanto are isotopically lighter, consistent with lithium loss from chlorite as temperature increases.

Overall, the FME mass-balance and fluid δ^7Li point to a local redistribution of elements in the metapelites from the Kodiak complex, suggesting that the system behave as closed, as the studied units are underplated as a part of thick turbiditic sequence. In the Shimanto belt, the loss of FME suggest rather an open system and large-scale fluid circulation, where the studied unit makes the damage zone of an-out-of-sequence thrust. Such opposite trend between Kodiak and Shimanto is largely controlled by (i) the amount of internal strain within the different units and (ii) the proximity to large-scale fault zones.