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Melt inclusions track dehydration reactions in slab across volcanic arcs

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The stability and breakdown of mineral phases in subducting slabs control the cycling of trace elements through subduction zones (Gill, 1981). Stability of key minerals and the partitioning of trace elements between these minerals and liquid phases of interests have been charted by natural sample analysis and experimental constrains. However, systematic study from arc front to far back-arc has seldomly shown that the expected geochemical variations of the slab liquid are actually recorded by natural samples (e.g., Kelley *et al.*, 2006). Complexities arising by uncertainties on the nature of the slab component (melts, fluids and supercritical liquids), source heterogeneities and transport processes (e.g., Hacker, 2008; Kessel *et al.*, 2005, Manning, 2004). Using data from olivine-hosted melt inclusions sampled along and across the NE Japan and southern Kurile arcs, we demonstrate that experimentally and thermodynamically constrained phase stabilities in subducted materials indeed control the trace element signatures as predicted by these models and experiments. The main reactions that can be traced across arc are progressive breakdown of light rare earth element-rich accessory phase (e.g., allanite), enhanced dehydration of the lithospheric mantle (serpentinite breakdown) and changes in the nature of the slab component. This work elucidates subduction zone elemental cycling in a well-characterized petrogenetic setting and provides important constraints on the interpretation of trace element ratios in arc magmas in terms of the prograde metamorphic reactions within the subducting slab.

Hacker, B. R. (2008). H2O subduction beyond arcs. *Geochemistry, Geophysics, Geosystems* **9**.

Kelley, K. A., Plank, T., Grove, T. L., Stolper, E. M., Newman, S. & Hauri, E. (2006). Mantle melting as a function of water content beneath back-arc basins. *Journal of Geophysical Research: Solid Earth* **111**.

Kessel, R., Schmidt, M. W., Ulmer, P. & Pettke, T. (2005). Trace element signature of subduction-zone fluids, melts and supercritical liquids at 120–180 km depth. *Nature* **437**, 724-727.

Manning, C. E. (2004). The chemistry of subduction-zone fluids. *Earth and Planetary Science Letters* **223**, 1-16.

Gill, J. B. (1981). Orogenic Andesites and Plate Tectonics. *Orogenic Andesites and Plate Tectonics.*