

The path of fluids and the composition of melts in (ultra)high pressure subducted crust

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Aqueous fluids and melts are fundamental agents for chemical exchanges between different rock types in the subduction system. Constraints on their sources, pathways, and composition thus provide crucial information to reconstruct subduction processes. Garnet and accessory minerals constitute some of the most robust and ubiquitous minerals in subducted crust and can preserve multiple growth zones that track subduction-related metamorphism. Microbeam analysis of the chemical and isotopic composition of garnet and accessory minerals is used to investigate significant fluid-rock interaction at different stages of the subduction system.

The nature of the protolith and ocean floor alteration is preserved in relict accessory phases within eclogites that have been recrystallized at HP conditions. Minerals in the lawsonite-blueschists of the Tavsanli zone in Turkey record pervasive fluid exchange between mafic and sedimentary blocks at the early stage of subduction. High pressure shear zones and lithological boundaries show evidence of intense fluid metasomatism at depth along discontinuities in Monviso and Corsica. In the HP oceanic crust of the Zermatt-Saas Zone, garnet oxygen isotopes and tourmaline boron isotopes indicate multistage fluid infiltration during prograde metamorphism. In most cases analyses of distinct mineral zones enable identification of multiple pulses of internally and externally derived fluids during subduction.

Reconstruction of melt compositions is possible in the UHP rocks of the Kokchetav Complex. Restitic metapelites show a strong depletion in light rare earth elements (LREE), Th and U. This is attributed to complete dissolution of monazite/allanite in the melt and variable degree of melt extraction at T of ~1000°C. Large ion lithophile elements (LILE) are only moderately depleted indicating that phengite retains LILE in the residue. Melting at UHP conditions resulted in an increase in the Sm/Nd ratio and a decoupling of the Sm–Nd and Lu–Hf systems in the restite.