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Evidence for multiple fluid-rock-interaction in HP metamorphic ocean floor basalts from the Tianshan, NW China

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During subduction, slab fluids released from the subducting oceanic lithosphere, due to compaction and dehydration reactions, migrate within the slab upwards to the slab-mantle wedge interface. However, migration processes of these dehydration fluids are not well understood yet. Hydrophile volatile elements like sulfur are transported by slab fluids from their source lithologies through the slab and become incorporated in the forming fluid pathways due to precipitation and fluid-rock interaction. Consequently, hydrophile volatiles can be used as tracers to determine intra-slab fluid flow processes.

In this project, we investigated an eclogite-facies metabasalt from the HP/LT Akeyazi Metamorphic Complex of the South Tianshan Orogen, NW China. The sample consists of a blueschist matrix cut by several omphacite-dominated HP-veins, which formed under prograde to peak metamorphic conditions. Combining mineral chemical analyses of the blueschist matrix and the different types of veins with *in situ* $\delta^{34}S$ measurements of pyrite, as well as isotope analyses of C, O, Sr and Pb in mineral- and vein separates, we determined the sample's metamorphic evolution and reconstructed the related intra-slab fluid flow.

Large pyrite grains recording microbially-derived S and barite inclusions in pyrite indicate seafloor alteration under differently tempered hydrothermal conditions, which affected the protolith pillow basalt prior to subduction. This is further supported by dolomite $\delta^{13}C$ values close to seawater-carbonate compositions. Mineral chemical and isotopic compositions reveal a two stage intra-slab fluid flow under prograde to peak metamorphic conditions responsible for the formation of the omphacite-dominated veins. The first HP fluid, showing MORB-like pyrite $\delta^{34}S$ signatures of -0.75 ± 1.76‰ in the vein, originated from dehydrating ocean floor basalts. The second HP fluid composition suggests, instead, an origin from the basalt-sediment transition as documented by negative pyrite $\delta^{34}S$ values of -10.75 ± 1.47‰. Pathways formed by the first fluid were reused and enlarged by the second fluid, which however also formed new pathways. This sample, which shows only minor influence of retrograde alteration, provides detailed insights into intra-slab fluid flow and fluid-rock-interaction processes at HP/LT metamorphic conditions and allows a better understanding of fluid transfer and sulfur speciation in subduction zones.