

The effects of high-pressure metasomatic fluids on blueschist-facies overprints of eclogites from the subduction channel

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To understand geochemical processes of subduction-zone metamorphism, especially at the slab-mantle interface in the subduction channel, is crucial for understanding arc magmatism with characteristic geochemical signatures (e.g., high LILEs and low HFSEs). We studied a ~ 1.5 m metabasaltic boulder with well-preserved pillow-lava structure from the Chinese Western Tianshan UHPM belt. The boulder has dm-sized eclogitic interiors and cm-sized blueschist rims. Both eclogitic interiors and blueschist rims are dominated by omphacite, glaucophane, clinozoisite, garnet plus minor phengite, quartz, titanite, apatite, and carbonates, but glaucophane and clinozoisite modal abundances increase with decreasing omphacite abundance towards blueschist rims. Given the presence of the same or similar mineral inclusions in glaucophane and clinozoisite porphyroblasts from both eclogitic interiors and blueschist rims, we conclude that the blueschist rims share a similar peak metamorphic condition with the eclogitic interiors, but have experienced stronger rehydration. The protolith of both blueschist rims and eclogitic interiors is geochemically E-MORB-like. Blueschist rims and eclogitic interiors yield a well-defined Rb-Sr isochron with an age of 309 ± 12 Ma (MSWD = 1.7), possibly representing the timing of rehydration.

Mass balance calculations show that, compared with the eclogitic interiors, the blueschist rims have gained REEs (more than 25%), U and Th (more than 50%), as well as Pb and Sr (more than 100%), but lost P (~ 75%), Li and Be (~ 50%). The gain of REEs-U-Th, especially Pb and Sr, reflects the addition of these elements by external fluids, while the breakdown of apatite and omphacite during rehydration may be responsible for the loss of the latter. However, the rather insignificant loss of LILEs (~ 5%) indicates the conservation of these elements by the formation and stability of phengite during these processes and thus the LILEs cannot contribute to the arc geochemical signature.