

Boron isotopes of tourmaline and muscovite in pelitic schist from China southwestern Tianshan: Insight into the evolution of fluids in subduction zones

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The HP-UHP metamorphic belt of southwestern Tianshan in China is a rarely preserved oceanic subduction zone, which consists predominantly of meta-siliciclastic rocks with lens-shaped metabasites. The metapelites from the Kebuerte Valley and adjacent area within this belt contain quartz, albite, garnet, phengite, paragonite, chlorite, and minor rutile, titanite, glaucophane, clinozoisite, allanite, graphite, carbonate and tourmaline. The well preserved coesite inclusions (~100 μm) in garnet are encircled by a narrow rim of quartz, which were identified by optical microscopy and confirmed by Raman spectroscopy. Using the computer program THERMOCALC, the peak metamorphic conditions of 29 kbar and 565 $^{\circ}\text{C}$ were obtained via garnet isopleth geothermobarometry. The predicted UHP peak mineral assemblage comprises garnet + jadeite + lawsonite + carpholite + coesite + phengite, high-Si phengite (Si=3.5-3.65 p.f.u.) formed in this stage. While a late greenschist-facies overprint with fluids, when normal-Si phengite (Si=3.3-3.5 p.f.u.), paragonite and tourmaline formed.

In this study, we analysed chemical composition and boron isotopes of three kinds of muscovite and tourmaline by EPMA, LA-ICPMS and LA-MC-ICPMS. High-Si has less Li than normal-Si phengite. And paragonite shows relative enrichment in B and Sr, phengite is enriched in Cs, Ba. These three kinds of muscovite have similar boron isotopes (-13‰~-9‰, average -11.7 ‰). Tourmaline crystals belong to dravite, with B-isotope ratios ranging from -10.2 ‰ to -3.1 ‰ (average -6.0 ‰).

Taken together, fluids in peak stage had more Li than retrogression and came from pelitic schist themselves. And in the retrogression, paragonite and normal-Si phengite came from breaking down of high-Si phengite, without external fluids, which can also be proved by boron isotopes of tourmaline. In addition, there exists 5.7‰ boron isotope fractionation between tourmaline and muscovite.