A fluid inclusion study from the late Paleozoic retrograde eclogite from the Yunotani Valley of the Omi area, Hida-Gaien Belt, Japan

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Primary fluid inclusions trapped in subduction metamorphic rocks can provide direct information concerning composition and origin of slab-derived fluids. In order to investigate fluid signatures at the mantle wedge beneath forearc regions, we conducted microthermometry for primary fluid inclusions in both prograde eclogite-stage omphacite and retrograde blueschist-stage quartz, in the late Paleozoic retrograde eclogite from the Yunotani Valley of the Omi area, Hida-Gaien Belt, Japan. Note that the investigated blueschist-stage quartz forms a microvein along cracks of omphacite. The investigated eclogite occurs as mafic layers or lenses which are intercalated in metasedimentary rocks with the mineral assemblage paragonite + phengite + garnet ±glaucophane + quartz + rutile. Recent study confirmed that the retrograde blueschist-stage reached the pumpellyite stability field of P = ~0.62–0.70 GPa and T = ~280–320°C (Shinji and Tsujimori 2019 doi:10.2465/jmps.180716).

The primary fluid-inclusions in both omphacite and quartz are aqueous two-phase inclusions of liquid and vapor. Their molecular species in a liquid and gas phase were identified using micro-Raman spectroscopy. The fluid inclusions of the eclogite-stage omphacite are characterized by relatively high salinity of ~8.0–8.2 wt% NaCl equivalent and the brine freezing temperatures at ~-70°C suggests presence of divalent ions such as Ca^{2+} and/or Mg^{2+}. In contrast, fluid inclusion in blueschist-stage quartz shows relatively low value of ~2.4 wt% NaCl equivalent. The liquid phase of the fluid inclusion transforms completely into solid phases at ~-38°C, suggesting existence of the limited monovalent ions such as Na^{+} or/and K^{+} in the fluids.

Our preliminary data demonstrates that the pervasive fluids entrapped at prograde eclogite-stage and retrograde blueschist-stage had different chemical compositions. This suggests different fluid sources at eclogite and blueschist depth. Our observation is consistent with the different fluid compositions recorded in zoned lawsonite in Guatemalan eclogite (Hara et al. 2018 doi: 10.1016/j.lithos.2018.09.001). In our study, the existence of higher salinity fluids in the eclogite-facies conditions can suggest more effective transportation of the lithophile elements into the mantle wedge at deeper forearc regions.

Keywords: Slab-derived fluid, Mantle wedge beneath forearc region, Fluid inclusion, Microthermometry, Retrograde eclogite, Retrograde blueschist-stage pumpellyite

