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三波川帯・五良津岩体のひすい輝石 - 藍晶石エクロジャイトの成因と意味
Petrogenesis and implications of jadeite-kyanite eclogite from the Iratsu body of the Sanbagawa belt, SW Japan

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Discovery of a new occurrence of jadeite- and kyanite-bearing eclogite from an outcrop within the Iratsu body of the subduction-type Sanbagawa belt, SW Japan, allows us to assess existing solid-solution models for clinopyroxene, and obtain insights into spatial variation in P-T conditions and/or H_2O activity during the eclogite-facies metamorphism of this region. The jadeite + kyanite assemblage is stable at higher P-T conditions or lower H_2O activity compared to paragonite. There is no significant difference in bulk rock composition between the newly found jadeite-kyanite eclogite and paragonite eclogite, which is the predominant eclogite type in the Iratsu body. The jadeite-kyanite eclogite is a medium-grained massive metagabbro consisting mainly of garnet, omphacite, kyanite, quartz, epidote, phengite, subcalcic amphibole and rutile. Pre-eclogitic relics of sodic augite ($Jd_{7-24}Acm_{6-16}$), actinolitic hornblende, Fe-rich garnet ($Alm_{62-71}Grs_{19-25}Prp_{5-13}Sps_{3-4}$) and magnetite are sporadically preserved. Eclogitic garnet ($Alm_{54-61}Grs_{16-20}Prp_{20-25}Sps_{1-2}$) optically shows a dusty appearance due to abundant microscopic inclusions of kyanite, quartz, epidote, phengite, omphacite ($Jd_{40-55}Acm_{7-13}$) and impure jadeite ($Jd_{62-86}Acm_{0-7}$). Jadeite is exclusively present as inclusions in garnet. The miscibility gap between the ordered omphacite (P2/n) and disordered impure jadeite (C2/c) progressively narrows during garnet growth, implying the temperature of the solvus apex coincides with the thermal peak of metamorphism. The observed compositional gap and the result of garnet-clinopyroxene Fe^{2+}-Mg exchange thermometry are consistent with the phase diagram calculated in the pseudo-binary augite ($Di_{66}Hd_{14}Acm_{20}$)-jadeite system by using the newest solid-solution model of Deiner and Powell (2012), and the calculated apex of the omphacite-jadeite solvus is at 625 deg.C. However, calculated pseudosections with XRF-derived bulk rock composition and the solid-solution model have no jadeite stability field for any reasonable values of P, T, X_{Fe3+} and M_{H2O}, although the matrix assemblage is satisfactorily reproduced. This may suggest effective bulk composition around growing garnet was significantly different from the XRF-derived bulk rock composition. The localized feature of eclogite-facies equilibration is also inferred from the observed microstructures such as Omp + Qz + Amp pseudomorphs (prograde symplectites) after igneous augite. We obtain the jadeite stability field in the calculated pseudosections by subtracting augite from the XRF-derived bulk composition. High chlorine contents of amphibole (<1.5 wt% Cl) and apatite (<7.0 wt% Cl) indicate that the eclogite-facies equilibration was triggered by an influx of saline fluids. Multi-equilibrium thermobarometry for the assemblage Grt + Omp + Ky + Ph + Ep + Qz gives metamorphic P-T conditions of around 2.3 GPa and 600 deg.C. The estimated high-P conditions are also supported by high residual pressure (max. delta omega-1 = 13.3 cm^{-1}, equivalent to 0.85 GPa) of quartz inclusions in garnet. These results imply the presence of a significant metamorphic pressure gradient within the Iratsu body, and detailed baric structure of this region will be revealed by further application of the quartz-in-garnet barometry (Enami et al. 2007).

Reference: Deiner and Powell (2012) J Metam Geol 30, 113-130; Enami et al. (2007) Am Mineral 93, 1303-1315.

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