Datolite in the high-pressure marble from the Eastern Iratsu body of the Sanbagawa metamorphic belt

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Datolite [$CaBSiO_4(OH)$] was newly found from an eclogite-facies marble collected from the Eastern Iratsu body, where the eclogite-facies metamorphism has been recognized (e.g., Takasu & Kohsaka, 1987), in the Sanbagawa metamorphic belt of central Shikoku. The investigated marble is composed of calcite-dominated matrix and quartz pool, the latter of which contains datolite as an inclusion mineral in garnet. The matrix mainly consists of calcite, diopside, and garnet. Weak foliation is defined by the elongation of coarse and deformed grains of calcite. Garnet in the matrix contains omphacite, epidote, quartz, phengite, and albite as inclusions. Quartz pool occurs concordantly with the main foliation and is composed of quartz, garnet, calcite, and diopside with trace amount of pyrite and titanite. Garnet in the quartz pool shows patchy texture with the almost pure grossular part ($Grs_{98}Adr_2$) occurring as dark cores in back-scattered electron images (BSI) and the surrounding andradite-rich part ($Grs_{90}Adr_{10}$) recognized as bright part in BSI, the latter of which contains datolite.

The formation conditions of the datolite-bearing bright part of the garnet were estimated using quartz-Raman barometry (Kouketsu et al., 2014a) and thermodynamic calculation. Quartz grains occurring in the bright part were carefully selected and measured by a Raman micro-spectrometer (RAMANtouch, NanoPhoton), yielding $\Delta\omega_1$ values of ~5. Based on the mineral assemblage, the following temperature-dependent reactions were considered in the system of CASH-CO_2 using Perple_X (Connolly, 2005). The lack of zoisite and wollastonite in the quartz pool indicates a temperature range of approximately 500-600 ºC under the assumption of X_{CO2} ~ 0.01:

zoisite + quartz + calcite = grossular + CO_2 + H_2O

calcite + quartz = wollastonite + CO_2

Consequently, the formation conditions of the datolite-bearing bright part of the garnet were estimated as ~550 ºC and 1.1-1.3 GPa, which coincide with the peak temperature conditions of surrounding non-eclogite unit of the Besshi district (Kouketsu et al., 2014b).

In the Sanbagawa metamorphic belt, the most common phase of borosilicate is tourmaline that is formed both in prograde stage and retrograde stage. Datolite is reported only as vein-filling minerals that is considered to be retrograde origin in the Sanbagawa belt (Kato et al., 1957; Minagawa and Nishio, 2002). Both datolite and tourmaline can be stable under the pressure-temperature conditions of the Sanbagawa metamorphic belt including prograde through peak to most of retrograde stage. However, datolite is generally stable under the alkaline conditions (Yang and Rosenberg, 1995) where tourmaline is not (Morgan and London, 1989). The finding of datolite instead of tourmaline indicates the strong alkaline conditions during the formation of quartz pool. Model calculations of Galvez et al. (2015) indicated that the aqueous fluids equilibrated with a metapelite under the expected P-T conditions would be alkaline conditions if carbon is not incorporated in the model. According their calculation, the alkalinity of the fluid equilibrated with the rock would decrease during the exhumation. Therefore, tourmalines recognized in the retrograde stages of the Sanbagawa metamorphic belt becomes stable due to such decrease of

alkalinity.

References: Connolly (2005) 10.1016/j.epsl.2005.04.033; Galvez et al. (2015) 10.1016/j.epsl.2015.06.019; Kato et al. (1957) 10.2465/ganko1941.41.198; Kouketsu et al. (2014a) 10.2138/am.2014.4427; Kouketsu et al. (2014b) 10.1111/iar.12075; Minagawa & Nishio (2002) Mem. Fac. Sci. Ehime Univ. 8, 11-17.; Morgan & London (1989) 10.1007/BF00373721; Takasu & Kohsaka (1987) 10.5575/geosoc.93.517; Yang and Rosenberg (1995) 10.2138/am-1995-5-616

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