天草下島に分布する長崎変成岩類の片麻岩に見られる部分溶融の証拠

Evidence of Partial Melting of Migmatitic Felsic Gneiss from Nagasaki Metamorphic Complex in Amakusa-Shimoshima, western Kyushu, Japan

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The Nagasaki Metamorphic Complex in Amakusa-Shimoshima is divided into the lower and upper units. The former and the latter are composed mainly of pelitic schists and gneisses with mafic and felsic composition, respectively. The upper unit is considered to have located at lower crust that was shortened due to ductile flow toward trench side (Miyazaki et al., 2013). The unit belongs to the high-pressure granulite facies and represents migmatitic mode of occurrence, which implies potential presence of melt that enhanced the ductile deformation. This study reports microstructural features indicative of partial melting in a felsic migmatitic gneiss.

The migmatitic felsic gneiss dealt with this study represents U-Pb zircon age of 125.8±1.8 Ma (Mori et al., 2018 JpGU). It is composed mainly of garnet, quartz, muscovite, zoisite and aggregate of fine-grained zoisite + albite + muscovite that is former plagioclase. Minor amounts of graphite, zircon, apatite, rutile, chlorite, and iron sulfide also occur. Tiny grains of hornblende are included in the rim of garnet. The matrix zoisite commonly includes epidote in the core. The epidote contains significant amounts of rare earth elements (REE) and is composed of Y-poor core and Y-rich rim. The garnet grains are roughly divided into two types of coarse- and fine-grained. The X_{Mg} [=Mg/(Mg+Fe)] of the coarse-grained garnet increases from the core to the rim and decreases at the extreme periphery, while that of the fine-grained garnet monotonically decreases from the core to the rim. The coarse-grained garnet represents Y-rich and P-poor core and Y-poor and P-rich rim whereas Y-poor and P-rich domain is dominant in the fine-grained garnet. A polyphase inclusion composed of chlorite + muscovite + quartz + $CaCO_3$ is found from the rim of coarse-grained garnet. The inclusion shows polygonal shape and has cuspate offshoots filled with chlorite or muscovite. Apatite is included in the core of the coarse-grained garnet but is not found from the rim. The fine-grained garnet and the rim of the coarse-grained garnet include Y-rich REE-epidote.

We applied Zr-in-rutile geothermometer (Ferry & Watson, 2007), garnet-hornblende geothermometers (Graham & Powell, 1984; Powell, 1985; Ravna, 2000), and hornblende-plagioclase geothermometer (Holland & Blundy, 1994). These results are consistent among them within their errors and represent 720−770 ˚C as the peak condition. The pressure at the peak condition was estimated utilizing garnet-hornblende-plagioclase-quartz geobarometer of Kohn & Spear (1990), and we obtained the pressure of 9.1 −10.2 kbar.

The estimated condition lies above the melting reaction of zoisite + muscovite + quartz + water = kyanite + melt (cf. Schliestedt & Johannes, 1984). The polygonal shape of the polyphase inclusion in the rim of

coarse-grained garnet could represent negative crystal of garnet. Combining the constituent minerals of the inclusion, it is likely that the polyphase inclusion was originally melt inclusion.

The concentration of yttrium and phosphorus in the rim of coarse-grained garnet is similar to that in fine-grained garnet. Based on the presence of melt inclusion in the rim of coarse-grained garnet, we consider that fine-grained garnet nucleated during the partial melting with the formation of the rim of coarse-grained garnet. The Y-rich REE-epidote is in the matrix and included in the fine-grained garnet and the rim of the coarse-grained garnet, so we consider that Y-poor garnet and Y-rich REE-epidote coexisted with the melt. The lack of apatite inclusion in P-rich domain of both garnets may indicate that the phosphorus in P-rich domain in garnet was supplied by breakdown of apatite during the melting.

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