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後退変成期の塩素に富む流体活動–東南極セールロンダーネ山地ブラットニーパネの例

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Chlorine-rich fluid activity during retrograde metamorphism – an example from Brattnipane, Sør Rondane Mountains, East Antarctica

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Chlorine-rich fluid or melt activity in pelitic gneisses during near-peak metamorphism at ca. 600 Ma has been detected throughout the Sør Rondane Mountains, East Antarctica (Higashino *et al*., 2012). Here we report an example of a Cl-rich fluid activity during retrograde metamorphism from Brattnipane (Koyubi-one).

New example was found as a vein developed in a mafic, garnet-orthopyroxene gneiss (TK2009121002c). The vein is about 1 cm thick, discordantly cutting the penetrative gneissosity in this area. Axial plane of the isoclinal to tight fold that is parallel to the penetrative gneissosity is also discordantly cut by the same vein. The vein mainly consists of garnet, amphibole, biotite, quartz without orthopyroxene. On the other hand, the host gneiss additionally contains plagioclase and orthopyroxene, and lacks quartz.

Garnet is weakly zoned, Mn content is lower and Mg content is higher in the core. Development of the higher Mn, lower Mg rim is strong in the vein and gets weaker distant from the vein. Plagioclase distant from the vein shows weak zoning of rim-ward decrease of Ab content. This plagioclase is termed 'core' hereafter because nearer to the vein, replacement/overgrowth by more albitic plagioclase (termed 'rim') on such a plagioclase 'core' becomes common. This core/rim boundary is sharp, and the 'core' is almost absent in the plagioclase in the vein.

The garnet-hornblende Fe-Mg geothermometer (Ravna, 2000) applied to the garnet-hornblende pair that coexist in the center of the vein gave 830 ^{o}C and the pair that are about 2 cm away from the vein center gave 690 ^{o}C, respectively. Coexistence of garnet, orthopyroxene and Cl-poor hornblende off the vein center is supported from the microstructural constraints, so pressure condition is estimated using the garnet-orthopyroxene geobarometer (Harley, 1984), which gave 8.5-9.5 kbar at 690-830 ^{o}C. The high-temperature result in the center of the vein and the lower-temperature obtained off the vein center could either represent a real temperature gradient, or a result of Mg-Cl avoidance rule in amphibole, because X_{Mg} of amphibole decreases towards the vein center where Cl content of the amphibole is high. If the Mg avoidance rule is not considered, the temperature condition of 690 ^{o}C could represent the closure temperature condition of the system. Therefore, this result suggests that the Cl-rich fluid of ca. 830 ^{o}C infiltrated when the wall rock was cooled below 690 ^{o}C. This result, combined with the mode of occurrence of the vein cutting the penetrative gneissosity, suggests that the vein was formed during relatively early stage of the retrograde metamorphism.

Since biotite and amphibole near the vein have higher Cl content than those occur distant from the vein, it is evident that infiltration of Cl-bearing fluid occurred during the vein formation. The fugacity ratio of the fluid that coexisted with the Cl-rich biotite, log[f_{HCl}/f_{H2O}] (Selby & Nesbitt, 2000) is estimated to be -2.97 to -2.46 at 690 ^{o}C. This value is almost the same as or slightly higher than the log[f_{HCl}/f_{H2O}] value estimated for the pelitic gneiss that experienced the infiltration of Cl-rich fluid or melt (Higashino *et al*., 2012).

Plagioclase zoning implies that supply of Na from the vein to the host rock also occurred, and therefore, we consider that one of the cations that was mobile with Cl was Na. Manganese, although minor, could be another element that was introduced by the Cl-rich fluid activity because garnet near the vein shows development of higher Mn rim compared to the garnet distant from the vein.

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