昇温変成段階における大陸衝突帯中部地殻への塩素に富む流体流入 —東南極セール・ロンダーネ山地パーレバンデの例

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Prograde Cl-rich fluid infiltration to the middle crust of the continental collision setting - An example from Perlebandet, Sør Rondane Mountains, East Antarctica

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In the the Sør Rondane Mountains (SRM), East Antarctica, Cl-rich biotite, apatite and hornblende have been detected from felsic and mafic gneisses along the large scale shear zones and tectonic boundaries over 200 km (Higashino et al., 2013a; 2013b; 2015a), corresponding with the boundaries of magnetic anomaly domains determined by Mieth et al. (2014). In the eastern SRM (Balchenfjella), Cl-rich biotite and apatite in pelitic gneisses have been interpreted to represent a Cl-rich fluid or melt that was present at near peak-metamorphic condition of ca. 0.8 GPa and 800 ^{o}C (Higashino et al., 2013a). In the central SRM (Brattnipene), Cl-rich hornblende and biotite are formed along garnet-hornblende veins, and 'diffusion-like' profile of Cl content in hornblende and biotite decreasing from the vein towards the wall rock is observed (Higashino et al., 2015b). Mass balance analysis revealed that elements mobile in brines rather than in melts were added to the wall rock, suggesting that brine infiltration produced the garnet-hornblende veins in Brattnipene (Higashino et al., 2015b). In order to understand the variety in the timing of Cl-rich fluid infiltrations in the SRM, and finally to understand the origin of the Cl-rich fluids, we carried out detailed petrographic and geochlonological study on pelitic and felsic gneisses from Perlebandet in the western SRM.

Utilizing microstructures of Cl-bearing biotite in pelitic and felsic metamorphic rocks, the timing of Cl-rich fluid infiltration was correlated with the pressure-temperature-time (*P-T-t*) path of upper amphibolite to granulite facies metamorphic rocks from Perlebandet. Microstructural observation indicates stable Al_2SiO_5 polymorphs changed from sillimanite to kyanite + andalusite + sillimanite, and *P-T* estimates from geothermobarometries, including Zr-in-rutile geothermometry for the peak temperature estimate, point to a counterclockwise *P-T* path characteristic of the SW terrane of the SRM. Zircon inclusions in garnet and sillimanite were analyzed by *in situ* LA-ICP-MS for U-Pb dating, and the zircon rims yielded ca. 580 Ma, probably representing the timing of garnet-forming metamorphism at Perlebandet.

Inclusion-host relationships among garnet, sillimanite, and Cl-rich biotite (Cl > 0.3 wt%) reveal that the formation of Cl-rich biotite took place during prograde metamorphism in the sillimanite stability field. The subsolidus muscovite breakdown to form sillimanite porphyroblats was contemporaneous with the Cl-rich fluid infiltration because Cl-rich biotite is included in them. This process was followed by partial melting reaction consuming Cl-rich biotite. Biotite with the highest Cl content is included in garnet overgrowing the sillimanite porphyroblast. This was followed by formation of moderately Cl-bearing, retrograde biotite replacing garnet. Similar timings of Cl-rich biotite formation in different samples, and similar $f(H_2O)/f(HCl)$ values of coexisting fluid estimated for each stage using biotite composition by the method of Munoz (1992) can be best explained by Cl-bearing fluid infiltration. The retrograde fluid either derived externally or was released from crystallizing Cl-bearing partial melts. Localized distribution of Cl-rich biotite and hornblende along large-scale shear zones and detachments in the SRM supports the external input of Cl-rich fluids through tectonic boundaries during continental collision.

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