Variation in microstructures and chemical compositions in pelitic gneisses from the Lützow-Holm Complex at Akarui Point, East Antarctica

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Rocks occurring in the same outcrop are considerd to have been in equilibrium under the same pressure-temperature condition. Different chemical composition in different mineral assemblage can be explained in terms of isophysical variation. We dealt with two pelitic gneisses (No. I-026 and I-027) from the same outcrop in Akarui Point of the Lützow-Holm Complex, East Antarctica. One is sillimanite-free (I-026) and the other is sillimanite-bearing (I-027). These rocks with different assemblage show differrent microstructure and chemical composition of the constituent minerals. This study aims to account for the chemical and microstructural variation in these rocks.

Microstructures

The mineral assemblage of the studied gneisses is garnet, biotite, plagioclase, K-feldspar, quartz with or without sillimanite. Preferred orientation of biotite defines the foliation of these rocks. Biotite in both samples is pale yellow to pale brown or brown.

Garnet grains represent variation in size even in one sample (1.0-3.0 mm in I-026 and 1.3-4.2 mm in I-027 in diameter). Most of garnet grains in both samples are round shape but some in I-026 represent irregular shape. Garnet in I-026 contains inclusions mainly of plagioclase with 0.06-0.50 mm in size of which spatial density is about 20 grains per $1mm^2$. In contrast, the inclusions in garnet in I-027 are mostly quartz that shows 0.01-0.02 mm in size and occurs in numerous amount.

Mineral Chemistry

Garnet grains in both samples have chemically heterogeneity such that Ca content and X_{Mg} (=Mg/Fe+Mg) decrease from the core to the rim. Furthermore, the rim in contact with biotite represents lower X_{Mg} than that in contact with other minerals. The core compositions of garnet show that Ca content and X_{Mg} are higher in I-026 than in I-027.The plagioclase inclusion in the garnet core shows higher Ca content than that in the garnet rim. Biotite is chemically homogenous in both samples. X_{Mg} is higher in I-026 (X_{Mg}=0.66) than in I-027(X_{Mg}=0.56).

Discussion

The heterogeneity at the rim of garnet suggests that Fe-Mg exchange reaction between garnet and biotite proceeded after the peak of the metamorphism. We treat the core composition of garnet as that under the peak metamorphism.

In the AFM approximation, garnet and biotite coexisting with sillimanite are expected to be higher Mg/Fe than those free from sillimanite. However, the present observations disagree with the prediction. Garnet contains significant amount of Ca, requiring addition of CaO to the chemical system. In the garnet composition diagram with respect to Ca-Mg-Fe, garnet in I-027 represents higher Ca and Mg/Fe than that in I-026. These features are well explained as an isophysical variation in the K_2O-CaO-FeO-MgO-Al_2O_3-SiO_2-H_2O system.

The microstructural differences between the rocks, such as mineral species and size of inclusions in garnet, and shape of garnet, could be ascribed to some different processes or evidence during garnet growth.