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Microstructure of corona of garnet amphibolites from the Lutzow-Holm Complex, East Antarctica

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Corona is a microstructure that any mineral or its aggregate surrounds another mineral. This suggests that corona was formed by the reaction between the interior mineral and the matrix minerals. Estimating this reaction, enables us to know which component transferred and how temperature and pressure changed. Microstructure of constituent mineral in the corona also provides duration of reaction and strain of rocks. In this study, we described the microstructure, crystal size distribution of biotite in the corona and chemical composition of constituent minerals of a corona from the Lutzow-Holm Complex, East Antarctica.

Geological outline

In the Lutzow-Holm Complex, metamorphic grade increases from amphibolites facies in the northeast to granulite facies in the southwest. The granulite facies metamorphic rocks are widely distributed throughout East Ongul Island. The rock types are mainly garnet gneiss and hornblende gneiss. Ultramafic rocks occur as thin layers in garnet gneiss. The ultramafic rocks analyzed in this study are composed mainly of hornblende and porphyroblasts of garnet. Corona structure occurs between garnet and hornblende.

Microstructure

In the matrix, hornblende-rich domain and plagioclase-rich domain occur. Both domains consist of hornblende, plagioclase, brown biotite, and orthopyroxene. Garnet porphydroblast (about 15mm diameter) occurs in the hornblende-rich domain and locally shows concavo-convex shape (around 0.5mm). Garnet (long axis 0.10-0.45mm) that is rounded and irregularly shaped locally occurs at the extension of embayed part. The corona consists mainly of plagioclase and green biotite, and occurs around the outer edge of garnet. Crystal size of green biotite increases with increasing the distance from garnet. In immediate proximity to garnet, biotite occurring at the embayed part of garnet has the long axis that orientates at right angles to garnet.

Crystal Size Distribution

We measured area of all biotite grains(about 3300 grains) in the corona, using image analysis soft(image J) and calculated projected area diameter. We obtained the crystal size distribution for three domains(1,2,3 domains according to the distance from garnet) identified by naked eye. The mode of crystal size distribution is smaller than average and gently decrease on the coarse-grained side as compared with the fine-grained side. The crystal size distribution of 2and 3 is similar to lognormal distribution. 2 has high standard deviation relative to 3.

Chemical composition

Garnet has homogeneous interior and trim that shows higher Fe and lower Mg than the interior. Orthopyroxene in the corona has higher Al and lower Si and Fe+Mg than orthopyroxene in the matrix. Plagioclase in the matrix shows chemical zoning Xan=0.38˜0.46 from core to rim. In contrast, plagioclase in the corona has chemical zoning Xan=0.65˜0.84. Biotite in the corona has higher Al and lower Si, Ti and K+Na than biotite in the matrix.

Discussion

The crystal size distribution of biotite in the corona resembles to lognormal distribution, suggesting that biotite maintained continuous nucleation and growth with reduced rate of nucleation, during corona formation. Thus this suggests that recrystallization didn’t take place significantly despite high temperature condition. Bulk composition of the corona, estimated from mode and chemical composition of minerals, has higher K and lower Fe than bulk composition of the matrix, deduced from chemical composition of garnet, hornblende and plagioclase. This suggests that K is supplied from the outside and Fe is leached through fluid during corona formation.

Keywords: East Antarctica, Lutzow-Holm Complex, corona