Occurrence and chemical composition of a corona around garnet from the Lützow-Holm Complex at Rundvågshetta, East Antarctica

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Garnet grains in high-grade metamorphic rocks often show corona structures. In the Lützow-Holm Complex (LHC) of East Antarctica, the coronas are widespread from transitional to granulite-facies zones and have been regarded as important evidence for decompression in a clockwise pressure-temperature path (e.g., Hiroi et al., 1991; Iwamura et al., 2013; Takamura et al., 2017). The coronas have a variation in their constituent minerals, e.g., orthopyroxene + cordierite (e.g., Kawasaki et al., 1993), biotite + plagioclase (Ikeda and Shimada, 2015), orthopyroxene + spinel + plagioclase ± sapphirine (e.g., Hiroi et al., 1991; Ikeda, 2011; Iwamura et al., 2013), and orthopyroxene + plagioclase (e.g., Takamura et al., 2017). We have been investigating the mass transfer and formation process of some kinds of corona occurring in the LHC (Ikeda, 2011; Ikeda and Shimada, 2015; Mori and Ikeda, 2018). Here, we report the occurrence and chemical composition of the corona around garnet in a mafic gneiss from Rundvågshetta (sample no. I-122) and will discuss the formation process.

The studied gneiss is composed mainly of hornblende, garnet, and plagioclase. The garnet grains (5 mm in diameter) are mostly surrounded by the symplectitic coronas composed of orthopyroxene (pale green to pale red), plagioclase, and magnetite. Some parts of the periphery of the garnet grains contact with the matrix hornblende or plagioclase directly without the corona. The matrix is composed mainly of equigranular hornblende and plagioclase (2-4 mm in diameter) with a minor amount of biotite (1-2 mm long). The hornblende exhibits pleochroism from brownish-green to light brown. Biotite is brown to light brown. Some grains of the matrix plagioclase show albite twinning.

The chemical analysis was performed using an EPMA (JEOL JXA-8530F) at Kyushu University. All iron in garnet and orthopyroxene was treated as ferrous, and the ferric content in hornblende was calculated following the method of Holland and Blundy (1994) and Dale et al. (2000). The definition of anorthite content (An) is 100*Ca/(Ca + Na), and that of X_{Mg} is $Mg/(Mg + Fe^{2+})$. The garnet grains have an almost homogeneous composition (Alm44Prp37Grs18Sps1) with the exception of the rim. X_{Mg} decreases outward at the rim which contacts with the corona or matrix hornblende directly. In contrast, any compositional change was not observed at the rim which has a direct contact with the matrix plagioclase. The coronal orthopyroxene and plagioclase are chemically homogeneous within the corona. The coronal orthopyroxene has X_{Mg} and Al content of 0.71 and 0.18 apfu (O=6), respectively. The coronal plagioclase has high An content of 94-96, whereas that of the matrix plagioclase is slightly low (An87-95). The matrix hornblende corresponds to pargasite according to the classification of Leake et al. (1997). The composition is heterogeneous among grains as well as even in one grain, which has a range of X_{Mg} from 0.73 to 0.83.

The absence of zoning at the garnet-plagioclase contact and the presence of zoning at the garnet-hornblende and garnet-corona contacts suggest that the zoning was not related with the corona formation. If the zoning was formed before the corona formation, the zoning would be erased by the consumption of the garnet. Therefore, the Mg-Fe exchange reaction between the garnet and the coronas or matrix hornblende took place during a retrograde stage after the corona formation completed. The inferred corona-forming reaction based on textural observation is garnet + hornblende + $plagioclase_{matrix}$ = orthopyroxene + $plagioclase_{corona}$ + magnetite + H_2O. However, the direct contact between the garnet and the matrix hornblende or plagioclase without the corona suggests that the corona-forming reaction did not take place at some boundaries. We consider that the corona-forming reaction requires additional factors such as mass transfer during the formation and that the path of the mobile component in the rock may largely affect the corona formation.

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