Composition of constituent minerals in corona-bearing and -free mafic gneisses from the Lützow-Holm Complex at Skallen, East Antarctica

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Corona is one of the non-equilibrium microstructures and has been employed to infer pressure-temperature path of the metamorphic rocks. The corona around garnet is common in mafic to ultramafic gneisses in the Lützow-Holm Complex (LHC) of East Antarctica (e.g., Hiroi et al., 1991). However, not every garnet in mafic to ultramafic gneisses accompanies the corona. In our ongoing study to reveal the controlling factors of presence and absence of the corona, we compare the composition of garnet and hornblende of the corona-bearing (no. I-223) and -free (no. I-232) mafic gneisses from Skallen.

The metamorphic grade of the complex increases progressively from the upper amphibolite facies to granulite facies toward the southwest, and the LHC is divided into three zones referred to as the amphibolite-facies zone, transitional zone, and granulite-facies zone (Hiroi et al., 1991). Recent studies have revealed that both transitional and granulite-facies zones had undergone high temperatures that exceed 800 ˚C (e.g., Iwamura et al, 2013; Kawakami et al., 2016). Skallen is an exposure located in the granulite-facies zone.

The constituent minerals in the matrix of the studied samples are almost same (garnet, hornblende, plagioclase with minor amounts of clinopyroxene and orthopyroxene), but I-223 further contains biotite. The microstructure and chemical composition of I-223 is as follows. The garnet grain is coarse (15 mm in diameter) and surrounded by a symplectitic corona composed of orthopyroxene and plagioclase. Garnet is clearly divided into two domains of Ca-rich core (Xgrs=0.23) and Ca-poor rim (Xgrs=0.18). X_{Mg} [=Mg/(Mg+Fe)] increases toward rim from 0.22 to 0.27, and that in the outer part of the rim decreases toward the boundary between the garnet and the corona from 0.27 to 0.22. The Ca-poor rim of the garnet includes irregular-shaped nanogranite composed of quartz, biotite, plagioclase, and K-feldspar. Hornblende is brown to brownish-green and polygonal. The X_{Mg} of the hornblende is 0.46-0.50. Matrix plagioclase often shows antiperthite intergrowing An50 plagioclase with Or96 K-feldspar. The coronal plagioclase has higher anorthite content (An80) than that in the matrix (An50). The microstructure and chemical composition of I-232 is as follows. The garnet grain is coarse (10 mm long) and elongated. The garnet and the hornblende define foliation of the rock. The hornblende is brown to pale brown. The composition of garnet gradually changes from core (Alm52Prp31Grs14Sps3) to rim (Alm52Prp28Grs17Sps3). The X_{Mg} in the hornblende varies from 0.60-0.70, and the composition is heterogeneous even in one grain. Most part of plagioclase is An45, and some parts of rim of the plagioclase have higher anorthite content of 70.

The garnet and hornblende in the corona-bearing gneiss have lower X_{Mg} than those in the corona-free gneiss. In addition, calcium content of the garnet and matrix plagioclase in the corona-bearing gneiss is higher than that in the corona-free gneiss. Therefore, we consider that bulk composition is one of the factors controlling the corona formation. The presence of nanogranite in the garnet surrounded by the corona suggests that partial melting and transport of the melt would cause the change of bulk composition in part.

Keywords: corona, garnet, nanogranite, Lützow-Holm Complex, Antarctica