東南極 Lützow-Holm 岩体に産出する苦鉄質-超苦鉄質グラニュライトの岩石学､相平衡モデリング及び結晶化したメルト包有物の重要性

齋藤陽介[1]、角替敏昭[1]
[1] *筑波大学生命環境科学研究科*

Petrology and phase equilibrium modeling of crystalized melt inclusions in partially melted mafic to ultramafic granulites and their significance from the Neoproterozoic - Cambrian Lützow-Holm Complex, East Antarctica

Yohsuke Saitoh [1] and Toshiaki Tsunogae[1]
[1]*University of Tsukuba*

We report here new petrological date of crystalized melt inclusions (CMIs) and phase equilibrium modeling of partially melted mafic granulite to evaluate the influence of partial melting to the phase relation from the Neoproterozoic - Cambrian Lützow-Holm Complex (LHC), East Antarctica (Shiraishi et al., 1992). Previous petrological studies of the LHC suggest an increase in the metamorphic grade from northeast (amphibolite facies) to southwest (granulite facies) (Hiroi et al., 1991). CMIs are often reported from the pelitic and felsic granulites (e.g. Cesare et al., 2009). However they are relatively rare in mafic to ultramafic granulites. We thus attempt to investigate textures of the CMIs in the mafic to ultramafic granulites to discuss the partial melting process.

The examined mafic and ultramafic granulites occur as boudin or small blocks of several meters within psammitic and hornblende-biotite gneisses of the granulite-facies zone. Based on detailed microscopic observations, we found CMIs bearing mafic and ultramafic granulites from four different exposures within the LHC. The representative samples of mafic to ultramafic granulite are composed mainly of coarse-grained garnet, hornblende, orthopyroxene, clinopyroxene, plagioclase, and ilmenite. The garnet often contains CMIs. The CMIs consist of fine-grained quartz, orthopyroxene, biotite, K-feldspar, plagioclase, and ilmenite which size varies from 1 to 50εm. The size of CMI grains is up to 100εm, and they show negative crystal shapes of the host garnet. We subsequently calculated chemistry of the CMIs based on modal abundance and chemistry of the minerals for each CMI. The results are nearly equivalent to the compositions of andesitic to dacitic melt.

Occurrence of hornblende and biotite within garnet in the rock suggests dehydration melting of the hydrous minerals and formation of andesitic to dacitic melt during prograde stage. Phase equilibrium modeling in NCKFMASHTO system demonstrated that some mafic to ultramafic granulites experienced considerable amounts of melt loss (up to 8.0 wt. %) defined by the stability field of hornblende and quartz. Stability field of quartz expands toward lower pressure side with increase of melt amount in the phase diagram. The influence of partial melting can be neglected for other sample, because amount of melt loss is up to 0.9 %. Based on phase equilibrium modeling of melt-bulk interaction, the stability field of quartz and hornblende is critical to estimate for the P-T condition and amounts of melt extraction during partial melting. We estimated peak P-T condition of 1000 °C and 11-12 kbar and clockwise P-T path for the rock based on the integrated bulk composition. The peak condition is comparable with but slightly higher than previous estimations of 800-950 °C and

7-12 kbar (Yoshimura et al., 2004), although it is well consistent with the result of Kawasaki et al., (2013) who employed newly proposed geothermobarometry (e.g. Ti in zircon thermometer and Ti in garnet geothermobarometry). Our results suggest that partial melting and melt loss are common processes even in mafic to ultramafic granulites from the LHC, and CMIs could preserve the composition of melt which has already been extracted from the system. Phase equilibrium modeling suggests that melt loss during prograde stage have critical influence on the mineral assemblage and stability field of the mineral of the examined samples.

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