Crustal melting at the bottom of the magma chamber: a case of the Pipairo-tonalite body, Hidaka Metamorphic Belt, northern Japan

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The Hidaka Metamorphic Belt (HMB) is a high-dT/dP type metamorphic belt in Hokkaido, northern Japan. The HMB is considered to represent a tilted section of island-arc type crust (Komatsu et al., 1989; Osanai et al., 1991). The metamorphic grade increases toward the west. Metamorphic rocks are divided into four metamorphic zones (I-IV) from east to west owing to the mineral assemblage (Osanai et al., 1986, 1991). Zone III and IV are upper amphibolite facies and granulite facies, respectively.

Granitic rocks are widely distributed in the HMB. They are subdivided into four types by the intrusive level; (1) upper granite-granodiorite, (2) middle tonalite, (3) lower tonalite, and (4) basal tonalite (Komatsu et al., 1986; Shimura et al., 1992).

The Pipairo tonalite body is one of the middle to lower intrusive level tonalite, and is distributed in the northern part of the HMB. The tonalite body has a good advantage because it can be continuously observable from the top to the bottom of the pluton. This study focused on the bottom boundary of the pluton.

The base rocks of the pluton belong to zone III, where the boundary is consisted by migmatites. From the inside to the bottom of the pluton, the migmatite changes from leucocratic nebulitic migmatite to melanocratic schlieren migmatite. In addition, schlieren migmatite occurs in the lowest portion adjacent to the country rock biotite gneiss. The nebulitic migmatites contain quartz and biotite symplectite, the reactions thought to be Crd+L -} Bt+Als+Qtz+V or Crd+Kfs+V -} Bt+Als+Qtz. In addition, K-feldspar and sillimanite are in parageneses and muscovite grew cutting through the K-feldspar, which may Kfs+Als+V -} Ms+Qtz. These reactions are cooling process.

Whereas melanocratic nebulitic migmatite and schlieren migmatite shows the feature of partial melting. In the leucosome of the melanocratic mebulitic migmatite, euhedral plagioclase, euhedral quartz grains are enclosed in a garnet magacryst. On the other hand plagioclase occur as a corroded shape in the gneiss part. It seems that they correspond to melt and restite, respectively. In addition, both leucosome and gneiss partly contain the quartz and biotite symplectites, and also sometimes orthopyroxenes is included in this quartz. These features indicate a reaction, Opx+Kfs(L)+H2O -} Bt+Qtz. Thus this rock contained orthopyroxene in the peak metamorphic stage.

The metamorphic P-T conditions are estimated to 800C and 600MPa, by geothermobarometers. The temperature condition is higher than that of country rock biotite gneiss. The heat source of the partial melting is thought to be the tonalite pluton. At the middle crustal condition, especially at the bottom of a pluton, partial melting is able to occur.

References

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