Petrological character of the Nozuka-dake granite and its tectonic setting in the Hidaka metamorphic belt, Japan

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The Hidaka metamorphic belt in central Hokkaido is considered to be a tilted island arc crust section. Mount Nozuka-dake area is located in the boundary between the central and southern part of the Hidaka metamorphic belt. Various kinds of igneous rocks are exposed in this area. The igneous rocks are divided into three stages. In the first stage the igneous rocks underwent mylonitic deformation along the Hidaka Main Thrust. The rocks of the second and third stages intruded after the deformation. Recently, the seismic research involving this area was carried out, then the arc - arc collision tectonics regarding the Hidaka metamorphic belt was argued. The relationship between the tectonic environment and the magmatism however has not been fully understood. We will describe the granitic rocks in this area, and discuss with petrogenesis of the granitic magma and its tectonic implication.

Cordierite tonalite, hornblende tonalite and pyroxene gabbro belong to the first stage. In the second stage gabbro-diorite complex (Niobetsu Complex) and biotite granite (Nozuka-dake granite) intruded. In addition to these igneous masses, dolerite dikes are exposed in this area as the third stage.

The Nozuka-dake granite belongs to the second stage, and is characterized by containing porphyritic K-feldspar and muscovite. Orthopyroxene including corroded biotite is locally presence in the granite. Its aluminum-saturated index (A/CNK) is 1.1 to 1.2. The petrological feature of the Nozuka-dake granite resembles that of the cordierite tonalite being of the first stage although K2O and Rb contents of the Nozuka-dake granite are higher than those of the cordierite tonalite.

The Niobetsu Complex belonging to the second stage contains a large amount of the tonalitic xenoliths derived from the host cordierite tonalite. These xenoliths consist of plagioclase - orthopyroxene - cordierite - quartz - biotite - K-feldspar - apatite - opaque mineral +/- garnet +/- spinel and show fine-grained granoblastic texture. Metamorphic P-T conditions are c. 800 C and -4 kbar. Fine-grained biotite occurred as corroded form and symplectitic aggregate with quartz, K-feldspar and orthopyroxene. Coarse-grained domains containing euhedral cordierite, plagioclase and K-feldspar are locally presence. These textures can be explained by melting reaction as follows, biotite + quartz = orthopyroxene + K-feldspar + melt, and/or biotite + garnet + quartz = orthopyroxene + cordierite + K-feldspar +melt. The A/CNK of the xenoliths is up to 1.9. The modal abundance of cordierite in the xenoliths is c. 37 percent. These lines of evidence suggest that the xenoliths are regarded as restite after leaving granitic melt from the cordierite tonalite. The inferred melt composition calculated by massbalance method using the xenolith and the host cordierite tonalite is identical with the chemical composition of the biotite granite (Nozuka-dake granite). Therefore, partial melting of the cordierite tonalite probably took place in the xenoliths caused by thermal effect of the basaltic magma (Niobetsu Complex), giving rise to granitic melt (Nozuka-dake granite). This magma process is considered to be essentially the same as that of the deeper part of volcanic arcs where crust components are fused by underplated basaltic magma.

The garnet bearing ferro-gabbro in the Niobetsu Complex yields a Sm-Nd garnet-whole rock isochron age of 18 Ma. This age is regarded as a timing of intrusion and solidification of the Niobetsu Complex.

Based on the seismic analysis, the Hidaka metamorphic belt was disclosure as a result of collision between Kuril and Northeast Japan arcs during the late Paleogene to Early Miocene. Taking timing of intrusion and petrological investigation into account, the Nozuka-dake granite and the Niobetsu Complex are regarded as a post-collision magmatism with respect to the arc-arc collision.