東南極セール・ロンダーネ山地に分布する変トーナル岩の成因

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Petrogenesis of meta-tonalite in the Sør Rondane Mountains, East Antarctica

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Proterozoic meta-tonalite named the Nils Larsen tonalite is widely distributed in the Sør Rondane Mountains, Eastern Dronning Maud Land, East Antarctica. The meta-tonalite mainly dominates Nils Larsenfjellet, Widerøefjellet, Walnumfjellet, and Lunckeryggen in the southwestern part of the Sør Rondane Mountains. Pioneering workers reports some important information for the meta-tonalite; 1) the geological map is published; 2) the lithotypes are mainly gneissose meta-tonalite; 3) isotopic dating yields ages of 956-920Ma; 4) geochemical features are similar to those of Archean tonalite-trondhjemite-granodiorite (TTG) associations (e.g., VanAutenboer1964; Takahashi et al., 1990; Shiraishi et al., 1992, 2008; Osanai et al., 1996; Ikeda and Shiraishi, 1998). Therefore, the first petrogenetic model was concluded that the meta-tonalite composed a huge single batholith and was derived from a partial melting of oceanic crust during the Grenvillian.

We newly performed detailed geological survey of the meta-tonalite in a wide area. The lithofacies of the meta-tonalite lack unity over the mountains. We recognized that the meta-tonalite consists of various plutonic rocks such as tonalite, granodiorite, quartz-diorite, and gabbro. These evidences lead us to a consideration that the rocks in the meta-tonalite are not derived from a single magma, and they comprise a complex intrusion. Therefore, the petrological feature should be reinvestigated, and the petrogeneses must be reexamined.

The rocks in the meta-tonalite intrusion are largely divided into three types based on the lithology and petrography. The first is gneissose Bt-Hbl meta-tonalite, which involves many elongated mafic enclaves. This is the main lithotype in Nils Larsenfjellet, Widerøefjellet, and Walnumfjellet. The Bt-Hbl meta-tonalite is mainly composed of plagioclase, quartz, biotite, and horunblende with minor amount of K-feldspar. The elongated hornblende is conspicuous and makes foliation of the gneissose structure. Epidote and zoisite are recognised as secondary minerals replacing the essential phases. Some researchers reported that the rocks are mainly underlain by the epidote-amphibolite facies metamorphism (e.g., Shiraishi et al., 1992; Osanai et al., 1996). All of the minerals lose euhedral shapes and lack igneous texture such as zonal structure. The Bt-Hbl meta-tonalite show geochemical features of volcanic arc granitoids with low-K tholeiite signature, but not adakitic. The whole-rock and Sr-Nd isotopic compositions suggest that the magma was probably derived from partial melting of mafic lower crust with the composition of low-K oceanic arc basalt. Therefore, it is quite likely that the gneissose Bt-Hbl meta-tonalite was generated as a component of juvenile continental crust in oceanic-island arc setting. The timing of intrusion of the Bt-Hbl meta-tonalite is considered to approximately 900-800Ma by Rb-Sr and Sm-Nd whole rock isochron methods.

The second is Hbl-Bt meta-tonalite in Lunckeryggen, which is poor in mafic enclaves. This type is also observed in the southeastern end of Walnumfjellet. The mylonitiztion can be recognized under the microscope, but the degree of mineral deformation is lower than that of the gneissose Bt-Hbl meta-tonalite. The Hbl-Bt meta-tonalite yields a Rb-Sr whole-rock isochron age of about 700Ma. The third is Bt meta-granodiorite, which locally crops out in the northern end of Nils Larsenfjellet. The mylonitiztion can be also identified under the microscope. The degree of mineral deformation is similar to that of the Hbl-Bt meta-tonalite in Lunckeryggen. The Bt meta-granodiorite is sometimes mingled with granitic and quartz-dioritic rocks. The essential mineral assemblage and secondary minerals of both the Hbl-Bt meta-tonalite and the Bt meta-granodiorite closely resemble those of the gneissose Bt-Hbl meta-tonalite. However, euhedral hornblende and igneous plagioclase with oscillatory zoning exist in the Hbl-Bt meta-tonalite and the Bt meta-granodiorite, respectively. The both of the

Hbl-Bt meta-tonalite and the Bt meta-granodiorite are geochemically regarded as calc-alkaline adakites. Their Sr-Nd isotopes give an information of MORB-like protolith. It seems quite probable that they were derived from partial melting of subducted oceanic slab. In conclusion, we consider that the meta-tonalite association in the Sør Rondane Mountains was firstly formed as low-K tholeiitic granitoids, which composed of juvenile crust in oceanic-island arc in the timing of 900-800Ma. Subsequently, adakitic magmatism was sometimes visiting this area by hot slab subduction.

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