Petrological characteristics of Miocene basalts from Ootsu district, back-arc area of SW Japan arc

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Cenozoic basalts are widely distributed in the Chugoku district, SW Japan. These basalts are considered to be produced by asthenosphere upwelling in back-arc area, because most of the basalts are OIB (Ocean Island Basalts) in character. However, subduction signatures, such as Nb depletion, are also observed among basalts from this area. We report geological and petrological characteristics of basalts from Ootsu district, a back-arc area of SW Japan arc.

Miocene basalts of Ootsu district (hereinafter called Ootsu basalts) are composed of large amounts of lava flows and following pyroclastic fall deposits. Ootsu basalts usually contain olivine phenocrysts, which have tiny euhedral spinel inclusion, and clinopyroxene and plagioclase occasionally. Based on petrography, Ootsu basalts are divided into two types, magnetite-rich type basalts (MRBs) and magnetite-poor type basalts (MPBs).

MRBs and MPBs also have different contents of major and trace elements, and show several chemical compositional trends in each types. They are characterized as follows: (1) SiO2 content and FeO*/MgO ratio of MRBs and MPBs range from 46-52 wt.% and 1.00-2.42, 49-56 wt.% and 0.82-2.11 respectively, and (2) MRBs are rich in FeO* and TiO2 contents, and MPBs are rich in Al2O3 contents. In terms of SiO2 versus (Na2O+K2O), MRBs are plotted in the alkaline basalt field, and MPBs are plotted near the boundary between alkaline basalt and tholeiite fields. In the Nb-Zr-Y discrimination diagram, MRBs are plotted in within-plate alkaline basalts field, on the other hand, MPB are plotted in the fields of within-plate alkaline basalts and within-plate tholeiite. In the N-MORB normalized spider diagrams, these basalts show Nb depletion and Pb enrichment.

In the Cr-Al-Fe3+ ternary diagram, chromian spinels coexisting with olivine phenocrysts show crystallization trends convex from Cr to Fe apex, which are typical characters of alkaline basalts. Most pyroxene of Ootsu basalts are augite, and increasing in Fe2+ and Ca during crystallization. Some pyroxene of Ootsu basalts contain pigieonite in the groundmass. Assuming that the Fe-Mg exchange partition coefficient between basaltic melt and olivine is 0.3. Some of these rocks have the primary features of high NiO/MgO and low FeO*/MgO ratios of the bulk rock compositions, and Mg value and NiO content of olivine phenocrysts range from 87.9-87.2 and 0.34-0.28 relatively. The estimated compositions of primitive magmas for MRBs and MPBs suggest that they were derived from different sources. Having subduction signatures is potentially believed to be due to two possible models for these magma generation process: (1) the magma reacts with surrounding crustal rocks during its migration upward, and (2) subduction components enrichment from Philippine Sea Plate dehydration.