Trace element composition of high-Mg andesite in middle Miocence Southwest Japan Arc

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1. Sample and method

Setouchi Volcanic Rocks were formed in near trench region of middle Miocene Southwest Japan Arc. Most of previous studies were concentrated on the high-Mg andesite and olivine tholeiitic basalt which had been equilibrated with mantle peridotite. To discuss on the possible along arc geochemical variation and contribution of slab derived component to the magma source, we report major and trace element compositions of high-Mg andesite and coexisting basalts in the following localities.

(1) high-Mg andesites and olivine tholeiitic basalt in Osaka area

(2) high-Mg andesites and olivine tholeiitic basalt in Sanuki plain and adjacent islands

(3) high-Mg andesites in Takanawa Peninsula and adjacent islands

(4) high-Mg andesite in Oita area

(5) high-Mg andesitic rocks in Outer Zone of Kii Peninsula; magnesian diorite enclaves in Ohmine granitic rocks (Shinjoe and Shimoda, 1996) and high-Mg andesite dike in southern Kii Peninsula (Miyake et al., 1985)

Most of trace element concentrations including rare earth element and high field strength elements were determined on ICP-MS (VG PQ3) by glass bead method (Orihashi et al., 2003). Several trace elements and major elements were analyzed on XRF.

2. Results and Discussion

All the high-Mg andesite and basalt analyzed have low FeO*/MgO ratio (0.57-0.97), which suggests these rock can be equilibrate with Mg-rich olivine. Trace element enrichment was visualized by negative slope on N-MORB normalized trace element patterns, with overproportionally concentrated Pb and depletion of Nb and Ta, which are usually expected for island arc magmas. Essentially, these trace element patterns are common in all the high-Mg andesite and basalt analyzed. More detailed points were listed below.

(1) For high-Mg andesite and basalt of Setouchi Volcanic Rocks, contribution of subducting sediment, particularly partial melt of terrigenous sediments to the magma source were stressed based on their Sr, Nd, Pb isotopic compositions and trace element compositions (Shimoda et al., 2003). In addition, we inspected Nb/U ratio; both of the elements has similar incompatibility for the mantle minerals, though it was suggested that Nb have larger bulk distribution coefficient than U during the melting of sediments (Johnson and Plank, 1998). Average Nb/U for high-Mg andesite and basalt (=3.8) was obviously lower than those of estimated subducted sediment (=6.8: Plank and Langmuir, 1998) and upper continental crust (=8.9: Rudnick and Fountain, 1995), which is one of the supporting evidence of contribution of sediment melt as for the slab derived component.

(2) Though the age of subducting Shikoku Basin of Philippine Sea Plate changes along arc direction, systematic along arc trace element variation was not discerned. Abundance of the incompatible element might be controlled by local scale variation of addition of slab derived component to the mantle.

(3) Trace element composition of the two high-Mg andesitic rocks in the Outer Zone of Kii Peninsula cannot be distinguished from those of Setouchi Volcanic Rocks. In particular, Haneta dike is located ca. 70 km trenchward from high-Mg andesites in Osaka area, This fact may be a significant constraint to the tectonic environment of the high-Mg andesite magma production.

(4) A high-Mg andesite of Takahama bay in Takanawa Peninsula has geochemical characteristics similar to adakite (Sr/Y=39.4; chondrite-normalized La/Yb=16.2). Four analyzed samples from adjacent area lacks in such feature. 11.8-12.0Ma K-Ar whole rock age were reported for andesite from the same locality, and the ages are 2-3 Ma younger than andesitic rocks surrounding area (Sumii, 2000).

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