Geochemical marks of paleosubduction in the Tara-dake basalts from NW Kyushu, SW Japan

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Addition of aqueous fluids to mantle wedge to decrease its solidus temperature is considered to play an essential role to arc magma genesis. Relative depletion of HFSE is regarded as the strong evidence of this hypothesis. However, there is a possibility that HFSE depletion of basalts from well matured arcs located at subduction zones geologically long periods was formed far before magma generation. To evaluate the effect of paleosubduction to arc basalt geochemistry, geochemical studies for basalts at the place where subduction occurred at geologically past periods and does not occur at present are required.

NW Kyushu is one of the best regions to resolve this issue. Geologic structures of the Kyushu Island suggest that NW Kyushu was the back-arc region of paleosubduction. Deep seismic zones corresponding to currently subducting Philippine Sea plate are not observed beneath NW Kyushu. Thus, if the NW Kyushu basalts have geochemical signatures of arc basalts, it is the result not of current subduction but by paleosubduction. In this paper we report the bulk rock composition of the Tara-dake basalts from NW Kyushu.

The Tara-dake basalts (TDB) contain Nb = 5.3 – 43.7 ppm, La =8.7 – 38.7 ppm. The Nb/La ratio ranges from 2.0 to 0.5. TDB show no clear correlation between Nb/La and La concentration. Thus, addition of aqueous fluids to the NW Kyushu mantle could not explain the variation of Nb/La of TDB. Since MgO ranging from 10.6 to 3.1 wt. % also has no correlation with Nb/La, crustal assimilation could not also explain the variation of Nb/La of TDB. The most reasonable explanation of Nb/La variation of TDB is the interaction between asthenospheric mantle with low Nb/La and lithospheric mantle with high Nb/La. Since currently subducting Philippine Sea plate does not reach NW Kyushu, low Nb/La of lithospheric mantle is the result of paleosubduction before Philippine Sea opening.

The geochemistry of the Tara-dake basalts suggests that significant portions of the HFSE depletion of basalts from well matured arcs are caused by paleosubduction. For such arc basalts, the HFSE depletion does not directly suggest the essential role of dehydration of subducting oceanic plate to arc magma genesis.