Origin of spatial compositional variations of volcanic rocks from Northern Kurile Islands: Geochemical studies of active volcanoes on Paramushir, Atlasova, Antsiferova islands and submarine volcanoes

Olga Bergal-Kuvikas[1,2], Mitsuhiro Nakagawa[1], Gennady Avdeiko[2]

[1]Hokkaido University, Graduate School of Science, Department of Earth and Planetary Sciences, Japan, [2]Institute of Volcanology and Seismology, Russia

E-mail: kuvikas@mail.sci.hokudai.ac.jp

The Northern Kurile Islands form the part of Kurile-Kamchatka volcanic arc. The Pacific plate has subducted beneath the islands since the late Miocene to cause arc-type volcanism. We newly determined major and trace element compositions, Sr-Nd isotopic variations of Quaternary rocks from 7 subarial and 3 submarine volcanoes. Analysis of new and previous publications indicate that the Northern Kurile Islands belong to typical volcanic island arc. About it there are indicated Ta, Nb minimum on the spider diagrams and naturally enriched of the LILE, LREE and depleted of the HFSE, HREE from front to back arc zone. Peculiarities of petrography and whole-rock chemistry enable us to divide all volcanoes into three main zones: frontal, intermediate and rear ones. Frontal zone include Chikurachki, Tatarinova, Lomonosova, 1.3 volcanoes. The rocks are Ol-Cpx bearing Opx basaltic andesite. Fuss, Antsiferova volcanic group and Ebeko volcano locates at the intermediate zone. Hbl-Cpx-Ol-bearing Opx andesite are commonly characterized by the presence of hornblende phenocryst. Alaid, Grigoreva volcanic group locate at the rear zone. Ol-bearing Cpx basalts and basaltic andesite are typical. In addition, Alaid and Grigorev volcanic group is characterized by the largest eruptive volume (150 km^3). Frontal zone is characterized by lowest contents of incompatible elements (Rb, Ba, K) and LREES (Nd, Ce). Isotopic variations have the highest value of $^{143}Nd/^{144}Nd$ and $^{87}Sr/^{86}Sr$ as 0.7031-0.7034. In the opposite, rear and intermediate zones show narrower lower contents of $^{143}Nd/^{144}Nd$ and $^{87}Sr/^{86}Sr$ as 0.7029-0.7031. The rocks of rear zone show highest contents of LILE (K, Rb), LREES (La, Gd, Nd, Sm) and HFSEE (Nb, Ta). Both $^{143}Nd/^{144}Nd$ and $^{87}Sr/^{86}Sr$ ratios of the rocks from intermediate and frontal zones increase with increasing of silica contens. These suggest that andesitic and dacitic rocks from these zones are possibly affected by crustal component. In contrast, crustal assimilation might be minor process in the case of the rear zone, because basaltic rocks are predominant in the zone. Geochemical features of the mafic rocks investigate the spatial difference in magma sources of three zones. Rocks from rear zone are systematically enriched in Nb/Y, Th/Yb, Ta/Yb, Nb/Yb, La/Yb ratios. These data are implied by the fact that magma in the rear zone more enriched with comparing depleted frontal zone. In addition, chemical variations of fluid-mobile elements (Cs, Ba, U, Th, Sr) and immobile elements (Nd, Nb, Zr, Hf) of the mafic rocks will be explained by different types of subduction components.

In summary, the following parameters have mainly affected the observed geochemical zonation across the arc in the primary magma; variably depleted and enriched mantle source: the different type fluid flux from the slab to the mantle wedge.