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Petrological study of monogenetic volcanoes in the fore-arc region of the northern Kamchatka Peninsula

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The western part of the Pacific Plate is subducting under the Okhotsk Plate along Kuril-Kamchatka Trench, and the northern part of it is subducting under the Bering Sea Plate with high obliquity along the western Aleutians arc. The three plates form the Aleutian-Kamchatka triple junction (Eichelberger *et al*., 2013). The northern edge of the Pacific Plate is separated from Bering Sea Plate by transform fault, and the mantle edge beneath the Kamchatka Peninsula is thought to be open towards the Bering Sea.

There are at least 29 active volcanoes in the Kamchatka Peninsula. From the east to the west, arc volcanism on the Kamchatka Peninsula forms three zones parallel to the Kamchatka trench: the Eastern Volcanic Front (EVF), the Central Kamchatka Depression (CKD) including Klychevskaya Volcano Group (KVG) where the large volcanoes concentrate, and the Sredinny Ridge (SR) in the back arc side.

Along EVF, the straight volcanic chain is terminated around 55^{o}N (near the Kizimen volcano), and in further north the volcanic chain seems to deflect toward KVG corresponding to deeper depth of subducting slab. However, monogenetic volcanoes on the northward extension of the EVF exist and were studied in 1960s, called ‘ Kumuroch range ’ (Fedororenko., 1969). The present-day slab depth beneath the monogenetic volcanoes is about 60km (Gorbatov *et al*., 1997), and the crustal thickness is about 20-30km (Levin *et al*., 2002). These volcanic rocks were reported as basalt to andesite, having relatively high MgO content ($\sim$11.8 wt. %) and low FeO/MgO ratio ($<$1.0) (Uspensky and Shapiro., 1984). In summer 2013, we have identified 15 monogenetic volcanoes in this area (hereafter ‘ East Cone volcanic group ’ , EC) by using stereogram, and had investigated 8 volcanoes by using a helicopter.

In this study, we aim to reveal the origin of the EC lavas. For this purpose, we have first examined mineral assemblages under optical microscope and analyzed the whole rock major element compositions by XRF. All 16 samples are classified as basalt or basaltic andesite, of which the two lavas contain xenoliths, and one sample oxidized to red. The rocks exhibit porphyritic to seriate texture, containing plagioclase, clinopyroxene, olivine, opaque minerals, although, the proportion of minerals varies from sample to sample. The silica contents of all samples are over 50 wt. %, with the FeO/MgO ratio less than 2, indicating relatively undifferentiated characteristics.

In comparison to the typical island arc basalts having a similar silica content, the MgO contents of the EC lavas are higher by $\sim$4 wt. %. Accordingly, the EC lavas are similar to or classified into high-Mg andesite, which is considered to be generated by melting of relatively hydrous mantle (as an example, unsaturated with H_2O, 1.0GPa, 1100-1250 ℃, saturated with H_2O, 1.5GPa, 1030-1150 ℃) (Tatsumi., 1995; 2003).

The EC lavas scarcely include orthopyroxene, on the other hand, volcanic rocks of KG include orthopyroxene (Churikova *et al*., 2013). Mantle xenoliths from the Bezymianny volcano of KG is reported to be spinel harzburgites (Ionov *et al*., 2013). Combining these constraints, we discuss a regional variation in mineral assemblage and H_2O content in source mantle, H_2O content in the primary magma, and the crystallization temperature and pressure of the magmas.

By comparing the petrological characteristics of the EC lavas with those from other regions (e.g., KG), cleare constraints on the relationship between magma genesis and the tectonic setting are expected to be imposed.

Keywords: arc, high-Mg andesite, Kamchatka Peninsula, triple junction