Discovery of Quaternary volcanism in southern Sakhalin

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Cenozoic tectono-magmatic processes in the western Pacific margins and their precise timings are critical in comprehending the behaviors of the Pacific Plate motion and associated back-arc basin formation, such as those in the Philippine Sea Plate and the Eurasia margin during formation of the Sea of Japan.

Compared to the other parts of the western Pacific region, records of magmatism in the northwestern Pacific margin, including those in Sakhalin and Kamchatka, Russian Far East, are still not well studied.

The southern part of Sakhalin sporadically exposes Oligocene (~30 Ma) to Miocene (~5 Ma) basaltic to andesitic lavas and dikes along the western coast (Okamura et al., 1998; Shimazu et al., 1992; Takeuchi, 1997). Geochemical studies have suggested a change in magma generation occurred from older Oligocene-Miocene arc magmatism to younger Mid-Late Miocene alkaline and subalkaline intraplate-magmatism (Okamura et al., 2005). The largest occurrence of volcanic rocks in Sakhalin is in the Lamanon area, where basaltic lava and volcanic breccia are exposed in a wide (~40 km E-W and ~60 km N-S) zone. Furthermore, the Lamanon area is characterized by the presence of more than ten conspicuous cones, varying in size from ~1 to ~5 km in diameter. Erokhoev and Shilov (1971) documented one of the cones, Mt. Ichara, located at the western end, to be a dacite lava dome. But due to their difficult accessibility, no further research has been conducted on these cones.

We conducted a reconnaissance survey of the Lamanon cones in 2017, visiting three of the cones, Mts. Ichara, Krutaya, and Krasnova. Our survey confirmed that all of the cones are mono-lithologic, dacite lava dome. A recovered sample yielded a Pleistocene (<1 Ma) Ar-Ar plateau age, indicating the occurrence of Quaternary volcanism in Sakhalin for the first time. Furthermore, the whole-rock compositions of the Lamanon dacites show elevated Sr/Y ratios, and enrichment in Mg and Ni, which are consistent with geochemical affinities similar to those of adakite.

Since the slab depth of the Pacific Plate beneath the Lamanon area is deeper than 600 km, it is unlikely that dacite magma generation was related to the subducting slab. Instead, given that the Lamanon area is located at the northeastern continuation of the rift system within the Sea of Japan, we propose that deep crustal melting associated with the rifting may have generated the dacite magma.

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