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Eruptive sequence and magma system of the latest large silicic eruption of Kuttara volcano (Kt-1), southwestern Hokkaido

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Kuttara volcanic group, located in southwestern Hokkaido, started its eruptive activity ca. 80 ka. The volcano has repeated the large silicic eruptions several times. The youngest large silicic eruption (Kt-1) occurred ca. 42 ka, forming the present Kuttara caldera (Yamagata, 1994; Moriizumi, 1998). Total volume of Kuttara volcanic group is more than 100 km^3, being comparable to those of Shikotsu and Toya caldera volcanoes that locate near Kuttara volcanic group. However, it has not been still understood the reason for the multiple eruptions of voluminous silicic magma. In order to resolve this problem, it is important to reveal the eruptive sequence and the evolution of magma system. Therefore, we has carried out the geological and petrological studies about Kuttara volcanic groups. In this presentation, we reexamine the eruptive sequence of Kt-1 eruption and discuss the relationship between eruptive sequence and magma system.

Moriizumi (1998) recognized that Kt-1 pyroclasts are composed of pyroclastic falls (Kt-1pfa), pyroclastic flow (Kt-1pfl), and pyroclastic surge (Kt-1ps). Kt-1pfa is divided into lower and upper units (Kt-1 pfa1 and Kt-1 pfa2, respectively) on the basis of scoria fall deposits (Kt-1sfa). Kt-1 pfa1 includes hornblende-bearing pumices, whereas Kt-1 pfa2 is absent from such pumices. Kt-1 pfl has also no hornblende in pumices, and therefore, it is interpreted that Kt-1 pfa2 and -pfl occurred simultaneously.

In this study, we can divide pyroclastic falls into five units according to the time gaps on the basis of weathered layers of the top of each unit: from Kt-1A to Kt-1E in ascending order. In Kt-1A, -1B and -1C, there are some pumices including hornblende, whereas pumices in Kt-1D to Kt-1E have no hornblende. This suggests that units from Kt-1A to Kt-1C and from Kt-1D to Kt-1E respectively correspond to Kt-1 pfa1 and Kt-1 pfa2 defined by Moriizumi (1998). In addition, we recognize the pyroclastic flow and surge deposits, agreeing with Kt-1pfl and Kt-1ps, respectively. The pyroclastic falls comprise of white and banded pumices, and pyroclastic flow includes white pumice, scoria, and banded pumice˜scoria. Phenocrystic minerals of all the juveniles are quartz, plagioclase, orthopyroxene, clinopyroxene, and opaque minerals. On whole-rock chemistry, the juvenile materials of Kt-1 eruption show 59.2-74.1 wt.% in SiO_2. We identify four compositional trends, being clearly different in many Harker diagrams. On the basis of the compositional trends as well as mineral assemblage, we classified Kt-1 juveniles into four types as follows. Type1 is the most silicic rhyolite including hornblende. Type2 is a hornblende-free rhyolite and rhyodacite rock. Type3 is dacite having a small amount of hornblende. Type4 is characterized by wide compositional variation from rhyolite to andesite without hornblende. The compositional trends of Type1, -2, and -3 are clearly distinct at both silicic and mafic sides. In contrast, Type4 shows the compositional trend converging to Type2 at silicic side.

Considering the temporal change of juvenile types, components change with the progress of eruption. Type1 and -3 are present in Kt-1A. In Kt-1B and -1C, however, Type1 disappears and Type2 and -3 are found. In Kt-1D and -1E, only Type2 occurs. On the other hand, in Kt-1pfl, there is only Type4 juveniles. The difference in types of juveniles between pyroclastic falls and flow suggests that pyroclastic flow did not occur simultaneously with Kt-1D and -1E (Kt-1pfa2). The compositional trends for whole-rock chemistry of Type2 and -4 converge at silicic side. This indicates that pyroclastic flow generated after pyroclastic fall eruptions.

We recognize four types of juvenile materials in Kt-1 eruption. That is, four types of magma erupted in Kt-1 eruption. These magmas had been active in turn as the eruption progressed, suggesting the relationship between eruptive sequence and magma system.

Keywords: Kuttara volcano, caldera volcano, caldera-forming eruption, silicic magma, Petrological features, magma chemistry