

Geology and petrology of Taisetsu volcano group, Japan; Evolution of magma and long-term time variation of eruption rate

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Taisetsu volcano group locates at the northern part of the Taisetsu-Tokachi volcanic chain, which is situated at the southern end of Kuril arc. The volcano group started its activity ca. 1 Ma and is composed of andesitic lava domes and stratovolcanoes. Although previous studies (eg., NEDO, 1990; Katsui, 1979) revealed the outline of structure and eruptive history of the group, detail chronological and petrological studies have not been carried out. We have revealed the volcano stratigraphy and petrological features of the whole area of the volcano group. In addition, K-Ar ages of representative samples are also determined. Based on these data, we focus on the temporal change of eruption rate and magma types during 1 My in the volcano group.

According to the stratigraphy, location of eruption centers, mode of eruptive activity and petrological features, the activity of the volcano group can be divided into four major stages, as follows. Stage 1(1.0 ~0.75Ma): Fluidal andesite lava were effused from several eruption centers to form flat-shaped volcanic edifices which are distributed in N-S direction. Their total estimated eruptive volume is 26km³(DRE). Stage 2: It can be subdivided into sub-stage 2-1 (0.6Ma) and 2-2 (0.35 ~0.05Ma). Eruptive lavas of the former sub-stage are mostly covered by younger deposits. Detail structure of the edifice and the distribution of deposits have not been clear. The sub-stage 2-2, is further subdivided into central and western group according to the differences in mode of activity and location of eruption centers. The total estimated eruptive volume of stage 2 is 23km³. Stage 3(ca. 30 ka): The stage is characterized by most explosive eruptions in the volcano group, resulting to the formation of a plinian column and related pyroclastic flows. These activities formed the Ohachidaira caldera with 2 km in a diameter. The total eruptive volume is estimated to be 13km³. Stage 4 (ca. 30 ka - present): Main eruption centers moves to the southwestern part of the caldera to form several stratovolcanoes and lava domes. The total eruptive volume of stage 4 is 10km³. Based on the ages and estimated eruptive volume, the magma discharge stepdiagram of the volcano group is created to discuss a temporal change of magma discharge rate. The eruption rate of each stage is as follows; >0.07km³/ky for stage 1, >0.01km³/ky for stage 2-1, >0.06km³/ky for stage 2-2, >0.33km³/ky for stage 3, >0.33km³/ky for stage 4. According to the stepdiagram, the period from 0.7 to 0.4 Ma could be characterized by extremely low eruption rate and/or the presence of dormant stage.

Petrological features of the ejecta of Taisetsu volcano group can be distinguished among stages. All of the rocks are andesite and dacite, often containing mafic inclusions. These rocks contain plagioclase, clinopyroxene, orthopyroxene and Ti-magnetite as phenocrysts, associated with minor amounts of olivine, and quartz phenocrysts in some rocks. Although the rocks of stage 1 do not contain hornblende phenocrysts, those of stage 2 and 3 usually include hornblende phenocrysts. However, there rarely exist hornblende phenocrysts in the rocks of stage 4. The whole-rock SiO₂ contents range from 56.4 to 69.1 wt.% for host rocks and from 52.7 to 57.4 for the inclusions. Almost all the rocks are defined as medium-K in SiO₂ - K₂O and CA types in SiO₂-FeO/MgO diagrams, respectively. The host of the rocks from stage 1 is characterized by high Zr contents, compared with the rocks from other stages, whereas Zr contents in the mafic inclusions in the rocks from stage 1 are the same as those from other stages. Considering Zr contents and occurrence of hornblende phenocryst in andesite, magma type had changed largely during the possible long dormancy from 0.7 to 0.4 Ma. This would be related to the tectonic change at the junction between NE Japan and Kuril arcs.

Keywords: Volcano, Eruption rate, Formation history, Taisetsu, Geology and petrology, Transition of magma