The occurrence and petrology of the fine-grained pyroclastic materials of the Futatsudake-Shibukawa eruption in Haruna volcano.

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Haruna volcano is an active volcano of Quaternary which is located in the southern end of the NE Japan arc. Haruna volcano has 500000 years active time. Geshi and Takeuchi (2012) showed the activity is classified into older period (500-240ka), and newer period (45ka-) following activity halt of about 200,000 years. The newest activity in Haruna volcano is Shibukawa eruption (late 5th to early 6th century) and Ikaho eruption (late 6th to early 7th century), both of which occurred at the location of present Futatsudake (ages by Geshi and Oishi (2011)). Occurrences of ejecta from two eruption, as described in Soda (1989), indicate the different manner of pyroclastic flow generation; explosive destruction of the lava dome in the Shibukawa eruption, while column collapse in the Ikaho eruption. Suzuki and Nakada (2007) carried out detailed petrological study for the Ikaho eruption. They proposed mush-like felsic magma was remobilized by the injection of mafic magma. The important point in the eruption triggering was that mixed magma and heated magma with considerably lower viscosity than the original mush-like magma opened the vent, resulting in the decompression of whole felsic magma reservoir. However, no study has revealed the magma plumbing system and the eruption triggering process of the Shibukawa eruption. For the purpose of understanding these points, we have conducted the petrological study of the Shibukawa eruption. In particular, in this research, in order to clarify the progress of eruption and the temporal change of the erupted magma, fine-grained pyroclastic materials were studied rather than pumice blocks in the block and ash flow (BAF).

We sampled fine-grained pyroclastic deposits at four sites locating at the northeastern to eastern foot of Haruna volcano. All sites locate at the periphery of BAF mapped in Soda (1989). Therefore, our investigated sites correspond to the region where pyroclastic surge deposit emplaces (example of Unzen 1991-1995 eruption; Fujii and Nakada, 1999). We could observe the basal part of fine-grained pyroclastic material in three sites. In all sites, the strata were divided into multiple units according to their facies. The juvenile pumice clasts, the coarse part of the deposit, had variation in color (white, gray, light gray). We measured whole rock compositions of the pumice samples and found they are felsic andesite (SiO_2 =60.7-61.9wt.%; N=22). Thin sections were prepared for ten representative pumices and one volcanic ash sample. It is necessary to study the volcanic ash sample, because it is not possible to discuss the change in magma composition from lower to the upper layer, only with the pumice clasts for which whole-rock chemical analyses were performed. The phenocryst phases (Pl+Opx+Am+Fe-Ti Ox) in all samples form aggregates, so when they crystallized, they were in equilibrium. We observed free crystals (Pl+Opx+Am), pumice particles, and lava particles in the thin sections of volcanic ash. All thin sections of pumice and ash include the dusty zone of Pl, so these products resulted from either through magma mixing (between felsic and mafic magmas) or the heating of felsic magma by the mafic magma. In four out of five samples of gray pumice, breakdown reaction rims of amphibole and groundmass crystals were confirmed, so magma that formed gray pumice likely underwent a different ascending process in conduit, in comparison with the magma that formed white pumice.

Suzuki and Fukushima (2019, this conference) studied pumice blocks in the BAF from the Futatsudake-Shibukawa eruption. This result is similar to our result. Therefore, we infer magmas formed these two products was homogeneous in magma chamber. The original pyroclastic flow was separated into rock mass flow and pyroclastic surge as they descended river valleys, resulting in simultaneous

emplacement of the BAF and fine-grained pyroclastic materials at different distances from the river valleys.

Keywords: Haruna volcano, Block and ash flow, Pyroclastic surge, Magma mixing, Heating from hotter magma, Eruption trigger

