Magma plumbing system in the caldera-forming eruption of Haruna volcano indicated by Satomi pyroclastic flow deposit

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Haruna volcano is a large stratovolcano, located at the southernmost point of the NE Japan arc. Geshi and Takeuchi (2012) divided its activity into two stages (older and newer period). Haruna volcano had not erupted for 200,000 years after the older period. The activity of the newer period began at 45 ka with Haruna-caldera-forming eruption. This eruption emplaced 1.2 km^3 DRE of pyroclastic fall and flow deposit (Yamamoto, 2013). Oishi *et al.* (2011) showed the pyroclastic flow deposit can be divided into two groups, Satomi and Shirakawa pyroclastic flow deposit, based on the refractive indices of plagioclase phenocrysts.

Structure of magma plumbing systems and the triggering mechanisms of eruptions are basic knowledge to characterize eruptive activities in each volcano. Petrological studies on the ejecta have been used for understanding them. Such studies lead to the forecasting of future eruptions, which is strongly requested by society. Unfortunately, limited petrological studies focusing on detailed petrography have been conducted for Haruna volcano, except the study of the middle sixth century eruption (Suzuki and Nakada, 2007). With this motivation and background, we investigated the Satomi pyroclastic flow deposit of 45 ka Haruna-caldera-forming eruption.

In this study, pumice blocks of Satomi pyroclastic flow were sampled at three sites of the southern foot of Haruna volcano. The samples were classified as white pumice, gray pumice, whitish gray pumice and grayish white pumice. These have whole-rock compositions ranging from 62.8 to 66.3 wt.% in $SiO_{2,}$ showing that these pumices are dacite. There is no great difference among four types of pumice in whole-rock compositions. Compared with the data on pumices of Shirakawa pyroclastic flow (Kitani and Suzuki, 2019; JpGU meeting), there is no great difference too. Four types of pumice show phenocryst assemblages of Pl + Qt + Hb + Cum + Opx + Fe-Ti Ox. This indicates that these minerals crystallized in equilibrium. There is no great petrographical difference among four types of pumice. Dusty plagioclase and resorbed quartz phenocryst suggest that temperature of the melt surrounding the crystals rose. Temperature of the melt rises when (1) the felsic magma mixes with mafic magma or (2) the felsic magma is heated by mafic magma. Now, the pumices don’ t contain any phenocryst which crystallized from mafic magma like olivine, so if the felsic magma mixed with mafic magma, the mafic magma should be aphyric. Meanwhile, texture of orthopyroxene has recorded fluctuations in temperature of the melt.

We analyzed phenocryst mode of white pumices sampled at Matsunozawa with broad whole-rock compositions (3.6 wt.% in SiO_2). They are strongly porphyritic with 52.3-71.7 vol. % phenocryst, indicating that the magma erupted them was mush-like. It turned out that as whole-rock SiO_2 content increases, phenocryst content increases. The phenocryst content increase is accompanied by quartz increase and Fe-Ti oxide decrease. It might mean the difference in mixing ratio with mafic magma if the felsic magma mixed with mafic magma.

Based on the above, we estimated the state of magma plumbing system of Haruna-caldera-forming eruption. Firstly, there is a mush-like felsic magma which contains crystals above-mentioned. Secondly, mafic magma was injected into felsic magma. As a result, felsic magma mixed with mafic magma or was heated by mafic magma. This temperature rising event might have triggered the eruption.

Pumices contain many crystal fragments. It is assumed that high shear stress at the conduit walls promoted crystal fragmentation. Thus, the origin of gray pumices which contain more crystal fragments

than white pumices might be the magma which had ascended along the conduit margins where the shear stress is highest.

Keywords: Haruna volcano, Caldera-forming eruption, Pyroclastic flow, Mush-like felsic magma, Magma mixing, Heating from hotter magma

