CSD (Crystal Size Distribution) analysis for plagioclase phenocrysts in historical lavas of Sakurajima volcano -The control of magma plumbing system for the eruptive style and frequency-

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In order to obtain insights into roles played by magma plumbing system in the long-term behavior of eruptive activity, we conducted crystal size distribution (CSD) analysis of plagioclase phenocrysts in four historical lavas of Sakurajima volcano, located in southern Kyushu, Japan: Bunmei eruption (1471-76), An-ei eruption (1779-82), Taisho eruption (1914-15), and Showa eruption (1946). Bunmei, An-ei, and Taisho eruptions firstly fell pumice by Plinian eruptions from newly formed flank vents, and subsequently flowed lavas. Showa eruption firstly had fell ash frequently for about three months, and subsequently flow lava from the Showa crater. After Showa eruption, Vulcanian eruptions occurred frequently, indicating the temporal change of eruptive style from large volume Plinian eruptions with lava flows (c.a. 1 km^3 DRE) to small volume frequent eruptions (one event less than 10^{-3} km^3).

In four historical lavas, plagioclase phenocrysts are classified into 3 types. Type-A is represented by the clear texture and lower An content (around An60) in core and rim. Type-B shows the clear texture and higher An content (around An80) in core and lower An content (around An60) in rim, and the sharp compositional contrast between the core and the rim. In addition, the length of rim varies by a wide range as 10-200μm in all lavas. Type-C has the sieve texture and heterogeneous compositions in core. From above chemical analysis, the magma plumbing system consist of two magma reservoirs (felsic magma chamber and mafic magma chamber) where the crystallization proceeds to form phenocrysts. Type-A crystallizes in the felsic magma chamber in which the compositions gradually changes from felsic to mafic during hundreds years by repeated injections of mafic magmas. Type-B crystalizes in the mafic magma chamber, and the mafic magma continuously injects to the felsic magma chamber.

The CSD plots of both type-A and type-B can be approximated by log-linear CSDs. Slopes of type-A are constant regardless of eruptive ages, and those of type-B become steeper with time, that is, Showa has the steepest slope. From the CSD analysis, the residence time in the felsic magma chamber is nearly constant with time, whereas the residence time in the mafic magma chamber becomes shorter with time, indicating that both mantle-derived mafic magma supply rate and extraction-rate to the felsic magma chamber increase with time. The magmatic behavior such as crystallization and accumulation rates in the felsic magma chamber keeps a constant pace and has no influence on eruptive phenomena. On the other hand, the mafic magma chamber located at deeper level controls the surficial behavior in eruptive phenomena, such as frequency of eruptive events and dominant eruption styles of Vulcanian type, through increasing rates of mantle-derived mafic magma supply.

Keywords: Crystal size distribution, Plagioclase phenocryst, Magma plumbing system

