

Evolution of magma plumbing system of Sakurajima volcano in the last 50 years: Frequent vulcanian eruptions controlled by basalt injection

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Sakurajima volcano, a post-caldera volcano of Aira caldera in South Kyushu, has repeated plinian eruptions three times since 1471 and effused lava in 1946. Vulcanian eruptions have continued since 1955 until now. Nakagawa et al. (2011) concluded that three end-member magma mixing have occurred in 1914, 1946, 1958 and 1990; basaltic magma (B) inject into mixed magma of silicic (S) and andesitic (A) just before eruption. We develop petrological study of the vulcanian eruptions in the last 50 years to investigate temporal change of magma plumbing system in detail. Whole-rock SiO₂ content of erupted materials in the last 50 years are 58-64% (andesitic). Although these rocks have gradually changed to become more mafic with time since 1914, their compositional trends in SiO₂-variation diagrams are consistent with those of 1914 and 1946. All the ejecta contain plagioclase, orthopyroxene, clinopyroxene and magnetite as phenocrysts, and sometimes accompanying olivine. Plagioclase phenocrysts show compositionally bimodal distributions (An₆₀ and An₈₀), and sometimes there exist compositional peaks of An₉₀. Orthopyroxene phenocrysts show unimodal or bimodal distribution in the range of Mg#65-75, and clinopyroxene phenocrysts similarly in Mg#70-80. Furthermore, normally and reversely zoned phenocrysts of plagioclase and pyroxene usually coexist in a single sample. Olivine phenocrysts are mainly divided into two types, one is Fo₇₀ (surrounded by thick pyroxenes), and another is Fo₈₀ (surrounded by microlites, have no reaction rims). Bimodal distribution of plagioclase phenocrysts, coexistence of normally and reversely zoned phenocrysts and presence of Mg-rich olivines that compositionally disequilibrium with pyroxenes suggested that magma mixing also occurred in the last 50 years. S-magma: plagioclase (An=46-64), orthopyroxene (Mg#=60-68), clinopyroxene (Mg#=66-72) and magnetite, and A-magma: plagioclase (An=64-86), orthopyroxene (Mg#=68-76), clinopyroxene (Mg#=72-79) and magnetite, and B-magma: plagioclase (An=86-94) and olivine (Fo=75-82). The end-member magmas of these vulcanian eruptions are similar to those of Nakagawa et al.(2011). The relationships between ratios of these phenocrysts and whole-rock SiO₂ suggests that whole-rock compositional variations of juvenile materials since 20th century should be formed by injection of B-magma into the mixed magma of S and A (Nakagawa et al., 2011). The level of eruptive activity would correlate to whole-rock chemistry of juvenile materials. During the periods, in 1914 and from the late 1970's to 1980's, which the level of the activity increased, whole-rock SiO₂ contents of the juveniles had also decreased. This fact suggests that the scale and/or frequency of the injection of B-magma would control the level of eruptive activity. In other word, we suggest that monitoring of the B-magma might be essential to forecast future eruptive activity in Sakurajima volcano.