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Variations of basaltic magmas and their timing of injection into the magma system of Sakurajima volcano since AD 1779

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Sakurajima volcano has repeated plinian eruptions three times during the last 600 years and changed the mode of eruptive activity since the AD 1914 plinian eruption. Frequent vulcanian eruptions has continued since AD 1955. Nakagawa et. al(2011) concluded that two-end-member magma mixing of silisic magma(S-magma) and andesite magma(A-magma) occurred in 1471 and 1779, and three-end-member magma mixing of mixed magma(S+A) and basaltic magma(B-magma) since the 20th century. They concluded that the injection of the B magma has frequently occurred since then to change the mode of eruptive activity. Their evidences of the injecting were presence of Olivine and An=90 plagioclase phenocrysts and different mixing trend in SiO2 variation diagrams between the 20th century and previous products. However, petrological features of AD 1779 submarine eruptive products just after the terrestrial plinian eruption have not been revealed in detail. In this study, newly collected 1779 submarine products are investigated to discuss the magma plumbing system.

The AD 1779 submarine products are banded pumice and slightly vesiclated lavas. These contain plagioclase, orthopyroxene, clinopyroxene and magnetite as phenocryst associated with small amounts of olivine microphenocrysts, which were not recognized in the AD 1779 terrestrial products. These olivine phenocrysts do not have reaction rims of orthopyroxene. Average core compositions of these are about Fo=77. Compositional variations of other phenocrysts, except for magnetite, are nearly the same as those in the AD 1779 terrestrial and 20th eruption products. These olivine phenocrysts are diequilibrium with pyroxenes on the basis of Fe-Mg partitioning, suggesting that the basaltic magma injected into the mixed magma between the S and A magmas, which erupted as the AD 1779 terrestrial products. It should be noted that the injection of the basaltic magma had started just before the submarine eruption. On the other hand, olivine phenocrysts in the 20th century products are composed of two types, with or without reaction rims of orthopyroxene. Average core compositions of those without reaction rims are Fo=81, whereas those with reaction rims are less than Fo=74. These suggest that the 20th century products had been repeatedly injected by the basaltic magmas and that the basaltic magma injecting just before each eruption had olivine phenocrsyts with Fo=81. Although the injections of the basaltic magma has occurred just before the AD 1779 submarine eruption, two types of basaltic magma have injected . The basaltic magma in AD 1779 was less magnesian and contained olivine pehnoctysts with Fo=77, whereas those in 20th century were magnesian, having olivine phencorysts with Fo=81. This is consistent with distinct two chemical trends of AD 1779 submarine and 20th century products in SiO2 variation diagrams, such as P2O5 and MgO. Considering the presence and absence of the relict olivine phenocrysts, with reaction rims, the erupted magma during the 20th century were effected by previous injections of basaltic magmas. After the injection of olivine (Fo=77) in AD 1779, these olivine phenocrysts were reacted with more silicic melt not only to form the reaction rim but also to change their chemical compostions with less magnesian. Just before AD 1914 eruption, voluminous another basaltic magma with more magnesian olivine (Fo=81) had injected just before the AD 1914. The injected magma since AD 1955 has been similar to that of AD 1914, whereas volume of the magma has become smaller. However frequent, small scale of injection has continued to cause number of small, but explosive vulcanian eruptions.

Keywords: Sakurajima volcano, magma system, magma mixing, olivine, volcanic eruption