EVOLUTION OF HISTORIC MAGMA SYSTEM OF HOKKAIDO-KOMAGATAKE VOLCANO, JAPAN: IMPLICATIONS FOR STRUCTURE AND ERUPTION PROCESSES OF MUSH CHAMBER

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Hokkaido-Komagatake volcano is one of the most active volcanoes in Japan, and began eruptive activities (historic eruptions) in 1640 after about 5000 years’ dormancy. Plinian eruptions occurred in 1640, 1694, 1856 and 1929, and phreatomagmatic eruption in 1942. The 1640 plinian eruption produced large amounts of pyroclastic fall and flow (total=2.9 km³ DRE), whereas eruptive volume has decreased since then (0.36 km³ in 1694, 0.21 km³ in 1856, 0.52 km³ in 1929 and 0.003 km³ in 1942).

The juvenile ejecta of the 1640 eruption can be classified into three types, white pumice (SiO₂=59.8~62.4 wt.%), scoria (SiO₂=57.4~58.9 wt.%) and banded pumice. All of the ejecta contain phenocrysts of plagioclase, orthopyroxene, clinopyroxene, and Fe-Ti oxide, in order of decreasing abundance. Phenocryst contents of white pumice range from 25 to 52 vol.%, whereas the scoria is nearly aphyric (<7 vol.%). Core compositions of these phenocrystic minerals are nearly the same. Banded pumice forms linear chemical trend between white pumice and scoria, suggesting that banded pumice was formed by mingling between porphyritic white pumice (WP magma) and aphyric scoria magmas (S magma). Gray pumice has occurred since the 1694 eruption and shows intermediate chemical compositions (SiO₂=58.2~60.5 wt.%) and phenocryst contents (20~33 vol.%) between those of white pumice and scoria. Moreover, phenocrystic minerals in gray pumice sometimes show remarkable reverse zoning. Thus, the gray pumice would be mixing product between the WP and S magmas during the 1640 eruption.

Temporal variations of white pumice are observed in historic eruptions. In the 1640 eruption, phenocryst contents range from 25 to 42 vol.%. After the 1640 eruption, phenocryst contents abruptly increased about 10 vol.% and range from 36 to 52 vol.%. Since 1694, crystallinity has been nearly the same until 1942. This temporal change of crystallinity cannot be explained by constant crystallization process and suggests existence of zoned WP magma that is divided into inner melt-rich (crystallinity: 25~40 vol.%) and outer crystal-rich zones (crystallinity: >40 vol.%). In the 1640 eruption, melt-rich WP magma erupted selectively, whereas crystal-rich WP magma has remained in the magma chamber. Since the 1694 eruption, this residual crystal-rich magma has erupted. Matrix glass compositions and rim compositions of phenocrystic minerals of white pumice have gradually become felsic since the 1694 eruption, whereas whole rock chemical compositions have remained constant. These indicate that the WP magma has evolved although crystal fractionation has not occurred. After the 1640 eruption, melt of the WP magma has become more felsic and phenocryst contents considerably increased, hence the magma has become more viscous and solid-like state. Because of high viscosity of the WP magma, the eruptive volume has suddenly decreased since 1694.