Melt inclusion constraints on the pre-eruptive process of Kirishima-Ohachi 1235 subplinian eruption

*Yoshiharu Iwaki[1], Hidemi Ishibashi[2], Natsumi Hokanishi[3], ATSUSHI YASUDA[3], Toru Ishikawa[4]

1. Shizuoka University Graduate School of Integrated Science and Technology, 2. Shizuoka University, 3. Earthquake Research Institute,The University of Tokyo, 4. Kirishima Geopark Council

In this study, chemical compositions were analyzed for groundmass glasses, melt inclusions (MIs) and their host phenocryst minerals in the scoria and pumice of the 1235 subplinian eruption, Takaharu tephra, of Ohachi volcano, Kirishima, Japan, to clarify the magma plumbing system beneath the volcano and the pre-eruptive process of the eruption. Among the 4 stratigraphic units of the eruption, scoria, pumice and banded pumice in the b layer, which is the tephra of the climactic stage of the eruption, were used. Phenocryst mineral assemblages are plagioclase + olivine + orthopyroxene + clinopyroxene for the scoria and plagioclase + orthopyroxene + clinopyroxene for the pumice, respectively. Although scoria- and pumice-forming mafic and silicic magmas were mingled to form banded pumice, the boundary between mafic and silicic parts is not gradual, suggesting that chemical mixing was minimum. The results of chemical analyses of the MIs and the groundmass glasses revealed that (1) the groundmass glass and plagioclase-hosted MIs in the pumice (melt A) are rhyolitic with SiO_2~74.9wt.%, and (2) the composition variations of MIs in the scoria are mostly explained by post-entrapment crystallization (PEC) of their host phenocrysts from the common initial melt (melt B) with SiO_2~56.9 wt.%. However, the compositional variation of plagioclase-hosted MIs in the scoria, which are opened to the groundmass melt, cannot be explained by PEC, suggesting that a basaltic andesite melt was mixed with the melt B right before the eruption. Pre-eruptive temperature, H_2O content, and pressure conditions were estimated to be ~932℃, ~1.2wt.% and ~12MPa for the melt A and ~1040℃, ~4.6wt.% and ~210MPa for the melt B, respectively, assuming the melts were H_2O-saturated. The estimated pressures correspond to the depths of ~0.5km and ~8.6km for the melt A and B, respectively.

Based on the results, the pre-eruptive process of the 1235 eruption was proposed as follows; initially, there were two magma chambers at the depths of ~0.5km ~8.6km for the melt A and B, respectively. Then, a basaltic andesite melt intruded into the chamber of the melt B. The mafic melts, composing the groundmass of the scoria, was formed by mixing of the two mafic melts and then started ascent. During ascent to the surface, the mafic magma passed the shallow silicic chamber and entrained the melt A mechanically.

The composition of the melt B is similar to olivine-hosted MIs of the Shinmoedake 2011 eruption. Furthermore, the estimated depth of the chamber of the melt B is similar to depth of the mafic magma chamber beneath Shinmoedake inferred by Suzuki et al. (2011). These may suggest that the mafic chamber at the depth of ~8.6km is common beneath Ohachi and Shinmoedake. However, the estimated depths and compositions of the silicic magmas are different between the two volcanoes; the silicic magma of Ohachi is more differentiated, H_2O-poor and viscous. The conditional difference of silicic magmas may cause the systematic compositional difference of erupted magmas between Ohachi and Shinmoedake volcanoes.

Keywords: Ohachi volcano, melt inclusion, Kirishima, magma chamber, banded pumice

