Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SVC062-05 Room: 201B Time: May 23 10:00-10:15

Magma plumbing system beneath Fuji volcano, inferred from petrological study of Yufune-2 scoria

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Because of no recent eruption in Fuji volcano, syneruptive geophysical observations have not constrained magma plumbing system. Petrological studies of past eruptive products thus have an important role. As a target, we have selected a latest summit eruption, 2200 years ago. Yufune-2 scoria, product of this eruption, has an eastern dispersal axis (Miyachi, 1988). Scoria samples were collected from an outcrop locating 10 km to the east of the summit. We have divided the scoria deposit into 5 units (a-e; 10, 90, 5, 15, 60 cm thickness, respectively), each of which is distinctive in scoria size. The scoria size increases upward between unit-a and unit-b, but decreases in the upper units. The change in scoria size implies those of eruption intensity and eruption column height, if wind direction and intensity did not change. Bulk rock composition of scoria (50.5-51.2 wt. % SiO_2) does not change with eruptive unit. To further characterize erupted basaltic magma, we have analyzed thin sections of 4-6 scoriae for each unit.
Except the xenolith of basaltic lava included in scoriae of unit-a (Suzuki and Fujii, in prep.), scoriae seem homogeneous regardless of the eruptive unit. Phenocrysts of olivine and plagioclase (less than 2mm) are euhedral and lack in reaction rims. However, compositions of phenocrysts indicate slight heterogeneity and syneruptive mixing for erupted magmas. As a whole eruption, Fo contents of olivine cores vary between 73 and 80, while An contents of plagioclase cores vary between 65 and 92. Core compositional distribution is distinctive in each unit. All scoriae of unit-b and c are dominated by low-Fo (<76) and low-An (<85) cores. On the other hand, unit-e scoriae and half of unit-d scoriae are characterized by cores of high-An (>85) and high-Fo (>76), although some scoriae show wide Fo variety extending to Fo73. The high An (>85) plagioclase has homogeneous core and is characterized by small size (less than 500 micrometer). In unit-a scoriae and rest of unit-d scoriae, cores of phenocrysts show wide compositional range (Fo73-80, An65-92). As a whole, rim compositions of phenocrysts have correlation with compositional distributions of phenocryst cores. These lines of evidence indicate that 1) magma reservoir had a variety in the degree of crystallization just before the eruption, as represented by two endmembers, and 2) the two parts were partly mixed just before the eruption. Two endmembers did not have considerable gap, because 1) phenocryst core composition is continuous, and 2) plagioclase with low An (<85) core rarely includes high An (>85) region in the center of the core. Groundmass $SiO_2$and FeO*/MgO contents both increase with degree of crystallization inferred from compositional distribution of phenocryst cores, in the range of 51.0-51.7 wt. % and 2.0-2.2, respectively. Phenocryst abundance increases with the inferred degree of crystallization; 3-19 vol. % for total and 2-17vol. % for plagioclase.
We propose a preliminary model for the magma reservoir processes. Just before the eruption, less-crystallized magma at the lower part of the reservoir was injected into upper part with higher crystallinity, resulting in formation of the mixed magma erupted in unit-a. Then, the high-crystallinity part erupted without mixing in the climax (unit-b and unit-c). In the ending stage (unit-d and unit-e), less-crystallized magma at the lower part of the reservoir erupted, accompanied by mixed magma. Near-liquidus coexistence of olivine and plagioclase in the melt of the groundmass composition requires less than 2.5kbar and H_2O content of ca. 1.5wt.%, and 1110-

1120C, if QFM buffer is assumed.

Reference:

Suzuki, Y., Fujii, T., in prep. for JVGR. Effect of syneruptive decompression path to shifting intensity in basaltic sub-Plinian eruption: implication from microlite in Yufune-2 scoria from Fuji volcano, Japan.

Miyaji, N., 1988. History of younger Fuji Volcano. J. Geol. Soc. Japan. 94, 433-452.

Keywords: Fuji volcano, Yufune-2 scoria, Magma plumbing system, Phenocryst size, Phenocryst abundance, Magma mixing