Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SVC050-06 Room:302 Time:May 23 09:45-10:00

Petrological characteristics and time evolution of the 2011 eruptive products from Shinmoe-dake of Kirishima volcano

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Continuous sampling and analyses of eruptive products from an ongoing eruption can give detailed insights into the magmatic processes operating beneath the volcanoes. Furthermore, whole rock compositions and phenocryst contents obtained in the petrological analyses are necessary to model variable eruptive styles in Andesitic volcanoes (such as Plinian, Strombolian), because the compositions and contents partly control viscosity of magma at and near surface. From above points of view, we are analyzing eruptive products from the 2011 eruption of Shinmoe-dake, Kirishima volcano.

In our preliminary study, we used pumice blocks of up to 10 cm size and pumice particles in the ash, both of which were erupted on 26 January 2011. Pumice blocks were used for bulk rock analyses. On the other hand, pumice particles (ca.1-5mm) were used for chemical analyses of groundmass glass and phenocryst, as small particles are convenient for mounting many particles in a limited area in short time.

Both of pumice blocks and particles show a variable color; white, brown and gray. White and gray or brown parts coexist in some blocks and particles (banded pumice). White pumice blocks have higher bulk rock SiO_2 contents (61-62wt. %) than gray and brown ones (57-59 wt. %). On the other hand, MgO contents of white pumice blocks (ca. 3wt. %) are lower than in gray and brown blocks (ca. 4wt. %).

Groundmass compositions of pumice particles are correlated to their bulk rock compositions. Groundmass glass in gray and brown parts of pumice particles has lower SiO_2 and higher MgO contents than in white parts; SiO_2 =66-68wt. % and MgO=1.1-1.4wt. % for the former and SiO_2 =ca. 76wt. % and MgO=ca.0.3wt. % for the latter. Microlites (plagioclase, pyroxene and Fe-Ti oxides) are exceptionally found in gray and brown parts of the pumice particles. Therefore, whole groundmass of gray and brown parts should have lower SiO_2 and higher MgO contents than its glass part.

Above described chemical variety in pumice samples resulted from mixing of high and low temperature magmas. Although our observations are limited to small total area of pumice particles, phenocrysts of clinopyroxene, orthopyroxene, plagioclase and Fe-Ti oxides are commonly found in all colors of pumice particles. Core compositions of these phenocrysts are the same regardless of the colors of pumice particles. On the other hand, olivine phenocrysts are limited to gray and brown parts of the pumice particles. In addition, cores of olivine phenocrysts are not in equilibrium with those of two pyroxene phenocrysts. Furthermore, extensive reverse zonings of orthopyroxene phenocrysts are exceptionally found in gray and brown parts, as in Suzuki and Nakada (2007). These lines of evidence indicate low-temperature magma in the mixing corresponds to the white pumice sample. The high-temperature magma includes at least olivine as phenocryst. The high temperature magma was not erupted independently (i.e. without mixing with low-temperature magma) on 26 January.

The determination of the storage depths of the above two magmas may help to understand origin of the pressure sources detected by geophysical observations. By the way, our continuous examination of ash samples from small-scale eruptions of Shinmoe-dake since 2008 has revealed that fresh pumice particles (juvenile material) first appeared in ash at eruption on 19 January 2011. Hence, this presentation also seeks petrological relationship between the pumice particles issued on 19 January and the pumice samples issued on 26 January. Adding future samples from the ongoing activity and acquiring another data, such as volume ratios among pumice types of different colors and detailed analyses of phenocryst chemical zonings, we aim at revealing evolutions in the interactions between the high and low temperature magmas.

Keywords: magma mixing, banded pumice, bulk composition, groundmass glass composition, volcanic ash, juvenile material