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# Petrological characteristics and magma mixing of minor eruptions in 2011 at Shinmoedake, Kirishima volcano, Japan

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The 2011 eruption of Shinmoedake, Kirishima volcanic group, Japan, started with phreatomagmatic eruptions on 19 January. The eruptive activity was culminated with the sub-Plinian eruptions on 26-27 January, followed by lava effusion within the summit crater. Vulcanian explosions and minor ash emissions together with degassing activity from the summit crater occurred intermittently from February to September. Petrological studies on the eruptive products in January and February indicated that input of mafic magma to a magma chamber just before the sub-Plinian eruptions (e.g., Geshi et al., 2011; Saito et al., 2011; Tomiya et al., 2011). The products of the minor eruptions also contained essential material (Oishi et al., this JpGU meeting) but the origin of the material was not clear.

In this study, the essential products of the minor eruptions in March to June were analyzed to know their petrological characteristics and the eruption process. The samples are ash particles of the eruption on 13 March (March-ash), lapilli of the eruption on 18 April (April-lapilli) and pumiceous and scoriaceous ash particles (P- and S-types ; Oishi et al., 2012) of the eruption on 29 June (June-ash). Mode composition, chemical composition of phenocrysts and groundmass minerals, zoning profiles of olivines and bulk composition of groundmass were analyzed using EPMA.

Phenocryst contents of March-ash, and April-lapilli (34 vol%) are slightly higher than that of pumices of the sub-Plinian eruptions (26-28 vol%). Chemical composition of groundmass of March-ash and April-lapilli have slightly $SiO_2$ and $K_2O$-rich composition (65-67 wt.% $SiO_2$ and 3 wt.% $K_2O$) than that of the pumices of the sub-Plinian eruptions (61-62 wt.% $SiO_2$ and 2 wt.% $K_2O$). P- and S-type June-ash have similar groundmass composition to that of the pumice of the sub-Plinian eruptions. Plagioclase, clinopyroxene, orthopyroxene of phenocrysts and groundmass minerals of March-ash, April-lapilli and P and S types of June-ash have similar chemical composition to the sub-Plinian eruptions. Two-pyroxene thermometry applied to the March-ash and April-lapilli samples gave 960-970 degree C, that was similar to the estimates for the magmas erupted January and February. Core compositions of olivine phenocrysts of all samples are similar, but March-ash and April-lapillil have slightly Fo-poor rims.

Similar chemical compositions of phenocrysts, groundmass minerals and groundmass of the eruptive products to those of the sub-Plinian eruptions indicated that magma mixing process proposed for the sub-Plinian eruptions occurred in March to June. Slight variation in the groundmass composition and mode composition from March to June could be caused by change of mixing ratios between mafic and felsic magmas. Assuming that the normal zoning in the rim of the olivines was produced by the magma mixing event, the residence time of the olivines was 5-30 days for March-ash and 2-20 days for April-lapilli. The residence time is similar or a little longer than that estimated for the eruptions in January and February (1-10days). These results suggest that the mafic magma input to felsic magma intermittently occurred after the sub-Plinian eruptions to cause the mionor eruptions in March to June.

Keywords: Kirishima volcano, Shinmoedake, 2011 eruption, petrology, magma mixing, olivine