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Injection of hot mafic magma prior to the 2011 eruption of Shinmoedake, Kirishima volcano, Japan

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The 2011 eruption of Shinmoedake, Kirishima volcano, Japan, started at 19th January with an phreatomagmatic eruption. The climactic stage (as of 31st March) was the sub-Plinian eruptions on 26th to 27th January, followed by some Vulcanian eruptions (e.g., 1st and 14th February), accompanied by other small eruptions. Most of essential materials were mafic andesite with $\text{SiO}_2 = 57$ wt.%, whereas in the material by 26th to 27th January there were also silicic one with $\text{SiO}_2 = 62-63$ wt.% (Geshi et al., 2011). The mafic andesite is a mixture of the low-temperature silicic andesite (mushy magma) and a high- temperature basaltic magma with $\text{SiO}_2 = 53-54$ wt.%, deduced from the compositions of phenocrysts and melt inclusions (Saito et al., 2011). The injection of the basaltic magma perhaps affected the sequence and styles of the eruptions, and it is necessary to estimate when and how the mafic magma injected into the magma system.

In this study we mainly analyzed magnetite, which is appropriate to investigate magma processes with time scales between days to years because of its large diffusion coefficients. We analyzed minor components, as well as the major component (Usp; Ti concentration), especially Mg/Mn, which is sensitive to melt composition and a good indicator of magma mixing (e.g., Tomiya & Takahashi, 2005).

Deduced from chemical compositions and zoning profiles of magnetite (and ilmenite), the mafic injection occurred just prior to the 26th to 27th January sub-Plinian eruptions, but did not occurred prior to the Vulcanian eruptions in February. Furthermore, the mafic injections occurred both about 2 years and several tens of years or more before the 2011 eruption. Thus, mafic injection occurred repeatedly before the 2011 eruption, and the last one induced the climactic sub-Plinian eruptions.

Keywords: Shinmoedake, Kirishima, magma mixing, magnetite, time scale