Temporal variation of conduit process during the 2018 eruptive activity at Shinmoedake volcano, Japan: Implications from a time series of ash characteristics

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We investigated a time series of characteristics of ash particles to discuss change of the conduit process during the 2018 eruptive activity at Shimoedake volcano, Kirishima, Japan. The 2018 eruptive activity exhibited following a transition of three stages of eruptive style: (1) Ash emission in March 1–5, (2) dome-forming with strombolian eruptions in March 6–8, and (3) discrete vulcanian eruptions after March 9. Along with the transition, magma supply rate from the chamber inferred from tiltmeter and GNSS data was constant in the ash emission stage, increases (March 6) and subsequent decreases (March 7–8) in the dome formation stage, and constant again in the vulcanian stage (Ueda, 2018). Also, the volume of lava dome linearly increases from morning of March 6 to March 8 in the dome stage, and almost constant in the vulcanian stage, as revealed by SAR observation (Ozawa, 2018).

We analyzed twenty ash samples during the 2018 eruptive activity: two from the ash emission stage, fifteen from the dome stage, and three from the vulcanian stage. The ash particles were divided into 9 type as VCF (vecicular colorless), DCFF (dense colorless with fine microlite), DCFC (dense colorless with coarse microlite), VBF (vecicular black), DBF (dense black), LITH, ALT, PL, and MM (mafic mineral), based on the observations by stereoscopic microscope and SEM. The glossy surfaces in the VCF, VBF, DCF, and DBF indicate these particles are juvenile particles. The component analysis of the ash samples reveals that (1) the ALT and LITH dominated in the ash emission stage, (2) the VCF and DCF are abundant in the dome-forming stage with high abundant of DCFC in March 6, and (3) the DCF is rich and VCF is poor in the vulcanian stage. The textural analysis suggests the characteristics of plagioclase microlite (crystallinity, number density (MND) and crystal size distribution) are similar among the VCF, VBF, DCFF and DBF, whereas the DCFC has high crystallinity with low MND. The co-existence of parts of DCFF with DCFC were often found in a single particle. The glossy surfaces, textural similarity in plagioclase microlite, and different vesicularity in the VCF, DCF, VBF, and DBFF suggest these particles originate fresh new magma undergoing similar decompression path with different degree of outgassing. In contrast, the DCFC is interpreted as a partially-consolidated magma that ascended prior to the dome eruption or as part of the 2011 lava dome from the high crystallinity with low MND. Also the co-existence of parts of DCFF and DCFC in a single particle implies an erosion of partially-consolidated magma in the shallow conduit (DCFC) by newly ascended magma (DCFF).

Temporal variation of the conduit process during the 2018 eruptive activity at Shinmoedake volcano is explained by the enlargement of the conduit associated with increase in magma supply rate and subsequent outgasssing and sealing of the lava dome with the decrease in magma supply. During the ash emission stage in March 1–5, volcanic gas was emitted, destructing the country rock consisting of hydrothermally altered materials. In the early dome-forming stage of March 6, the increase of magma supply rate caused the erosion of the partially-consolidated magma, resulting in the enlargement of the conduit region. In the later dome-forming stage of March 7, the magma supply rate decreases, which

ceased the enlargement and gradually sealed the conduit. Consequently in the vulcanian stage after March 9, the sealing of pathway of outgassing in the shallow conduit due to decrease of magma supply rate caused pressurization inside the dome, generating the vulcanian eruptions.

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