Cyclic degassing behavior accompanying dome-forming lava effusion at Shinmoedake volcano in the 2018 eruption

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Shinmoedake volcano, one of the most active volcanoes in the Kirishima complex in Japan, had a series of eruption in 2018. At the beginning of the eruption sequence in March 2018, Shinmoedake had a dome-forming effusive eruption. Observation networks of the National Institute for Earth Science and Disaster Resilience (NIED, V-net), the Japan Meteorological Agency (JMA), and the Geospatial Information Authority of Japan (GSJ, GEONET) around the Kirishima area detected significant ground deformation accompanying the lava effusion. The deformation can be explained by assuming a pressure source located at the same position (7 km NW from Shinmoedake, depth of 10 km) that is adopted to explain syn-eruptive ground deformation in the 2011 eruption (Ueda, 2018, VSJ). The time series of the magma chamber contraction obtained by geodetic observations provides remarkable insight to constrain the macroscopic behavior of the eruption mechanism. Here, we examine characteristics of volcanic earthquake catalogue, seismic, acoustic, tilt, SO2 gas flux measurement, and visual observation data obtained by observation networks of NIED, JMA, and University of Tokyo, to constrain detail aspects of the effusive eruption such as the magma flow regimes inside the conduit.

Hypocenters of low-frequency earthquakes accompanying the lava effusion are distributed almost vertically in the range of 0.1–3.2 km from the surface. Therefore, we assume vertical elongated conduit geometry. Syn-eruptive seismic waveforms record cyclic tremor signals with a peak frequency of about 0.8 Hz, with a duration of 5–20 minutes as well as repose time. The tremor is accompanied with explosive degassing from the crater, which is recorded by infrasound, SO2 gas flux measurement, and visual camera data. Tilt data with a bandpass filter of 250–2000 s show inflation-deflation cycles of the Shinmoedake edifice accompanying the cyclic degassing. Both inflation and deflation of the filtered tilt data correspond to the repose time and amplitude increasing of the tremor.

Some features of the cyclic degassing at Shinmoedake from our data set are summarized as follows: (1) Inflation of the volcano edifice (2) Beginning of degassing and deflation of the volcano edifice (3) End of degassing and repose time until next inflation. Such an inflation-deflation cycle is reported by Takeo et al. (2013) from observation data of lava effusion in the 2011 eruption. Dome-forming lava effusion at Santiaguito also produces such a cyclic degassing and related ground deformation (Johnson et al., 2014). The inflation prior to the degassing may have similar source physics to that related Strombolian and Vulcanian eruptions. Next our challenge is to quantify the source of those signals to estimate the amount of relating gas or magma, and relationship with the time series of the magma chamber contraction.

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Keywords: Lava dome, Shinmoedake

