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Periodic two-phase magma flow beneath Miyakejima volcano, JAPAN

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Miyakejima volcano, Japan, has experienced extraordinary volcanic activities since 2000, e.g., caldera formation at the summit, enormous seismic swarms and emission of volcanic gases. NIED Miyakejima volcano observation network recorded seismic and tilting data associated with these phenomena. The initial dike intrusion occurred on June 26 and 27, suggesting the upwelling magma toward the summit and lateral intrusion from the main reservoir to northwestern region beneath the volcano. During the caldera formation stage (July 8 to August 18, 2000), we recorded periodic step-like tilt changes and VLP earthquakes with 50-s duration with the intervals of 12 to 60 hours. The analyses of tilt and broadband seismic data suggest that the source mechanisms of them are cyclic jerky opening of magma sill with a strike of about N40-70W, an dip of 20 degrees climbing toward the summit. The depth is mostly about 6-7 kilometers and the volumetric changes of each opening is about 10ˆ6 to 10ˆ7 mˆ3. This opening and periodicity are interpreted to be due to the instability of two-phase flow in the magma plumbing system, i.e. pressure-drop oscillation. This is a non-linear phenomenon, and the flux in the sill is controlled by the pressure difference between the gas capacity and the fluid at the exit. The tilt-step and VLP are caused by the runoff from one stable to another stable state with the duration of 50-s. The periodicity is chiefly determined by the capacity of the compressible cavity at the top part of the conduit, and the temporal changes in tilt step intervals presumably correlated to the rise and descent of the magma head and caldera bottom in the conduit. Prior to these tilt-steps, we observed a series of LP events, which are also caused by two-phase flow instability called density drop oscillation.