V032-030 Room: C310 Time: May 28 14:45-15:00

Pressure drop oscillation model for tilt-steps at Miyakejima volcano

Eisuke Fujita[1]

[1] NIED

Tilt-steps observed during the 2000 Miyakejima volcano eruption have following interesting features: (1) 46 events were periodically observed from July 8 to August 18, (2) periodicities of once or three times per day with 12 to 60 hours interval, (3) tilt-steps on July 8 and 9 (No.1, 2) differ from those 44 tilt-steps after July 11; No.1: radial expansion from the summit area and precursory tilt changes of the accelerated subsidence at the summit, No.2: many earthquakes after the tilt-step, No.3 and after: many precursory earthquakes, (4) asynchronous with episodic summit eruptions, (5) tilt changes of expanding volcanic body and LP swarms from about 1 hour before the tilt-steps, (6) 50-s pulse wave occurred associated with a tilt-step. Our analyses of tilt and broadband seismic data suggest that the source mechanisms were opening of sill-like magma reservoir in NW-SE direction from the southeast part in the island with an angle of 20 degrees climbing to the summit. The opening per a tilt-step is about 10 - 50 cm and volume change is about 0.1-1.1x10*7m*3. In addition, the supplemental observation should be notified to recognize tilt-steps; (a) tilt-steps occurred in the system established by the dike intrusions during June 26 and 27, (b) the system also experienced the first eruption on July 8, 18:41 and became pressure-free system by the eruption on August 18, (c) small tilt-steps and LP events were observed in July 2 to 5, (d) gravitational observation suggested the vacant area had been established by July 2 (Furuya et al., 2001).

For a source model of tilt-steps, we propose a gas-liquid system, consisted of magma, vapor and volcanic-gases. They were filled in the sill-conduit area. The unsteady flow of such a two-phase system causes oscillations and here we consider the phenomena called pressure drop oscillation.

The subsurface magma supplying system at Miyakejima volcano is inferred from the analyses of tilt and seismic data consisted of a conduit to the summit from the magma reservoir beneath the southeast part of the island and the sill intruded northwestward. There was a gas pocket at the upper part of the conduit and it became a close-system in pressure at the eruption on July 8. The gases were continuously generated in the magma reservoir and they were accumulated in the gas-pocket. We define the gas pressure and the pressure at the exit of the sill as Pg and Pe, respectively and their difference is dP = Pg - Pe. The state of the dP and the flux f in the sill follows the periodical traces. 1. when f is small, the magma head gradually raises and dP also increases, 2. when dP reaches to a threshold, f moves to an another steady state, and f rapidly increases, 3. then the f decreases slowly and dP also decreases, 4. dP reaches to the minimum value, then f decreases to the original state. The observed phenomena, that is, the preparation stage, the tilt-step and 50-s pulse wave, and the relaxation of tilt change correspond to the state of 1, 2 and 3, respectively.

The fundamental feature of this pressure drop oscillation is explained by a Van der Pol equation and this equation gives temporal changes with oscillations. The capacity of compressive area mainly determines the period of the change of the flux. The observed tilt-step intervals were longer in the latter period. This may suggest the increase of the volume of the compressive area, in other words, the descent of the magma head.