Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SVC48-19 Room:104 Time:May 20 09:00-09:15

A sketch in a shallow part of the conduit preceding a Vulcanian eruption

Minoru Takeo[1*], MAEHARA Yuki[2], ICHIHARA Mie[1], OHMINATO Takao[1], KAMATA Rintaro[1], OIKAWA Jun[1]

[1]Earthquake Research Institute, University of Tokyo, [2]Schlumberger K.K.

The sub-Plinian and the Vulcanian eruptions at the Shinmoe-dake volcano were preceded by inflations at shallow depths near the summit. The inflation-deflation cycles were also recorded during the magma-effusive stage, with a typical period of one hour, synchronized with volcanic tremors or long-period events. Almost all Vulcanian eruptions were preceded by trapezoidal inflations, whose durations systematically lengthened as time progressed, and were followed by various time sequences of tilt motions, which became increasingly more complicated throughout the frequent Vulcanian eruptions. In spite of the complicated time sequences of the preceding inflations, we have found clear linearity with a constant gradient of 0.45 between the logarithm of the preceding durations versus elapsed time for each sub-stage.

During the magma-effusive stage, the conduit must have been filled up by magma, which was more degassed than in the sub-Plinian stage, including pores or porous structures. Therefore, it seems to be probable that certain parts of the conduit interior were occupied by poroelastic material, and that the strength of the conduit interior was heterogeneous. The preceding inflation should begin at this instant, gradually increasing in proportion with pressure buildup. When the pressure exceeded a yield value, the gas pocket area should be deformed plastically, causing a slight leakage of volcanic gas to the upper side in the conduit, and creating a volcanic glow and a slight deflation and/or a phreatomagmatic eruption. On the contrary, the lower side of the gas pocket area acted as a porous media, defusing the high-pressured gas to the deeper part in the conduit. This caused the deepening of the centroidal source depth approaching the eruption. During this time, the pressure confined in a closed strong magma frame must increase without any dynamic affect on the outside. Assuming that a Vulcanian eruption is induced by a catastrophic rupture of the closed magma frame in a conduit due to magma degassing overpressure, the clear linear relation could be interpreted that the degassing from the magma in the conduit declines exponentially with time. In conclusion, the observations can be consistently explained based on the assumption that a Vulcanian eruption is induced by a catastrophic rupture of the closed magma frame due to overpressure caused by magma degassing, and the degassing from magma declines exponentially with time. To sum up the above discussion, we propose a sketch in a shallow part of a conduit preceding a Vulcanian eruption.

Keywords: Vulcanian eruption, Tilt motion, Physical process in a conduit