

Eruption process of vulcanian eruptions in Shinmoe-dake inferred from ash fall volumes and durations of volcanic tremors

*Jun Oikawa¹, Yasuhisa Tajima²

1. Earthquake Research Institute, University of Tokyo, 2. NIPPON KOEI CO.,LTD

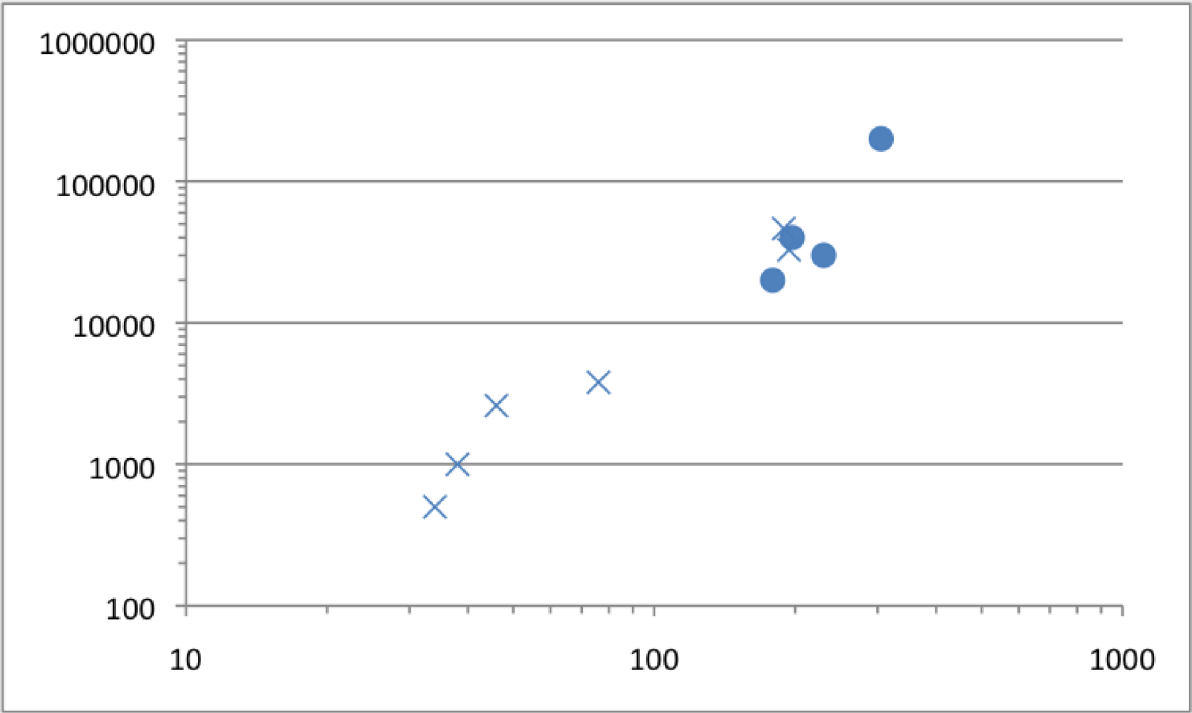
The latest eruptive activity of Shinmoe-dake started on August 22, 2008. Subsequently, it erupted on March 30, April 17, May 27, June 27 and 28, and July 5 and 10, 2010. In 2011, the eruption started on January 19 included subplinian and vulcanian explosions. and was followed by sub-Pulinian eruption on 27 January. Eruptive activity gradually ceased since February 2, and moved to vulcanian activities. It erupted on October in 2017 and on March in 2018. Eruptions continued until June 27. Oikawa and Tajima (2019a, 2019b) discuss the relation of ashfall volumes and durations of vulcanian eruptions that is characterized by the power law: ashfall volume is proportional to durations to the second power.

In this study, we attempt to explain this relationship by considering a simple model of the eruption process. We consider a magma reservoir just below the summit crater, and assume that a cylindrical conduit extend to the crater. The cross-sectional area of the conduit is S . Erupting magma of volume V_e enter the magma reservoir and the pressure rises accordingly. The relation between pressure and volume change of the reservoir is $dV=AdP$, where A is the constant. Assuming that the flow in the conduit is quasi-steady turbulent flow, the mean velocity u is $u^2 = B(P-P_a)$ with B as the constant and P_a as the atmospheric pressure. After the eruption started with the explosion, the eruption proceeds with the above settings. Assuming that the time from the start to when the flow velocity becomes 0 and the eruption ends is T_e , $V_e = D \cdot T_e^2$ is derived using D as a constant ($D=ABS^2/4$). Therefore, the amount of eruption volume is proportional to the square of the eruption duration.

This study shows that the amount of eruption volume is proportional to the square of the eruption duration assuming a simple model. The important assumption were that the flow in the conduit was a quasi-steady turbulent flow, and that the shape of the conduit and the physical properties of the eruptive magma did not change. At Shinmoe-dake, after the crater was buried with lava in the eruption in 2011, the vulcanian eruption may have continued without significant changes in the parameters constituting the eruption site.

Keywords: vulcanian eruption, ash fall volume, durations of eruptions, Eruption process

M [x10³ kg]



T [s]