A model for controlling mechanism of explosion earthquake intensity

Takahiro Miwa[1]; Atsushi Toramaru[1]

[1] Earth and Planet. Sci, Kyushu Univ.

This study proposes a model for controlling mechanism of explosion earthquake intensity on the basis of the correlation between the ash feature and the explosion intensity. In vulcanian eruptions of Sakurajima volcano, volcanic glassy particles which bear gloss and smooth surface (S-particle) are erupted. S-particle has low vesicurality and sharp particle edge, and often shows stepped structure. Therefore, we think that S-particles are formed by the brittle fragmentation of degassed fresh magma. Number fraction of S-particles to total volcanic ash (S-fraction: X_s) is proportional to maximum amplitude of explosion earthquake (Miwa et al., in preparation). This relationship may indicate that the amount of fresh magma in shallow conduit controls the maximum amplitude of explosion earthquake. Injected fresh and hot magma batch heats the magma plug at the vent, leading to the expansion of the pore fluid and the consequent increases in the internal pressure of magma plug. The pressurization from the below due to degassing at the magma chamber or deeper level of the conduit makes the plug system critical. Just before explosion, the following force balance on the magma plug is satisfied between the upward force of pressurization (SP_g) from deeper level, the frictional force with wall and the gravity:

SP_g=(miuS_f Kb/V)X_s+Mg

where S is cross section of conduit, miu is the frictional coefficient between magma plug and conduit wall, S_f is contact area between magma plug and conduit wall, K is the effective bulk modulus, b is constant, V is volume of conduit zone before fresh magma batch injected, M is mass of magma plug including injected magma batch and g is acceleration of gravity. When the value of left hand side exceeds that of right hand side, explosion occurs. The essential point of this relation is that the frictional force is proportional to X_s (fraction of fresh magma). SP_g which could be maintained before explosion is proportional to frictional force and X_s. SP_g seems to be proportional to the maximum amplitude of explosion earthquake. Consequently, the maximum amplitude of explosion earthquake is proportional to X_s. So, using this model through the effect of friction between magma plug and conduit wall, we can explain the observational fact that X_s controls the maximum amplitude of explosion earthquake.