Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SVC54-04 会場:301B 時間:5 月 20 日 11:30-11:45

マグマだまりにおける過飽和度揺らぎによって支配される噴出量・噴火様式・噴火様式推移のモデル
Model of eruption mass and style and of their temporal change controlled by fluctuation of degree of supersaturation

寅丸 敦志 [1*]
TORAMARU, Atsushi[1*]

[1] 九州大学大学院理学研究院地球惑星科学部門
[1]Department of Earth and Planetary Science, Kyushu University

The current big issue of volcanology is to clarify factors controlling the magnitude, style and the temporal behavior of eruption. I propose a model for predicting an eruption mass and style, and their temporal change on the basis of the fluctuation of degree of supersaturation in magma chamber.

We assume a square consisting of n x n (e.x., 512 x 512) parcels as a magma chamber with the vacant conduit connected to the surface, in which each parcel has a degree of supersaturation of volatile with a Gaussian probability density function (PDF) in space. We think that an eruption is triggered when the volume of parcels with the degree of supersaturation for vesiculation under the lithostatic pressure in magma chamber exceeds the volume equal to that of the vacant volcanic conduit. This triggering condition (triggering supersaturation) links the average supersaturaion and variance of PDF each other. So one of them is automatically determined when the other is given. Once an eruption is triggered, the decompression vesiculation is induced by unloading of magma. Parcels contributing to decompression vesiculation have a certain degree of supersaturation, which is less than the triggering supersaturation according to the saturation curve. Parcels satisfying the decompression vesiculation condition are identified as decompression vesiculation parcels. The connected regions of decompression vesiculation parcels are defined as 8 neighbor connection of decompression parcels. We calculate the size distribution of connected regions, and suvery the largest connected region which is regarded as unit size when magma ascents to the surface. We divide a square (magma chamber) of n x n into sub-squares with unit size of largest connected region. As each sub-square has a different fraction (¥phi) of decompression vesiculation parcels, we have a distribution function of decompression vesiculation fraction for the whole magma chamber. A decompression vesiculation fraction ¥phi corresponds to a potential enthalpy to drive a sub-square of magma to the surface. A sub-square with higher ¥phi generates larger volume of gas phase by decompression at the triggering of eruption, and has a potential to ascend with higher velocity. Thus each sub-square has different potential, according to fraction of decompression vesiculation parcels. We define two thresholds of ¥phi. One is explosive threshold ¥phi$_1$. A sub-square with ¥phi ($>$ ¥phi$_1$) can ascend to the surface explosively with high velocity reaching 10 m/s or higher at the surface. The other is effusive threshold ¥phi$_2$. A sub-square with ¥phi (¥phi$_1$ $>$ ¥phi $>$ ¥phi$_2$) ascends up to the surface with mild or very slow ascent velocity less than 10 m/s at the surface. A parcel with ¥phi ($<$ ¥phi$_1$) cannot ascend up to the surface and remained in magma chamber. In this model, we can define explosive mass and effusive mass and the temporal change of eruption intensity depending on ¥phi of each sub-square. We carried out a Monte Carlo simulation on the basis of the above-mentioned idea. As a result, if PDF of the degree of supersaturation has higher average or the magma chamber is relatively homogeneous, then the eruption is almost explosive and most extent of magma is evacuated, like a caldera-forming eruption. Decreasing the average supersaturation and increasing the variance of PDF, the eruption shift to an explosive eruption followed by an effusive eruption and to an eruption which only produce an effusive flow of magma such as lava flow. This transition of eruption styles from explosive to effusive and the relation to the erupted mass can account for commonly recognized transition between eruption styles in nature.

キーワード: 減圧発泡, 噴出量, 噴火様式, 噴火推移, 過飽和度
Keywords: decompression vesiculation, erupted mass, eruption style, temporal change of eruption, degree of supersaturation