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

SVC50-07 会場:104 時間:5 月 23 日 15:30-15:45

霧島新燃岳 2011 年 1 月 26-27 日サブプリニー式噴火におけるテフラ拡散・堆積過程への制約
Constraining tephra dispersion and deposition from cyclic subplinian explosions at Shinmoedake volcano, Japan, 2011

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Andesitic subplinian explosions were repeated at Shinmoedake, Kyushu, Japan, on 26-27 January 2011. Tephra produced from the explosions were transported by strong seasonal wind, and crossed over the Kyushu Island then reached Pacific Ocean. The fallout deposits were widely observed in the area of down-wind direction. We estimate tephra volume, plume height, and magma discharge rate of the explosions based on field data and theoretical and empirical approaches.

In general theoretical and empirical models or methods are used to study tephra dispersal and physical parameters, in which a plenty of tephra data (mass per unit area, thickness, and clast size with distance) is required to give improved constraints on modeling results and to reduce uncertainties in estimates of eruption parameters and hazard. Although large-scale volcanic eruptions have provided such opportunities to examine theoretical and empirical approaches, small-scale eruptions are often more difficult to constrain because smaller volumes of erupted tephra tends to give only a small number of outcrops due to poor preservation of deposits. Data typically need to be collected soon after an eruption. Thus model applications to relatively small-scale eruptions have not been well studied.

The subplinian eruption that occurred at Shinmoedake volcano provides an interesting tephra dataset and an excellent opportunity to examine theoretical and empirical approaches on tephra volume estimation, clast dispersion under wind effect, which are crucial to evaluate quantitatively tephra dispersal and resultant hazards. Tephra volume is estimated using a relationship between dispersal area and thickness of tephra, or a relationship between dispersal area and mass per unit area. Bi-cubic spline interpolation method is also examined. Results from different methods produced similar tephra volume (11-21 million m^3 for the 26 pm to 27 am explosions and 2-4 million m^3 for the 27 pm explosion). For plume height estimation, a classical clast dispersal model and a predictive numerical model both using maximum clast size are applied. For all subplinian explosions, estimated plume height and magma discharge rate lie on 8.5-9.5 km above sea level and $7 \pm 3 * 10^5$ kg/s, respectively. The results are consistent with direct and geophysical observations, and also suggest that the explosions occurred every 12 hours with similar mass discharge rate but a decrease of erupted magma volume.

キーワード: テフラ, 噴煙高度, サブプリニー式噴火, 新燃岳, 霧島
Keywords: Tephra, plume height, subplinian, Shinmoedake, Kirishima