

Textural constraints on the dynamics of the 2000 Miyakejima eruption

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Miyakejima Volcano is a basaltic-andesite stratovolcano active from ~10.000 years, located on the north of the Izu-Bonin arc. During the last 600 years the volcano has been characterized mainly by flank fissure activity, with explosive phreatomagmatic eruptions on the coastal areas. In the last century, the activity became more frequent and regular with intervals of 20 to 70 years (1940, 1962, 1983 and 2000). The last activity started on 27 June 2000, with a minor submarine eruption on the west coast of the volcano, and proceeded with six major summit eruptions from July 8 to August 29. The eruptions led to the formation of a collapse caldera ~1.6 km across. The total erupted tephra represents only 1.7% in volume of the caldera, the high fragmentation of magma produced mainly fine-grained volcanic ash.

In order to improve the understanding on the triggering and dynamics of this explosive eruption, we carried out a detailed investigation of the erupted materials with particular attention to the textural features of juvenile pyroclasts (Vesicle and Crystal Size Distributions). The stratigraphic record can be divided into six fall units, corresponding to the six summit eruptions, although juvenile materials were identified only in 4 units (unit 2, 4, 5, 6). We selected about 100 juvenile grains sampled from the bottom to the top of each level, to be analyzed by scanning electron microscopy. The study of juvenile morphological features allowed us to recognize the existence of three characteristic morphotypes, showing marked differences in their external morphologies and internal textures (from poorly to highly crystallized and vesiculated clasts). The distribution of these morphotypes is non-homogeneous along the eruptive sequence indicating changes of dynamics during magma ascent. Juveniles do not show features inherited from the interaction with external water. Vesicle Volume Distributions of the selected ash grains show that the three types of pyroclasts experienced different nucleation and growth processes. Also the Vesicles Number Densities (VNDs) vary of about one order of magnitude in the different populations (from 107 to 108 cm⁻³), with values comparable with those commonly related to sub-Plinian and Plinian eruptions. Data from the CSD analysis show perfect agreement with the measured VNDs (crystal population densities increasing with VNDs), suggesting a link between the degassing history and the syn-eruptive crystallization.

The results of the textural analysis are used to produce a conduit model for the 2000 Miyakejima eruption. Textural analysis and modeling data are presented to reconstruct the eruptive dynamics leading to this high - energetic eruption.