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Behavior of water in an explosive eruption as revealed by measurement of water content in volcanic glasses

Satoshi Okumura[1], Satoru Nakashima[2], Michihiko Nakamura[3]

[1] Earth and Planetary Sci, T.I.T, [2] Interactive Research Center, Tokyo Inst. Technol., [3] Inst. Mineral. Petrol. Econ. Geol., Tohoku Univ.

During magmatic eruption, water content in magmas decreases with decompression. A useful way to get information on the degassing process is to analyze water in volcanic glasses. The degassing processes of hydrous magma in the conduit were studied for the 1929 explosive eruption of Hokkaido Komagatake on the basis of the analysis of water content in eruptive materials.

The water analyses were mainly carried out by FT-IR microspectroscopy. The water contents in the melt inclusions were determined using IR absorbances at 4500 and 5200cm-1 corresponding to X-OH groups and H2O molecules, respectively, because these bands are suitable for the determination of water contents higher than a few percent. The analyses of the melt inclusions indicate that the pre-eruptive water contents of the magma are around 3.1wt% for all the eruption stages. This constant water content suggests the homogeneous magma chamber situated deeper than 3.3km. The water contents in the matrix glasses were determined using absorbances at 3550cm-1 corresponding to X-OH groups + H2O molecules. The water content in matrix glasses cannnot be directly measured by FT-IR microspectroscopy because the pumices are highly vesiculated. Thus the compression technique with internally heated pressure vessel was used to evaluate water contents in the matrix glasses. The obtained values are around 0.8wt% for all the eruption stages. The resulted constant water contents around 0.8wt% indicate that water contents in the magma at fragmentation level might be nearly constant for all the eruption stages. These water contents in the melt inclusions (3.1wt%) and in the matrix glasses (0.8wt%) show the exsolution of 2.3wt% (about 75% of the initial water contents) during the ascent.

The veiscularities of eruptive materials were also measured by two different methods: glass beads technique and image analysis on BSE images. The measured vesicularities can be mostly explained by the amount of exsolved water assuming that the bubbles expanded at 0.8wt% water saturation pressure. The measured vesicularities of eruptive materials in the initial and final eruption stage are, however, slightly lower than that in the other eruption stages, although the amounts of exsolved water are alomost constant during the eruption stage. The difference of vesicularity may indicate the change of degassing process at initial and final eruption stages.

The present study developed several new methods for determining water contents both in melt inclusions and in matrix glasses. The obtained results may be used as a quantitative data set for evaluating degassing processes in the explosive volcanic eruption.