Advancement of magma fragmentation by heterogeneious bubble distribution

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Decompression times reported in previous studies [1] suggest that thoroughly brittle fragmentation is unlikely in actual explosive volcanic eruptions. What occurs in practice is *brittle-like fragmentation*, which is defined as the solid-like fracture of a material whose bulk rheological properties are close to those of a fluid [2].

In this study, we demonstrate the link between the inhomogeneous structure of bubbles and the development of cracks that may lead to brittle-like fragmentation Through laboratory experiments and numerical simulation [3]. A rapid decompression test was conducted in the BL20B2 beamline of SPring-8 to simulate the fragmentation of a specimen whose pore morphology was revealed by X-ray microtomography. The dynamic response during decompression was observed by high-speed photography.

Large variation was observed in the responses of the specimens even among specimens with equal bulk rheological properties. The stress fields of the specimens under decompression computed by finite element analysis shows that the presence of satellite bubbles beneath a large bubble induced the stress concentration. On the basis of the obtained results, a new mechanism for brittle-like fragmentation is proposed. In the proposed scenario, the second nucleation of bubbles near the fragmentation surface is an essential process for the advancement of fragmentation in an upward magma flow in a volcanic conduit.

 This study was supported by KAKENHI Grant-in-Aid for Scientific Research from JSPS (Nos. 24656119, 26630047, and 16H04039). The synchrotron radiation experiments were performed at BL20B2 of Spring-8 with the approval of JASRI (Proposal Nos. 2013B1037, 2014B1275, and 2015B1154).

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Keywords: Experimental Volcanology, Fragmentation, X-ray microtomography, High-speed photography

