Laboratory experiments on magma fragmentation with analogous materials

Hideaki Kurihara[1]; Sho Suzuki[2]; Masaharu Kameda[3]; Mie Ichihara[4]

[1] Mecanical engineering systems, Tokyo Univ of A&T; [2] Mechanical Systems Eng., TUAT; [3] Mechanical Systems Engineering, TUAT; [4] ERI, U. Tokyo

Fragmentation of porous materials is studied experimentally to understand explosive volcanic eruption. Commercial syrup was used as an analogous material of magma. A pressure-vacuum chamber was used to apply rapid decompression on the materials. Initial pressure of the materials was varied from 1 MPa to 4 MPa. The fragmentation process due to the decompression was monitored by high-speed photography as well as pressure measurement. In order to make bubbly syrup, Hydrogen peroxide-water solution was mixed into the syrup. The initial gas-volume fraction of the syrup was fixed as 2%. The viscosity of the syrup was varied with water contents in the syrup. The viscosity was in the range from 10^5 Pa s to 10^8 Pa s. The fragmentation was observed when the viscosity was larger than 10^7 Pa s, and the initial pressure was larger than 2.5 MPa. The hoop stress at the initiation of fragmentation was about 0.6 MPa, which was constant under various initial pressures as well as viscosities. This value was also equal to the disruptive strength of the syrup, which was obtained by tensile stress measurement. The experimental results imply that the fragmentation occurs when the hoop stress reaches the disruptive strength of the material within its relaxation time, which is defined as the ratio of viscosity to rigidity.