Volcanic eruption in a beaker: bubble formation and convection in a magma chamber

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We have carried out laboratory experiments to explore the vesiculation process coupled with convection in a magma chamber. We have used milk as an analogue for magma. Vesiculating milk under heating exhibits two types of the convection pattern depending on the viscosity variation.

When the viscosity of the milk is large, vesicles are uniformly distributed through the chamber and the vesicle size distribution becomes the power law type distribution. On the other hand, when the viscosity of the milk is small, vesicles are separated from the liquid parts of the milk, and the size distribution of the vesicle becomes the exponential type.

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We have carried out laboratory experiments to explore the vesiculation process coupled with convection in a magma chamber. We have used milk as an analogue for hydrated magma. Vesiculating milk under heating exhibits two types of the convection pattern depending on the viscosity variation.

When the viscosity of the milk is large, vesicles are uniformly distributed through the chamber. Convection is developed in the whole layer of the mixture of the milk and vesicles. The convective flow promotes variation of the vesicles velocity. This causes the collision and coalescence of the vesicles, which generates the variety of vesicle sizes. In such a case, the vesicle size distribution becomes the power law type distribution. On the other hand, when the viscosity of the milk is small, vesicles are separated from the liquid parts of the milk, and generates a foam layer above the milk. This foam has uniform upwelling velocity. Each vesicle in the foam never coalesces each other. The size of each vesicle is determined only by its surface tension. In such case, the size distributions of the vesicle become exponential type.

These experiments show that the difference of the viscosity makes the vesicle size distributions variable.