

Dynamics of bubbles and liquid in magma chamber. milk and cream

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How does the volcanic eruption happen? That cause has been thought the vesiculation of magma under the ground. It is very difficult to directly observe the vesiculation in the magma chambers. However, we can see the similar phenomenon using simple analogue materials in the laboratory and we can imagine the real dynamics. Namiki et al. (2003) have conducted an analogue experiment heating milk and cream. They paid attention to difference in the property of milk and cream, and they compared the convection patterns and the bubble size distributions between these two materials. Based on thier study we focus on the difference of the viscosity of material and tried to reveal the physical condition of the turning point of the foam layer formation.

The milk, non-fat milk and cream were used in our analogue experiments. The viscosity of them depends on the water content and the water-fat ratio. Water causes vesiculation. The viscosity of the liquid rises when fat increases relatively, which keeps the bubble in the liquid.

In the experimental procedure of milk heating, at first characteristics of the heated milk is similar to boiling of hot water. Several minutes later, bubbles of the water steam generated in liquid layer stood up to the part of liquid level, and formed the foam layer of constant height. The bubble moves upward from the liquid-foam layer boundary. In the non-fat milk experiment it seems like water and the foam layer never be formed. In the case of cream heating, at first cream suddenly boiled. After several minutes the liquid layer involved the bubbles and it was expanded. The bubble and liquid convected together. The reason of variation of the condition is likely due to the viscosity of the liquid, which depends on the ratio of water and fat.

Therefore we mixed non-fat milk and cream (the water-fat ratio is 1:1) to controll the viscosity, and we measured the boundary of the phenomena. As a result, a clear change appeared when the ratio of the non-fat milk and cream was 1:7. When the ratio of the non-fat milk and cream was 1:6, bubbles were separated from the liquid layer and a foam layer was produced. This ratio is turning point, that is to say 1:7.