Dynamics of fluid including bubbles - convection of magma revealed by cream and syrup heating experiments

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The existence of the bubbles in the magma at the volcanic conduit is a critical factor for the variety of the eruption style of volcanoes. In general, the escape of gases from the molten magma depends on the fluid viscosityand on the size of the bubbles. In the last conference in 2007, we showed experimental results of these relationship using cream. It was observed that the size of bubbles involved into the flow are ascending with time and the convecting patterns drastically changed twice in the sequence.

To observe variation of the bubble size, we carried out an anologue experiment with bottom heating starch syrup. The viscosity of the liquid syrup gradually increases due to the evaporation of the water content. In the first stage of the experiment when the viscosity is low, the bubbles generated from the bottom of the tank rise quickly. After the viscosity increases by moderate heating, small bubbles become involved by the downward flow. When they reach a specific height of the tank, they expand and float up again. There is temperature heterogeneity in the convecting fluid. Fluid in the cold region stagnates and fluid in the hot region dynamically circulates.