Deformation experiments with analogue poly-phase materials

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Geological materials are poly-phase composites in general. Rocks are composed of several different solid phases, and partially molten materials are of solid and liquid phases. Magmas are also solid-liquid or liquid-liquid mixtures. They are made of materials with different rheological properties. Rheological behavior of such mixtures is a key to understanding the dynamics in the Earth.

We are now investigating rheological behavior of two-phase composites by rotational deformation experiments with two-liquid composites (silicon oil + syrup or water). All liquids are Newtonian, and the viscosity of a syrup can be controlled by changing the temperature. Behavior of a two-phase composite must be strongly dependent on the configuration (e.g., size, geometry, distribution) of the minor component. The configuration can progressively evolve with deformation. The interplay between the rheological property and the configuration is crucial in understanding rheology of composite materials. Our first step is to investigate the evolution of configuration. Varying the size, viscosity contrast and strain rate, we are studying the evolution of a minor component.

Preliminary results

A spherical inclusion (drop) of sugar syrup embedded in silicone oil deforms into different shapes according to given conditions. Several characteristic shapes are identified; 1) undeformed type, 2) steady elongate type, 3) stretching type, 4) winged type. In particular, the behavior of the last type might play an important role in mixing of different magmas.