Fluid dynamics experiments on the breakup of liquid metal diapirs

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Abstract

The validity of the iron rain scenario, *i.e* the widely accepted model for the dynamics of iron sedimentation through a magma ocean during the latest stage of the Earth's accretion, is explored via a suite of laboratory experiments. The liquid gallium and mixtures of water and glycerol are used as analogs of the iron and the molten silicate respectively. This allows us to investigate the effects of the viscosity ratio between iron and silicate and to reproduce the relevant effects of surface tension on the fragmentation dynamics. While the classical iron rain scenario considers a population of purely spherical drops with a single characteristic radius that fall towards the bottom of the magma ocean at a unique velocity without any further change, our experiments exhibit a variety of stable shapes for iron drops, a large distribution of sizes and velocities, and an intense internal dynamics within the cloud with the superimposition of further fragmentations and merging events. The relatively complex dynamics we find in our liquid metal experiments will likely have interesting consequences when interpreted into state of the art thermochemical equilibration models.
