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## A few simple laboratory experiments to mimic and understand acoustic measurements recorded on the field by geophysicists

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In collaboration with **Jean-Christophe G eminard, Val erie Vidal, Francisco Melo and Maurizio Ripepe.**

A **non-intrusive way to monitor in situ activity of volcanoes** and lava lakes consists in literally listening to their acoustic activity (sonic and infrasonic), which is partly produced by **large bubbles bursting** on top of the vent or at the lake surface. This method, first brought to the fore by A.F. Richards in 1963, has been successfully used since (e.g. works by M. Ripepe, S. Vergnolle and more recently J. Johnson).



In order to investigate the role the non-Newtonian properties of lava could play on bubbles bursting and thus on the acoustic signal recorded on top of volcanoes vents and lava lakes, we developed the following laboratory experiments: bubbles are injected at the bottom of a plexiglass container filled with a commercial hair-dressing gel solution. This type of solution, in addition to be easy to prepare and stable through time, well mimics the non-Newtonian rheology of lava: it is shear thinning (viscosity drops if the fluid is sheared) and presents a threshold.

Due to the viscoelastic properties of such a fluid, a bubble rising through it presents an elongated shape ended by a cusp (*photo below*); after a few seconds rise, the bubble reaches the top, and eventually bursts **generating an audible sound!** The most significant results we obtained are the followings:



- **During the bubble bursting, the bubble body acts as a motionless resonator excited by the film breaking** at the top of the bubble head. The bubble wall does not significantly deform during the characteristic duration of the sound emission, which thus presents a well defined frequency. The opened bubble body thus selects resonant modes among which the fundamental is the most intense.
- **The total amount of energy released strongly depends on the dynamics of the film rupture.** And, measuring the acoustic energy is not enough for obtaining a good estimate of the total energy release during the bubble bursting.

### Related articles —————

- *Acoustic emission associated with the bursting of a gas bubble at the free surface of a non-Newtonian fluid*, [T. Divoux](#), V. Vidal, F. Melo, & J.-C. G eminard, Phys. Rev. E **77**, 056310 (2008).
- *Acoustic signal associated with the bursting of a soap film which initially closes an overpressurized cavity* V. Vidal, J.-C. G eminard, [T. Divoux](#) & F. Melo, Eur. Phys. J. B **54** 3, 321-339 (2006).