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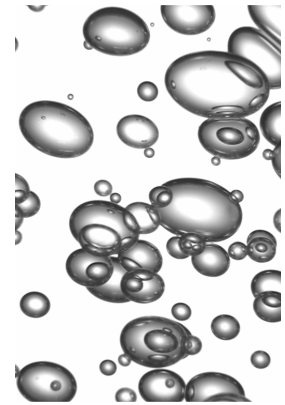
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Intermittent outgassing through a non-Newtonian fluid: from extreme statistics... to magma intermittent degassing

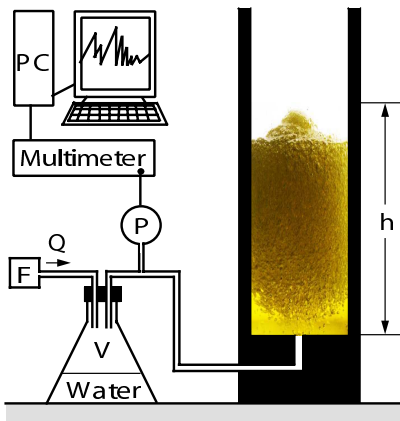
In collaboration with **Jean-Christophe G eminard, Val erie Vidal,
Eric Bertin and Maurizio Ripepe.**

The flow of a Newtonian fluid through a non-Newtonian fluid is a complex topic which reveals to be interesting for both Physics and Geophysics communities. We brought to the fore and studied **the intermittent dynamics of air bubbles rising up through a column of a non-Newtonian fluid**. In practice (*photo below*), air is injected, through a chamber, at the bottom of a column filled with a hair-dressing gel solution. **In a given range of the imposed constant flow-rate, the system spontaneously alternates between two regimes:** bubbles emitted at the bottom, either rise independently one from the other, or merge to create a channel connecting the bottom air-entrance to the free surface.



The formation of a gas channel is due to the fact that two successive bubbles can catch up because the fluid is *shear thinning*. The channel collapse is linked to the time-dependant properties of the fluid; Thus, the non-Newtonian properties of the fluid are fully responsible for such an intermittent behaviour. The most important results associated with this intermittency are the followings:

- **Such an intermittency is strongly reminiscent of classic on/off intermittency.** However, the distribution of the gas channel lifespans displays a decaying power-law, with an exponent significantly smaller than the exponent $3/2$ predicted for on-off intermittency. This result suggests that non-standard intermittency mechanisms are at stake in presence of a non-Newtonian fluid.
- **This intermittency is analog to the intermittent degassing process experienced by some basaltic volcanoes.** First, the *bubbling* regime would correspond to the puffing and/or stronger explosive activity, whereas the *gas channel* regime would correspond to the long-lasting quiescent period of activity of the volcano. Second, the variations of the column height with the flowrate present strong analogy with the variations of volcanoes dome height observed on the field.



Related articles

- *Intermittent outgassing through a non-Newtonian fluid*, [T. Divoux](#), E. Bertin, V. Vidal, & J.-C. G eminard, submitted to Phys. Rev. Lett. (04/07/08).
- *D egazage intermittent   travers une colonne de fluide complexe*, [T. Divoux](#), V. Vidal, F. Melo, & J.-C. G eminard, *Compte Rendu des 11^{eme} Rencontres du Non-Lin aire*, Paris (2008) (ISBN 2-9516773-7-5).