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Imaging isotherms and velocity fields in convective viscous fluid

A. Davaille, A. Limare, V. Vidal, J. Vatteville, M. Le Bars, C. Carbonne & G. Bienfait

Laboratoire de Dynamiques des Fluides Geologiques, IPGP/ UMR 7154, 4 Place Jussieu, 75 252 Paris cedex 05, France (Email: davaille@ipgp.jussieu.fr)

To understand convective motions in natural systems such as lava lakes or planetary mantles, we need to characterize convection at high Prandtl number. Good laboratory analogs are viscous fluids, such as sugar syrups or mixtures of salted water and cellulose. To reach Rayleigh numbers between 10ˆ3 and 10ˆ8, temperature differences between 10 and 70°C have to be imposed across the experimental cell. Moreover, convective motions are slow (1 mm/sec to 1 mm/hour), temperature heterogeneities can reach 10-25°C, and experiments can run for several weeks. To monitor the experimental temperature field on such long times, we have developed a new technique using liquid crystals slurries which enables to image several isotherms with a precision of ś0.1°C, or 0.2 to 1% of the typical temperature differences applied to the system. In certain cases, local temperature gradients are available as well. This technique can be used in combination with PIV to obtain simultaneously the velocity field. We use our new method to describe the pattern of thermal convection in viscous homogeneous fluids with a temperature-dependent viscosity.