Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05947, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05947
EGU General Assembly 2008

Elastic-skinned gravity currents

A. C. Slim (1) and N. J. Balmforth

(1) Department of Mathematics, University of British Columbia (anja@math.ubc.ca)

The surface of an active pahoehoe lava flow rapidly cools to form a thin solid crust above the still molten, flowing interior. The stresses induced in the solid crust due to the underlying fluid motion can result in wrinkling of the surface, producing a characteristic "ropy" appearance. As a simplified model of this, we theoretically and experimentally investigate the behaviour of a viscous fluid flowing beneath a thin elastic "skin" in two different geometries: one in which the fluid induces a shear stress in the skin, thus causing it to buckle, and the second where the fluid flow drags the skin into an obstacle to initiate buckling. Our theoretical model consists of the Stokes equations for the fluid coupled to the nonlinear Föppl–von Kármán equations for the skin. We use a linear stability analysis to investigate conditions for the onset of wrinkling, and a lubrication approximation in particular limits to study the nonlinear evolution. We complement this with a suite of experiments.