Supplementary Material: Buoyancy versus local stress field control on the velocity of magma propagation: insight from analog and numerical modeling

1 SUPPLEMENTARY TABLES AND FIGURES

1.1 Figures

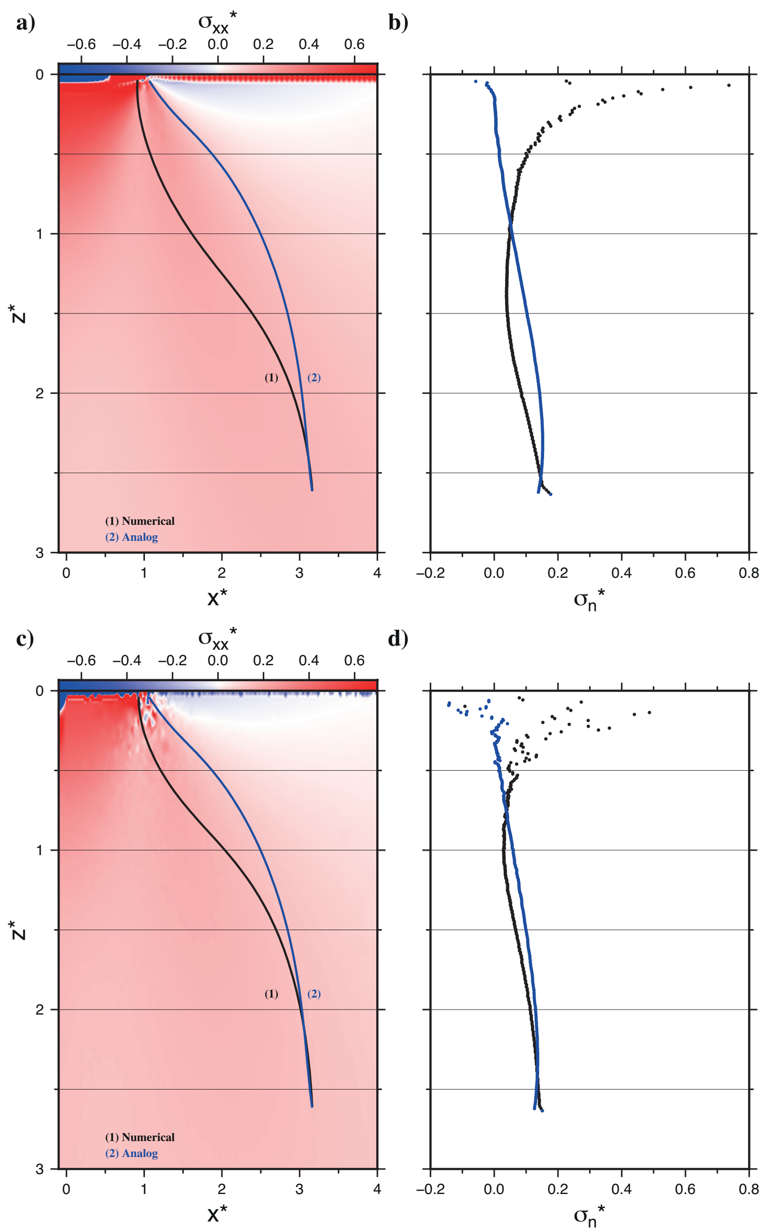

Figure S1. Comparison of numerically computed stress fields and corresponding trajectories obtained from the BE model for experiment 61. a) 3D calculation of the horizontal component of the stress field perturbation. b) Normal component of the external stress field acting perpendicular to the crack opening direction estimated from the 3D calculation. c) 2D calculation of the horizontal component of the stress field perturbation in plane strain approximation (Same as Fig. 4a of the manuscript). d) Normal component of the external stress field acting perpendicular to the crack opening direction estimated from the 2D calculation (Same as Fig. 4c of the manuscript). Stresses are normalized by the pressure applied at the surface. Compression is positive while tension is negative. Vertical and lateral dimensions are normalized by the half-length of the load applied at the surface, the grey line at $z^* = 0$ is for the position of the applied load.

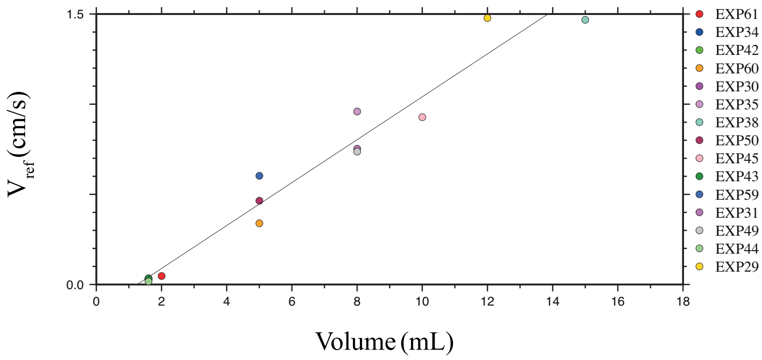

Figure S2. Velocity of reference corresponding to the vertical ascent of a buoyant crack for the 15 air injections as a function of the volume injected. As the gelatin and the air have the same physical properties in all experiments, the velocity is proportional to the volume injected as described by Takada (1990).

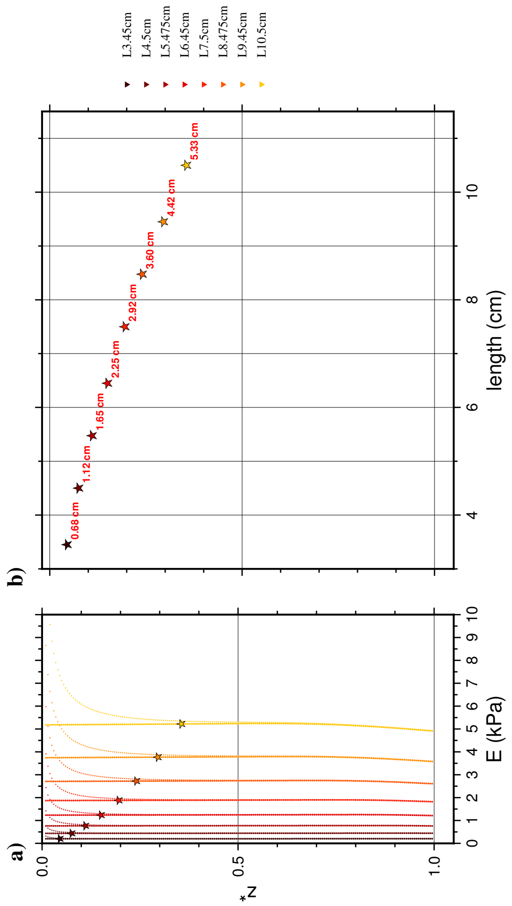

Figure S3. Depth influence of the free surface as a function of crack length. a) Strain and potential energy release along the vertical path derived from the BE model for vertical air-filled cracks of various length (from 3.45 to 10.5 cm) propagating inside gelatin (E is set to 2150 Pa, ν to 0.48, ρ_{gel} to 1020 $\mathrm{kg/m^3}$). Triangles are for the values obtained with a free surface and the circles are for the values obtained after the free surface was artificially removed. The red star marks the depth at which there is a significant difference between both estimations ($\left|\frac{\partial \Delta E}{\partial z}\right| > 1.5$). This depth is reported in panel b as a function of crack length.

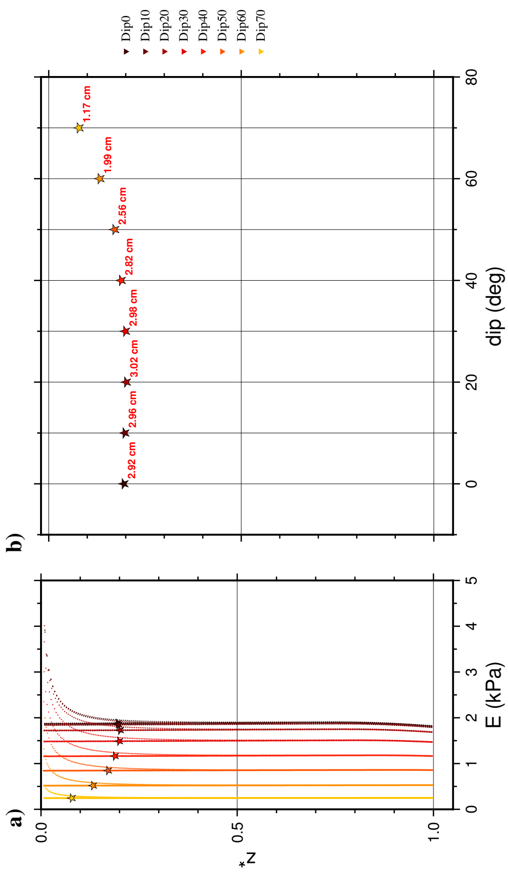

Figure S4. Depth influence of the free surface as a function of path inclination. a) Strain and potential energy release along the linear path derived from the BE model for inclined air-filled cracks of 7.5 cm propagating inside gelatin (E is set to 2150 Pa, ν to 0.48, ρ_{gel} to 1020 $\mathrm{kg/m^3}$). Various trajectories are considered with angles from the vertical comprised between 0 and $70°$. Triangles are for the values obtained with a free surface and the circles are for the values obtained after the free surface was artificially removed. The red star marks the depth at which there is a significant difference between both estimations ($\left|\frac{\partial \Delta E}{\partial z}\right| > 1.5$). This depth is reported in panel b as a function of crack inclination.

REFERENCES

Takada, A. (1990). Experimental study on propagation of liquid-filled crack in gelatin: shape and velocity in hydrostatic stress condition. *Journal of Geophysical Research* 95, 8,471–8,481