We report the results of a series of analogue laboratory experiments which investigate the cooling, convection and solidification of channelized lava flows with non-Newtonian rheologies. In the experiments, slurries of kaolin and molten polyethylene glycol flowed with a constant flux down an inclined channel under cold water.

Two crust cover regimes were identified in solidifying flows: (a) a 'mobile crust' regime in which a mobile raft of crust formed in the centre of the channel, separated from the channel walls by open shear zones, and (b) a 'tube' regime, in which the surface crust covered the entire channel and jammed against the channel wall. Experiments with cooling but no solidification showed that thermal convection occurs in organised rolls aligned with the shear flow.

The degree of surface crust coverage and the transition between crust cover regimes is quantified in terms of two dimensionless parameters: the Bingham number describing the plasticity of the fluid relative to viscous stresses, and a dimensionless parameter that characterises the rates of surface shear and surface solidification. We find the presence of an internal yield stress significantly alters the degree of crust cover, and the location of crust cover regime transitions.