This study examines the effect of a viscoplastic lava rheology on the isothermal flow of a viscoplastic fluid in a rectangular channel. It is designed to correct several models proposed and cited in the volcanological literature which are based on flawed assumptions and produce physically impossible results. It is also designed to provide data useful for field and laboratory studies of viscoplastic lava flows.

Numerical solutions for the velocity field are found using a finite-difference-based multigrid scheme with an augmented Lagrangian algorithm. Several key parameters (such as maximum velocity, flow depth and plug region dimensions) useful for field and laboratory studies are tabulated in terms of the net down-channel flow rate. The results are checked against analytical results in both the viscous and completely plastic limits. The results are then compared to observations of surface velocities of isothermal channel flows of slurries comprised of polyethylene glycol and kaolin. Potential uses of this data-set for field studies are also discussed.