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Modelling the agglutination of volcanic spatter

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The volcanic processes and deposits formed as a result of fire-fountaining are special because what happens to the hot particles of spatter when they fall back to the ground has major significance for how the eruption will affect the landscape. If the clots of spatter are sufficiently cold and rigid when they land, they will form a pile of debris whose slopes can be no steeper than the natural angle of rest. If the clots are hot enough to be soft on landing they can stick together (agglutinate), allowing a steeper spatter rampart to be built. However, if the clots are even hotter, they can coalesce into a molten mass that will then spread out like an ordinary lava flow and potentially travel large distances. This may explain the general lack of substantial vent structures in the likely source regions of continental flood basalts and lunar mare basalts.

Using a combination of computational fluid dynamics and laboratory modelling, Sumner et al. (2005, JVGR in press) studied totally fluid clasts, finding that an impact Reynolds number $>$80 causes the clast to splash on landing. The model results match the behaviour both of fluid droplets in laboratory experiments and of real volcanic deposits studied in the field.

Our current work addresses the impact and accumulation of a pile of clasts with specified diameter, core size, core and rind temperature. It attempts to quantify the combination of circumstances that will allow (a) single clasts to deform and/or rupture upon landing and, (b) how piles of such clasts evolve into a mobile mass. The key parameters in this problem are the time taken to reach thermal equilibrium and whether the bulk viscosity of the equilibrated mass is sufficiently low for the pile to flow under its own weight. To cope with computational modelling of the solid components of chilled clasts, we are using hybrid Finite Element/Discrete Element Analysis code, which allows us to combine fluid flow and brittle failure. We have maintained a ‘reality check’ on the computer modelling by means of laboratory analogue experiments and field ob-

servations. Our laboratory experiments rely on paraffin wax as a magma analogue. We have modelled the evolution of piles of clasts with prescribed initial temperature structures, and having viscosity defined as a function of temperature according to standard models of silicates. We have studied the situation in which the pile is continuously being added to from above to reveal the influence of accumulation rate on the thermal and rheological evolution, and the weight that drives spreading, and hence the final morphology.

Sumner JM, Blake S, Matela RJ, Wolff JA (2005) Spatter. *Journal of Volcanology and Geothermal Research (in press)*