

Tar River Study

Many of the flow in Calder's dataset go down the Tar River Valley. These flows can travel a total of about 3 km before flowing into the sea. The profile of the valley can be seen in Fig.. One can roughly fit this profile by two inclines, the first from an elevation of 900m.

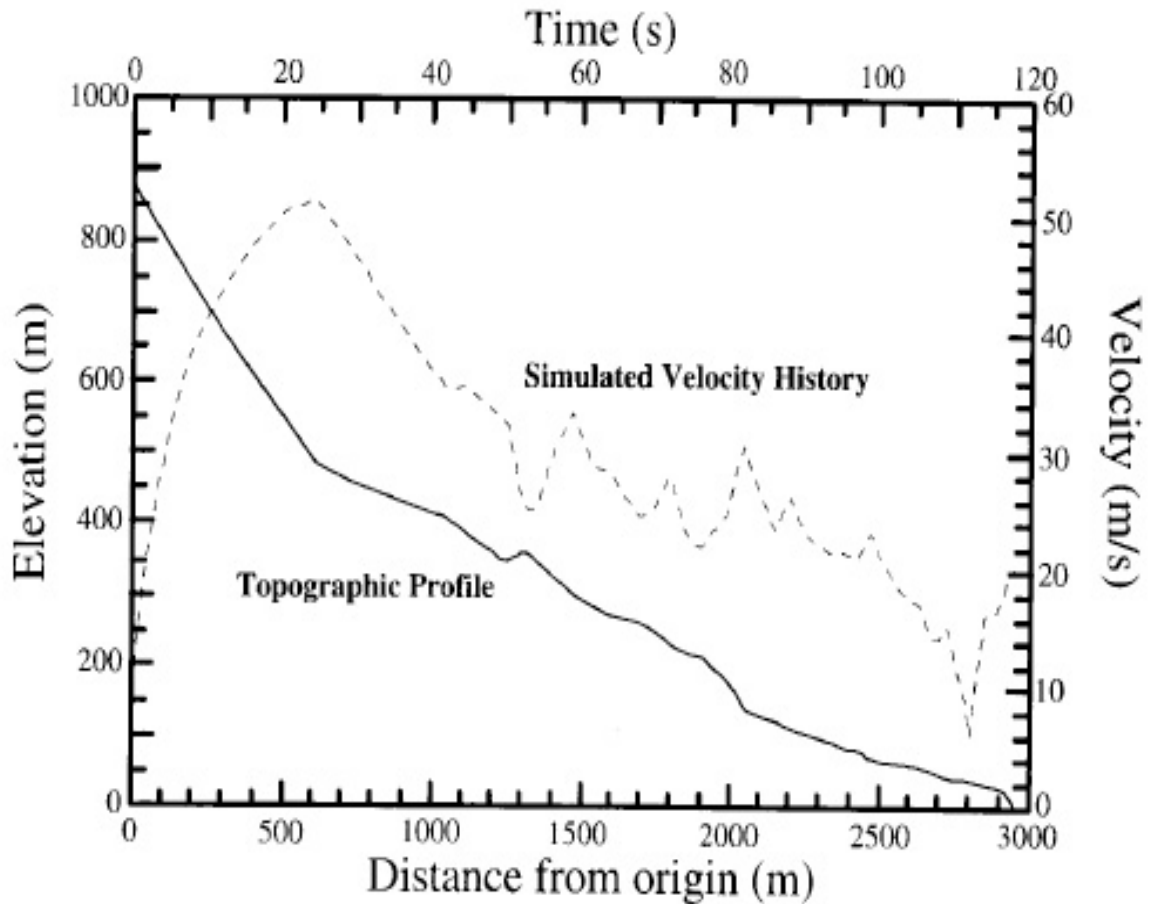


Figure 8. Comparison of simulated flow velocity history with topographic profile for a typical flow path with the MONT1 parameters. The chosen flow pathway originated on the synthetic dome, traveled down the Tar River valley (deflecting off crater or valley walls in some locations), and entered the sea at the mouth of the Hot River (see Figure 7a).

Figure 1: Elevation profile of the Tar River Valley. (The sample velocity profile was computed using an older computer model.)

to 475m with a horizontal extent of 0 to 600m (an angle of about 35°), and the second from elevation 475 to 0m., with horizontal distance from 600 to 3000m (an 11° angle). One can

estimate frictional dissipation by a simple sliding block model,

$$\begin{aligned} \frac{dx}{dt} &= u \\ \frac{du}{dt} &= \sin(\theta) - \mu \cos(\theta) \end{aligned} \tag{1}$$

Using this model, a $\mu \approx 0.5$ implies the flow travels only to $x = 915m$; $\mu = 0.25$ gives a runout of $4802m$. So a flow would just make it to the sea if the effective dissipation were about 0.3-0.35.

So what is the right value of the dissipation? It is known that larger events run out further - see Fig.. One could try to use Calder's runout data to estimate/fit an effective friction relation. If you look at the .xls file Eliza sent, there are about 3 dozen events that flowed down the Tar River Valley only, and ran out longer than 1km (getting away from the small flow binning problem). For most of these flows, the volume was inferred from the runout, based on estimates and a little calibration that was done (that is my read of our conversations with Eliza). Look for just those flows where the volume seemed to be measured by means other than using the runout length. There are about a dozen. These come in two parts - collapse events and 'standard' pyroclastic flows. The collapse events seem to travel quite far for their size. The standard pyroclastic flows do not go as far. Can we extract useful information to estimate friction - perhaps two friction coefficients, one for collapse events and one for standard events. Can we do a similar splitting of all the data for Robert's Levy process model?

Runout (km.)	Volume ($10^6 m^3$)	Comments
1	.04	this is one piece of data - the calibrated vol-runout
1.5	.15	
3	.3	3 small flows, $0.3 \times 10^6 m^3$ total volume
2	.3	3 small flows, $0.3 \times 10^6 m^3$ total volume
3	.3	3 small flows, $0.3 \times 10^6 m^3$ total volume
2.7	.3	3 small flows, $0.3 \times 10^6 m^3$ total volume
4	3	White River Valley, plume observed
2.9	.38	Tuitts Ghaut
6	14.3	Tuitts Ghaut, dome collapse
5	2	White River, collapse, plume
4	6	White River, collapse, plume
3	4	collapse
3	2	dome collapse, runout to the river delta

So we might have 2 estimates of friction, one for standary pyroclastic flows, one for flows accompanied by collapse events. For the standard flows,

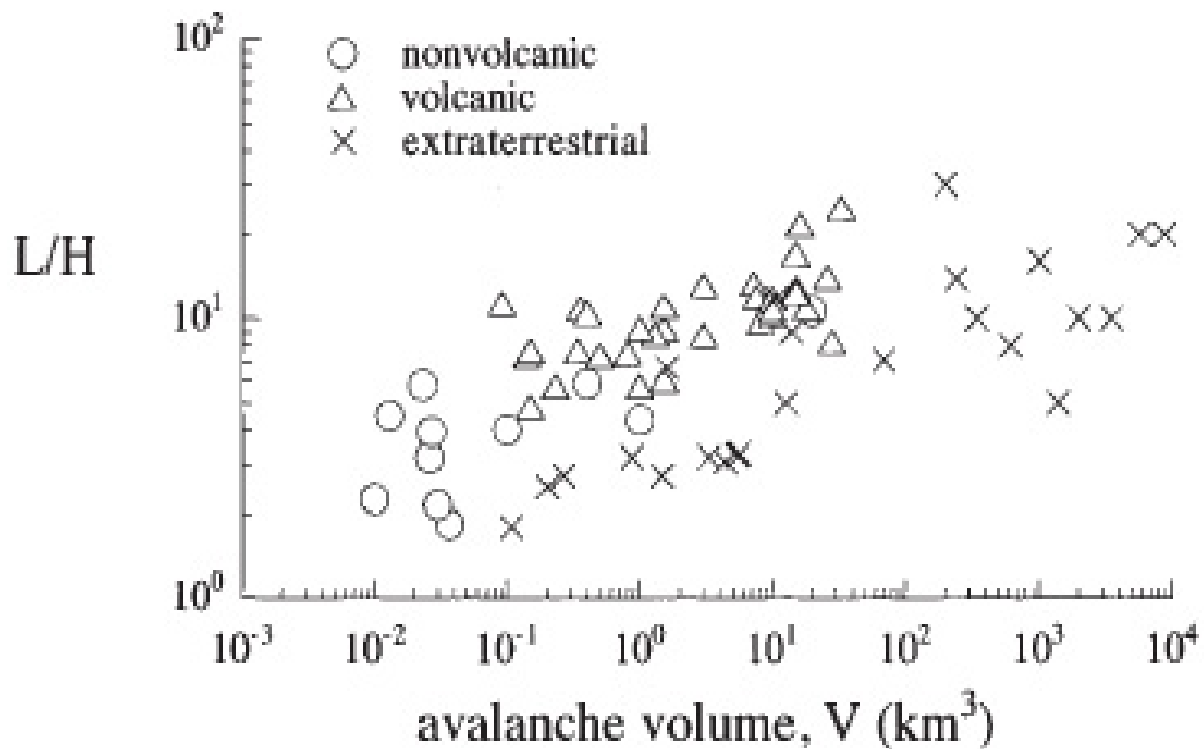


Figure 1. Relative runout L/H as function of rockfall volume V . Data compiled from Howard (1973), Voight (1978), Lucchitta (1978, 1979), Crandell et al. (1984), Francis et al. (1985), Siebert et al. (1987), McEwen (1989), and Stoopes and Sheridan (1992).

Figure 2: Runout versus volume for different kinds of flows, from Dade and Huppert, *Geology* 1998.

Runout (km.)	Volume ($10^6 m^3$)
1	.04
1.5	.15
3	.3
2	.3
3	.3
2.7	.3
2.9	.38

we could try to determine a friction-volume relation using Gaussian process model (there is

some sense from other sources that a power law $F = F_0 V^\alpha$ might be reasonable). Difficulty - guessing the covariance structure. Without covariance estimate, we can find a best linear unbiased estimate, but how to find errors? Can we parameterize correlation and make an estimate of that parameter?

Collapse events seem to suggest another friction relation, with a much smaller value of dissipation. And the 5 collapses show a wide spread. Don't know what to do in this case. Perhaps a similar estimate of friction via GPs, based on the volcanic and terrestrial non-volcanic events in the Dade-Huppert figure?