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Internal processes of rock avalanches and their relation to sedimentology

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Landslides are a broad suite of hill-slope processes resulting in distinctive geomorphic and sedimentological deposits. Rock avalanches are low frequency, high magnitude, high speed, long-runout landslides often involving more than 10^6 m^3 of bedrock and cover. Rock-avalanche deposit morphology is topographically constrained, unconfined examples show unrestricted spreading and thinning; valley-confined examples show several classes related to runout and mass distribution. A recently advanced sedimentological model for rock-avalanche deposits is based on extensive grain-size distribution data. Analysis of samples shows a mismatch of data when compared to the Weibull distribution. Weibull distributions have been proposed to fit repeated crushing with an exponent related to the number of crushing events. Our work shows that the data better fit a power-law distribution with the particle-size distribution being fractal across at least four orders of magnitude in grain size, as is commonly found for glacial till, fault gouge and dynamic crushing. With increasing transport distance, the fractal dimension tends toward 2.58, a value shown to represent equal probability of grain fracture across all size fractions. Variations in fractal dimension are significantly correlated with grain size, and imply that beneath a relatively inactive carapace, fragmentation is an ongoing process through the duration of rock avalanches. However, the power-law model is not an ideal match in all cases and the reasons for this are attributed to varying stages of evolution of rock avalanches and the confining valley morphology.