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A new scaling law for the runout of large rock avalanches: from the laboratory to the field.

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Large rock avalanches are commonly described by their relative runout length, defined as the ratio of the runout distance to the fall height. This quantity shows a tendency to increase with volume from a value of about 2 at volumes smaller than $10^5 m^3$ to values larger than 10 for volume in excess of $1km^3$. However attempts to scale the runout length with the initial volume are not satisfying, as this "scaling law" exhibits extremely large scatter, the origin of which remains controversial.

We report in this paper the results of laboratory experiments aimed at understanding the parameters controlling the runout length of a rock avalanche in a simple "cliff-collapse" geometry. The experiment consists of a sudden release a pile of dry granular material which is then allowed to spread on an horizontal surface. Both the runout length and the morphology of the resulting deposit are investigated as a function of the volume released, the initial aspect ratio of the granular pile, the spreading surface properties and the bead size. Two different flow geometries (linear or axisymmetric) are considered. Our main result is that the runout length varies only with the aspect ratio of the initial granular pile and is independent of the volume released.

The same approach is then applied to image analysis of the landslides localized along the walls of the Valles Marineris Canyon on Mars. The runout of the Valles Marineris landsides do not scale with their volume but with an estimate of the initial aspect ratio of the mobilized rock mass (before collapsing), exhibiting a much better collapse of the data than the "classical" approach. The results of these two separate investigations suggests that the "classical" approach is not applicable, at least in the case of a cliff

collapse where the rock mass spreads along a small slope.