Geophysical Research Abstracts
Vol. 14, EGU2012-2417, 2012
EGU General Assembly 2012

Mobility of Pyroclastic Flows and Rock Avalanches: a Functional Relationship of Scaling Parameters

B. Cagnoli (1) and G.P. Romano (2)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy (bruno.cagnoli@ingv.it), (2) Dept. of Mechanical and Aerospace Engineering, La Sapienza University, Rome, Italy

Flows of angular rock fragments are released down a concave upward chute in the laboratory to study their mobility which is measured considering the travel distance of the centre of mass of the granular masses. The prediction of flow mobility is necessary, in volcanic and mountain regions, to assess natural hazards caused by pyroclastic flows and rock avalanches.

The longitudinal profile of our chute is similar to that of the flanks of Mayon volcano in the Philippines. Our flows are dry and they have different masses (30 and 60 g) and different grain size ranges (0.5-1, 1-2 and 2-3 mm). The values of all the other variables that can affect the travel distance are held constant. Flow mobility is measured as the reciprocal of the apparent coefficient of friction that is equal to the ratio of the vertical drop of the centre of mass to its horizontal distance of travel. Our dimensional analysis generates a functional relationship between the apparent coefficient of friction and a scaling parameter that contains grain size and flow volume.

Our experiments demonstrate that the finer the grain size, the more mobile is the centre of mass of the flows. This is due to the fact that the finer the grain size (all the other features the same), the larger is the number of particles in the flow so that the agitation due to the interaction with the rough containing boundary surfaces penetrates relatively less inside the flows. Flows with less agitated particles per unit of flow mass dissipate less energy per unit of travel distance.

We show also that the larger the volume of the flow (all the other features the same), the less mobile is its centre of mass. This is due to the fact that the frontal portion of a flow reaches the less steep part of the curved chute and stops before the rear portion preventing the rear portion and the centre of mass from travelling further downhill. This phenomenon is more prominent in larger volume flows because their frontal and rear ends are more distant.

Our experiments show also that larger volume deposits (all the other features the same) have a longitudinal spreading that is larger than that of smaller volume deposits. Therefore, even if the apparent coefficient of friction of larger volume flows (estimated considering their centres of mass) is larger, the frontal ends of their deposits are located in a more distal position than those of smaller volume flows. For this reason, an apparent coefficient of friction estimated considering the most distal end of the deposits (as usually done in the literature) would be smaller when flow volume increases. The more distal position of the frontal end of larger volume deposits is also an important phenomenon (together with the actual mobility of the centre of mass of the flows) that needs to be considered when natural hazards are assessed in mountain regions.