



Erosion by debris-flows: sediment budget and channel-shaping processes

A. Remaître (1), J.-P. Malet (1,2), O. Maquaire (2)

(1) UMR 7516, School and Observatory of Earth Sciences, University Louis Pasteur, Strasbourg, France, (2) CNRS UMR 6554, University of Caen Basse-Normandie, Caen, France

Debris-flows consist of a fully saturated mixture of water, sediment and debris that can travel several kilometres. While a huge amount of work has been performed for debris-flow triggering mechanisms, there are still few studies discussing the quantification of erosion by debris flows. Therefore, little is known about the scouring processes during the debris-flow run-out. One objective of this work is to present the main results of a typical debris-flow prone torrent field observations and associated sedimentological aspects, and to make a rough analysis how the erosion of the channel may depend on some specific characteristics of the torrential reaches.

In the early evening of 5 August, 2003 a large debris flow occurred at the Faucon torrent, which is located in the Barcelonnette basin, in the South French Alps. This debris flow caused substantial damages on several buildings located on the torrential fan. Some morphological aspects of this debris-flow event are presented through a careful field survey and a multidisciplinary material characterization.

Firstly, the observations show that the triggering area corresponds to a strong incision (about 2 m depth) in scree slopes, on two locations in the upper part of the watershed. The triggering volume ranges from 7 500 to 9 500 m³. The grain-size distribution of the debris-flow deposits in this area is typical of granular debris-flows (fine elements content < 2%).

Secondly, we particularly take caution about estimation of the debris-flow volume along the flow track. The estimation has been realized on the basis of a sediment budget through a field survey before and after the debris-flow event. A two-step methodol-

ogy has been adopted:

1. a general appraisal between the volume of the triggering area and the volume of the deposits in the channel and on the alluvial fan;
2. a more detailed study of the debris-flow volume variations during the run-out based on the volume estimation for each torrential reaches. In order to simplify the volume calculations, morphology of the debris flow and check-dams locations have been implemented in ArcView 3.2®.

The total volume of the debris flow deposits was estimated to be 45 000 m³ on the fan, and 15 000 m³ in the channel. Channel scour is responsible of the great difference between the high difference between the triggering volume and the deposited volume. Considering both the triggered and the deposited volumes and the length of the debris-flow track, the channel scoured rate has been back-calculated (15 m³.m⁻¹). Laboratory tests show that the 2003 debris-flow event started as granular flow, bulked increased in fine elements by incorporating marly sediments along the torrential paths and transformed into a muddy debris-flow.

Finally some considerations about the comparison between the characteristics of check dams, the channel-shaping of the torrential reaches and the volume of the scoured sediments are discussed.