Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10994, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10994
EGU General Assembly 2008

Dry-snow slab avalanche release revisited: shear vs. collapse?

J. Schweizer (1), J.B. Jamieson (2, 3)

(1) WSL, Swiss Federal Institute for Snow and Avalanche Research SLF, Davos, Switzerland

(2) Department of Civil Engineering, University of Calgary, Calgary AB, Canada

(3) Department of Geoscience, University of Calgary, Calgary AB, Canada

(schweizer@slf.ch / Fax: +41 81 4170110 / Phone: +41 81 4170164)

With new theoretical ideas and experimental evidence our picture evolves of how dry-snow slab avalanches release. Whereas it is generally accepted that the weak layer fracture precedes the slab fracture, the microstructural view on weak layer failure challenges the traditional weak layer shear fracture assumption. Looking at a slope from a distance, it is quite clear that large parts of the slope lost their shear support and were sliding down-slope. A fracture that spread along the layering of the snowpack (in-plane and out-of-plane fracture) must have occurred. How exactly that fracture initiated and where the energy comes from that has driven it, is presently not fully clear. We try to summarize the present state of knowledge with the aim to provide a consistent picture. Consistent with our present state of knowledge, but also consistent for natural release as well as for artificially triggered fractures on slopes and flats (whumpfs). Key for understanding is the focus on scale and the fact that snow is a highly porous media (comparable to cellular solids) subject to mixed mode loading (compression and shear). Failure inevitably leads to structural failure (or collapse, also called crushing or localised volume reduction) which is observed as vertical displacement. In foams, if a cell fails or collapses the neighbouring cells are subject to bending forces. This crushing might lead to an instability involving a shear type mode of fracture, also called compressional shear crack propagation. In the case of failure of porous rocks under compression, the fracture (collapse) has been described as an-

ticrack, i.e. a closing mode I fracture since it resembles a propagating mode I crack. Given the description of failure in porous media, it seems clears that snow slab failure (natural release) starts in the weak layer below the slab with damage. The damage at the micro-scale follows from bond-breaking which at a given deformation rate starts to dominate bond-formation so that the area progressively weakens. The stress distribution at the grain-scale is complex and the failure mode largely unknown. Damage localization typically involves structural failure that can occasionally be seen as vertical displacement (also called collapse). Once a critical size is reached (typically on the order of the slab thickness) the energy released from the slab exceeds the fracture energy of the weak layer. Energy for fracture propagation sources are deformation energy and potential energy gained from the vertical displacement. In conclusion, to understand dry-snow slab avalanche release it seems unnecessary to focus on either shear or collapse as these failure types seem to be linked.