Geophysical Research Abstracts
Vol. 14, EGU2012-10585, 2012
EGU General Assembly 2012

The material, morphological, and mechanical similarities between sensitive clay landslides and dry snow slab avalanches: Implications and applications

D. Gauthier and D.J. Hutchinson

Dept. of Geological Sciences and Geological Engineering, Queen's University, Kingston, Canada (gauthier@geol.queensu.ca)

Recent research has suggested that certain similarities exist between the material properties, morphological expression, and mechanics of large landslides in sensitive clay soils (e.g. in Eastern Canada and Norway), and slab avalanches in dry seasonal snow (e.g. in Western Canada and Alpine countries). To further this concept, we review existing research, and highlight some previously unrecognized similarities between sensitive clay landslides and dry slab avalanches. For example, both snow and sensitive clay are highly porous with a meta-stable fabric or texture, show brittle yielding at high strain rates, and near complete loss of cohesion with extensive remoulding is observed in both. In both materials, yielding is structural and there is a corresponding volumetric collapse of the fabric following bond failure. Furthermore, slopes of sensitive clay and seasonal alpine snow are naturally layered, with variations grain size, density, stiffness, strength, etc., occurring over a variety of scales through the depth profile. Possible layering in both includes strong, thick strata overlying relatively thin, weak ones; these are primary features of the clay or snow, formed during deposition or by some subsequent metamorphic process that alters bonding or individual grains. Progressive failure in the fabric of a buried weak layer in snow leads to detachment of the overlying slab; this same process has been modeled successfully in sensitive clay. Observed triggering factors in sensitive clay landslides and slab avalanches include relatively minor, local loading, or some natural temporal material change acting on overlying layers, leading to a destabilization and failure in underlying layers. Slides are observed on very low angle or nearly flat slopes in both sensitive clay and snow. In both, bulk displacement or flow of the overlying snow or clay strata may not occur, despite an extensive basal failure. In those cases a large scale (e.g. 1-10 m) ribbed or 'thumbprint' morphology may develop in the failed area, although in snow this is usually observed on steeper slopes. In the cases where extensive flow does occur, in both sensitive clay landslides and dry slab avalanches the flow and its impacts are of the remoulded, fluid-like state of the material, whereas the triggering and initial failure occurs in the undisturbed, meta-stable state. Taken together or individually, the similarities described here could be exploited by researchers interested in either type of hazard. For example, whereas large landslides in sensitive clay are exceedingly rare yet highly hazardous, many small slab avalanches may be triggered intentionally and safely in order to study their properties. Those findings could then be applied directly or with some modification to the corresponding landslide problem.