

Permafrost landslides with molards as a geomorphological landmark of permafrost degradation: a worldwide survey

Costanza Morino (Laboratoire EDYTEM, CNRS UMR 5204, Université Savoie Mont Blanc, France), Susan Conway (Laboratoire de Planétologie et Géosciences, CNRS UMR 6112, Nantes Université, France), Florence Magnin (Laboratoire EDYTEM, CNRS UMR 5204, Université Savoie Mont Blanc, France), Philip Deline (Laboratoire EDYTEM, CNRS UMR 5204, Université Savoie Mont Blanc, France), Kristian Svennevig (Geological Survey of Denmark and Greenland, Denmark), Alexander Strom (Geodynamics Research Center, JSC Hydroproject Institute, Russia), Reginald Hermanns (Geohazards and Earth Observation, Geological Survey of Norway, Norway), Carla Tapia Baldis (Geocryology Unit, Ianigla, CCT Conicet, Mendoza, Argentina) and Axel Noblet (Department of Earth Sciences, University of Western Ontario, Canada).

Abstract

Periglacial territories are experiencing a high warming rate, which is exacerbating landslide extreme events in terms of frequency and magnitude, in addition to their increased unpredictability. Rapidly identifying whether a landslide event is related to permafrost degradation is becoming increasingly important to understand the state of periglacial slopes in response to climate change. Our study looks at how to use the landform called “molard” as a marker of permafrost degradation in arctic, sub-arctic and mountain environments. Molards in permafrost terrains are mound of loose debris that derive from the degradation of blocks of ice-rich sediments mobilised by a landslide. Once the ground ice has thawed, its cementing action is lost, inducing collapse of the material into molards. So far, few examples of permafrost molards have been reported in literature, and up to now they have been considered a rare morphological feature with a very local significance. Here we reconstruct the permafrost, geological, geographical settings of thirty three landslides characterised by molards showing that they are a widespread form in terrains characterised by various permafrost distribution, from continuous to isolated. The source materials of these landslides are predominantly composed of loose debris or rheologically weak bedrock, a predisposing characteristic to host ground ice. This evidence can be pivotal in identifying those terrains in permafrost environments that are prone to gravitational failures. Permafrost molards are a much more common landform than previously expected, and they are essential in deciphering the state of permafrost terrains. It should be noted that morphologically similar landforms frequently described as “hummocks” have also been reported from areas where permafrost conditions are absent. The geomorphological and possible genetic difference of “molards” and “hummocks” is part of ongoing studies.

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