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Permafrost is a crucial factor for paraglacial landscape modifications in glaciated mountain regions

Paula Hilger (1,2), Bernd Etzelmüller (2), Kristin S. Myhra (3), Reginald L. Hermanns (1,4), Benjamin Jacobs (5), Michael Krautblatter (5), Florence Magnin (2), and Sebastian Westermann (2)

(1) Geohazards and Earth Observation, Geological Survey of Norway, Trondheim, Norway (paula.hilger@ngu.no), (2) Department of Geosciences, University of Oslo, Oslo, Norway, (3) Faculty of Education, Arts and Sports, Western Norway University of Applied Sciences, Sogndal, Norway, (4) Department of Geosciences and Petroleum, Norwegian University of Science and Technology, Trondheim, Norway , (5) Department of Civil, Geo and Environmental Engineering, Technical University of Munich, Germany

Ground temperatures in steep slopes are a well-recognized factor for slope stability. Rock walls with cold permafrost tend to be stable due to additional cohesion provided by ice bonds. A warming of such rock faces influences the ice rheology in rock joints and decreases tensile and compressive stresses in rock masses.
During transitions between glaciation and inter-glaciation many steep mountain slopes encounter repeatedly strong cooling and warming, leading to permafrost aggradation and degradation over relatively short time periods depending on regional deglaciation patterns. We hypothesize that this dynamic and the related irreverible rock fatigue is a major factor for slope destabilisation after deglaciation in addition and in concert to debuttressing.
To test this hypothesis, we have employed a 2D heat flow model over glacial-interglacial cycles, which subsequently has been input into a thermo-mechanical stability model. In addition, emerging sliding planes and deposits from major rockslides were dated using cosmogenic nuclides. The results indicate the development of progressive rock-slope failure modulated by permafrost development that acts to transiently influence the mechanical stability of bedrock. Permafrost dynamics may therefore be an overlooked factor for understanding valley forming and modifying processes during glacial-interglacial transitions, while at the same time influencing present-day rock-fall processes in deglaciated areas.