Geophysical Research Abstracts
Vol. 20, EGU2018-672, 2018
EGU General Assembly 2018

Initial failure timing of gradually moving rockslides in western and northern Norway

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The steep flanks of the Norwegian valley and fjord system are characterised by rock-slope failures and deep-seated slow-moving rockslides. Rock avalanches peaked shortly after deglaciation but continued throughout the entire Holocene and historic time. More than 300 active rock slopes demonstrating post glacial deformation are mapped in Norway. Today, seven rockslides are classified as high-risk objects, based on a hazard evaluation that results in a high or very high hazard and potential loss of life.

We have dated vertical transects along three slip surfaces above gradually failing slope blocks, using terrestrial cosmogenic nuclide (TCN) exposure dating. The chronologies allow us to estimate the timing of initial failure and potential sliding rates ever since. We present results from two rock-slope instabilities at Revdalsfjellet in the Troms county in northern Norway and one active rockslide at Mannen in Møre og Romsdal, western Norway. To complement the data for discussion, we re-calculated the ages and slip rates for two additional rockslides in western Norway: the Skjeringahaugane slide in Sogn og Fjordane (Hermanns et al., 2012), and the Oppstadhornet rockslide in Møre og Romsdal (Hermanns et al., 2013), using revised TCN production rate parameters.

The ages from the two adjacent Revdalsfjellet rockslides suggest different timings for the onset of deformation. While sliding at Revdalsfjellet 1 initiated during the mid Holocene, Revdalsfjellet 2 indicates deformation since the Holocene Thermal Maximum (HTM). The latter coincides with the initial failure of the Mannen rockslide (1000 km away). Deformation at the Oppstadhornet rockslide seems to have started shortly after local deglaciation, which also applies for early deformation at the main Skjeringahaugane sliding surface. New results of a secondary sliding surface at Skeringahaugane suggest that this surface became active during the mid Holocene.

Debuttressing is a common driving factor for slope failure and slope deformation following the deglaciation. This is demonstrated by the peak of mass wasting activity during the late Pleistocene and early Holocene and the onset of two of our studied gradually moving rockslides. However, because of the concurrence of initial failure close to the HTM and mid-Holocene at rockslides in northern and western Norway, we argue that the change of thermal conditions in these rock slopes was one of the driving factors for distabilisation.

Hermanns, R.L., Redfield, T.F., Bunkholt, H.S.S., Fischer, L., Oppikofer, T., 2012. Cosmogenic nuclide dating of slow moving rockslides in Norway in order to assess long-term slide velocities. In: Eberhardt et al. (eds.), Landslides and Engineered Slopes: Protecting Society through Improved Understanding. Taylor & Francis Group, London, 849-854.

Hermanns, R.L., Oppikofer, T., Dahle, H., Eiken, T., Ivy-Ochs, S., Blikra, L.H., 2013. Understanding long-term slope deformation for stability assessment of rock slopes: The case of the Oppstadhornet rockslide, Norway. In: Genevois R. & Prestininzi A., (eds.) International conference on Vajont - 1963-2013. Italian Journal of Engineering Geology and Environment, Book series 6, Rome, Italy, 255–264.