The “Permolards” project – investigating the factors leading to permafrost landslides and their mobility

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Discontinuous permafrost is prevalent in most mountainous regions around the globe (e.g., Obu et al., 2019). In periglacial territories, ice provides the “cement” that holds many mountain slopes in place. In the context of the increase of global mean temperatures, permafrost environments are experiencing unprecedented warming that is resulting in failures of mountain slopes (e.g., Draebing et al., 2014). These failures often mobilise permafrost materials, which can manifest as frozen blocks of loose debris or poorly lithified bedrock. These blocks come to rest within or proximal to the landslide deposits and degrade into permafrost molards, which are conical mounds of loose debris (e.g., Morino et al., 2019). In addition, such landslides can have unexpected complex behaviours and long runout due to the inclusion of ice and water into the sliding mass (e.g., Morino et al., 2021; Roberti et al., 2017). In a project funded by the French Scientific Research Council (ANR), we have been investigating the formation of molards via field observation and analogue laboratory experiments (Philippe et al., 2023) to gain insight into the range of materials that can produce molards and the factors that control their final shape. In parallel, we have been using topographic data in combination with temperature logger data (from field deployments) as inputs into a thermal model to understand the permafrost conditions preceding such mass wasting events. This is giving us insights into the conditioning factors that lead to such events. Using satellite data, we have compiled a database of 39 landslides with candidate permafrost molards from around the world, which is giving us insights into the types of terrain, lithologies and permafrost conditions that favour these types of mass movement. As a final strand to this project, we have begun to investigate how the distribution of molards in the landslide deposits can provide additional information on the landslide dynamics, which in turn helps us to better understand the role of ice and water in the mobility of these landslides. In this presentation, we will summarise the key results of this project, showing examples from Nordic countries and outline key avenues for future research.

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