Study of the degradation of ice-cemented sediment produced by landslides into molards

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Date de la soutenance
16/05/2025 à 14:00

Lieu de la soutenance
Université de Caen, Campus 1

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Abstract

In this thesis, I aim to broaden the understanding of geomorphological features known as permafrost molards - conical mounds of loose debris that can be found in landslide deposits in periglacial environments. If ground ice degrades in mountain slopes due to current climate change trends this can result in more frequent slope failures. Since molards are proposed to originate from ice-cemented blocks of debris being transported within the landslide material and degrade into conical mounds over time, they indicate the presence of an area of discontinuous permafrost at the level of the detachment zone. To better understand the physical processes leading to the formation of molards and how these processes determine the final molard shape, I studied the degradation of ice-cemented blocks under controlled laboratory conditions. To investigate the molards' distribution within the landslide deposits, their individual shape parameters and their material composition, I studied seven molard landslides. I found that the initial block's fracture surfaces, material composition, and the location of its degradation determine the resulting molards' shape and size. The dominant degradation process of the initial ice-cemented block depends on the complexity of the degrading material, especially the content of the fine material and ice content which then determines the final morphology. By degrading initial CO_2 and H_2O ice-cemented blocks of sediment under martian pressure, I find that molards can also form by sublimation processes, therefore supporting the reports of molard candidates on other planetary bodies.