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## **Molards, a new geomorphological tool for the identification of permafrost degradation in periglacial terrains around the globe**

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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. Such molards cannot form without ground ice, which cements the source material, allowing it to behave like solid during transport. Once the ground ice has thawed, its cementing action is lost, inducing collapse of the material into molards. We reconstruct the permafrost, geological, geographical settings of more than 50 landslides characterised by molards, compiling data available in the literature. We apply quantitative terrain analysis using high-resolution DEMs to describe, quantify and compare their topographic characteristics, morphometry, dynamics, and molards distribution and density. Our results show that landslides with molards can occur in terrains characterised by various permafrost distribution, from continuous to isolated. These landslides show a variety of morphological and morphometric characteristics, source materials often composed of loose debris or rheologically weak bedrock, and their molard distribution reflects the dynamics of the landslide. In this study, we show that molards are an indicator landform of permafrost degradation under different permafrost, geomorphological and geological conditions, and that they can be used to decipher landslide dynamics in cold environments.

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