Characterizing the setting and mechanisms of permafrost landslides in the central Mackenzie Valley, NWT

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Results from this work enable researchers, engineers, and communities to better understand how permafrost landscapes may change in the near future and what specific mitigation and adaptation strategies may be necessary to mitigate the effects of permafrost landslides on infrastructure and the environment. This project documented the distribution and initiation of recent acceleration of permafrost landslides in the central Mackenzie Valley. A close association was established between past forest fires and recent landslides. This includes novel styles of permafrost landslides that are larger and occur more rapidly than traditional forms of permafrost slope failure.

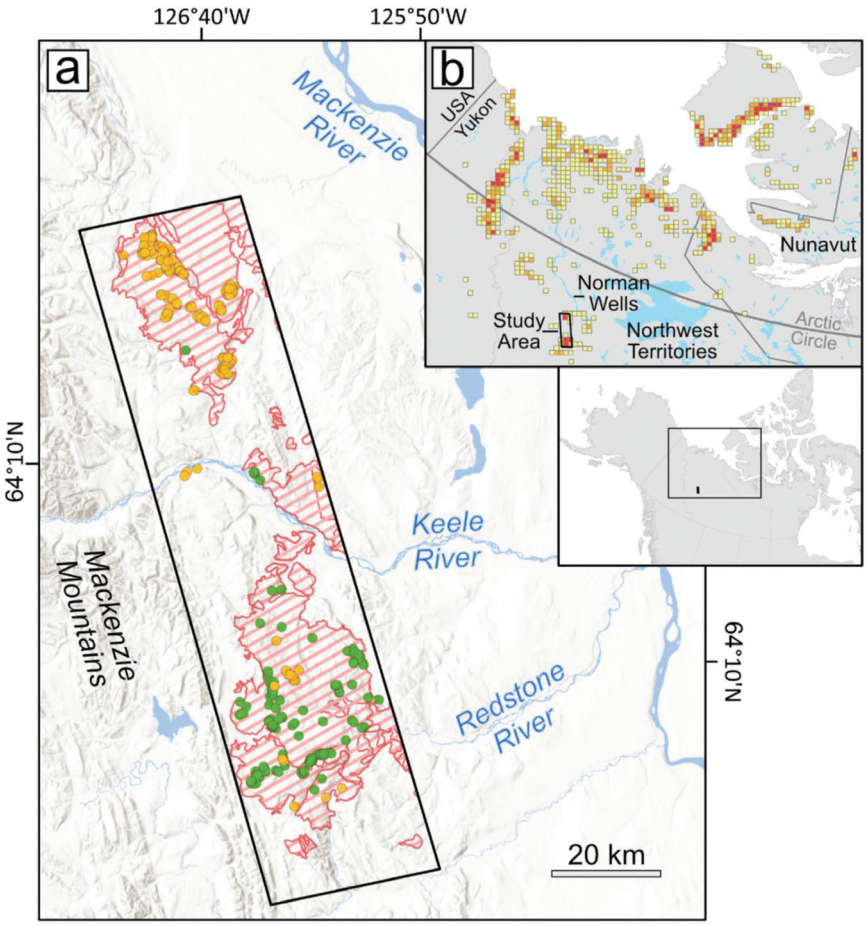

Figure 1. Past fire activity and new permafrost landslides go together in the ~4,000 km^2 study area. Outline of study area (black box) with mapped retrogressive thaw slumps (green) and deep-seated permafrost landslides (yellow) from 2020 satellite imagery. Areas with forest fires are shown with hatched red lines.

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Research summary

Continued permafrost thaw can weaken hillslopes, potentially triggering widespread permafrost landslides. Increasing numbers of these landslides can pose significant risk to both aquatic ecosystems and infrastructure. This research documented the distribution, drivers, and types of recent permafrost landslides in the central Mackenzie Valley, an area that was previously thaw-stable. Characterizing these landslides using field observations and satellite imagery revealed a close association between forest fire activity in the 1990s and recent (2005–2020) increases in permafrost slope failures (Figure 1). This underscores the role of past fires in preconditioning this landscape for widespread slope failure. Additionally, a new type of permafrost landslide was documented, where failure occurs along the permafrost base, resulting in particularly large disturbances (Figure 2).

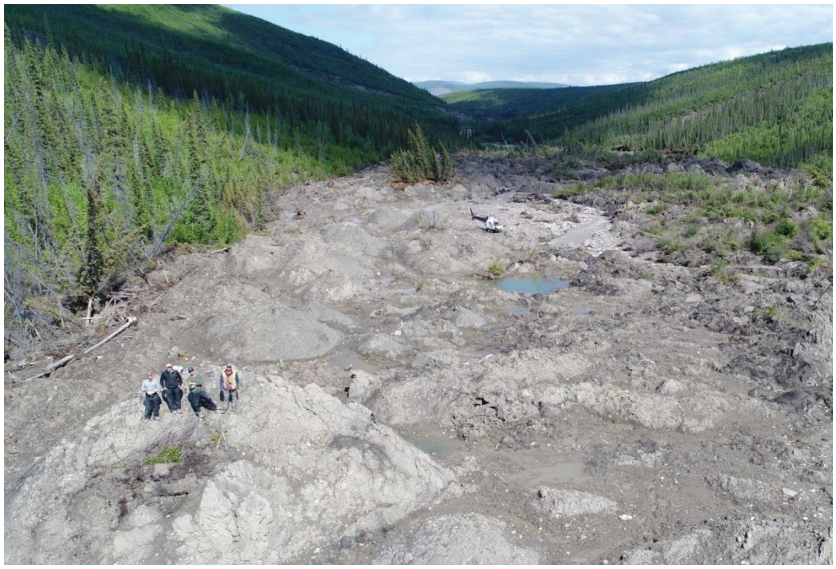

Figure 2. Portion of a deep-seated permafrost landslide deposit (~ 1.2 km long) in the Redstone River basin. This landslide occurred in 2018 and mobilized around 5 million cubic meters of frozen material into the river valley.

Taking action

Understanding how and why permafrost landslides occur is essential for predicting which areas might be at risk and developing strategies to protect infrastructure and the environment. The next phase of research may expand to study permafrost landslides across the entire Northwest Territories and create maps that identify areas of risk.

Connections to other projects

1 This project is part of Theme 1 — *Characterisation of permafrost* and linked to other projects in the theme. The objective of Theme 1 is to improve understanding of ground-ice loss and its consequences.

Partners, team members and support

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References

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