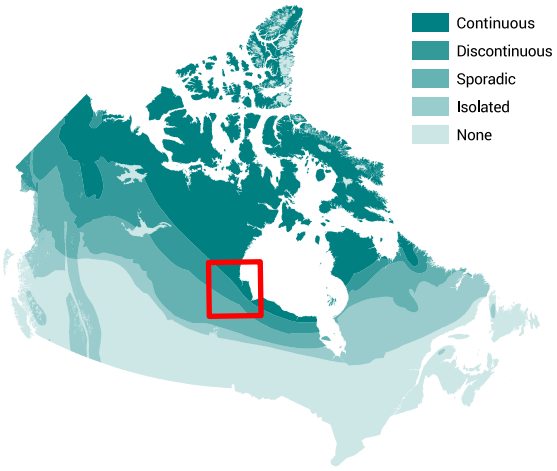
Ice-wedge volume, distribution, genesis, and influence on landscape evolution in the Barrens of northern Manitoba



Study locations: The Barrens of northern Manitoba.

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Keywords: Ice wedge, thermokarst, peatland, forest-tundra ecotone.

This research has practical implications for the prediction and mitigation of permafrost-thaw hazards around crucial northern infrastructure (the Hudson Bay Railway) and polar bear habitat, while also advancing fundamental knowledge of ice-wedge development in uplifted permafrost peatlands. Climate-induced permafrost degradation in the Barrens of northern Manitoba is expected to be severe. The distribution of ground ice will determine thaw-induced infrastructure damage and habitat loss. This project supports northern resilience through collaborations with the Hudson Bay Railway and Wildlife Conservation Society Canada.

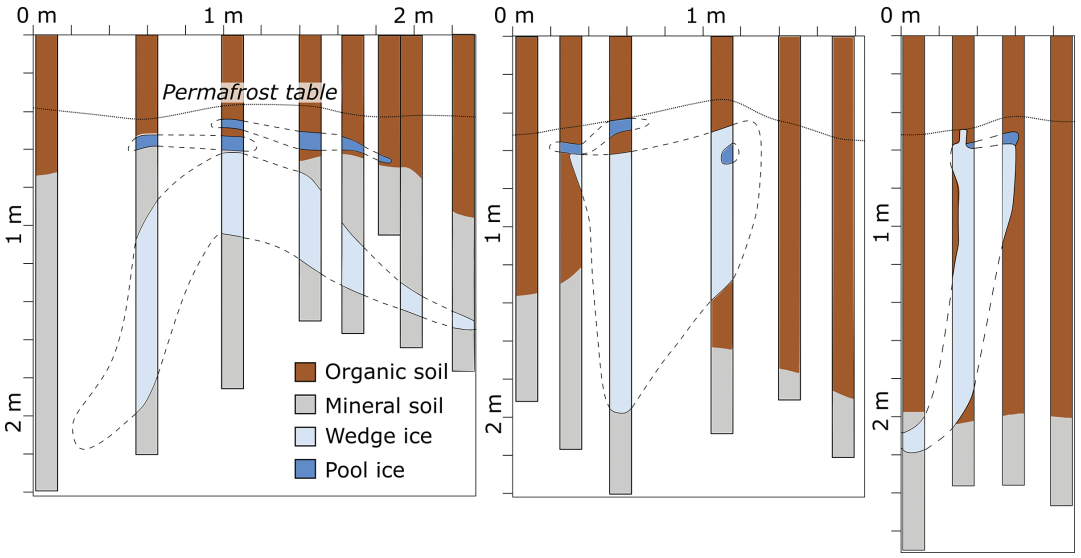

Figure 1. Borehole transects across ice wedges in the Barrens. Dashed lines represent interpolations.

Research summary

The role of wedge ice in landscape evolution is unknown in the Barrens of northern Manitoba. The goal of this research was to investigate ice-wedge volume, distribution, genesis, and impacts on thermokarst dynamics in the Barrens. To do so, ground-ice conditions, permafrost thermal regimes, and geomorphological changes were assessed using field data and remote sensing. Results indicate that ice wedges represent about 3% of the upper 2.5 m of ground in the Barrens. Because ice wedges are close to the permafrost table, they are vulnerable to

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permafrost thaw. Thermokarst is most widespread where peat is thinnest and near-surface ice content is relatively high. Observed landscape changes associated with fires, wetting, greening, and drainage are predicted to amplify and accelerate in the future. These location-specific results are necessary for infrastructure management and northern Manitoba's conservation strategies under a warming climate.

Taking action

To support proactive adaptation to hazards associated with permafrost thaw along the Hudson Bay Railway, results from this study will be used by engineers who are modelling the anticipated impacts of thaw along the rail. To support habitat conservation, we recommend working towards measures that will decrease the spread of tundra fires in the Barrens to limit the long-term impacts of fires on permafrost and wildlife. Given the observed influence of ground ice on landscape evolution, conservation efforts in this region would greatly benefit from additional field-based, empirical understanding of permafrost and ground-ice dynamics in specific habitats, such as in polar bear maternity denning areas. Although preliminary results indicate landscape resilience to change, we should aim to limit physical anthropogenic disturbances in areas where excess ground ice is near the ground surface to maintain permafrost stability.

Connections to other projects

This project is part of Theme 1 — *Characterisation of permafrost*. Characterising ground ice is required to determine the hazards and impacts associated with permafrost thaw and therefore relevant to Theme 4 - *Hazards and impacts associated with permafrost thaw*. The results of this project are important to stakeholders (Hudson Bay Railway, Parks Canada) and enable progress with the objectives of Theme 5 — *Adaptation to permafrost thaw*.

Partners, team members and support

This work would not have been possible without the important field contributions of Emmanuel L'Hérault.

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References

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