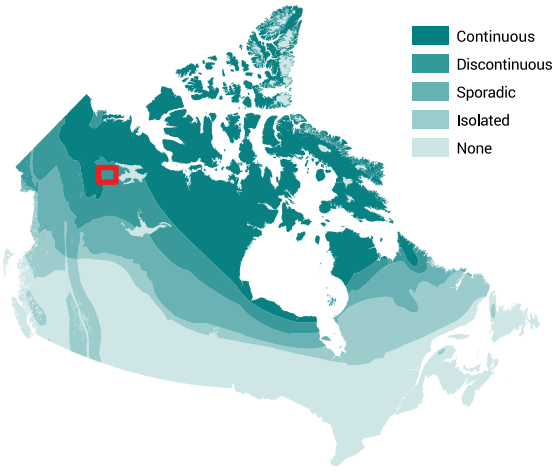
Community-scale mapping of surficial geology and permafrost conditions for the Hamlet of Tulit'a, Northwest Territories



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Study locations: Tulit'a. Northwest Territories.

Keywords: Community mapping, surficial geology, permafrost conditions, ground ice, excess ice content, geohazard, community project.

This project created a surficial geology and permafrost conditions map at a community-scale (1:10,000) for the Hamlet of Tulit'a, located in the central Mackenzie Valley region at the confluence of the Great Bear and Mackenzie rivers. The map enables us to develop a partnership with the Sahtu Renewable Resources Board and improve our understanding of permafrost conditiots within the community. Our documentation of ground ice in town can now better inform community members, land-use planners, and engineers of potential risks and challenges associated with permafrost degradation.

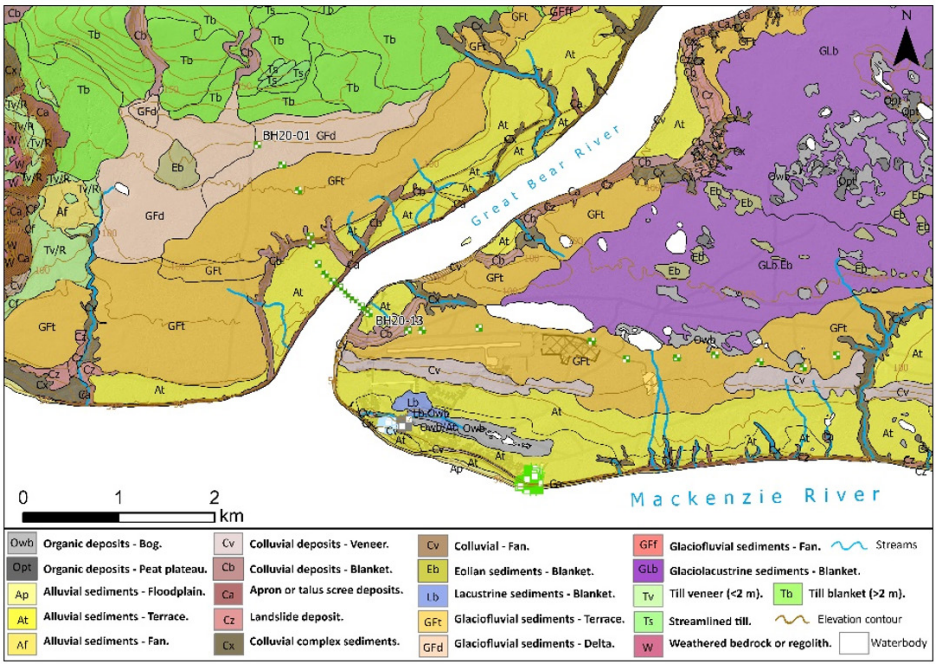

Figure 1. Surficial geology map of Tulit'a created at a community-scale (1:10,000).

Research summary

This project involved a partnership between the Northwest Territories Geological Survey (NTGS), NWT communities, and researchers from the Permafrost ArChives Laboratory (PACS lab) at the University of Alberta to provide

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community-scale (1:10,000) maps of surficial geology and permafrost conditions for the community of Tulit'a. This mapping and report follow community consultations and field investigations conducted in 2022 and 2023, including the presentation of the maps to gather community feedback. The maps provide baseline surficial geology and permafrost information to better understand potential permafrost issues and assist the community and stakeholders in making better-informed planning decisions. The field investigations revealed that tulit'a is built on ice-poor alluvial deposits composed of sand with trace of silt and clay. In 2022, drilling identified a lacustrine basin — a basin formed by, or associated with, ancient lake environments — dating back approximately 8,000 years BP (Before Present). This lake formed as a result of ancient shifts in the Mackenzie River's channels, initiated by the uplift of the land after glacial ice melted, which altered drainage patterns and created new basins for water accumulation. The lacustrine deposit underlies the sports fields and McPherson Street subdivision completed that year and contains 30% to 90% excess ice up to 3 meters deep. Despite the thaw sensitivity of ice-rich permafrost, the deposit lacked visible surface indicators, highlighting the need for integrated, ground-based investigations prior to development.

Taking action

Current maps of the central Mackenzie Valley were made for regional geological applications at the time of oil and gas exploration, and those that are now used by land use planners and engineers date back to the 1970s and 1980s and are neither designed nor at the proper resolution for community planning. Previous maps (≥1:125,000) also often overlook the local geologic history and the recent thermal regime of the permafrost. High-quality surficial geology and permafrost conditions maps (1:10,000) are now essential for characterizing permafrost within a community. The next steps are to develop similar maps for the other communities in the Northwest Territories. Maps for Fort Good Hope are on their way, and NTGS are currently developing high-quality maps for the four coastal communities (Tuktoyaktuk, Paulatuk, Sachs Harbour, and Ulukhaktok) based on this project.

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. This project focuses on the variability of ground ice at a local scale and emphasizes the importance of ground truthing and field investigations in characterizing permafrost.

Partners, team members and support

This research benefited from the support of the community members of Tulit'a, and the NTGS. We are grateful for the help of Ed Hoeve and TetraTech who shared their expertise and past geotechnical research done in the community. We thank Ashley Rudy, Niels Weiss and Philippe Normandeau from the NTGS for reviewing the report and the maps.

Acknowledgment, thanks and funding

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Reference

Chiasson, A., Yakeleya, J., Kokelj, S.V. and Froese, D.G. (In Revision). Community mapping of the surficial geology and permafrost characteristics for the Hamlet of Tulít'a, Northwest Territories. Northwest Territory Geological Survey, Yellowknife, 87 p. and 2 maps.

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