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HIGH-RESOLUTION MAPPING OF GLACIAL LANDSCAPES IN CENTRAL MAINLAND NUNAVUT USING ARCTICDEM DATA AND LANDSAT 8 IMAGERY

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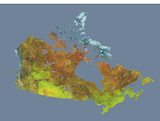
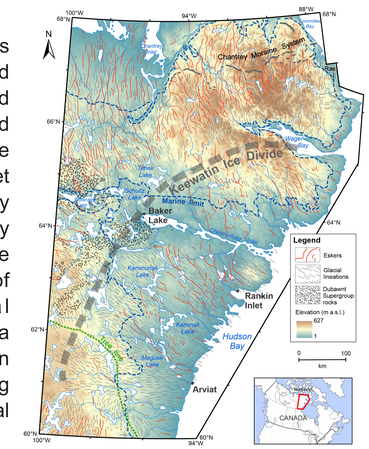


INTRODUCTION

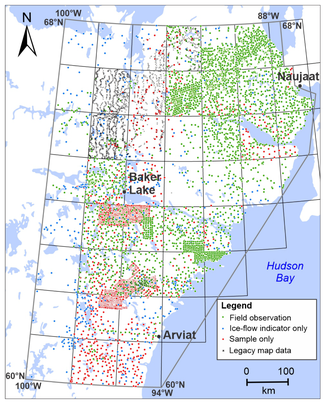
High-resolution digital elevation models (DEMs) have generated unparalleled images of landforms and transformed geomorphological mapping in glaciated terrains. The Keewatin region, where the largest dome of the Laurentide Ice Sheet (LIS) was located, is an area with a poorly constrained paleo-ice dynamics history due, in part, to incomplete mapping of the glacial geomorphology. New maps of glacigenic features and glacial landsystems were produced for an area covering approximately 415,000 km^2 in central mainland Nunavut using ArcticDEM, Landsat 8, previous surficial mapping, and field observations.



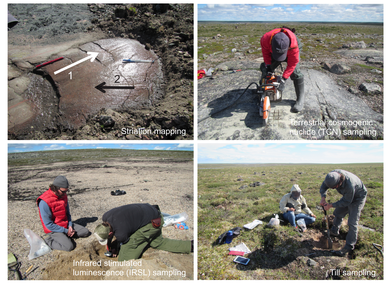
METHODS

Our new mapping integrates selected geomorphological features from 83 digitally converted surficial geology maps and information from >14,000 field stations, updated by visual, computer-based mapping and verification of previously mapped features with high-resolution ArcticDEM data (2-m res resampled at 5 m) and Landsat 8 (pansharpen to 15-m res) images. The overlay of a transparent (40-60%) Landsat 8 mosaic over the hillshaded ArcticDEM proved to be the most useful combination to map the glacigenic landforms. Glacial geomorphological features were individually identified (lines and points), or regrouped in generalized areas (polygons). Information (metadata) is stored in attribute tables for each mapped feature, including feature type, subtype (if distinguished), and original map data source.

Field stations

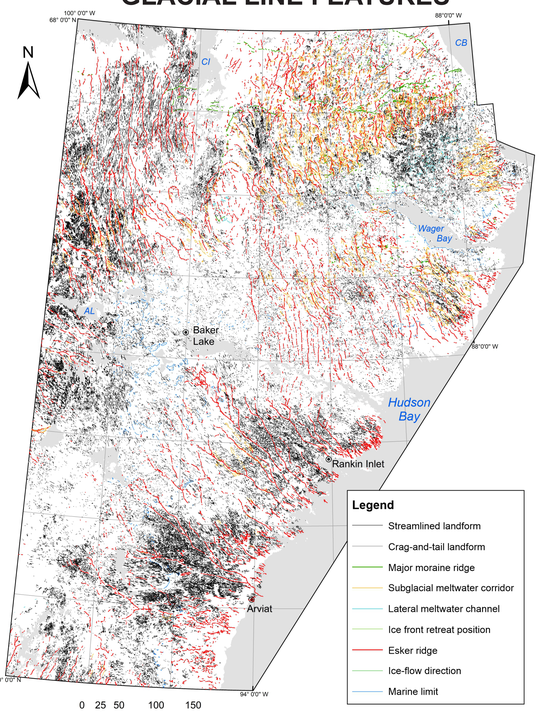


Field observations

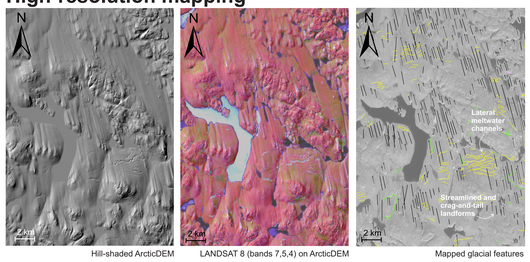


In addition to the mapped features, sites with ground observations, ice-flow measurements or samples collected for Quaternary studies, and with observations taken from an aircraft, were included as point features. Selected information collected at the 14,153 field stations were compiled from a number of publications or from proprietary Geological Survey of Canada datasets.

GLACIAL LINE FEATURES

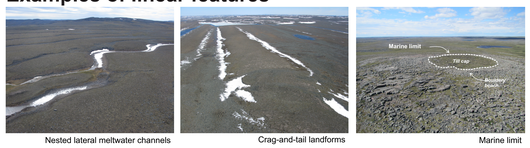


High-resolution mapping



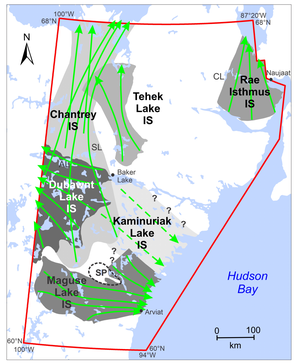
Hill-shaded ArcticDEM | LANDSAT 8 (bands 7,5,4) on ArcticDEM | Mapped glacial features

Examples of linear features

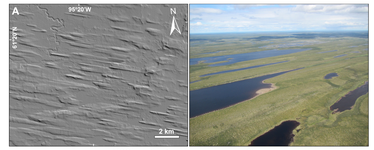


Nested lateral meltwater channels | Crag-and-tail landforms | Marine limit

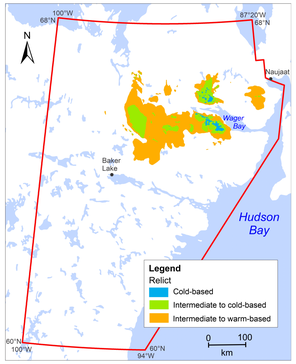
INTERPRETED GLACIAL LANDSYSTEMS



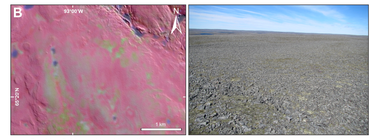
A. Ice streams - Six separate ice streams are recognized, including one defined by a strongly converging pattern of streamlined landforms, a till plume and lateral shear moraines (Tehek Lake IS), and the previously hypothesized Chantrey IS, a far-reaching ice stream extending into the core of the region.



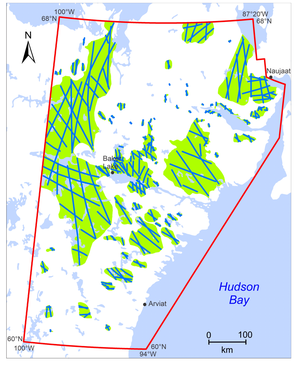
MSGLs within the Maguse Lake Ice Stream



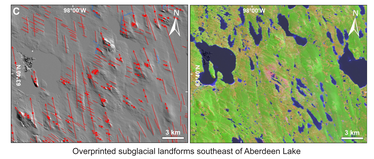
B. Relict terrains - A continuum of relict glacial landsystems is mapped between Baker Lake and Wager Bay based on basal ice thermal conditions imprinted by varying amounts of glacial erosion and weathering. The mapping is supported by new field observations and preliminary ^{10}Be abundances in bedrock.



Boulder fields and bouldery diamictons in an intermediate to cold-based glacial terrain



C. Palimpsest landscapes - Regions with superimposed streamlined landforms are identified based on the integration of generalized landform trends and are supported by the regional ice-flow chronology. The degree of overprinting and duration of events have not been established.



Overprinted subglacial landforms southeast of Aberdeen Lake

SUMMARY

An incomparable, detailed inventory of >156,000 glacigenic features in central mainland Nunavut provides new coverage where low-density or no maps existed. The updated mapping permitted the consolidation, scaling and harmonisation of existing maps in a properly georeferenced database in ArcGIS 10.0 mxd format (Behnia et al., 2020). Coherent glacial landsystems were interpreted based on the identification and grouping of mapped glacial features, supported by abundant field observations (McMartin et al., 2020). The new georeferenced, multi-scale datasets and interpreted glacial landsystems provide a comprehensive framework to strengthen reconstructions of the glacial history and dynamics of the LIS, identify distinct glacial sediment transport paths for applications in mineral exploration, and test numerical modelling of the LIS in support of climate change studies and long-term evolution of modern ice sheets.

Future work

The next phase of this compilation will include the comprehensive mapping of glacial ice flowsets and the synthesis of ice divide location and migration paths. The interpretation of new geochronological data on surface materials (TCN, IRSL, ^{14}C) in the entire region will help evaluate the significance of inheritance for glacial erosion and provide an update on ice margin retreat positions and marine limit chronology. A continuation of the glacial geomorphological mapping is planned to the west of the study area in the Northwest Territories and Nunavut between longitudes 100° and 108° W, and latitudes 60° and 68°N.

This work is part of the Synthesis of Glacial History and Dynamics Activity of Natural Resources Canada Geomapping for Energy and Minerals (GEM) Rae project.

RELATED PUBLICATIONS

Behnia, P., McMartin, I., Campbell, J.E., Godbout, P.-M., and Tremblay, T., 2020. Northern Canada glacial geomorphology database: Part 1 – central mainland Nunavut. Geological Survey of Canada, Open File 8717, ver. 2020. https://doi.org/10.4095/327796

McMartin, I., Godbout, P.-M., Campbell, J.E., Tremblay, T., and Behnia, P., 2020. A new map of glacigenic features and glacial landsystems in central mainland Nunavut, Canada; Boreas. https://doi.org/10.1111/bor.12479

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