ACKNOWLEDGMENTS

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Irvine, M.L., 2011. Living on unstable ground: Identifying physical landscape constraints on planning and infrastructure development in Nunavut communities, Unpublished M.Sc. thesis, Memorial University, St Johns Newfoundland and Labrador, Department of Geography, 239 p.

Smith, I.R., Irvine, M.L., and Bell, T., 2012. Surficial geology, Clyde River, Baffin Island, Nunavut: Geological Survey of Canada, Canadian Geoscience Map 58 (preliminary version), scale 1:10 000. doi:10.4095/289603

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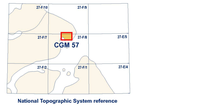
Abstract

Geological mapping of periglacial landforms and permafrost features was undertaken as part of a community-scale assessment of how different aspects of the physical environment pose risks to existing and future infrastructure development, and how climate change may further alter infrastructure vulnerability. Airphoto and ground surveys were used to identify and map gelifluction lobes (Fig. 1), nivation hollows (Fig. 2), thermokarst depressions (Fig. 3), and ice wedges (Fig. 4). Additional insights were gained by drilling and analyzing 14 permafrost cores (0.19–2.83 m long; Irvine, 2011). Ice-rich, raised marine silty-sand deposits, containing saline permafrost, underlie much of the present town and airport. Surficial sediments in areas of recent development were found to be generally ice poor, upslope from the coastal terraced regions, appear to potentially be much less affected by ground ice and saline permafrost, but are more subject to surface-slope deformation, and the wind drifting and melting of snow in the lee sides of prominent recessional moraines.

Résumé

La cartographie géologique du modelé périglaciaire et des entités du pergélisol a été entreprise dans le cadre d'une évaluation à l'échelle de la collectivité sur les risques que peuvent poser différents aspects du milieu physique pour l'aménagement d'infrastructures existantes et à venir, ainsi que sur la possibilité que le changement climatique augmente la vulnérabilité de ces infrastructures. Des photos aériennes et des levés au sol ont servi à repérer et à cartographier des lobes de gélifluxion (Fig. 1), des niches de nivation (Fig. 2), des dépressions thermokarstiques (Fig. 3) et des coins de glace (Fig. 4). D'autres renseignements ont été obtenus grâce au prélèvement et à l'analyse de 14 carottes de pergélisol (de 0,19 à 2,83 m de longueur; Irvine, 2011). Des dépôts de sable silteux marin, salin, sillieux, riches en glace et contenant un pergélisol salin, reposent sous une grande partie de la ville actuelle et de l'aéroport. Les sédiments superficiels qui se trouvent dans des zones où de nouveaux aménagements ont été entrepris, en amont des régions côtières en terrasses, semblent beaucoup moins susceptibles de contenir de la glace de sol et du pergélisol salin, mais seraient plus touchés par la déformation des pentes, ainsi que par l'amoncellement de neige sous l'effet du vent et la fonte de la neige sur les côtés abrupts d'importantes moraines de retrait.



Cover illustration:
Permafrost core from northeast part of town showing ice-rich silty-sands situated shallowly below the base of the active layer, Clyde River, Baffin Island, Nunavut. Photograph by M.L. Irvine. 2011-512

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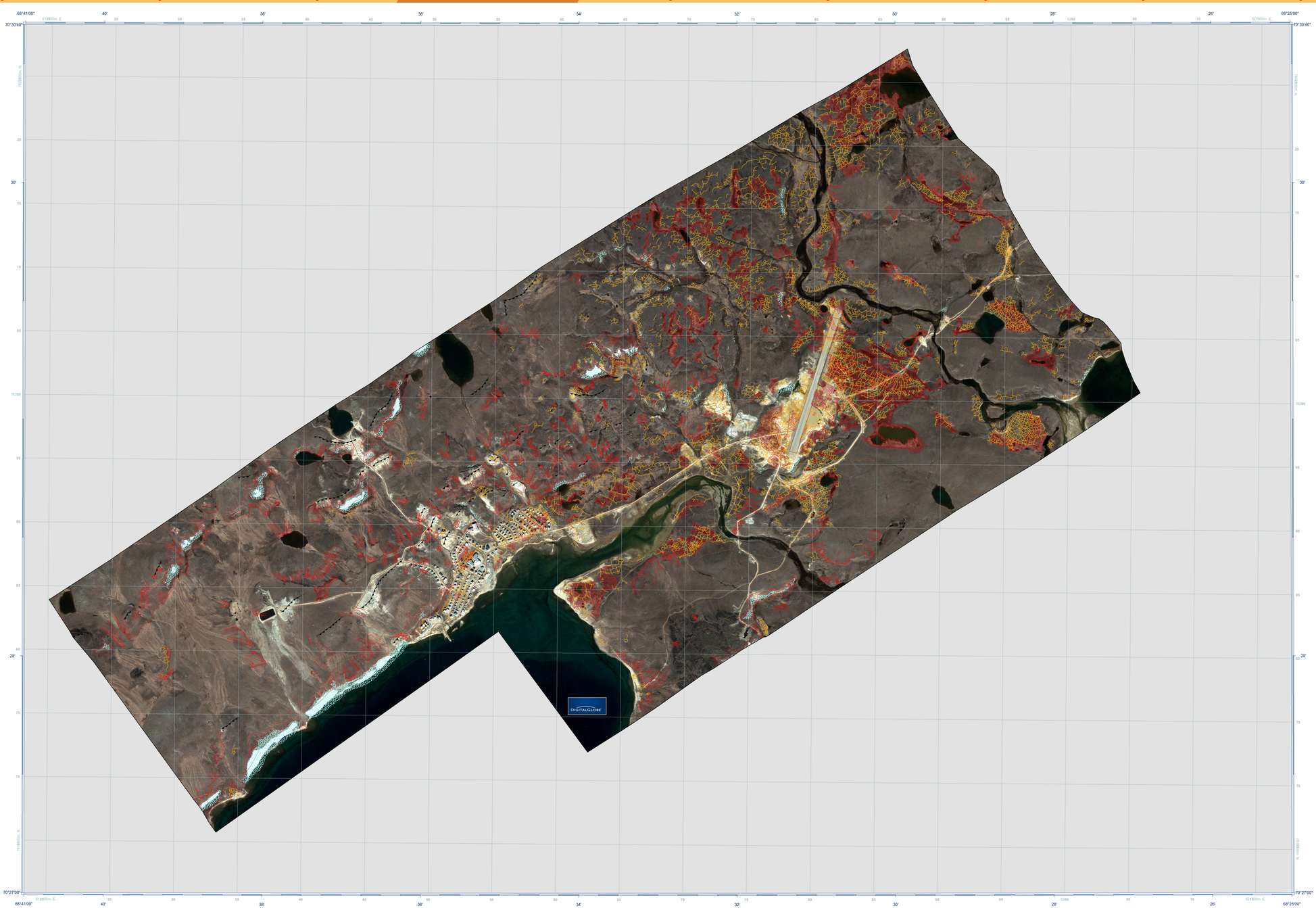
CANADIAN GEOSCIENCE MAP 57
(preliminary version)
PERIGLACIAL AND PERMAFROST GEOLOGY
CLYDE RIVER
Baffin Island, Nunavut
1:10 000



Periglacial/Permafrost Geology

- *Nivation hollow*
- *Thermokarst depression*
- *Snow packs. Perennial accumulations of wind-drifted snow and firn in lee-side depressions.*
- *MORAINE*
- *Gelifluction lobe margin*
- *Gelifluction lobe flow direction*
- *Ice wedge*
- *Road, gravel*
- *Contour line (interval 10 m)*

Note:
Polygon boundaries mapped along coastlines, lakes/ponds and perennial snowpacks reflect those identified in the 1969 airphotographs. Differences between these and the 2005 satellite image reflect erosion, water level and anthropogenic changes, and a significant reduction in the modern extent of perennial snowpacks.

Snowpack polygon and lateral moraine data included in this map are from Smith et al. (2012).

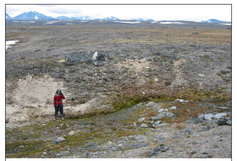


Figure 1. Gelifluction lobe formed by the slow downslope movement of seasonally thawed sediments as a result of frost heave and liquefaction. Individual lobes can be tens to hundreds of metres long, with lobe fronts tens of centimetres to +1 m high.

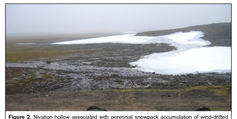


Figure 2. Nivation hollow associated with perennial snowpack accumulation of wind-drifted snow in lee side of a lateral moraine. Summer melt creates wet conditions downslope of the snowpack, which combined with colder temperatures around the snowpack can contribute to greater weathering and erosion of earth materials. Over a long period of time this can lead to development of a topographic hollow.

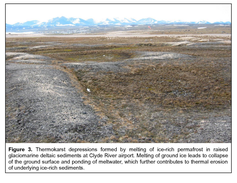


Figure 3. Thermokarst depressions formed by melting of ice-rich permafrost in raised glaciomarine deltaic sediments at Clyde River airport. Melting of ground ice leads to collapse of the ground surface and ponding of meltwater, which further contributes to thermal erosion of underlying ice-rich sediments.

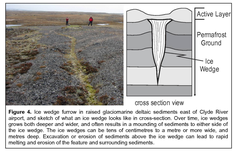


Figure 4. Ice wedge furrow in raised glaciomarine deltaic sediments east of Clyde River airport, and sketch of what an ice wedge looks like in cross-section. Over time, ice wedges grows both deeper and wider, and often results in a mounding of sediments to either side of the ice wedge. The ice wedges can be tens of centimetres to a metre or more wide, and metres deep. Excavation or erosion of sediments above the ice wedge can lead to rapid melting and erosion of the feature and surrounding sediments.

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Surficial and periglacial-permafrost geology mapping based on ground surveys (2007–2008; I.R. Smith, M.L. Irvine, and T. Bell), permafrost coring (2008; M.L. Irvine, M. Allard, E. L'Hérault, and I.R. Smith),and airphoto interpretation by I.R. Smith using 1:6400 scale black-and white vertical airphotos, flight line A21157, August 9, 1969, photos 28–51, 58–81, 128–142.

Cartography by R. Boivin

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CANADIAN GEOSCIENCE MAP 57
PERIGLACIAL AND PERMAFROST GEOLOGY
CLYDE RIVER
Baffin Island, Nunavut
1:10 000

250 0 250 500 750 1000 m

Map projection Universal Transverse Mercator, zone 19
North America Datum 1983

Base map at the scale of 1: 50 000 from Natural Resources Canada, with modifications.
Elevations in metres above mean sea level.

Proximity of the North Magnetic Pole causes the magnetic compass to be erratic in this area.
Magnetic declination 2012, 39° 29'W, decreasing 38.7' annually.

This publication, including digital data, can be downloaded free of charge from GeoPub (http://geopub.nrcan.gc.ca/). It is also available from the Geological Survey of Canada Bookstore (http://qsc.nrcan.gc.ca/bookstore).

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PERIGLACIAL AND PERMAFROST GEOLOGY
CLYDE RIVER
Baffin Island, Nunavut

Fine trim marks around perimeter of map sheet. Trim map sheet first, then fold at folding marks.

Cover and additional panels are 17cm wide when folded.