Geological Survey of Canada
Open File 8435

BIG PICTURE IDEAS AT THE GEOLOGICAL SURVEY OF CANADA: THE GLACIATED ARCTIC LANDSCAPE AND ITS SEDIMENT COVER

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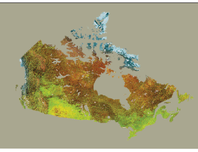
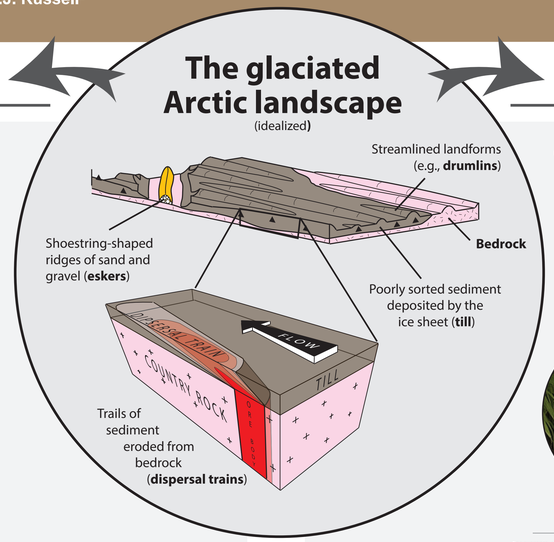


The glaciated Arctic landscape

(idealized)



1 The ice hypothesis

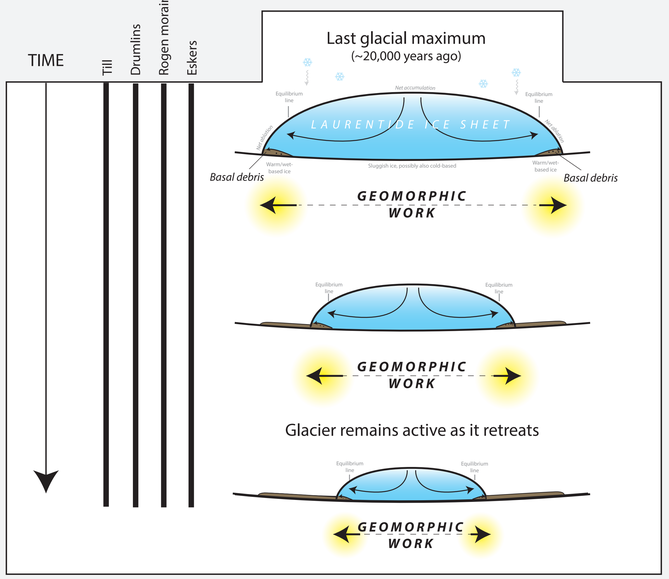
The landscape was generated primarily by the action of glacier ice

A. "Ice marginalist" hypothesis

Most sedimentary and geomorphic work –and in particular the generation of streamlined landforms and till– was performed beneath the **margin** of the ice sheet, over a **short time** (thousands of years?), during **deglaciation** (i.e., after the last glacial maximum), as the ice front retreated.

Art Dyke *Lynda Dredge*

For example, see Dyke, A.S. and Dredge, L. 1989. Quaternary geology of the NW Canadian Shield *in* Fulton, R.J. (ed.), Quaternary Geology of Canada and Greenland, Geological Survey of Canada, p. 189-214.
See also Craig, B.G. and Fyles, J.G. 1960. Pleistocene geology of Arctic Canada. Geological Survey of Canada, Paper 60-10, 21 p.



PROS

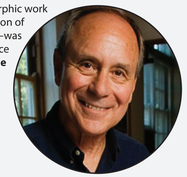
The "ice marginalist" hypothesis provides a reasonable explanation for the multiple swaths of drumlins in the Arctic, which commonly terminate obliquely against each other, and the common correlation between drumlins, striations, till dispersal trains, and eskers--this suggests a common gradient dictated by ice-surface slope generated all these features.
(These correlations are particularly well displayed in the Slave Province, where abundant dispersal-train data exist (i.e., KIDD dataset) in addition to landform and striation data.)

CONS

Arguably more difficult to explain large dispersal trains and large tree-shaped eskers under this model. Difficult to explain how individual drumlins are generated beneath a laminar (non-turbulent) fluid (i.e., glacier ice).

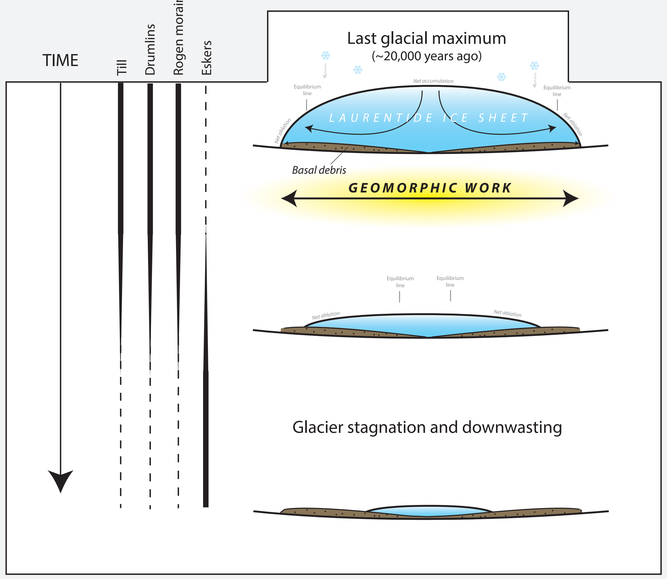
B. "Ice maximalist" hypothesis

Most sedimentary and geomorphic work –and in particular the generation of streamlined landforms and till– was performed deep beneath the ice sheet **interior**, over a **long time** (10s of thousands of years?), prior to deglaciation (e.g., during the **last glacial maximum**).



Bill Shilts

For example, see Shilts, W.W. et al. 1987. Canadian Shield in Graf, W.L. (ed), Geomorphic Systems of North America. Geological Society of America, Centenial Special Volume 2, p. 119-161.



PROS

The "ice maximalist" hypothesis provides a reasonable explanation for large, long-distance dispersal trains in the Arctic, in addition to long tree-shaped eskers.

CONS

Arguably harder to explain the multiple swaths of drumlins in the Arctic, which commonly terminate obliquely against each other, and the common correlation between these drumlins and striations, till dispersal trains, and eskers. Difficult to explain how individual drumlins are generated beneath a laminar (non-turbulent) fluid (i.e., glacier ice).

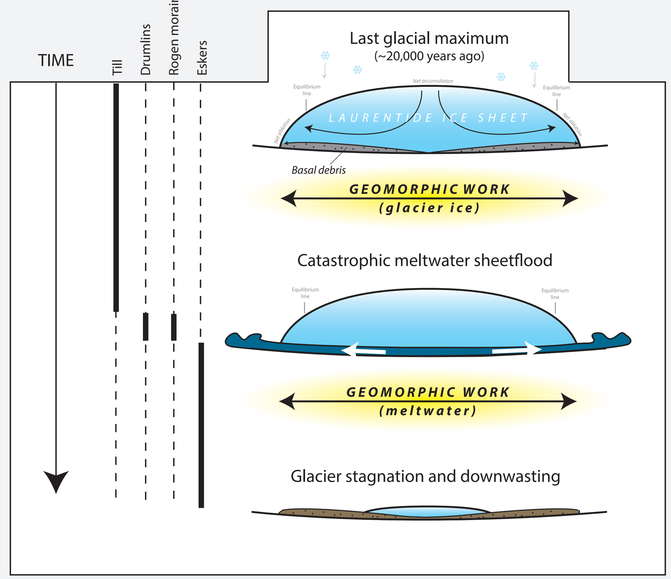
2 The meltwater hypothesis

The landscape was generated primarily by —or at least substantially modified by— the action of large meltwater floods beneath the glacier

Vern Rampton *Dave Sharpe*

Much sedimentary work (**till generation**) occurred **deep** beneath the ice sheet, prior to deglaciation, due to the action of **glacier ice**. One or more catastrophic **subglacial meltwater floods** occurred afterwards, close to the time of the last glacial maximum, prior to significant ice retreat. These performed much of the geomorphic work: they generating landforms such as **drumlins**. They also generated some dispersal trains (e.g., pencil-shaped kimberlite trains in the Slave Province).

For example, see Rampton,V.N. 2000. Large-scale effects of subglacial meltwater flow in the southern Slave Province, Northwest Territories, Canada. Canadian Journal of Earth Sciences, v. 37, p. 81-93.
See also Rampton, V.N. and Sharpe, D.R. 2014. Detailed surficial mapping in selected areas of the southern Slave Province, Northwest Territories. Geological Survey of Canada, Open File 7562, 31 p.



PROS

The meltwater hypothesis provides a reasonable explanation for the generation of drumlins. (Drumlin-like forms can be generated beneath turbulent fluid flows. Yardangs in deserts and elongate streamlined forms on stiff muddy tidal flats are good examples.)

CONS

Arguably harder to explain the multiple swaths of drumlins in the Arctic under this model, especially given the common oblique terminations of the drumlin sets against each other, and the common correlation between the drumlin sets and striations, till dispersal trains, and eskers. Also, if meltwater performed most geomorphic work in generating the Arctic landscape, why are copious amounts of well-sorted sand and gravel not observed on the landscape and at terminal ice-margin positions?

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