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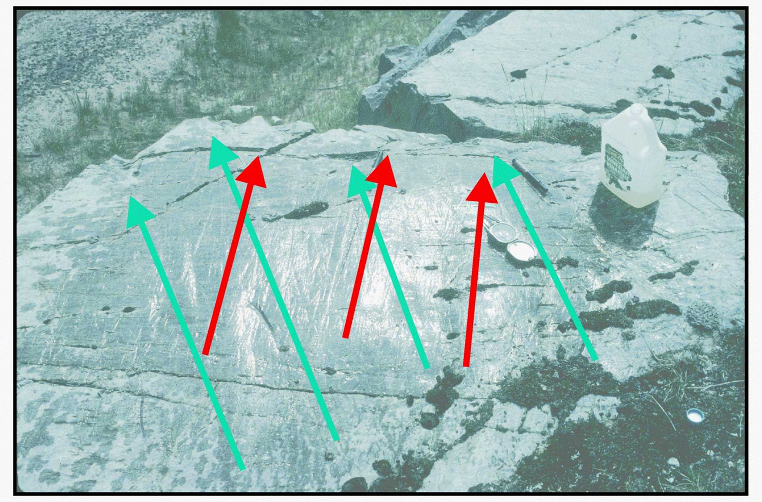
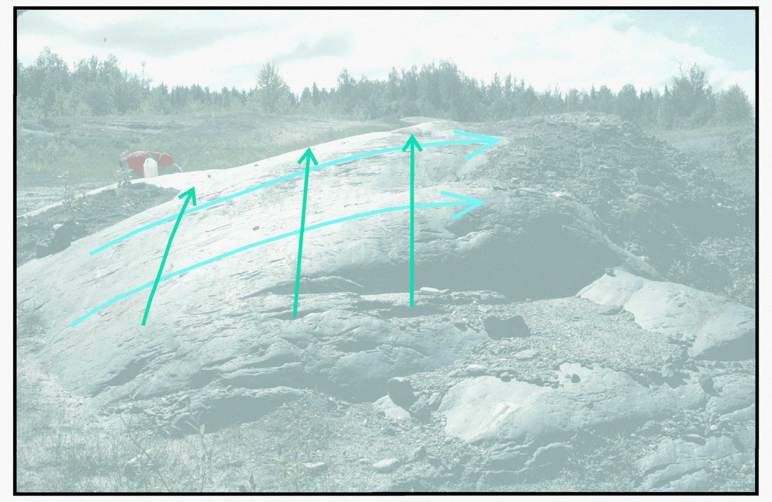
GEOLOGICAL SURVEY OF CANADA COMMISSION GÉOLOGIQUE DU CANADA

Canada

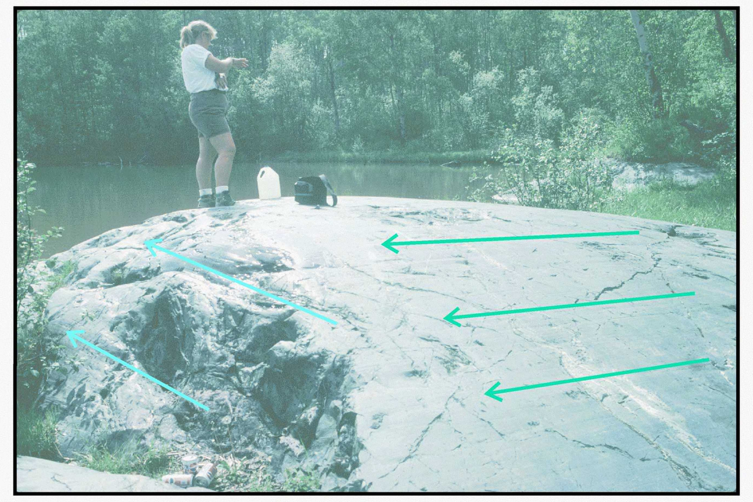
ICE FLOW INDICATORS IN THE TIMMINS AND KIRKLAND LAKE AREAS, NORTHEASTERN ONTARIO



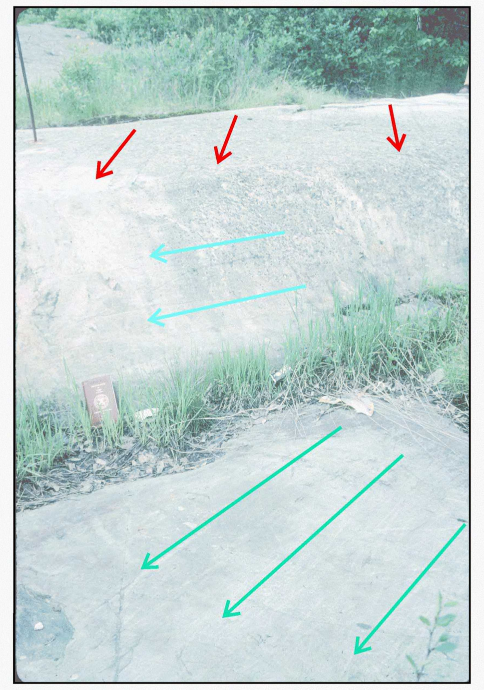
A Highway 101, 40 km southwest of Timmins (UTM: 433950, 5343000). Striations trending 195° (green arrows) across the top of the outcrop crosscut by younger striations (red arrows) trending 215°.



B K66 basin, Kidd Creek Mine property, Timmins (UTM: 474279, 5394649). Well developed roche moutonnée and striations trending 235° (blue arrows). Younger southeast flow towards 165° (green arrows) has striated the northwest side of the outcrop but has not reshaped it.



C Twin Falls Dam, east of Iroquois Falls (UTM: 530500, 5399000). Older striations trending 234° (blue arrows) preserved in the lee (south) of younger, southward ice flow that has shaped and striated the outcrop towards 170° (green arrows).



D Northern College Campus, Kirkland Lake (UTM: 573250, 5334250). Older steep sided wall and striations trending 205° (blue arrows) and younger flat lying surface striated at 175° (green arrows) on the protected lee (south) side of the outcrop. The youngest ice flow has striated the uppermost surface towards 145° (red arrows).

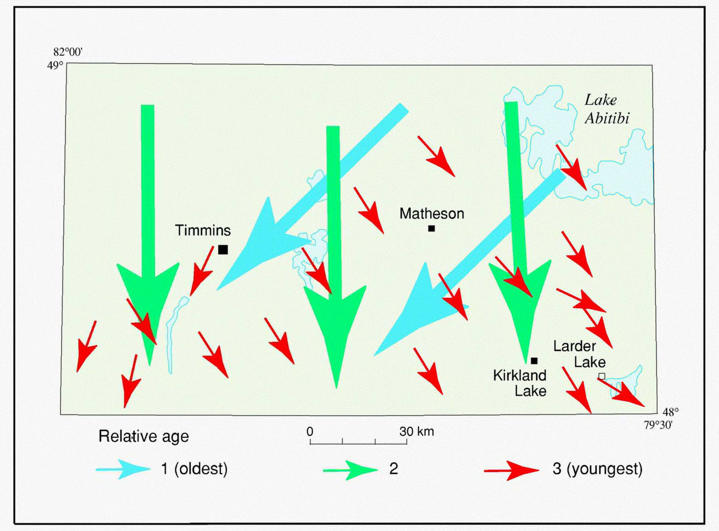
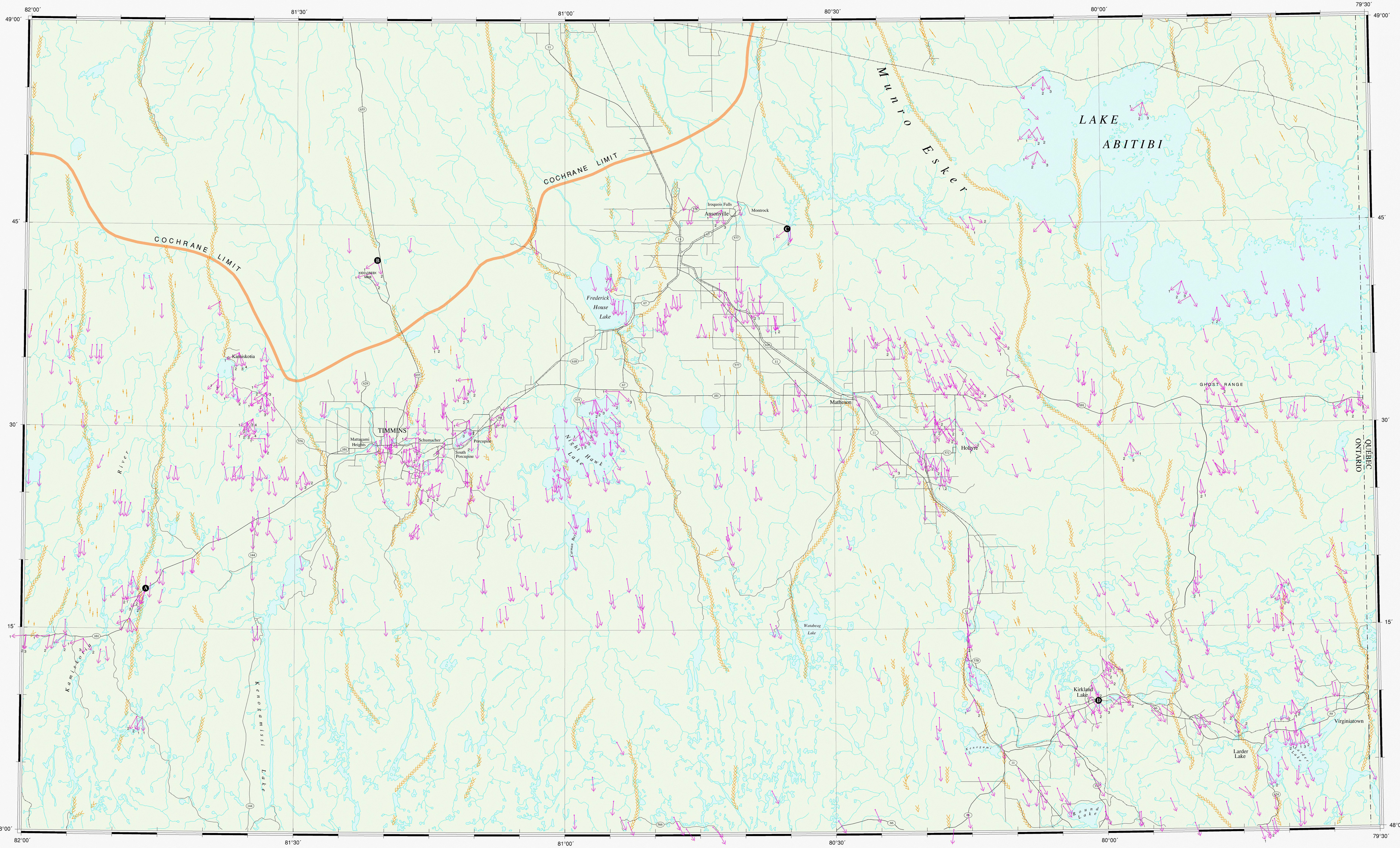


Figure 2. Regional ice flow patterns.



Summary

The Timmins and Kirkland Lake mining camps are in the western part of the Abitibi Greenstone Belt, the world's largest greenstone belt and Canada's primary source of precious and base metals (Figure 1). Because most of the region is covered by a thick and often complex sequence of glacial deposits, till geochemistry and indicator mineral tracing are principal exploration methods. To be effective, however, these methods require an understanding of ice flow patterns that transported mineralized material down-ice.

Until recently, drift prospecting programs in the region relied on an ice-flow model based primarily on the orientation of striations and glacial landforms produced by the final south and southeast ice flows that prevailed during deglaciation. The prolonged use of this simple but incomplete model may explain the disenchantment with drift prospecting methods. In later years, extensive overburden drilling for mineral exploration and stratigraphic purposes, revealed evidence for older southwest ice flows that better explained anomalies of glacial dispersal incompatible with the first model.

Striations can reveal useful information about ice flow patterns across the region, however, the published striation information for the region was inadequate. Most measurements on surficial geology maps record only the final south and southeast ice flows. Therefore, between 1992 and 1994, freshly stripped outcrops on mineral exploration and mine properties and freshly exposed outcrops along lake shorelines were examined to look for evidence of older ice flows. These new measurements were combined with existing striation and fluting data from surficial and bedrock geology maps published over the last 60 years to produce a map showing the distribution eskers, flutings and individual striations and cross-striation measurements. These data, when combined with our existing knowledge of the Quaternary stratigraphy of the region, provide a reasonable ice flow model for drift prospecting.

From bottom to top, the Quaternary stratigraphy of the Timmins- Kirkland Lake region consists of: 1) older tills and associated sediments, one of which is a carbonate-rich till transported south from the Hudson Bay Lowlands; 2) organic-bearing non glacial sediments of the Owl Creek Formation; 3) sandy Matheson till, deposited by ice flowing southwest, then south and finally southeast; 4) Barlow-Ojibway glaciolacustrine deposits; 4) clay-rich Cochrane Till, in the north part of the area, deposited by south and southeastward ice flows (DiLabio et al. 1988; Veillette and McClenaghan, 1995).

Three major ice flows that predate the Cochrane readvances are preserved in the striation record for the region (Figure 2). The oldest ice flow (blue arrow; Photos B, C, D) crossed the area towards the west-southwest (240). This flow likely is associated with the main phase of the Laurentide Ice Sheet (Veillette and McClenaghan, 1995). Towards the end of glaciation, ice flow shifted southward (green arrows; Photos A, B,C, D). As the Laurentide Ice Sheet thinned in the final stage of glaciation, ice flow (red arrows; Photo D) shifted southeast (120 -160) towards the Harricana Moraine (Veillette, 1989). Minor shifts (red arrows) in ice flow occurred at the end of glaciation; ice flow shifted southwestward (180 -200) towards the Chapleau Moraine in the Timmins area (Photo A) and shifted eastward (120 -150) in the Kirkland Lake area. All three phases of ice flow (blue, green and red) likely are associated with the deposition of Matheson Till, the youngest and most ubiquitous till sheet. Older tills that underlie Matheson Till may be associated with older southwest or southeast ice flows (Veillette and McClenaghan, 1995), not shown in Figure 2.

Any combination of all three phases of ice flow may be preserved on an outcrop in the region. Four striated sites showing various combinations of the three ice flow events are shown in Photos A to D. The blue, green and red ice flow arrows on the photos are associated with the blue, green and red ice flow arrows in Figure 2. These four sites are highlighted here because they display well preserved striations and they are accessible to geologists working in the region.

Implications for Exploration

Ice flow across the region shifted through time from southwestward to southeastward. It is important to consider all of these ice flow patterns for Matheson and older tills when using till geochemistry and indicator minerals to explore for gold, base metals and diamonds in the region. This map is the first detailed and comprehensive dataset of striations for the Timmins - Kirkland Lake region. These data should be used for future till sampling programs as well as for reinterpreting the vast quantity of existing overburden drill hole data from previous exploration projects.

Note: Striation data for this map are available from the Geological Survey of Canada as a digital computer file in spreadsheet format.

Acknowledgments

Royal Oak Mines Ltd., Kinross Gold Corp., Falconbridge Ltd., Placer Dome Inc., Gwen Resources Ltd., Regal Goldfields Ltd., Sudbury Contact Mines Ltd., W.A. Hubacheck Consultants Ltd., and Ontario Hydro kindly allowed access to their properties for the regional striation compilation. R.C. Paulen and C.A West assisted with the field work. L.H. Thorleifson suggested improvements to this map. Digital cartography was completed by Northwood Geoscience.

SYMBOLS

Striation — oldest 1, 2, 3, 4 youngest

Numbers on map refer to relative age of striations at individual sites only, and are not for correlating between sites.

Esker

Fluting or drumlinoid form

References and Sources of Striation and Fluting Measurements:

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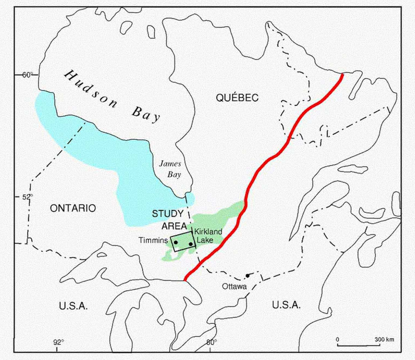

Figure 1: Location map

Paleozoic carbonate rocks

Abitibi Greenstone Belt

Grenville Front

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1995

SHEET 1 OF 1

Scale 1 : 200 000 échelle

Miles 0 5 Milles

Kilometres 0 5 Kilomètres

UTM ZONE 17, NAD 1927

NODA • EDNO

CANADA ONTARIO

Northern Ontario Development Agreement

Entente de développement du nord de l'Ontario

Minerals • Minéraux