

Nielsen, E. 2001: Quaternary stratigraphy, till provenance and kimberlite indicator-mineral surveys along the Lower Hayes River; in Report of Activities 2001, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 121-125.

SUMMARY

During the past field season, 69 till and two alluvial sand samples were collected from seven sections exposed in river cuts in the northern Superior Province and adjacent Hudson Bay Lowland of Manitoba. The survey was undertaken to outline the Quaternary stratigraphy and determine the provenance of tills in the northern Superior Province and adjacent Hudson Bay Lowland of Manitoba in support of diamond exploration. These objectives will be met using a combination of pebble analysis, carbonate analysis, matrix geochemistry, textural analysis, kimberlite indicator-mineral analysis and pebble-fabric analysis.

INTRODUCTION

The Manitoba Geological Survey has undertaken multimedia geochemical and kimberlite indicator-mineral surveys across the northern Superior Province over the past six years. These surveys have attracted the attention of numerous major and minor mineral exploration companies (Fedikow et al., 1997, 1998, 1999, 2000). While interest in kimberlite indicator minerals has been particularly high, the source(s) of the indicators continues to elude investigators. Manitoba Geological Survey's kimberlite indicator-mineral surveys, as well as most of those sponsored by the mineral exploration industry, have been conducted in areas of relatively thin till and samples have generally been collected from hand-dug pits. However, sampling from hand-dug pits is not a viable technique for mineral-tracing surveys in the Hudson Bay Lowland and adjacent areas of the northern Superior Province because the overburden may be more than 100 m thick and multiple tills of uncertain provenance subcrop at depth. Prior to extending mineral-tracing and geochemical surveys into the northernmost part of the northern Superior Province and adjacent Hudson Bay Lowland, reverse circulation drilling or other 'remote' sampling would be necessary to gain a clear understanding of the subsurface stratigraphy and till provenance. Mapping of selected river exposures would greatly enhance the understanding of the Quaternary stratigraphy and till provenance in support of regional mineral exploration, especially for diamonds.

OBJECTIVES

This survey was undertaken to outline the Quaternary stratigraphy and determine the provenance of tills in the northern Superior Province and adjacent Hudson Bay Lowland of Manitoba in support of regional mineral exploration. These objectives will be met using a combination of pebble analysis, carbonate analysis, matrix geochemistry, textural analysis, kimberlite indicator-mineral analysis and pebble-fabric analysis.

RELIEF

Most of the area south of Hudson Bay and east of the Nelson River has low relief. The study area includes areas underlain by Paleozoic carbonate bedrock and the Fox River greenstone belt, and the area south to the latitude of Brassey Hill (approximately 55° 30' N). Thick overburden, permafrost and extensive muskeg dominate this area. Exposures of Precambrian and Paleozoic rock and Quaternary sediments occur almost exclusively along river valleys, incised as the result of differential isostatic uplift over the last 8000 years (e.g., Nelson, Gods, Hayes, Fox, Stupart and Pennycutaway rivers). The rivers and creeks are commonly incised 30 to 50 m into the Quaternary sediments that blanket the area.

PREVIOUS WORK

Recent work on the Quaternary stratigraphy of the Hudson Bay Lowland of Manitoba by Nielsen et al. (1986), Berger and Nielsen (1990), Dredge et al. (1990) and Roy (1998) focused primarily on the geology along the Nelson River, downstream from Gillam. These studies highlighted the chronostratigraphy of the Quaternary deposits and only casual consideration was given to the lithostratigraphy of the tills in the area. Nielsen et al. (1986) outlined a stratigraphy comprising four tills and two non-glacial sequences, not including the present interglacial. The three uppermost tills were deposited by ice flowing out of Hudson Bay in a southwesterly direction, whereas the lowest till was deposited by southeasterly flowing ice originating in the Nunavut region, north of Manitoba. However, limited information is available on the extent and character of the tills in the Gillam area, across the Hudson Bay Lowland and adjacent northern Superior Province of Manitoba.

METHODS

Helicopter-supported fieldwork was undertaken during a three-week period in August, using Gillam as the central staging area. Of the numerous sections exposed along the Hayes, Gods, Pennycutaway, Fox, Stupart and other rivers and

creeks in the area, seven sections were selected for detailed investigation (Fig. GS-18-1). The seven sections, along the Lower Hayes River, were selected based on the availability of a suitable helicopter-landing site, nature of the geology, distance and relative spacing from other sites and proximity to previously surveyed areas in the northern Superior Province. Samples were collected at 2 to 3 m intervals in each of the seven sections. Two sample types were taken at each sampling interval: an 11 L sample was taken for kimberlite indicator-mineral and gravel analysis and a 2 kg sample was collected for geochemistry. Sixty-nine till and two coarse sand samples were collected from the seven sites for analyses. Pebble fabrics, consisting of 30 clasts each, were measured at 19 locations.

De Beers Canada Exploration Inc. extended their offer to concentrate, pick and analyze by electron microprobe the kimberlite indicator minerals free of charge. In keeping with our usual confidentiality practice, the sampling site locations are not revealed to De Beers or identified in the accompanying figures. Calcite and dolomite content will be determined at the laboratories of the Geological Survey of Canada in Ottawa. Pebble counts, textural analysis and geochemical analysis will be contracted out.

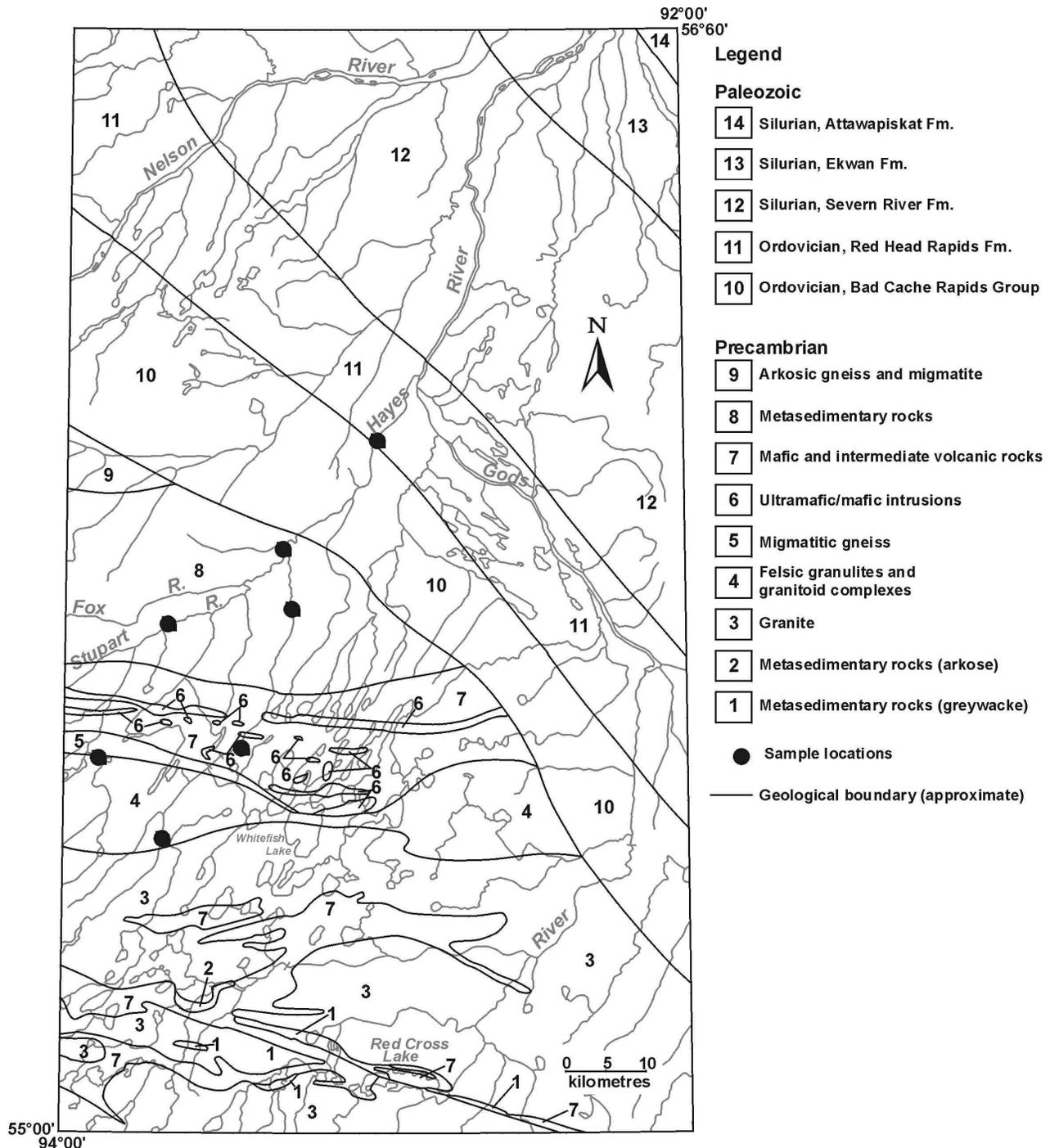


Figure GS-18-1: Location of the seven measured stratigraphic sections along the Lower Hayes River in the northern Superior Province and adjacent Hudson Bay Lowland.

RESULTS

The seven stratigraphic sections (Fig. GS-18-2) highlight thick till accumulations generally capped by glaciolacustrine silt and clay deposits, postglacial marine sediments and in places thick deposits of alluvium. Three distinct tills were identified in the field based on the colour and texture of the matrix and stratigraphic position. Pebble fabric measurements suggest a fourth till, not identified in the field, that may be present at the base of some sections. A composite stratigraphic section is presented in Figure GS-18-3.

The oldest till, exposed at the base of four sections, is olive-grey. It is finer textured than the overlying tills and at two sites underlies non-glacial sediments, interpreted to be Sangamon interglacial beds. This till has been tentatively correlated with the Amery till on the Nelson River based on its stratigraphic position. The Amery till has not been found in the multimedia surveys in the northern Superior Province. Nine samples were collected for analysis. Pebble fabrics measured at four sites give contradictory results: two fabrics indicate ice flow towards 255° and two fabrics indicate ice flow towards 115°. Striations on a boulder pavement at one site suggest ice flow towards 235° to 250°. Correlation with the Sundance till is also possible. Clearly, additional work is needed to determine the proper correlation and provenance of this pre-Sangamon till(s).

The overlying till is olive-grey and outcrops in all seven exposures examined. It is a fine-textured till that has not previously been seen in hand-dug pits in the northern Superior Province multimedia surveys and is correlated with the Long Spruce till on the Nelson River. Forty samples of this till were collected for analysis. Pebble fabrics measured at 10 sites record ice flow towards 195°, although there is considerable scatter in the orientations. Striation measurements on a boulder pavement at one site indicate ice flow towards 210° to 215°. Striations measured on bedrock exposed in the Stupart River, not far from one site and at approximately the same elevation as the base of the section, record ice flow towards 220°. These striations are not positively correlated with striations associated with the Long Spruce till.

The uppermost till is exposed in only four sections and is yellowish brown. This is the surface till throughout the Hudson Bay Lowland and adjacent parts of the northern Superior Province, but it is underrepresented in exposures along the river valleys because of erosion during postglacial valley incision. Similar fine-textured till was encountered in a few sites in the Knee Lake area (M. Fedikow et al., work in progress, 2001). It is correlated with the Sky Pilot till exposed along the Nelson

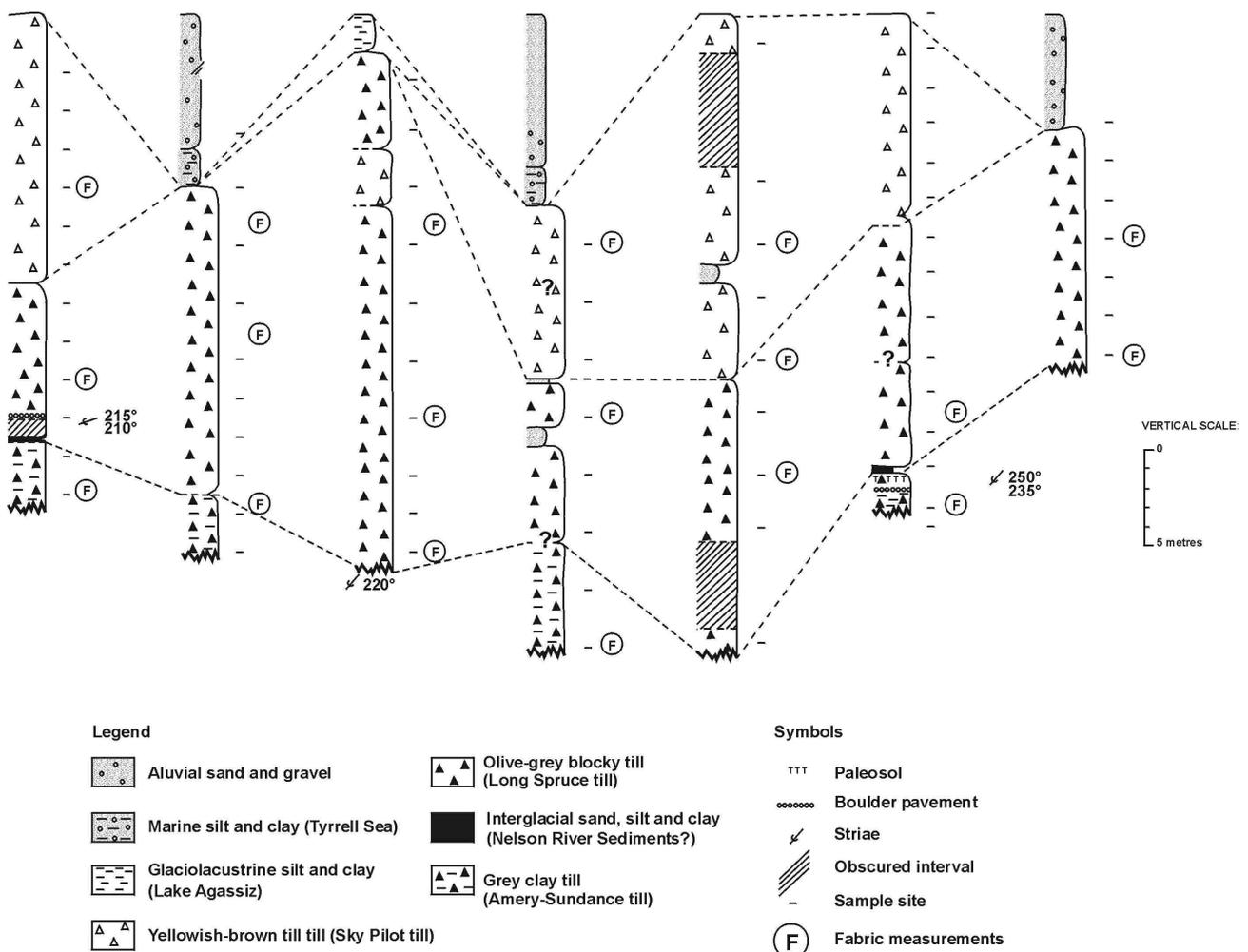


Figure GS-18-2: Quaternary stratigraphy and probable correlation of the seven sections along the Lower Hayes River.

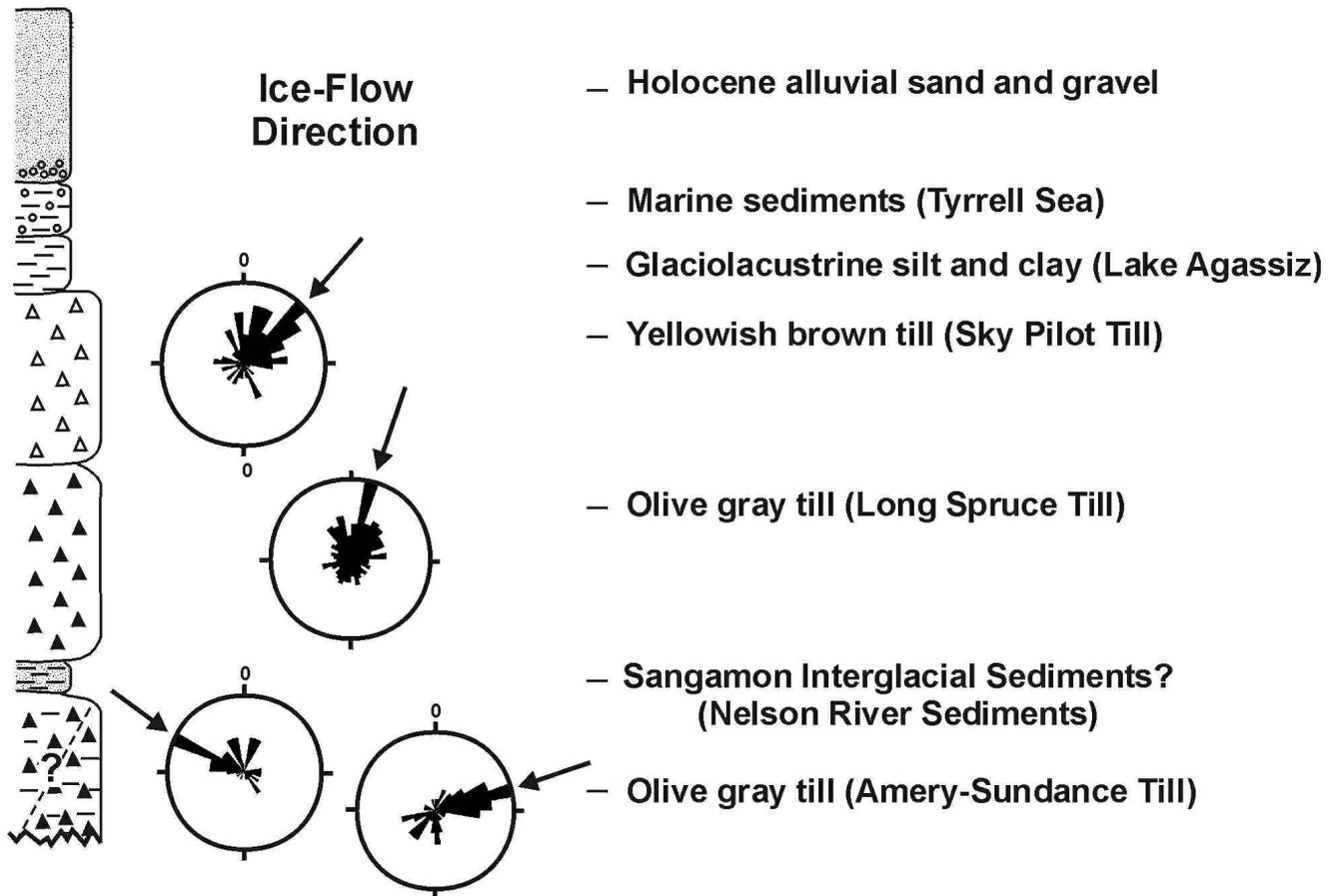


Figure GS-18-3: Composite stratigraphic section with ice-flow directions and correlation with Quaternary sediments along the Nelson River.

River. Twenty samples of this till were collected for analysis. Pebble fabrics measured at three sites indicate this till was deposited by ice flowing towards 225°, which is consistent with ice flow recorded in the Knee Lake area and elsewhere.

Four sections were capped by glaciolacustrine silt and clay deposited in glacial Lake Agassiz, fossiliferous marine sediments including gravel, sand, silt and clay deposited in the Tyrrell Sea and/or Holocene alluvial sand and gravel. Two samples of coarse, sandy alluvium were taken for kimberlite indicator-mineral analysis.

ACKNOWLEDGMENTS

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