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GLACIAL HISTORY OF THE HUMBER RIVER BASIN

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ABSTRACT

Ice-flow and clast provenance data from the Humber River Basin indicate that a regionally extensive northwestward flow event, crossed the Grand Lake and Deer Lake valleys from a source in the Topsail Hills. This was followed by a local flow event southwestward down the Humber River Basin. Ice-flow events in the northern part of the basin remain unclear.

Three diamicton units have been identified but correlations with the ice-flow events have not been made. However, clast provenance data suggests that all the diamicton units are associated with the northwestward flow. Diamictons are the lowest stratigraphic unit in the basin.

Evidence of deltas at 140 m a.s.l. in the Deer Lake, Grand Lake and Birchy Lake areas indicate the existance of a large proglacial paleolake in central Newfoundland, during deglaciation. Below about 45 m a.s.l., rhythmically bedded silts and clays were deposited in a marine(?) environment; deltaic sediments and associated glaciofluvial sediments are also common.

INTRODUCTION

The Humber River Basin (Figure 1) is a lowland between several potential Late Wisconsinan ice dispersal centres, which makes it an important area for the understanding of glacial events on the west coast. The thick (>60 m) overburden reported from the basin (Vanderveer and Sparkes, 1982; Environment Canada, 1980) suggests the potential for an extended Quaternary stratigraphic and paleoenvironmental record. In particular, the Humber River Basin may have been affected by ice from several different sources, including the Long Range Mountains, Topsail Hills and Birchy Ridge. Similarly, the elevation of much of the area below marine limit (Brookes, 1974), and the presence of several, major modern lakes, suggest the area may have been effected by marine incursion and/or a lacustrine environment following deglaciation.

The objective of this study was to examine the Quaternary stratigraphy and the potentially complex glacial history of the area. Field work in 1989 consisted of a three-week reconnaissance program, designed to review existing work. This will be followed by detailed section descriptions and compilation of the Quaternary stratigraphic record.

REVIEW OF QUATERNARY STUDIES

The recorded glacial history of the Humber River Basin is confusing and contradictory. Vanderveer (1982) and Vanderveer and Sparkes (1982) have provided the most complete record for the upper Humber River Basin, although their views are not entirely supported by evidence from other researchers in the area (MacClintock and Twenhofel, 1940; Rogerson, 1979).

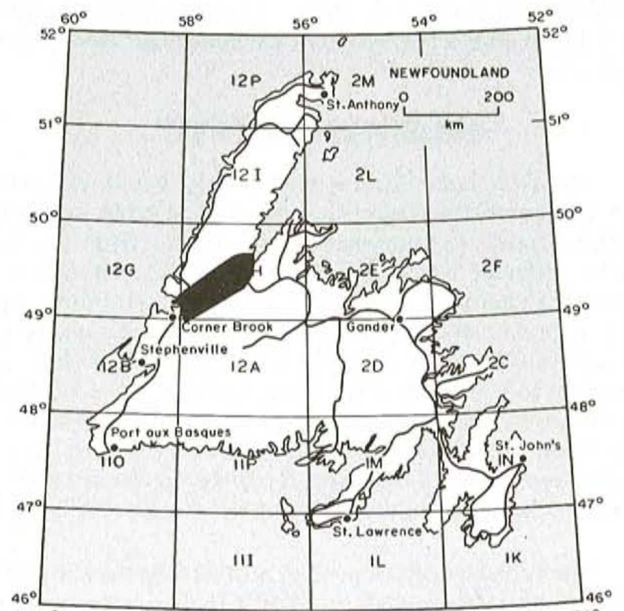


Figure 1. *Location of study area.*

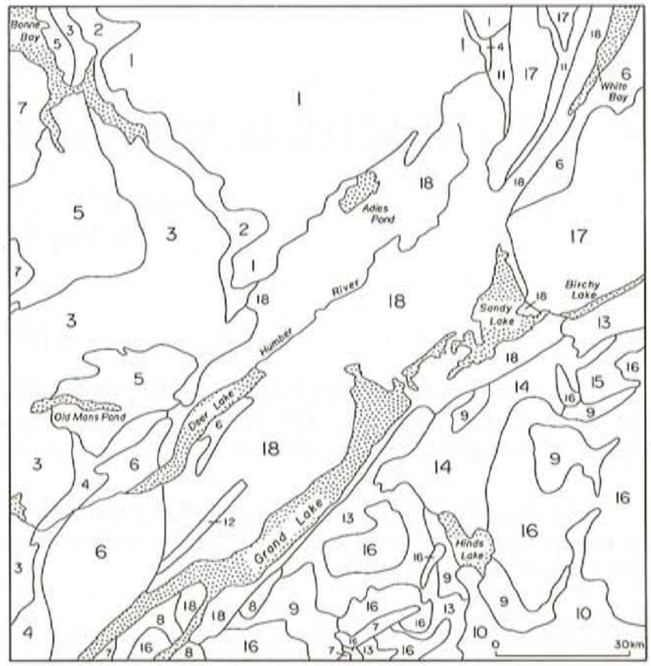
On the basis of striae, till fabrics and geomorphology, Vanderveer and Sparkes (1982) suggested that three separate ice movements (ice phases) affected the Humber River Basin during the Wisconsinan glacial stage, each of which may be correlated with a distinctive till unit. The first-phase ice advanced southward and southwestward through the basin and deposited a compact, fissile, reddish, silty-clay till. Gabbro clasts included within the sediment were cited as originating from a source to the northeast, whereas the red colour was derived from local Carboniferous bedrock. This phase 1 ice was reported to be pre-Late Wisconsinan (Vanderveer and Sparkes, 1982) and overlain by interstadial–interglacial sands and gravels. Phase 2 ice advanced east and southeastward from the Long Range Mountains and deposited a light-grey to grey-brown, poorly consolidated, silty-sand till. Striae and clast provenence data were used to determine the ice-flow direction. Phase 3 ice advanced south to southwestward through the basin and deposited a short transported till, comprising clasts of local provenance; this unit also forms the surface landforms. In many areas, especially around Deer Lake, these sediments are capped by glaciofluvial and/or glaciolacustrine–marine sediment, over 60-m thick (Environment Canada, 1980).

MacClintock and Twenhofel (1940) suggested that the northern Grand Lake–Sandy Lake basin was occupied by ice moving generally northward into White Bay. This is largely supported by Lundqvist (1965), who records an early northwestward flow and a later northeastward flow around Sandy Lake, and by Grant (1972) who records north–south-oriented crag-and-tail hills in the area north of Sandy Lake. These lines of evidence are all from east of Birchy Ridge, and may reflect an ice-flow history unrelated to events in the Deer Lake lowlands. Rogerson (1979), working in the Wigwam Brook area, to the west of Birchy Ridge, provides data from striae and till fabric analyses that suggest an early flow to the northeast followed by a dominant ice flow to the northwest.

BEDROCK GEOLOGY

The Deer Lake Basin is underlain by poorly exposed Carboniferous sandstones, siltstones, shales, mudstones and conglomerates of varying textures and colours (Hyde, 1984). These rocks are bounded on the west by lower Ordovician to upper Proterozoic psammites and schists, and Ordovician to Cambrian carbonates (Figure 2). Precambrian gneisses outcrop north of the basin. Devonian megacrystic biotite granites and Silurian felsic volcanic rocks make up the northeastern margin of the basin (Hibbard, 1983). Granites and felsic volcanics of the Topsails intrusive suite also form the eastern margin of the basin. Topsails granites commonly have peralkaline affinities (Whalen and Currie, 1988).

The variable bedrock geology surrounding the Humber River Basin assists the clast provenance studies. For example, the presence of gneisses from the Long Range Mountains within the till in the basin, would be evidence for the southeastward ice flow, suggested by Vanderveer and Sparkes (1982), whereas the presence of Topsail Hills rock types would be evidence of ice flow, in a northwest direction. A secondary transport mechanism from outside of the basin is fluvial activity. The Humber River flows through gneissic bedrock in its upper reaches and some clasts in the Deer Lake Basin are associated with fluvial sediments. However, the proportion of gneissic clasts will be expected to decrease downstream in the basin, and clast roundness are indicative of fluvial transport. Clasts from the Topsail Hills are unlikely to be fluvially transported into the Deer Lake Basin. The use of



CARBONIFEROUS

18 — *Sandstone, siltstone, shale, mudstone, conglomerate, limestone, dolostone (Barachois, Codroy, Deer Lake, Anguille groups)*

DEVONIAN AND EARLIER

17 — *Biotite granite, granodiorite, diorite (Wild Cove Pond and Gull Lake Intrusive suites)*

16 — *Amphibole–pyroxene granite, quartz syenite, locally peralkaline (Topsails intrusive suite)*

15 — *Quartz syenite, quartz monzonite, diorite, gabbro*

14 — *Biotite granite, granodiorite, quartz monzonite*

DEVONIAN–SILURIAN

13 — *Rhyolite and trachytic flows, volcaniclastics*

SILURIAN

12 — *Schists, felsic to intermediate volcanics*

11 — *Felsic volcanics, volcaniclastics (Sop's Arm group)*

10 — *Pillow lava, volcaniclastics, felsic volcanics, shale (Buchans Group)*

ORDOVICIAN

9 — *Tonalite, diorite, gabbro, granite (including Hungry Mountain Complex)*

MIDDLE ORDOVICIAN–CAMBRIAN

8 — *Pillow lava, volcaniclastics*

LOWER ORDOVICIAN–UPPER PROTEROZOIC

7 — *Gabbro, diorite, peridotite (ophiolite)*

6 — *Pelite, psammite, schist (Fleur de Lys Supergroup)*

5 — *Undivided sedimentary rocks, greenschist*

CAMBRIAN–ORDOVICIAN

4 — *Sandstone, phyllite, schist (Grand Lake Brook Group)*

3 — *Carbonates*

LOWER CAMBRIAN

2 — *Siliclastic, carbonates, minor basalt (Labrador Group)*

PRECAMBRIAN

1 — *Gneiss, paragneiss*

Figure 2. *Bedrock geology of study area (after Hibbard, 1983; Hyde, 1984; Whalen and Currie, 1988).*

some rock types by Vanderveer and Sparkes (1982), e.g., gabbro, described as being diagnostic of southwestward flow, must be questioned because gabbros are found to the east of Grand Lake within Units 7, 9 and 15 (Figure 2).

ICE-FLOW HISTORY

Field work concentrated on verifying existing striae data and filling in gaps, where possible. Because of the soft bedrock and thickness of the overburden cover, few striae sites were found in the basin itself, and most erosional data are from surrounding areas. Depositional evidence comes from oriented landforms and clast provenance within glacial sediments.

Depositional and erosional evidence suggests that a dominant westward to northwestward flow event affected the area (Figure 3), with a likely source in the Topsail Hills. This conclusion is supported by west- to northwest-directed striae, and clasts identified as originating in the Topsail Hills (Colman-Sadd, personal communication, 1989) found on both the west and east sides of Deer Lake. This flow direction is contrary to that suggested by Vanderveer (1982) and Vanderveer and Sparkes (1982), and reported in subsequent publications (e.g., Batterson and Kirby, 1988; Proudfoot *et al.*, 1988). This flow event is clearly seen as far north as Adies Pond; farther north, its existence is more speculative, where striae sites having directional indicators and supporting clasts provenance data are rare, and inconclusive.

A southwestward ice-flow direction is recorded by striations in the northern part of the basin and on Birchy Ridge (Figure 3), and by flutes and crag-and-tail hills described by Vanderveer and Sparkes (1982). This flow is likely more recent than the west to northwest flow because it is consistent with the orientation of surface landforms in the basin. This flow is not recorded on the east side of Birchy Ridge, which is elevated about 230 m above the basin. This suggests that the southwestward flow event was either a thin ice-mass that did not cross Birchy Ridge, or that its eastward extension was blocked by ice in the Sandy Lake Basin. There is little data to suggest that this flow event extended as far as modern Deer Lake.

QUATERNARY SEDIMENT

The thick sediment cover reported in the Humber River Basin was deposited in a number of environments, including subglacial, glaciofluvial, lacustrine and marine. Diamictons are found overlying bedrock. Vanderveer and Sparkes (1982) suggested that three till types are exposed within the basin, each correlating with an ice-flow direction described earlier. Most of their sections were exposed in backhoe test-pits and, therefore, were not available for examination. However, several other complex sections were noted during the present reconnaissance survey, one at the Pasadena dump exposing 3 distinct diamictons. Other sections to the north of Deer Lake exposed 2 diamictons. Detailed sediment descriptions were not made of any of these sections, but will be the focus of future work in the Humber River Basin.

Waterlain deposits overly diamictons and outwash deposits are the most common, occuring at different elevations. These deposits occur either as gravelly esker ridges, or as flat-lying gravel and sands associated with proglacial fluvial activity. The northern end of Grand Lake and around Sandy Lake have large areas of outwash sediments.

A previously undocumented high-level delta was found in the Pasadena area (Plate 1). This delta occurs at an elevation of about 136 m a.s.l. in the South Brook valley. The delta could have resulted from local ponding between ice in the South Brook valley and the valley sides. Fan deltas occur at similar elevations along the eastern margin of Grand Lake, and Lundqvist (1965) and Liverman and St. Croix (1989) described lacustrine and deltaic sediments at similar elevations in the Birchy Lake area. This suggests the possible existence of a large ice-dammed lake encompassing the Deer Lake–Grand Lake–Sandy Lake–Birchy Lake area, during Late Wisconsinan deglaciation (Plate 2). Possible spillways for this lake are White Bay, south of Hampden and the southwestern outflow of Grand Lake. Both these areas have outwash deposits that might be associated with such a spillway. An ice dam in areas lower than 150 m a.s.l. both in the Indian Brook valley (about 110 m a.s.l.) to the east, and in the Humber Gorge (5 m a.s.l.) to the west, would have been required to impound such a lake. The lack of identified lacustrine sediments in much of the proposed proglacial lake basin is problematic. Further work is planned to test this glacial lake hypothesis.

Below approximately 45 m a.s.l., a sequence of fluvial and/or deltaic sands overlying rhythmically bedded silt and clay is common. This elevation marks delta topsets in the area and is coincident with marine deltas in the Bay of Islands (Brookes, 1974). However, no marine fauna have been discovered in the Deer Lake sediments to confirm a marine origin. About 5 m of silt and clay grading upward into fine to medium sands are observed in river cuts, e.g., at Rocky Brook (Plate 3). At Deer Lake airport, about 35 m of rhythmically bedded silt and clay overlain by 20 m of fine to medium sands were intersected in a drillhole (Environment Canada, 1980).

DISCUSSION

Reconnaissance work in the Humber River Basin has yielded interpretations inconsistent with previous work. Two well-defined ice-flow directions have been identified in the central and southern part of the basin. An early regional ice-flow event to the northeast, from a source in the Topsail Hills that crossed Grand Lake and Deer Lake, is suggested on the basis of striae and clast provenance. This was followed by an advance southwest down the Humber River Basin. This later flow event was likely confined to the valley and is recognized in striae and landform evidence. No conclusive evidence was found of the southeastward flow suggested by Vanderveer and Sparkes (1982). In the northern part of the basin, interpretation of ice-flow history is more speculative. There is evidence of south and southwestward ice flow in

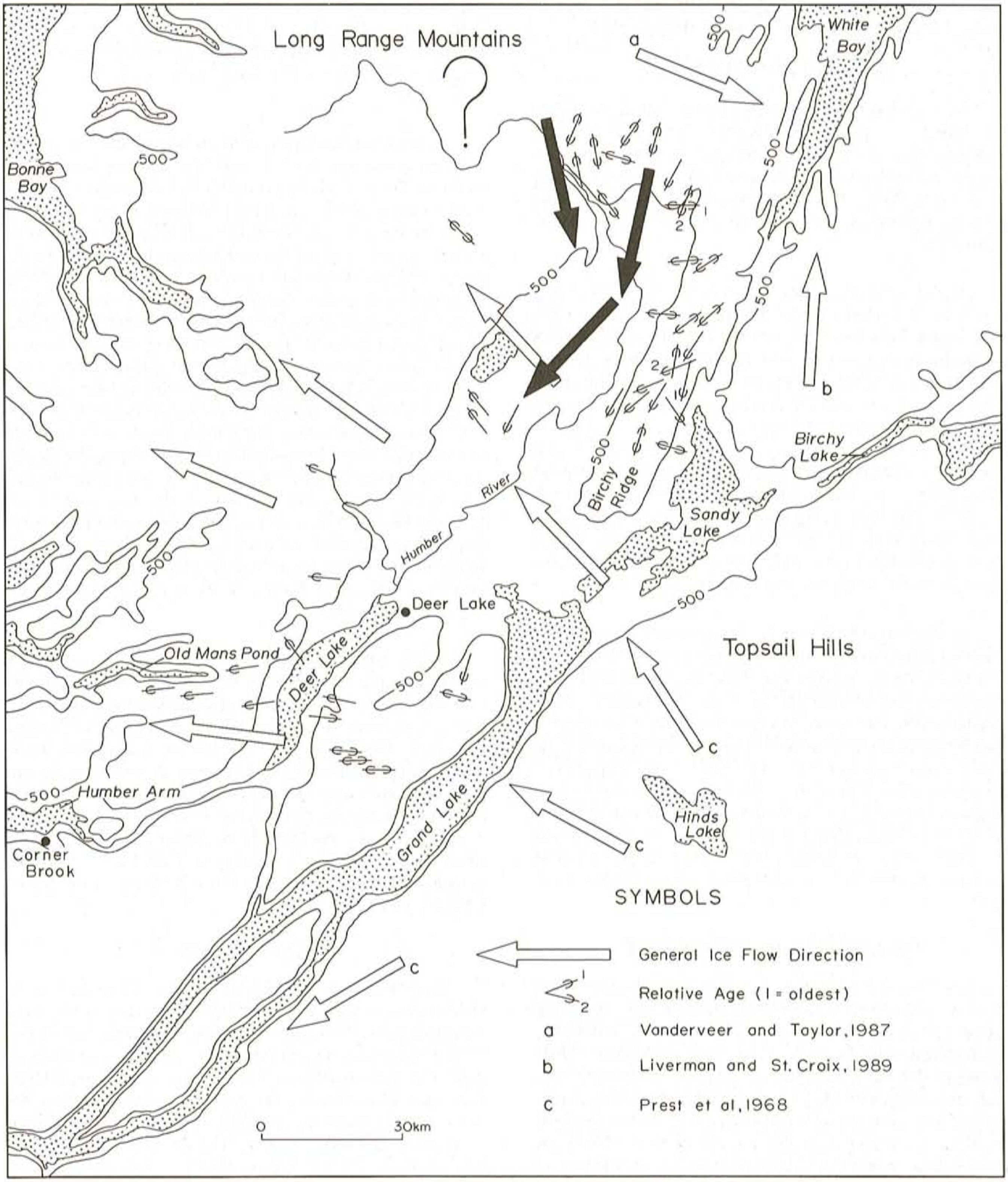


Figure 3. *Ice-flow directions in the Humber River Basin; generalized trends are derived from a variety of sources.*

Plate 1. *5 to 6 m of rhythmically bedded silt and clay overlain by delta bottomsets and foresets in the Rocky Brook valley. These sediments were deposited during higher water levels in the Deer Lake basin, possibly associated with marine incursion.*

Plate 2. *Deer Lake with Grand Lake in background and Sandy Lake in top left of photograph. Data suggests a proglacial lake occupied all three lake basins during the Late Wisconsinan.*

Plate 3. *Deltaic gravels exposed at 136 m a.s.l. near Pasadena. Combined with data from other areas, this is good evidence for a large proglacial lake in the Deer Lake–Grand Lake–Sandy Lake area.*

some areas, and of westward flow in other areas. Outside the basin, there is evidence for eastward flowing ice in the Hampden area (Vanderveer and Taylor, 1987) and northward flow to the east of Birchy Ridge (Liverman and St. Croix, 1989). It is unlikely that all these flows are contemporaneous, but the sequence of events is unclear.

Deglaciation was marked by proglacial fluvial activity and a possible major glacial lake of speculative extent and duration, followed by a period of probable marine incursion. The elevation of deltas in the Deer Lake area at about 45 m a.s.l. is consistent with marine deltas in the Bay of Islands that have been dated at about 12,600 years BP (Brookes, 1974).

The Humber River Basin has the potential for a complex stratigraphic record that extends from the Holocene through the Late Wisconsinan (or earlier). This is based on the following factors:

1) the extremely thick sediment accumulation is the basin,
2) the weak bedrock of the Humber River Basin provided an abundant sediment supply,
3) the area was affected by several ice-flow events from different sources,
4) the possible existence of a large glacial lake, and
5) the probable period of marine incursion.

The latter two factors are significant because they are both depositional events, which add to the preservation potential for earlier deposits. The basin is also important to our understanding of the interaction, if any, between two major ice-dispersion centres, on the Topsail Hills and on the Long Range Mountains.

Future work will concentrate on sedimentology, stratigraphy and Quaternary history from existing and backhoe exposures, with emphasis on reconciling the sequence of glacial and deglacial events in the Humber River Basin.

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REFERENCES

Batterson, M.J. and Kirby, G.E.
1988: Quaternary geology of the Pasadena–Deer Lake area: A review and discussion. *In* Soils of the Pasadena–Deer Lake area, Newfoundland. Newfoundland Soil Survey Report No. 17, Research Branch, Agriculture Canada, pages 123-130.

Brookes, I.A.
1974: Late Wisconsinan glaciation of southwestern Newfoundland with special reference to the Stephenville map area. Geological Survey of Canada, Paper 74-30, 31 pages.

Environment Canada
1980: Ground water resource evaluation of the Deer Lake airport, Newfoundland. Water Planning and Management Branch, Inland Waters Directorate, Atlantic Region, Halifax, Nova Scotia, 57 pages.

Grant, D.G.
1972: Surficial geology, western Newfoundland. *In* Report of Activities, Part A. Geological Survey of Canada, Paper 72-1A, pages 157-160.

Hibbard, J.
1983: Geology of the Island of Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 83-106.

Hyde, R.S.
1984: Geology and mineralization of the Carboniferous Deer Lake Basin, western Newfoundland. *In* Mineral Deposits of Newfoundland—a 1984 Perspective. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 84-3, pages 19-26.

Liverman, D. and St. Croix, L.
1989: Quaternary geology of the Baie Verte Peninsula. *In* Current Research. Newfoundland Department of Mines, Geological Survey of Newfoundland, Report 89-1, pages 237-247.

Lundqvist, J.
1965: Glacial geology in northeastern Newfoundland. Geologiska Foreningens i Stockholm Forhandlingar, Volume 87, pages 285-306.

MacClintock, P. and Twenhofel, W.H.
1940: Wisconsin glaciation of Newfoundland. Geological Society of America Bulletin, Volume 51, pages 1729-1756.

Proudfoot, D.N., Grant, D.R. and Batterson, M.J.
1988: Quaternary geology of western Newfoundland. Field Trip Guidebook A6, Geological Association of Canada, Annual Meeting, St. John's, Newfoundland, 41 pages.

Rogerson, R.J.
1979: Drift prospecting in the Deer Lake lowlands. Westfield Minerals Limited, Reidville, Newfoundland, 12 pages. [12H (559)]

Vanderveer, D.G.
1982: Quaternary mapping—Upper Humber River area. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 82-1, pages 192-194.

Vanderveer, D.G. and Sparkes, B.G.
1982: Regional Quaternary mapping: An aid to mineral exploration in west-central Newfoundland. *In* Prospecting in Areas of Glaciated Terrain—1982. *Edited by* P.H. Davenport. Canadian Institute of Mining and Metallurgy, Geology Division, pages 284-299.

Vanderveer, D.G. and Taylor, D.M.
1987: Quaternary mapping—glacial dispersal studies, Sop's Arm area, Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 87-1, pages 31-38.

Whalen, J.B. and Currie, K.L.
1988: Geology, Topsails Igneous Terrane, Newfoundland. Geological Survey of Canada, Map 1680A, Scale 1:200,000.

NOTE: Geological Survey Branch file numbers are included in square brackets.