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AGGREGATE AND SURFICIAL MAPPING IN NTS MAP AREAS 13E/1, 13F/3 AND 13F/4, LABRADOR

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ABSTRACT

During 1997, field work concentrated along the Trans-Labrador Highway (TLH), west of Goose Bay in NTS map areas 13E/1, 13F/3 and 13F/4. The main objective of this mapping program was to locate, sample and analyze sand and gravel aggregate and determine their potential for use as road-construction material for the TLH. There are numerous sources within the study area, and several of these are located along the TLH and contain estimated reserves of 50 000 m^3 to several million cubic metres of sand and gravel. Petrographic quality of these deposits is variable and their petrographic numbers generally range between 100 to 300.

Ice-flow and surficial-geology maps are being prepared for the field area to aid in mineral exploration and other land uses, and are expected to be released in the spring/summer of this year. Regional ice movement during the late Wisconsinan is southeastward. This is shown by numerous constructional features visible on aerial photographs, and from field observations of erosional features such as roches moutonnées and striations.

INTRODUCTION

An aggregate- and surficial-mapping program was conducted in 1997 in three 1:50 000-scale map areas; these are NTS map area 13E/1 (Mouni River), NTS map area 13F/3 (Pinus River) and NTS map area 13F/4 (untitled). The objectives of the aggregate-mapping program were to locate, map and sample sand, gravel and till materials, in support of the construction and upgrading of the Trans-Labrador Highway (TLH). Mapping aggregate deposits and providing data such as source, quality and distance of deposits in advance of construction projects will help road builders, contractors and consultants determine sources and quality of material available in a given area, and evaluate distance to transport these materials to a specific job site, a factor that can greatly affect construction cost. This information also provides governments with a more accurate way to project costs.

Surfical mapping was conducted to determine ice-flow direction and to produce 1:50 000-scale surficial maps to aid mineral-exploration activities. There are few surfical-geology maps at this scale for Labrador. Surficial maps provide useful information to field geologists and prospectors by showing landform types (where rock outcrops are located, and ice-movement directions) which are necessary to determine source rocks when drift prospecting. These maps will help determine the regional ice-flow history, will be useful in determining sediment dispersal patterns, and it will help identify material for geochemical sampling, and help assist in the interpretation of the geochemical data.

PHYSIOGRAPHY

The study area is located in the Churchill River basin, Labrador, between 61°00' and 62°30'W, and 53°00' and 53°15'N (Figure 1). This forested region has elevations of less than 30 m asl along the Churchill River, and greater than 526 m at the top of its highest peaks. The north and central part of the area form an undulating plateau. The southeast and southwest parts are deeply dissected by the Churchill River, along which are found large fluvial terraces of thick, medium- to fine-grained, micaceous sand, generally underlain by marine silt and clay. These terraces are several kilometres wide in places, forming step-like formations having steep escarpments. Numerous parabolic sand dunes are found on the surface of these terraces. At higher elevations, away from the Churchill River valley, the area is generally rugged and mainly covered by drift. There are numerous hills, ridges, bog, large shallow lakes and ponds, and it is dissected by many turbulent rivers and streams. On the plateau, large glaciofluvial outwash deposits containing eskers up to 20 km long are found. Flutes and drumlinoid topography are also common.

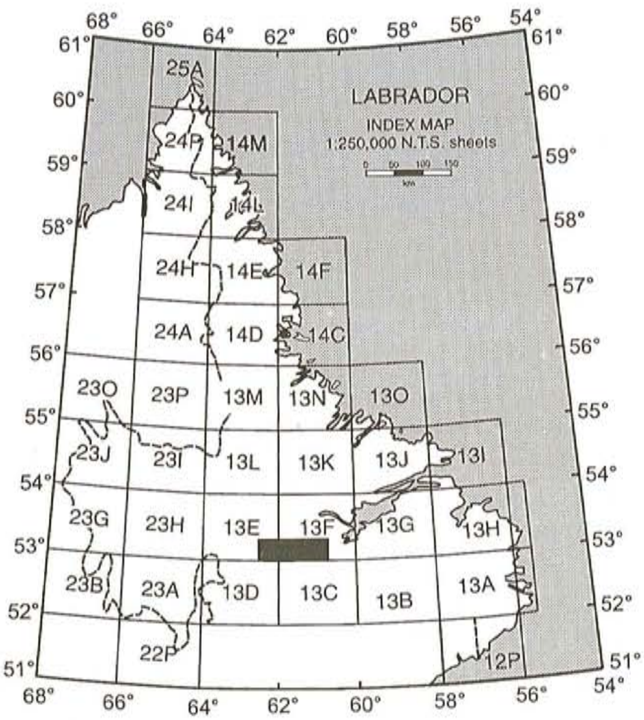


Figure 1. *Location of study area.*

The study area was traversed by foot, truck, boat and helicopter. Part of the field area is accessible along the gravel base TLH that crosses the central part of the area north of the Churchill River. This road is undergoing upgrading and reconstruction, resulting in major improvements and accessibility. The southeast part of NTS map area 13F/03 is accessible by boat along the Churchill River. Boat traverses were also conducted in some of the river systems and ponds. Boat traversing is tedious, time consuming and sometimes dangerous because of the shallow nature of most of the ponds and rivers, and numerous boulders where rivers were shallow and rough. Foot traverses were conducted to potential sand and gravel deposits within 8-km-walking distance from the road, and the helicopter was used to obtain samples from otherwise inaccessible areas. Forest cover in parts of the study area made ground traversing difficult and prevented access by helicopter.

PREVIOUS WORK

Kindle (1924), Tanner (1944) and Blake (1956) conducted extensive studies on the geography and geology of Labrador. Part of their investigations looked at terrace deposits along the Churchill River valley, their depositional environments and sea-level change. Liverman (1997) conducted a study on the Quaternary geology of the Goose Bay area. Examing the occurrences of glaciomarine clays Liverman (*op. cit.*) concluded that the sea level had reached a level of over 100 m asl along the Churchill River. He also looked at ice-flow patterns in the Goose Bay area and mapped an east-southeast ice flow, apart from the Grand Lake valley, where a southeast flow is indicated.

Reconnaissance surficial-geological mapping at 1:50 000 scale (Fulton and Hodgson, 1970), based mainly on aerial photographic interpretation, has been completed for the field area. This work was part of a much larger program, covering over 95 000 km^2 of southern and eastern Labrador. Compilation of these maps at 1:250 000 scale (Fulton *et al.*, 1979) and 1:500 000 scale (Fulton, 1986) show glacial-flow features having a dominant southeast flow direction.

An aggregate-resource study, which covers a 6-km-wide corridor along all roads in Newfoundland and Labrador, including the TLH, was conducted by the Department of Mines and Energy from 1978 to 1982 (Environmental Geology Section, 1983a, b; Kirby *et al.*, 1983). This study outlined areas of potential aggregate within the corridor area. In addition to these data, geotechnical bedrock maps were compiled at a scale of 1:250 000 (Bragg, 1985).

Kirby (1995) sampled small gravel showings near the Pinus River. Sampled material in this deposit showed an average grain-size distribution of 57 percent gravel, 42 percent sand and less than 1 percent silt–clay. Petrographic numbers range from 132 to 134, having an average of 133. This deposit is generally less than 2 m thick and could not supply large volumes of high-quality aggregate.

MAPPING AND ANALYTICAL METHODS

Interpretation of aerial photographs (1:50 000-scale black-and-white, 1:20 000-scale black-and-white and 1:12 500-scale colour) was used to locate potential sand and gravel deposits . Where possible, samples were taken from natural exposures such as stream-cuts, shorelines and gullies. Natural exposures are rare in the study area; a few are present in major river valleys but these are generally restricted to fine-grained postglacial deposits. Man-made exposures are present along the TLH in the form of road-cuts, and pit and quarry excavations, but these represent a small portion of the total area. Where exposures were not available, samples were collected from 1-m-deep hand-dug pits. Digging pits with pick and shovel was difficult to impossible in some places because of boulders or a thick, cemented B-soil horizon, making it impossible to see the undisturbed parent material. Lack of exposures meant that deposit thickness was commonly difficult to assess. As previously noted, because of the dense forest cover, inaccessibility and lack of exposures, airphoto interpretation was the only practical means of mapping in some areas.

Sampling provided material for petrographic and grain-size analyses; approximately 15 kg of material was collected for field sieving. Field sieving and petrographic analysis were performed on most samples containing >8mm size material. A split of the sand–silt–clay fraction (<8 mm) was retained for laboratory sieve analysis, which involved drying and splitting the sample to a manageable size (70 to 140 g) and wet and/or dry sieving of each sample following the procedures outlined by Ricketts (1987).

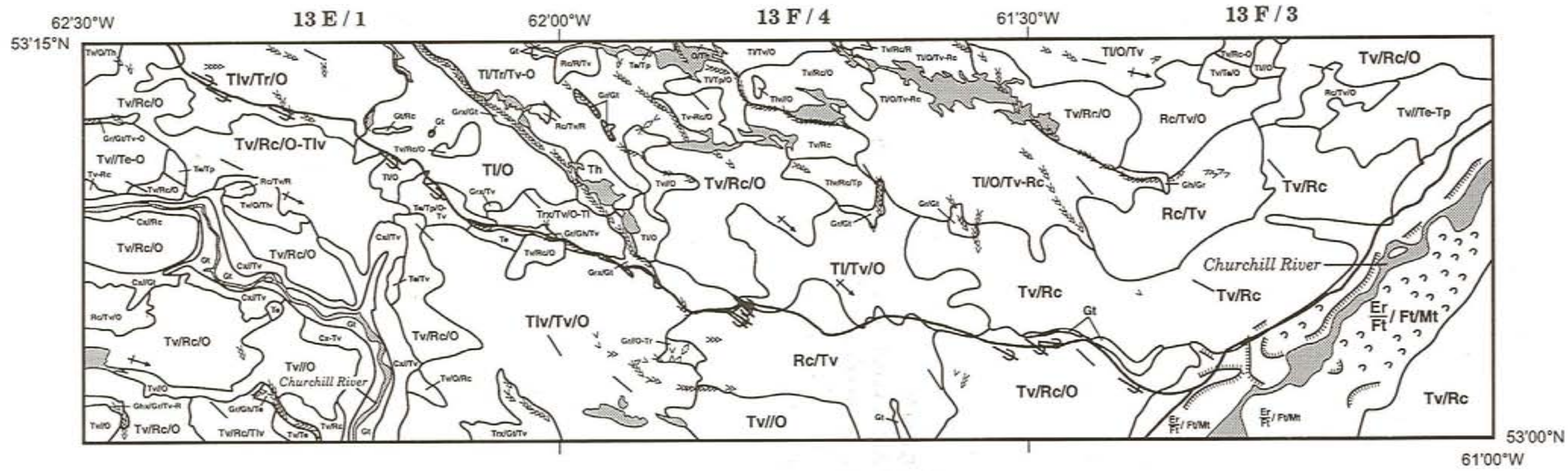
Aggregate samples were examined to determine the petrographic characteristics (Bragg, 1995; Ministry of Transportation (MTO) 1994; Canadian Standards Association, 1973) of the pebble fraction (16 mm to 32 mm) as a preliminary means of determining aggregate quality for construction purposes. Petrographic analysis is a subjective description of aggregate quality, but this information does determine whether the aggregate is good or poor and whether there is a need to conduct more detailed studies of aggregate quality. The petrographic number, which can range from 100 to 1000, is derived by taking the sum of the percentage of each rock type present in the pebble fraction (in a sample of approximately 100 pebbles) multiplied by a petrographic factor (based on soundness and durability) assigned to that rock type (Ricketts and Vatcher, 1996). The petrographic factor is determined mostly by type and grain size of the rock in a given sample, and also by the presence of silt–clay coatings, weathering, staining, degree of sphericity, rounding and fracturing. The lower the petrographic number, the better the quality of aggregate material. For example, a clean, hard, fresh granite would normally have a petrographic number of 100, whereas for a friable, soft shale it would be 1000. Most deposits contain a combination of different rock types having different petrographic factors. The proportion of each of these components determines the petrographic number. For most purposes, aggregate material used in concrete requires a petrographic number of 135 or less, whereas in road asphalt and Class A and B gravels a petrographic number up to 150 is acceptable (Newfoundland Department of Transportation, 1987). The rounding of pebbles, the number of fracture faces and their sphericity are important considerations in using an aggregate for concrete. These factors affect the bonding capabilities of concrete, the amount of water necessary to make concrete, and has a direct relation on the strength of concrete.

SURFICIAL GEOLOGY

The entire area has been extensively glaciated and contains a wide variety of landforms related to glacial advance and retreat (Figure 2). During the advance of the ice sheet, valleys were modified and deepened by the ice and later filled with glacial debris. Upon retreat of the ice, streams and rivers incised the glacial debris progressively during uplift of the surface, and fluvial deposits were left along the valley walls. Such remnants are abundant and well exposed at numerous localities along the Churchill River. The area is characterized by a great diversity of materials and morphology. In most areas, materials and landforms that may be unrelated in origin and composition are mixed complexly (Fulton *et al.*, 1975). The Churchill River valley has a complex stratigraphy having units of glacial till, glaciofluvial sand and gravel, glacial marine muds, fluvial and aeolian sand deposits exposed in sections. The earliest deposition resulted during glacial advance when material was picked up or pushed along, reworked, and later deposited down-ice as till or gravel. Later, as glaciers melted, seawater flooded the valley. Glaciofluvial action continued, resulting in interaction between the marine and glaciofluvial environments. This resulted in the formation of glaciomarine muds, forming deposits 100 m or more in thickness (Liverman, 1997). As meltwater from retreating glaciers continued to flow, terraces of fluvial sand were formed on top of the muds. Wind action in the absence of vegetation resulted in the formation of parabolic sand dune complexes, to form the youngest unit (Plate 1).

Landforms common to the plateau region include till ridges, eskers, drumlins, outwash plains and terraces. The most abundant surficial sediment is till, forming lineated ridges, planes and veneers. Evidence in the form of glacial grooving and striae at the top of higher hills indicates that ice completely covered this area. The ice movement was southeastward. Although the ice may have made repeated advances over the area, all evidence of glaciation other than the last has been obliterated. Rock has been removed from several of the southeast-trending valleys where the scouring and plucking action of the advancing ice would be concentrated (Stevenson, 1969). Locally, large blocks of granitic gneiss are scattered across the surface; many of these measure 2 by 2 m. In some areas, rib moraines were formed by the advancing glaciers. These till ridges are generally less than 300 m long, 5 to 20 m high, and occur at right angles to the direction of ice flow. The ridge tops are periodically fluted or drumlinized in the direction of ice movement. In other areas, extensive deposits of drift were laid down by glaciers in the form of long parallel low ridges with tapered ends. These fluted and drumlinoid till ridges, 1 to 2 km long, cover perhaps half of the area. Individual ridges may be 4 km or more long and over 300 m wide. These long ridges separated by shallow trenches, give striking linear patterns to much of the ground moraine. Generally, they form a single direction toward the southeast. Locally, direction may change to become south to southeast in the western part of the map area or east to southeast in the eastern part of the map area. These trends are generally locally controlled by terrain topography, but flow took a more eastern direction in the northeast part of the map area.

There is some controversy on the mode of formation of drumlins and drumlinoids features. Liverman (1997) indicates that some researchers do not give credit to the long standing belief that drumlins and drumlinoid features were formed by



LANDFORM CLASSIFICATION

Genetic Category

Morphology	Colluvial (C)	Aeolian (E)	Glaciofluvial (G)	Marine (M)	Fluvial (F)	Glacial (T)	Organic (C)	Rock (R)
apron (a)	Ca							
concealed by vegetation (c)	C						Rc	
eroded and dissected (e)	C	Ee	Ge	Me	Fe	Te		
hummock (h)		Eh	Gh			Th		
lineated (l)		El				Tl	Ol	Rl
ridge (r)		Er	Gr	Mr	Fr	Tr	Or	Rr
terrace (t)			Gt	Mt	Ft	Tt		Rt
veneer (v)	Cv	Ev	Gv	Mv	Fv	Tv	Ov	
complex (x)	Cx		Gx	Mx	Fx	Tx		Rx
plain (p)			Gp			Tp		

0 10km

- Geological boundary
- Esker (flow direction known or assumed, unknown)
- Lineated till ridges
- Crag- and- tail hill
- Striae
- Parabolic dunes
- Terrace scarp

Figure 2. *Generalized surficial geology map.*

LANDFORM CLASSIFICATION (to accompany Figure 2)

Each outlined area is assigned a landform classification consisting of up to three genetic categories and modifiers that designate the types of deposits within each area. Each category within a landform classification is listed in order of dominance and is separated from the other categories by a slash (e.g., Tv/R). The areas are divided so that generally three landforms or deposit types are identified within a given area. The landform classification system is also used to denote the approximate percentage of landforms occurring within an outlined area, but those that comprise less than 5 percent of the area are not included in the classification. Four variations of the landform system are as follows:

1. Where three different landforms are included in a single map unit they are each separated by a single slash (/) and their relative percentages are (60-85), (15-35) and (5-15) respectively.
2. Where two landforms are included in a single map unit, a double slash (//) or single slash (/) is used to separate them, and their relative percentages are (85-95) and (5-15) for double slash, or (60-85) and (15-40) for a single slash.
3. A horizontal line is used to show that one material overlies another. For example, $\frac{Ev}{Ft}$/Ft/Mt indicates that there is a 60 to 85 percent aeolian deposit overlying fluvial deposits, 15 to 35 percent exposed fluvial deposits and 5 to 15 percent marine deposits.
4. A hyphen between two landform types indicates that they are approximately equal in area. For example, Tv-Rc indicates that till veneer and rock concealed by vegetation or a thin regolith are equal in area.

LANDFORM CLASSIFICATION: GENETIC CATEGORY

Symbol	Depositional Environment	Origin and Characteristics of Materials
F	Fluvial	Alluvium, consisting of silt and clay to bouldery gravel, forms terraces and plains associated with modern stream channels, their floodplains and deltas; deposited by fluvial action at or below maximum flood levels
C	Colluvial	Colluvium, generally consisting of coarse-grained bedrock-derived materials, but may include sand, silt or clay, accumulates on the lower parts, or at the base, of steep rock faces; transported by gravity
E	Aeolian	Medium- to fine-grained sand and silt, well sorted, poorly compacted; commonly occur as dunes up to 10 m high; transported and deposited by wind
G	Glaciofluvial	Fine-grained sand to coarse-grained cobbly gravel occur as plains, ridges (eskers), hummocks, terraces and deltas; generally greater than 1 m thick; deposited as outwash in an ice-contact position or proglacially
M	Marine	Clay, silt, gravel and diamicton; sand is present in some places, generally moderately to well sorted and commonly stratified, but may be massive; occur as beach ridges, terraces and bars; deposited in a marine environment; gravel and sand by shoreline wave action; may include shells, clay and silt deposited from suspension and turbidity currents; gravel is generally a wave-washed lag
T	Glacial	Includes all types of till; composed of diamicton (a sediment with grain-size range from boulder to silt/clay); transported and subsequently deposited by or from glacier ice with no significant sorting by water
O	Bog	Poorly drained accumulations of peat, peat moss and other organic material; developed in areas of poor drainage
R	Rock	Bedrock

LANDFORM CLASSIFICATION: MORPHOLOGY

Symbol	Morphology	Description
c	concealed by vegetation	Vegetation mat developed on either colluvium surfaces or a thin layer of angular frost-shattered and frost-heaved rock fragments overlying bedrock; includes areas of shallow (less than 1 m) discontinuous overburden
d	drumlinoid	Elongate ridge(s) between 6 and 60 m high, 75 and 600 m wide, and 100 to 6000 m long; ridges have a rounded end pointing in the up-ice direction and gently curving sides that taper in the down-ice direction; exhibit a convex longitudinal profile, commonly with a steeper slope in the up-ice direction; consist of subglacially formed deposits shaped in a streamlined form parallel to the direction of glacial flow; commonly consists of till, although some may contain stratified drift; may have a rock core
e	eroded and dissected	Series of closely spaced gullies or deeply incised channels; can have a dendritic pattern or dissected may be a single straight or arcuate channel; gullies and channels may contain underfit streams
h	hummock	An apparently random assemblage of knobs, mounds, ridges and depressions without any pronouced parallelism, significant form or orientation; formed by glacial melting during ice stagnation and disintegration; includes subglacial, englacial, supraglacial and stratified materials
l	lineated	Elongate spindle-shaped ridge(s) between 6 and 60 m high, 75 and 300 m wide and up to 4000 m long; ridges are commonly straight-sided, taper at one or both ends, and have a flat longitudinal profile; consist of subglacially formed deposits shaped in a streamlined form parallel to the direction of glacial flow; commonly consist of till, although some may contain stratified drift; may have a rock core
p	plain	A comparatively flat, level, or slightly undulating tract of land; materials are either till, glaciofluvial, alluvial, marine or lacustrine sediments; bedrock features are commonly masked by the overlying sediments
r	ridge	Narrow, elongated and commonly steep-sided feature that rises above the surrounding terrain; materials are either rock, till, glaciofluvial, marine, lacustrine, aeolian, or organic sediments
t	terrace	Long, narrow, level or gently inclined step-like surface, bounded along one edge by a steeper descending slope or scarp and along the other by a steeper ascending slope or scarp; materials are either till, glaciofluvial, alluvial or lacustrine sediments; generally formed by fluvial and glaciofluvial erosion and marine wave action
v	veneer	Any deposit less than 2 m thick; morphology of the underlying unit is evident
x	complex	Commonly used to indicate numerous esker ridges that are closely spaced; can be used where any genetic category exhibits numerous surface expressions in a small area, and in which no single element can be defined

Plate 1. *Parabolic sand dunes located on the northwest side of the Churchill River in NTS map area 13F/3.*

for fill and subgrade road material.

Many large sand and gravel deposits are located within the study area (Figure 3). Most deposits along the Churchill River consist of fine micaceous sand in combination with silt–clay units. These deposits are considered poor quality for most construction purposes but can be used for fill and subgrade road material. Other deposits are inaccessible or located too far from roads to make quarrying feasible. Sample data are available from some of these deposits, but because of their location, discussion of these deposits are not considered in this report.

The suitability of these deposits is based on grain-size characteristics (Table 1), having primarily low silt–clay content. All deposits have variable grain-size concentrations, but, generally, have less than one percent silt–clay. Detailed results for sample data will be available on request. Results of petrographic analysis from the study area indicate variable petrographic quality throughout the study area. Rock types from which these petrographic numbers were determined consist essentially of gneiss and granitic gneiss. The study area lies in the interior Grenville Province of central Labrador, containing rock formations of metasedimentary gneisses of middle to early Proterozoic age (Wardle *et al.*, 1988). There is a great compositional and textural diversity among the gneissic rocks. Wardle (*op. cit.*) described the area as consisting of pink to grey, quartz-feldspar-biotite-garnet-sillimanite gneiss, and foliated to gneissic, K-feldspar-megacrystic granitoid rocks. The extreme southeast corner of the study area contain rock types of the Mealy Mountains Intrusive Suite, including weakly foliated monzonite and monzodiorite. Gneisses typically give good petrographic numbers, although, gneiss samples collected in the central Labrador study area generally have numbers ranging from 150 to 300. This is the result of mica and hornblende layers throughout the rock, which constitute planes of weakness, reducing petrographic quality. The effect of mica–hornblende layers may be reduced if the rocks are crushed, increasing the petrographic quality, and making the aggregate more acceptable for higher quality use, such as in concrete and asphalt mix.

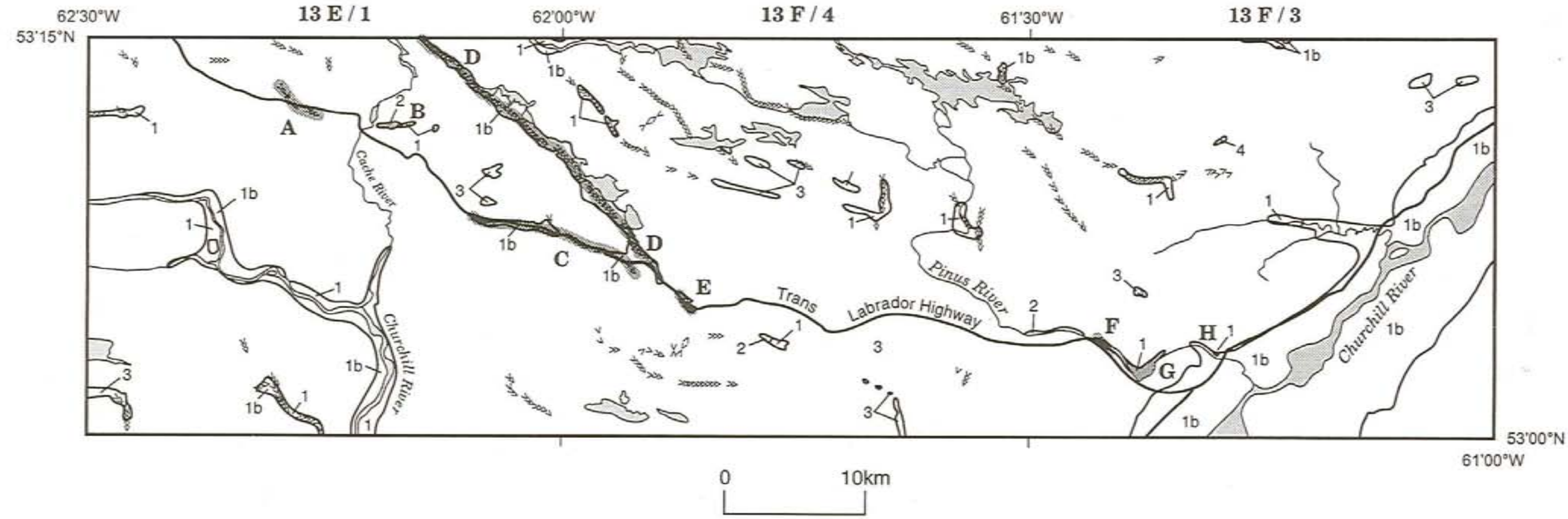
Potential sand and gravel deposits located in close proximity or along existing road routes (Figure 3) can be

the action of ice-sheets on ground moraine, but instead, they may have resulted from major subglacial meltwater flows. Regardless of this debate, regional ice movement is clearly defined by features such as striae, crag-and-tail hills, roches moutonnées, or orientated rock markings, as well as drumlinoid features; all are orientated toward the southeast. This work is consistent with the glacial landforms and deposits map of Labrador and eastern Quebec (Klassen, 1992) and work by and Liverman (1997) in the Goose Bay area.

In the plateau region, large volumes of moving water flowing from the melting glaciers picked up and carried debris tens of kilometres from its source. During transportation the material was washed, sorted and rounded and deposited as eskers containing essentially sand and gravel-size material. Most eskers are orientated in the same general direction as the drumlinoid features, although eskers do not indicate ice-flow direction, but flow of meltwater within or beneath a glacier. Some of these eskers are over 20 km long.

POTENTIAL AGGREGATE DEPOSITS

Aggregate sampling was concentrated on glaciofluvial outwash deposits. Till sampling to locate tills having a low silt–clay content was also conducted. Tills generally have higher silt–clay concentrations than gravel. All till samples collected in the study area have silt–clay content ranging from 10 to 25 percent. These tills are unsuitable for most construction purposes (Vanderveer, 1983), although they can be used



KEY

1 Contains granular material; probability of locating economic deposits is moderate to high

1b Contains sand-size granular material; high potential for economic exploitation of sand; low to moderate potential for coarser granular material

2 Contains thin (less than 2 m thick) or discontinuous granular material; also includes areas where distribution of thicker deposits could not be determined by field investigation; probability of locating economic deposits is moderate to low

3 Contains granular materials but deposits are not substantiated by field investigation; probability of locating economic deposits is moderate to low

4 Material of granular composition (e.g., sandy tills and colluvium) that generally contains up to 6 percent silt-clay content, but may be beneficial for higher grade uses

Zones of aggregate potential along road route. Zones A through H are referred to in the text

Eskers (flow direction known or assumed, unknown): sinuous ridges of granular material; moderate to high potential for economic exploitation

Figure 3. *Generalized aggregate-resource map.*

Table 1. Summary results of sand and gravel deposits sampled in the vicinity of the Trans-Labrador Highway

		Grain-size Analyses				Petrographic Analyses			
Deposit	Estimated M3	No. of Samples Analyzed	% Gravel +5 mm	% Sand +78 um to 5 mm	% Slt-Cly -78um	No of Samples Analyzed	Petro Range	Petro Average	Comments
A	50000	6	68.4	30.2	1.4	4	104-300	213	1.5-km-long dissected esker having thickness of 3 to 7 m. Rock outcrop and thin units of outwash sand are located near-by.
B	3000000	7	†	†	†	4	106-112	105	Partly eroded and dissected terrace containing sand and gravel. Deposit thickness range from 1 to 15 m. Bedrock petrusions were observed at two locations along the terrace.
C	1500000	23	66.4	33.4	0.2	8	262-317	270	Esker complex over 12 km long and 3 to 15 m thick
D	2500000	8	47.1	51.2	1.7	15	252-297	280	20-km-long esker having thickness of 2 to 15 m.
E	200000	8	52.3	47.2	0.5	7	105-122	110	Esker and gravel hummock deposit
F	150000	3	71	28.7	0.3	3	149-300	244	800-m-long esker, 10 to 11 m thick
G	4500000	4	†	†	†	3	102-240	155	Glaciofluvial terrace 2 to 8 m thick. Outcrop and till exposures were noted along river bank were terrace is located
H	1000000	1	†	†	†	1	145	145	Glaciofluvial terrace 30 m thick, possibly underlain by medium to fine micaceous sand

Note: Estimated quantities in table are based on airphoto interpretation and observations at field sample locations. Grain-size percentages are based on a compilation of sample data for each deposit.

† Information will be available at a later date.

considered for road construction and road upgrading. These deposits include:

A) An esker located near the north-central part of NTS map area 13E/1 (Plate 2). The esker is followed, in part, by the TLH. This dissected esker (Figure 3) is approximately 1.5 km long and is 3 to 7 m high. It contains approximately 50 000 m^3 of pebble–cobble–gravel containing approximately 1.4 percent silt–clay. Six samples were collected from 3- to 7-m-high road-side exposures, and 1-m-deep hand-dug pits. Rock outcrop and thin units of silt–clay are located in areas adjacent to the esker.

B) A glaciofluvial terrace deposit (Plate 3) in NTS map area 13E/01 is located near the Cache River. It is 6 km long, 1 to 2 km wide, and 1 to 15 m thick. The terrace deposit contains approximately 3 000 000 m^3 of gravel, boulder sandy gravel, pebble–cobble gravel and medium to fine micaceous sand. One sand sample was collected from a 5-m-stream exposure and six gravel or sand samples were taken from 1-m-deep hand-dug pits. This deposit is interrupted by till hummocks and bedrock exposures.

C) This 12-km-long esker complex extends from the west part of NTS map area 13F/4 to the east part of NTS map area 13E/1. It is traversed by the TLH for most of its length. The esker complex is 3 to 15 m thick. It contains an estimated 1 500 000 m^3 of pebble–cobble gravel, boulder–cobble gravel, sandy gravel and sand (Plate 4). Twenty samples were collected from road and quarry exposures with heights ranging from 1 to 10 m, and three samples were taken from 1-m-deep hand-dug-pits.

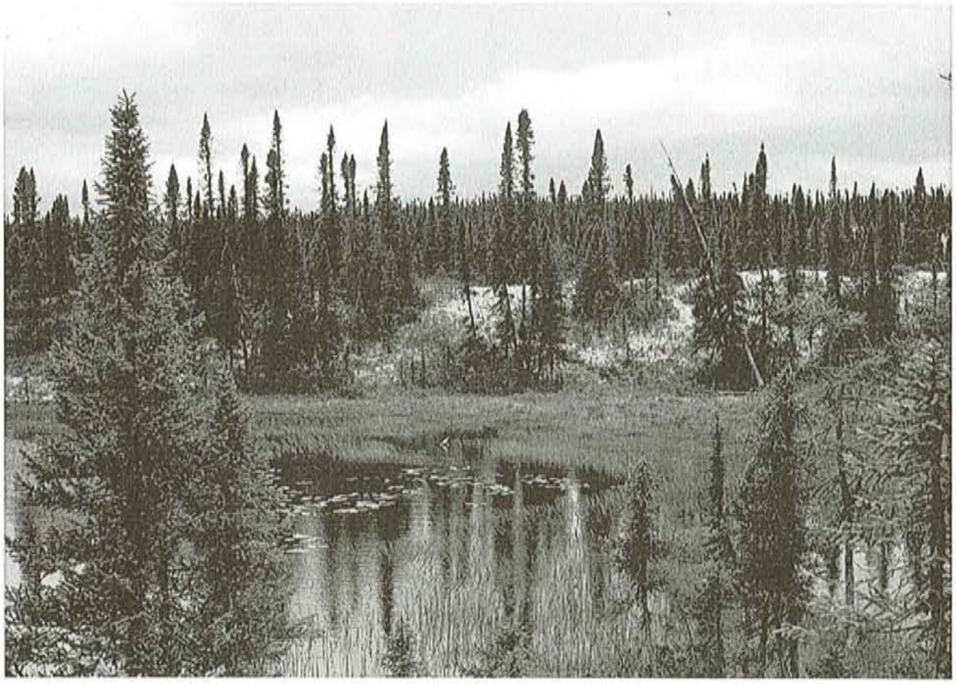


Plate 2. *A 3- to 7-m-high esker, at deposit A, in NTS map area 13E/1.*

Plate 3. *Glaciofluvial terrace deposit near the Cache River (deposit B) in NTS map area 13E/1.*

E) This 4-km-long esker–hummock deposit is located along the TLH in the west part of NTS map area 13F/4. The esker and hummocks range in height from 4 to 8 m. The deposit area is approximately 4 km long and 1 km wide and contains an estimated 200 000 m^3 of sandy gravel, sand and cobble–boulder–gravel. Samples were collected from road and quarry exposures with heights of 1 to 4 m.

F) An esker located on the southwest side of the Pinus River in the west part of NTS map area 13F/3 is another potential source of gravel aggregate. It is about 100 m from the road. This 800-m-long esker is 10 to 11 m thick and contains an estimated 150 000 m^3 of material. Three samples collected from 1-m-deep hand-dug pits at the top of this esker deposit indicate it has a cobble–boulder texture.

G) Gravel was sampled at several locations in a glaciofluvial terrace along the Pinus River. This terrace is approximately 2 km long and 700 m wide and ranges in height from 2 to 8 m (Plate 5). It contains an estimated 4 500 000 m^3 of gravel and sand. Textures vary from cobble–boulder to sandy–pebble gravel. All samples were collected from the river and stream-cuts through this deposit.

H) A glaciofluvial terrace deposit was sampled on the north side of the TLH, east of the Pinus River. This steep-sided deposit is 300 m long, 200 m wide and up to 30 m thick. It contains an estimated 1 000 000 m^3 of material. Cobble gravel was collected from a 1-m-deep hand-dug pit at the top of the terrace. This gravel deposit may be underlain by a medium to fine micaceous sand, similar to deposits on the west side of the Pinus River. Quarry exposures and backhoe-dug pits on the west side of the Pinus River show about 2 m of gravel over more than 10 m of sand.

D) This 20-km-long esker system begins near the TLH at the west end of NTS map area 13F/04 and extends in a northwest direction away from the road cutting across the northeast corner of NTS map area 13E/1. It contains over 2 500 000 m^3 of gravel and sand. Eight samples were collected from 1-m-deep hand-dug pit. This 2- to 15-m-high gravel esker is flanked by medium- to fine-grained micaceous sand.

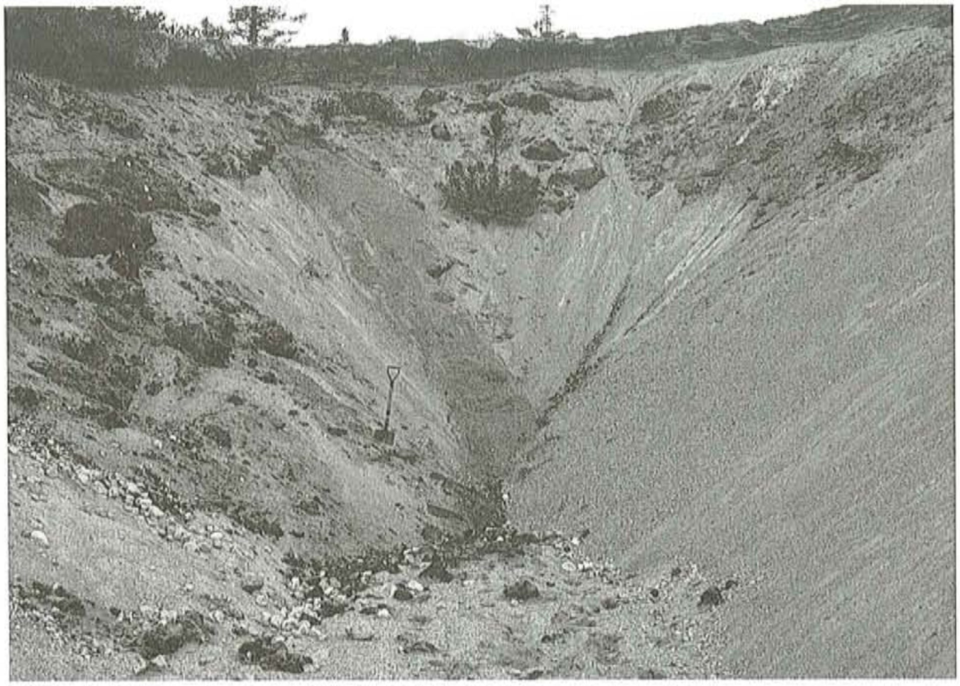


Plate 4. *An 8- to 10-m sand exposure in deposit C, located along the Trans-Labrador Highway, in NTS map area 13F/4.*

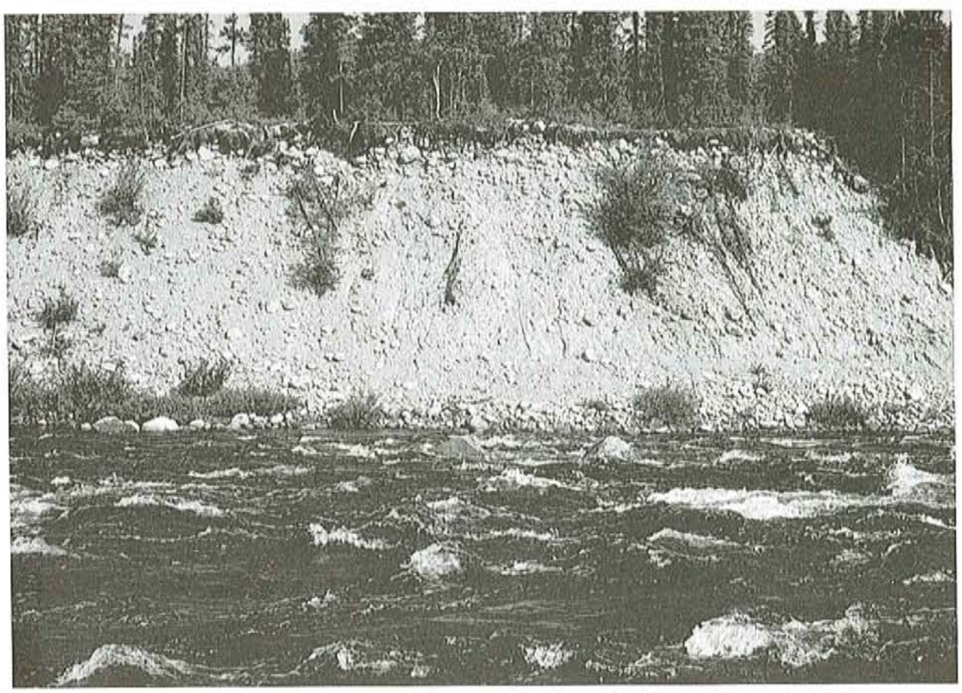


Plate 5. *An 8-m-high gravel exposure (deposit G) along the Pinus River, in NTS map area 13F/3.*

After the glaciers started to melt, and retreat, large deposits of glacial tills were left behind. Most of these tills were in the form of drumlinoid fields with individual drumlinoid features ranging from 2 to 3 km in length, with a few, more than 5 km in length. Ice flow was southeastward across the area as suggested by ice-striation marks, drumlinoid features and craig-and-tail hills.

The aggregate potential of till in the study area is restricted for use as fill material. Till samples collected contain 10 to 25 percent silt–clay, too high for most construction purposes. The till can be washed and screened but this is uneconomic. The Churchill River valley was filled with sediment consisting mostly of fine micaceous sand from fluvial deposition, and silt–clay of glaciomarine origin. These materials have poor aggregate value, nor are they useful in drift prospecting. In the plateau region, eskers (up to 20 km long), and glaciofluvial terraces contain deposits of sand and gravel. Airphoto interpretation and field investigations have revealed that some these deposits are substantial enough to support large aggregate pit and quarry operations. These include esker deposits along the TLH in NTS map areas 13E/1 and 13F/4, a terrace deposit near the Cache River and terrace and esker deposits near the Pinus River. Gravel deposits near the Pinus River may become an aggregate source for the town of Goose Bay. Increasing demand at Goose Bay and the lack of good quality aggregate may make this necessary. Interest in this area as an aggregate source may increase when upgrading of the TLH is completed, making trucking easier and faster, and decreasing transportation time.

CONCLUSIONS

The area was completely glaciated during the late Wisconsinan. The advance of glaciers changed and shaped the land by breaking off large blocks of rock, reworking and transporting this debris in its path, deepening valleys and redepositing material as glacial till or, as sand and gravel.

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REFERENCES

Blake, W. Jr.
1956: Landforms and topography of the Lake Melville area, Labrador, Newfoundland. Geographic Bulletin, Geographical Branch, Department of Mines and Technical Surveys, Ottawa, No. 9, pages 75-100.

Bragg, D.J.
1985: Unpublished (maps 13F and 13E): Geotechnical bedrock compilation maps of Newfoundland. Scale 1:250 000. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File NFLD. (1485).

1995: Petrographic examination of construction aggregate. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey, Report 95-1, pages 77-89.

Canadian Standards Association
1973: CSA standard A23.2.30, Rexdale, Ontario, pages 207- 209.

Environmental Geological Section
1983a: Site data and 1:50 000 scale maps. Field maps for all surficial and glacial mapping and aggregate resource mapping projects. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File NFLD (1267).

1983b: 1:50 000 scale aggregate resource maps outlining zones of aggregate potential within a 6-km-wide corridor in Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File NFLD (1300).

Fulton, R.J.
1986: Surficial geology, Red Wine River, Labrador, Newfoundland (1:500 000 scale). Department of Energy, Mines and Resources, Geological Survey of Canada, Ottawa, Map 1621A.

Fulton, R.J. and Hodgson, D.
1970: Surficial geology (uncontrolled mosaic; 1:50 000 scale). Geological Survey of Canada, Project 690043; Open File 59.

Fulton, R.J, Hodgson, D.A. and Minning, G.V.
1975: Inventory of Quaternary geology, southern Labrador - Terrain Studies in undeveloped areas. Geology Survey of Canada, Department of Energy, Mines and Resources, Ottawa, Paper 74-46, 14 pages.

Fulton, R.J., Hodgson, D.A., Thomas, R.D. and Minning, G.V.
1979: Surficial materials, Winokapau Lake (1:250 000 scale). Department of Energy, Mines and Resources, Geological Survey of Canada, Ottawa, Map 79-21.

Kindle, E.M.
1924: Geography and geology of Lake Melville district, Labrador Peninsula, Memoir 141. Department of Mines, Geological Survey, Ottawa, 105 pages.

Kirby, F.T.
1995: Aggregate-resource assessment projects, Newfoundland and Labrador. *In* Current Research. Newfoundland Department of Natural Resources, Geological Survey, Report 95-1, pages 105-112.

Kirby, F.T., Ricketts, R.J. and Vanderveer, D.G.
1983: Inventory of aggregate resources of Newfoundland and Labrador. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 83-2, 36 pages.

Klassen, R.A. (Compiler)
1992: Glacial landforms and deposits, Labrador, Newfoundland and eastern Quebec, 1:000 000 scale. Department of Energy, Mines and Resources, Geological Survey of Canada, Map 1814A.

Liverman, D.
1997: Quaternary geology of the Goose Bay area. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey, Report 97-1, pages 173-182.

Ministry of Transportation (MTO)
1994: Procedures for petrographic analysis of coarse aggregate. Ministry of Transportation, Ontario, Laboratory Testing Manuel, Volume 2, LS-609, 18 pages.

Newfoundland Department of Transportation
1987: Specifications Book, Tendering Section. St. John's, Form 315 and 904, 12 pages.

Ricketts, M.J.
1987: Coastal Labrador aggregate resources. Mineral Resource Report, Department of Mines and Energy, Mineral Development Division, 50 pages.

Ricketts, M.J. and Vatcher, S.V.
1996: Granular aggregate-resource mapping in the Roddickton-Main Brook area, Great Northern Peninsula. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey, Report 96-1 pages 41-53.

Tanner, V.
1944: Outline of the geography, life and customs of Newfoundland - Labrador. Acta Geographic, Volume 8, page 245.

Stevenson, I.M.
1969: Lac Brule and Winokapu Lake map areas, Newfoundland and Quebec (13D, 13E). Geological Survey of Canada, Department of Energy, Mines and Resources, paper 67-69, 16 pages.

Vanderveer, D.G.
1983: Aggregates - the often maligned and often forgotten mineral. *In* 19th Forum on the Geology of Industrial Minerals. Proceedings. *Edited by* S.E. Yudt. Ontario Geological Survey, Miscellaneous Paper 114, pages 65-78.

Wardle, R.J., Kjarsgard, B., Crisby, L.V.J., Anstey, C.X., Harris, M., and Lawlor, B.
1988: Geology of the Goose-Pinus rivers area (13F/3, 4, 5 and 6), Central Grenville Orogen, Labrador. *In* Current Research. Newfoundland Department of Mines, Mineral Development Division, Report 88-1, pages 49-58.