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SURFICIAL GEOLOGY OF THE SCHEFFERVILLE AREA (LABRADOR PARTS OF NTS 23J/10 AND 23J/15)

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ABSTRACT

Surficial geology mapping was conducted in the Schefferville area (the Labrador parts of map sheet NTS 23J/10 and 23J/15). Detailed ice-flow mapping in this study provides support for the previous models of regional ice-flow history. The results suggest that such models may be applied on a local scale, although some local topographic variation from regional patterns is apparent in areas of high relief. Where well-oriented clast fabrics are found, they suggest northwest–southeast flow indicating that a later northeast flow had little effect on deposited sediment.

The landscape in the study area is dominantly one of erosion, rather than deposition, and this will result in problems when applying conventional drift-exploration methods. Over much of the area, the effects of meltwater erosion and deposition dominate, with glacial processes having little effect on the surface sediment cover. Thus, both glacial and glaciofluvial models of dispersal have to be considered.

Thick sections exposed in mine pits are interpreted as showing the effects of the last glacial event to affect the area, rather than a long glacial history. Surface diamictons show no consistent colour, but reflect the erodibility and colour of local bedrock.

INTRODUCTION

The Schefferville area straddles the border between western Labrador and northeastern Quebec. From 1945 to 1982, it was the site of intensive exploration, development and mining of iron ore. Recent research by the Department of Mines and Energy has identified the Labrador Trough as a likely area for other mineral resources including PGE, and massive sulphides (Swinden *et al.*, 1991). Studies by the Geological Survey of Canada have identified this region as an area of complex ice-flow, and possibly possessing an interesting Quaternary stratigraphic record (Klassen and Thompson, 1987; *in press*). This, combined with the comparative cost advantages of work in a relatively developed area, led to selection of the Newfoundland part of the 23J/10 and 23J/15 NTS map sheets for study.

OBJECTIVES

The objectives of the project are:

1) map the surficial sediment cover of the area, using aerial photographs and field checking; and to identify the grain size, thickness and genesis of the sediment;

2) map ice-flow indicators (striations, landforms, and clast fabrics) and investigate clast provenance in order to examine the ice-flow history of the area;

3) examine and map the geomorphology of the area;

4) integrate the information obtained to interpret a Quaternary geological history for the area; and

5) use the geological history in developing a model for sediment dispersal that would assist mineral-exploration companies using drift-exploration techniques.

LOCATION AND ACCESS

The town of Schefferville is located 150 km north of Labrador City in the interior of the Labrador–Ungava Peninsula (Figures 1 and 2). It is serviced by the Q.N.S.& L. rail service, and a modern airport, but has no external road connections. Access in the northern part of the map area is good via the network of mining and exploration roads built during the period of mining activity. Access to the southern part of the map area is possible by boat or helicopter, whereas the western hills are only accessible by helicopter.

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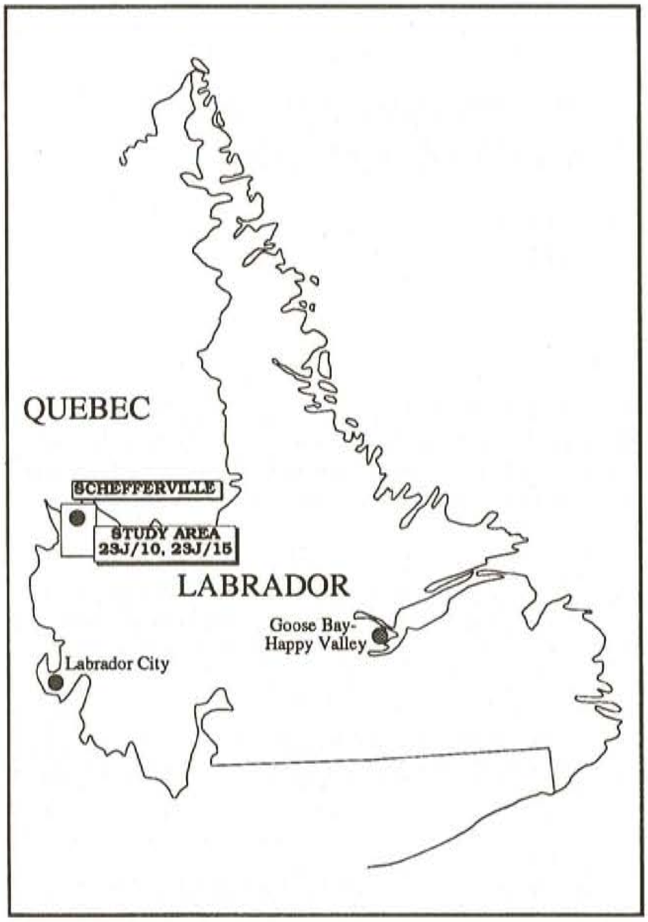

Figure 1. *Location of study area.*

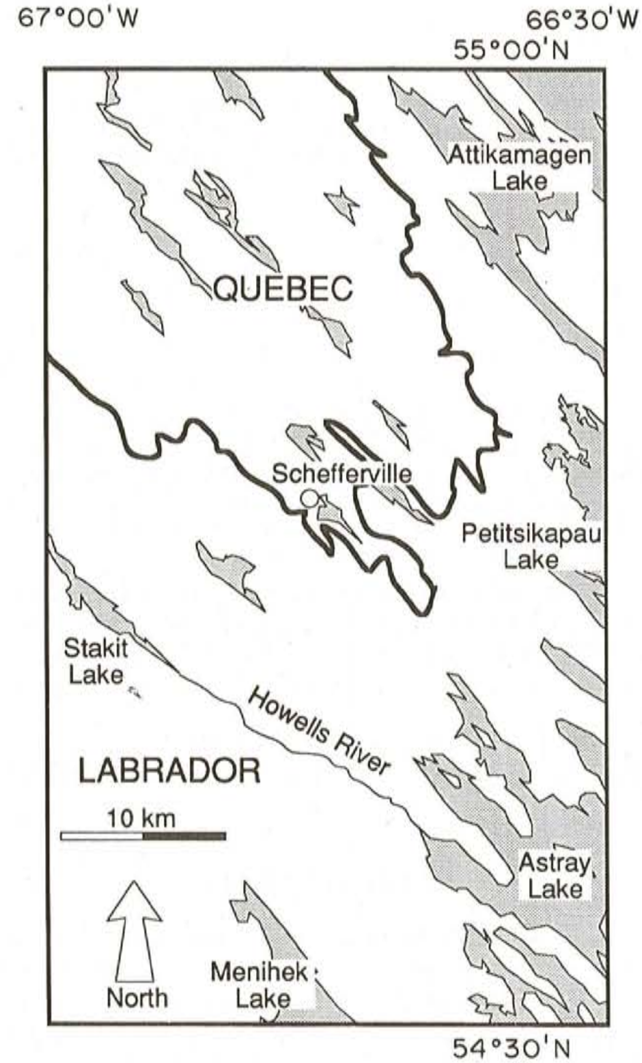

Figure 2. *Main features of the study area.*

BEDROCK GEOLOGY

The geology of the area was first described by A.P. Low, who also identified the economic potential of the iron-ore deposits of the Labrador Trough (Low, 1896). Further detailed mapping was performed from the 1940's onward by the Iron Ore Company of Canada, and the Geological Survey of Canada. Wardle (1982) compiled existing information on the Labrador Trough geology into a comprehensive map of the area. The bedrock of the southwest part of the study area consists of Archean gneisses and granites of the Superior Province Ashuanapi Complex (Greene, 1974; James and Stephenson, *this volume*). The remainder of the study area is underlain by Lower Proterozoic sedimentary and volcanic supracrustal rocks of the Labrador Trough (Greene, 1974; Wardle, 1979; Wardle and Bailey, 1981). These include iron formation, chert, quartzite, dolomite, sandstone, siltstone and shale of the Sokoman, Denault, Menihek, Fleming, Wishart and Dolly formations (Wardle, 1982).

Economic interest has been mainly in the iron ore exploited for 30 years in the Shefferville area. McConnell (1984) described zinc anomalies found in lake- and stream-geochemistry surveys in the Iron Arm and Howell's River areas, but was unable to locate a source. Swinden *et al.* (1991), on the basis of several prospects and occurrences, suggested that the eastern Labrador Trough has the potential for further massive sulphide deposits.

PREVIOUS WORK

Low (1896) noted striations at the north end of Dyke Lake indicating southwesterly ice flow. Harrison (1952) recognized three directions of flow in the Schefferville area, a southeastward flow that sculpted the main features of the landscape, followed by a flow to the northwest, and subsequently a flow to the northeast. Henderson (1959) also recognized an early dominant landforming southeasterly flow, with a later shift in flow to the east. He was unable to find evidence for a northeast flow in the Schefferville area, but on the evidence of striae in the Stakit Lake area, suggested that a regional northeast flow preceded a local late southeast flow down the Howell's River valley (Figure 2). Kirby (1960, 1961, 1966) reported till-fabric analyses in the Schefferville area that showed the last ice movement in the area was oriented north-northwest–south-southeast. He also reported striations that are interpreted as showing an early northeast flow followed by a later south-southeast flow, suggesting that the age relationship derived by Henderson (1959) was incorrect. Klassen and Thompson (1987, 1989, *in press*) identified five phases of ice movement in the Schefferville area through mapping of erratics and striation evidence. Phase I consisted of westward flow from the Schefferville area, identified by dispersal of trough erratics onto the Archean highlands to the west of the study area. Phase II consisted of north to north-northeast flow, affecting mostly the area north and west of the present study area. Phase III consisted of flow both northwest and southeast from an ice centre located southeast of Attikamagen Lake, which migrated north of Schefferville. Phase IV consisted of strong eastward flow across the Archean Highlands into the Trough, affecting mainly the area south of Schefferville. Phase V was considered to be minor and short lived, and resulted in northeastward flow in the Schefferville area, which had little effect on outcrop morphology.

Klassen and Thompson (1987) described till stratigraphy in the region. A regionally recognized red to red-brown surface till overlay a grey-brown till, which in turn overlies a dark-grey till. At one site, fluvial gravels were identified separating red and grey-brown tills, possibly indicating preservation of non-glacial sediments. Klassen and Thompson (1987) suggested that the tills are lithologically distinct, and may represent significant changes in the directions of glacial transport.

Henderson (1959), Derbyshire (1960, 1962, 1964) and Ives and Kirby (1964) described the numerous meltwater channels found in the Schefferville area, suggesting that most were formed subglacially rather than at the margin of retreating ice.

FIELD METHODS

The study area was covered using a combination of all-terrain vehicle, boat, helicopter and foot. Striations were measured and mapped from rock outcrops. Existing trenches, pits, and disused mines provided exposure of sediments for section work supplemented by hand excavation of shallow pits. Well-exposed sections were cleared, described, and photographed, and where considered relevant, clast-fabric measurements were made using standard techniques. From diamicton exposures, samples of matrix were collected and analyzed for geochemistry and texture, and 80 to 120 pebbles were collected for clast lithology identification.

A significant departure from field methods used by previous workers was the routine use of a sun compass. Such an instrument is required due to the presence of large volumes of iron-rich rock in the Schefferville area, which disturbs the local magnetic field. Use of the sun compass (see Larochelle, 1963 for description of methods) showed that magnetic compasses were unreliable with unpredictable variations over short distances, with deviations ranging from 0 to 60°, averaging 10 to 20°.

GEOMORPHOLOGY AND SURFICIAL GEOLOGY

The geomorphology and surficial geology of the study area is varied and form distinct zones (Figure 3). The

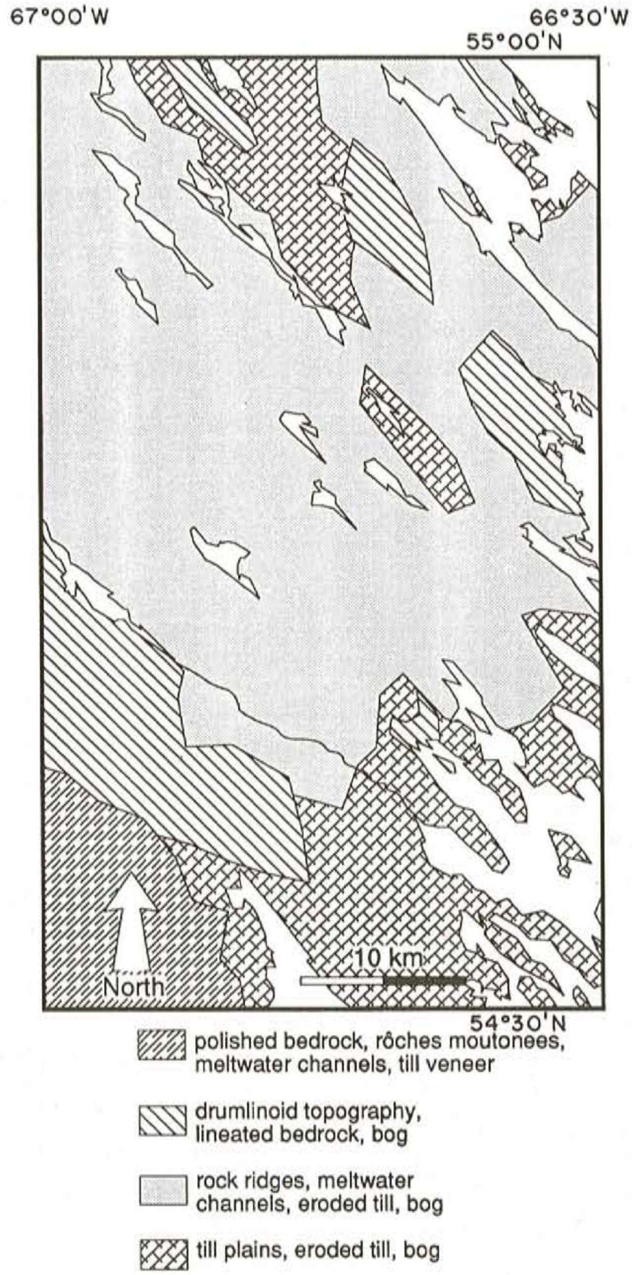

Figure 3. *Sketch map showing simplified geomorphology and surficial geology of the study area.*

highlands southwest of the Howells River valley have a landscape dominated by ice-sculpted bedrock having numerous rôches moutonées and perched boulders, with the eastern slopes showing many bedrock-controlled meltwater channels. Drainage in this area is disorganized, and reflects bedrock weaknesses. Surficial sediment is generally thin and restricted to valley bottoms, consisting mostly of a veneer of diamicton, with some glaciofluvial deposits, and areas of bog.

The Howells River valley and Stakit Lake area form a broad lowland with numerous drumlinoid landforms. Relief is comparatively low (2 to 8 m), and individual features are

200 to 500 m long and 50 to 300 m wide. Limited examination of these features suggests that they are largely composed of bedrock having a thin till cover on the crests, and extensive areas of bog in intervening lows. Their morphology is variable, but generally does not fit the 'classical' egg-shaped drumlin. The long axes of the features are oriented northwest-southeast, parallel to bedrock strike. The genesis of drumlins and related features is controversial. The conventional view is that they form subglacially through the action of ice flow on a till substrate (Smalley and Unwin, 1969; Boulton, 1987; Menzies, 1989; Boyce and Eyles, 1991). This model has been challenged by Shaw (1983), Shaw and Kvill (1984), Sharpe (1987), and Shaw and Ashley (1988) who suggest that drumlins are formed by major subglacial meltwater flows. The morphology of the Schefferville features resembles those described by Shaw and Kvill (1984), and their bedrock composition suggests that these are erosional features. The common regional occurrence of bedrock sculpted by meltwater, and the numerous meltwater channels indicate a very active high-pressure subglacial water system and provide some inconclusive support for drumlin formation by subglacial meltwater, with large-scale water erosion modifying existing bedrock ridges.

East of the Howells River valley and Stakit Lake, the landscape consists of bedrock ridges, with their sides scarred by meltwater channels (Plate 1). The ridges have some areas of till veneer and thicker areas of till are restricted to valley bottoms or are found in the lee of bedrock highs. Glaciofluvial deposits are rare, and consist mainly of gravel fans at the base of meltwater channels. Meltwater channels are common on valley sides. Two meltwater channels located east of Louise Lake, 10 km southeast of Schefferville, illustrate the control of bedrock structure on morphology. They are found on the western slope of a northwest–southeast-oriented bedrock ridge, and both have an elongate U shape in plan, with the bottom of the U lying to the south (Figure 4, Plate 2). The channels are connected by a poorly defined sinuous channel, with a further U shaped off-shoot. The channels are steep sided, flat bottomed and slope up to the south at 2 to 5°. The height of the outer wall increases toward the apex of the U, reaching an estimated 45 to 60 m high in the northerly example, and 30 to 40 m in the other. The inner walls also increase in height to a maximum of 10 to 20 m at the apex in each case. The width of the channels remains fairly constant at 100 to 200 m, widening at the apex of the U. The area surrounding the channels consists mostly of bare rock and a few scattered erratics. The local bedrock consists of shales and siltstones of the Dolly Formation (Wardle, 1982), and examination of the orientation of bedding planes surrounding the channels shows that each formed within a dipping antiform. The meltwater has preferentially eroded softer shale horizons, and its path was controlled by the structure of surrounding, more resistant siltstones. It is suggested that such landforms must form subglacially, with meltwater under pressure, in order to form channels that run against topographic gradient. The almost 180° change in direction of the channels resulted in particularly high-water pressures and velocities on the outside wall at the apex of the U resulting in maximum erosion at this point. The poorly defined channel linking the features indicate that they formed

Plate 1. *Meltwater channels, southeast of Stakit Lake.*

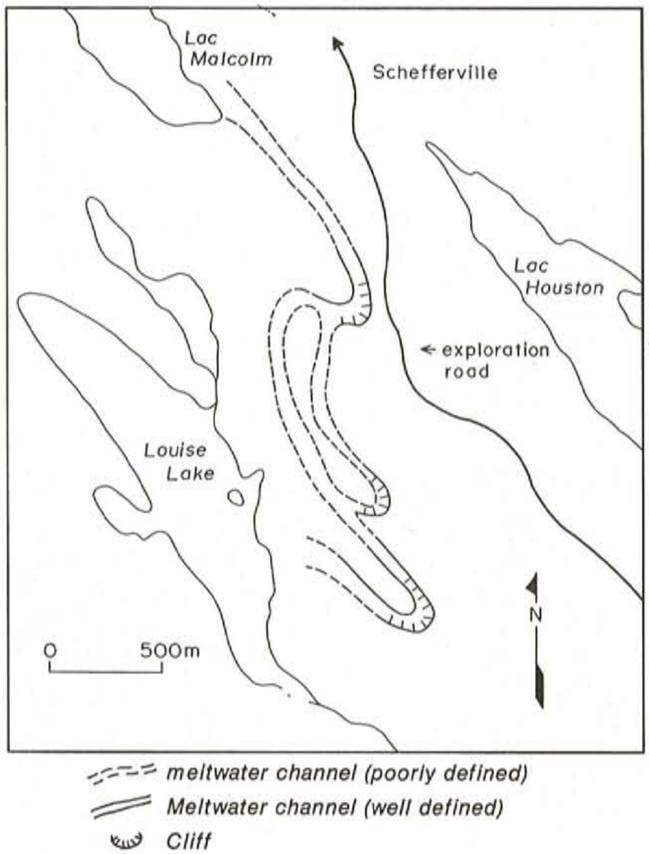

Figure 4. *Sketch map of meltwater channels, Louise Lake area.*

simultaneously as part of a single subglacial meltwater system, possibly as subglacial meltwater flow was confined against the valley sides. The shape and path of many other meltwater channels in the area can be related to bedrock structure, generally following bedrock strike, and exploiting easily eroded bedrock. Meltwater channels crossing strike do so along faults and other bedrock weaknesses.

Around Astray and Petitsikapau lakes the landscape is subdued, and has a more continuous drift cover. Where fresh polished bedrock outcrops are exposed (notably at lake

Plate 2. *U-shaped meltwater channels southeast of Schefferville; note slope up to apex of U.*

margins), they are well striated, but sinuous grooves, cavettos, and 'rat-tails' are commonly found (Plate 3). These suggest high velocity subglacial water flow during deglaciation, and may be related to meltwater channels and drumlinoid features described above. Sediment cover is variable in thickness, but generally less than 1 to 3 m. Till is common, and is frequently eroded by minor meltwater channels, or forms featureless plains. Glaciofluvial deposits are rare to absent. Areas of bog are extensive at the margins of large lakes, and in any low-lying areas. Howell's River has formed a large delta, 1 to 2 km wide, where it enters Astray Lake, constituting a significant area of modern alluvium.

Plate 3. *'Rat-tails' in sinuous groove, likely formed by subglacial meltwater erosion, north end of Dyke Lake.*

ICE FLOW

Interpretation of ice-flow history is based mainly on mapping of striations and distribution of indicator lithology clasts. Some care has to be exercised when examining outcrop on the margins of major lakes in the area. The effects of wind on lake ice results in major push effects on the lake shore, with boulder ramparts generated on stony beaches, and inhibition of tree growth up to 30 m back from the shoreline (Pyökäri, 1981). Such shore ice may freeze boulders to its base, and striate bedrock as it is thrust over the shoreline. Thus, striae sites at lake edges were examined critically, with the expectation that striations resulting from ice push would be shallower, broader, and less consistent, both locally and regionally, than glacial striae.

Ice flow is complex, with at least three regionally significant flow events clearly recorded (Figure 5). A strong flow to the southeast, parallel to bedrock strike is shown by large-scale oriented landforms (drumlinoid features, crag and tails, and numerous rôches-moutonées). Striations parallel to this flow trend are common, but are often overprinted and crosscut by striae indicating flow to the northeast. In the Attigamagen Lake area, this later flow can be separated into two components, a northeast flow and an east-northeast flow, although the age relationship between them is not clear. Labrador Trough erratics found overlying Ashuanapi Complex bedrock in the southwest of the field area suggest a westward flow although no corroborating striation evidence was found. These observations can be easily accommodated in the flow models of Klassen and Thompson (1987, 1989).

Forty fabric measurements were made in this study, of which only three show strong unimodal fabrics (using the statistical criteria outlined in Liverman *et al.*, 1990). These are all indicative of northwest–southeast flow, supporting the contention of Kirby (1960, 1961, 1966) that this ice flow was the main influence on sediment dispersal.

CLAST FABRIC

Clast fabric is an important indicator of the environment of deposition in diamictons as orientation of clasts is controlled by the processes depositing the diamicton. Diamictons are of particular interest as they are the chosen medium of sampling in most drift-prospecting studies. In lodgment till, strong orientations both parallel and transverse to glacial flow direction are expected (Lawson, 1979, 1982; Dowdeswell and Sharp, 1986). In basal melt-out till, fabrics are also strong, but may be subsequently modified by reworking. Subaerial debris flow results in less well-oriented inconsistent girdle fabrics, sometimes oriented parallel to local slope (Boulton, 1971; Lawson, 1979). When considering the results of drift prospecting, the genesis of sediment being sampled is important, with transport distances varying considerably between basal tills, and diamictons deposited by other processes.

Forty clast fabrics were obtained on diamictons throughout the area, mostly from thick sections exposed in mine pits in the central part of sheet NTS 23J/15. Clast fabrics were analyzed on a Macintosh microcomputer using the Stereo™ program (MacEachren, 1989).

Mean orientation, and strength of alignment were calculated by the eigenvector methods of Mark (1973, 1974) and Woodcock (1977). The S_1 value measures the strength of the mean clast alignment, and can range from 0.33 (weak) to 1.0 (strong). Figure 6 is a plot following the method of

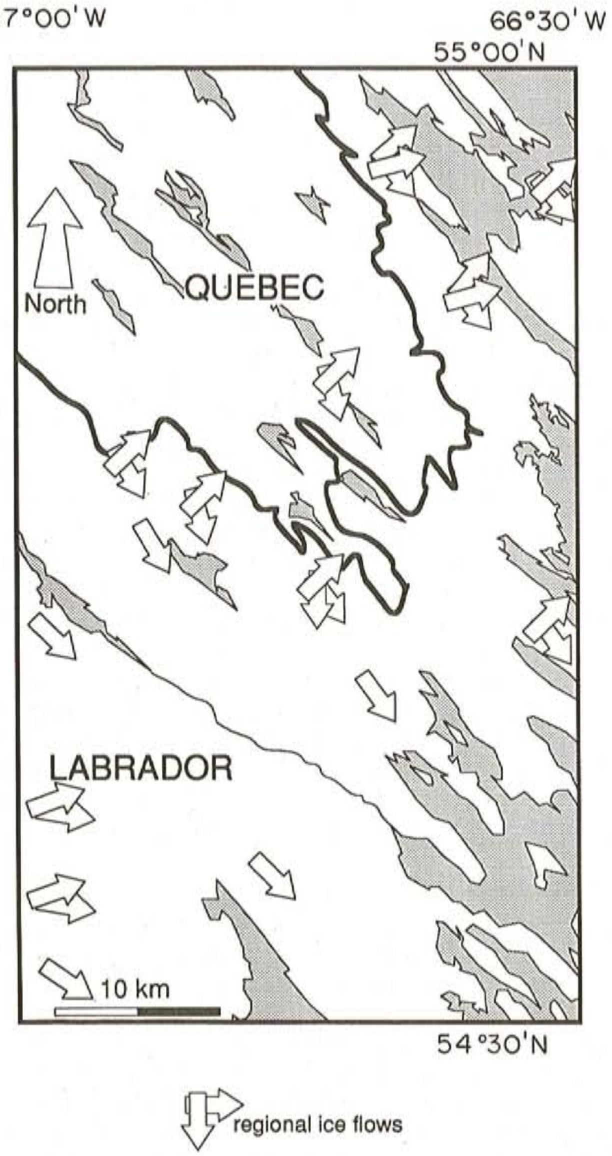

Figure 5. *Ice-flow history, Schefferville area.*

Woodcock (1977) and Rappol (1985). In this diagram, fabrics plotting in the upper left side of the diagram are considered to have a cluster distribution, whereas those in the lower right part have a girdle distribution. The parallel diagonal lines mark increasing values of a strength parameter (k), with weak fabrics plotting closer to the origin. Examination of the diagram shows that fabrics are variable, but weak to moderate girdle fabrics dominate. This indicates that undisturbed basal tills are rare, and the use of clast fabric as an ice-flow indicator requires caution.

Burnt Creek Sections

The thickest and best exposed sections in the study area are found in the Burnt Creek/French mine that straddles the Quebec–Labrador border 4 km north of Schefferville. Up to 30 m of Quaternary sediments are found overlying highly

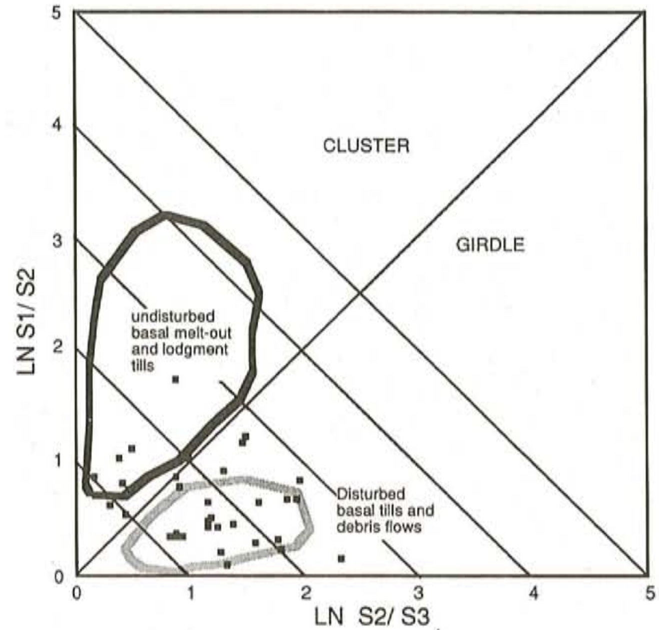

Figure 6. *Diagram of clast-fabric eigenvalues, using the method of Woodcock (1977). The Y axis is the natural logarithm of the ratio between S_1 and S_2, and the X axis is the natural logarithm of the ratio between S_1 and S_3.*

weathered bedrock (Plate 4). Two sections are described in detail here.

Plate 4. *West wall of Burnt Creek mine, showing up to 30 m of surficial sediment exposed in broad bedrock low.*

exposed, showing three to four diamicton units of differing colour (Figure 7, Plate 5). Two vertical transects, 3 m apart, were made through the section.

The basal unit is a coarse dark reddish-brown diamicton (Munsell colour 5YR 4/4, moist), at least 1.5 m thick. It is massive, unsorted, having a matrix of medium sand to granules, and stone-rich. The clast component consists of 30 percent cobbles to boulders, higher than most diamictons seen in the study area. Two clast fabrics have a general northwest–southeast trend, and show moderately to well-oriented girdle distributions (S_1 values of 0.73 and 0.61).

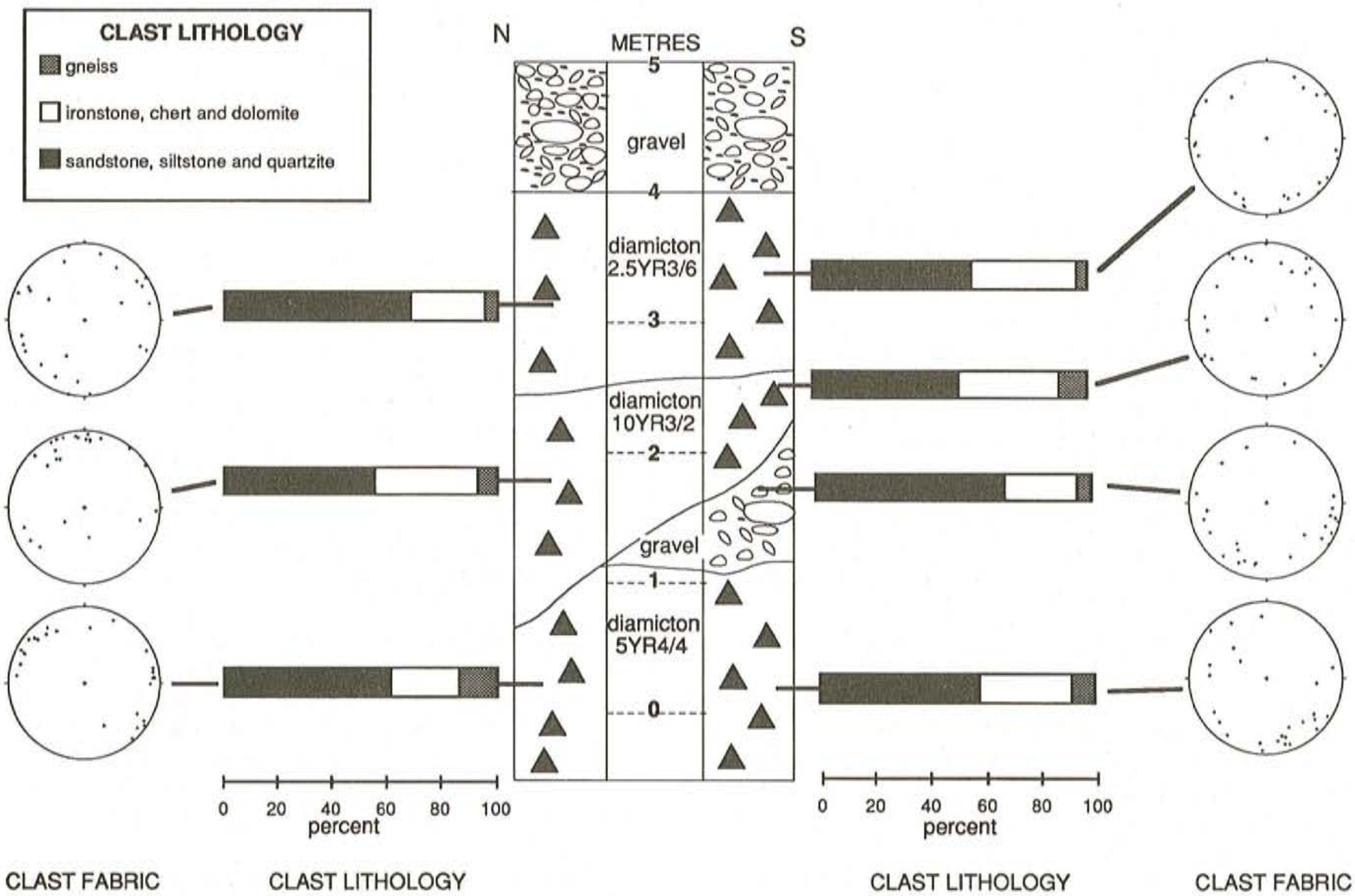

Figure 7. *Section diagram, Burnt Creek 1, showing lithology, clast fabrics and clast lithology.*

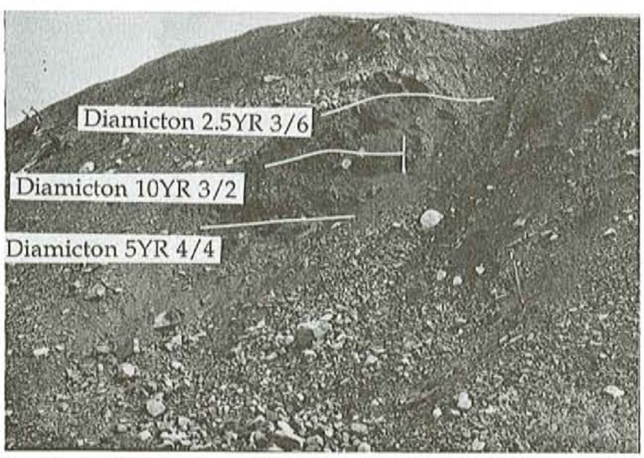

Plate 5: *Burnt Creek 1 section. See text for explanation.*

The second unit is only seen on the southern side of the exposure, and consists of a very poorly sorted pebble gravel. It is 1 m thick at this point, but pinches out to the north. It is massive, clast to matrix supported, having cobbles and granules and a coarse sand matrix. Clasts are mostly subrounded. A single clast fabric shows a moderately oriented girdle distribution (S_1=0.54), with an east–west trend.

Overlying a sharp contact that dips at a low angle to the north is a dark greyish-brown diamicton (10YR 3/2, moist) of generally finer matrix texture than the underlying units. The unit is 1 m thick on the north side of the exposure but thins to 30 cm to the south. The matrix is poorly sorted consisting of mostly silt and clay, and clasts compose 50 percent of the unit. Cobbles and boulders are rare, forming less than 5 percent of the coarse clasts. Two clast fabrics trend north–south, and northeast–southwest, and show moderately oriented girdle distributions (S_1=0.55, S_1=0.59 respectively).

The uppermost diamicton unit is 1.2 to 1.5 m thick, and dark red (2.5 YR 3/6, moist). The basal contact is horizontal and sharp. The diamicton is massive, and moderately stony, having very few cobbles or boulders. The matrix is poorly sorted silty clay. Two clast fabrics show weak to moderate girdle distributions (S_1=0.51, 0.55), with southwest–northeast and east–west trends.

The section is capped by 1.5 m of poorly sorted, clast-supported pebble-cobble gravel. Cobbles and boulders form 30 percent of the unit, which has a coarse sand and granule matrix. The basal contact is sharp and horizontal, and is overlain by a lag of cobbles. The gravel shows some rough horizontal bedding, and clasts are mostly subrounded to rounded.

The clast lithology of the section is uniform, with no clear differentiation between units (Figure 7), showing between 4 and 13 percent gneiss derived from the Ashuanapi Complex, 53 to 66 percent clastics, and 25 to 37 percent iron formation, chert and dolomite.

Klassen and Thompson (1987) suggested that the various coloured till sheets in the area may be related to the five-fold ice-flow history they defined by striations and indicator erratics. This section, consisting of multiple diamicton units, offers the potential for such correlation. The last two ice-flow events to affect this area were a strong southeast flow, followed by a late northeast flow. The lowermost unit has consistent, moderate to strong clast orientations, and may be a basal till deposited in conjunction with a southeast ice flow. Fabrics in the overlying diamictons, however, are inconsistent in orientation, and are typical of those obtained from debris flows rather than basal tills. Deposition of these units as a series of debris flows is also suggested by the lateral variability in thicknesses, the similarity in clast lithology throughout the section, and the textural variation. The section lies in a broad bedrock low, and would have acted as a sink for either subglacial or supraglacial gravity flow. This sequence is only found in one location in the pit, despite extensive exposure of Quaternary sediments, suggesting that each diamicton does not represent a regional event. The bedrock exposed in the mine pit is variable in colour, and the colour variations within the section may be due to local variation in incorporation of local material, rather than regional provenance. It is suggested, then, that the diamicton units represent a single basal till, overlain by a series of debris flows. The overlying gravel is coarse and poorly sorted, and was likely deposited in an ice-proximal glaciofluvial environment.

Burnt Creek 2

The thickest exposures of Quaternary sediment in the area lie on the southwest wall of the Burnt Creek/French mine pit. Extensive clearing was required to expose a continuous section, so descriptions were made in a number of gulleys, and incorporated into a composite section (Figure 8).

The thickest sequences lie in a broad bedrock low (Plate 4), with 30 m of surficial sediment overlying an undulating surface of soft and highly weathered bedrock. Bedrock outcrops to the surface on the mine pit wall 350 m north of the described section, but constitutes less than 3 m of the 30-m-high wall at the base of the bedrock low. The lowest surficial unit exposed is a discontinuous bed of well-sorted sand, silt, and clay up to 50 cm thick. It consists mostly of planar-laminated fine sand and silt, draping an uneven bedrock surface. Some indistinct ripple lamination is also present. Rare coarse clasts up to 3 cm diameter are found. This unit is overlain by a diamicton, 1 to 1.2 m thick, very dark greyish-brown to brown (10YR 3/2, 10YR 5/3, moist), containing a single small sand lens. The basal contact is planar and dips to the east at 5 to 10°. The contact undulates, and clasts from the diamicton appear to be impressed into the underlying unit. The diamicton is in turn overlain by a well-sorted sand and silt bed, 10 to 15 cm thick, having irregular, undulating upper and lower contacts. The bed fines upward from medium sand to fine sand and silt. This is overlain by 15 m of diamicton that varies in colour from dark grey to dark brown (10YR 4/1, 10YR 5/2, 10YR 3/2, moist). The upper 10 m of this unit is marked by a network of reddish-brown and brown bands (10YR 4/3, 5YR 4/4, dry). These bands are 3 to 10 cm thick, vary in thickness laterally, mostly lie flat, and are spaced 0.5 to 1 m apart. They surround thin laminae of sand.

Overlying a covered contact is 9 m of yellowish-red diamicton (5YR 4/6, moist), stonier than underlying diamictons and more consolidated. The southern end of the section lies lower than the northern end, and here the lower dark-grey diamicton is directly overlain by 1 to 2 m of coarse gravel. This unit is very poorly sorted, and contains many boulders and cobbles, having a maximum diameter of 1 m. The gravel is clast supported, roughly horizontally bedded, with a coarse sand to granule matrix. The basal contact is sharp and undulating, but has no lag of coarse clasts. The unit thins to a veneer of cobbles and pebbles where it overlies the yellowish-red diamicton.

Ten clast fabrics were obtained from this section. The majority are weak to moderate girdle distributions, having no consistent mean orientation, typical of debris flows (Boulton, 1971; Lawson, 1979). The exception is the uppermost measurement, which shows a strong south to southwest unimodal distribution (S_1=0.72), and may represent basal deposition either by lodgement or basal melt-out.

Clast lithology shows little consistent vertical variability, and the pebble samples contain between 58 and 80 percent clastics, 15 and 45 percent iron formation, chert and dolomite, and 1 to 9 percent gneiss. Colour differences between diamictons do not seem to reflect major provenance differences.

It is suggested that the diamicton sequences represent deposition in a large subglacial cavity in the lee of the bedrock high, north of the described section. Large volumes of diamicton and meltwater would be released from the base of the ice at the up-ice edge of the cavity, and would flow to fill the topographic low. The conformable interbedding of sorted sediments with diamicton at the base of the section is interpreted as showing deposition of diamictons by debris flow into standing water. The network of banding seen higher in the section may represent sorting at the margins of debris flows by running water. The colouration is likely formed post-depositionally due to oxidation by percolating groundwater. The cavity would be progressively filled, and then disappear, being overridden by flowing ice. As the ice sheet waned, the upper diamicton was deposited by lodgement or basal melt-out. Subsequent meltwater erosion partially removed the upper diamicton cover, leaving gravels directly overlying the debris-flow sequence.

CONCLUSIONS

The detailed ice-flow mapping in this study provides support for the regional ice-flow history proposed by Klassen and Thompson (1987, 1989, *in press*), and suggests that it may

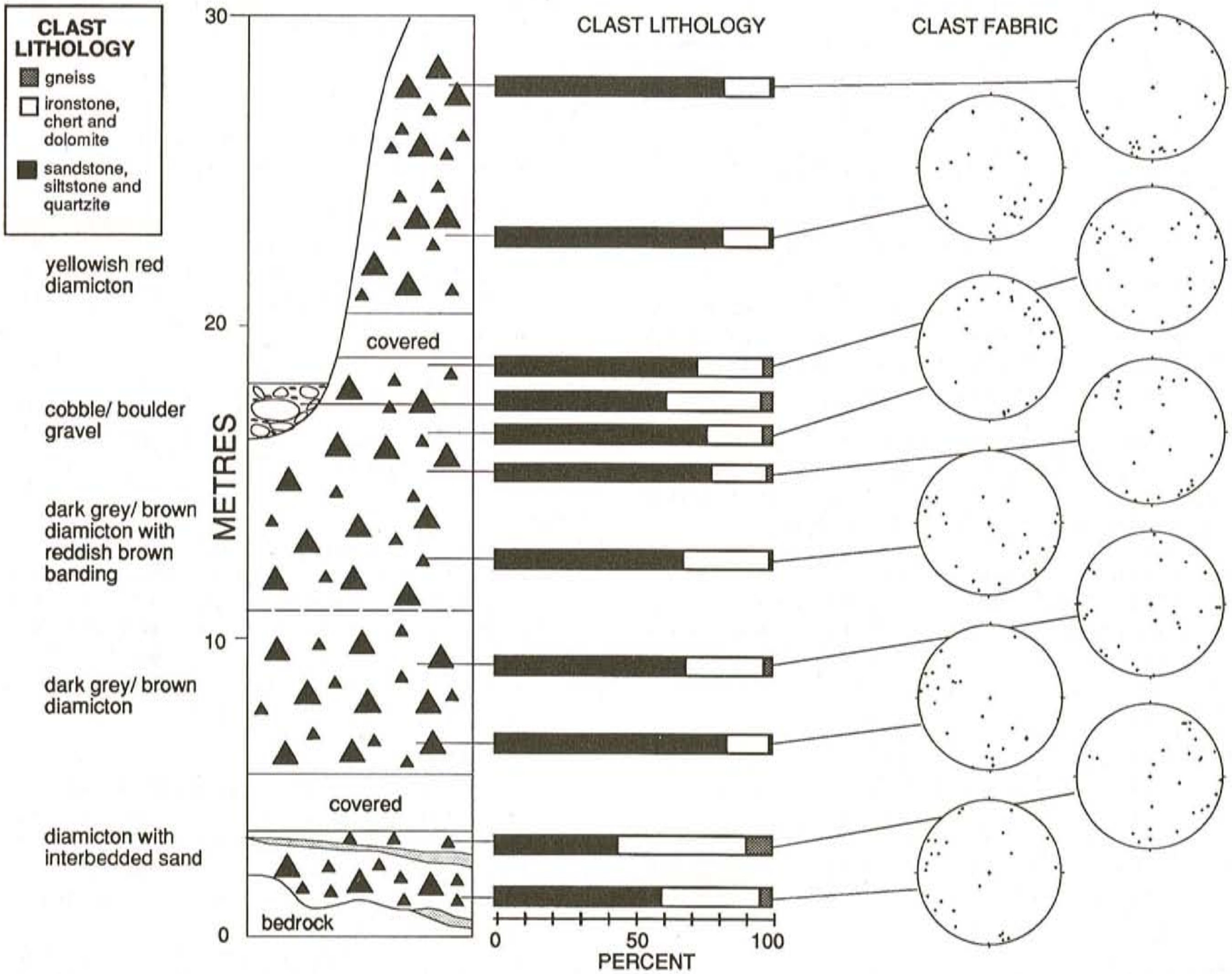

Figure 8. *Composite section diagram, Burnt Creek 2, showing lithology, clast fabrics and clast lithology.*

find application on a local scale. Considerable local topographic variation from regional patterns is apparent in areas of high relief. Detailed striation mapping at the property level is advisable to provide information regarding local flow conditions. Where well-oriented clast fabrics are found, they suggest northwest–southeast flow, supporting the contention of Kirby (1961) that a later northeast flow had little effect on deposited sediment.

The landscape in the study area is dominantly one of glacial and meltwater erosion, rather than deposition, which results in problems when applying conventional drift-exploration methods. Over much of the area, the effects of meltwater erosion and deposition dominate, with glacial processes having little effect on the surface sediment cover. There is evidence that the meltwater flows affecting the area were able to transport clasts up to boulder size. Therefore, both glacial and glaciofluvial models of dispersal have to be considered. Glacial dispersal models in Labrador have been described by Klassen and Thompson (1989, *in press*) and Batterson (1989a, b). Glaciofluvial models are less well understood, but in general, transport distances should be greater than in glacial systems, and matrix geochemistry harder to interpret (Perttunen, 1989). Flow directions, and likely source directions, can be interpreted from mapping of geomorphology and measurement of orientations of sedimentary structures within the sediments.

Thick sections exposed in mine pits are interpreted as showing the effects of the last glacial event to affect the area, rather than a long glacial history. Exposure in the mine pits was poor, however, and the preservation of soft bedrock suggests that preglacial or interglacial sediments may also be present. The stratigraphy based on diamicton coloration outlined by Klassen and Thompson (1987) was not identified in the present study, and it is suggested here that the surface diamicton shows no consistent colour, but reflects the erodibility and colour of local bedrock.

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