Current Research (1986) Newfoundland Department of Mines and Energy, Mineral Development Division, Report 86-1, pages 271-282

QUATERNARY MAPPING AND EXPLORATION IN THE BELLBURNS MAP AREA (12 I/5 and 6) AND TRAPPER PROSPECT AREAS

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ABSTRACT

The Bellburns map area is located on the Northern Peninsula and hosts several zinc deposits, including the Trapper Prospect. Surficial deposits are divided into six major lithogenetic units: namely 1) bedrock, 2) glacial, 3) glaciolacustrine, 4) glaciofluvial, 5) marine, and 6) organics. Bedrock is best exposed along the coast and the Long Range escarpment. Glacial sediments have very limited exposure and are divided into lodgement and water-lain till facies. Glaciolacustrine sediments occur on the highlands in the central portion of the area, and are interpreted to have been deposited in a glacial lake produced by Laurentide ice from Labrador. Minor deposits of glaciofluvial gravel are found on the floors of the glacially scoured troughs that incise the Long Range escarpment. Marine sediments blanket the area to an elevation of 140 m.

Two glacial events are proposed, an earlier flow of Laurentide ice and a subsequent readvancement of Long Range ice; each event was followed by marine incursions.

Detailed Quaternary exploration was conducted in the Trapper Prospect area. Surficial sediments are water-lain and most of the boulders are transported. Mineralized float was most abundant 0.7 to 0.9 km northwest and west of the prospect, apparently related to the draining of the glacially dammed lake.

INTRODUCTION

During the 1985 field season, regional Quaternary mapping was conducted in the Bellburns (12I/5 and 6) map area, in support of detailed drift prospecting in the vicinity of the Trapper Prospect (Figure 1). The area was selected because it is known to host several mineral deposits, including the Daniel's Harbour zinc mine, and also because of the occurrence of numerous mineralized boulders. The aims of the study were: to define the surficial deposits in terms of their physical properties and spatial distribution; to identify glacial ice flow features; to study, in detail, the high grade mineralized boulders that are located west of the Trapper Prospect, and to determine their depositional environment and possible source area.

The study area extends eastward from the coast to the Long Range Mountains. Accessability was along the Northern Peninsula highway and the moderately extensive network of woods roads in the area. The field program included surficial mapping, soil profile sediment sampling, backhoe test pitting to establish stratigraphic relationships, and dithizone field testing for zinc.

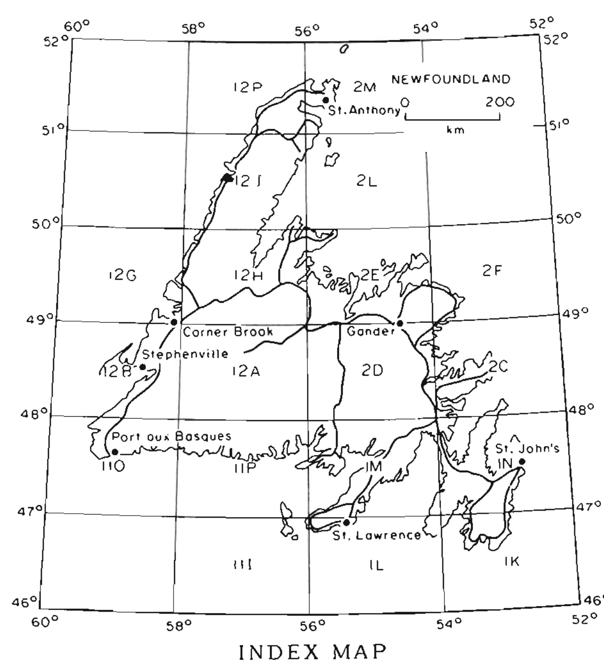


Figure 1: *Location map of Bellburns map area.*

Glacial History

Many researchers, e.g., Murray (1882), Daly (1921), Coleman (1926), Flint (1940), McClintock and Twenhofel (1940), Tanner (1940), Brookes (1969, 1970), Grant (1969a, b) and Prest (1970), have speculated on the glacial history of western Newfoundland. This interest stems from the controversy concerning the glacial history of insular Newfoundland. In particular, the question of whether the island was glaciated by the Labrador sector of the Laurentide ice sheet, or supported independent ice masses has not been completely resolved. For the Northern Peninsula, Grant (1969a, b, 1970, 1972a, b, 1973a, b, 1974, 1975) has proposed the following four phases in the glacial sequence based on regional surficial investigations:

a) During the Wisconsin, Laurentide ice advanced southward from Labrador, impinging onto the lowland areas of the Northern Peninsula and up to 300 m above sea level on the flanks of the Long Range Mountains. The limit of the southern extent of this ice is placed at St. John Bay, north of Port au Choix.

b) Subsequent to retreat, which was mainly by ice calving, marine levels reached a maximum of approximately 90 m higher than present day sea levels.

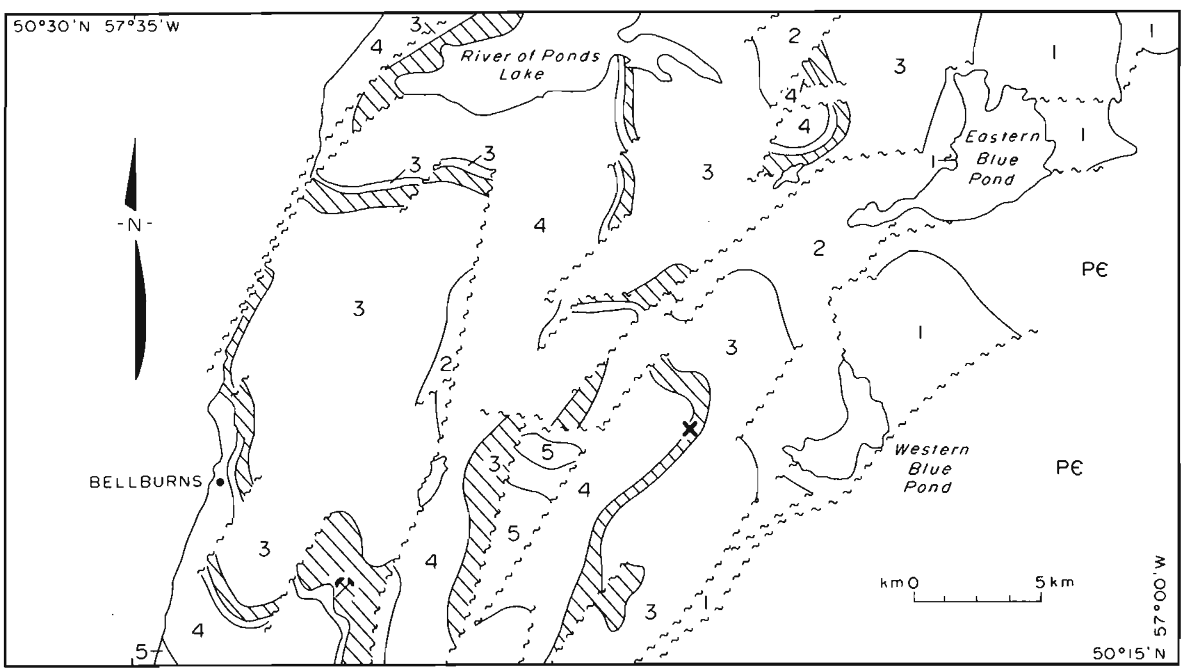
c) Readvance of Long Range ice during the Late Wisconsin to the lowlands, including 20 km beyond the present coastline.

d) Finally, retreat of the Long Range piedmont glaciers by ice calving into deep marine water.

Bedrock Geology

The Long Range Mountains are primarily composed of Grenvillian gneisses and granites. Overlying the Precambrian basement (Figure 1) are fault-bounded Cambrian rocks of the Labrador Group (Knight, 1977, 1978, 1980, 1985; Knight and Boyce, 1984). Unit 1 consists of the Bradore Formation, a red arkosic sandstone; the Forteau Formation, composed of pink, crystalline dolomite and gray shaly fossiliferous limestone, black shales and oolitic limestones; and the Hawke Bay Formation, which comprises white quartz-rich sandstone.

The Port au Port Group (Unit 2) comprises the Petit Jardin and March Point formations of middle to late Cambrian age. The March Point Formation has very limited exposure in the study area, and is composed of dark-gray shales and yellow weathering gray dolostones. The Petit Jardin Formation is much more extensive and consists primarily of stromatolitic, wavy laminated, buff weathering dolostones.



LEGEND

ORDOVICIAN

5 Goose Tickle Formation and unnamed rocks.

4 Table Head Group: Table Cove, Black Cove, Table Point formations.

3 St. George Group: Watts Bight, Boat Harbour, Catoche, Aguathuna formations.

CAMBRIAN

2 Port au Port Group: March Point, Petit Jardin formations.

1 Labrador Group: Bradore, Forteau, Hawke Bay formations.

PRECAMBRIAN

Grenville basement: granite and granite gneiss.

Figure 2: *Generalized bedrock geology of the Bellburns (12I/6 and 5) map area (modified from Knight 1985). Cross-hatched areas represent zones of potential mineralization in diagenetic dolostone.*

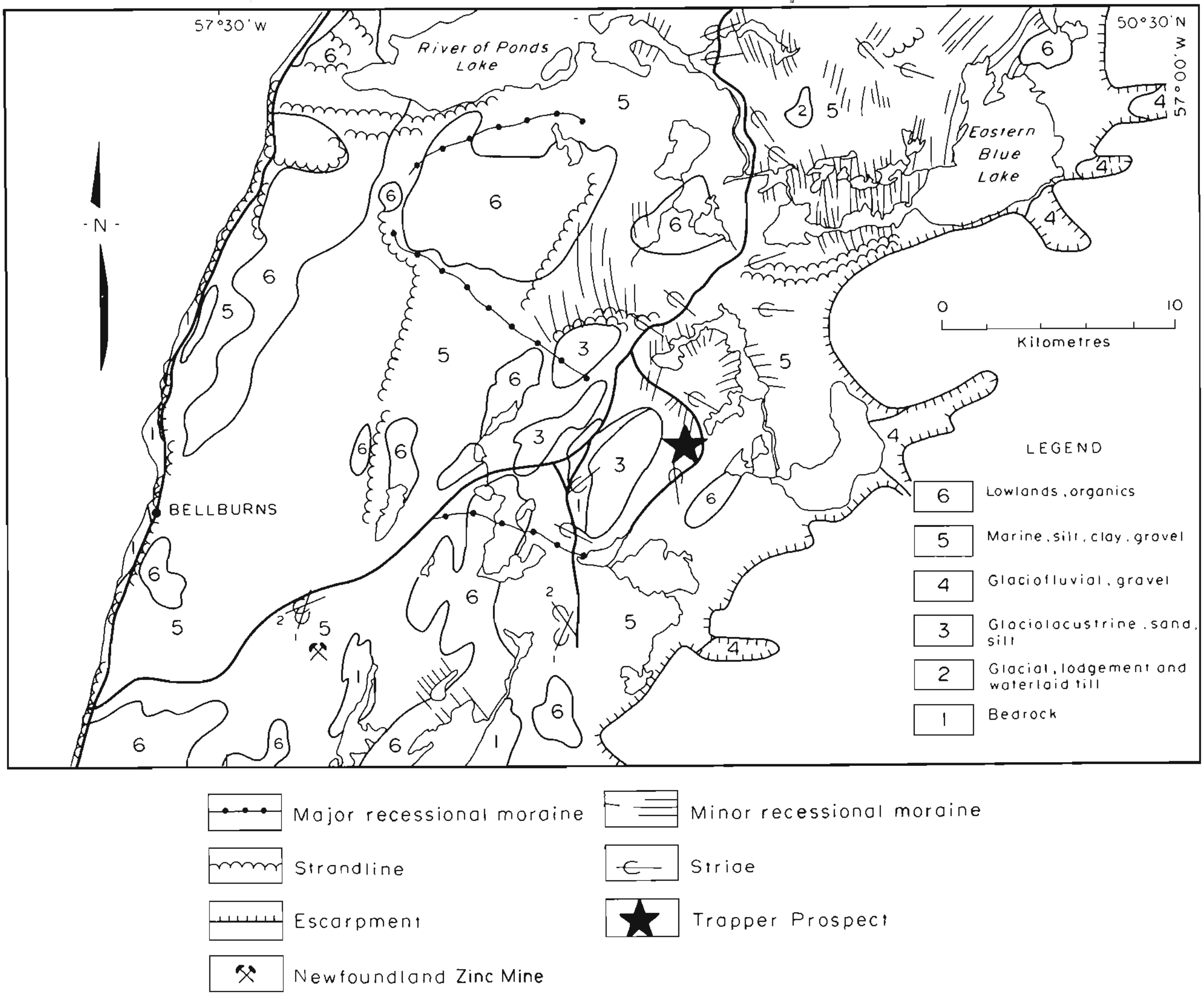


Figure 3: *Surficial geology of the Bellburns study area.*

The Lower Ordovician St. George Group (Unit 3) is divided into the Watts Bight, Boat Harbour, Catoche and Aguathuna formations. The basal Watts Bight Formation is dark gray to black, fine to medium grained, mottled, cherty dolostone. Interbedded limestones, dolostones, shaly limestones and diagenetic dolostones characterize the poorly exposed Boat Harbour Formation. The distinctive Catoche Formation is composed of well bedded, gray limestone containing extensive dolomitic burrow-mottling. In the upper portion, the limestone is replaced by light to dark-gray, vuggy, diagenetic dolostone, commonly referred to as psuedobreccia, which hosts zinc mineralization. Overlying the Catoche Formation are the microcrystalline dolostones of the Aguathuna Formation.

The Middle Ordovician Table Head Group (Unit 4) comprises the Table Point Formation, a blue-gray, fossiliferous, well bedded limestone and laminated dolostone; the Table Cove Formation, a thinly bedded, nodular, lime mudstone containing shale interbeds; and black shales of the Black Cove Formation. Interbedded green sandstones and black shales define the Goose Tickle Formation (Unit 5), a wedge-shaped unit that extends from Brian's Pond northward to the central part of the study area.

REGIONAL QUATERNARY MAPPING

Regional Quaternary work at 1:50,000 scale was conducted over the study area and involved surficial mapping, determining ice flow directions and establishing stratigraphic relationships.

Coverage of the study area was obtained by road, helicopter and boat traverses. During the regional mapping program, 164 suites were visited and 350 samples collected. At each location, landform information, such as landform type, drainage and vegetation type, was recorded. As well as landform information, detailed sedimentological discriptions on deposit type, soil horizon, texture, compaction, structure, fissility, sorting and nature of the contact with other units were noted. Matrix samples (material less than 4 mm), usually from the C horizon, were collected from each unit encountered. Soil profile samples of the B, BC and C horizons were taken consistently over the study area, to establish soil-dependant geochemical trends. Where the sediment contained

Table 1. Indicator pebble classification for the Bellburns study area.

Rock Type Code No.	Description	Map Unit	Formation
05	Sandstone	5	Goose Tickle
95	Very light-gray limestone, clacite spar	4	Table Point
90	Dark-gray, fossiliferous limestone	4(3)	Table Point (Catoche)
96	Cherty limestone, chert	3(4)	Catoche (Table Point)
89	Dark-gray limestone containing dolomite seams	3	Catoche
98	Cherty dolostone	3	Catoche (Aguathuna)
94	Laminated dolostone	3	Aguathuna (Boat Harbour)
97	Diagenetic, dark, vuggy dolostone	3d,3	Catoche (Watts Bight)
93	White, sparry, veiny dolostone	3d	Catoche
92	Pseudobreccia	3d	Catoche
99	Mineralized pseudobreccia	3d	Catoche
91	White, vuggy, microcrystaline dolostone	2(3)	Petit Jardin (Aguathuna)
12	Oolitic limestone with brown weathering rind	1	Forteau
01	Gray to black shale	1	Forteau (Goose Tickle)
32	White quartzite	1	Hawke Bay
22	Intrusives	PE	N/A
50	Weathered pebbles	N/A	N/A

a substantial number of pebble-size clasts, a population of approximately 100 was collected for lithological identification. Boulders were also identified and described, including observations on the degree of rounding, color, grain size, and the type of mineralization. Generally, 10 to 20 boulders were examined at each locality and samples were collected from mineralized float.

Specific indicator rock types, which included representative samples from each major rock unit (Figure 2; Table 1), were identified for the purpose of aiding in the determination of transport directions. The rock types selected represent facies within a rock unit that are unique to that unit, or can be correlated with the rock unit with a reasonable degree of certainty. Pebble collections from surficial sediments were then classified into the selected lithological catagories.

Overall, the area is generally a gently undulating carbonate terrane, locally exhibiting karstic features. It is covered by extensive areas of bog, particularly along the coast. Marine sediments, commonly fossiliferous, dominate the surficial deposits, and there is evidence of marine reworking of the other surficial deposits across most of the area (Figure 3).

Major glacial features in the study area include three large moraines, aligned perpendicular to the coast, located in the central region of the study area. In addition, there are well developed cross-valley moraines associated with the major valleys extending from the Long Range Mountains. These moraines have minor relief, are closely and regularly spaced, and can be seen clearly on aerial photographs. The cross-valley moraines extend approximately 10 km from the escarpment and are related to ice that originated from the Long Range Mountains.

The surficial geology has been divided into six mappable units: bedrock, glacial sediments (lodgement and water-lain till facies), glaciolacustrine deposits, glaciofluvial deposits, marine deposits, and organics.

Bedrock (Unit 1)

The best bedrock exposures occur along most of the coastline and on the escarpment and highlands of the Long Range Mountains. Topographic highs are generally structurally controlled, and bedrock is generally exposed along the flanks. Isolated bedrock outcrops are also found in lowland areas, swamps and bogs. However, there is usually 1 to 2 m of surficial sediments overlying bedrock.

Natural bedrock exposures are rounded and weathered, and nearly all evidence of glacial grooves or striations is obliterated. Fresh bedrock surfaces, exposed along logging roads, provide fresh unweathered outcrops where polished and striated surfaces may be observed.

Glacial Sediments (Unit 2)

Glacial sediments have limited exposure (less than 10 percent) in the study area, however, they were encountered in numerous hand-dug and backhoe pits. Two facies were identified:

a) An unsorted, unstratified, brownish-gray, overconsolidated diamicton is interpreted as lodgement till (Plate 1). This till facies contains subrounded to subangular clasts, which are commonly striated and of local provenance. The overall structure is compact, with an average of 46.6 percent silt and clay content. This facies is assumed to have been deposited by ice from the Long Range Mountains, and is the latest glacial event that occurred during the Late Wisconsin.

b) A more common facies is an underconsolidated, poorly sorted, sandy diamicton. This facies locally contains evidence of sorting, e.g. sand lenses, and is interpreted as representing a water-lain till, deposited at the ice-water interface. Difficulty was

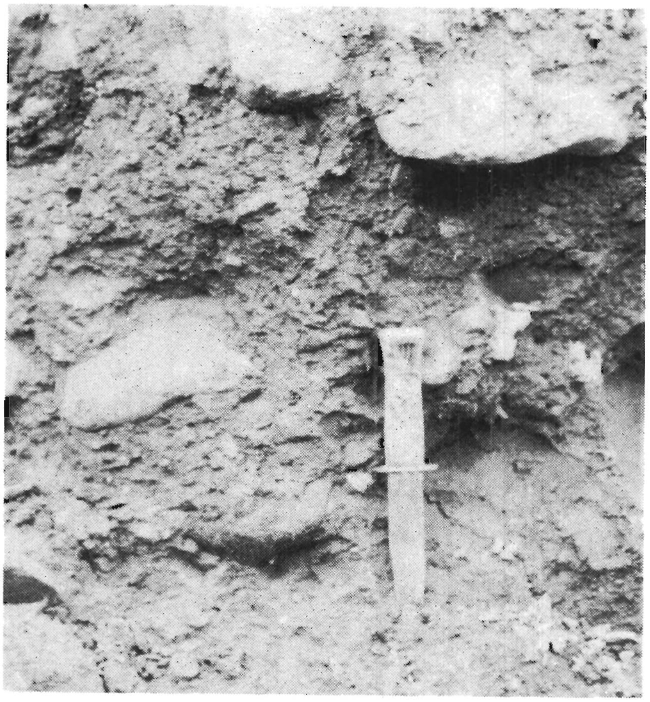


Plate 1: *Overconsolidated, fissile, unsorted, unstratified, silty diamicton containing subrounded to subangular clasts.*

encountered in distinguishing this facies from poorly sorted marine sediments. Generally, if the sediment exhibits a very wide range of grain size, and contains no marine fauna, it is defined as water-lain till. However, there is a gradation from ice to marine environments, including ice-rafted sediments, which make the determination subjective.

Glaciolacustrine Sediments (Unit 3)

Moderate to well sorted, locally stratifical, silty sand to sand deposits were identified on three highland areas near the Trapper Prospect in the central part of the map area. These sediments occur above the known marine limit (Grant, 1972c) up to 200 m above present sea level. Topography of the area is gently rolling to flat. Sediments vary in thickness from 40 to 90 cm and grade into a poorly sorted, pebbly diamicton. The well sorted sands appear to have been water-lain. This, and the lack of any marine evidence, suggests the sediments were deposited in a glacially dammed lake.

Glaciofluvial Deposits (Unit 4)

The glacially scoured troughs that cut the face of the Long Range Mountains are generally floored by glaciofluvial and fluvial sediments. Five meters of well sorted, well stratified, sandy pebble gravel occur in a stream cut in the valley that enters Eastern Blue Pond. Other glaciofluvial deposits were identified between the central highlands west of the Trapper Prospect and southwest of Big Northeast Pond (Plate 2). These deposits probably represent abandoned drainage ways.

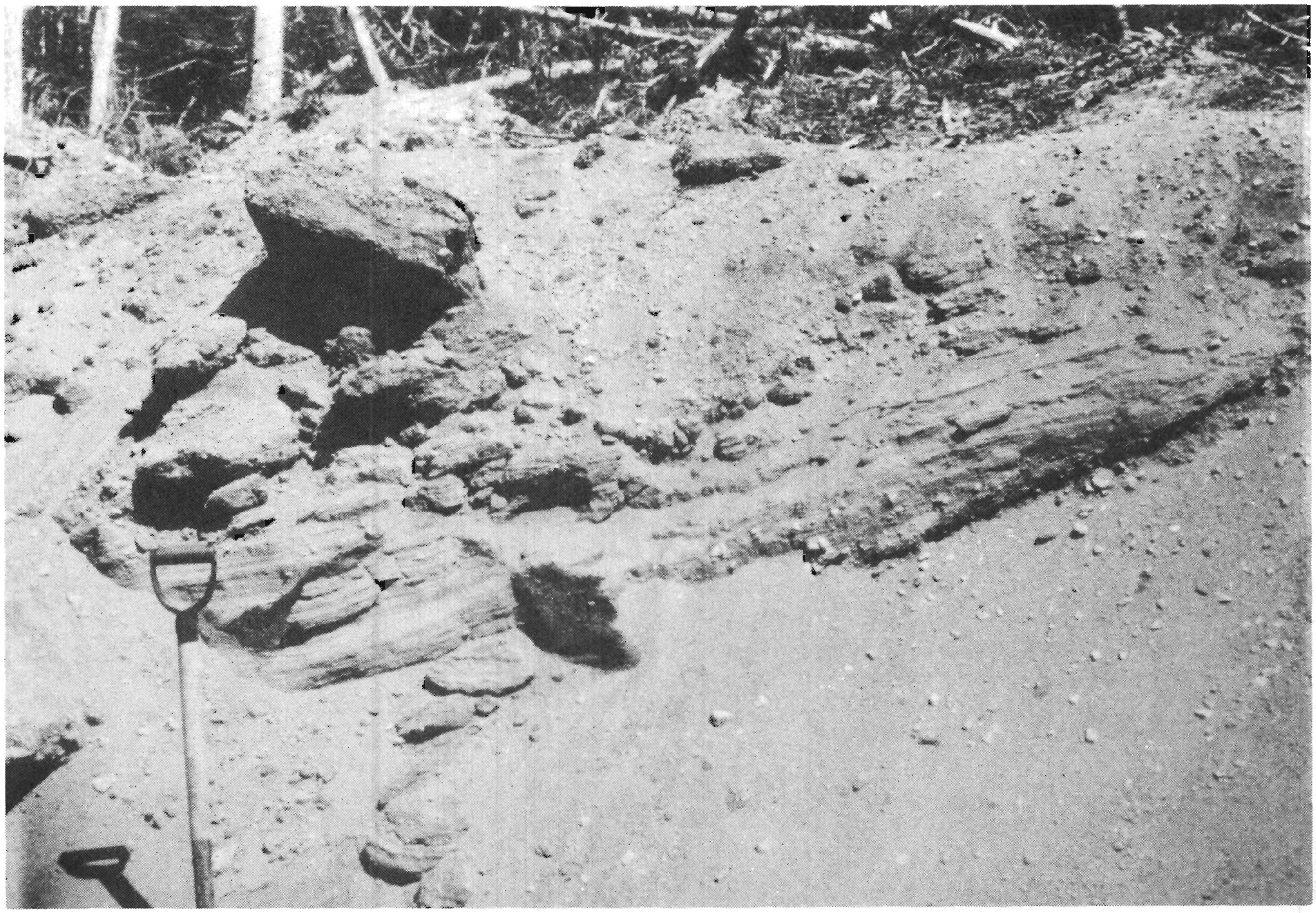


Plate 2: *Well stratified, well sorted pebbly sand in glaciofluvial sediments (Unit 4).*

Plate 3: *Quaternary marine shell bed in abandoned beach deposit.*

Marine Sediments (Unit 5)

Marine sediments make up the majority of the surficial sediments in the study area, extending from the coast to the base of the Long Range Mountains. The sediments exhibit enormous variability over short distances. Grant (1975) also found it difficult to differentiate the marine facies from glacial deposits. Generally marine sediments are quite coarse grained, contain a large pebble fraction, and have a silty sandy matrix (32.09 percent silt and clay). These sediments are well to poorly sorted and are generally massive. The plutonic component of the pebble fraction in the marine sediments appears to be enriched compared to the tills. At a locality 1 km north of the Daniel's Harbour mine site, the clasts averaged 21 percent intrusives compared to 10 percent in the underlying lodgement till.

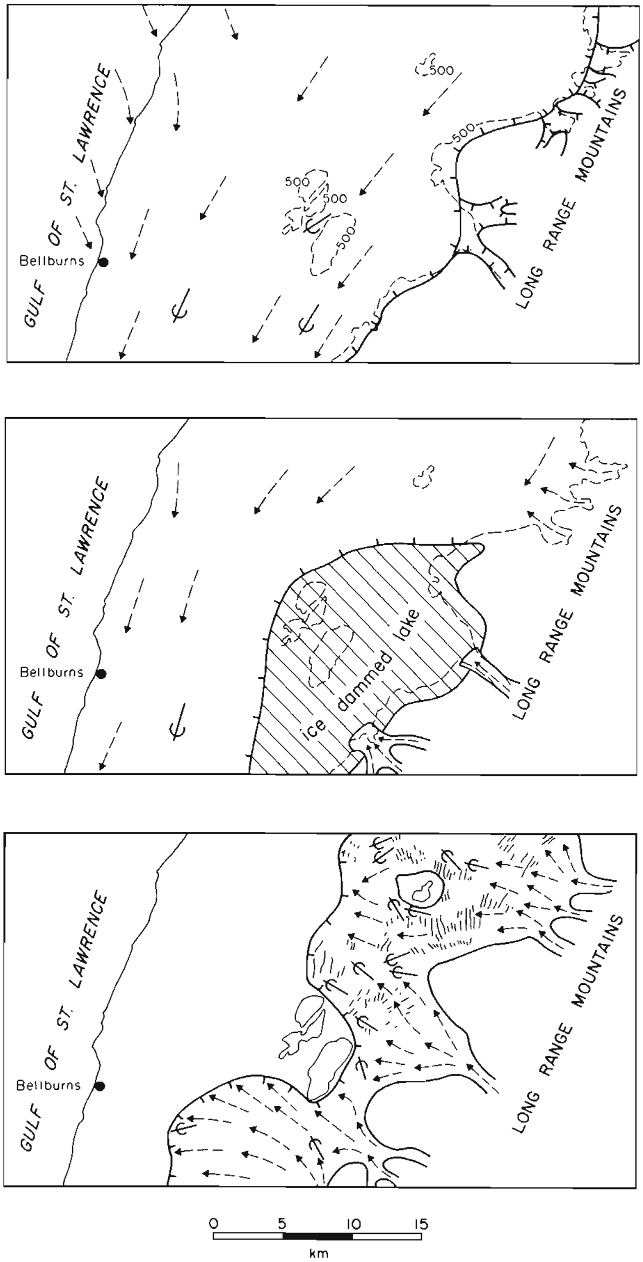
The sediments commonly contain shell debris and shells were collected from a total of 17 localities, 16 of which were not previously sampled. Shell debris (Plate 3) was collected up to an elevation of 138.5 m, 38 m higher than the marine limit defined by Grant (1972c). Buried marine sediments were encountered 1.2 km south of Bellburns Pond in a backhoe trench. Here, fossiliferous pebbly silt is overlain by silty, overconsolidated, lodgement till, which in turn is overlain by moderately sorted underconsolidated marine sediments. This indicates a marine incursion prior to the last glacial event and a second marine incursion following deglaciation. Marine fossils in the lowest unit were collected for dating.

Organics (Unit 6)

Extensive bogs and marshlands are situated along the coast, south of River of Ponds Lake, and northward from Brian's Pond to Cobo's Pond. Although not as continuous, bogs are common in the coastal lowland plains. Organic sediments usually overlie nearshore marine deposits or bedrock.

Glacial Flow Patterns

Two glacial ice flow patterns were identified in the study area. Evidence for the two events includes striae and moraine systems (Figure 3). Striae were observed at ten localities and two glacial ice flow directions were determined. The earliest flow, to the southwest at 210, was generally parallel to the coastline. Straie related to this flow event occur 0.6 km northeast of Mike Lake and 2 km southwest of Big North East Pond. The most prevalent and dominant set of striae is the western trend (250 to 290), related to the last glacial event that originated from the Long Range Mountains.



<u>Phase I.</u> Labrador ice being deflected by the Long Range Mountains, down the Northern Peninsula.

<u>Phase II.</u> During deglaciation, a glacially dammed lake is created between the ice margin, which is being topographically controlled, and the Long Range escarpment. There is a significant amount of calving from the valley glaciers into the lake. This is considered to be a relatively short lived event.

<u>Phase III.</u> Late Wisconsin readvance of the Long Range valley glaciers onto the coastal plain. Flow is topographically controlled by relief on the plain. This is considered to have been a relatively minor event.

Figure 4: *Proposed model of deposition.*

Two moraine systems occur in the area—cross-valley moraines that are relatively small and much larger moraines orientated perpendicular to the coastline. The cross-valley moraines are related to glaciers that originated in the Long Range Mountains. The origin of the other larger moraines is equivocal. They either represent recessional moraines of ice (presumably Labrador ice) that retreated northward up the peninsula, or they are interlobate moraines produced by coalescing glaciers from the Long Range Mountains (Grant, 1969b).

Evidence as to the origin of these moraines is generally lacking and any interpretation is speculative. However, if the cross-valley moraines are taken to represent the extent of the ice from the Long Range Mountains, then the two types of moraines do not appear to be related to the same glacial event. The large moraines and the southwest straie could suggest that there was an earlier glacial event with ice direction parallel to the coast, i.e., the Laurentide ice sheet from Labrador crossed over the Strait of Belle Isle and was channeled down the coastline of the Northern Peninsula.

Model of Deposition

A tentative model of deposition is proposed, which attempts to include all the observed information from the study area (Figure 4). There are several characteristics of the surficial geology which must be considered:

1) Evidence of ice flow indicates two flow directions, an early direction parallel to the Northern Peninsula (210), followed by ice advancing toward the coast (250-290) from the Long Range Mountains.

2) Buried marine sediments, 1 km northeast of Mike Lake, indicate marine events prior to the last glacial event.

3) Distinctive and abundant cross-valley moraines can be traced from near the foot of the Long Range Mountains westward. The distribution of these moraines is topographically controlled; thus it appears that the ice was relatively thin and of limited extent.

4) Marine limit in the area appears to have been 140 to 150 m above present day sea level, and marine sediments and erosion have masked or subdued most of the glacial features in the area.

5) Water-lain sediments occur above known marine limits in the central portion of the study area.

When considering the information available, it appears there are two identifiable glacial events, an early flow down the peninsula, then an ice advance from the Long Range Mountains. Each event was followed by marine incursion. It appears that the earlier glacial event was probably Laurentide ice from Labrador that was diverted southward by the Long Range Mountains. As the ice retreated, probably by calving into marine waters, large moraines were deposited perpendicular to the coast. Some time later, ice readvanced from the valley glaciers of the Long Range Mountans, depositing cross-valley moraines. This readvance was realtively minor, ice being quite thin and of limited extent. Marine levels following deglaciation mask virtually all of the topography.

The water-lain silts above known marine limits must have been deposited in a glacially dammed lake. Considering the relatively local extent of the Long Range ice advance, it seems unlikely that the glaciers could have coalesced west of the central highlands. Therefore, it is assumed that the earlier Labradorian ice formed a glacially dammed lake during retreat, where the silts and sands were deposited (phase II of Figure 4).

QUATERNARY EXPLORATION PROGRAM

Exploration in 1963 by Pegg (1964) for Leitch Gold Mines Ltd. led to the discovery of the Daniel's Harbour zinc deposit. During the same program, high- and low-grade zinc float of unknown origin was discovered approximately 30 km northeast of the Daniel's Harbour deposit. This became known as the Trapper Prospect. Tecam Exploration Ltd. (1976) and Lane (1980) conducted follow-up exploration with geological mapping, diamond drilling and soil geochemistry. Mineralization exposed at the bedrock surface was determined by drilling to be a 0.3 m thick bed of sphalerite-rich pseudobreccia. The mineralized float previously identified, which trends westward from the mineralized bedrock, was assumed to be glacially deposited. The boulders are considered to have originated from the mineralized outcrop, and represent the eroded remains of the deposit. No other sources were considered.

A detailed Quaternary exploration program was conducted in the Trapper Prospect area. Lines were run by chain and compass, with station sites every 250 m. Hand-dug pits were excavated to an average depth of 70 to 80 cm, and sediment matrix and clast samples were collected from the C horizon. Soil profile samples were also collected at several stations. Boulders were identified and sampled if they contained mineralization. A skidder-mounted backhoe was also employed in the Trapper Prospect area to provide better exposure of sediments and to establish stratigraphic relationships. A total of 18 backhoe pits were dug, and 77 samples were collected.

The study area includes the Trapper Prospect and extends across the topographic high 1 km north of Little North East Pond. Mineralized bedrock occurs at the base of the highland, whereas the mineralized float is primarily found 60 m higher on the eastern flanks of a prominent ridge (Figure 5). Float had been identified (Pegg, 1964) from the bottom of this ridge, westward for 2 km. During the past field season, several additional mineralized boulders were located and 25 were sampled. The majority of the mineralized boulders are concentrated on the flank of the ridge, covering an area 1 km wide that extends 0.5 km west of the Trapper Prospect.

During detailed mapping five surficial units were identified (Figure 5). Unit 1 consists of sand, pebbly sand and gravel deposits below the marine limit. These sediments are well oxidized in the B horizon and are generally well to moderately well sorted. Genetically, they appear to be related to marine deposition, although no marine shells were found in the area. The Trapper Prospect is located in a low-lying area within this marine unit. Surficial sediments over the prospect are thin (less than 10 cm) and consist of a fine sand with a high organic content.

Unit 2 comprises lowland bog and swampy areas. A large area of marshland extends along the base of the hill on the eastern side. Sediments are organic, and range in thickness from 20 cm to 1 m.

Along the eastern flank of the hill, an area of boulder concentration was identified (Unit 3). Pavements of very well rounded psuedobreccia boulders (Plate 4), many of them mineralized, occur 0.1 km northwest of the Trapper Prospect. Although the majority of boulders are rounded, several very large (diameter greater than 1 m), angular to subangular, mineralized boulders occur 0.9 km west of the prospect. Well sorted sand and pebbly sand are usually developed between and beneath the boulders.

Fine sand and silts containing minor pebbles (Unit 4) occur above a known marine limit of 140 m. This unit was found in the central portion of the area and covered the highest elevations. Generally, the sediments are well sorted, moderately compact and grade into a very poorly sorted, sandy, pebbly diamicton. The silt and sand vary in thickness from 0.30 to 0.90 m with an average of 0.70 m. Since the sediments

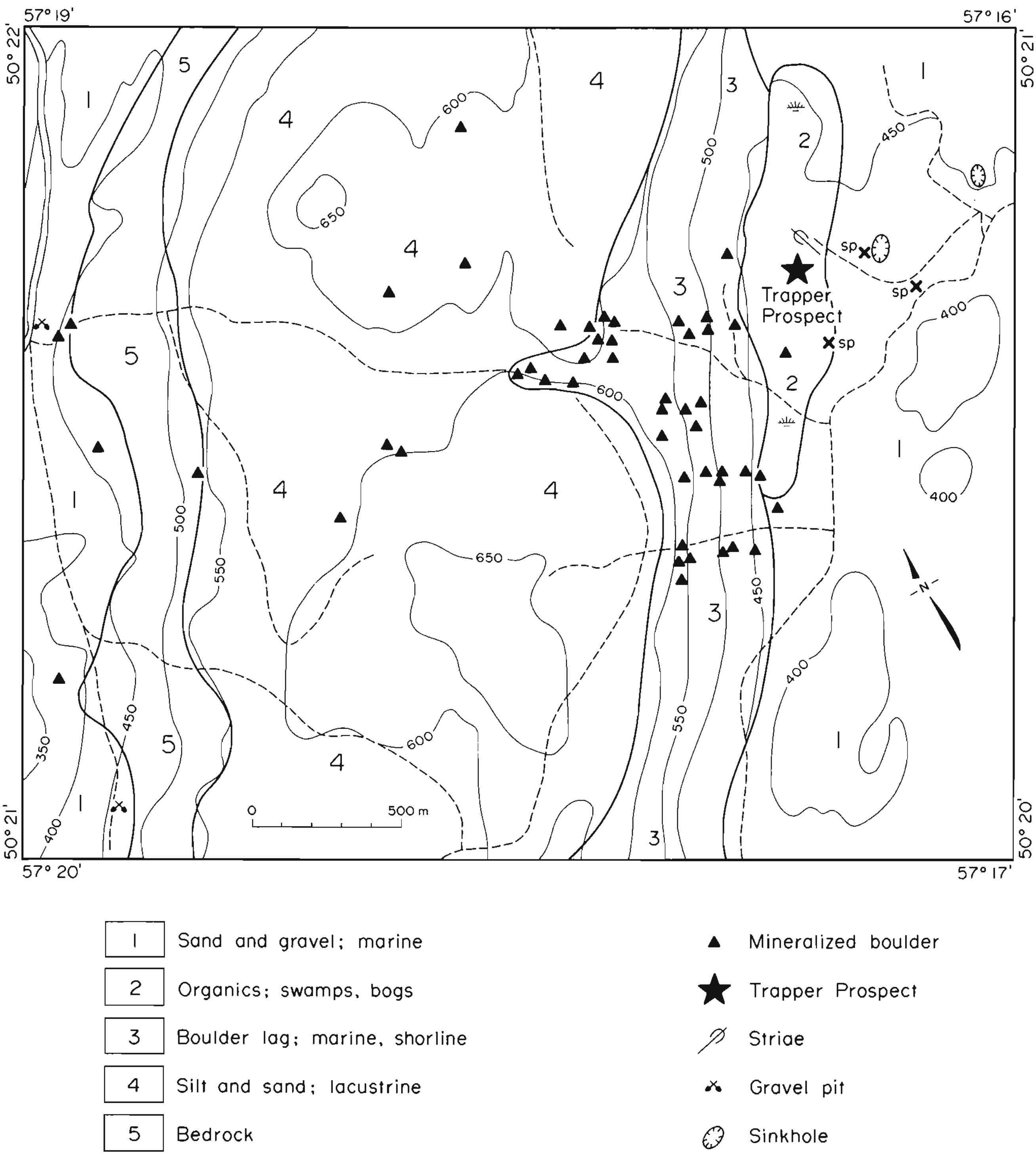


Figure 5: *Surficial deposits and mineralized boulders in the Trapper Prospect study area.*

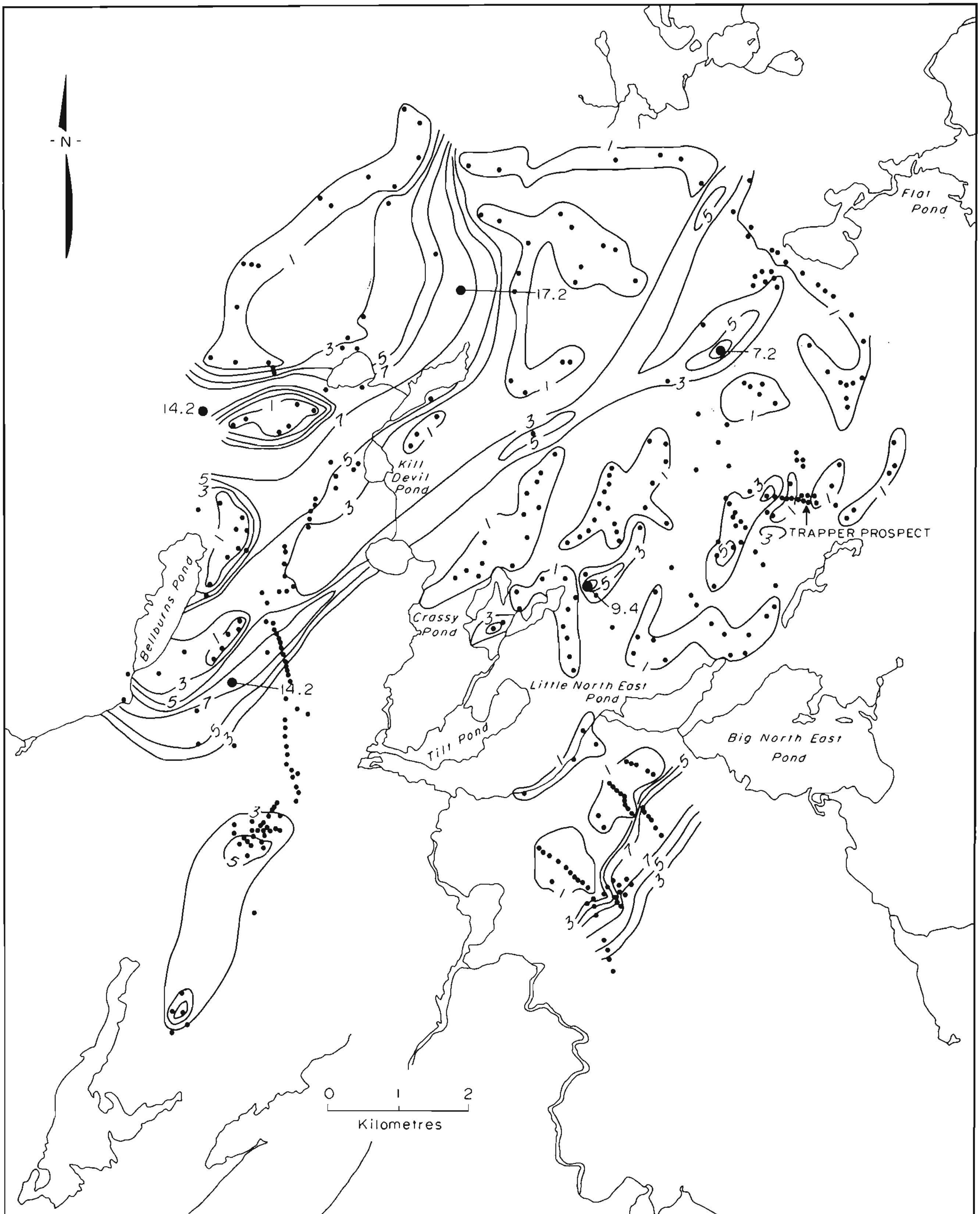


Figure 6: *Drift thicknesses in the Bellburns Pond - Trapper Prospect area; spot thicknesses are included.*

Plate 4: *Very well rounded pseudobreccia boulders; many are mineralized in the Trapper Prospect area.*

are water-lain and non-marine, and grade into a diamicton, they are interpreted as glaciolacustrine, and grade into a flow or water-lain till.

Bedrock (Unit 5) is exposed along the western side of the highland, covered in places by a thin veneer of sand.

Drift Thickness

Overburden thicknesses were compiled for the Trapper Prospect area from drillhole information in assessment files (Figure 6). To correct for casing, 1 m was subtracted from the recorded thickness.

Surficial sediments vary from thin patches of marine sediments of less than 10 cm to areas of buried valleys with over 17.2 m of material. Two major buried-valley systems were identified in the preliminary assessment of drillhole data in the Trapper Prospect area. The largest system has a maximum sediment thickness of 17.2 m, with an average thickness of greater than 7 m along its entire traced length. The second system is quite linear and appears to mark the trace of a fault zone; the greatest sediment thickness occurs near Bellburns Pond.

Future Research

Sediment geochemistry and grain size analyses of the samples are ongoing. The use of the various sediments will be assessed in terms of an exploration medium. Mineralized boulders will be analyzed and the type of mineralization will be compared to the mineralization at the Trapper Prospect, in an attempt to determine the source of the boulders.

ACKNOWLEDGEMENTS

Lloyd St. Croix, Sharon Scott and Greg Jesperson were very capable, cheerful and patient field assistants, and were sincerely interested in the project and its successful completion. Thank-you to the residents of Portland Creek and Daniel's Harbour for their hospitality and help, especially Hughie Wentzell, Freda Wentzell and Rhoda House. Newfoundland Zinc Mines and Teck Exploration were always very helpful, and particular appreciation is extended to Roland Crossby and Jerry O'Connell. The manuscript was critically reviewed and improved by Martin Batterson, Doug Vanderveer, Byron Sparkes and Dan Bragg.

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