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QUATERNARY MAPPING–LA POILE (110/9) AND LA POILE RIVER (110/16) MAP AREAS, SOUTHWESTERN NEWFOUNDLAND

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ABSTRACT

Mapping was conducted during 1986 in the La Poile (110/9) and La Poile River (110/16) map areas of southwestern Newfoundland. Five hundred and thirty matrix samples were collected from the 'C' soil horizon in lodgement and melt-out till facies. Samples were obtained from flutes, crag and tail hills, ramps, and hummocks. A representative pebble fraction was obtained at 150 sites and matched to bedrock map units. Quaternary sediments are divided into six units: (1) colluvium, (2) alluvium, (3) glaciofluvial, (4) hummocky deposits, (5) bouldery till veneer, and (6) lineated till forms. Ice flow in the study area was to the south (170–180°) and extended to at least the coast. Transport distance of pebble-size clasts found in flutes is probably not more than 10 km. Analyses of the particle size, pebble types and geochemical data are on-going, and will be used to further characterize and define the various deposit types.

INTRODUCTION

During the 1986 field season, Quaternary mapping was conducted in the La Poile (110/9) and La Poile River (110/16) map areas (Figure 1). This project is a continuation of the provincially funded Quaternary Mapping Program, designed to provide information on glacial dispersal, distribution of glacigenic sediments, and till geochemistry in support of mineral exploration.

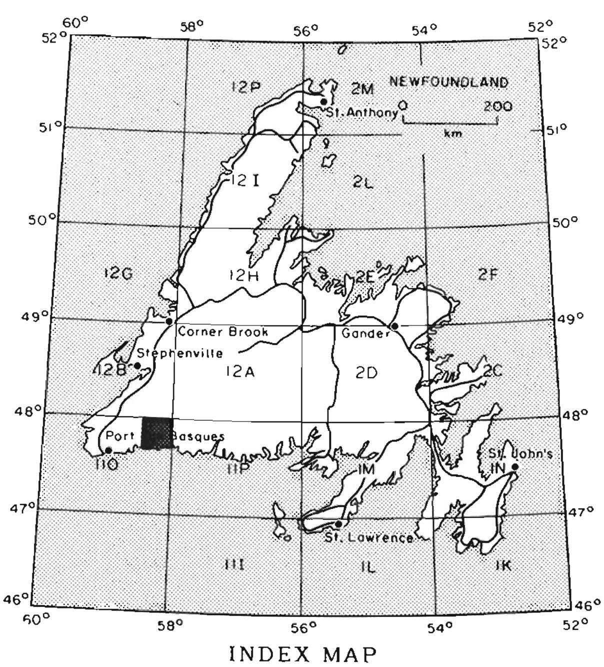

Figure 1: *Location of field area.*

Geological Setting

The La Poile and La Poile River map areas (Figure 2) are located in the southwestern part of the eastern crystalline belt (Gander Zone) of the Newfoundland Appalachians (Chorlton, 1978, 1980). The study area is mainly underlain by three metavolcanic and metasedimentary units: the Bay du Nord Group (Unit 3), the La Poile Group (Unit 4)—hosting the Hope Brook gold deposit, and the Keepings Gneiss (Unit 1). These units are intruded by several generations of granitoid rocks, the most prominent of which are the Rose Blanche Granite (Unit 9), the La Poile Batholith (Unit 12) and the Chetwynd Granite (Unit 15). All units were affected by east-northeast-trending fault systems, such as the Cape Ray and Bay D'est faults.

Physiography

The study area is within the 'Atlantic Upland' physiographic subdivision of the Canadian Appalachian region (Twenhofel and MacClintock, 1940), and the topography is controlled largely by the relative resistance of rock type and the east-northeast-trending structural grain.

The northwestern part of the area, west of La Poile River and Bunker Hill Brook, is characterized by a gently rolling upland that is underlain mainly by the Rose Blanche Granite. This upland surface has an altitude ranging from 520 m in the north to about 200 m in the area west of North Bay. East of La Poile River, the terrain is rugged and irregular, and altitudes range from 450 m in the northeast to about 250 m in the south. This area is underlain by metamorphosed felsic volcanic and sedimentary rocks, amphibolite, gabbro and granitoid intrusions. The Iron Bound intrusives (granite, diorite) at the eastern margin of the map area form the highest hills in the area (593 m), and are a prominent landmark.

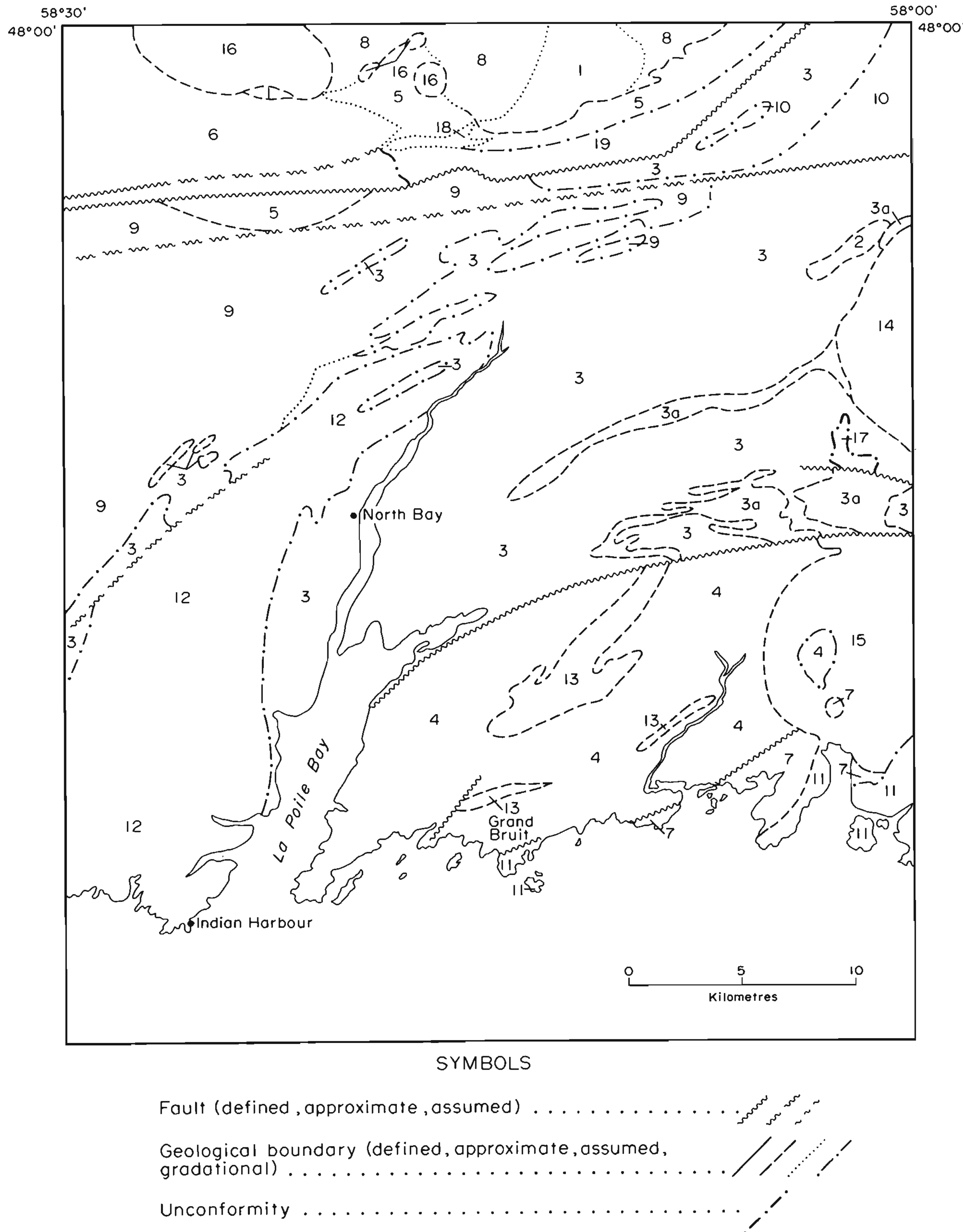

Figure 2: *Generalized geology of field area (after Chorlton, 1978, 1980).*

LEGEND *(Figure 2)*

DEVONIAN

19 *Windsor Point Group*

18 *Nitty Gritty Brook Granite*

17 *Leucogranite*

16 *Leucogranite*

15 *Chetwynd Granite*

14 *Iron Bound Intrusives*

SILURIAN

13 *Hawks Nest Pond Porphyry*

12 *La Poile Batholith*

11 *Otter Point Granite*

10 *Granodiorite, Tonalite, Granite*

9 *Rose Blanche Granite*

SILURIAN OR ORDOVICIAN

8 *Northern Granite*

7 *Cinq Cerf Complex*

6 *Felsic Granitoid Intrusions*

5 *Quartz Gabbro, Diabase, Diorite*

ORDOVICIAN

4 *La Poile Group*

3 *Bay Du Nord Group;* 3a, *Piglet Brook Rhyolite*

2 *Mafic Intrusive Rocks*

1 *Keepings Gneiss*

Field Program

The delineation of landform types by detailed sampling was the main emphasis of the field program. Five hundred and thirty matrix samples were collected from shallow hand-dug pits, on an approximately 2-by-2-km grid, and a representative pebble fraction was obtained at 150 of the 530 sites. Most of the pebble sites were on fluted forms in the east central part of the study area, south of an area of intrusives, which were used as tracers to determine the distances of transport.

A limited number of samples of glaciofluvial and modern alluvial sediments were collected within the lower part of the Cinq Cerf Brook valley to determine the presence of gold from the Chetwynd deposit.

REGIONAL QUATERNARY GEOLOGY

Glacigenic Sediments

Figure 3 summarizes the distribution of glacial sediments within the field area. Units 1 and 2 consist of colluvium and alluvium respectively, and were not extensively sampled or studied in any detail. They are of very limited extent, and their locations were determined solely from airphoto interpretation of landforms. Unit 3 is glaciofluvial sediment, consisting of sand and gravel associated with outwash systems, and is found within most valleys.

The northern part of the study area is characterized by low-relief, hummocky till deposits (Unit 4) and a thin bouldery till veneer (Unit 5). These hummocky deposits (Plate 1) probably owe their origin to both direct subglacial deposition and supraglacial melt out from stagnant ice. Widespread basal deposition of material from a boulder-rich debris zone (due to stagnant ice conditions) can produce a low-relief hummocky terrain since the debris load within this zone would not be uniform in its distribution. The material within these hummocks consists of a sandy till containing many large boulders of predominantly local origin.

Areas of featureless till veneer (Unit 5) occur mainly in the north-central part of the area. This unit is discontinuous and commonly consists of a locally derived boulder lag. The mode of deposition of this material may be similar to that of hummocks, i.e., melt out from stagnant ice.

The most widespread depositional features within the study area are linear forms that parallel regional ice flow (Unit 6, see symbols), and generally occur in areas lacking other sediment types. These features can be subdivided into three major types: flutes, till ramps, and ramped crag and tail hills. The fluted forms are up to 2 km long, 5 to 15 m high, have a relatively flat profile, and are most common in areas of relatively low relief (Plate 2). Till ramps occur up-ice of bedrock knobs and are up to 1.5 km in length, 400 m wide and 30 m in height. Several of the ramped hills also have tails that are up to 1.3 km in length, 200 m wide and 30 m in height.

Many mechanisms of flute formation have been proposed (Galloway, 1956; Boulton, 1971; Smally and Unwin, 1968; Shaw and Freschauf, 1973; Jones, 1982).

All of them involve complex interactions between erosional and depositional processes. It is generally accepted that these features develop in a subglacial environment and require an obstruction in the glacier's path to initiate deposition. This may be an embedded boulder, a bedrock knob, or a lodged block of frozen basal debris. Deposition of material down-ice of such an obstruction may be accomplished by lateral particle migration (plastic deformation) into a low pressure zone within the lee-side cavity of the obstruction, or by subglacial melt out if thawed-bed conditions occur. Lateral particle migration may explain the lack of any other sediment type in areas where the linear forms are most abundant and closely spaced, since the growth of the fluted forms would be at the expense of deposition in the intervening areas. Alternatively, these areas may be devoid of sediment due to erosion or nondeposition.

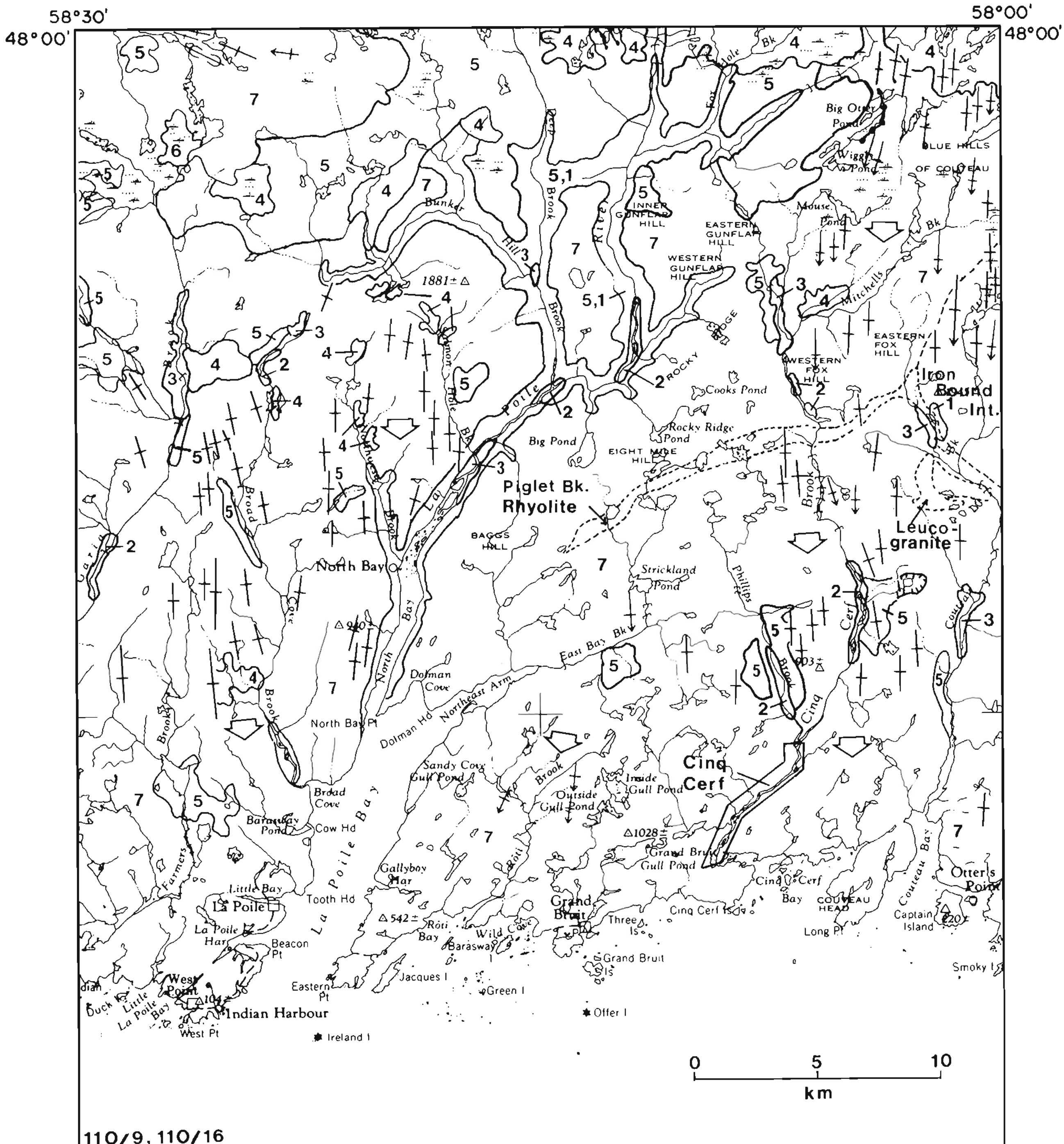

Figure 3: *Quaternary geology of the La Poile (110/9) and La Poile River (110/16) map areas.*

LEGEND

QUATERNARY

1 *Colluvium deposits; usually angular material of any particle size, accumulated on the lower parts or the base of slopes and transported by gravity through cliff failure and mass wasting*

Non-glacial environment

2 *Sand to bouldery gravel alluvium; up to 2 m thick, contains terraces and plains associated with stream channels and floodplains; commonly found in the larger valleys and may overlie glaciofluvial sediments*

Pro-glacial environment

3 *Ice-contact or glaciofluvial deposits; consisting of gravel and sand in the form of hummocks, terraces and plains; commonly within valleys*

Glacial environment

4 *Hummocky moraine (1 to 10 m thick); commonly consisting of sandy till, but may be composed entirely of boulders; (appears to be of a complex origin, possibly the result of ice disintegration)*

5 *Featureless till veneer; commonly discontinuous and less than 2 m thick; in some areas it consists entirely of boulders and includes colluvium deposits in deeply incised valleys*

6 *Linear forms consisting of silt–clay till; commonly overlain by a thin (1 m) mantle of a more sandy melt-out till containing more boulders; long, flat-profiled flutes are the most common form–other forms include till ramps and ramped crag and tail hills*

PRE-QUATERNARY

7 *Bare rock exposed or obscured by vegetation; includes areas of boulder-strewn bedrock*

SYMBOLS

Direction of regional ice flow

Striation (ice direction known, unknown)

Cirque

Longitudinal ice-flow features

Drumlinoid, fluting

Crag and tail hill

Ramped hills

Ramped crag and tail hills

Transverse ice-flow features

Crestline of moraine

Plate 1: *Hummocky terrain, north-central part of La Poile River map area.*

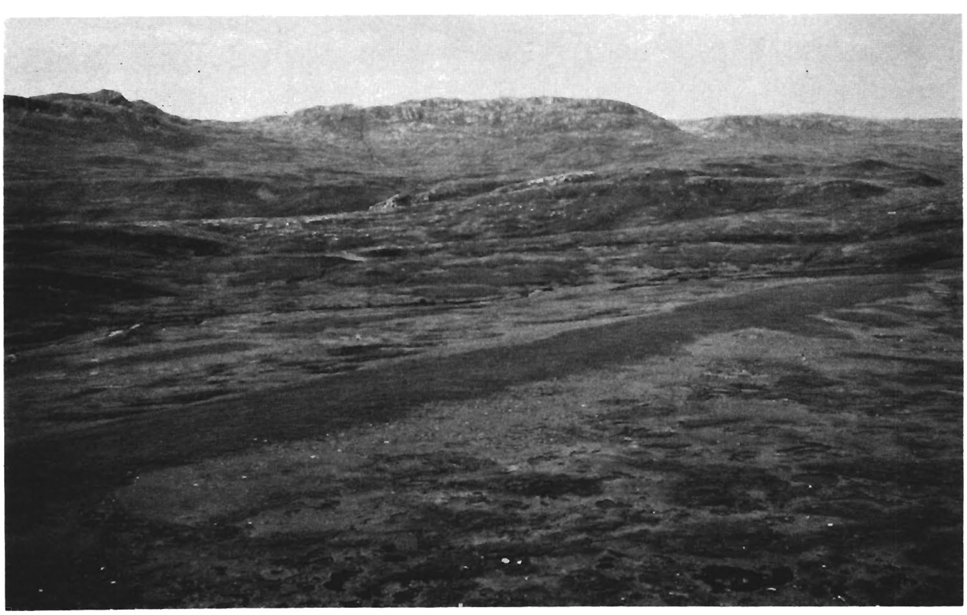

Plate 2: *Fluted ground moraine; ice flow was from left to right.*

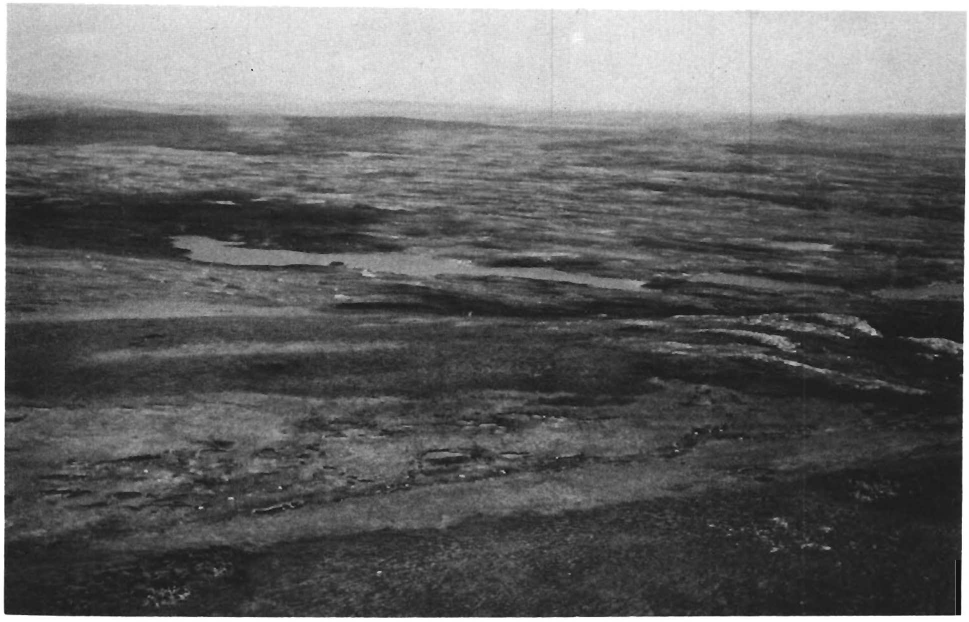

Plate 3: *Till ramp; deposition was on the up-ice side of the bedrock knob.*

Till ramps, unlike other streamlined forms, develop on the up-ice side of bedrock obstructions (Plate 3) and are a common depositional feature in this part of the southwest coast. Boulton (1971) observed till deposition on both the up-ice and down-ice side of a bedrock knob underneath the margin of a glacier in Svalbard, Spitsbergen. He suggested that the up-ice deposition is partially the result of pressure melting of the glacier sole and the subsequent gradual accumulation of particles released from the ice. The deposition of materials down-ice of the knob (ramped crag and tail hills) was in a lee-side cavity, and occurred by squeezing and slumping of subglacial till into the cavity. Although this type of deposition was observed by Boulton on a relatively small scale (tens of metres) it may be applicable to these large scale (greater than 1 km) forms in the study area. The material in the ramps consists of a very compact, possibly lodgement till, exhibiting preferred pebble orientations parallel to the direction of ice flow. These characteristics are consistent with that observed by Boulton for subglacial material found up-ice of bedrock knobs beneath the margin of modern glaciers.

Ice Flow

Ice flow in the area was predominantly to the south (170–180°), as indicated by numerous north–south-oriented depositional forms (flutes, till ramps, crag and tail hills). Glacial striae are not well preserved in the study area, but many bedrock stoss and lee forms indicate flow parallel to the linear features. Redirection of southward-flowing ice in response to topography is apparent in the vicinity of North Bay and La Poile Bay, and may indicate a thinning of the ice near the margin. In the northwest corner of the study area, linear forms indicate that ice movement was to the west-northwest and represents flow into St. George's Bay, probably in response to the regional slope.

Till Composition and Glacial Dispersal

An analysis of till composition is being undertaken as part of the study. A representative pebble fraction (16 to 64 mm) of tills was obtained at 150 sites, mostly from fluted forms and till ramps. Approximately 75 clasts were collected and identified from each hand-dug pit (75 to 100 cm deep), and where possible, the clasts were related to their bedrock source. The purpose of this investigation is to obtain an understanding of till provenance for the fluted forms, and, since these are the dominant depositional feature in much of the study area, to evaluate the features as sampling media for drift prospecting.

Initial analysis of this data indicates that between 30 and 60 percent of the pebble-sized clasts in these forms are of local origin (within 1 to 4 km of source) and the remainder have been transported as far as 10 km. Three bedrock units were selected and utilized as transport indicators on the basis of their position up-ice of many of the linear forms, and the degree by which they could be confidently identified in the pebble fraction. These units are: the Piglet Brook Rhyolite, a small leucogranite intrusion (Chorlton, 1980), and the Iron Bound intrusives (Dunsworth, 1981) (Figure 3). The most useful of these units was the Iron Bound intrusives, which consist of porphyritic granite and syenodiorite, and have a distinctive bluish-green and greenish-brown color imparted by hornblende, actinolite and biotite. These rocks form a large contiguous area at the eastern margin of the study area, and constitute the highest hills in the area. Clasts from these intrusives were identified in several flutes located approximately 3 km south of their source. At the north end of one of these forms, 29 percent of the pebbles in the till are from this unit, and this concentration decreases uniformly to 7 percent at the southern end, a distance of 1.5 km. This represents a dilution rate of 1.4 percent per 100 m of transport. The implications of this type of data with respect to the geochemical characteristics of the fluted till will be discussed in the final report on the area.

CONCLUSIONS

Constructional and erosional landforms in this area of southern Newfoundland were probably created during advance of ice (Late Wisconsin), which extended southward to at least the coast. Deposition of glacial sediments was not extensive, and in the southern half of the study area was primarily limited to linear forms, which include flutes, ramps, and ramped crag-and-tail hills. These features are formed subglacially through the processes of pressure melting, plastering onto the glacier bed, and squeezing of saturated material into cavities in the lee of subglacial obstructions (boulders or bedrock knobs). Transport distance for the majority of pebble-size fragments in these forms is probably not more than 10 km.

Analyses of till matrix for textural and geochemical variation, and pebbles for till provenance are on-going. The data will be used to further characterize and define the various depositional forms.

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