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Surficial Deposits, Geomorphic Features, and Late Quaternary History of the Terminus of the Northern Peninsula of Newfoundland and Adjacent Quebec-Labrador*

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Reconnaissance of landforms and deposits by the Geological Survey of Canada (Division of Quaternary Research and Geomorphology) commenced and completed in 1969, was undertaken to provide information for current bedrock geological mapping, geochemical prospecting, forest-capability inventory, and engineering feasibility studies, as well as to study certain interesting features noted on air photo mosaics by the writer in 1965 during compilation of the Glacial Map of Canada.

Topographically, the area centres on a lowland (0-400 feet above sea-level) bounded on the east by uplands rising 800-1,000 feet, on the south by eastward tilted plateau block of the Long Range Mountains rising to 2,000-2,500 feet, and on the west and north by the Strait of Belle Isle on the other side of which rises the dissected peneplain of southern Quebec-Labrador. The uplands and mountains are rugged, denuded, and boulder-strewn. Most of the mappable deposits and landforms occur on the lowland.

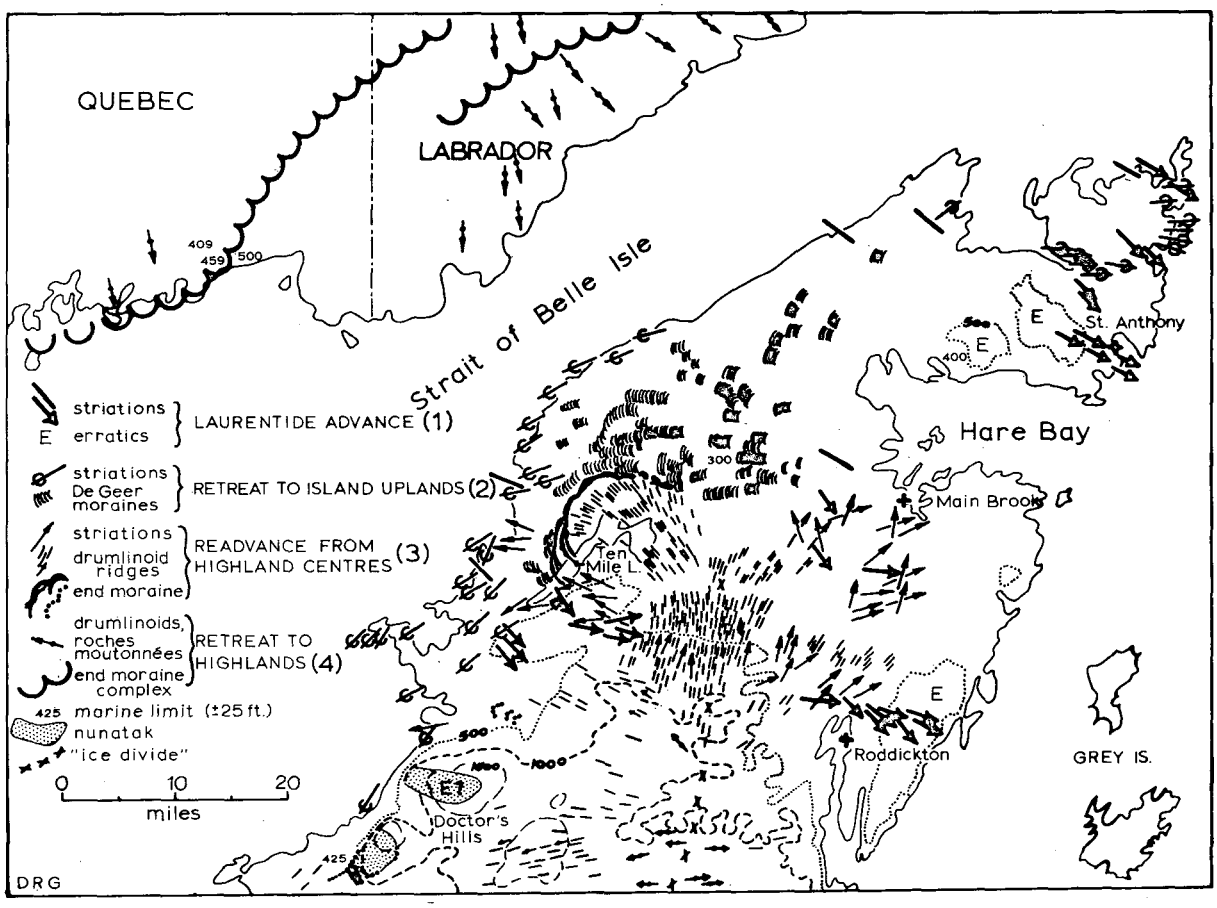

FIGURE 1 - Glacial features, Northern Peninsula of Newfoundland, and adjacent Quebec-Labrador

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Surficial deposits are generally thin and patchy, and composed mainly of till that is occasionally lodged around bedrock projections but which is usually concentrated as discrete moraines and drumlinoid ridges. Wave action has reworked the till below 300 or 400 feet above sea-level, but lag deposits and marine sediments are seldom recognizable. Geomorphic elements are readily identified as either glacial or structural because they are almost exclusively present as ridges with diagnostic features, are accentuated by forest growth, and are sharply delineated by innumerable lakes and bogs occupying the intervening depressions. A remarkable array of glacial constructional forms is present despite the paucity of drift. The largest and most significant is an end-moraine system 20 miles long with several kettled ridges and a relief of 50-150 feet. Large areas of numerous parallel minor moraines, of the "De Geer" type, are best seen in lakes as bouldery spits, islands, and shoals up to 1/2 mile long, 500 feet apart, 150 feet wide, and less than 25 feet high. An area of low attenuated drumlinoid ridges occurs 'up-glacier' from the end moraine. Raised strandlines are not common and are usually recognizable below 50 feet, except in Quebec-Labrador where they are present up to 500 feet.

The underlying bedrock structure produces distinctive geomorphic patterns, owing to the shallow drift and contrasting glacial landforms. Low, broad, gently curving swells up to 1/4 mile wide and extending for miles, are the upturned bevelled edges of gently folded beds that are progressively more disturbed to the east. Local variations in length, width, spacing, and relief of these ridges produces patterns related to lithology and structure, as well as to attitude. In contrast, narrow depressional lineaments, traceable as aligned bogs and rectilinear waterways, are fracture lines usually grouped in parallel systems, truncating and offsetting the stratification ridges. Major dislocation zones transect the area from north to south and east-west discontinuities are discernible as well. West of the end-moraine is an area of glacially sculptured bedrock, and to the north a larger expanse of similar, vague, lineated bedrock may also represent glacial scouring, as ice-flow there paralleled a joint system.

Another important group of depressional features are the numerous solution cavities occurring over a north-south zone west of Roddickton and Main Brook, of which the larger ones at least have been unroofed by the overriding glaciers.

Glacial striations are well developed, especially on the carbonate rocks, and are found where a till cover has been recently removed, as by wave action or road construction. Most exposures offer evidence of the sense of ice flow, usually by miniature crag-and-tail on algal, oolitic and coralline limestone, pebbly sandstone, and porphyritic crystalline rocks, as well as by miniature plucked surfaces, stoss-and-lee, and bevelled faces.

Striations and other ice-flow indicators are interpreted in terms of a four-phase glacial sequence.

1. Laurentide ice from Labrador advanced southeastward over at least the lowland portion of the Northern Peninsula, and perhaps 1,000 feet up the flanks of the Long Range Mountains as evidenced by unidirectional grooving, prominent roches moutonnées, Labradorian erratics on the uplands near Roddickton and St. Anthony, and a shelly drift that was spread widely over the area (although a radiocarbon date is needed to confirm that the shells date from the last interstadial - ca. 30,000 yr. B. P.). Crystalline erratics also occur on the sandstone summits (1,500-2,000 ft) of the Doctor's Hills in the southwest corner, but it is unknown whether they were emplaced by Labrador ice or Long Range ice, during a pre-Wisconsin, maximum-Wisconsin, or late-Wisconsin event.

2. Subsequent retreat, influenced mainly by a calving bay enlarging northeastward up the Strait of Belle Isle, is shown, by striations and De Geer moraines, to have proceeded concentrically inland to an ice divide near Hare Bay, while the sea was about 300 feet higher than present. The spacing and extent of De Geer moraines suggest the retreat lasted 300 years at most.

3. As the lowland ice-mass was retreating, Long Range ice re-advanced down onto the lowlands. On the northern flank, it expanded into the sea fluting and drumlinizing the marine deposits. A lobe moved westward into Ten Mile Lake basin and built the end-moraine, for which a maximum age of 10,900 yr. B. P. (GSC-1277) is implied by a date on marine shells incorporated into the till of the moraine. Shells in beach gravel, one mile beyond the moraine, that date 10,100 yr. B. P. (GSC-1270) help to bracket the date of the advance and indicate that by then sea-level had fallen to 200 feet (above present sea-level). On its northern and eastern margin, the advancing ice probably merged with the still-wasting lowland ice-mass because ice-frontal features are absent; its northern extent is there indicated instead by the southern limit of

De Geer moraines. Crossing striations near Main Brook suggest that wastage again took place differentially as the sea calved the western flank. Meanwhile, ice had advanced also westward toward the Gulf, but there ice tongues appear to have been diverted around two large nunataks because the summits of the Doctor's Hills bear a distinctively anomalous cover of patterned felsenmeer surrounded by meltwater channels, scoured bedrock, and lateral and interlobate moraines. The summit debris, and hence also the included erratics, can be no older than late Wisconsin, since patterned ground is developing today in two or three years on the floors of bedrock borrow pits at sea level. Across the Strait of Belle Isle, in Quebec-Labrador, a belt of dead-ice topography and small moraines mark at least a pause, if not a re-advance, that may correlate with the Ten Mile Lake event.

4. Active ice-flow, shown by lineated drift, crag-and-tail, and striated roches moutonnées, continued during the final retreat which culminated, not on the topographic divide of the Long Range, but several hundred feet lower at an ice divide located near the median line of the plateau.

Postglacial changes of relative sea-level vary throughout the area. In Quebec-Labrador the marine limit is shown by excellent trimlines at the lower limit of unmodified drift and perched erratics; massive boulder beaches occur only slightly lower. A prominent ridge in the morainal belt is trimmed off at 459 feet above sea-level, but beyond this ice-marginal position the sea has washed nearly to 500 feet, while younger moraine ridges in behind are unmodified at 409 feet, thus clearly demonstrating the variation of the marine limit with the age of deglaciation. In Newfoundland, on the other hand, no such trimlines are apparent. Shell-bearing beach sediment occurs up to 200 feet on both coasts and good De Geer moraines (generally conceded to indicate ice retreat in standing water) occur up to 300 feet in the interior. A prominent bench is incised in bedrock at about 400 feet above sea-level on the White Hills west of St. Anthony. While the area exhibits many subhorizontal structure planes that also outcrop as benches, the horizontal extent and other corroborative evidence suggests that this feature is probably a bona fide marine erosion surface. Finally, the interlobate moraine extending west from South Summit of Doctor's Hills is wave-modified below 425 feet. This variation in the marine limit is partly due to the difficulty of recognizing the criteria in the wooded terrain, but it is mainly the result of the deglacial pattern. There is no evidence that the sea flooded in after the retreat of the Ten Mile Lake ice lobe, and it seems that sea-level had dropped 50-100 feet prior to the advance. Moreover, the time interval extrapolated from the change of level and the probable rate of uplift (ca. 25-50 ft/century) agrees with the evidence of nearly synchronous retreating lowland ice and re-advancing highland ice. At present, sea-level is probably nearly stationary, or possibly even rising, on the west coast, whereas on the east coast sea-level is probably still falling owing to the apparent persistence of a significant late ice mass there.

Evidence of pre-Wisconsin or early-Wisconsin glaciation may be afforded by numerous 'old' cirques; that is, well-formed cirques which appear to have been overridden by the ice sheets described above and which seem not to have been re-occupied by glacier ice later. Many examples are found up to 1,000 feet on the northern flank of the Long Range Mountains. Significantly, others located along the north side of Hare Bay, notably St. Anthony Harbour, are now submerged about 50 feet. Even allowing for future rebound, these indicate a firm line near sea level, which is certainly a rare occurrence, especially in mid-latitudes. Even better examples of drowned cirques incise the cliffs of the Grey Islands and show no signs of having been overridden by an ice sheet. The surfaces of the Grey Islands, moreover, show a surprising 'maturity' of slopes and drainage patterns compared to the geomorphic appearance of similar geologic terranes elsewhere. Hence, although erratics prove the Grey Islands were glaciated by an ice sheet from the west at some time, the submerged cirques were apparently cut afterward, and thus by implication a preclassical-Wisconsin age for the 'old' and submerged cirques, as well as for the glaciation of the Grey Islands, seems indicated.

These results have application to a variety of current studies. The disjunct glacial pattern and atypical deposits have particular relevance to the interpretation of geochemical anomalies and the provenance of mineralized erratics. Plans to consolidate run-off for hydroelectric development must contend with meagre overburden, seasonal desiccation, and underground drainage evidenced by sinkholes, disappearing rivers, and intermittent lakes. Thin soils and poor drainage are also factors limiting forest capability. On the other hand, the shallow drift and abundant lakes that continually expose new outcrops by shore-ice movement, greatly facilitate geological mapping.