SURFICIAL GEOLOGY OF THE PROVINCE OF NOVA SCOTIA

MAP 92-3

Compiled by R.R. Stea, H. Conley and Y. Brown

SCALE
1:500,000 or 7.89 miles to 1 inch

NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES

MINES AND ENERGY BRANCHES

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HALIFAX, NOVA SCOTIA

1992

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Map reviews: R. C. Boehner and D. R. MacDonald, Nova Scotia Department of Natural Resources; R. N. W. DiLabio and R. J. Fulton, Geological Survey of Canada.

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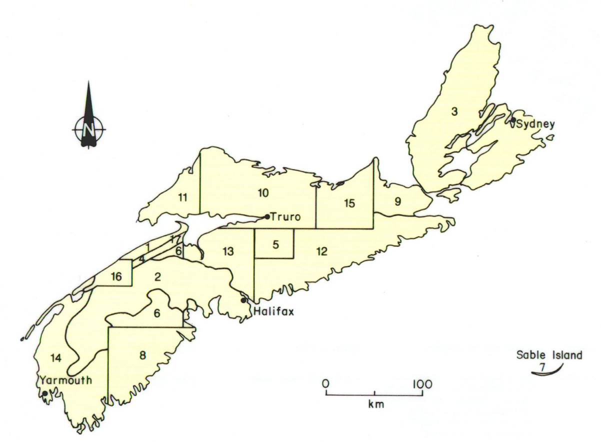
The Surficial Geology of the Province of Nova Scotia is available in digital form through Land Registration and Information Service, Amherst, N.S.

For notification of errors or omissions to the Surficial Geology contact the Nova Scotia Department of Natural Resources.

Index map to compilation sources



EXPLANATION

This map depicts the distribution and nature of Quaternary glacial and other surficial deposits in Nova Scotia. Outlined on the map is the glacial history of Nova Scotia. Surficial deposits form the parent materials for most soils in Nova Scotia. The data on this map are an aid to environmental studies, mineral exploration, agriculture, forestry and construction.

Figure 1 is a summary of the stratigraphic and temporal relationships of Nova Scotia Quaternary deposits. Quaternary lithostratigraphic units in Nova Scotia are arranged by region and time from the lowest or earliest units to the highest or latest units. The erosional stratigraphic record (striations) is also shown on this Figure (see also Fig. 2). Ice flow phases are correlated with till sheets by comparing regional ice flow directions with till provenance and fabric. Named Quaternary lithostratigraphic units are shown on this figure and described in more detail on back of the map. Reference sections used to construct this diagram are numbered on the bottom of the diagram. Refer to the map on the reverse side for section locations and descriptions.

Colours on Figure 1 refer to lithogenetic units described in the legend (i.e. green units are tills; orange – glaciofluvial, etc.). Screened regions on the diagram imply ice–free conditions prevailing, indicated by soil formation. Arrows indicate the uncertainty of age assignments in this compilation. Dated fossil materials (bone, shells, wood and peat) are depicted on the diagram in their stratigraphic and temporal context. Reworked fossil materials (i.e. shells in till) have arrows pointing to their presumed source beds. Roman numerals correspond to pollen stratigraphic units (see list of sites on back for further description).

Intensely oxidized deposits (Bridgewater, Mabou Conglomerates) may predate the earliest glaciation. A pre–Illinoian interglacial interval (200,000–300,000 yr B.P.) is indicated by dates on shells in till in southwest Nova Scotia. The last interglacial period, the Sangamonian (75,000–128,000 yr B.P.), is represented by marine and terrestrial deposits underlying tills of the last glacial period, the Wisconsinan. The Salmon River Sand in southwest Nova Scotia has a warm water fauna indicating present–day conditions. During this time sea level was up to 5 m higher than at present. This higher sea level cut a shoreline whose remnants are flat, wave–cut rock benches underneath glacial deposits. At the same time forests grew on land. These forest communities changed from hardwood–dominated (Unit I) during the warm part of the interglacial to spruce and fir forests (Unit III) in the colder phases.

It is not certain when glaciers first developed in the Wisconsinan. In northern Cape Breton Island, ice–free conditions may have persisted until 50,000 yr B.P.; offshore in the Gulf of St. Lawrence perhaps later. Continuous ice cover throughout most of the Wisconsinan stage is indicated on the mainland, except for indications (soils?, lacustrine deposition) of short–lived ice retreat at several sections.

The earliest Wisconsinan ice flows in Nova Scotia were eastward (Phase 1a, Fig. 2) then southeastward (Phase 1b, Fig. 2). Several widely–spaced striation sites reveal a distinct eastward flow, preserved in bedrock lee–side hollows and depressions, later overrun by southeastward–trending striations. In fact, the eastward ice flow may represent a separate, older phase of glaciation. The Hartlen, East Milford, Richmond and Red Head Tills (Fig. 1) were formed during these ice flows. The East Milford Till contains boulders of igneous rocks from the Cobequid Highlands and basaltic rocks from the North Mountain which were transported southeastward and can be traced to the Atlantic Coast, up to 120 km down–ice. This phase may represent glaciers with an Appalachian or Laurentide source.

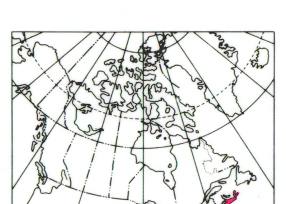
The second major ice flow trend (Phase 2, Fig. 2) was southward and southwestward from the Escuminac Ice Center in the Prince Edward Island region. This event is recorded by southward–trending striae crossing earlier southeastward–trending striae at many localities on the upland regions of Nova Scotia and New Brunswick. The Lawrencetown and Eatonville Tills (Fig. 1) were formed during this flow event. Material from the vast area of redbeds in northern mainland Nova Scotia and Carboniferous basins in the Prince Edward Island region was transported southward onto the metamorphic and igneous terranes of mainland Nova Scotia. Southward dispersal of distinctive Cobequid Highland erratics occurred with the dispersal of the red material.

During the next ice flow event (Phase 3) granites from the Atlantic Uplands Physiographic Province were transported northward onto the North Mountain. The Hants and Beaver River Tills were formed during this ice flow phase. Erratics from the Cobequid Highlands can be found throughout the Cumberland – Pictou Lowlands to the north. Northward–trending striations can be traced across the northern mainland of Nova Scotia (Fig. 2). This well documented northward ice flow was clearly in response to the development of an ice divide in southern Nova Scotia (Fig. 2). Ice flow was northward and southward from this divide across the axis of the Nova Scotia peninsula. This divide may have formed as a result of marine incursion into the Bay of Fundy or a climatic event.

The final phase of ice flow resulted from remnant ice caps developed from the Scotian Ice Divide (Fig. 2). Eskers and striations cut across features formed by earlier ice flows. Ice caps or glaciers that formed over the Chignecto Peninsula and southern Nova Scotia had margins on land marked by moraines, ablation till, glaciofluvial deposits, and the pinch–out of stony till sheets. The Shulie Lake and Toney River Tills were formed during this last ice flow phase. Ice flow during this last phase was funnelled westward into the marine basins. Erosional features and deposits relating to these late–glacial ice caps are restricted to low–lying areas.

At the end of the Late Wisconsinan the sea encroached into the Bay of Fundy and ice retreat occurred rapidly through calving. Glaciomarine deltas formed along the coast, dated from 14,300 to 12,600 yr B.P. Peat formed in depressions on land starting 12,700 yr B.P. The climate warmed and spruce trees migrated into the region along with ice age mammals including caribou. Indians first hunted in Nova Scotia at Debert 11,000 years ago. Then, suddenly, the climate became cooler and inhospitable. Glaciers advanced in some areas from highland remnants sometime after 11,000 yr B.P. Late-glacial sites (Fig. 3) record the change of climate. Lakes were inundated with sediment due to decreased vegetation cover. Glacial sediments buried some former peat bogs.

By 10,000 years ago all remaining ice melted and the climate warmed rapidly. Spruce forests were established in the early post–glacial period.



Index Map

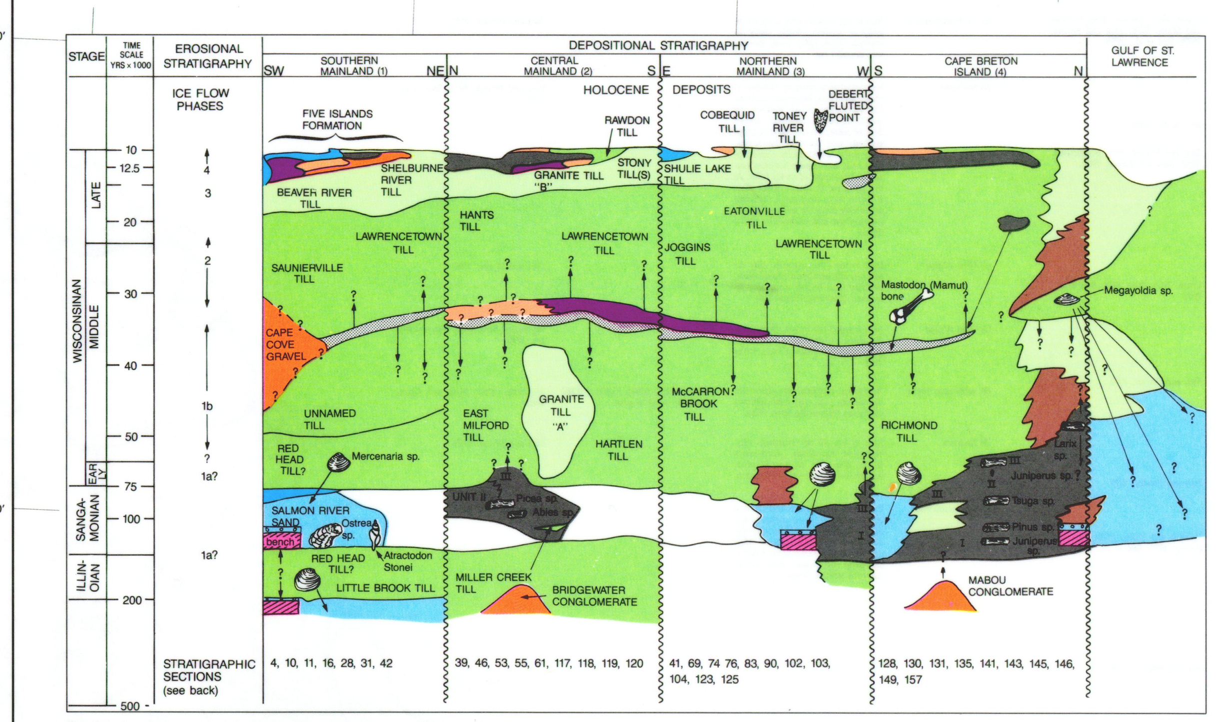


Figure 1. Space–time diagram illustrating the stratigraphic and temporal relationships between mapped surficial units and units found only in stratigraphic sections.

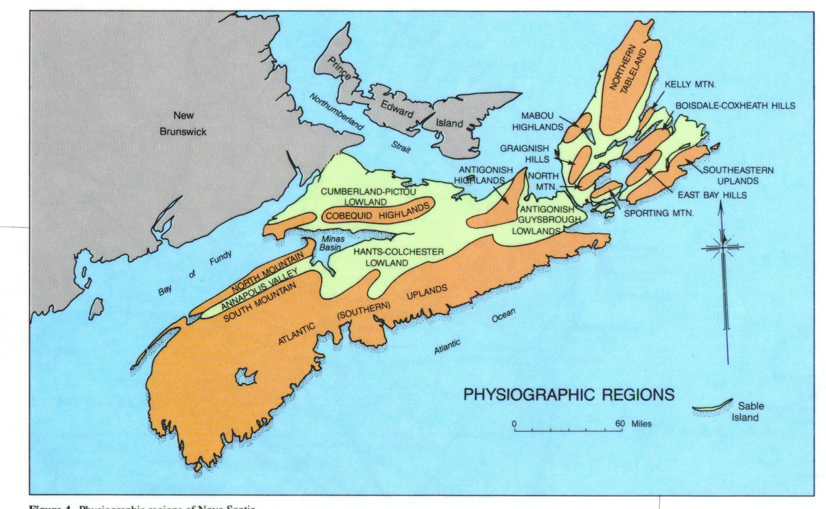
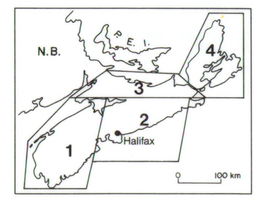


Figure 4. Physiographic regions of Nova Scotia.



This map shows the areas used for the stratigraphic compilation.

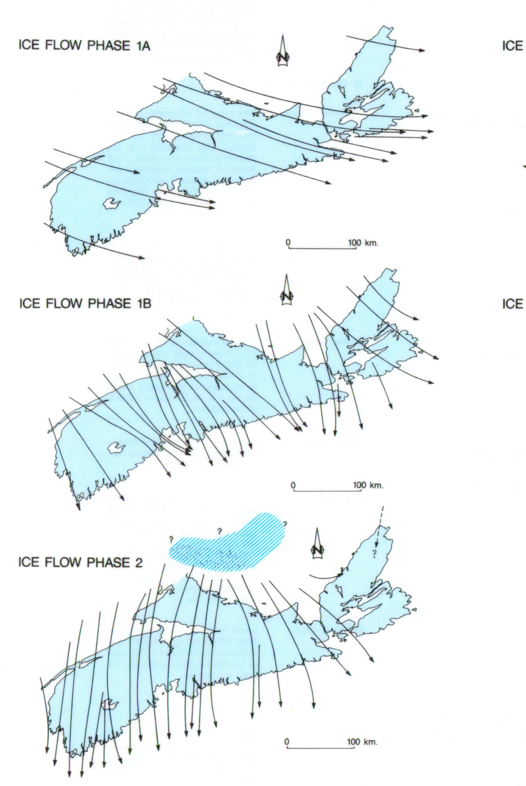


Figure 2. Ice flow patterns deduced from striation and drumlin directional data. Ice flow phase 1 depicts ice flows from an **Appalachian** or **Laurentide** source area eastward (1a) and southeastward (1b) across the Bay of Fundy and onto the continental shelf areas. Southward and southeastward flow patterns during ice flow phase 2 stem from the **Escuminac Ice Center** on the shelf north of mainland Nova Scotia. Ice flow phase 3 represents flows from the **Scotian Ice Divide** straddling the mainland of Nova Scotia. During ice flow phase 4 remnant ice caps flowed into marine basins adjacent to the Province.

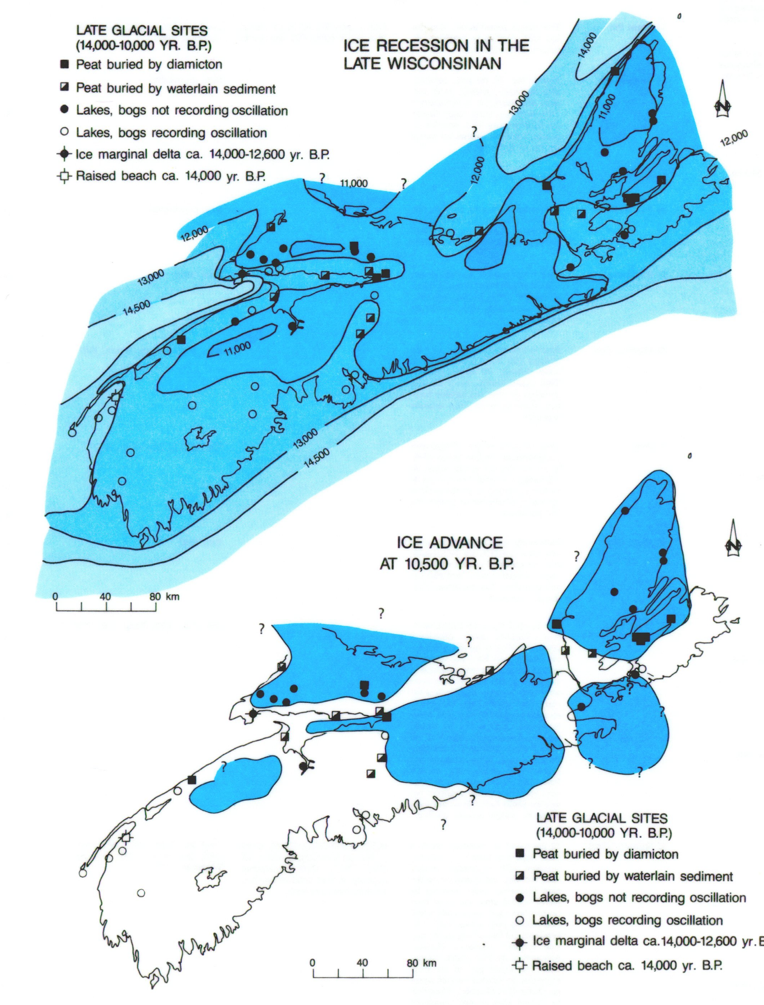


Figure 3. Ice recession in the Late Wisconsinan. The first map shows the successive positions of the Late Wisconsinan ice margin during the period from 14,500 yr B.P. to 11,000 yr B.P. Darker colours show progressively later areas of ice cover. The marginal positions are based on lake and bog stratigraphy, limiting radiocarbon dates, ice marginal landforms and topography. Lake cores that show a transition from organic sediment to mineral sediment and back to organic sediment at the base are defined as lakes recording "oscillation" (see explanation). Such lakes are generally older than 12,000 yr B.P. and as old as 14,000 yr B.P. in southern Nova Scotia. The second map depicts an ice advance ca. 10,500 yr B.P. based on till and outwash covered late–glacial peat sites and lake sites not showing the climatic "oscillation".

MAJOR COMPILATION SOURCES

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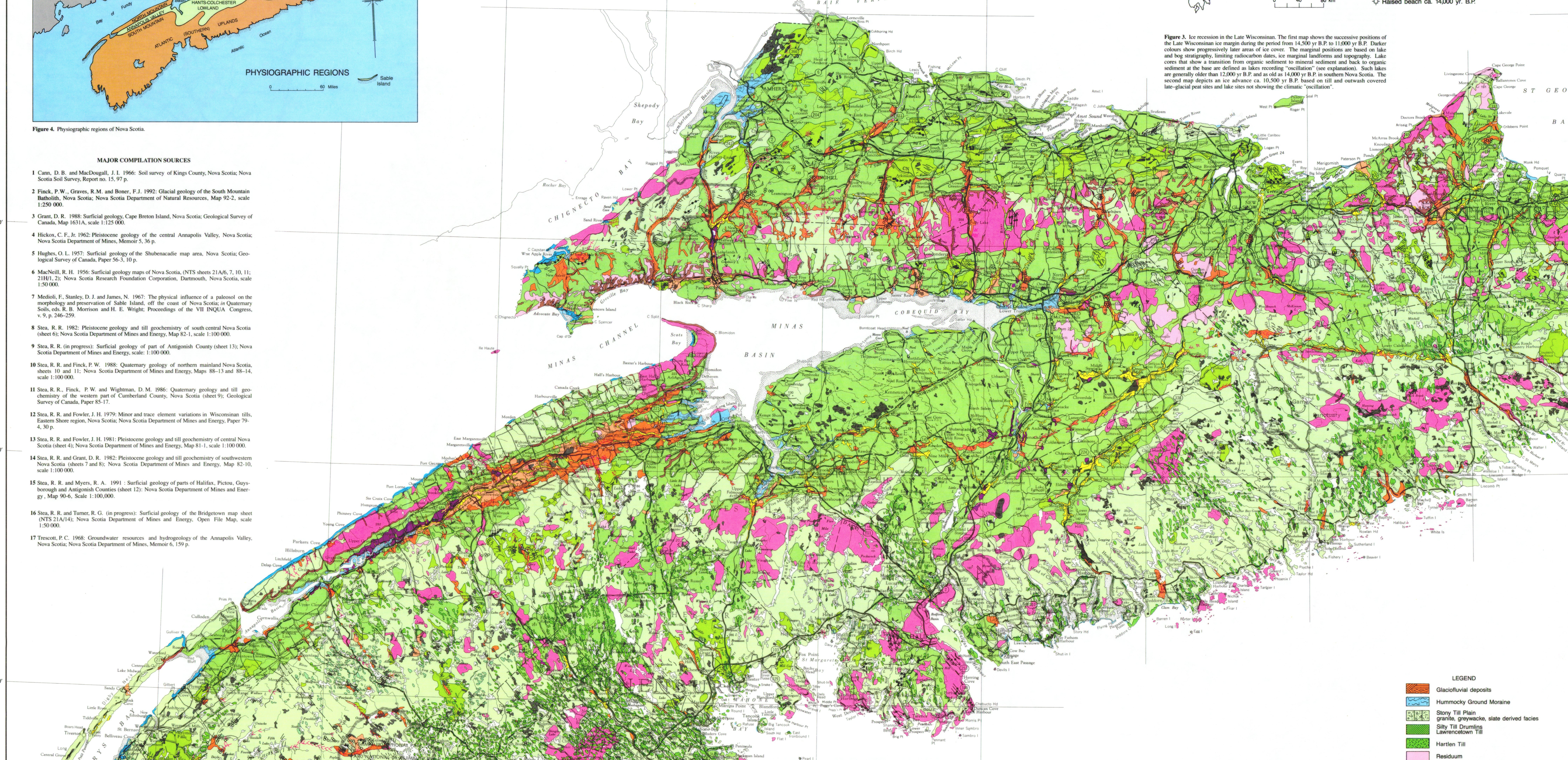


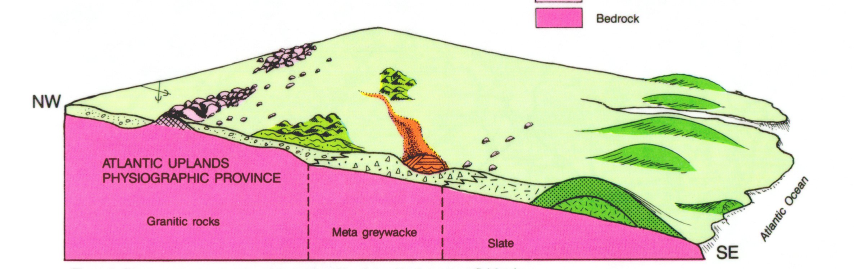


Figure 6. Diagrammatic representation of the stratigraphic relationships between surficial units on the Atlantic Uplands physiographic region.

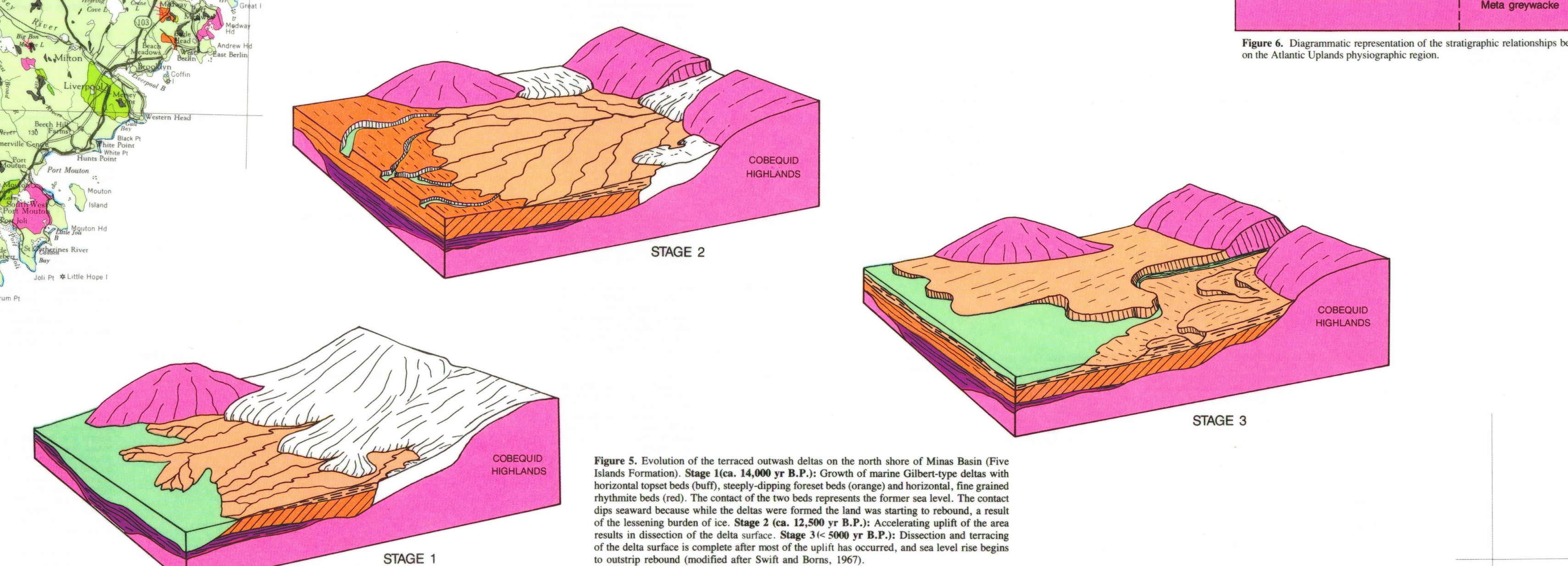
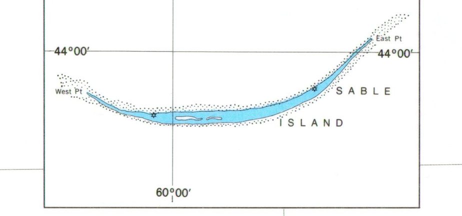


Figure 5. Evolution of the terraced outwash deltas on the north shore of Minas Basin (Five Islands Formation). **Stage 1(ca. 14,000 yr B.P.):** Growth of marine Gilbert-type deltas with horizontal topset beds (buff), steeply-dipping foreset beds (orange) and horizontal, fine grained rhythmite beds (red). The contact of the two beds represents the former sea level. The contact dips seaward because while the deltas were formed the land was starting to rebound, a result of the lessening burden of ice. **Stage 2 (ca. 12,500 yr B.P.):** Accelerating uplift of the area results in dissection of the delta surface. **Stage 3(< 5000 yr B.P.):** Dissection and terracing of the delta surface is complete after most of the uplift has occurred, and sea level rise begins to outstrip rebound (modified after Swift and Borns, 1967).



SYMBOLS

Geological boundary
Cirques (large, semicircular rock basins)
Roche moutonnée (truncated elliptical outcrop, steep lee side, barb points down-ice)
Glacial striae (large and small linear grooves on rock; ice flow direction known, unknown, 1 indicates older striae, barb points in the direction of ice flow; printed on reverse side)
Drumlins, fluted terrain (ridges and elliptical hills parallel to ice flow; symbols printed on reverse side)
Moraine ridge (ridges perpendicular to ice flow; major, minor)
Hummocks (mounds of till and sand and gravel)
Esker (sinuous ridge of sand and gravel, generally parallel to ice flow; direction of meltwater flow assumed or known, unknown)
Delta (kame, outwash)
Kettle (circular depressions or pits; large, small)
Meltwater spillway, channel (flat bottomed valleys with misfit streams)
Terrace scarp
Location of stratigraphic section of special interest (numbers refer to sections referenced in the time–space diagram (Figure 1) and in the sources of geological information on the back)

LEGEND

	UNIT*	DESCRIPTION	TOPOGRAPHY	THICKNESS	ORIGIN	ECONOMIC AND ENVIRONMENTAL SIGNIFICANCE
POST LAST GLACIATION (HOLOCENE)	ORGANIC DEPOSITS	Sphagnum moss, peat, gyttja, clay	Forms bogs, fens and swamps, swamps generally form along river valleys	Bogs; 1 m at the edge, 5 m in the centre; swamps, < 2 m	Develop by infilling of ponds or river courses by vegetation	Source of fuel, fertilizer, medicinal and industrial products; wet lands provide nesting and feeding habitats for wildlife; peat extracts contaminants from groundwater
	COLLUVIAL DEPOSITS	A complex mixture of glacial deposits, weathered and frost-shattered rock and soils	Forms a blanket of material over steep valley walls; a talus cone or rotational slump	Increases from < 1 m at the top of the valley wall or slope to 5 m at the base	Formed by periods of downslope creep and/or mass movements along valley sides	Source of aggregate of poor quality; valley sides can be subject to rapid, destructive slides; deforestation can cause severe erosion; zone of springs and seeps
	ALLUVIAL DEPOSITS	Gravel, sand, mud; bedded, coarse at base, finer at top, stream channels generally gravelly sand, floodplains sand	Flat or gently sloping river valley floodplains and sloping alluvial fans	Thin veneer, < 1 m, in small streams; » 20 m in large floodplains	Deposited by streams and rivers after retreat of the last glaciers	Major source of groundwater, source of aggregate, utilized for pasture land; limitations for crop use and construction include flooding, high water table, poor drainage
	MARINE DEPOSITS	Gravel, sand, silt, clay; locally overlain by peat (salt marsh)	Beaches, spits and bars; intertidal salt marsh and mud flats; beaches along Atlantic coasts, Cape Breton Island, Sable Island, Northumberland Strait; salt marsh and mud flat mainly along Bay of Fundy shoreline	Beaches 2-8 m; salt marsh < 2 m	Formed by coastline sedimentation through wave action, longshore currents and tides	Wildlife sanctuaries, feeding grounds, recreational areas
LAST GLACIATION (WISCONSINAN)	GLACIOLACUSTRINE DEPOSITS	Sand, silt, clay; laminated to massive, massive or crudely stratified diamictons (mixture of gravel, sand and mud)	Flat or gently rolling terraces perched above modern stream or river valleys	Generally > 2 m; can attain 30-40 m along major valley systems	Deposited in a ponded body of water either in direct contact with ice or fed by glacial meltwater	Clay utilized for brickmaking, pottery; land used for pasture; limitations include poor drainage and surface runoff
	GLACIOMARINE DEPOSITS	Gravel and sand; bedded, dipping seaward 5 - 10°; locally silt and clay	Gently sloping shoreline above modern tide level, with protruding ridges (raised beaches) and scarps (wave-cut terraces)	Shoreline deposits vary from 4-5 m; gravelly raised beach ridges 3-10 m	Deposits formed as the sea flooded a lowered coastline, depressed by the glaciers' weight. As the land rebounded after the glacier left, the shoreline was raised above sea level	Gravel and sand utilized for aggregates; cultivated for crops, used as pasture land; groundwater source
	GLACIOFLUVIAL DEPOSITS: OUTWASH FANS, DELTAS AND VALLEY TRAIN DEPOSITS	Gravel and sand; massive to horizontally stratified, coarse to fine gradation within sections and deposits	Fan-shaped lobes at the mouths of valleys (O.F.); belts of outwash confined to valleys (V.T.); topset part of Gilbert-type deltas (O.D.), (see Fig. 5)	Outwash fans 5-30 m; valley trains 5-50 m; outwash deltas 5-25 m	Deposition by freely wandering glacial streams in front of a glacier (O.F.); meltwater streams confined to valley walls (V.T.); meltwater streams depositing material in to the ocean (O.D.)	Source of quality aggregate for concrete, roadbase, especially in areas of hard rocks; excellent aquifer, sometimes confined by clay at the base (O.D.); rapid drainage and acidity impede cultivation; aquifer easily contaminated
	KAME FIELDS AND ESKER SYSTEMS	Gravel, sand and silt, diamicton layers; poorly to well bedded, horizontal to angular beds, faulting and collapse features common	Steep-sided mounds or hummocks (moulin kames); pitted terraces on valley sides (kame terrace); sinuous, steep-sided ridges (eskers)	Generally 4-6 m; kames 4-20 m; kame terraces 3-30 m; eskers 5-10 m	Streams of glacier meltwater depositing material in holes in ice (M.K.); between glacier and valley slopes (K.T.); in water (kame delta); in tunnels in the ice (E.)	Source of aggregate of varied quality; severe limitations to crop use include stoniness, rapid drainage and irregular topography; utilized for blueberries, pastureland
	GROUND MORAINE AND STREAMLINED DRIFT: HUMMOCKY GROUND MORAINE (NOT DIFFERENTIATED IN CAPE BRETON ISLAND)	Till (mixture of gravel, sand and mud of direct glacial origin) often sandy and stony; loose, inclusions of waterlain sediment	Irregular rough topography, local ridges (ribbed moraine), depressions or pits (kettles)	Variable from 2-25 m	Material released from on top of, or within, stagnant ice masses by melting; usually at or near the margins of these ice masses	Source of aggregate of poor quality; severe limitations to crop use, construction include stoniness, drainage, topography and acidity; poor buffering capacity for acid rain
	STONY TILL PLAIN AND DRUMLINS	Till; stony, sandy matrix, material derived from local bedrock sources; drumlin facies: siltier till due to erosion and incorporation of older till units by glaciers	Flat to rolling, with many surface boulders; drumlins-elongate or oval hills veneered by stony till, with underlying multiple till layers (see Time-Space diagram)	Till plain 2-20 m; drumlins 4-30 m	Material released from the base of an ice sheet by melting; these tills deposited by ice sheets centered over Nova Scotia (see Time-Space diagram)	Moderate limitations to crop use include stoniness, rapid drainage, erodibility; factors affecting use for construction include shallowness, stoniness and high water table; poor buffering capacity for acid rain
	SILTY TILL PLAIN AND DRUMLINS	Till; silty, compact, material derived from both local and distant sources; drumlin facies: siltier till, higher percentage of distant source material including red clay	Flat to rolling, few surface boulders; till is thick enough to mask bedrock undulations; drumlins often with multiple tills (see Time-Space diagram)	Till plain 3-30 m; drumlins 4-30 m	Material released from the base of ice sheets by melting or lodgment; these tills deposited by ice sheets centered outside of Nova Scotia (see Time-Space diagram)	Generally provide the best agricultural land in the province, moderate drainage and stoniness; moderate to good buffering capacity for acid rain because of transported calcareous bedrock components
PRE LAST GLACIATION	ROCK: RESIDUUM	Fragmented rock consisting of angular blocks and finer interstitial debris; overlain by thin, discontinuous veneer of till	Flat to strongly rolling	1-4 m	Mechanical and chemical disintegration of bedrock occurring before and during glaciations	Used for road base aggregate; severe limitations for crop use; generally forested; acid rain buffering capacity depends on rock type but generally poor
	BEDROCK	Bedrock of various types and ages; glacially scoured basins and knobs, overlain by thin, discontinuous veneer of till, shaped by glacial erosion	Flat to strongly rolling; ridges of hard rock exposed in thin till areas; rock with stoss and lee form roche moutonnée		Areas of glacier erosion and/or non-deposition	Forested regions, little use as crop land; acid rain buffer-capacity depends on rock type, but generally poor

* Glacial units are classified by origin and associated landforms according to a system developed by Goldthwait (1988).

Nova Scotia Department of Natural Resources
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