NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY

MAP 90-4

TILL CLAST AND GLACIAL GEOLOGY OF

CHESTER

INT.S. SHEET 21A/09

NOVA SCOTIA

R.M. GRAVES and P.W. FINCK

SCALE 1:50,000

Miles 1 0 1 2 Miles

Kilometres 1 0 1 2 3 4 Kilometres

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY

JACK MACISAAC, MINISTER

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HALIFAX, NOVA SCOTIA

1990

LEGEND

TILL CLAST LITHOLOGIES

Biotite monzogranite: light to medium grey; medium- to coarse-grained; K-feldspar megacrysts (2-3 cm); 8-14% biotite; 0% muscovite; bedrock sources are the Sandy Lake Monzogranite and Sherwood Monzogranite, includes minor granodiorite from north of the map area

Biotite ± muscovite ± cordierite monzogranite: colour varies: light grey, buff, pink; medium- to coarse-grained; K-feldspar megacrysts (2-3 cm); plagioclase cores commonly saussuritized; 3-5% biotite; 0-2% muscovite; subhedral to euhedral cordierite common as a second mafic mineral; commonly hematized; bedrock source is the New Ross Leucomonzogranite

Biotite ± muscovite monzogranite: colour varies: greyish-white, light buff, pink; coarse-grained; highly megacrystic (2-4 cm); 5% biotite; 0-1% muscovite; minor hematization; bedrock source is the Spectacle Lake Leucomonzogranite

Porphyry: colour varies: greyish-white, dark grey, pink; fine- to medium-grained; seriate groundmass matrix; quartz (5 mm), K-feldspar (1-3 cm) and plagioclase (.5-1 cm) megacrysts; plagioclase may be saussuritized; 2-10% biotite; trace-3% muscovite; probable sources are the Panuke Lake Leucomonzogranite and mafic porphyry bodies

Biotite muscovite monzogranite: colour varies: pink, buff, grey, white; fine- to medium-grained and medium grained equigranular; the fine-grained variety may exhibit quartz (3-4 mm) and K-feldspar (5-7 mm) megacrysts; 3-5% biotite; trace-3% muscovite; commonly hematized; minor greisenization; bedrock source is the Panuke Lake Leucomonzogranite, includes lesser Tantallon Leucomonzogranite

Leucocratic rocks: colour varies: buff, white, pink; fine- and medium-grained equigranular; rare quartz megacrysts (3-5mm); 0- trace biotite; 0-3% muscovite; both micas locally absent; this unit includes leucocratic monzogranite, pegmatite, felsic dyke rocks and mica aplite; bedrock sources are the Panuke Lake Leucomonzogranite and Long Lake Leucogranite

Meguma Group: grey to green wacke; grey to greyish-black slate

Foreign: metasiltstone; quartzite; basalt; sandstone; diorite; bedrock sources are from the Cobequid Highlands, Carboniferous and Triassic sedimentary basins, and the North Mountain basalt

SURFICIAL UNITS

Quaternary

Holocene

A — **Alluvial Deposits (A):** gravel, sand, silt, minor clay and organics; forms floodplains

Late Wisconsinan

ICSD — **Ice Contact Stratified Drift (ICSD):** interbedded sand, gravel and boulder gravel; rapid grain size transition between beds; individual beds vary in thickness from 1 cm to 1 m; total thickness varies from veneer to greater than 12 m; interstratified locally with till; spatially associated with Granite Till C

GTC ≤ GWC ≤ SLC — **Granite Till C (GTC):** loose, pale brown (10YR6/3)* to yellowish-brown (10YR5/4); structured sandy matrix with bedded sand and sand-gravel lenses; two and locally three granite types are common, angular to subangular granite clasts; Meguma Group metasediments and foreign pebbles; clasts reflect both local and distal bedrock sources, transport distance is <200 m to 5 km; has a hummocky morphology

Greywacke Till C (GWC): loose, yellowish-brown (10YR5/4); matrix is comminuted granite and greywacke deposited as bedded to massive sand and sand-gravel lenses; contains granites, slate and more local greywacke clasts; has a hummocky morphology; colour and pattern represent area of greywacke input from local bedrock, till is often dominated by up-ice rock types

Slate Till C (SLC): loose, pale brown (10YR6/3) to light yellowish-brown (10YR6/4); matrix is comminuted granite and slate with structured sandy matrix and interbedded sands; gossan stained; contains granites, greywacke and local slate; has a hummocky morphology; colour and pattern represent area of slate input from local bedrock, till is often dominated by up-ice rock types

GTB ≤ GWB ≤ SLB — **Granite Till B (GTB):** loose to moderately compact, moderate yellowish-brown (10YR5/4) but may vary from greyish-orange (10YR7/4) to dark yellowish-brown (10YR4/2); till is stony though the matrix to clast ratio is variable; matrix is 80% to 90% sand, 10% to 20% silt and clay; washed sandy zones around boulders and clay skins on pebbles are common; clasts are dominated by a single granite type and commonly a minor second granite type, granite clasts are highly angular to subangular; transport distance varies from ~200 m to 1 km; Meguma Group and foreign clasts are often faceted and striated

Greywacke Till B (GWB): loose; stony; pale brown (10YR6/3) to brown (10YR5/3); sandy matrix; clasts are predominantly angular Meguma Group greywacke, contains local granites and slate in contact areas

Slate Till B (SLB): loose; stony; light olive brown (5Y5/6); sandy matrix, clasts predominantly angular Meguma Group slate; contains local granites and greywacke in contact areas

LT — **Lawrencetown Till (LT):** moderately compact, cohesive, reddish brown (5YR4/4) to dark reddish-brown (5YR3/4); matrix is massive though fissility is seen; clasts are often less than 5% of the till; greenish mottles are common in the weathering zone; high percentages of Meguma Group and foreign clasts with varying amounts of local and far travelled granites; Meguma Group and foreign clasts range in size from pebbles to boulders and are usually faceted and striated; clast provenance is underlying bedrock and sources as distal as 90 km

UT — **Undivided Tills (UT):**** contains Granite Till A, Lawrencetown Till and Granite Till B; due to limited areal extent individual tills do not form mappable units; in general dominated by Lawrencetown Till

Early Wisconsinan?

GTA ≤ HT — **Granite Till A (GTA):** compact to highly compact; moderately stony; dark brown (7.5YR4/4); exhibits a well developed subhorizontal fissility; pebbles include Meguma Group, foreign, local and far travelled granites; Meguma Group and foreign clasts are faceted and striated

Hartlen Till (HT): compact; stony; dark grey (7.5YR N) massive, iron and manganese staining on fissility planes; clasts dominated by angular Meguma Group clasts, also contains South Mountain Batholith granites

Pre-Winconsinan?

R — **Bedrock**: areas where B soil horizon is developed to bedrock; weathered, shattered bedrock is common; thin till may occur in bedrock hollows; striations may be seen on unweathered outcrop; bedrock structure is easily observed on air photographs

* Colours from Munsell Soil Colour Chart

** Stratigraphic position is not implied

SYMBOLS

- Surficial contacts (defined, gradational, based on bedrock geology, assumed)
- Drumlin (bar defines orientation of long axis)
- Kettle hole — K
- Moraines (minor major)
- Till mound — h
- Fluvial terrace
- Meltwater channel
- Lineament
- Windsor Group float — w
- Composition and/or genesis of material largely uncertain — ?
- Till fabric rose diagram
- Stratigraphic section
- Striations (direction of flow known, unknown)
- Area of till veneer
- Till Sample Site, Refer to Boner et. al. (1987) For Geochemical Data — • 239

Planimetric base produced by the SURVEYS AND MAPPING BRANCH, DEPARTMENT OF ENERGY, MINES AND RESOURCES. Updated from aerial photographs taken in 1972 and 1973. Culture check 1974. Published in 1976.

Cartography by:
L.R.I.S., Amherst, Nova Scotia

SUMMARY OF PREVIOUS WORK

Numerous studies, listed in Stea and Brisco (1984), address the regional effects of Wisconsinan glaciation on Nova Scotian surficial geology. However, little detailed work has been conducted in this map area. Stea and Fowler (1981) mapped the area at a scale of 1:100 000 as part of a regional geochemical survey. They described the major till units and presented a regional stratigraphic framework.

Mineral exploration companies have utilized till as a sampling medium but do not discuss the glacial geology in detail. Sinclair *et al.* (1980) described tills in the Bezanson Lake area and used till clast geology to map the Meguma Group–South Mountain Batholith bedrock contact.

TILL UNITS

Granite Till A

Exposures of this till are rare within the study area. It exists as a thin and restricted till cover near Mill Cove and The Pinnacle. At Millet Lake it occurs in a drumlin core overlain by Granite Till B.

Granite Till A is compact, brown to dark brown and stony with a sandy matrix. It exhibits properties characteristic of a lodgment till, as defined by Dreimanis (1976). The clast assemblage is dominated by granites derived from underlying and local up-ice sources with significant amounts of Meguma Group and other allochthonous clasts. For example at The Pinnacle, 500 m south of the Sherwood Monzogranite - New Ross Leucomonzogranite contact, 27% of Granite Till A clasts are derived from the underlying New Ross Leucomonzogranite and 20% from the up-ice Sherwood Monzogranite. A southeast direction of transport is implied by the clast geology. Meguma Group clasts constitute 38% of the pebble fraction at this site and are probably derived from the greywacke roof pendant north of Leminster (map sheet 21A/16).

Till fabric 1 in Granite Till A has an east-west orientation, parallel with ice flow features assigned to ice flow phase 4 of Stea and Finck (1984). Till fabric 2 was measured in the laterally equivalent Granite Till at Blandford and has a general northwest-southeast orientation consistent with ice flow phase 1 of Stea and Finck (1984). It is suggested that the discrepancy between the direction of glacial transport indicated by fabric 1 and by the pebble lithology is a result of re-setting of the till fabric by younger overriding ice during ice flow phase 4.

Lawrencetown Till

This till occurs as drumlins and a thin ground moraine 1-2 m thick near New Ross and Holden Lake. In the area mapped as Undivided Tills it is interspersed with lesser amounts of Granite Till B. Lawrencetown Till is cohesive, reddish-brown, and has a muddy matrix, but is sandy where the granite content is significant. It is interpreted as a basal melt-out till (Nelson, 1976).

The clast assemblage exhibits a variety of rock types derived from underlying bedrock to sources north of the South Mountain Batholith. A non-granitic pebble content of 30%-40% is present in the till. Foreign clasts are often metasiltstones of uncertain provenance and basalts eroded from the North Mountain 50 km to the north. The indistinct character of the metasiltstones does not allow a reliable inference of their source but in general these rock types are believed to originate in the Cobequid Highlands. Near New Ross, amygdaloidal basalt derived from the North Mountain constitutes 20%-40% of the Lawrencetown Till clast fraction. The precise direction of glacial transport cannot be defined using basalt clasts due to the large source area. In the same area, 40%-60% of the till clasts are locally-derived Panuke Lake Leucomonzogranite and New Ross Leucomonzogranite pebbles. Farther travelled biotite monzogranite from the Salmontail Monzogranite is also present. The distance to the closest possible source of this intrusion is 4 km (Ham, 1988). The average renewal distance in Lawrencetown Till is 4.2 km with a minimum of 1.4 km and a maximum of 10.5 km. The renewal distance, as defined by Peltoniemi (1985), is the distance over which the proportion of a new rock type increases in the till from 0% to 50%.

Fabric 3 at Simms Settlement has a strong north-south orientation indicative of a southward direction of transport (ice flow phase 2 of Stea and Finck, 1984).

Granite Till B

Granite Till B is the most widespread surface till in the study area and forms a flat to rolling ground moraine. It is loose, yellowish-brown and stony with a sandy matrix.Clasts are angular to subangular (after Powers, 1953). In drumlin sections it is less than 2 m thick and overlies Lawrencetown Till or Granite Till A. As a ground moraine it varies in thicknesses from 1-6 m. Granite Till B is tentatively interpreted as a basal melt-out till and is generally correlative with loose sandy tills mapped by Grant (1963) and Stea and Fowler (1979).

Granite Till B has a spectrum of clast composition, from till of local derivation to till in which the source of part of the pebble fraction is greater than 2 km. The average renewal distance in locally-derived Granite Till B is 100-400 m. In a 2 m till exposure north of Dauphinees Mill Lake, greisenized granite bedrock is incorporated into the local till sheet. The lateral displacement distance to surface is less than 5 m. Transport distances of this hydrothermally altered bedrock are similar to those predicted for the most local clasts in Granite Till B. The Spondo Lake area is an example of an area where the clast geology of the local till changes rapidly as a bedrock contact is crossed. The transition from granite till to Meguma Group till is achieved over a distance of tens to hundreds of metres.

Granite Till B exhibiting a more distal provenance has a polymictic clast content. Some granitic clasts have been transported hundreds to a few thousands of metres and represent more than one bedrock source. The dominant granitic clast type usually represents underlying bedrock, except over small granitic bodies or near the up-ice contact of a bedrock body. This till contains Meguma Group and/or) other allochthonous clasts. Incorporation of older tills is believed to contribute to the diverse clast geology. Granite Till B having a more distal provenance is well exposed north of Highway #103 along an access road leading to Panuke Lake. The till is clast-poor, commonly containing less than 10% clasts. It is loose, matrix supported and sandy. Bedded sand and gravel lenses and washed zones around boulders are observed in well exposed sections.

Fabrics in Granite Till B are difficult to measure due to the lack of elongated clasts. Fabric 4 was measured in a sandy, clast-poor variety of Granite Till B. Fabric 5 was measured in Greywacke Till B. Both fabrics are oriented northwest-southeast. Dispersal of biotite monzogranite along the Beech Hill road is southeastward in Greywacke Till B and coincides with the measured fabrics.

At Simms Settlement, stony Granite Till B overlies Lawrencetown Till and has inclusions of the older till, suggesting this unit formed during ice flow phases 3 and(or) 4. Granite Till B and laterally equivalent tills probably correlate with late ice flow radiating from a South Mountain Batholith ice cap or an ice divide on the Southern Uplands, defined as flow phase 3 of Stea and Finck (1984). This ice centre was short-lived, had regionally variable flow directions and produced immature tills. On this map sheet most of the till was transported in a southeastward direction.

Granite Till C

This unit occurs as a discontinuous hummocky ablation moraine and as isolated till mounds that commonly coalesce to form sinuous ridges with low relief. Except for the Spondo Lake area, isolated mounds of Granite Till C occur across the entire map sheet. Ablation moraine is mapped near Long Lake, Beech Hill Lake and Dauphinees Mill Lake. A broad belt of granite, greywacke and slate ablation till extends southeastward from Spectacle Lake to Chester. In this area, Greywacke Till C and Slate Till C were mapped as facies equivalents of Granite Till C.

Granite Till C is loose, pale yellowish-brown and has a structured sandy matrix. A section is well exposed in a till cut west of Goat Lake at sample site #265. Fluvial sediments consistent with deposition by planar sheet flow are interlayered with till. The sedimentary fluvial structures are preserved but are deformed by loading and dewatering. Planar bedded sand is seen wrapped beneath boulders, indicating scouring of till (Shaw, 1982) by flowing meltwater with subsequent deposition of sand and drop-out of the boulders. Subparallel sand lenses appear to be analogous to gutter casts. Clast counts are often varied, revealing local and up-ice granites, Meguma Group and(or) other allochthonous rock types. Granite Till C is interpreted as an ablation deposit.

Fabric 6 was measured in Greywacke Till C north of Chester Basin. Its major mode is 185-005° with lesser southwest-northeast and southeast-northwest modes. In this area, a south-southeast clast dispersal from distinctive granitic bodies is well defined in Greywacke Till C. Spectacle Lake Leucomonzogranite (Corey, 1988) was observed 4 km south of the bedrock source area (sample #212). Clasts identified as Millet Lake Monzogranite and Panuke Lake Leucomonzogranite were mapped 2 km south of their bedrock source. Sample #270 near Bayswater contains leucocratic granite clasts. In the same area, clasts of similar lithology occur in locally derived samples of Granite Till B (sample #s 263 and 268). The clasts were probably dispersed southward from the Panuke Lake Leucomonzogranite at Northwest Cove. The average renewal distance in Granite Till C is 3.5 km, but varies from 280 m to 8.5 km.

Westward flow in the lowland areas to the east (Prest *et al.*, 1972; Stea, 1982) diverged to the southwest and encroached on the South Mountain Batholith. Clast dispersal evidence is found north of Queensland, Halifax County, where unusually high Meguma Group clast percentages (10%-26%) occur in an area of hummocky moraine. The closest source for Meguma Group rocks is near Upper Hammonds Plains to the northeast. This area is also enriched in fine- to medium-grained leucomonzogranite possibly derived from the Tantallon Leucomonzogranite which is also to the northeast. At Pockwock Lake (map sheet 11D/12) southwest-trending striations and till fabrics support the presence of a southwest flow (Finck and Graves, 1987). The terminus of this flow is unknown, however at Windsor Road there is an occurrence of Sandy Lake Monzogranite boulders believed to be eroded from parent inliers near Connaught Lake (M.C. Corey, personal communication) suggesting the southwestward flow reached this region.

In a rock quarry near fabric site 5 (Windsor Road), Granite Till C was observed overlying Greywacke Till B. Granite Till C and equivalent facies are lithostratigraphic units and relate regionally to more than one ice flow phase. The authors correlate Granite Till C and laterally equivalent facies with ice flow phases 3 and(or) 4 of Stea and Finck (1984). Similarly, Granite Till B was formed by one or both of these two late ice flows.

Ice Marginal Features

Conical mounds and lineated moraines are common in the Chester area. Composed of Granite, Greywacke and Slate Till C, these features form a broad arcuate belt across the southern portion of the map sheet. Ice marginal features on the Aspotogan Peninsula were mapped using air photographs; the till composition was not directly observed.

Transversely lineated topography and deposition of hummocky supraglacial diamict resulted from the incremental marginal stagnation of active glacial ice (Eyles, 1982). Such a process produces hummocky sinuous ridges, conical hills and pitted surfaces or kettles similar to those developed in the map area. These features form belts of terminal moraine consistent with criteria outlined by Goldthwait (1907). He also noted that a terminal moraine forms around an ice lobe at a significant maximum extent. This process and resulting glacigene landforms are consistent with ice sheet retreat in New England, described by Koteff and Pessl (1981), where active ice was fringed by a marginal zone of stagnant ice.

North of Highway #103, at Middle River, a large 20 m high conical hill of interlayered till and bedded gravel and sand was mapped in association with a series of other conical hills, depressions and stratified drifts. The mound is restricted to the end moraine belt and is probably a kame moraine. A concentration of sinkholes was mapped in this area and southwest to Chester Basin by Fairbault (1908). He attributed the sinkholes to the presence of gypsum bedrock. Sage (1954) believed this area to be underlain by Goldenville Formation rocks, not gypsum. The authors feel that depressions in this area are kettles associated with the mounds characteristic of Greywacke Till C and Slate Till C. The authors agree that minor amounts of gypsum and(or) limestone are present, however bedrock is mainly Meguma Group greywacke and slate. The authors did not observe any limestone or gypsum clasts in Greywacke or Slate Till C near Chester Basin. It should be noted that small amounts of local bedrock occur in Slate Till C within tens of metres of crossing the up-ice contact between granitoid rocks and slate near Millet Lake.

The moraine belt from directly north of Chester to Aspotogan and the general nature of the surface till east of Highway #14 are consistent with active ice fringed by a marginal zone of stagnant ice. Koteff and Pessl (1981) state that stagnant margin ice forms an obstruction to moving ice behind it, forcing the upward shearing of live ice. Abraded material is transported upward along shear planes. Upon melting, this material may be left as ablation till, boulder lag and transversely lineated moraine. Topography is subdued in the map area, thus it is unlikely that boulder lag east of Highway #14 formed by material falling onto an ice surface. Rather, the boulder lag formed by the melt-out of debris-rich bands.

The lack of a boulder lag over Granite Till C south of Spectacle Lake suggests flowing ice stagnated rapidly with little upward shearing of subglacial or englacial material onto the ice surface. Sugden (1970) noted that stagnation is likely to reflect the downwasting of an ice sheet where sudden truncation of ice supply might be expected. Fluvioglacial landforms are associated with stagnant ice. This is consistent with the presence of kame moraines and ice-contact stratified drift in the area.

Note: Detailed explanation of till units is restricted to granitic and allochthonous tills overlying the South Mountain Batholith. Discussion of Meguma Group tills is included in the description of lithological facies in the legend.

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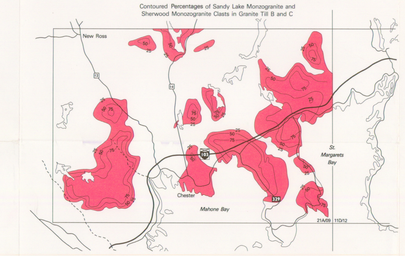
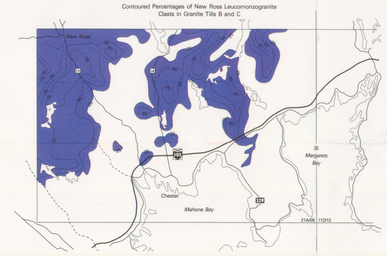
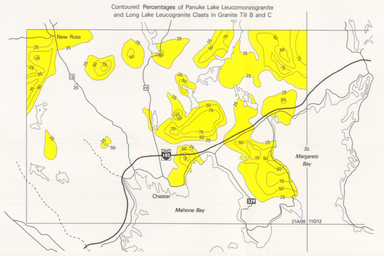
Contoured Percentages of Sandy Lake Monzogranite and Sherwood Monzogranite Clasts in Granite Till B and C



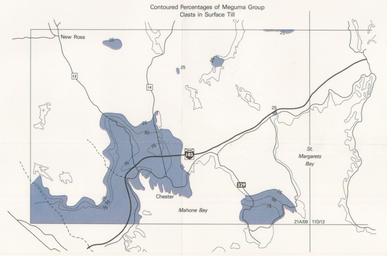
Contoured Percentages of New Ross Leucomonzogranite Clasts in Granite Tills B and C



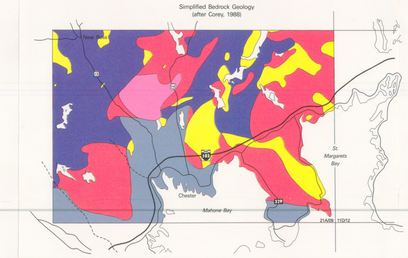
Contoured Percentages of Panuke Lake Leucomonzogranite and Long Lake Leucogranite Clasts in Granite Till B and C

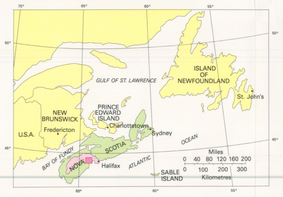


Contoured Percentages of Meguma Group Clasts in Surface Till

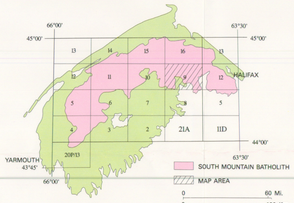


Simplified Bedrock Geology (after Corey, 1988)





Location Map



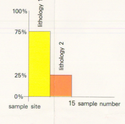


Illustration shows the system of lithological representation used on this map. Each histogram represents the relative percentages of the lithologies found in the pebble fraction of an 8-9 kg till sample.