LEGEND

SURFICIAL DEPOSITS

QUATERNARY

HOLOCENE - LATE WISCONSINAN

A-OW **UNDIFFERENTIATED ALLUVIAL AND OUTWASH DEPOSITS (A-OW):** A; silt, sand and gravel; forms alluvial floodplains and alluvial channel deposits. OW; silt, sand and gravel; massive or horizontally bedded; channel sequences common; forms flat plains and terraced deposits.

IC **ICE CONTACT DEPOSITS (IC):** silty sand, gravel and boulders, abrupt grain size transition from shallow to steeply dipping beds; faulting is common; clasts reflect provenance of surrounding till; may be interstratified with till; forms kames and thin gravel deposits near lakes; thickness 1-6 m.

LATE - MIDDLE WISCONSINAN

BRT **BEAVER RIVER TILL (BRT):** Divided into **ablation, ground moraine** and **drumlin-derived units.**

GTC **Ablation moraine (GTC):** Granite lithological facies; loose, matrix to clast supported till; may contain interbeds of silt, sand and gravel; colour varies from very pale brown (10YR7/4) to yellowish-brown (10YR5/4); forms poorly developed hummocks and ridges with associated ice contact deposits; clasts and matrix are generally locally-derived, glacial transport is toward the southeast and south.

GTB **Ground moraine:** Subdivided into granite **(GTB),** greywacke **(GWB)** and slate **(SLB)** lithological facies; structureless stony matrix though sandier varieties with minor washed zones around boulders are common; colour varies from light-yellowish-brown (10YR6/4) to dark yellowish-brown (10YR4/4) in the granitic facies, light olive-brown (2.5Y5/4) in the greywacke and slate facies; generally forms a featureless ground moraine; exhibits rapid lithological change down-ice of bedrock contacts, >90% of clasts are transported less than 1 km; renewal distances vary from tens to hundreds of metres; thickness 1-6 m; glacial transport is southeastward.

GWB

SLB

GTB(D) **Drumlin-derived moraine (GTB(D)):** Loose, medium- to coarse-grained sandy matrix, moderately stony, minor washing; colour is brown (10YR5/3) to dark yellowish-brown (10YR4/4); till matrix and forms a ground moraine between drumlins; nongranitic lithologies are incorporated from stratigraphically older till; matrix composition is in part dependent on composition of reworked older till; thickness is 1-4 m; striae and glacial transport directions are the same as those of the ground moraine unit, however a strong southeast transport was inherited from older reworked southeast transported till(s).

LT **LAWRENCETOWN TILL (LT):** Muddy to sandy till, moderately compact, jointed, greenish mottling in the weathered zone; colour varies from dark reddish-brown (2.5YR2/4) to strong brown (7.5YR4/6); occurs as a ground moraine and drumlins; clast lithologies vary from 10-90% local bedrock to 10-90% non-granitic clasts derived from as far as 90 km, distal sources are the metasedimentary /volcanic/massif complex of the Cobequid Highlands, Meguma Group, metasedimentary and volcanic rocks of the White Rock, New Canaan, Kentville and Torbrook Formations, and North Mountain basalt; renewal distances vary from hundreds of metres to tens of kilometres; thickness 1-5 m as a ground moraine and 6-30 m as drumlins; dispersal direction varies from southward to southeastward.

PRE-QUATERNARY

D **RESIDUUM (D):** Chemically weathered bedrock; commonly develops a soil-like consistency due to in situ weathering followed by glacial mixing; may retain hypidiomorphic granular texture of parent granite, preservation of K-feldspar megacrysts and hydrothermally altered fine-grained zones restricted to the topographically higher regions of the Southern Uplands; thickness varies from a thin veneer to >3 m.

R **BEDROCK (R):** Glacially scoured bedrock; areas of discontinuous till veneer and R-horizon soil developed to bedrock; bedrock structure and large-scale features of glacial erosion are easily discernible on aerial photographs.

SYMBOLS

Striations; sense of ice flow (known, unknown, 1 is oldest, 2 is youngest,from MacNeill)

Contact between surficial units (abrupt, gradational, assumed)

Contact between surficial units inferred from bedrock geology

Lineaments; may or may not be structurally controlled, possible ice scour along structurally weakened zones

Bedrock ridges (linear, strike)

Till veneer

Drumlin

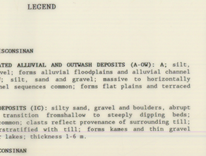
Ablation mound

Esker, flow direction unknown

Moraine (minor)

Kettle

Escarpment in unconsolidated sediment



This illustration shown the system of lithological representation used on the map. Each bar represents a clast type. The bar height denotes the percentage of that clast type in the pebble fraction of the till. Clast lithologies on histograms are keyed to the legend. Axis of histogram defines sample location.

FIGURE 1: This figure shows the incorporation of Meguma Group wacke clasts into the Beaver River Till ground moraine with the resulting dilution of up-ice granitic clasts. Glacial transport is towards the southeast, approximately perpendicular to the granite-metasediment contact. Renewal distance in the Beaver River Till ground moraine is 200 m.

PREVIOUS WORK

Till in the New Germany area (NTS sheet 21A/10) has been examined extensively by soil scientists, government and exploration geologists. As part of the Nova Scotia Soil Survey, Cann et al. (1958, 1965) and MacDougall et al. (1969) divided the soils of Lunenburg, Kings and Annapolis Counties producing 1:126 720 scale maps. Mapping of the soil catenas included a reference to the parent material from which the underlying Quaternary deposit may be inferred. This work assisted the present survey in determining till unit boundaries over the granitic terrain and was the primary source of information used to deduce the type of drift cover blanketing Meguma Group bedrock. In addition to the soil mapping of Cann and MacDougall, MacNeill (1956) produced 1:50 000 scale surficial geology maps that showed the distribution of drumlins, ice contact and fluvioglacial deposits.

Although exploration geologists have utilized soils and tills as geochemical sampling media over the South Mountain Batholith (SMB), little mapping of the tills and no separation of geochemically and lithologically distinct till units was attempted. Within the map area exploration concentrated on the Sn, W and U potential of the Fallaland Ridge-East, Dalhousie area. The most significant discovery was at Lake Torment where Shell Canada Resources Limited (MacGillivray, 1982) and Kiss Resources Canada Limited (MacLeod, 1982, 1983) reported tin anomalies in the soil and till. Tin-bearing boulders were also discovered, however a bedrock source for the geochemical anomalies and metalliferous float was not located.

INTERPRETIVE NOTES

Map Units

BEDROCK (R)

Ten percent of the study area was mapped as bedrock. Although this unit is not a surficial deposit, its occurrence and distribution is largely dependent on glacial processes. Bedrock as a map unit includes bare rock outcrop, regions of thin till and large weathered areas where B-soil horizon has developed to bedrock. All tills mapped on this map sheet occur sporadically within this unit. In the area of Lake Pleasant on the west side of the map sheet and near the Sherbrooke Lake bedrock area on the east side of the map sheet a veneer of Lawrencetown Till is the most common deposit. At Mount Uniacke and Beaver River Till predominates.

The general relief and configuration of the land surface results from the effects of glacial erosion and bedrock structure. Large strike ridges near Meiseners Section on the west side of the map sheet and at Dale Lake in the southeast corner of the map sheet were formed by glacial smoothing and plucking by ice as it flowed parallel to the major joint system. These regions, as will an area north of Sherbrooke Lake, were scoured by very erosive southeastward-flowing ice.

Surfaces of bedrock outcrops are commonly weathered or frost shattered, destroying glacial striations. However striations on outcrop recently exposed during road construction reveal two major directions of glacier flow and a third minor flow. The oldest flow was toward the east-southeast with an average direction of 120°. A younger flow was also southeastward with an average direction of 148°. The age relationship between these two sets of striations was determined on an outcrop east of Pleasant River Lake where nailhead striations trending 112° are crosscut by younger 150° striations and grooves. Flow direction was defined by well developed crag and tail. Near Wild Duck Lake striations of the oldest flow are crosscut by northwest-trending striations. The presence of northwestward-trending striations indicates that ice flow originated to the south and that the SMB ice cap or divide of Stea (1988) was situated south of Wild Duck Lake.

RESIDUUM (D)

Less than one per cent of the study area was mapped as residuum. It was noted in gravel pits and hand dug holes in the northwest part of the map sheet, varies in thickness from <0.5 m to >3 m, and is commonly greyish-brown or pale grey in colour. MacNeill (1956) documented the presence of residuum on the SMB by disturbing 10 occurrences of unconsolidated granitic bedrock that he believed was formed by intense weathering. However mahogany-and dark salmon-coloured "weathered" granite bedrock described in some instances by MacNeill (1956) represents intensive hydrothermal (hematitic) alteration of bedrock and is not residuum.

One kilometre west of Waterloo Lake (site 1) >3 m of grey residual granite is exposed in a road cut. Insitu weathering of the granite has produced a loose material with the original hypidiomorphic granular texture of the parent granodiorite bedrock. The residuum is easily excavated with a pick and shovel. Grey bands of silty material containing non-granitic clasts were observed in the residuum. The bands are believed to be till wedges developed by the opening of tension fractures in the down-glacier direction during continued glacial drag and subsequent infilling with till (Dreimanis, 1969). The bands generally strike northeast and dip to the southeast.

Greyish-brown residuum mixed and transported by ice is also preserved in a small gravel pit east of Waterloo Lake (site 2). The original texture of the parent bedrock is completely destroyed leaving a loose disaggregated mass called grus. It overlies bedrock inscribed with striations trending 120°. The direction of ice flow indicated by the striations is in agreement with the orientation of the till wedges west of Waterloo Lake.

Residuum is overlain by Beaver River Till (GTB) along a logging road (site 3) separating Upper and Lower Thirty Lakes in the southeast corner of the map sheet. The till contains intensely weathered granodiorite clasts which were recycled from the underlying residuum. Residuum was also incorporated into overlying Lawrencetown Till as noted in a gravel pit 2 km east of Waterloo Lake (site 4). The transition zone between these two units is approximately 0.5 m in width and contains allochthonous clasts mixed into the residuum during reworking by the overriding glacier.

Pavich (1986) calculated a rate for saprolite (residuum) development of 1 m per 250 000 years in a granite gneiss of the Virginia Piedmont. Based on this information and the observed thickness of residuum on this map sheet and elsewhere on the SMB (4-6 m) a pre-Pleistocene age is suggested for the residuum on map sheet 21A/10. This is in agreement with a pre-Pleistocene age suggested by MacNeill (1956) and also postulated for weathered bedrock in New Brunswick (Wang et al., 1981) and Cape Breton (McKeague et al., 1983).

LAWRENCETOWN TILL (LT)

Forty percent of the map area is covered by Lawrencetown Till. It occurs as drumline and ground moraine extending from Dalhousie road in the north to Barss Corner in the south and primarily overlies Meguma Group bedrock. It is bordered on the east by Sherbrooke Lake and extends westward past Springfield. This area of Lawrencetown Till is a northwesterly extension of the Lunenburg drumlin field of Grant (1963).

The greatest concentration of drumlins occurs near Springfield and New Germany where individual drumlins reach heights of 30 m. Although the majority of the drumlins are oriented northeast-southeast some have a southward alignment suggesting deposition or more likely reorientation by a younger south-trending ice movement (Stea and Boone, 1989). Lawrencetown Till ground moraine varying from <1 m to 3 m in thickness occurs between the drumlins. Bedrock exposure is primarily restricted to the areas of ground moraine.

Clasts in the Lawrencetown Till reflect both a local (SMB) and foreign provenance. Bedrock sources for the latter are found 35-50 km to the north in the basaltic lavas of the North Mountain, metasedimentary and metavolcanic rocks of the White Rock Formation, and grey-black slate from the Meguma Group, Torbrook and Kentville Formations. The percentage of non-granitic lithologies present varies depending on the facies of Lawrencetown Till. The drumlin facies is consistently dominated by 50-90% non-granitic rock types whereas the ground moraine facies contains 10-50%. Drumlins near Springfield contain non-granitic clasts of grey, pink and purple quartzite, dark grey-black rhyolitic tuff, grey-black slate and basalt. The preponderance of White Rock clasts in the Springfield area results from the large area of subcropping up-ice metasedimentary and metavolcanic rocks to the northwest. In contrast, drumlins of the New Ross drumlin field east of Sherbrooke Lake contain no rocks of the White Rock Formation and are dominated by grey-black slate and basalt. Quartzites are not found in bedrock up-ice to the northwest of the New Ross drumlin field.

Although the provenance of non-granitic clasts in Lawrencetown Till within the map area indicates that large scale (50 km) southeast glacial dispersion occurred across the SMB, the SMB component only reflects underlying and/or bedrock sources from <12 km up-ice. A discussion and explanation for this is presented below.

Most Lawrencetown Till in the study area shows limited dispersion of clasts derived from immediately up-ice granite bodies. For example, within Lawrencetown Till ground moraine near Springfield, up-ice Scrag Lake Granodiorite clasts (1a) are dispersed approximately 2 km down-ice across the Lake George Leucomonzogranite with a concomitant increase in the proportion of leucomonzogranite in the till. Similarly in the Butler Lake area there is significant onlap of the Dalhousie Leucomonzogranite southeastward onto the Salmontail Monzogranite with only 20-25% incorporation of locally-derived Salmontail Monzogranite at an onlap distance of 5-6 km. Near Springfield drumlins overlap a bedrock contact between the Scrag Lake Granodiorite and the Lake George Leucomonzogranite (c.f. Horne, 1987). Although the Lawrencetown Till contains granite clasts eroded from the underlying bedrock, there is virtually no clast dispersion of Scrag Lake Granodiorite southeastward onto the Lake George Leucomonzogranite.

In all examples there is a total absence of granite clasts derived from bedrock units >12-35 km up-ice to the northwest as mapped by MacDonald and Ham (1988), Grey and Horne (1989) and Ham (1989). This implies the existence of a 20 km skip zone within which the bedrock was not incorporated into the Lawrencetown Till.

A model is presented for erosion, incorporation, transportation and deposition of material within Lawrencetown Till. A large proportion of the material in Lawrencetown Till was eroded and incorporated into a basal ice position by southeast- to south- flowing ice north of the SMB over the Fundy, Horton and Meguma Group rocks. As the ice impinged on the north flank of the SMB subglacial debris was sheared into an englacial position. This halted any further input of eroded bedrock material into the Lawrencetown Till. As such, granitic debris was not incorporated into the Lawrencetown Till as ice flowed across the SMB. Prior to and/or at the time of deposition locally-derived granitic lithologies were incorporated as Lawrencetown Till was deposited by a process of basal melting, suggested by Nielsen (1976). The amount of locally-derived granitic debris and the amount of dispersion are proportional to the resonance time of the Lawrencetown Till in a basal ice position prior to deposition. Thus drumlins contain very little local material while ground moraine contains more granite clasts and shows greater dispersion.

BEAVER RIVER TILL (BRT)

The Beaver River Till is divided into **ablation, ground moraine** and **drumlin-derived** units after Finck et al., 1989.

Ground Moraine: This unit is subdivided into granite **(GTB),** greywacke **(GWB)** and slate **(STB)** lithofacies. Greywacke and slate ground moraine cover 18% of the map sheet, occurring in the central and southern part of the map area overlying Meguma Group bedrock. Since mapping by the authors was restricted to the SMB and the immediate exocontact, the distribution of greywacke and slate ground moraine is based primarily on Nova Scotia Soil Survey maps (Cann et al., 1958, 1965; MacDougall et al., 1969). This work was modified to accomodate airphotograph interpretation and mapping observations along the SMB-Meguma Group contact during the current survey. Granite ground moraine covers 31% of the map area. It is restricted to the east, north and west margins of the map sheet.

Beaver River ground moraine forms a flat featureless to rolling topography. Drumlins are less common in this unit than in areas of Lawrencetown Till. Where drumlins occur the ground moraine usually forms till veneer overlying stratigraphically older tills. The till composition of drumlins in areas of limited access was based on airphotograph interpretation and regional mapping. As such the surface till on some of these drumlins may actually be Beaver River drumlin-derived moraine or older Lawrencetown Till.

Clasts in ground moraine tills are locally derived and can be used to infer underlying bedrock geology. A comparison of the clast geology of the Beaver River Till with the bedrock geology of the area (Fig. 1), shows that the distribution of granite and Meguma Group till clasts closely mirrors the known bedrock geology. The accurate representation of bedrock lithologies in the clast geology of the overlying ground moraine is due to the short (200 m) renewal distances in the till (Fig. 2). In areas of thin till (<1 m), such as overlying the East Dalhousie Leucomonzogranite in the north-central portion of the map sheet and overlying small porphyry and leucomonzogranite bodies south of Springfield Lake, the renewal distance in the till is a few tens of metres.

The short transport distance of clasts in the ground moraine makes it difficult to determine the direction of glacial transport using clast dispersal evidence. However the bulk of the ground moraine appears to have been transported southeastward with minor dispersal towards the northeast during late stage ice flow reversal.

Drumlin-Derived Moraine (GTB(D)): Approximately 13 of the map area is covered by drumlin-derived moraine. It occurs along the north edge of the map sheet and near Meiseners Section. This till is a laterally equivalent facies of the Beaver River granite ground moraine enriched in non-granitic lithologies due to its proximity to the Lawrencetown Till. At Meiseners Section the enrichment of Meguma Group greywacke in this till results from recycling of the Lawrencetown Till.

Mapping of the drumlin-derived moraine near Meiseners Section is problematical. In this area bedrock was mapped as Little Round Lake Monzogranite by Horne (1987). Tills in the area generally appear to be drumlin-derived moraine, however some samples containing up to 70% Meguma Group greywackes appear to be GWB. This inconsistency might be explained by the presence of unmapped subcropping inliers of Meguma Group rocks.

Ablation Moraine (GTC): Approximately 13 of the map area is covered by granitic ablation moraine. It forms a poorly developed hummocky moraine restricted to the northwest corner of the map sheet. Till exposure is limited with its distribution based mainly on airphotograph interpretation. The ablation moraine will be discussed more fully in marginal notes on the map sheet immediately to the north, 21A/15.

ICE CONTACT DEPOSITS (IC)

Approximately 13 of the map area is covered by ice contact deposits that form an esker and small kames near Tommy Lake and small kames southeast of Waterloo Lake. Esker and kame sediments are derived primarily from glacial debris by the washing and sorting action of meltwater. The clast geology of the ice contact deposits will reflect the provenance of the englacial and subglacial load. In areas of Beaver River ground moraine clasts of the ice contact deposits are derived from the clast geology of the till and hence reflect local bedrock geology. Direct field evidence occurs north of Tommy Lake where kame gravel is composed predominantly of Lake George Leucomonzogranite. The till is Beaver River ground moraine and the underlying bedrock is Lake George Leucomonzogranite. Ice contact deposits also have a lithologic content representative of the surrounding Lawrencetown Till. Southeast of Waterloo Lake, the Lawrencetown Till bears 10-50% granite believed to be Scrag Lake Granodiorite, 4-32% Joe Simon Leucomonzogranite and 40-70% allochthonous clasts. In this area kame gravel at two sites has a similar lithologic composition of 25% Scrag Lake Granodiorite, 5% Joe Simon Leucomonzogranite and 70% allochthonous clasts.

* Renewal distance is the distance required by a given rock type (measured from the proximal contact of the up-ice lithology) to increase its proportion in till from 0% to 50% (Peltoniemi, 1985).

Till Clast Lithologies

1a **Biotite granodiorite (1a)/monzogranite (1):** grey; texture varies: fine- to coarse-grained, medium grained equigranular and medium- to coarse-grained; contains megacrysts of K-feldspar; 10-15% biotite; bedrock sources are the Scrag Lake Granodiorite, Salmontail Monzogranite, Little Round Lake Monzogranite, Whale Lake Monzogranite and Walden Monzogranite

2 **Biotite ± muscovite ± cordierite leucomonzogranite:** colour varies: light grey; buff and pink; medium- to coarse grained; contains megacrysts of K-feldspar; 3-5% biotite; 0-2% muscovite; commonly hematized; bedrock sources are the New Ross Leucomonzogranite and Lake George Leucomonzogranite

3 **Porphyry:** grey; fine- to medium-grained inequigranular texture; 3-10% biotite; 1-2% muscovite in porphyry having minor biotite (3-5%) content; bedrock sources are the Little Round Lake Monzogranite, small unnamed porphyry intrusives and textural variations of the Salmontail Monzogranite

4 **Biotite muscovite leucomonzogranite:** colour varies: white, grey, buff, pink and red; texture varies: fine grained equigranular and fine- to medium-grained; may contain quartz and K-feldspar megacrysts; 3-5% biotite; 0-2% muscovite; commonly hematized; bedrock sources are the Panuke Lake Leucomonzogranite, East Dalhousie Leucomonzogranite and fine grained dyke rocks

5 **Leucocratic rocks:** colour varies: white, pink; texture varies: fine grained equigranular and pegmatitic; trace biotite; 0-2% muscovite; bedrock sources are the Keddy-Seavey Leucogranite and pegmatitic intrusives

6 **Meguma Group:** grey-green wacke; grey to greyish-black slate; clasts are derived predominantly from the Meguma Group but include Torbrook and Kentville Formation lithologies

7 **Foreign:** slate; quartzite; amygdaloidal and non-amygdaloidal basalt; indurated sandstone; volcanic breccia, mafic intrusives, rhyolite and rhyolitic tuff; bedrock sources are the North Mountain basalt, White Rock Formation, mafic dyke rocks, and Triassic sedimentary basins

* All granite bedrock units are after Horne (1987)

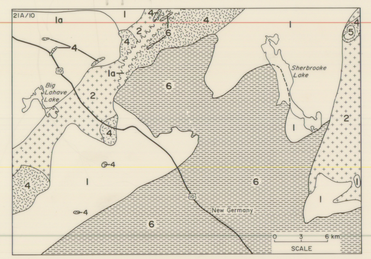
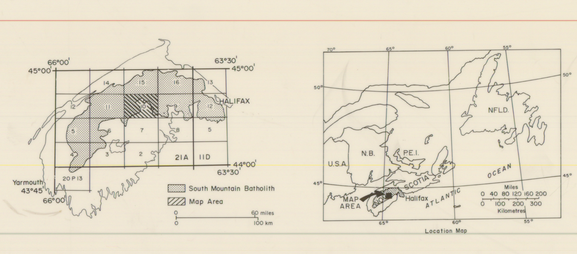


FIGURE 2: Simplified bedrock geology of the New Germany map sheet (21A/10) modified after Horne (1987). Bedrock units are keyed to the till clast legend and histograms on the glacial geology map.



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

Cann, D. B. and Hilchey, J. D. 1958: Soil survey of Lunenburg County, Nova Scotia; Nova Scotia Soil Survey, Report no. 7, 48 p.

Cann, D. B. and MacDougall, J. I. 1965: Soil survey of Kings County, Nova Scotia; Nova Scotia Soil Survey, Report no. 15, 97 p.

Corey, M. C. and Horne, R. J. 1989: Preliminary geological map of Milford (NTS sheet 21/11); Nova Scotia Department of Mines and Energy, Open File Map 89-014, scale 1:50 000.

Finck, P. W., Graves, R. M. and Boner, F. J. 1989: Preliminary glacial geology of the South Mountain Batholith, Nova Scotia; Department of Mines and Energy, Open File Map 89-018, scale 1:250 000.

Grant, D. R. 1963: Pebble lithology of the tills of southeast Nova Scotia; M.Sc. thesis, Dalhousie University, Halifax, Nova Scotia; Nova Scotia Department of Mines and Energy, Thesis 129, 235 p.

Ham, L. J. 1989: Preliminary geological map of Digby (NTS sheet 21A/12); Nova Scotia Department of Mines and Energy, Open File Map 89-013, scale 1:50 000.

Hicock, S.R. and Dreimanis, A. 1984: Glaciotectonic structures as useful ice-movement indicators in glacial deposits: four Canadian case studies; Canadian Journal of Earth Sciences, v. 22, p. 339-346.

Horne, R. J. 1987: Preliminary geology map of New Germany (NTS sheet 21A/10); Nova Scotia Department of Mines and Energy, Open File Map 87-004, scale 1:50 000.

MacDonald, M. A. and Ham, L. J. 1988: Preliminary geological map of Gaspereau Lake (NTS sheets 21A/15 and part of 21H/02); Nova Scotia Department of Mines and Energy, Open File Map 88-016, scale 1:50 000.

MacDougall, J. I. and Rowland, J. L. 1969: Soil survey of Annapolis County, Nova Scotia; Nova Scotia Soil Survey, Report no. 16, 84 p.

MacGillivray, G. 1982: Report on geological, till and rock geochemical surveys, East Dalhousie, Nova Scotia; Nova Scotia Department of Mines and Energy, Assessment Report 21A/10C 51-K-28(01).

MacLeod, J.L. 1982: Report on geological, till, stream sediment and rock geochemical surveys, East Dalhousie, Nova Scotia; Nova Scotia Department of Mines and Energy, Assessment Report 21A/10C 51-K-28(02).

MacLeod, J.L. 1983: Report on geological, stream sediment, till geochemical surveys and trenching, East Dalhousie, Nova Scotia; Nova Scotia Department of Mines and Energy, Assessment Report 21A/10C 51-K-28(03).

MacNeill, R. H. 1954: Deeply weathered granite in Nova Scotia; Nova Scotia Research Foundation, Halifax, Nova Scotia, Paper 54-1, 10 p.

MacNeill, R. H. 1956: Surficial geology maps of Nova Scotia; Nova Scotia Research Foundation Corporation, Dartmouth, Nova Scotia; scale 1:50 000.

McKeague, J. A., Grant, D. R., Kodama, H., Beke, G. J. and Wang, C. 1983: Properties and genesis of soil and the underlying gibbsite-bearing saprolite, Cape Breton Island, Canada; Canadian Journal of Earth Sciences, v. 20, no. 1, p. 37-48.

Nielsen, E. 1976: The composition and origin of Wisconsinan tills in mainland Nova Scotia; Ph.D. thesis, Dalhousie University, Halifax, Nova Scotia; Nova Scotia Department of Mines and Energy, Thesis 277, 256 p.

Pavich, M. J. 1986: Processes and rates of saprolite production and erosion on a foliated granitic rock of the Virginia Piedmont; in Rates of Chemical Weathering of Rocks and Minerals, eds. S. M. Colman and D. P. Dethier; Academic Press, Inc., p. 552-590.

Peltoniemi, H. 1985: Till lithology and glacial transport in Kuhmo, eastern Finland; Boreas, v. 14, p. 67-76.

Stea, R. R., Turner, R.C., Flpck, P.W.and Graves, R.M. 1988: Glacial dispersal in Nova Scotia; a zonal concept; in Prospecting in Areas of Glaciated Terrain 1988, eds. D. R. MacDonald and K. A. Mills; Canadian Institute of Mining and Metallurgy, p. 37-79.

Stea, R. R. and Brown, Y. 1989: Variation of Drumlin orientation, form and stratigraphy relating to successive ice flows in central and southern Nova Scotia; Sedimentary Geology, v. 62, p. 225-240.

Wang, C., Ross, C. J. and Rees, H. V. 1981: Characteristics of residual and colluvial soils developed on granite and of the associated pre-Wisconsinan landforms in north-central New Brunswick; Canadian Journal of Earth Sciences, v. 18, p. 487-494.

OPEN FILE MAP 89-019

PRELIMINARY
GLACIAL AND TILL CLAST GEOLOGY OF
NEW GERMANY
NTS 21A/10
SOUTH MOUNTAIN BATHOLITH PROJECT

P. W. FINCK, R. M. GRAVES AND F. J. BONER

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY

Jack MacIsaac, Minister — John J. Laffin, D.Eng., FEIC, P.Eng., Deputy Minister

HALIFAX, NOVA SCOTIA
1989

Scale 1:50 000
Kilometres
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Miles
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Department of Mines and Energy

Canada-Nova Scotia Mineral Development Agreement