NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY

MAP 87-4

TILL CLAST AND SIMPLIFIED GLACIAL GEOLOGY OF

HALIFAX AND SAMBRO

(N.T.S. SHEETS 11D/12 and 11D/05)

NOVA SCOTIA

R.M. GRAVES and P.W. FINCK

SCALE 1:50 000

Miles 1 0 1 2 Miles

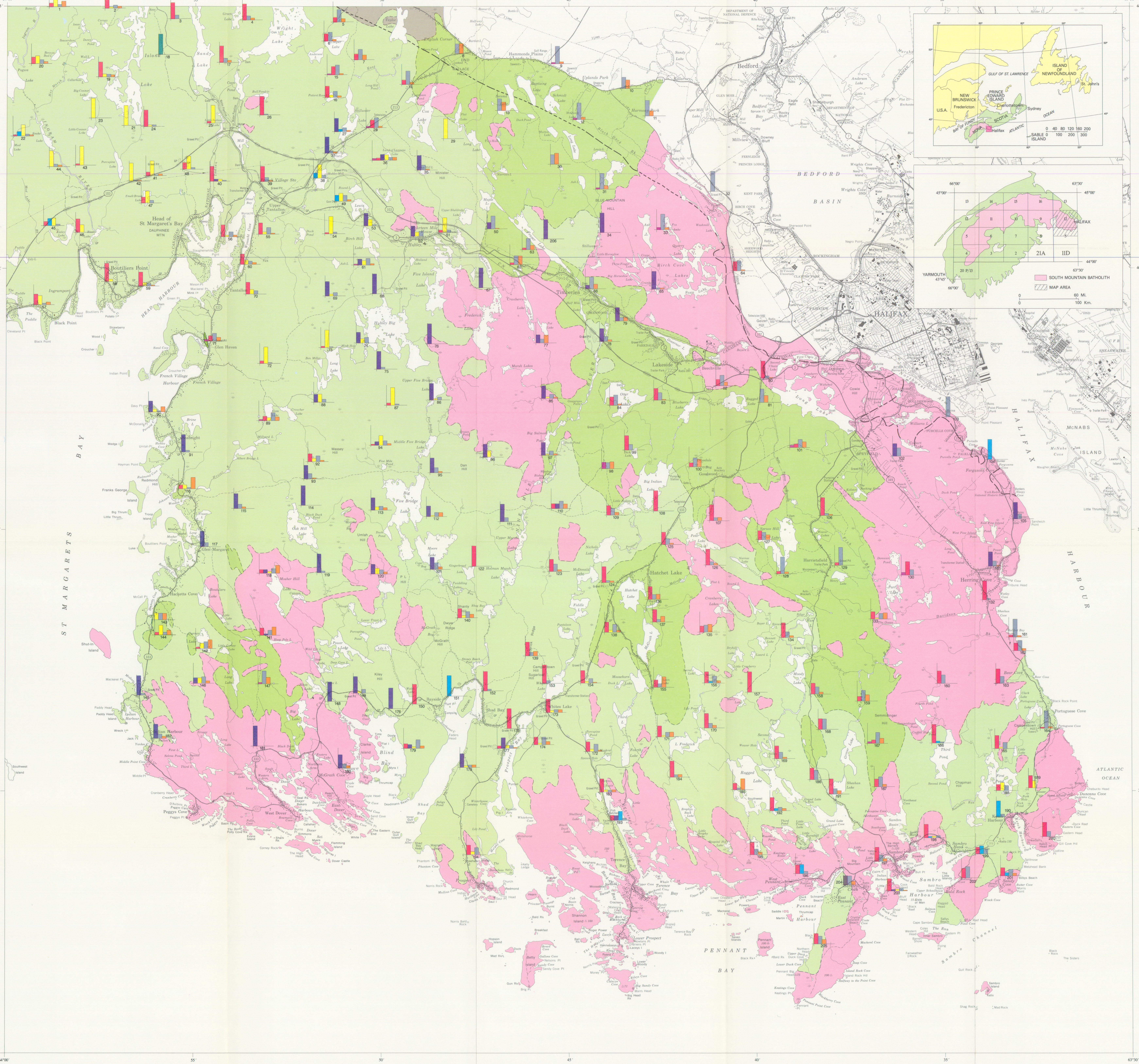
Kilometres 1 0 1 2 3 4 Kilometres

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY

HONOURABLE KEN STREATCH, MINISTER — JOHN J. LAFFIN, P.ENG., FEIC, DEPUTY MINISTER

HALIFAX, NOVA SCOTIA

1987



LEGEND

TILL CLAST LITHOLOGIES (11D/12)

- **Granodiorite**: light to medium grey; medium- to coarse-grained; K-feldspar megacrysts (2-3 cm); 15% biotite; 0% muscovite.
- **Biotite monzogranite**: light to medium grey; fine- to coarse-grained; K-feldspar megacrysts (2-3 cm); 10% biotite; 0% muscovite; bedrock sources are generally the Sandy Lake Monzogranite and the Harrietsfield Monzogranite.
- **Muscovite ± biotite ± cordierite monzogranite**: light grey to buff; medium- to coarse-grained; K-feldspar megacrysts (2-3 cm); 5% biotite; 0-2% muscovite; saussuritized feldspar cores; minor cordierite; bedrock source is the Halifax Peninsula Leucomonzogranite.
- **Porphyry**: colour varies: light buff, whitish grey; fine- to medium-grained; inequigranular matrix; quartz (2-5 mm) and K-feldspar (3-10 mm) megacrysts; 2-10% biotite; 0-1% muscovite; bedrock source is the Tantallon Leucomonzogranite.
- **Muscovite-biotite monzogranite**: colour varies: light buff, white, grey; fine- to medium-grained equigranular; minor quartz (3-4 mm) and K-feldspar (5-7 mm) megacrysts; 2-5% biotite; trace-3% muscovite; minor hematization; bedrock source is the Tantallon Leucomonzogranite.
- **Leucocratic rocks**: colour varies: white, pink, light buff; fine-grained equigranular; 0-1% biotite; 0-2% muscovite; bedrock source is the Tantallon Leucomonzogranite.
- **Meguma Group**: greywackes, grey quartzites, grey-black slates.
- **Foreign**: quartzite; meta-siltstone; basalt; rhyolite; tuff; sandstone; siltstone; diorite; diabase; hornblende granite; bedrock sources are the Minas Sub-basin, North Mountain basalt, Cobequid Highlands.

SIMPLIFIED SURFICIAL UNITS

Quaternary

Late Wisconsinan

- **Granite Tills**: loose to moderately compact; moderate yellowish brown (10YR5/4)[1] but may vary from greyish orange (10YR7/4) to dark yellowish brown (10YR4/2); matrix is 80% to 90% sand, 10% to 20% silt and clay; granite clasts are angular to subangular; Meguma Group and foreign clasts vary from pebble to boulder size, may be faceted and striated; locally overlain by a loose, sandy, greyish orange (10YR7/4) to moderate yellowish brown (10YR5/4) till; structureless sandy matrix with bedded sand and sandy gravel lenses; may have a hummocky morphologic expression.
- **Slate Till**: loose, light olive brown (5Y5/6); sandy matrix, clasts are typically greater than 50% angular Meguma Group slate, may contain local granites in contact area. (Note: Granite Tills have lateral equivalents within the Slate Till.)
- **Lawrencetown Till**: cohesive; moderate brown (5YR4/4 to 5YR3/4); matrix may be massive though fissility is common; facies gradation from brown, compact silt-sand till to reddish, moderately compact mud till; Meguma Group and foreign clasts range in size from pebbles to boulders and are usually faceted and striated.

Late Wisconsinan (?)

- **Granite Till A**: compact to highly compact; dark yellowish brown (10YR4/2) to moderate brown (5YR4/4); moderately stony, sandy matrix; Meguma Group and foreign clasts are faceted and striated.

Pre-Quaternary

- **Bedrock**: areas where B soil horizon is developed to bedrock; weathered, shattered bedrock is common; thin till may occur in bedrock hollows; large areas of glacially scoured bedrock.

[1]Colours after Goddard *et al.*, 1980

SYMBOLS

Contact between major surficial geological units (gradational)

Geological boundary between Meguma Group rocks and South Mountain Batholith granitic rocks (defined, approximate)

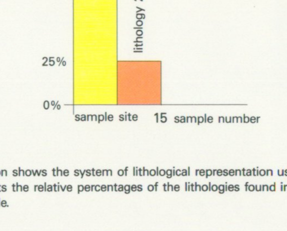


Fig. 1: Illustration shows the system of lithological representation used on this map. Each histogram represents the relative percentages of the lithologies found in the pebble fraction of an 8-9 kg till sample.

Planimetric base produced by the SURVEYS AND MAPPING BRANCH, DEPARTMENT OF ENERGY, MINES AND RESOURCES. Updated from aerial photographs taken in 1977. Culture check 1977. Published in 1980.

MRMS Cartography by: Maritime Resource Management Service Inc. Amherst, Nova Scotia

TILL CLAST PERCENTAGES

Sample No.	Till type	Granodiorite	Biotite monzogranite	Muscovite ± biotite ± cordierite monzogranite	Porphyry	Muscovite biotite monzogranite	Leucocratic rocks	Meguma group	Foreign
1	GTB	0	19	0	0	48	0	8	25
2	GTB	0	66	0	0	8	0	14	12
3	GTB	0	82	0	0	0	0	18	0
4	GTB	0	78	0	0	0	0	14	8
5	GTB	0	23	0	0	0	0	62	15
6	GTB	0	41	0	0	0	0	47	12
7	GTB	0	28	0	0	0	0	51	21
8	LT	0	0	0	0	0	0	50	50
9	LT	5	0	0	0	0	0	86	9
10	LT	0	0	0	0	0	0	55	45
11	LT	0	0	0	0	0	0	75	25
12	LT	5	0	0	0	0	0	83	12
13	LT	0	0	0	0	0	0	58	42
14	GTA	0	22	0	0	0	0	67	11
15	GTB	3	42	0	0	0	0	48	7
16	GTB	0	54	0	0	8	0	30	8
17	GTB	0	77	0	0	0	0	16	7
18	GTB	0	0	0	0	0	100	0	0
19	GTB	0	73	0	0	9	0	11	7
20	GTB	0	30	0	0	41	0	17	12
21	GTB	0	0	0	0	100	0	0	0
22	GTB	0	5	0	23	57	0	9	6
23	GTB	0	0	0	0	100	0	0	0
24	GTB	0	84	0	0	8	0	8	0
25	GTB	0	9	0	0	91	0	0	0
26	GTB	0	97	0	0	0	0	3	0
27	GTB	0	0	64	11	0	0	21	4
28	GTA	6	39	0	0	0	0	50	5
29	Regolith	0	0	0	0	100	0	0	0
30	LT	0	0	0	0	0	0	48	52
31	LT	5	0	0	0	0	0	79	16
32	GWB	0	0	0	0	0	0	100	0
33	LT	10	0	0	0	0	0	80	10
34	GTB	0	0	100	0	0	0	0	0
35	GTB	0	0	73	0	0	0	23	4
36	GTC	8	10	27	0	25	0	15	15
37	GTB	0	0	83	0	0	0	12	5
38	GTB	0	0	0	23	65	0	12	0
39	GTB	0	75	0	0	0	0	19	6
40	GTB	0	73	11	0	11	0	5	0
41	GTB	0	15	0	0	77	0	2	6
42	GTB	0	0	0	0	94	0	3	3
43	GTB	0	5	0	0	95	0	0	0
44	GTB	0	0	0	0	80	0	11	9
45	GTB	0	20	0	35	40	0	5	0
46	GTB	0	65	0	0	35	0	0	0
47	GTC	0	30	0	0	59	0	11	0
48	GTB	0	30	0	0	65	0	5	0
49	GTB	0	0	28	0	38	0	27	7
50	LT	0	0	30	0	0	0	67	3
51	GTB	0	13	0	0	75	0	12	0
52	GTB	0	0	52	0	21	0	27	0
53	GTB	0	0	62	0	32	0	6	0
54	GTB	0	5	0	0	88	0	7	0
55	GTA	0	55	0	0	11	0	27	7
56	GTB	0	60	0	0	5	0	25	10
57	GTB	0	49	0	0	43	0	2	6
58	GTB	0	90	0	0	10	0	0	0
59	GTB	0	70	0	0	15	0	13	2
60	GTC	0	53	0	0	21	0	16	10
61	GTA	4	0	30	0	23	0	34	9
62	LT	0	10	0	0	0	0	44	46
63	LT	0	14	0	0	0	0	60	26
64	GTB/GWB	0	47	0	0	0	0	49	4
65	GTB	0	0	90	0	0	0	5	5
66	LT	0	0	19	0	0	0	56	25
67	GTB	0	0	100	0	0	0	0	0
68	GTB	0	0	100	0	0	0	0	0
69	GTB	0	0	73	0	11	0	16	0
70	GTB	0	59	0	0	22	0	19	0
71	GTA	10	30	0	0	0	0	40	20
72	GTB	0	11	0	0	83	0	6	0
73	GTB	0	7	0	0	89	0	4	0
74	GTB	0	0	53	0	21	0	26	0
75	GTB	0	0	91	0	0	0	9	0
76	GTB	0	0	100	0	0	0	0	0
77	LT	0	0	42	0	0	0	16	42
78	GTB	0	0	66	0	0	0	25	9
79	GTB	0	0	67	0	0	0	16	17
80	GTB	0	85	0	0	0	0	10	5
81	LT	0	0	0	0	0	0	66	34
82	LT	0	31	0	0	0	0	52	17
83	LT	0	58	0	0	0	0	38	4
84	LT	0	42	0	0	0	0	50	8
85	GTB	0	0	64	0	6	0	21	9
86	GTB	0	0	85	0	4	0	11	0
87	GTB	0	7	0	0	90	0	3	0
88	GTB	0	0	42	0	42	0	16	0
89	GTC	4	20	0	0	16	0	42	18
90	GTB	0	0	54	0	15	0	4	27
91	GTB	0	0	90	0	0	0	10	0
92	GTC	0	42	0	0	16	0	32	10
93	GTB	0	0	70	0	0	0	26	4
94	GTC	0	6	16	0	48	0	21	9
95	GTB	0	0	70	0	0	0	25	5
96	GTB	0	0	67	0	33	0	0	0
97	GTB	0	0	65	0	5	0	23	7
98	LT	33	0	0	0	0	0	33	34
99	GTB	0	72	0	0	0	0	28	0
100	LT	0	20	0	0	0	0	45	35
101	LT	11	17	0	0	0	0	43	29
102	GTB	0	0	60	0	0	0	40	0
103	STB	0	0	0	0	0	0	100	0
104	GTB	0	0	0	100	0	0	0	0
105	GTB	0	0	80	0	0	0	20	0
106	GTB	0	89	0	0	0	0	6	5
107	GTB	0	74	0	0	0	0	13	13
108	GTB	0	100	0	0	0	0	0	0
109	GTB	0	48	0	0	0	0	35	17
110	GTB	0	23	23	0	0	0	34	20
111	GTB	0	0	86	0	0	0	14	0
112	GTC	0	0	53	0	5	0	21	21
113	GTB	0	0	62	0	12	0	16	10
114	GTB	0	0	100	0	0	0	0	0
115	GTB	0	0	74	0	0	0	22	4
116	LT	0	18	0	0	17	0	8	57
117	GTB	0	0	80	0	0	0	20	0
118	LT	0	16	16	0	7	0	20	41
119	GTB	0	0	95	0	0	0	5	0
120	GTB	0	0	46	0	27	0	18	9
121	GTB	0	0	60	0	0	0	30	10
122	GTB	0	100	0	0	0	0	0	0
123	GTB	0	60	0	0	0	0	36	4
124	GTB	0	81	0	0	0	0	10	9
125	GTB	0	63	0	0	0	0	32	5
126	GTB	0	79	0	0	0	0	14	7
127	LT	0	43	0	0	0	0	35	22
128	LT	0	11	0	0	0	0	78	11
129	LT	0	8	0	0	0	0	92	0
130	LT	10	65	0	0	0	0	25	0
131	GTB	0	0	72	0	0	0	25	3
132	GTB	0	95	0	0	0	0	5	0
133	LT	0	36	0	0	5	0	28	31
134	GTB	0	72	0	0	0	0	25	3
135	LT	0	31	0	0	0	0	33	36
136	LT	0	59	0	0	0	0	21	20
137	GTB	0	59	0	0	0	0	9	32
138	LT	0	47	0	0	8	0	37	8
139	GTB	0	65	0	0	0	0	17	18
140	GTB	0	46	0	0	10	0	29	15
141	LT	0	33	4	0	0	0	23	40
142	LT	0	4	0	0	24	0	31	41
143	GTC	0	0	0	0	34	0	33	33
144	GTB	0	13	0	0	50	0	12	25
145	GTB	0	0	95	0	0	0	5	0
146	LT	0	0	28	0	27	0	34	11
147	LT	4	0	0	0	0	0	64	32
148	GTB	0	0	100	0	0	0	0	0
149	GTB	0	0	80	0	4	0	16	0
150	GTB	0	100	0	0	0	0	0	0
151	GTB	0	0	0	100	0	0	0	0
152	GTB	0	90	0	0	0	0	10	0
153	GTB	0	90	0	0	0	0	10	0
154	GTB	0	65	0	0	8	0	24	3
155	LT	0	35	0	0	0	0	16	49
156	GTB	0	53	0	4	0	0	34	9
157	GTB	0	100	0	0	0	0	0	0
158	GTB	0	55	0	0	0	0	34	11
159	LT	0	19	0	0	0	0	52	29
160	GTB	0	60	0	0	0	0	40	0
161	GWB	0	5	0	0	0	0	90	5
162	GTB/GWB	0	38	0	0	0	0	51	11
163	GTB	0	70	0	0	0	0	30	0
164	LT	0	4	0	0	0	0	90	6
165	GTB	0	66	0	0	3	0	31	0
166	GTB	0	93	0	5	0	0	2	0
167	LT	4	14	0	0	0	0	56	26
168	LT	0	50	0	0	0	0	50	0
169	GTB	0	63	0	0	0	0	32	5
170	GTB	0	69	0	0	0	0	19	12
171	GTB	0	52	0	0	6	0	21	21
172	GTB	0	46	0	0	9	0	37	8
173	GTB	0	65	0	0	10	0	13	12
174	GTB	0	41	0	0	4	0	41	14
175	GTB	0	100	0	0	0	0	0	0
176	GTB	0	0	100	0	0	0	0	0
177	GTB	0	9	55	0	16	0	16	4
178	GTB	0	0	68	0	8	0	12	12
179	GTC	0	21	19	0	6	0	44	10
180	GTB	0	0	67	0	0	0	19	14
181	GTB	0	0	100	0	0	0	0	0
182	GTB	0	0	70	0	0	0	20	10
183	GTB	0	67	0	0	11	0	11	11
184	GTB	0	80	0	0	0	0	10	10
185	LT	0	34	0	0	0	0	12	54
186	GTB	0	55	0	0	0	0	45	0
187	LT	0	37	0	0	0	0	50	13
188	GTB	0	34	0	0	40	0	26	0
189	GTB	0	63	0	0	37	0	0	0
190	GTB	0	0	0	86	0	0	14	0
191	GTB	0	73	0	0	0	0	18	9
192	GTB	0	66	0	10	0	0	16	8
193	GTB	0	23	22	45	0	0	10	0
194	GTB	0	49	0	0	14	0	37	0
195	GTB	0	63	0	0	0	0	26	11
196	GTB	0	45	0	45	0	0	10	0
197	GTB	0	66	0	0	0	0	28	6
198	GTB	0	71	0	6	10	0	13	0
199	GTB	0	35	0	40	0	0	25	0
200	GTB	0	73	0	0	0	0	27	0
201	GTB	0	43	0	15	0	0	32	10
202	GTB	0	44	0	0	0	0	56	0
203	GTB	0	62	9	0	8	0	15	6
204	GTB	0	44	0	0	0	0	44	12
205	GTB	0	50	0	0	0	0	35	15
206	GTB	0	0	100	0	0	0	0	0

Till Types*

GTC	Granite Till C
GWB	Greywacke Till B
STB	Slate Till B
GTB	Granite Till B
GTB/GWB	Till collected near South Mountain Batholith/Goldenville Formation contact
LT	Lawrencetown Till
GTA	Granite Till A

*Classification after Finck, P.W. and Graves R.M., N.S.D.M.E. Maps 87-1,2

SUMMARY OF PREVIOUS WORK

The recognition of till clasts and boulders as useful tools in mapping glacial geology in Nova Scotia is not a new concept. In previous studies of Nova Scotian Quaternary geology the use of till clasts was vital in determining the provenance and direction of till transport. Prest (1896), while exploring for gold at Blockhouse, recognized a far-travelled, dark coloured clay till containing basalt clasts as distinct from an overlying locally derived auriferous slate till. Such observations are important when searching for gold in glacial terrain overlying the gold-bearing Meguma Group rocks.

Hickox (1962) identified granitic boulders of South Mountain Batholith origin north of the Batholith. The boulders occurred in till on the Annapolis Valley floor and as surface erratics along the North Mountain and Bay of Fundy shore. Identification of these boulders allowed Hickox to infer the presence of a north-flowing ice cap centered on the Southern Uplands.

Grant (1963) differentiated locally derived granite, greywacke, slate and hybrid tills and also distinguished distally derived red muddy tills. He stated that locally derived tills were "characterized by the dominance of one rock species in amounts ranging from 80 to 100 percent and this same species always underlies the till as bedrock". The hybrid till is a "mixture of pebbles from the three local sources". Grant described the red muddy till as "translational to a similar red till developed on the shale and sandstone of the Minas Basin area". Thus, Grant classified the pebble lithologies and determined till provenance based on clast origin.

Stea (1980), Wilson et al. (1980), Stea (1982), MacGillivray (1983), Stea and Finck (1984), Stea et al. (1986) and Turner and Stea (1986) have also recognized that distinctive pebble assemblages are associated with individual till units. The authors recognized clast dispersion and were able to make reliable inferences regarding the nature of underlying bedrock and (or) the direction of ice flow.

INTERPRETIVE NOTES

Provenance of Till Units

Granite Till A

This till is exposed at Hackets Cove, Glen Haven, Meisenеrs Point, west of Little Indian Lake (NTS 11D/12) and near Pockwock Lake (NTS 11D/13). It normally forms a drumlin core till; however, at Glen Haven and Pockwock Lake it occurs as an exposed surface till. Granite Till A contains a high proportion of angular granite clasts derived from local bedrock. Allochthonous clasts are always present in the till. The till was transported in a southeast direction correlative with ice flow phase 1 of Stea and Finck (1984). Granite Till A is stratigraphically equivalent to the Hartlen Till mapped by Stea and Fowler (1979).

At Hackets Cove, Granite Till A overlies a small pluton of grey, fine-grained muscovite-biotite monzogranite mapped as part of the Tantallon Leucomonzogranite by MacDonald and Horne (1987). Approximately 70% of the pebble fraction of the till is derived from the underlying two-mica monzogranite with a minor percentage of the clasts originating in the Halifax Peninsula Leucomonzogranite of MacDonald and Horne (1987). West of Little Indian Lake, Granite Till A contains biotite monzogranite, fine-to medium-grained muscovite-biotite monzogranite and quartz-feldspar porphyry, all interpreted as having been derived from the underlying Sandy Lake Monzogranite (MacDonald and Horne, 1987) and Tantallon Leucomonzogranite. Granite from underlying bedrock and nearby up-ice sources to the northwest constitute 65-85% of the till clast content.

Despite the general domination of Granite Till A by local bedrock clasts, a significant proportion of this till consists of more distally derived clasts. At Porcupine Lake 25% of the clasts in Granite Till A are biotite monzogranite. The nearest up-ice bedrock source of biotite monzogranite is 4 kilometres to the northwest. Granite Till A is also characterized by a significant (15-35%) component of Meguma Group and foreign clasts. At Little Indian Lake the closest up-ice source for the Meguma Group fraction of the till is metagreywacke 25 kilometres to the northwest.

Lawrencetown Till

A broad area of Lawrencetown Till extends from Sambro on the southern coast of the Halifax Peninsula (Map Sheet 11D/12) north to Hammonds Plains. It also occurs west of Pockwock Lake (Map Sheet 11D/13) as a thin drift cover interspersed with lesser amounts of Granite Tills A and B. It is characterized by a high non-granitic pebble content that varies from 40-100%, generally decreasing with distance transported across the South Mountain Batholith. Lawrencetown Till was transported in a southward direction correlative with ice flow phase 2 of Stea and Finck (1984).

South of Hammonds Plains, clasts in the Lawrencetown Till are almost entirely derived from north of the South Mountain Batholith. Distinctive pebbles such as diorite, diabase, rhyolite, sandstone and siltstone are found in this till. Donohoe and Wallace (1982) mapped diabase dyke swarms and diorite intrusives in the Cobequid Highlands, 90 kilometres north of the Hammonds Plains area. They also mapped rhyolite in the Fountain Lake Group. Sedimentary rocks in the till are greenish-brown to reddish-brown and were derived from the Minas Sub-basin of Bell (1958), 60 kilometres to the north. Similar pebble assemblages occur in Lawrencetown Till drumlin cuts at Goodwood and Whites Lake (NTS 11D/12). West of Pockwock Lake (Map Sheet 11D/13) gneissic granite clasts were noted in the Lawrencetown Till. These clasts probably originated 70 kilometres to the north in the Cobequid Highlands.

Down-ice dispersal of granites in Lawrencetown Till has been recognized. The clasts are often small and weathered making coarse grained clasts difficult to distinguish with regard to granite type. Granodiorite clasts occur in Lawrencetown Till overlying the Big Indian Polyphase Intrusive (11D/13) mapped by Corey (1987). The granodiorite appears to have been derived from a body north of the polyphase intrusive and from numerous inliers mapped within the intrusive. Microgranite and two-mica monzogranite, derived locally from the Big Indian Polyphase Intrusive, are less abundant when compared with the amount of granodiorite, Meguma Group, and foreign clasts in the till.

Granite Till B

This till sheet covers the majority of the granitic terrain on Map Sheets 11D/12 and 11D/13. Its direction of transport is problematical and may vary from southeast to southwest.

Granite Till B can be subdivided into lithologically distinct facies that correlate with the underlying bedrock geology. A facies change is observed west of Nine Mile River where a bedrock contact between the Halifax Peninsula Leucomonzogranite and Harrietsfield Monzogranite has been delineated by MacDonald and Horne (1987). West of this contact, the granite clasts are dominated by monzogranite derived from the Halifax Peninsula Leucomonzogranite, whereas east of the contact the granite drift lithology is characterized by Harrietsfield Monzogranite. The transport distance of granite clasts is generally ‹ 1 kilometre.

Sampling of till overlying small intrusive bodies demonstrates the local nature of clast dispersion in portions of Granite Till B. At Fergusons Cove (NTS 11D/12) a small leucoporphyry body mapped by MacDonald and Horne (1987) is overlain by Granite Till B containing 100% leucoporphyry clasts. The small size (0.6 square kilometres) of the intrusion implies a local source for the clasts in the till and a maximum transport distance of a few hundred metres. Similar patterns of limited dispersion are evident at Hackets Cove, Bates Lake, Tantallon and Pockwock Lake.

Where local provenance is so dominant, till clasts can be used to predict underlying bedrock geology. Near Hubley Big Lake (NTS 11D/12) two bodies of fine grained two-mica monzogranite are inferred using available bedrock exposure and till clast geology. The presence of radiometrically more evolved granitic bodies within the area of Halifax Peninsula Leucomonzogranite is substantiated by eU and eU/eTh ratio airborne spectrometric data (GSC, 1979). The fine-grained two-mica monzogranites are similar to those mapped within the Tantallon Intrusive Suite. Fine-grained two-mica monzogranites are also seen in Granite Till B at Third Pond (NTS 11D/12). A local body or dyke(s) is believed to be the source for these clast types.

An unusual feature of Granite Till B in the study area is the high percentage of Meguma Group clasts. It contains greater than 50% greywacke and (or) slate at some localities (e.g. Sambro Head and Wrights Lake NTS 11D/12). The Meguma Group clast background is elevated when compared to granite tills examined to the west of this map sheet. There are two possible sources for these clasts: (1) The Lawrencetown Till has transported Meguma Group clasts across the Halifax Peninsula. The younger flow phase that formed Granite Till B incorporated these lithologies from the Lawrencetown Till and re-deposited the clasts in Granite Till B. (2) A late southwest ice movement may have transported Meguma Group clasts southwest across the region, reworking or forming the local granite till.

Granite Till C

This till occurs as hummocks near Hubley Big Lake and Smelt Brook Lake, and as an ablation boulder lag mantling or grading into Granite Till B (Finck and Graves, 1987). Limited data for this unit preclude a thorough understanding of its provenance. Clast dispersion is believed to be southward based on dispersion observed in ablation till west of the study area on Map Sheet 21A/09.

Clast counts in this till are often multimodal and are indicative of both local and distal sources. This is illustrated at Hubley Big Lake and Smelt Brook Lake where local two-mica monzogranite is diluted by significant amounts (10-50%) of up-ice granite, Meguma Group and foreign clasts.

SUMMARY

Granite Till A is dominated by local and up-ice granites and contains a significant Meguma Group and foreign clast component. It was deposited by ice flowing in a southeast direction and is correlative with ice flow phase 1 mapped by Stea and Finck (1984) and the Hartlen Till of Stea and Fowler (1979).

The Lawrencetown Till has a "dual provenance", as established by Stea and Fowler (1979) and corroborated by the present survey. It is characterized by local and up-ice South Mountain Batholith granite and non-granitic clasts from north of the Batholith. Ice crossing the Cobequid Highlands, Windsor Basin and Meguma Group rocks entrained material and dispersed clasts in a southward direction across the study area. The southward movement is correlative with ice flow phase 2 mapped by Stea and Finck (1984).

Granite Till B is the major surficial unit in the study area. The clasts are derived from local bedrock sources and transported generally ‹1 kilometre. Clasts in the most local till were transported a few hundred metres. The direction of transport in this till is problematical; it may vary from southeast to southwest. Stratigraphic evidence suggests that the till was formed during ice flow phases 3 or 4 mapped by Stea and Finck (1984).

Granite Till C has a limited areal distribution. Clast geology is varied and represents local and distal bedrock sources. Its direction of transport appears to be southward. Granite Till C may correlate with ice flow phases 3 or 4 mapped by Stea and Finck (1984).

REFERENCES

Bell, W.A.
1958: Possibilities for Occurence of Petroleum Resources in Nova Scotia, N.S.D.M., 177p.

Corey, M.C.
1987: Geological Map of Mount Uniacke (West Half), Nova Scotia (NTS Mapsheet 11D/13); Nova Scotia Department of Mines and Energy Map 87-8, 1:50 000

Donohoe H.V., Jr. and Wallace, P.I.
1982: Geological Map of the Cobequid Highlands, Nova Scotia Department of Mines and Energy. Maps 82-6, 82-7, 82-8.

Finck, P.W. and Graves, R.M.
1987a: Glacial Geology of Mount Uniacke (West Half), Nova Scotia (NTS Sheet 11D/13); Nova Scotia Department of Mines and Energy Map 87-1, 1:50 000

Finck, P.W. and Graves, R.M.
1987b: Glacial Geology of Halifax and Sambro, Nova Scotia (NTS Sheets 11D/12 and 11D/05); Nova Scotia Department of Mines and Energy Map 87-2, 1:50 000.

Geological Survey of Canada
1979: Geophysical series, Airborne Gamma Ray Spectrometric Map No. 35411 (12G) Equivalent U/Equivalent Th, Halifax mapsheet, 1:50 000.

Goddard, E.N., Trask, P.D., De Ford, R.K., Rove, O.N., Singewald, J.T., Jr. and Overbeck, R.M.
1980: Geological Society of America Rock Color Chart Huyskes-Enschede, Netherlands, 10p.

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.

Hickox, C.F., Jr.
1962: Late Pleistocene ice cap centered on Nova Scotia; Geological Society America Bulletin, v. 73, p. 505-510.

MacDonald, M.A. and Horne, R.J.
1987: Geological Map of Halifax and Sambro, Nova Scotia, (NTS Mapsheets 11D/12 and 11D/05); Nova Scotia Department of Mines and Energy Map 87-6, 1:50 000

MacGillivray, G.
1983: Geological and Geochemical Surveys, Ship Harbour Property, Halifax County, Nova Scotia; Billiton Canada Ltd., Nova Scotia Department of Mines and Energy, Assessment Report 11/D15B 07-H-97(03)

Prest, W.H.
1896: Glacial succession in central Lunenburg, Nova Scotia; Proceedings and Transactions of the Nova Scotian Institute of Science, Halifax, v. 9, session 1895-96, p. 158-170

Stea, R.R.
1980: A study of a succession of tills exposed in a wave cut drumlin, Meisners Reef, Lunenburg County; *in* Mineral Resources Division, Report of Activities, 1979; Nova Scotia Department of Mines and Energy Report 80-1, p. 9-20.

Stea, R.R.
1982: The properties, correlation and interpretation of Pleistocene sediments in central Nova Scotia; unpublished M.Sc. Thesis, Dalhousie University, Halifax, Nova Scotia; Nova Scotia Department of Mines and Energy, Thesis 503, 215 p.

Stea, R.R. and Finck, P.W.
1984: Patterns of glacier movement in Cumberland, Colchester, Hants, and Pictou Counties, northern Nova Scotia, *in* Current Research, Part A; Geological Survey of Canada, Paper 84-1A, p. 477-484.

Stea R.R., Finck, P.W. and Wightman, D.M.
1986: Quaternary geology and till geochemistry of the western part of Cumberland County, Nova Scotia (Sheet 9). Geological Survey of Canada, Paper 85-17.

Stea, R.R. and Fowler, J.H.
1979: Minor and trace-element variations in Wisconsinan tills, Eastern Shore Region, Nova Scotia; Nova Scotia Department of Mines and Energy, Paper 79-4, 30 p.

Turner, R.G. and Stea, R.R.
1986: The Garden of Eden dispersal train *in* Program and Summaries, Tenth Annual Open House and Review of Activities; Nova Scotia Department of Mines and Energy, Information Series No. 12, p. 129-133.

Wilson, B.H., Sarkar, P.K., Sinclair, P.E., MacGillivray, G., Richardson, J. and Harnish, S.A.
1980: Report on prospecting boulder mapping, till fabric analysis and rock geogchemistry; East Kemptville, Yarmouth County, Nova Scotia; Shell Canada Resources Limited; Nova Scotia Department of Mines and Energy, Assessment Report 21A/04A 51-R-25(02).

ACKNOWLEDGEMENTS

The authors would like to thank R. Stea of the Nova Scotia Department of Mines and Energy for reviewing the map. The authors would also like to thank M. MacDonald, R. Horne and M. Corey for valuable discussion regarding the bedrock geology of the study area and for the use of their geology maps prior to publication. We thank the other department geologists with whom we discussed aspects of Nova Scotia geology: they are R. Boehner, H. Donohoe, R. Ryan, and P. Smith. Able field assistance was given by E. MacDonald and S. Young. Editorial assistance was provided by D. MacDonald.