THE SOUTHERN CONTACT OF THE ACKLEY GRANITE, SOUTHEAST NEWFOUNDLAND; LOCATION AND MINERALIZATION

by

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The southern contact of the Ackley Granite was mapped in detail in two areas to precisely locate its position (Maps 1, 2, 3) and to follow-up whole rock geochemical anomalies (Colman-Sadd *et al.*, 1981). The main mineral showings in the Rencontre Lake area occur within the granite adjacent to the contact. Similarly, between Gisborne Lake and Rally Pond, many small showings of molybdenite, fluorite, pyrite, and hematite and numerous quartz veins and pods, and large dikes of an unusual rock type known as quartzolite occur close to the margin of the granite. (Quartzolite is an igneous plutonic rock which contains 90% or more quartz and less than 10% feldspar, IUGS classification). Rock geochemical anomalies for Sn, F, U, Mo and Li are also concentrated near the margin in the Rally Pond - Gisborne Lake area (Dickson, in prep.).

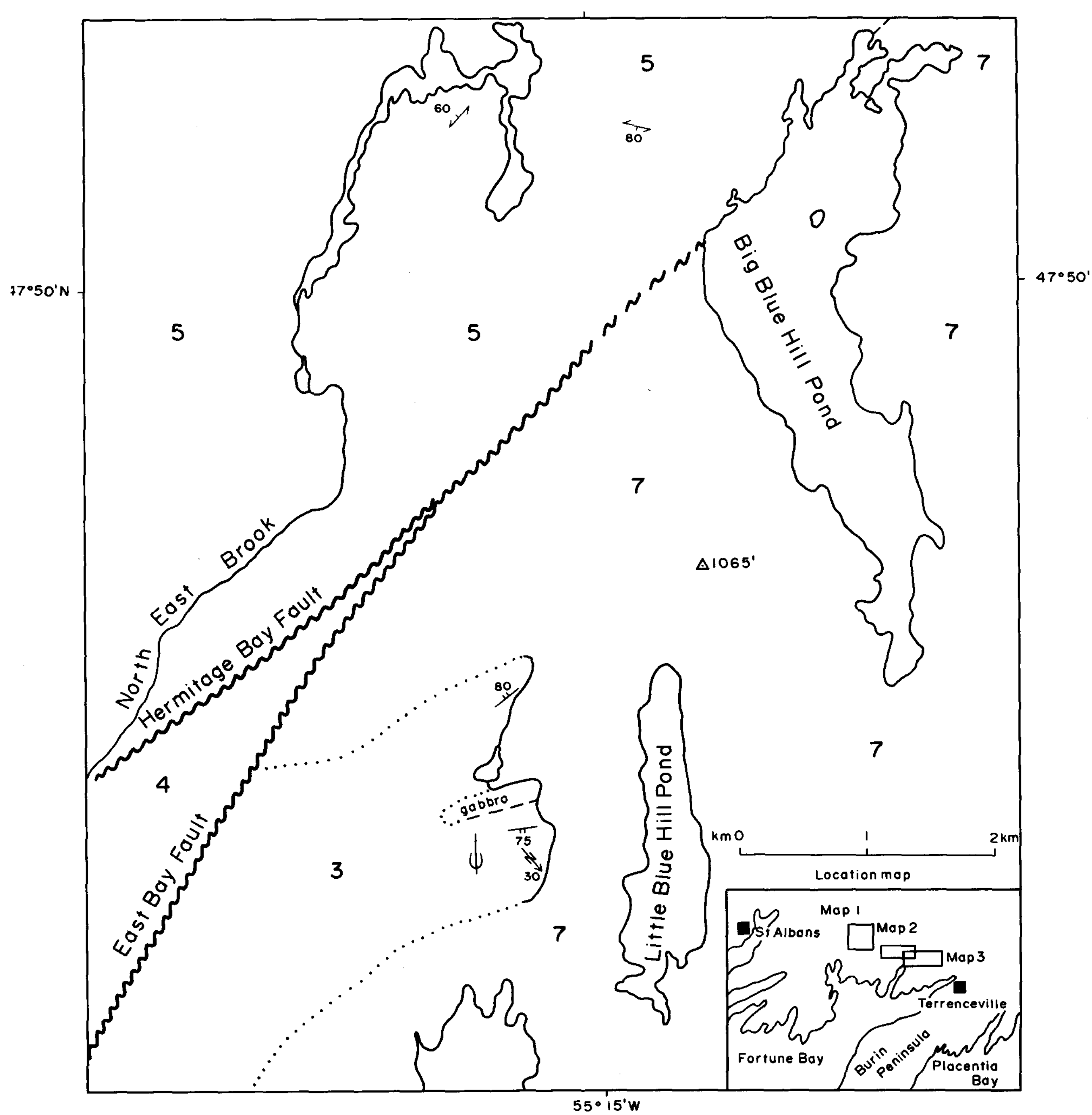
BIG BLUE HILL POND AREA

The contact of the Ackley Granite in the Big Blue Hill Pond area (Map 1) was found to be located further to the west than previously shown (Anderson, 1965). The contact with the Cambrian and older(?) Youngs Cove Group is well exposed in several places and is vertical. Numerous large (>10 m) screens of Youngs Cove Group sandstone occur within the granite up to 200 m from the contact. Near the southeastern corner of the Youngs Cove Group, west of Little Blue Hill Pond (Map 1), large granite dikes also cut the sandstones and form a mixed zone up to 200 m wide. The Youngs Cove Group in the area forms a sequence of easterly trending, steeply dipping, thinly to thickly bedded, generally massive, rusty sandstones and siltstones which have been deformed to form small folds. Contact metamorphism has produced randomly oriented muscovite and fresh brown biotite. The feldspars show variable alteration to sericite. Pyrite is common in the sediments and where weathered gives the rusty appearance to the rocks. The Youngs Cove Group is cut by a 200 m thick vertical gabbro dike which has been contact metamorphosed by the Ackley Granite to an assemblage of tremolite - actinolite, plagioclase, epidote and magnetite, with relict augite in the cores of some of the amphibole crystals.

The Ackley Granite, in the Big Blue Hill Pond area, shows three main textures. The most common variety of granite is coarse grained, equigranular, biotite granite which is locally cut by fine grained, porphyritic dikes of granite. This latter type also underlies sizeable areas and typically contains small phenocrysts of quartz, orthoclase perthite and plagioclase in a fine grained granite matrix. The third variety of granite lies to the northwest of Little Blue Hill Pond and is medium grained, slightly porphyritic, biotite granite and is texturally and mineralogically identical to the coarse grained granite with a hypidiomorphic granular texture. The mineralogy consists of quartz, orthoclase perthite, plagioclase (An_{15}), biotite and minor magnetite, apatite and zircon. All varieties of granite in the area are slightly altered with secondary hematite and sericite. No economic minerals were found in the area.

RALLY POND AND GISBORNE LAKE AREA

The Ackley Granite contact with the Precambrian formations between Rally Pond and Gisborne Lake (Maps 2 and 3) is generally well defined. Only areas west



Map I. Geological map of the Ackley Granite contact in the Little Blue Hill Pond area

LEGEND

DEVONIAN

7 **ACKLEY GRANITE:** Mainly medium grained, miarolitic, slightly porphyritic, biotite granite; minor, undivided, coarse grained, equigranular biotite granite.

6 **CROSS HILLS GRANITE-DIORITE COMPLEX: 6a,** Metagabbro and diabase; **6b,** medium grained, biotite-hornblende granodiorite and granite.

SILURIAN-DEVONIAN

5 **NORTH WEST BROOK COMPLEX:** Foliated, medium grained, biotite ± muscovite granite with minor older, foliated, coarse grained, porphyritic, biotite granodiorite; minor screens of Ordovician or older metasediment.

?ORDOVICIAN OR OLDER

4 **SIMMONS BROOK BATHOLITH:** Medium to coarse grained, gray granodiorite and diorite.

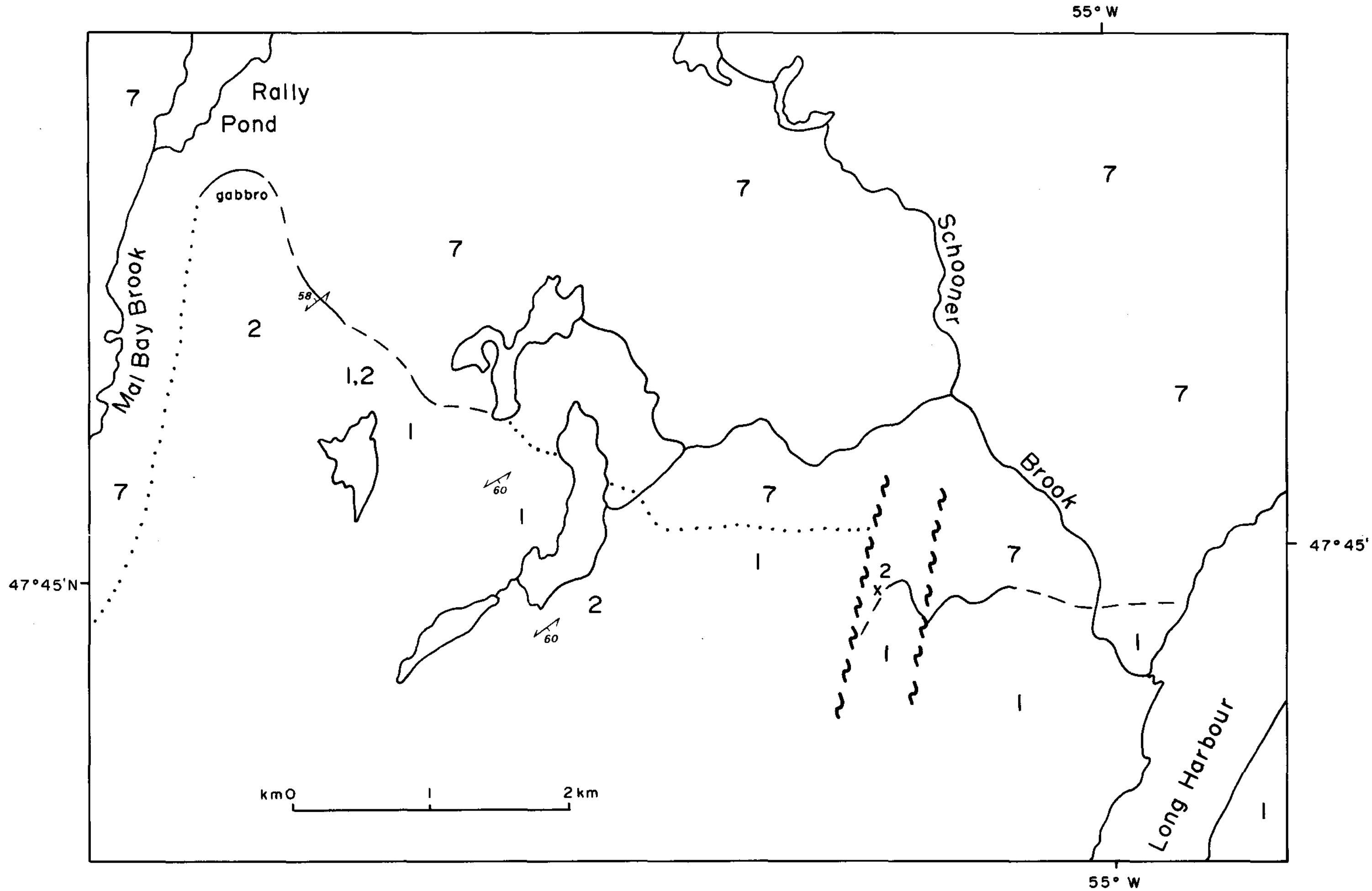
CAMBRIAN AND OLDER

3 **YOUNGS COVE GROUP:** Dark and light gray, micaceous sandstone; hornfels.

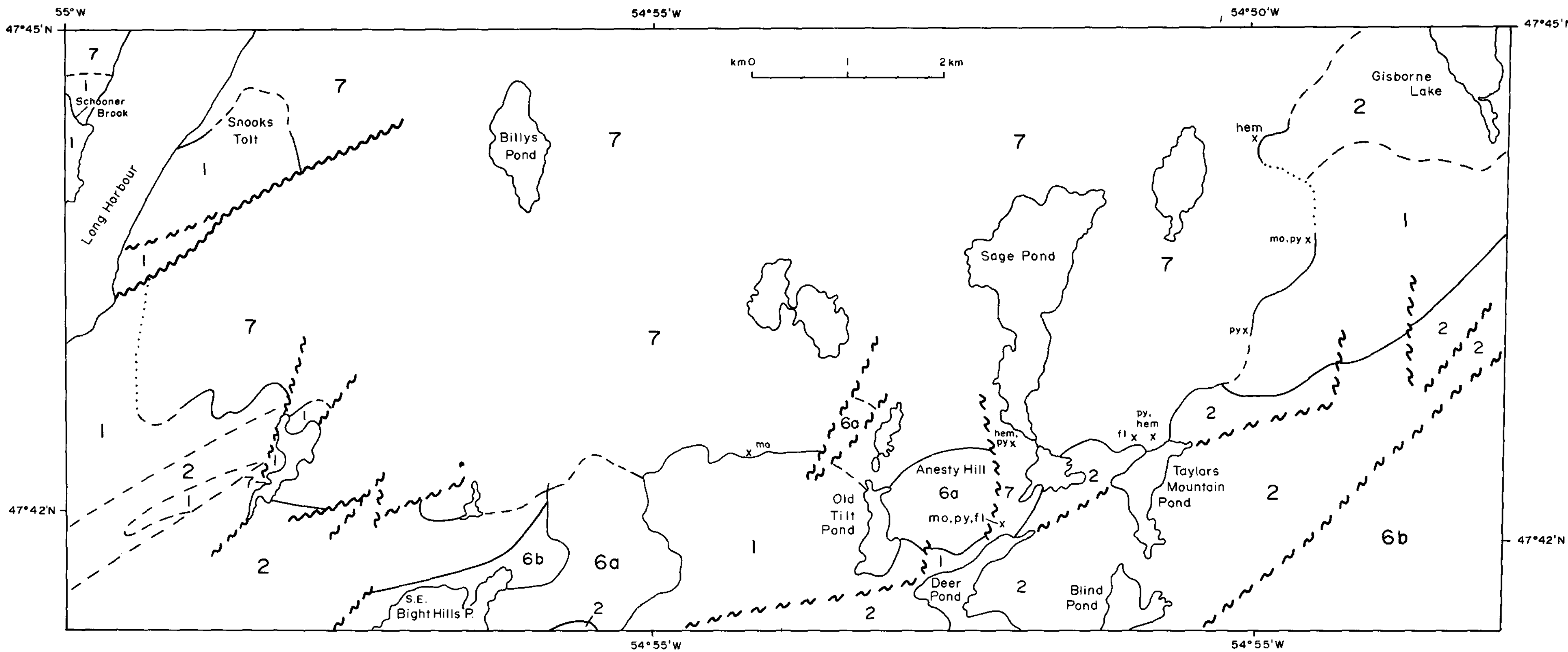
LATE PRECAMBRIAN

2 **ANDERSONS COVE FORMATION:** Unseparated gray, green and minor red, terrigenous sediments: includes minor undivided mafic flows.

1 **BELLE BAY FORMATION:** Predominantly volcanic breccias, ash flow tuffs, flow layered rhyolite and basalt flows; minor unseparated gabbro.



MAP 2. Geological Map of the Ackley Granite contact between Rally Pond and Long Harbour



MAP 3. Geological map of the Ackley Granite contact between Long Harbour and Gisborne Lake

of Schooner Brook, southwest of Snooks Tolt, and southwest of Gisborne Lake are poorly defined due to lack of exposure. The contact is exposed in several places but usualy there is a small gap in exposure. The contact is everywhere near vertical. The contact is modified in places by small unexposed cross faults. South of Snooks Tolt the affects of faulting on the rocks are apparent. Along the trace of the fault, which has been eroded to form a deep gorge, the granite is highly jointed and locally contains subhorizontal slickensides which trend parallel to the fault trace. In other areas topographic lineaments with apparently abrupt changes in the trend of the contact are attributed to the small cross faults.

Rare xenoliths of rhyolite and sandstone from the Precambrian formations were found within the granite but always close to the contact.

The Precambrian sediments and volcanics have been contact metamorphosed by the Ackley Granite to produce a hard hornfels in a narrow aureole up to 200 m in width. The hornfels consists of a recrystallized assemblage of quartz, feldspar, muscovite and biotite, and rarely andalusite and possibly staurolite in the metasediments. Dikes and veinlets of granite rarely cut the volcanics and sediments and usually penetrate only a few metres into the country rock. However, dikes of quartz-feldspar porphyry, which may be related to the Ackley Granite, occur throughout the Belleoram map area (Williams, 1971).

The Ackley Granite varies from coarse to medium grained, equigranular, biotite granite in the vicinity of Rally Pond and Gisborne Lake to fine grained, equigranular to slightly porphyritic, biotite granite towards the south. An important factor is the altitude of the contact, which appears to control the width of the zone of fine grained granite. Along Schooner Brook and Long Harbour, which are at sea level, the zone of fine grained granite is about 200 m wide. On higher ground west of Schooner Brook and underlying most of Map 3 southeast of Snooks Tolt, the zone of fine grained granite is up to 4 km wide. The transition from fine to coarse grained granite is gradual with a few dikes of fine grained granite intrusive into the coarse grained granite in the Long Harbour - Gisborne Lake map area (Map 3). However, in the Rally Pond - Long Harbour map area, dikes of fine grained porphyritic granite, which cut coarse grained granite, are abundant.

The apparent increase in width of the zone of fine grained granite may be due to proximity to the roof or margin of the batholith. The presence of miarolitic cavities, tuffisites, and granophyric textures shows that the granite is high level. Similarly, a plot of normative Q:Ab+An:Or for this unit of the Ackley Granite (Unit 14, Dickson, 1980) shows a concentration of points near the ternary minima of Tuttle and Bowen (1958) for 0.5 and 1 kb P_{H_2O} and the 1 kb minimum at An_3 of James and Hamilton (1969). Thus, a change in altitude of 250 m clearly could have a significant effect on the crystallization of the granite. A similar high level origin for the petrogeneses of the various granite phases and molybdenite prospects at Rencontre Lake 12 km southwest of Rally Pond is proposed by Whalen (1980). It is clear, therefore, that this phase of the Ackley Granite formed at a very high level and very close to the roof.

Quartzolite dikes, quartz veins and pods, hematite-quartz veins and zones of highly altered granite occur within the granite close to the contact with the country rocks and are most abundant in the Sage Pond area (Map 3).

The quartzolite dikes are probably a very late stage differentiate of the marginal phase of the Ackley Granite. The dikes are discontinuous and rarely more than 15 m in length and 5 m in width. The dikes are resistant to weathering and commonly form low, smooth, glacially polished ridges which weather white and are commonly pink, red or white on fresh surfaces. The quartzolites have a hypidiomorphic granular texture with abundant quartz and interstitial, highly sericitized, feldspar and locally abundant pyrite and fine grained fluorite.

MINERALIZATION

In a few localities southeast of Anesty Hill, molybdenite occurs in the several quartzolite dikes. However, the molybdenite occurrences are very small and probably do not exceed 0.1% MoS_2. The occurrences are described in McLachlan (1953) and Rickets and Bumgarner (1954) who did not consider the showings to be economic for molybdenite. Trace molybdenite occurs in pyrite bearing quartzolite, 2.5 km east of Sage Pond, close to the contact with rhyolitic volcanics.

Quartz veins and pods are common along the margin of the granite. They are generally small and rarely exceed 2 m. The veins consist of coarse anhedral quartz crystals with minor inclusions of feldspar and sericite.

About 2.5 km west of Anesty Hill, coarse 5 to 20 mm, locally abundant molybdenite flakes occur in numerous small pods in veins of quartz over an area of about 100 m^2. The quartz occurs in coarse grained, equigranular granite within 100 m of the contact with Precambrian basic volcanics. The proportion of molybdenite is overall less than 0.1% in the quartz veins.

Specular hematite-quartz veins of varying sizes were found near the margin of the granite east of Sage Pond. The veins are composite in places with texturally distinct fine grained hematite-quartz adjacent to coarse grained hematite with well formed quartz crystals. Fine grained granite is also found mixed with the hematite. Thin veinlets of hematite also occur in some quartzolite dikes. Analysis of a thin section of coarse grained, hematite-veined quartzolite, 400 m north of Taylors Mountain Pond, indicated the presence of trace amounts of cassiterite. The cassiterite occurs as 0.5 mm, subhedral, interstitial crystals with variably developed simple twins and one crystal is zoned. The proportion of cassiterite in the thin section is less than 0.1% of the mode.

Highly altered grey granite is located east of Anesty Hill. The alteration occurs in narrow zones 1 to 2 m in width and up to 10 m in length. The altered granite locally contains fluorite and hematite, and is highly sericitized. Only quartz is left of the original minerals. This rock is probably a griesen.

The granite in the Anesty Hill area contains the highest whole rock tin value of 242 g/t (Colman-Sadd *et al.*, 1981). Samples of granite from the contact zone between Gisborne Lake and Rally Pond contain most of other high tin values. Additional samples of quartz veins, quartzolites, hematite veins, altered granite, molybdenite bearing samples from the Wylie Hill and Motu molybdenite prospects, and the adjacent fresh granite from each locality have been collected and analysed for major elements and tin. The results are presented in Table 1.

Major elements show that the host granite is highly differentiated with high SiO_2 and very low MgO and CaO. The molybdenite bearing granites have a very high SiO_2 content which may be partly due to alteration which has depleted the Na_2O content of the granite. Secondary coarse muscovite and highly altered small plagioclase phenocrysts are common. Whalen (1980) suggests that silicification of the mineralized granites has occurred.

The altered gray granite (analysis 221153) shows a severe depletion of Na_2O and pronounced depletion of K_2O and a

TABLE 1: MAJOR ELEMENT AND TIN ANALYSIS OF SAMPLES FROM THE SOUTHERN MARGIN OF THE ACKLEY GRANITE

SAMPLE NO.	221148	221149	221150	221151	221152	221153	221154	221155
ROCK TYPE	GRANITE	HEM. VEIN	GRANITE	QUARTZO-LITE	GRANITE	ALTERED GRANITE	GRANITE	QUARTZ VEIN
SiO_2	77.6	87.6	78.6	85.5	77.7	84.5	76.7	90.5
Al_2O_3	11.85	2.15	11.65	9.90	12.00	8.70	12.55	4.83
Fe_2O_3	.57	8.33	1.28	.40	.98	1.25	.29	.06
FeO	.44	.12	.14	.02	.13	.43	.48	.21
MgO	.09	.05	.04	.03	.12	.13	.10	.04
CaO	.21	.10	.13	.52	.30	.16	.27	.19
Na_2O	3.24	.35	3.55	.39	3.10	.44	3.46	1.88
K_2O	4.79	.88	4.54	.73	4.78	2.87	4.86	.60
TiO_2	.21	.06	.13	.12	.25	.24	.16	.17
MnO	.13	.11	.03	.01	.02	.20	.03	.02
P_2O_5	.01	.01	.01	ND	.01	.01	ND	ND
LOI	.47	.39	.37	1.02	.55	1.35	.71	.40
TOTAL	99.51	100.15	100.47	98.64	99.84	100.28	99.61	98.90
Sn g/t	9	177	23	16	8	221	12	11

SAMPLE NO.	21156	21157	21158	21159	21160	21161	21162	21163
ROCK TYPE	GRANITE	QUARTZ VEIN	GRANITE	QUARTZ VEIN	WYLIE HILL GRANITE	WYLIE HILL GRANITE	MOTU GRANITE	MOTU GRANITE
SiO_2	75.6	96.6	77.2	96.8	81.1	76.3	80.8	81.5
Al_2O_3	12.85	1.03	12.45	1.15	10.30	13.15	11.20	10.35
Fe_2O_3	.46	.06	1.10	.08	.30	.61	.36	.17
FeO	.84	.12	.02	.10	.81	.50	.14	.20
MgO	.05	.02	.07	.02	.08	.16	.06	.05
CaO	.33	.09	.25	.08	.19	.19	.18	.23
Na_2O	3.81	.23	3.57	.29	2.61	2.77	2.83	2.61
K_2O	4.98	.25	5.27	.27	4.29	4.07	4.75	4.41
TiO_2	.11	.02	.08	.01	.15	.17	.15	.14
MnO	.05	.01	.03	.01	.01	.01	.02	.02
P_2O_5	.10	.03	ND	ND	.02	ND	ND	.01
LOI	.63	.22	.36	.16	.68	1.25	.52	.40
TOTAL	99.81	98.68	100.40	98.97	100.54	99.19	101.01	100.09
Sn g/t	6	2	2	2	6	30	6	3

Analyst: H. Wagenbauer, Department of Mines and Energy corresponding decrease in Al_2O_3 and increase in SiO_2 and FeO and Fe_2O_3.

Tin values for the hematite vein, altered granite, quartzolite samples and its host granite, and a molybdenite bearing granite from Wylie Hill are enriched compared to the background values for tin in the area. However, the background is also high with a mean value for tin in the Long Harbour - Gisborne Lake area of 13 g/t. The tin content of the altered granite is significantly enriched compared to its host rock (analysis 221152). The mineralogy of the altered granite is quartz, sericite, fluorite, and specular hematite, and is similar to that found in greisen associated with the Cornwall tin deposits, apart from the apparent absence of tourmaline in the altered granite. However, trace amounts of tourmaline occur in samples collected in the Long Harbour - Gisborne Lake area.

The molybdenite mineralization in the quartz veins and quartzolite dikes clearly formed during late stage crystallization of the marginal facies of the Ackley Granite (see also Whalen, 1980). The original feldspar within the quartzolite dikes has been completely altered to sericite. The dikes also contain up to 2.5% F with visible fluorite (O'Brien, personal communication, 1981). Thus, the quartzolites may have formed by hydrothermal alteration of aplite dikes. The tin mineralization probably formed during crystallization of the aplites as both the quartzolite and granite are enriched in tin in this area.

The greisening of the granite is a late hydrothermal event which has introduced tin, fluorine, iron and manganese, and depleted sodium, potassium and aluminum.

The formation of the greisen and the alteration of the aplites to form quartzolite may be related hydrothermal events.

REFERENCES

Anderson, F.D.
1965: Belleoram, Newfoundland. Geological Survey of Canada, Map 8-1965.

Colman-Sadd, S.P., Dickson, W.L., Elias, P., and Davenport, P.H.
1981: Whole rock analytical data, statistical printouts and maps of plutonic igneous rocks and selected country rocks from southern Newfoundland (1M/10-16; 2D/1-5). Newfoundland Department of Mines and Energy, Mineral Development Division, Open File - Nfld. (1157).

Dickson, W.L.
1980: Geology of the Ackley Granite, eastern Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 80-197.

in prep: Geology and geochemistry of the Ackley Granite and parts of the North West Brook and Eastern Meelpaeg complexes, southeast Newfoundland (Parts of map sheets 1M/10, 11, 14, 15, 16, 2D/1, 2, 3, and 7).

James, R.S. and Hamilton, D.L.
1969: Phase relations in the system $NaAlSi_3O_8$ - $KAlSi_3O_8$ - $CaAl_2Si_2O_8$ at one kilobar water vapour pressure. Contributions to Mineralogy and Petrology, Volume 21, pages 111 - 141.

McLachlan, D.C.
1953: Geologic prospecting of Long Harbour - Gisborne Lake area in southeast Newfoundland. *In* Newfoundland Project, private report to American Zinc Company of Tennessee, Appendix A.

Ricketts, J. and Bumgarner, J.
1954: Report on field examinations in Newfoundland. Private Report, American Zinc Company of Tennessee.

Tuttle, O.F. and Bowen, N.L.
1958: Origin of granite in light of experimental studies in the system $NaAlSi_3O_8$ - $KAlSi_3O_8$ - SiO_2 - H_2O. Geological Society of America, Memoir 74, 153 pages.

Whalen, J.B.
1980: Geology and geochemistry of the molybdenite showings of the Ackley City Batholith, southeast Newfoundland. Canadian Journal of Earth Sciences, Volume 17, pages 1246-1258.

Williams, H.
1971: Geology of Belleoram map area (1M/11), Newfoundland. Geological Survey of Canada, Paper 70-65.