BASEMENT - COVER RELATIONSHIPS AND PLUTONIC ROCKS IN THE MAKKOVIK SUBPROVINCE, NORTH OF POSTVILLE COASTAL LABRADOR (13J/13, 130/4)

by

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INTRODUCTION

Geological mapping of the eastern part of the Labrador Central Mineral Belt, north of Postville (13J/13, 130/4) was completed during the 1981 field season. This work, along with the earlier projects of Bailey (1981), Gower (1981) and Ryan (in preparation) and the ongoing project of Ermanovics (in preparation), has now covered the whole of the Makkovik Subprovince (Taylor, 1972) at 1:100,000 scale. Previous regional reconnaissance surveys in the area have been conducted by the Geological Survey of Canada (*cf.* Douglas, 1953; Christie *et al.*, 1953; Kranck, 1953; Stevenson, 1970; Taylor, 1979) and BRINEX (Morrison, 1958; Gandhi, 1969). In addition, BRINEX and Placer Development have carried out more detailed studies of the coastal strip along the northwest shore of Kaipokok Bay (Sutton, 1971a, 1971b; 1972; Burns, 1980), in the vicinity of Salmon Pond (Griep, 1977) and at a small uranium showing at the head of Kaipokok Bay (Lever and Davidson, 1978). Results from these surveys were often at variance with each other (*e.g.* the 'mylonite' of Sutton is shown as 'felsic tuff' by Burns) and no consistent regional picture emerged. The aim of this project was to resolve some of the inconsistencies, and compare the geological evolution of the area with that established in the adjacent parts of the Makkovik Subprovince. The results of this survey agree most closely with those of Sutton (1971a, 1971b; 1972), but modifications have been made based on observations outside his project area, and these may have far-reaching implications with regards to the evolution of the Makkovik Subprovince as presently understood for this area (cf. Marten, 1977).

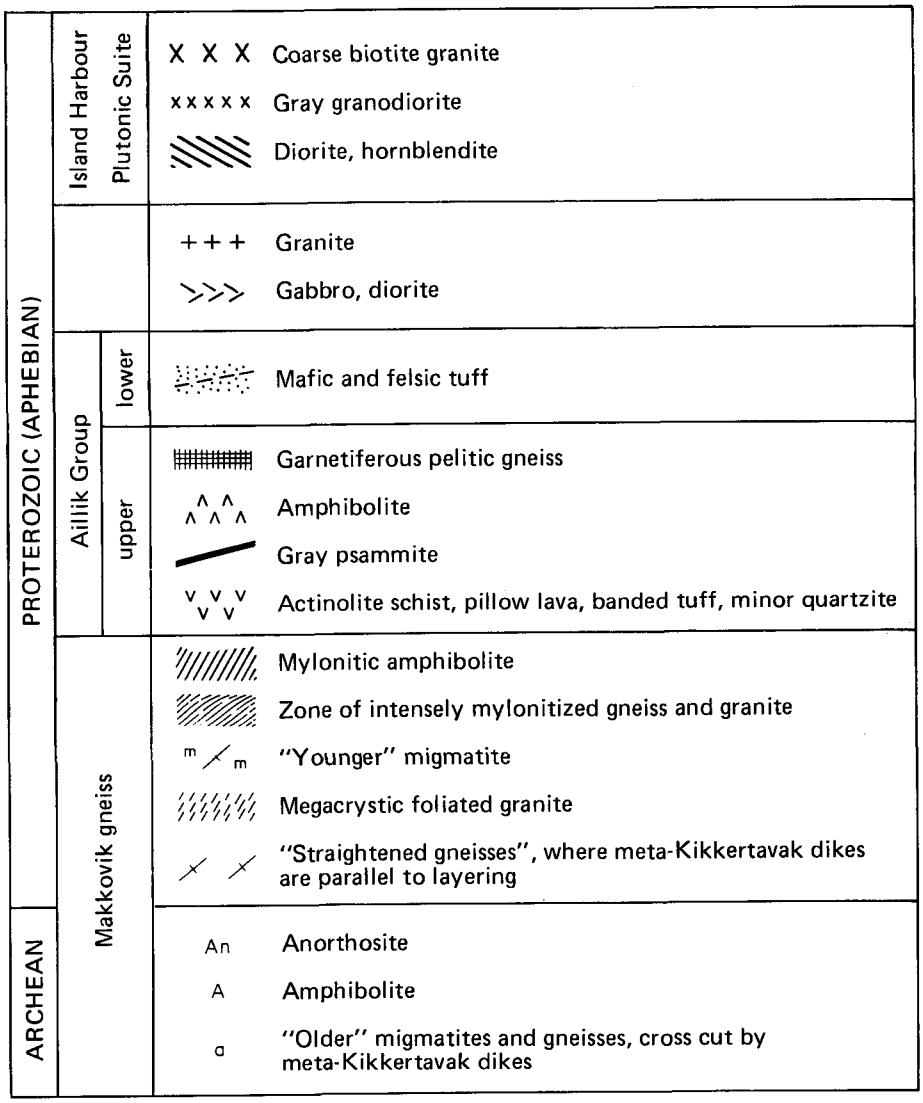
The area (Figure 1) comprises predominantly quartzofeldspathic and mafic gneisses referred to as Makkovik gneiss*, supracrustal rocks of the Aphebian Aillik Group, and granitoid rocks of the Aphebian Island Harbour Bay+ (Bay of Islands) plutonic suite. Brief descriptions are presented here, but more detailed information will be available in the notes accompanying the 1:50,000 scale maps for the area (Ryan, Kay and Ermanovics, in preparation).

MAKKOVIK GNEISS

The term 'Makkovik gneiss' has been suggested by I.F. Ermanovics (personal communication, 1981) to encompass the gneisses which occur in the Bay of Islands (Island Harbour Bay) area, and will be retained here to include all the gneisses occurring in this part of the Makkovik Subprovince. These rocks have had a long deformational and metamorphic history, and probably include both Archean and Proterozoic components. An Archean age for parts of the complex is suggested by comparison with the Nain

* Makkovik gneiss is used as an informal term. We recognize that this will need revision in compliance with the Code of Stratigraphic Nomenclature.

+ Island Harbour Bay plutonic suite will be used herein to avoid confusion with the Bay of Islands Complex in western Newfoundland and to conform with the terminology of Ermanovics and Korstgaard (1981).


PROTEROZOIC (APHEBIAN)
ARCHEAN
Island Harbour Plutonic Suite
Aillik Group
lower
upper
Makkovik gneiss
X X X Coarse biotite granite
xxxxx Gray granodiorite
Diorite, hornblendite
+++ Granite
Gabbro, diorite
Mafic and felsic tuff
Garnetiferous pelitic gneiss
Amphibolite
Gray psammite
Actinolite schist, pillow lava, banded tuff, minor quartzite
Mylonitic amphibolite
Zone of intensely mylonitized gneiss and granite
"Younger" migmatite
Megacrystic foliated granite
"Straightened gneisses", where meta-Kikkertavak dikes are parallel to layering
An Anorthosite
A Amphibolite
"Older" migmatites and gneisses, cross cut by meta-Kikkertavak dikes

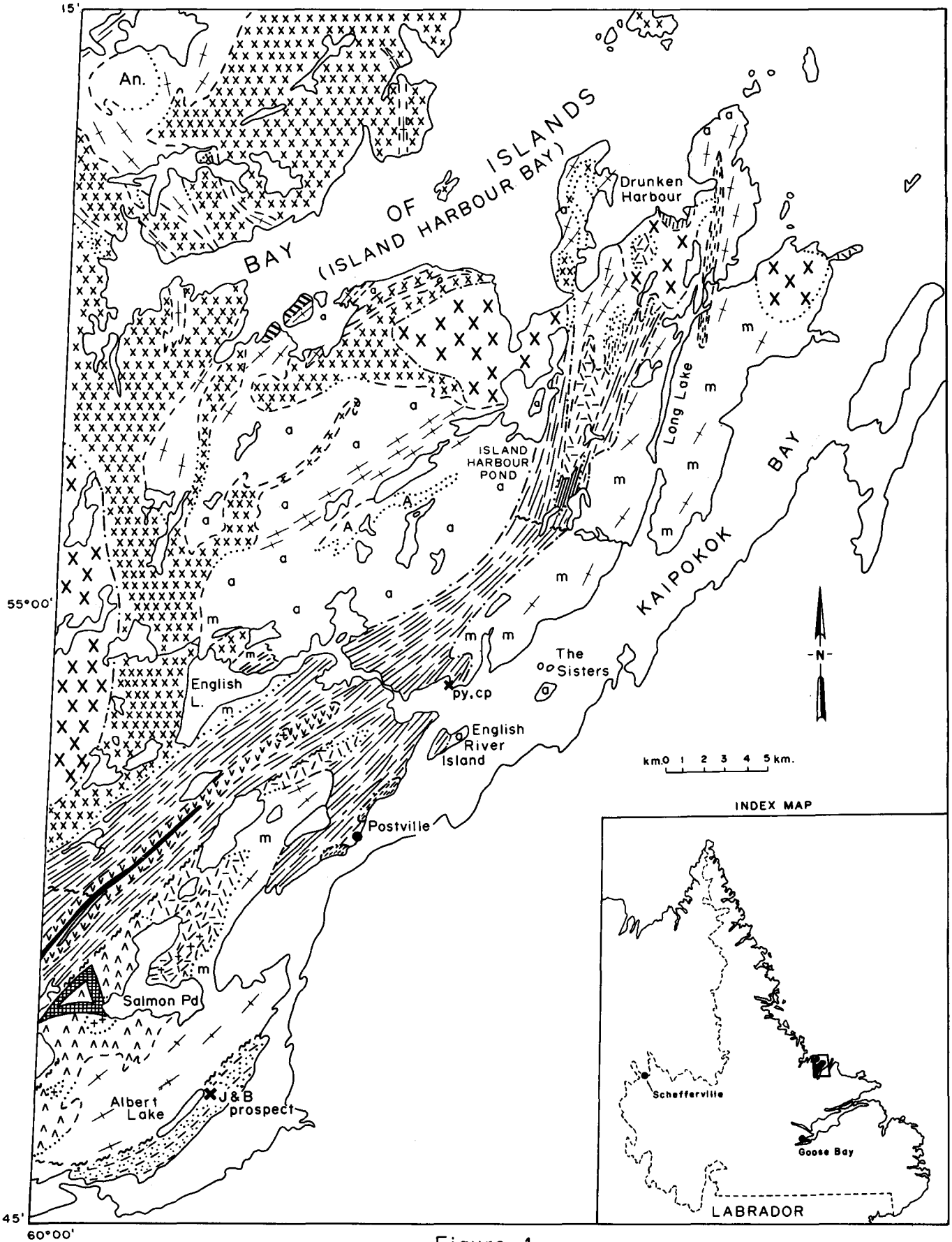

15'
An.
BAY OF ISLANDS
(ISLAND HARBOUR BAY)
Drunken Harbour
Long Lake
ISLAND HARBOUR POND
KAIPOKOK BAY
55°00'
English L.
The Sisters
py.cp
English River Island
-N-
km.0 1 2 3 4 5 km.
Postville
INDEX MAP
Salmon Pd
Albert Lake
J&B prospect
Schefferville
Goose Bay
LABRADOR
45'
60°00'

Figure 1

province to the northwest, based primarily on the relationship of metamorphosed diabase dikes to gneissic layering. These amphibolite dikes are correlated with the late Archean - early Proterozoic Kikkertavak dike swarm of the Kanairiktok Bay area (Ermanovics, personal communication, 1981), and where they still display a discordance to a gneissic layering, the layering is considered Archean. Where both the amphibolites and gray gneisses are parallel as a result of subsequent 'straightening', the layering is considered to be Proterozoic. The most extensive area of rocks with discordant dikes occurs north of English Lake, but other smaller areas occur around Bay of Islands. However, most of the area is characterized by 'straightened' gneiss and migmatite in which the metamorphosed dikes occur as parallel layers in a more leucocratic host.

PRE-DIKE ROCKS

Rocks which are clearly intruded by amphibolitized Kikkertavak dikes comprise migmatite, amphibolite and anorthosite, the anorthosite constituting a large enclave in straightened gneiss northwest of Bay of Islands (Island Harbour Bay).

The migmatites (Plate 1) are characterized by an irregular granite vein network which pervades a discontinuously layered gray to pink biotite gneiss. Isolated pods and inclusion trains of amphibolite and hornblende, with rarer anorthositic gabbro, are present locally.

Migmatitic and quartz veined, locally layered, pyroxene bearing amphibolite is interleaved with the early migmatites north of English Lake.

Gabbroic anorthosite and related rocks outcrop as an ovoid intrusion approximately 10 km northwest of Bay of Islands (Island Harbour Bay). It comprises recrystallized, sugary textured, gray to white weathering anorthosite and gabbroic anorthosite, amphibolitic metagabbro and layered ultramafic rocks.

THE DIKES

The amphibolite dikes (Plate 1), in contrast to the gneisses which they intrude, are not migmatitic. They are dense, massive, black to green weathering rocks which are locally plagioclase porphyritic.

POST-DIKE ROCKS

Gneisses throughout most of the area are well layered gray granodioritic rocks with parallel or slightly discordant massive amphibolite units (Plate 2). These are considered to be derived by Hudsonian structural reorientation of the gneiss/dike relationships described above. In contrast to the migmatitic character of the Archean gneisses, these younger gneisses are well layered rocks with little internal disruption. Exceptions occur along the west shore of Kaipokok Bay where a wide zone of younger migmatite occurs, and adjacent to the Island Harbour Bay plutonic suite where contact migmatization is extensively developed.

The 'straightened' gneisses are regularly layered and the alternating mafic and felsic layers are continuous along strike for many tens of metres. In places, the reworking appears to have occurred under an intense mylonitic regime, for feldspars and quartz have been tailed out, pegmatites are disrupted to isolated rounded pods, and rootless intrafolial folds are common.

In the Drunken Harbour area, elongate, foliated, megacrystic, biotite granites, having slight discordance to the gneissic layering, are interpreted to have been emplaced synchronously with the 'straightening' event. K-feldspar phenocrysts up to 5 cm in length impart a pronounced L>S fabric to these rocks.

Plate 1: Openly folded metadiabase (amphibolite) dike in early migmatites, Bay of Islands. Lower half of photo comprises multiphase granodiorite of Island Harbour Plutonic Suite.

Plate 2: "Straightened gneiss". Reworked early migmatite and meta-diabase dikes, Bay of Islands. Island Harbour granodiorite at left.

The 'straightened' gneisses are considerably migmatized along the western shore of Kaipokok Bay north of Postville. The gneissic layering in the paleosome is disrupted and convoluted and the amphibolites commonly occur as isolated rafts. The neosome is a gray, granodiorite, somewhat similar to the earliest phases of the Island Harbour Bay plutonic suite.

REFOLIATED MAKKOVIK GNEISS

A pronounced north-northeast trending zone of mylonitization, with gradational boundaries, up to 10 km wide overprints all the earlier gneissic structures west of Kaipokok Bay. The zone comprises gray to pink, quartzo-feldspathic and green amphibolitic rocks, ranging texturally from tightly folded and transposed gneisses to flinty ultramylonites (Plate 3). Deformed granites are recognized locally (*cf.* Sutton, 1972).

AILLIK GROUP

Metasedimentary and volcanic rocks of the Aillik Group outcrop west and southwest of Salmon Pond and southeast of Albert Lake.

Strongly deformed mafic and intermediate volcanics and psammitic metasediments of the lower Aillik Group (Marten, 1977) occupy a tight synform within the refoliated (mylonite) zone. Predominant are strongly schistose, ribbed weathering actinolite metabasites of uncertain protolith in which quartz stringers parallel the foliation. Locally, zones of relict primary structures can be recognized indicating that the protolith to the metabasites was gabbro, bedded tuff, volcanic breccia and pillow lava. Minor amounts of banded gray quartzite (metachert?) have also been observed with the metabasites. Metasedimentary rocks, varying from biotite schist to andalusite-bearing, thinly bedded psammites, occupy the central portion of the belt and structurally overlie the metabasites.

Southwest of Salmon Pond, similar lithologies occur as an intimate part of the gneiss complex. Here, the metabasites are hornblende rather than actinolite bearing, and the psammitic metasediments are represented by garnet- and muscovite-bearing lithologies.

A faulted wedge of upper Aillik Group (Marten, 1977) occurs at the head of Kaipokok Bay. These comprise buff to green weathering, interlayered mafic and felsic tuffs, with lesser amounts of gray porphyritic rhyolite and dense, green mafic flows and/or sills.

GABBRO AND DIORITE

Elongate bodies of gabbro and diorite occur mainly within the mylonite zone between Salmon Pond and Drunken Harbour. They are generally fresh, subophitic textured, medium grained rocks, but are locally pegmatitic. Margins may be foliated and metamorphosed, but the interiors are massive except for narrow shear zones. A pink to white weathering granitic dike network intrudes the gabbro locally.

GRANITE

A granitic network locally dissects the gabbros, and at Salmon Pond granite occurs as a discrete elongate intrusion cutting the gabbro and amphibolite (Griep, 1977). It is medium grained, weakly foliated, locally sparsely porphyritic and contains biotite $\pm$ hornblende.

ISLAND HARBOUR BAY PLUTONIC SUITE

The Island Harbour Bay (Bay of Islands) plutonic suite is a multiple intrusion dominated by gray granodiorite and pink granite (Ermanovics, 1980). In the map area the granodiorite is the more abundant phase.

The gray granodiorite occurs as a marginal phase and is well developed around the Bay of Islands (Island Harbour Bay), where it exhibits a

Plate 3: Finely laminated mylonite from refoliated gneiss zone near Postville.

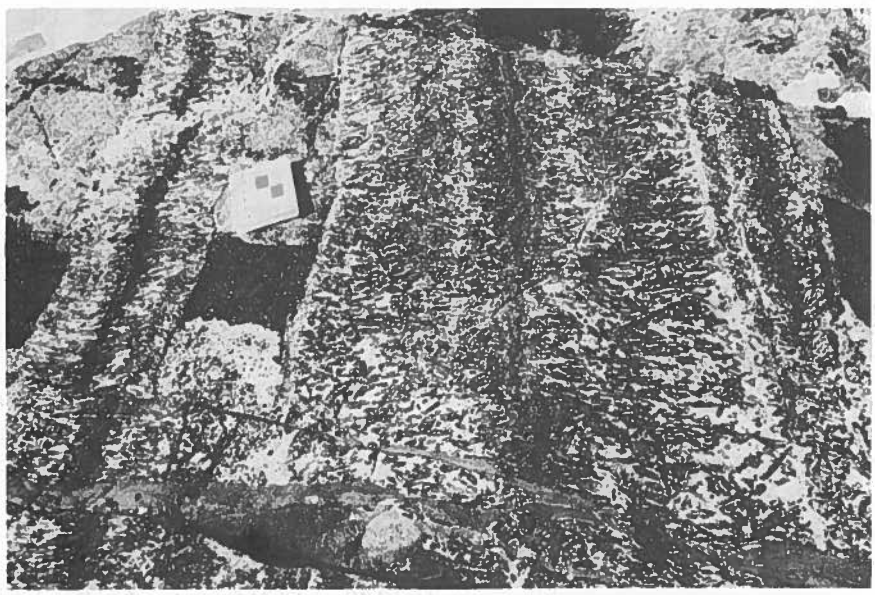


Plate 4: Comb-layering in diorite dikes, Bay of Islands.

lit-par-lit migmatitic relationship with, and contains abundant rafts of, the country rock gneisses. The granodiorite is a very fine to medium grained sphene-rich rock which has at least four components varying from dark, biotite-rich diorite to leucocratic granodiorite. It is massive or weakly foliated. It may also display well developed igneous layering and is, in places, porphyritic.

Two of the islands and adjacent mainland along the south shore of the Bay of Islands (Island Harbour Bay) display large ultramafic to dioritic rafts within the granodiorite, which appear to be remnants of an appinite association. The diorite locally occurs as dikes in the hornblendite and metadiorite. These dikes display spectacular development of comb-layering formed by prismatic hornblendes nucleated normal to the dike walls (Plate 4).

The interior phase of the Island Harbour intrusion west of English Lake comprises coarse, pink to gray, biotite granite. This phase also occurs as gently dipping sheets along the south shore of the Bay of Islands (Island Harbour Bay). It is sparsely porphyritic and north of Island Harbour Pond contains euhedral perthitic orthoclase megacrysts up to 6 cm in length.

POSTTECTONIC MINOR INTRUSIONS (NOT SHOWN ON SKETCH MAP)

The area contains abundant subhorizontal, commonly red weathering diorite dikes. They are generally 1 m thick. Thicker dikes are locally present, and these may display crude compositional layering.

Coarsely porphyritic diabase dikes are present in places. These are steeply dipping, brown weathering, fine to medium grained rocks, characterized by large (several centimetres in size) phenocrysts and glomerocrysts of plagioclase.

A few narrow, black lamprophyre dikes were noted along the south shore of Bay of Islands (Island Harbour Bay) and the west shore of Kaipokok Bay.

Rhyolitic dikes have also been noted in a few areas. Narrow, gray, quartz-feldspar porphyry dikes cut the gneisses at Bay of Islands and English Lake. At the former locality, they predate intrusion of the early gray phase of the Island Harbour Bay plutonic suite. A 30 m thick, pink, quartz-feldspar porphyry dike intrudes the Archean amphibolite northeast of English Lake. Homogeneous fine grained rhyolitic dikes are present in the vicinity of Long Lake.

Pegmatites are locally present in the border zone of the Island Harbour Bay plutonic suite. They contain quartz, feldspar (albite, microcline, amazonite), biotite, muscovite, beryl, garnet and fluorite.

STRUCTURE

All rocks, except the posttectonic minor intrusions show a foliation, and a polyphase deformational Archean and Proterozoic history is apparent.

The relationship of amphibolite dikes to the rocks they intrude indicate that the Archean gneisses and layered amphibolites have undergone at least two deformational episodes and a period of migmatization before dike intrusion.

After intrusion of the dikes, the gneiss/dike complex was subjected to several periods of Hudsonian deformation and metamorphism. In zones of low deformation, where discordance to layering is preserved, the dikes may be folded (Plate 1); stretched plagioclase phenocrysts and a hornblende lineation are apparent. Outside, these low deformation augen, the reworked gneiss/dike complex displays a regular layering, in places mylonitic, and exhibits a moderately south-plunging mineral lineation. This lineation is

also apparent in foliated megacrystic granites in the Long Lake area. Locally both gneissic layering and lineation are folded, a feature which appears to have predated development of Hudsonian migmatites in the Long Lake area.

An intense zonal mylonitization is superimposed on the Hudsonian migmatites, and it too is a poly-deformational feature. Outside the present map area this zone is continuous with the refoliated gneisses at the Aillik/gneiss contact mapped by Marten (1977) on the southeast shore of Kaipokok Bay (Figure 2). In the margins of the zone an early mylonitic gneissosity is overprinted by a younger mylonite fabric which is the dominant fabric in the zone. In many places the younger fabric is of L>>S type, and the generally shallow southerly plunge of the lineation gives rise to rocks which exhibit a finely foliated or banded aspect on horizontal outcrop surfaces (Plate 3), but which show their original character on surfaces normal to the lineation.

The dominant foliation in the mylonite zone is also the foliation present in the lower Aillik Group confined to this zone. The lower Aillik Group occurs as a southwest plunging synform west of Salmon Pond and is directly correlative with Marten's Post Hill synform (Figure 2). Both the Aillik Group rocks and the mylonite have been refolded about northeast trending axes, and either due to original variable plunge of the supracrustals or plunge of the refolding structure, the supra-crustals are not continuous around this structure. The northeast-trending Witch Lake slide (Figure 2) may be related to subvertical translation during this phase of deformation. The Island Harbour Bay plutonic suite and the gabbros in the mylonite zone and near Salmon Pond may have been intruded before this late folding episode for both are locally weakly foliated. The deformation itself may in some way be related to late structural adjustments following intrusion of the Island Harbour Bay pluton. A domal structure in the gneisses north of English Lake (Figure 2) may also be a consequence of this, but the relative age of this particular fold structure has not been established.

The deformational chronology from the Makkovik Subprovince then, is indicative of at least two locally recognizable periods of folding during the Archean (Kenoran Orogeny), and further polyphase deformation and metamorphism during the Aphebian (Hudsonian Orogeny). Two Hudsonian deformational episodes predated a migmatization event, and further zonal deformation (mylonitization) and folding was superimposed on this migmatite. The zonal mylonitization and concomitant infolding of the Aillik Group is equivalent to Marten's (1977) D_1-D_2 event, and the subsequent refolding on northeast-trending axes as shown in Figure 2 corresponds to his D_3.

ECONOMIC GEOLOGY

The most significant known mineral occurrence in the area is the J & B Prospect (Lever and Davidson, 1979). This is a zone of anomalous radio-activity in sheared rhyolitic tuffs and associated mafic flows or sills of the upper Aillik Group near Albert Lake. The zone is generaly less than 2 m wide and occurs intermittently along strike for 1.5 km. The host rocks are epidotized and hematized, and the mineralization appears to be largely structurally controlled along the sheared contact between felsic and mafic bands.

Radioactivity has also been reported from the migmatitic gneisses in the area of Long Pond (Morrison, 1958; Sutton, 1971a; Burns, 1980). This is confined to pegmatites and is due to the presence of U-Th-REE bearing minerals such as allanite, crystals of which may reach several centimetres in length.

A pyritic gossan with minor chalcopyrite occurs in mylonitized

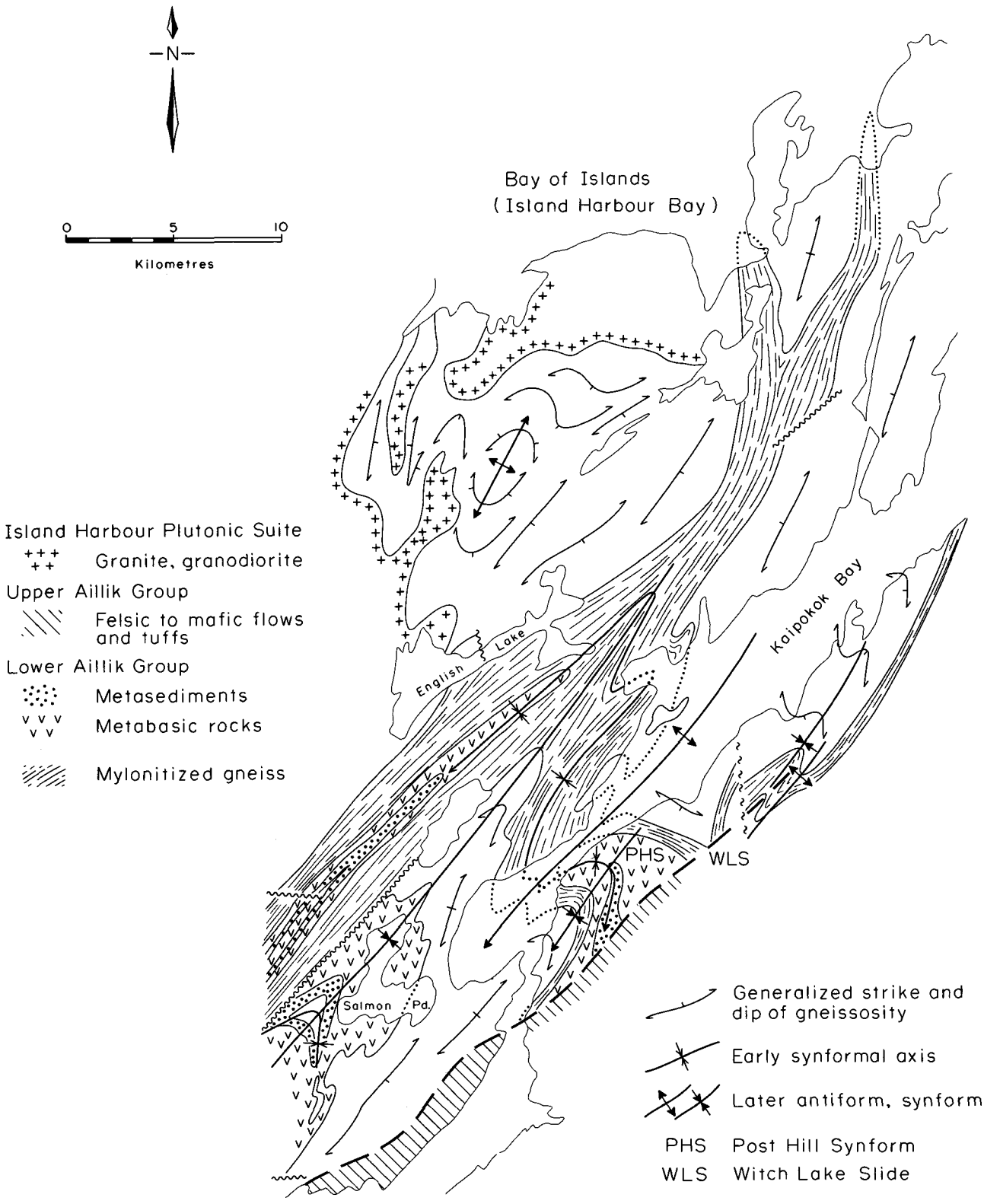


Figure 2: Correlation of map units and structures across Kaipokok Bay

gneiss and gray granite on the coast north of English River Island. Smaller rusty pyritic zones are found within the gabbro intrusions.

A small fluorite showing was documented by Morrison (1958) from coarse granite west of Drunken Harbour and fluorite was observed microscopically in the same granite north of Island Harbour Pond.

RELATIONSHIPS OF THE AILLIK GROUP TO THE GNEISSES

Relationships between the gneisses and Aillik Group have been discussed by Sutton (1972) and Marten (1977). These studies have concluded that the gneisses around Kaipokok Bay (referred to by them as the Hopedale Complex) represent the Archean basement on which the Aphebian Aillik Group was deposited. The unconformity between the two was obliterated by intense subhorizontal and later subvertical translation (tectonic sliding) along the basement-cover interface which led to the development of a well defined mylonite (slide) zone at the gneiss-Aillik contact. This mylonitic deformation was attributed to the Hudsonian Orogeny, but it was considered that the migmatitic gneisses outside the zone of reworking were Archean in age.

This study also supports the existence of a mylonite (slide) zone between the lower Aillik Group and migmatites but questions the age of migmatization. If the correlation of the discordant metadiabase dikes of the Bay of Islands area with the late Archean - early Proterozoic Kikkertavak dikes of the Nain Province is valid, then the amphibolite facies metamorphism which overprints them must be Proterozoic (Hudsonian) in age. This metamorphism was accompanied by structural reorientation of the dikes and an earlier migmatite banding, such that throughout most of the map area the parallel gray gneiss-amphibolite layering is a combination of the earlier gneissosity plus dikes, which have been structurally reworked during the Hudsonian. It is these 'straightened gneisses' which comprise the paleosome to the migmatites of the 'Hopedale Complex' around Kaipokok Bay, and therefore this migmatization must be an even younger Hudsonian event.

Marten (1977) concluded that the earliest penetrative fabrics recognizable in the Aillik Group could be related to the mylonite (slide) zone which overprints the migmatites and separates them from the Aillik, and therefore these fabrics represent the initial penetrative effects of the Hudsonian Orogeny on the cover. If this is the case, and the migmatites are themselves a product of the Hudsonian, then the pre-mylonitic Hudsonian metamorphic and structural history of the gneisses is missing from the Aillik Group in the area of Marten's study.

The same conclusion with regards to the deformation in the lower Aillik Group and the enclosing mylonites west of Salmon Pond can be drawn from this study since the fabric in the mylonite is also the fabric of the supracrustals and metamorphic grade in both is upper greenschist - lower amphibolite. However, south of Salmon Pond, higher grade metavolcanic and metasedimentary rocks correlated with the lower Aillik Group appear to be an intimate part of the middle amphibolite facies gneiss terrain. There is no slide (mylonite) zone present in this area and the contact between the quartzofeldspathic gneisses and supracrustal rocks is apparently a gradational one in which amphibolite layers become increasingly abundant in the gneisses towards the metavolcanics (Griep, 1977). If this is a slide zone as well, it does not have the fine mylonitic fabric so characteristic of the other slide zone at the gneiss/Aillik interface. The foliation in the gneisses and the supracrustals appears to be the same age, and therefore, it would seem that the Aillik Group in this area has been subjected to

the same history as the surrounding gneisses. How then can we explain both the presence of Aillik Group in a middle amphibolite facies gneiss terrain and the occurrence of lower grade Aillik Group in a mylonite (slide) zone which overprints these same gneisses?

Marten has suggested that the present disposition of the Aillik Group and the migmatitic gneisses along the southeast shore of Kaipokok Bay is the result of a modified unconformity between Aphebian cover (Aillik Group) and Archean basement (migmatites of the "Hopedale Complex"). This is implausible if the migmatites themselves are Hudsonian. In addition, the relationships described from south of Salmon Pond would suggest that the Aillik Group had been deformed and metamorphosed concomitant with the development of the gneisses. Why then does the history of the Aillik Group in slide contact with the migmatites show no record of the earlier events? Conceivably, the intense penetrative deformation associated with the mylonitization has obliterated any vestiges of these earlier events in the cover. However, the preservation of bedding and other primary features of the supracrustals in the mylonite zone indicates that they have not been subjected to any higher grade metamorphic and deformational episodes. An alternative explanation may be that the Aillik Group, bounded by slide zones, is highly allochthonous and has undergone much later deep-level tectonic slicing into a terrain which had already been subjected to migmatization earlier in the Hudsonian. The lower grade assemblages of Aillik rocks adjacent to and within the slide zones would suggest this, and therefore imply that the Aillik Group in these zones was far removed, either laterally or vertically from their present site when this migmatization occurred.

The above interpretation implies that the Makkovik Subprovince has had a much longer metamorphic history than previously suspected. However, this conclusion becomes invalid if the amphibolite dikes of the area are not Kikkertavak equivalents and the supracrustal rocks south of Salmon Pond are not Aillik Group. A geochronology program focusing on these problems is presently underway.

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