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GEOLOGY OF THE SAND HILL RIVER - BATTEAU MAP REGION, GRENVILLE PROVINCE, EASTERN LABRADOR

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ABSTRACT

The Sand Hill River - Batteau map region is subdivided into six structural-lithological entities, namely the 1) Domino domain, 2) Earl Island domain, 3) Paradise metasedimentary gneiss belt, 4) Sand Hill Big Pond gabbronorite, 5) Paradise Arm pluton, and 6) the White Bear Arm complex. The Domino and Earl Island domains consist of granitoid plutonic rocks and orthogneiss, together with layered mafic intrusions and rare metasedimentary gneiss. The Paradise metasedimentary gneiss belt comprises cordierite-garnet-sillimanite-kyanite pelitic gneiss with minor quartzite, psammitic gneiss, calc-silicate rocks and amphibolite. Sapphirine and orthopyroxene are present in metasedimentary gneiss adjacent to the Sand Hill Big Pond gabbronorite. The Sand Hill Big Pond gabbronorite and White Bear Arm complex are both composed of anorthosite, norite, gabbro and monzonite, and are interpreted as having been contiguous prior to the emplacement of the linear Paradise Arm pluton. Other rocks mapped include pre-Grenvillian mafic dikes of various ages, and late Precambrian - early Paleozoic north-northeast- trending mafic dikes.

Regional structures have a consistent west-northwest trend and are associated with tight folds and major strike-slip faults. A north-directed thrust was mapped in the northeast part of the area. Many prominent photolineaments are interpreted to be related to post-Grenvillian faulting and dike emplacement.

The best prospects for economic mineralization are sulfide-rich zones and muscovite-rich pegmatite in the Paradise metasedimentary gneiss belt.

INTRODUCTION

Reconnaissance geological mapping at 1:100,000 scale of the Sand Hill River - Batteau map region in 1985 marks the second year of a 5-year Canada - Newfoundland joint project, aimed at completing mapping of an 80 km wide coastal fringe of the Grenville Province in southeastern Labrador.

The Sand Hill River - Batteau map region comprises seven NTS 1:50,000 scale map areas (3E/4,5,12 and 13H/1,2,7,8), which encompass an area of approximately 6100 km^2 (Figure 1). The only previously published geological map for the area is that of Eade (1962) at 1:50,000 scale. Apart from very small areas of metasedimentary and mafic gneiss, Eade showed three broad units: granitic gneiss, granitic plutons and gabbroic intrusions. In a general way, this project has confirmed his lithological subdivision, although at first sight the revised map (Figure 2) appears to bear little resemblance to that of Eade. Major revisions have been made to the positions of many geological boundaries and much of Eade's granitic gneiss unit has been identified as metasedimentary gneiss and extended well beyond its former boundaries.

Apart from mineral exploration activity, other geological investigations have been confined to coastal localities. These areas were initially visited by Lieber (1860), Packard (1891) and Daly (1902), and more recently by Christie (1951), Douglas (1953) and Kranck (1939, 1953). In addition, Grasty *et al.* 1969) reported K-Ar ages for a granitic intrusion and two mafic dikes from the northeast part of the region.

Reconnaissance mineral exploration activity, carried out by British Newfoundland Corporation (BRINCO) Ltd., has been confined mostly to the southwest portion of the map area. Initial investigations were by Piloski (1955), and later by Kranck (1966) and Bradley (1966). More detailed mapping was done by Donohue (1966) in the Sand Hill Big Pond area.

The present mapping has benefited from complete aeromagnetic map coverage (Geological Survey of Canada, 1974a,b) and extrapolation of units from previously mapped areas to the north and west (Gower *et al.*, 1982, 1983, 1985; Owen *et al.*, 1983).

This project is a contribution to the Canada-Newfoundland Mineral Development Agreement, 1984-1989

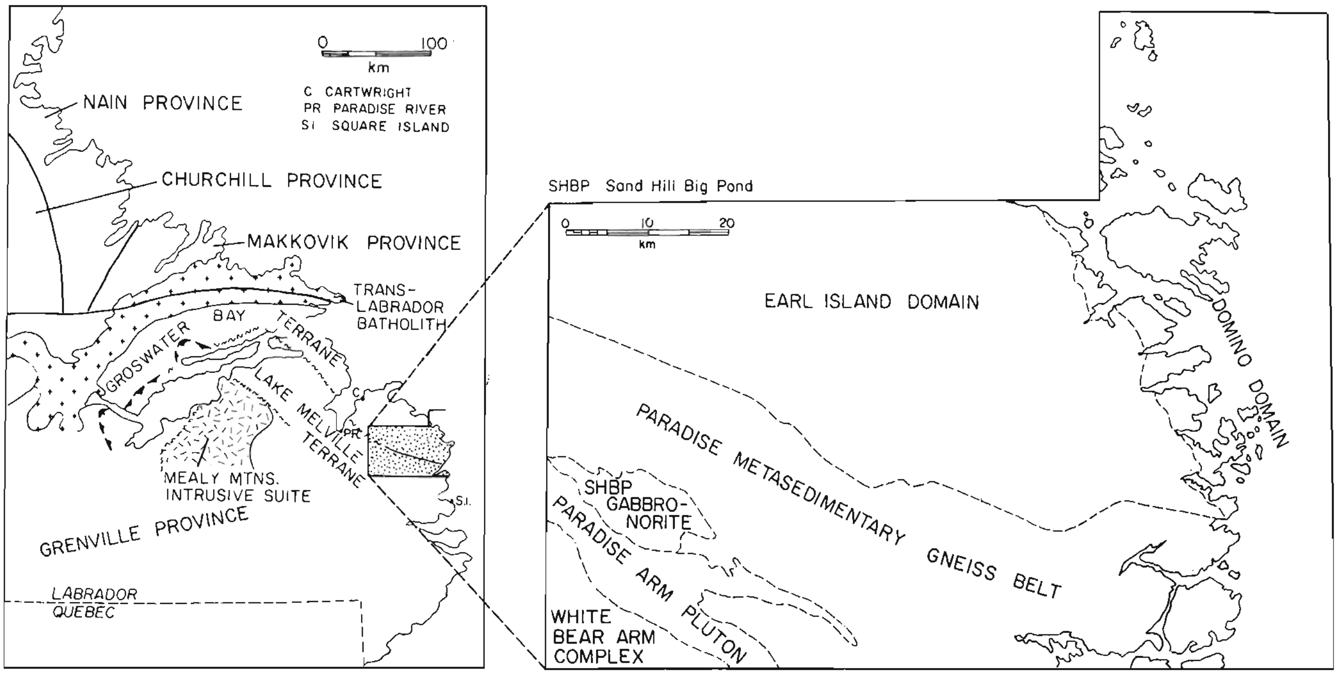


Figure 1: *Location and structural-lithological subdivision of the Sand Hill River - Batteau map region, Grenville Province, eastern Labrador.*

REGIONAL SETTING AND SUBDIVISION OF MAP AREA

The study area is situated entirely within the Grenville Province and straddles the southeastward extension of the boundary between the Groswater Bay and Lake Melville terranes (Gower, 1984; Gower and Owen, 1984). The location of the area is shown in Figure 1.

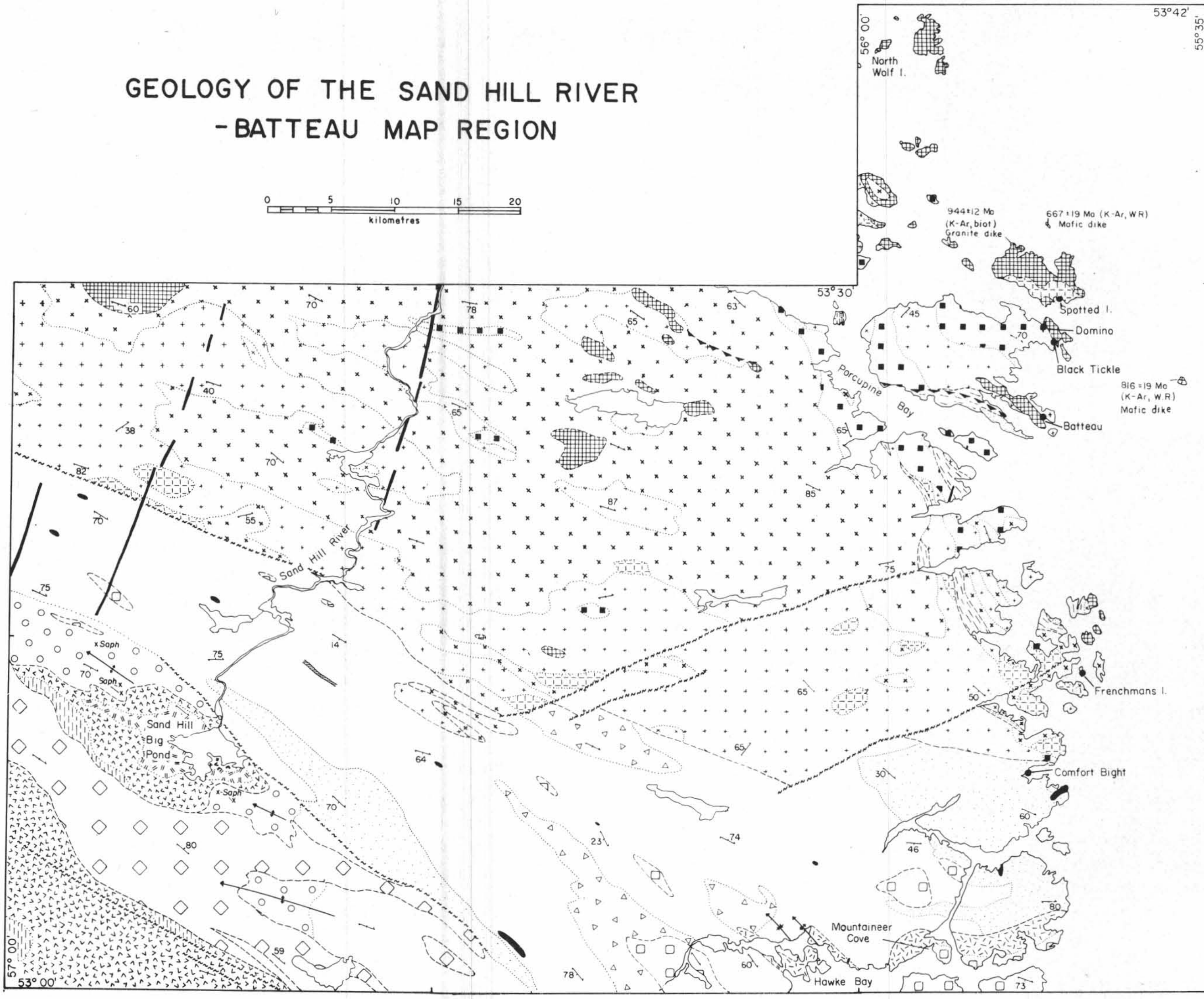
The map area can be divided into six major lithological entities. These are: 1) Domino domain, 2) Earl Island domain, 3) Paradise metasedimentary gneiss belt, 4) Sand Hill Big Pond gabbronorite, 5) Paradise Arm pluton, and 6) White Bear Arm complex. The Domino domain and Sand Hill Big Pond gabbronorite are new informal names; the other terms were introduced by Gower *et al.* (1985). From previous mapping and regional geological synthesis, it is anticipated that the Earl Island domain would intersect the coast roughly between Porcupine Bay and Comfort Bight, and that the area to the north would compare most closely with typical Groswater Bay terrane gneisses mapped farther northwest. Instead of the predicted pattern, it appears that the whole coastal region (Domino domain) differs, both in rock types present and their variability, from the interior (Earl Island domain). This variability could be simply an artifact of better coastal exposure, and lithological contrasts may be a result of preferential weathering and lack of exposure of selected units inland. Therefore, pending further work, the Domino and Earl Island domains are described separately as distinct lithological entities.

Domino Domain

The Domino domain, named after Domino (Figure 2), consists of granitoid plutonic rocks, layered mafic intrusive bodies and minor metasedimentary gneiss. Severely deformed and migmatized derivatives of the granitoid plutonic rocks are separately designated as orthogneiss in Figure 2. The Domino gneiss of Lieber (1860) was not classified, by our criteria, as a gneiss at its type locality, but instead was mapped as a fairly homogeneous, K-feldspar megacrystic, granitoid plutonic rock.

The granitoid plutonic rocks include biotite- and hornblende-bearing diorite, quartz diorite, monzonite, quartz monzonite, hornblende-biotite granodiorite, biotite granodiorite and muscovite-biotite granite. A notable feature of the Domino domain is the common occurrence of megacrystic variants of the granitoid rock types. The rocks are mostly medium grained, but include fine and coarse grained types. Color varies from black and white, or gray in the dioritic units to pink, creamy or brown in the granites. The mineralogy comprises a plagioclase-quartz-biotite ± K-feldspar ± epidote assemblage including accessory apatite, sphene, allanite, opaque minerals and, locally, garnet. In places, the rocks are homogeneous and weakly foliated, elsewhere they are stongly deformed and migmatized and grade into well banded orthogneiss.

The granitoid plutonic rocks are intruded by minor granitic intrusions of several ages and pre-Grenvillian mafic dikes of at least two ages. The earlier dikes are metamorphosed to amphibolite facies; they are strongly deformed and locally have a net-veined (agmatitic) appearance where injected by granitic leucosome. The later dikes, which truncate the more strongly deformed earlier mafic dikes (Plate 1), lack net-veined characteristics but also have a metamorphic (amphibolite-facies) mineralogy. Some mafic dikes contain plagioclase phenocrysts.



LEGEND

LATE PRECAMBRIAN - EARLY PALEOZOIC

Gabbro, diorite dikes.

MIDDLE PROTEROZOIC OR OLDER

Domino and Earl Island domains

- Layered mafic intrusions (troctolite, norite, gabbro, monzonite, syenite).
- Muscovite-biotite granite.
- K-feldspar megacrystic granitoid rocks, generally hornblende bearing.
- Hornblende-biotite granodiorite to granite.
- Biotite-hornblende diorite to quartz monzonite.
- Hornblende-biotite orthogneiss.

MIDDLE PROTEROZOIC OR OLDER (continued)

Paradise metasedimentary gneiss belt

- K-feldspar megacrystic biotite granodiorite to granite.
- Hornblende diorite to quartz diorite, orthogneiss in part.
- Muscovite-rich pelitic gneiss.
- Sillimanite-cordierite pelitic and semipelitic gneiss, minor calc-silicate rocks.
- 'Charnockitic' pelitic gneiss, locally sapphirine bearing.
- Diatexite derived from pelitic gneiss protolith.
- Quartzite.
- Amphibolite and metagabbro.

MIDDLE PROTEROZOIC OR OLDER (continued)

Paradise Arm pluton

- Monzodiorite, monzonite, quartz syenite, granite.

White Bear Arm complex and Sand Hill Big Pond gabbronorite

- Fine to medium grained leuconorite.
- Gabbro, norite, troctolite, commonly coronitic and layered.
- Anorthosite, leuconorite.

Geological boundary; approximate, diffuse

Thrust; undifferentiated fault

70 Gneissosity, foliation

x Saph Sapphirine locality

Antiform, synform

Figure 2: *Geology of the Sand Hill River - Batteau map region.*

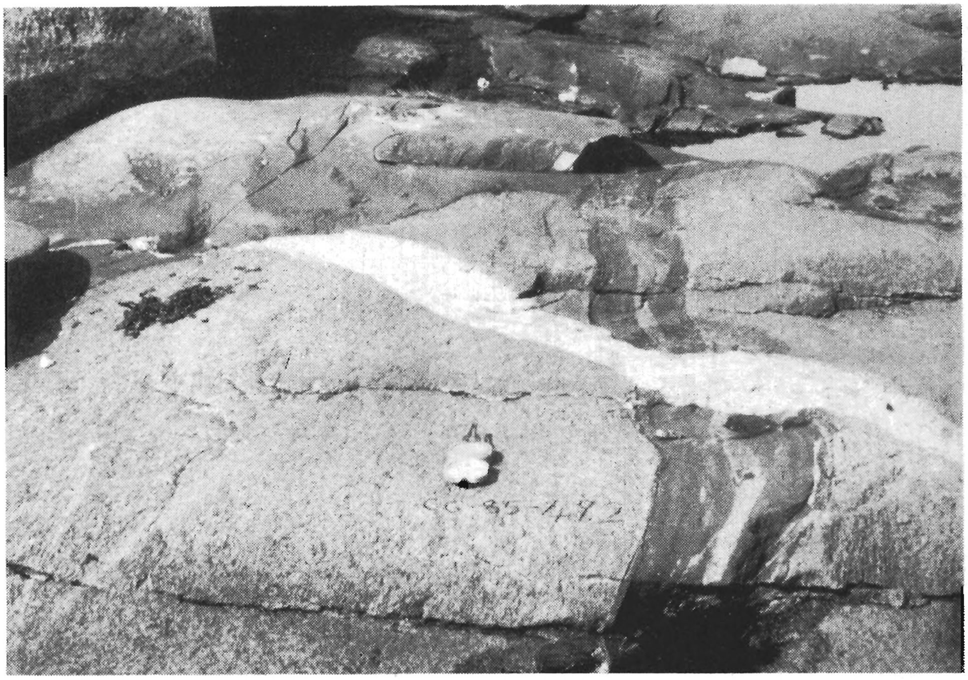


Plate 1: *Quartz diorite of the Domino domain intruded by early deformed mafic dike, later less deformed mafic dike (across top of photograph) and pegmatite which is severely attenuated in later mafic dike. Frenchmans Island area.*

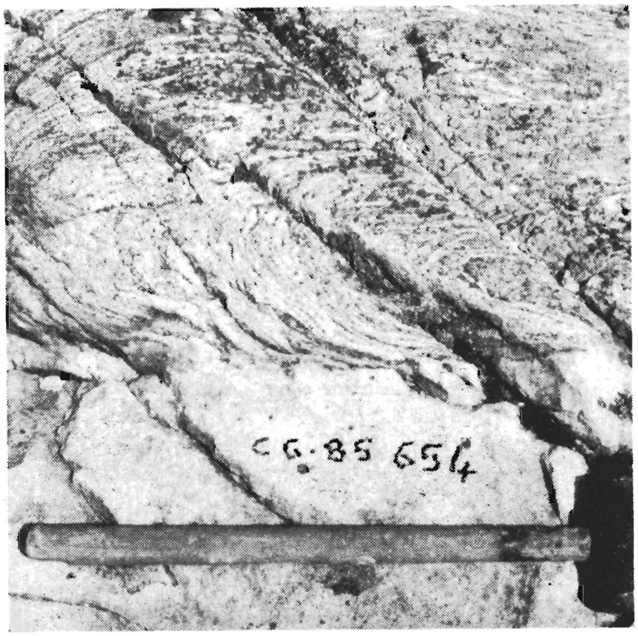


Plate 2: *Biotite granodiorite gneiss discordantly intruded by pink, muscovite-biotite granite. Elsewhere the granite is intruded by the later mafic dikes of Plate 1. Frenchmans Island area.*

Apart from the muscovite-biotite granite, most of the granitoid rocks appear to form an intergradational package. The granite, however, is probably later as it is intruded only by the later mafic dikes. Also, the granite is the only unit seen to unequivocally intrude orthogneiss (Plate 2). Assuming protolith equivalence between the other granitic plutonic rocks and the orthogneiss, it is thus inferred that granite postdates the migmatization which variably affected other granitoid units.

Layered mafic intrusive rocks in the Domino domain include gabbro, norite and minor troctolite, with leucocratic and melanocratic variants. Ultramafic rocks are a minor associated rock type. These rocks have either sharp or gradational contacts with associated diorite, monzonite and, locally, syenite. Layering is best seen in the more melanocratic units and is particularly well exposed on North Wolf Island (Figure 2). Gradations between the lower gabbroid part and the upper more felsic part of a layered unit commonly occur over a few metres and, if exposure is not perfect or if the rocks are deformed, the transition may not be observed. Contacts between the felsic top of one layered unit and the overlying base of the next are sharp, but many instances were seen where felsic material, identical to that in the underlying layered unit, has agmatitically invaded the overlying mafic rocks (Plate 3). These examples are interpreted to indicate that the lower layered unit was emplaced later and that the injected material is a late stage differentiate of the felsic part of the lower unit. No geochronology has been carried out on these layered mafic intrusions but a similar gabbro monzonite at Grady Island (40 km northeast of Cartwright) has been dated at 1610 ± 30 Ma (Brooks, 1983). It is suspected by the authors that these layered mafic intrusions will yield similar ages.

Typically, contacts between the layered mafic intrusions and their granitic hosts are tectonized, but chilled borders

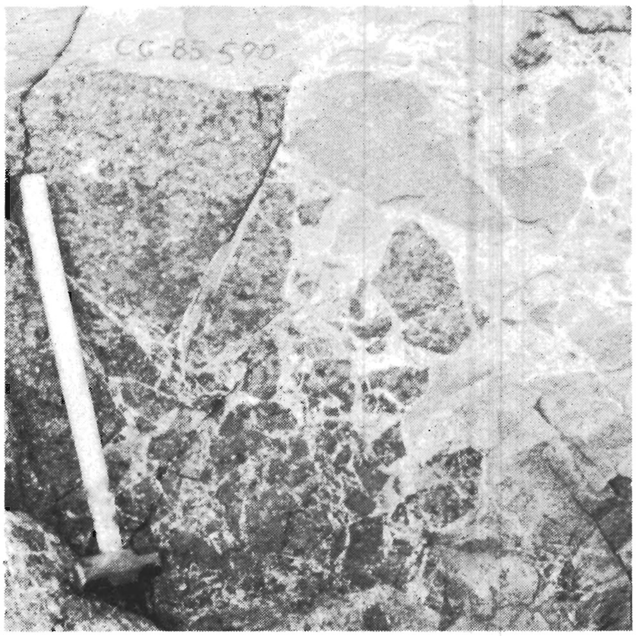


Plate 3: *Agmatitic relationships between mafic rocks and monzonite at the base of a layered unit in a layered mafic intrusion. South of Batteau.*

at some localities clearly demonstrate that the layered mafic intrusions postdate at least some of the granitoid plutons. As most granitoid plutons in the Grenville Province in eastern Labrador have an age of ca. 1650 Ma (Gower and Owen, 1984; Gower and Ryan, 1986), the time interval between granitoid plutons and layered mafic intrusions need not have been great.

The main area of metasedimentary gneiss in the Domino domain is located south of Batteau (Figure 2). The rocks are well banded gneiss containing a muscovite-biotite-opaque mineral restite and a pink quartzofeldspathic leucosome. Garnet may be present in the restite and tourmaline occurs sporadically. Pods and more continuous layers of amphibolite probably represent former mafic dikes. Farther south, in the Frenchmans Island area, small isolated areas of sillimanite-bearing metasedimentary gneiss are found within granitoid rocks. These are interpreted by the authors as mega-enclaves that were enclosed by the granitoid plutons during emplacement.

The only radiometric dates presently available in the study area are from the Domino domain. Ages of 816 ± 19 Ma and 667 ± 19 Ma (K-Ar, whole rock) were obtained from mafic dikes, and an age of 944 ± 12 Ma (K-Ar, biotite) was obtained from a granitic intrusion (Grasty *et al.*, 1969). These ages have been adjusted from those originally reported using IUGS recommended decay constants (Steiger and Jager, 1977). The meaning of the dates on mafic dikes is difficult to evaluate without additional geochronology, but the 944 Ma date, which is similar to biotite ages reported elsewhere from the Groswater Bay terrane (see Gower and Ryan, 1986), probably reflects late-Grenvillian uplift and cooling.

Earl Island Domain

The Earl Island domain underlies most of the northern part of the Sand Hill River - Batteau map region. Comparable rocks to the north and west have been described by Gower *et al* . (1982, 1985). Within the map area, the two main rock types are biotite-hornblende diorite to quartz diorite and biotite granodiorite containing minor hornblende. These are similar in mineralogy, texture and fabric to analogous rocks in the Domino domain. Most of the granodiorite underlies the southern part of the Earl Island domain; dioritic rocks are more extensive farther north. This distribution is interpreted to mean that the granodiorite is a higher level rock type that has been infolded farther north to give the alternating pattern of elongate granodiorite bodies within diorite that is evident in Figure 2.

Small areas of granite and megacrystic granitoid rocks depicted in Figure 2 have similar mineralogical and textural characteristics to their counterparts in the Domino domain. As in the Domino domain, these rocks (except, perhaps some of the granite) are regarded by the authors merely as mineralogical variants of the diorite and granodiorite, rather than unrelated intrusions.

Other rock types in the Earl Island domain include mafic rocks and rare occurrences of metasedimentary gneiss. The mafic rocks consist of gabbro, amphibolite and melanocratic diorite, locally with norite and ultramafic units. Although these rocks tend to be resistant to erosion and form hills, exposure is not adequate to observe layering comparable to that in coastal localities. The rare occurrences of metasedimentary gneiss include muscovite- and sillimanite-bearing rock types, interpreted as enclaves within granitoid plutons of the Earl Island domain.

Paradise Metasedimentary Gneiss Belt

The Paradise metasedimentary gneiss belt underlies much of the southern half of the Sand Hill River - Batteau map region. Gradually tapering, it can be traced continuously northwestward for a further 80 km (Gower *et al.* 1982, 1985; Gower and Owen, 1984).

The dominant rock type is a sillimanite-biotite-cordierite pelitic or semipelitic gneiss, including areas of muscovite-rich pelitic gneiss and diatexite. Minor associated rocks include quartzite and/or lean banded iron formation, psammitic gneiss, calc-silicate rocks and amphibolite. The pelitic gneiss is pink and black, creamy, white or buff weathering, medium grained and well banded. All stages of migmatization are seen from pods of leucosome within a relatively homogeneous paleosome to dismembered rafts of restite in diatexite. Restite minerals include biotite, sillimanite, cordierite and opaque minerals. Garnet is an additional restite mineral but, in contrast to similar gneisses farther northwest, is somewhat rare. Relict kyanite is present in the central part of the map area.

Adjacent to the Sand Hill Big Pond gabbronorite, the metasedimentary gneiss has a buff, gray or brown weathering appearance (Plate 4), and lacks the well banded leucosome-restite contrasts that occur throughout the remainder of the area (see Metamorphism).

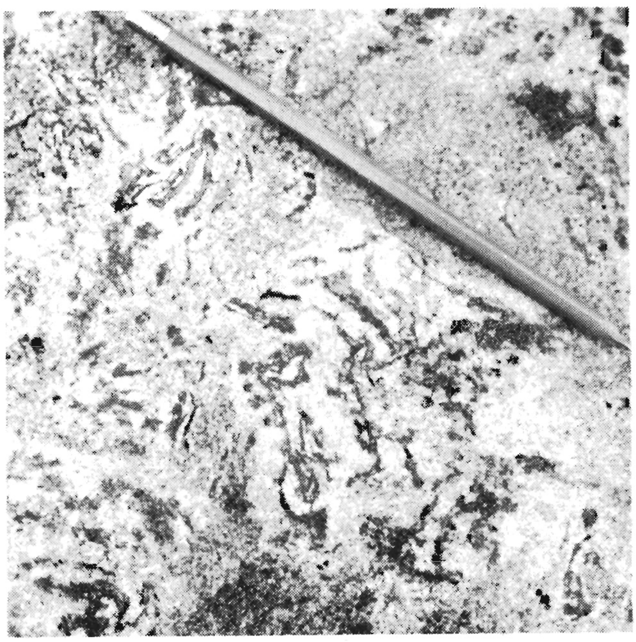


Plate 4: *Charnockitic pelitic gneiss adjacent to Sand Hill Big Pond gabbronorite. This unit locally is sapphirine bearing.*

The muscovite-rich metasedimentary gneiss is a schistose to well banded, fine to coarse grained, pink, white or gray rock that has a variably migmatized appearance. In places, the rocks show a fine lamination, which may reflect relict bedding, but elsewhere they have discontinuous lenses or patches of leucosome in a wispy or contorted restite. Commonly these rocks contain sillimanite. Without thin section assessment, it is uncertain whether the muscovite-rich metasedimentary gneisses are retrograde products of higher grade metamorphic assemblages, or if they indicate areas of lower grade metamorphism.

White weathering diatexite, interpreted as the product of extensive melting of pelitic gneiss, is most common in the south-central part of the study area. In contrast to similar rocks associated with metasedimentary gneiss in other parts of the Grenville Province of eastern Labrador, these rocks lack garnet, but instead commonly contain cordierite.

Other rock types in the Paradise metasedimentary gneiss belt are volumetrically minor. Quartzite, interbanded with calc-silicate rocks, correlates with a marked aeromagnetic anomaly 8 km northeast of Sand Hill Big Pond. Thinly bedded quartzite, associated with amphibolite, calc-silicate rocks and pelitic gneiss, occurs at several coastal localities. Calc-silicate rocks, consisting of a grossular/andradite-diopside-calcic plagioclase-quartz $\pm$ calcite assemblage, are generally present either as thin layers or boudinaged pods, and are not abundant. However, at one locality 9 km south of Comfort Bight, they are a major rock type, together with quartz-rich metasedimentary rocks, and form a section about 100 m thick (Plate 5). Amphibolite, similar to that discussed by Gower *et al.* (1985) as being of supracrustal origin, is exposed sporadically but, because of inadequate exposure, cannot be assigned to a specific protolith. It is certain (from field relationships and textural criteria) that amphibolite at some localities represents remnants of mafic dikes or larger intrusions although some amphibolite is probably of supracrustal origin. The metasedimentary gneisses are also characterized by pyritic zones and muscovite-bearing pegmatites (see Economic Mineral Potential).

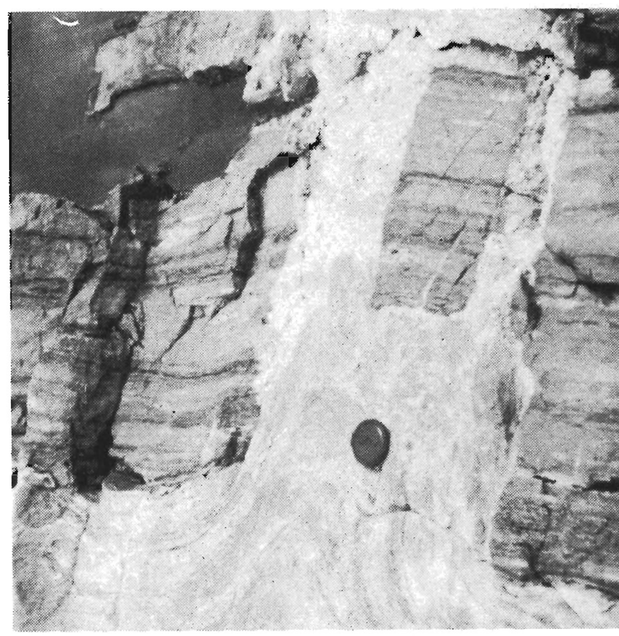


Plate 5: *The birth of a pegmatite in calc-silicate and quartzitic metasedimentary gneiss. South of Comfort Bight.*

An additional feature of the Paradise metasedimentary gneiss belt is the presence of granitoid plutonic rocks, which range in size from isolated outcrops to the moderate-size plutons found in the southeast part of the map region. The isolated outcrops comprise white, pink or gray weathering, medium to coarse grained, homogeneous, K-feldspar megacrystic and non-megacrystic granodiorite, granite and quartz diorite. Biotite is the characteristic mafic mineral but hornblende-bearing rocks are found in the central part of the study area.

The granitoid pluton in the southeast part of the map area is subdivided into a central zone of pink, medium to coarse grained, K-feldspar megacrystic, biotite granodiorite to granite, and an outer envelope of brown or gray weathering, medium grained quartz diorite. The K-feldspar megacrystic core is homogeneous, weakly foliated to massive and commonly contains enclaves of ultramafic, mafic and metasedimentary rocks. The outer envelope, although referred to as quartz diorite, also includes a broad range of dioritic and amphibolitic rock types, and the whole envelope has an inhomogeneous, moderately foliated to gneissic, migmatized appearance. It is evident that the core and envelope are spatially associated, and it can be demonstrated that the core of the pluton was emplaced after the migmatization that affected the outer envelope. Determination of petrogenetic relationships between the two units awaits more detailed study.

Sand Hill Big Pond Gabbronorite

Mafic plutonic rocks in the Sand Hill Big Pond area were first outlined by BRINCO Ltd. (Bradley, 1966; Donohue, 1966). The rocks include gabbro, leucogabbro, norite, leuconorite, troctolite and anorthosite, including minor occurrences of monzonite along the southwest flank of the unit. One of the most typical rock types is a dark weathering, coarse grained leuconorite containing large, black or gray, primary plagioclase and rusty brown orthopyroxene. Commonly, plagioclase is recrystallized at grain boundaries to white weathering granules. Rocks with less orthopyroxene or more olivine grade into anorthosite and troctolite respectively. In the olivine-bearing rocks, double hypersthene-pargasitic amphibole coronas are ubiquitous. Near its southern boundary, the Sand Hill Big Pond gabbronorite consists of much finer grained rocks that do not appear to be mineralogically distinct from their coarser grained counterparts. Very coarse grained rocks are also present—one locality southeast of Sand Hill Big Pond has pyroxene crystals up to 40 cm long.

Paradise Arm Pluton

The Paradise Arm pluton (Figure 2), previously thought to terminate at the eastern boundary of the Paradise River map area (Gower *et al.*, 1985), has now been traced across the Sand Hill River - Batteau map region, giving it a mapped length exceeding 110 km. The area where it was shown to pinch out (Gower *et al.*, 1985) was re-examined in more detail and, although the pluton narrows, it is now known to continue through without break.

The pluton is a homogeneous, white to pink, medium to coarse grained K-feldspar megacrystic rock, containing megacrysts that are between 1 to 7 cm in diameter and make up 5 to 35 percent of the rock. Partly because of variations in megacryst abundance, the rocks can be variably described as granodiorite, granite, monzogranite and syenogranite. Mafic minerals include biotite, hornblende and, more rarely, orthopyroxene and garnet. Locally, dioritic and/or metasedimentary gneiss enclaves are present but most of the pluton is free of xenolithic material.

The Paradise Arm pluton is interpreted here to postdate the Sand Hill Big Pond gabbronorite and the White Bear Arm complex, and it is suggested here that these two units were contiguous prior to emplacement of the Paradise Arm pluton along a linear zone of weakness.

White Bear Arm Complex

The mafic rocks that underlie the southeast corner of the Sand Hill River - Batteau map region are part of the White Bear Arm complex (WBAC), a major plutonic body that extends from Paradise River to Square Islands, a distance of 150 km. Within the map region, the White Bear Arm complex consists of gabbro, norite, minor troctolite and their leucocratic variants. The rocks are fine to medium grained, dark gray, black or rusty weathering, homogeneous, and massive, and have partially or completely preserved igneous textures. Commonly, the mafic rocks are injected by buff-pink, fine to medium grained monzonite in an anastomosing or agmatitic fashion.

Late Precambrian - Early Paleozoic Mafic Dikes

Three major, and one minor, north-northeast-trending mafic dikes were mapped in the study area. The major dikes consist of black or brown weathering, coarse grained, ophitic-textured gabbro containing interstitial K-feldspar and partially hydrated mafic silicates.

The two western dikes are on line with intrusions mapped in coastal areas 25 km east of Cartwright (Eade, 1962; Gower *et al.*, 1982; Owen *et al.*, 1983). Assuming the dikes in the study area are direct extensions of those on the coast, both dikes would have a strike length of about 75 km. The dike in the north-central part of the map region was previously unknown. It is exposed on Sand Hill River and is clearly visible on aerial photographs.

On the coast, the western dike has been dated at 553 ± 22 Ma (K-Ar, biotite, Wanless *et al.*, 1970). The co-ordinates originally reported for the dated sample were given erroneously as 53° 44′ N, 56° 49′ W. This is the location shown by Owen *et al.* (1983), who did not locate the dike, but assumed that it existed as indicated and was simply missed during 1:100,000 scale mapping. When the dike could not be found during re-examination of the area (M. Tubrett, personal communication, 1985), the quoted location was queried and found to be incorrect. The correct co-ordinates are 53° 46′ N, 56° 38′ W on Cartwright Island (W.D. Loveridge, personal communication, 1985).

The minor dike, approximately 1 m wide, was found at two localities in the Porcupine Bay area (Figure 2). A dike of similar width and appearance occurs directly along strike, on the north side of Hawke Bay, some 35 km to the south. Although these dikes are widely separated, the persistence over considerable distances of similar, albeit larger dikes farther west may indicate that these minor dikes were injected along a common line of weakness.

Structure

The structure of the map region is dominated by a prevalent west-northwest to northwest trend which affects all rocks except the late Precambrian - early Paleozoic mafic dikes. Foliation and gneissosity are moderately to steeply inclined and the majority of dips are to the southwest. Measured lineations do not show any consistent plunge direction except those associated with a thrust north of Porcupine Bay. Evidence for minor, tight to isoclinal folding is ubiquitous, especially in the metasedimentary gneiss. Large folds were identified in places (Figure 2).

The thrust north of Porcupine Bay has an approximate southward dip of 45°. It is marked by a broad zone of well banded gneiss, mylonite and ultramylonite (Plate 6). Rotated K-feldspar porphyroclasts indicate northward transport of the hanging wall. A mylonite zone 15 km to the west, but roughly on strike with that near Porcupine Bay, may be a continuation of the same structure. However, no severely mylonitized rocks were observed at shoreline exposures between the two areas of mylonite.

Mylonite is also associated with a series of northwest-trending strike-slip faults. In addition to mylonite zones, these are further defined by marked photolineaments and straight

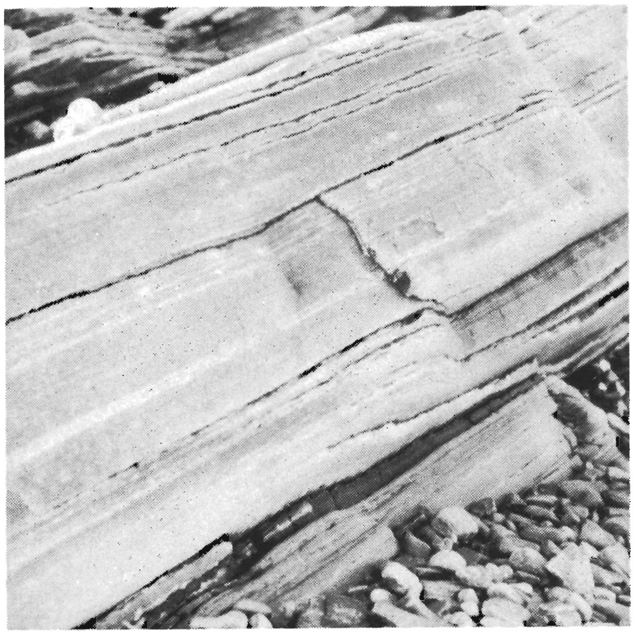


Plate 6: *Mylonite from thrust zone southwest of Batteau.*

valleys. Other well defined, parallel photolineaments suggest that additional similar faults may be present, for which field evidence is presently lacking. These faults are anticipated in the structural model outlined for the Lake Melville terrane by Gower *et al.* (1985).

In addition to the structures outlined above, there is a well defined pattern of east-northeast- and west-northwest-trending photolineaments. These correlate with aeromagnetic features and some are known to be associated with zones of hematite alteration. The east-southeast- trending photolineaments are interpreted as sinistral faults, which have, in places, offset the boundary between the Earl Island domain and the Paradise metasedimentary gneiss belt.

No direct information is available for the north-northwest-trending photolineaments. However, the two trends are bisected by the late Precambrian - early Paleozoic mafic dikes. Such a pattern (whereby the photolineaments represent shear directions and the mafic dikes are a bisecting tensional direction) is compatible with a stress regime proposed by Gower *et al.* (1986) to explain post-Grenvillian events, including the formation of the Lake Melville and Sandwich Bay graben, and emplacement of north-northeast-trending mafic dikes.

Metamorphism

Metamorphic grade in the map region is amphibolite to granulite facies. The granulite facies assemblages are best developed in the southwest part of the region.

In the Earl Island and Domino domains, assemblages containing epidote, allanite and sphene are ubiquitous in the dioritic and granodioritic rocks, and garnet occurs sporadically. The presence of epidote, allanite and sphene is characteristic of the Groswater Bay terrane, whereas these minerals are absent in much of the Lake Melville terrane. The metasedimentary gneiss enclaves in the Earl Island and Domino domains are mostly muscovite bearing, but sillimanite was found in the Frenchmans Island area. Double coronas of hypersthene and pargasitic amphibole mantle olivine in mafic rocks in the Domino domain.

Pelitic gneiss in the Paradise metasedimentary gneiss belt is characterized by K-feldspar-plagioclase-quartz-opaque minerals ± biotite ± cordierite ± sillimanite ± kyanite ± garnet ± orthopyroxene ± sapphirine assemblages. Sillimanite and cordierite are ubiquitous, and, typically, the cordierite is partially or completely pseudomorphed by biotite and sillimanite. Garnet is uncommon but occurs sporadically throughout the map area, except in the metasedimentary gneisses flanking the Sand Hill Big Pond gabbronorite and the Paradise Arm pluton. Kyanite is a relict mineral presently known only from the central part of the map region.

Orthopyroxene and sapphirine are restricted to the metasedimentary gneiss adjacent to the Sand Hill Big Pond gabbronorite and the Paradise Arm pluton. This gneiss has a distinct appearance in the field (Plate 4), is depleted in hydrous mafic silicates and garnet, and contains abundant magnetite. Sapphirine occurs at five localities in three areas close to the gabbronorite (Figure 2). These occurrences mark the first discovery of sapphirine in the Grenville Province of eastern Labrador. It is suggested here that the orthopyroxene- and sapphirine-bearing rocks document a high-pressure and high-temperature aureole adjacent to the Sand Hill Big Pond gabbronorite.

In the Sand Hill Big Pond gabbronorite and the White Bear Arm complex, igneous mineral assemblages and textures are widely preserved, except in mylonite zones. Double hypersthene-pargasitic amphibole coronas mantle primary olivine in both bodies.

Economic Mineral Potential

Assessment of the economic mineral potential of parts of southeastern Labrador was carried out by BRINCO Ltd. in 1954 and 1965. The later phase of activity included stream sediment geochemical sampling, and prospecting and geological mapping of selected areas. Although traces of base metal mineralization were discovered, and several geochemical anomalies were identified, exploration was discontinued.

From the present study and previous work (Gower and Erdmer, 1984; Gower *et al.*, 1985), the metasedimentary gneiss appears to have the highest economic potential. Sulfide zones (mainly pyrite) are common, especially in the better exposed coastal areas (Figure 3). One of these, at Mountaineer Cove near the entrance of Hawke Bay, was described by Douglas (1953, pages 12 and 13) as '...having a width of about 100 ft. and an unknown length.' He reported analyses of three samples for Fe, U and Ta, which gave a range of 16.75 to 25.94 percent Fe, and 'nil' values for U and Ta. Samples collected from this occurrence, and other localities during the present mapping, have been analyzed for Au; the results are indicated in Figure 3.

Eade (1962) also noted two pyritic showings in metasedimentary gneiss. One of his localities was found during the present study in the course of a brief helicopter

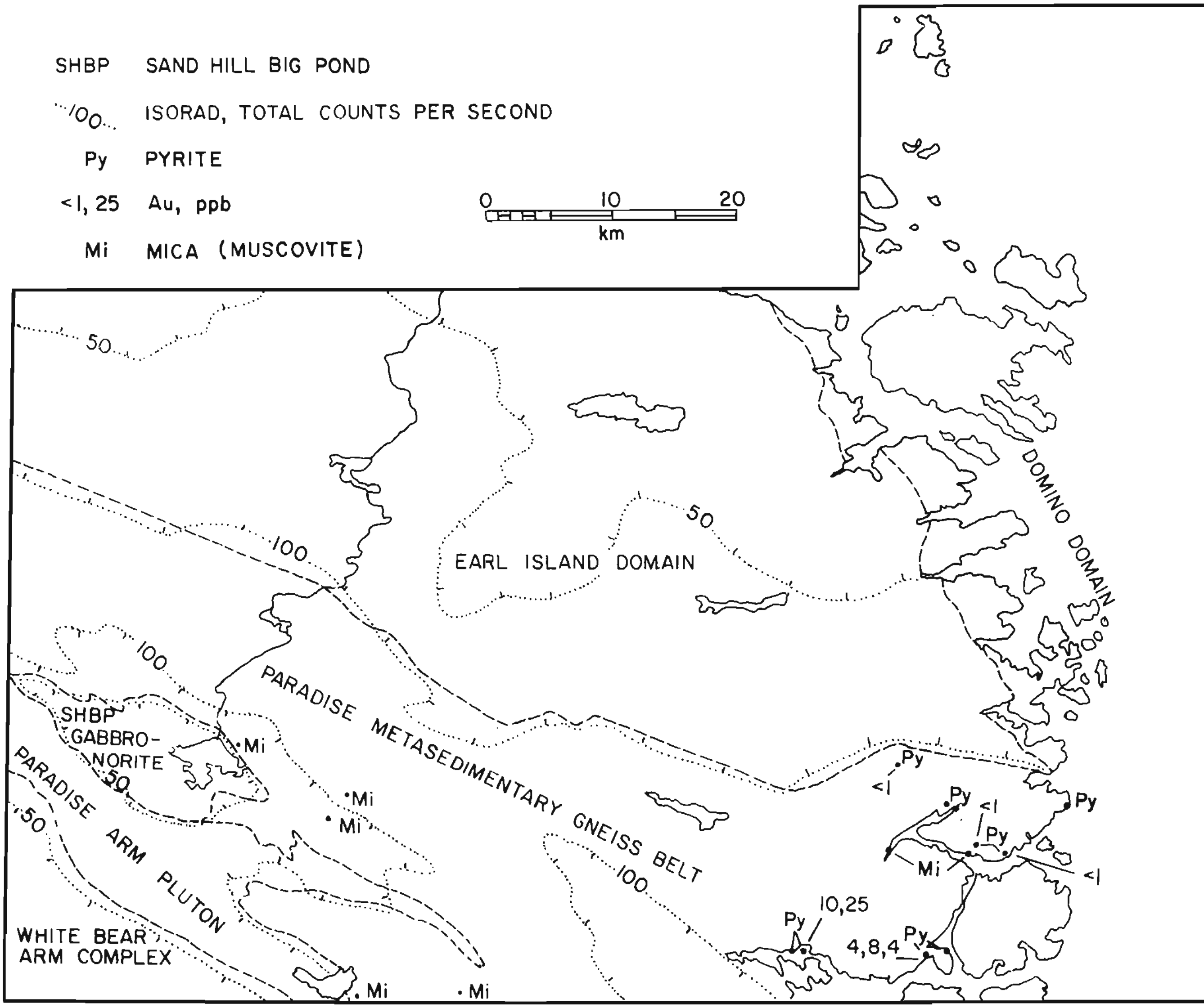


Figure 3: *Economic mineral potential map for the Sand Hill River - Batteau map region.*

search. Interestingly, the showing is roughly along strike with three other pyritic zones discovered during the present mapping. As none of these showings have been traced out for any distance, it is conceivable that detailed mapping would demonstrate that they belong to a single horizon.

Another showing, discovered during the present study, forms most of a small island near the north side of inner Hawke Bay. It gave the highest Au values obtained (albeit still background).

Muscovite-bearing pegmatites are also a characteristic feature of the metasedimentary gneiss. Only those localities where muscovite books exceed 5 cm in diameter are indicated in Figure 3. At several localities the books are considerably larger and reach 28 cm in diameter in one pegmatite (53°0.5'N, 56°36'W). The pegmatite is 10 m wide and has an exposed strike length of 50 m. It appears to be devoid of other minerals of potential economic interest.

Possibilities also exist for Ni-Co-Cr-Cu mineralization associated with the layered mafic intrusions and LIL mineralization associated with granitoid rocks. Douglas (1953) described a 20 m wide, Cu-bearing, magnetite-rich band in mafic rocks near Domino. Although no anomalous radioactivity was encountered in the map region (in contrast to previously mapped areas in eastern Labrador), anomalous Th has been reported (Kranck, 1966) from granitoid rocks in the area that are now mapped as part of the Paradise Arm pluton. Background scintillometer readings (see generalized contours in Figure 3) show high values over the Paradise metasedimentary gneiss belt and low values corresponding with the mafic intrusions. The distinction between the diorite and granodiorite of the Earl Island domain is also evident.

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