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PORT-CARTIER AREA

A.T. Anderson

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REPORT

PORT CARTIER AREA

by

A.T. Anderson

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INTRODUCTION

Purpose: It was known from the previous work of Faessler (1942) that anorthosite is a principal rock in the Port Cartier area. The writer and Dr. M. Morin observed gabbroic anorthosite rich in apatite and opaque oxides at scattered outcrops along route 15 between Port Cartier and Seven Islands during the summer of 1962. The present survey was decided upon in order to outline in reconnaissance the extent of these rocks.

Location: The area lies along the north shore of the St. Lawrence estuary between Port Cartier and Seven Islands and extends inland about 20 miles, covering an area of about 800 square miles enclosed by the geographic coordinates: latitude $50^{\circ}30'N$ to $50^{\circ}00'N$ and longitude $67^{\circ}00'W$ to $66^{\circ}30'W$. The townships of Port Cartier (Shelter Bay) and Clarke City lie within the area. Some of the area mapped is included in the wood limits of the Quebec North Shore Pulp and Paper Co. and of the Gulf Pulp and Paper Co.

Access: The area is easily reached by Quebec highway 15. There is an abandoned road to Brulé lake in the south center of the area and a club road to Hall lake in the southeast. Pasteur lake is easily reached via the Quebec North Shore access road and a side road to a fishing club. The river flowing south into

Note: Figures 1 to 5 mentioned in this report do not give a good xerox copy.

Pasteur lake is not navigable except for a short distance in highest water by small canoe and motor as it is very swift and shallow with a gravel bottom. Access to Morin lake and thence to a l' Anguille lake and Lac des Iles is by portage from Pasteur lake. Lac des Iles may also be reached by walking the abandoned Brulé lake road. This road is not passable by vehicles because of bridge washouts. In the south, navigation of the Dominick river proved surprisingly easy even late in the summer. The river was reached by portage from the end of the road to the Port Cartier city dump. In the east the Marguerite river is navigable for its entire length in the map area due to the dam. From the Marguerite river Hourglass lake and Jacques Cartier lake are reached by portage. The portage to Jacques Cartier lake is extremely steep beginning with a ladder and continuing up a cliff face, and it is only with extreme difficulty that two men are able to bring a canoe to the top. It proved necessary to use aircraft for access to the northern part of the area. Camps were flown into Asquiche lake, Sault aux Mouton lake, Big Day lake and Brulé lake. A short visit was made to the upper Pasteur river valley by aircraft.

Topography: The area is extremely rugged having an average relief of about 500 feet per half mile. The total relief is about 2200 feet. The three principal valleys (Pasteur, Anguille - Morin, and Marguerite) are steep walled and may be appropriately called fjords. Owing to the steepness of these three valleys access by traverse to the interior is difficult and time consuming.

There is no outstanding correlation between topography and rock type except that the banded gneisses tend to develop sharp ridges and valleys in places where the intersection of banding and jointing is approximately parallel to the surface. The gneissic granite tends to inhabit upland terrain as does quartz diorite.

Drainage: The area is principally drained by the Pasteur - des Roches, Anguille, Dominick, Brochu, Valin, Marguerite and Hall rivers all of which flow more or less to the south. Much of the southwestern part of the area is covered by muskeg swamp.

Forest and wildlife: Much of the south central part of the area burned in 1949 and 1955 and had not yet begun to grow back during the summer of 1963. Several other portions burned at earlier times and have grown back to a moderate extent. Old pulpwood cuttings have had profound effect in permitting extremely dense regrowth. The trees are spruces for the most part together with balsam, aspen and birch.

Partridge, rabbit, duck and beaver are common in the area, as are moose. Trout are sparse and appear to be utterly lacking from many of the lakes, probably as a result of pulpwood operations. The best trout lakes in the area are Pasteur lake, Morin lake, a la Cache lake and according to local report, Hall lake. Pike inhabit the Marguerite river. Bears were a nuisance part of the summer and a few caribou were seen.

Mapping: Mapping was done during the summer of 1963. The writer was ably assisted by Donald Palmer, senior assistant, who did much of the mapping and who helped prepare the map. John Purves and Guy Bastien were helpful assistants; John shared part of the mapping.

GENERAL GEOLOGY

Introduction: The area consists principally of two units: a basement complex of thoroughly metamorphosed rocks and a series of massive rocks forming stock or dome-like intrusions. The basement complex is made up of labradorite anorthosite surrounded by banded high-alumina, biotite-quartz-plagioclase, and granitic gneiss and quartzite which are interrupted in a variety of ways by large, blister-like bosses of homogeneous gneissic granite. The massive rocks include those of the Port Cartier igneous massif (anorthosite, gabbroic anorthosite, quartz gabbro, syenite and quartz syenite, and granite) and some similar rocks (quartz diorite and syenite and granite) forming subcircular, steeply walled masses. The Port Cartier anorthositic rocks are located exclusively near the coastline. In addition there are some fresh basaltic sills near the coast.

TABLE OF FORMATIONS

Pleistocene and recent	8	clay and sand
Paleozoic ?	not mapped	sandstone dykes aplite and basalt
Precambrian	7	metagabbro
	6	quartz diorite (a), syenite (b), granite (c)
	5	quartz gabbro (a), quartz syenite and syenite (b), granite (c)
	4	anorthosite and gabbroic anorthosite
	3	gneissic granite
	2	high alumina gneiss and quartzite (a), granitic banded gneiss (b), biotite-quartz-plagioclase gneiss (c)
	1	labradorite anorthosite

Labradorite anorthosite: Labradorite anorthosite is restricted to a medium sized body in the northeastern part of the Port Cartier area. The anorthosite is surrounded by a complex narrow zone (about 1000 feet wide) of relatively coarse grained massive granite, gneissic granite and anorthosite. Inside this zone anorthosite is locally cut by coarse grained, in places pegmatitic, granite. Surrounding the anorthosite on all sides in the map area is an outward-dipping, horseshoe shaped sequence of ~~paragneiss~~ ^{high-alumina gneiss}, banded gneiss and impure quartzite.

The labradorite anorthosite has a light weathered surface which is typically streaked with a brown stain derived from the weathering of iron bearing minerals. The sugary textured fresh surface is light grey to white. The rock is massive, although an indistinct Boliation can be observed in some outcrops and is due to lens-shaped aggregates of the minor dark minerals.

A single thin section of a specimen from near the eastern margin of the anorthosite body consists of a mosaic of equant, granulose plagioclase which is unzoned and devoid of antiperthite. Fine grained, micaceous alteration products are sparse. Polysynthetic twinning on (010) is predominant; complex twins on other planes are rare. Rittmann zone extinction angles indicate the plagioclase is An 60 approximately.

Traces of interstitial grad-twinning microcline were seen. Quartz is rare and associated with sieved epidote. Biotite is a faint yellow (alpha) to tannish green (beta and gamma). Sieved muscovite and green to bluish green amphibole are present in minor amounts. Traces of a highly birefringent mineral, probably

sphene, were observed and the slide contains one small opaque grain. A polished section demonstrated the presence of hemo-ilmenite.

Banded gneiss: Banded gneisses are widespread in the Port Cartier area and occur chiefly in the northeastern quarter where they form an outward dipping unit surrounding the body of labradorite anorthosite. Although the scale of mapping did not permit their precise demarcation in all places, three distinct subunits were recognized:

- 1) sillimanite gneiss, graphite gneiss, muscovite gneiss (collectively: high-alumina gneiss) and quartzite;
- 2) granitic banded gneiss
- 3) biotite-quartz-plagioclase gneiss

Where possible these have been separated on the map.

In general the high-alumina gneiss forms an approximately 2000 foot thick subunit closest to the anorthosite. Farther from the anorthosite the banded gneisses are richer in quartz, quartzite being the predominant rock type. Still farther from the anorthosite the quartzites are more feldspathic and grade into banded granitic gneisses. Although biotite-quartz-plagioclase gneiss is common as thin interlayers a few inches thick in the quartzitic and granitic banded gneisses, thick (hundreds of feet) marker units are present only at great distance from the labradorite anorthosite.

The transitions between these subunits are gradual on the map scale, but in detail the subunits may be intercalated on a scale of inches to several feet. The transition from one subunit

to another is accomplished in two ways: variations in the compositions of individual layer types and changes in the proportions of the different layers.

Petrography: Observed mineralogies of 14 thin sections of banded gneiss, subunit 1, are listed in table 1a. In general feldspar and quartz are the major minerals; biotite, muscovite, graphite and amphibole are locally abundant. The other minerals listed occur in variable minor quantities. Textures are granoblastic. Characteristically the plagioclase is unzoned, but albitic rims are common. Potassium feldspar is microcline as deduced from the cross hatched twinning and is commonly perthitic.

Sample A99 is of metaconglomerate and part of a fragment of granite comprises half of the thin section. In the granite fragment the plagioclase has a composition close to An 10. Another fragment, however, contains weakly zoned oligoclase.

Attention is drawn to the occurrence of traces of chalcopyrite together with pyrite in one specimen. Pyrite was observed in many outcrops of banded gneiss.

Zircon is abundant in most specimens. In two thin sections the zircons display overgrowths.

Subround lenses of garnet-diopside-epidote quartzite up to a foot or two in maximum dimension are of sporadic occurrence in the banded gneisses (figure 1).

The granitic banded gneiss was not studied in thin section. In some outcrops layers of granitic gneiss associated with high-alumina gneiss contain garnet in addition to quartz, feldspar and biotite. Pyrite and locally graphite also occur in the granitic banded gneiss.

In the field the biotite-quartz-plagioclase gneiss is characterized by a grey fresh surface and in some places by conspicuous magnetite porphyroblasts (figure 2). Locally large garnet porphyroblasts are common. Four thin sections are summarized in table 1b. Plagioclase is unzoned and rather calcic. Biotite is ubiquitous. Although quartz occurs in all thin sections it is a very minor constituent; in one case less than about 1 per cent of the section. The magnetite porphyroblasts are rimmed by hematite; rutile-ilmenite and hemo-ilmenite occur in respective specimens. Sparse zircon is seen in two of the thin sections. The thin sections were scrutinized for carbonate; none was found.

Gneissic Granite: Most of the area is underlain by monotonously uniform gneissic granite which forms rounded hilltops and hummocky upland terrain. In outcrop the gneissic granite has a pale pink to rusty appearance marked by wavy wisps of biotite rich material a few millimeters thick regularly spaced at intervals of a few centimeters in a host of leucogranite. Although a weak and irregular lamination is present locally, the structural aspect is generally that of a pencil gneiss. The fresh surface is pink.

The gneissic granite forms large blister-like bosses within the banded gneiss. In several localities the transition from banded gneiss to gneissic granite occurs in about 500 feet and is characterized by a progressively less distinct definition of bands and in some cases by increased proportions of intercalated layers of pencil gneiss.

Some intermediate regions between banded gneiss and gneissic granite (and locally within the banded gneiss) are comprised of a finer grained but grossly layered gneiss, the layers being of the order of several feet thick, except for uncommon ^{inch} ~~in~~ thick amphibolite layers. Arbitrarily these fine-grained, indistinctly layered gneisses are grouped with the banded gneisses.

One thin section was cut of pencil gneiss and found to contain plagioclase (An 21 with albitic rims), perthitic potassium feldspar, quartz, biotite, brown amphibole, apatite, overgrown zircons, sphene and possibly ilmenite. The texture is granitoid.

Rocks of the Port Cartier igneous massif: The Port Cartier igneous massif is comprised of a core of anorthosite and gabbroic anorthosite surrounded by a laterally discontinuous succession of quartz gabbro, fayalite syenite, quartz syenite and granite all of which are coarse grained and massive.

Anorthosite and coarse grained gabbroic anorthosite are irregularly interlayered; shoreline outcrops display diffuse lenses of very coarse grained (average crystal length about 8 inches) anorthosite in a matrix of coarse grained anorthosite. Patches of interstitial (granophyre-like) graphic quartz and potassium feldspar are common. Large black (?) allanites up to 1 cm. diameter occur in the interstitial granophyre-like material and are surrounded by haloes of radiating ("percussion") cracks. Large, but uncommon, crystals of magnetite and ilmenite are present; the magnetite is particularly common in the interstitial granophyric material.

In some places, such as on Pointe Noire and near the Gulf power dam on the Marguerite River, medium grained gabbroic anorthosite is prevalent and characterized in particular by megascopic ophitic and poikilitic textures; most commonly, chloritized orthopyroxene and interstitial ilmenite are in poikilitic intergrowth with plagioclase. In some places whitish clots of turbid plagioclase several inches in diameter are accompanied by drusy cavities in part filled with calcite and chloritized biotite. In other places (eg. north of route 15 about 2 miles east of Port Cartier) the gabbroic anorthosite contains red, one half inch in diameter, garnets. Locally the anorthositic rocks are exceptionally rich in iron titanium oxide minerals, as for example: just north of route 15 along the club road to the west end of Hall lake, also along the old lumber trail from old route 15 to the center of Hall lake, and in a large quarry north of route 15 about 6 miles west of Seven Islands. In these exposures the rock is medium grained and weathers rusty brown. It contains considerable pyroxene in addition to much (about 15 per cent) magnetite and notable apatite.

Because of the generally poor exposure and the reconnaissance scale of mapping, the interrelations and extent of the anorthositic rocks were not established.

As seen in thin section (table 1c) the anorthosite and gabbroic anorthosite have irregularly, but progressively zoned plagioclase; the zoning in many cases is related to the occurrence of clinozoisite, calcite and white mica and chlorite. Emphatically, the distribution of calcite, chlorite, clinozoisite etc. is conspicuously patchy; furthermore, these minerals are virtually restricted to the anorthositic rocks. The range of plagioclase

composition observed is An 67 to An 17. Some of the plagioclase is finely antiperthitic. Schillered clinopyroxene and olivine are present in some sections. Apatite is common and may be locally abundant -- of the order of 15 vol. per cent of the rock. Ilmenite is the predominant iron-titanium oxide mineral; although magnetite is absent from many of the polished sections examined, its presence is known from field observation.

Quartz gabbro, quartz syenite, syenite and granite form an incomplete envelope about the Port Cartier anorthosite and gabbroic anorthosite. These quartz-bearing rocks are medium grained and massive or faintly foliated. Although sharp contacts between the several saturated rock types exist in a few localities, relationships appear to be spatially gradational on the map scale. An apparently continuous transition between gabbroic anorthosite and quartz gabbro can be observed in outcrops on the west side of the gravel road from route 15 to the Quebec Cartier Mining Co. pier about 300 yards outside the company gates. The quartz in the quartz gabbro and in the granite is milky blue. Quartz in the quartz in the quartz syenite is not always apparent even on the weathered surface.

The gabbroic anorthosite, quartz gabbro and quartz syenite contain locally abundant red garnets. In the cases of the garnetiferous quartz gabbro and quartz syenite, xenoliths of quartzite and banded gneiss are also common. The xenoliths have a hornfelsic texture and display conspicuous reaction rims. The quartz of some medium grained quartzite xenoliths is milky blue, but other fine grained quartzite xenoliths have clear quartz.

Summaries of thin section observations on the saturated rocks of the Port Cartier igneous massif are compiled in table 1d. Plagioclases are andesines in the quartz gabbros and oligoclases in the quartz syenites and granite. Some of the andesines are antiperthitic. Textures are predominantly granitoid, but some fine grained matrix material is granulose.

Igneous rocks outside the Port Cartier igneous massif: ^M massive quartz diorite and syenite occur in isolated masses of variable dimensions which are not in spatigal continuity with the Port Cartier igneous massif. Two subcircular bodies comprised principally of quartz diorite are located respectively north of and adjacent to Hall lake in the southeastern portion of the map area and in the north central part of the area north of and adjacent to T-bone lake.

The quartz diorite is characteristically massive and medium to fine grained. It has a clean grey fresh surface. Although quartz diorite is the predominant rock of these bodies, rocks rich in potassium feldspar occur locally and are generally medium grained. In thin section (table 1e) the plagioclases are almost invariably zoned andesines or oligoclases. The rocks are not much different, mineralogically, from the quartz gabbros of the Port Cartier igneous massif. Indeed, the principal distinction is based on field observation and is due to the more easily recognizable and relatively more abundant potassium feldspar and finer grain size of the quartz diorite.

A lenticular body of syenite crosses Pasteur lake from northwest to southeast. Quartz, if present, is very minor. The body is not associated with any significant amount of quartz diorite. The rock has a characteristic pebbly, rusty or orange weathered surface and a difficultly obtained greenish grey fresh surface. The syenite is medium to fine grained and massive. In one outcrop euhedral zircons as long as two centimeters and several millimeters across stand out against the more easily weathered feldspathic matrix. Mineralogies are summarized in table 1f.

Metagabbro and amphibolite: Throughout the area there occur dike-like masses and lenses of metagabbro and amphibolite. The dikes are fine to medium grained and massive or foliated. In one case fine grained diabasic metagabbro (A12) can be seen to grade into amphibolite (A13) over a distance of about 15 feet (figure 3). Thin section data are summarized in table 1g. The textures are predominantly granulose-mosaic.

A number of differences between metagabbro or amphibolite and biotite-quartz-plagioclase gneiss deserve emphasis. The plagioclases of the metagabbro are zoned, those in the amphibolite are oligoclases. Plagioclases in biotite-quartz-plagioclase gneiss are considerably more calcic as a rule. Magnetite is accompanied by hemo-ilmenite or hematite in the quartz-plagioclase gneiss; whereas, in the metagabbro and amphibolite ilmenite and pyrite are the predominant opaque minerals. Quartz is rare or absent in metagabbro and amphibolite, but is essential, although minor, in biotite-quartz-plagioclase gneiss. No zircon was found in thin sections of metagabbro or amphibolite.

Basalts: In addition to the metagabbros there occur scattered sills and dykes a few feet thick of basaltic rocks (table 1h). These rocks are very fine grained and almost without any signs of alteration or metamorphism. The basalts occur chiefly near the St. Lawrence estuary, although A71 is from an outcrop about 10 miles north of the coast.

Aplite and sandstone dykes: Along the shore of the St. Lawrence there are also aplite dykes. The aplites are traversed by nearly vertical dolomitic sandstone dykes. No relationships were observed between the sandstone dykes and the basalts.

Mineralogical summary: Plagioclases occurring in various specimens of banded gneiss range in composition from albite to bytownite. Although progressively zoned plagioclase was not observed in banded gneiss, two compositions within the albite - oligoclase range were commonly detected in individual thin sections.

The plagioclase of an amphibolite demonstrably continuous with metadiabase is oligoclase, in contrast to the more calcic plagioclases of biotite-quartz-plagioclase gneiss.

The igneous rocks of the region, in most cases, contain progressively, normally zoned plagioclase generally in the labradorite - andesine range. Antiperthite is of irregular occurrence.

Potassium feldspar is perthitic microcline in the gneisses. In the thin sections examined of the Port Cartier igneous massif the potassium feldspar is perthitic but lacks grid twinning as a rule.

As determined by field observation mineral assemblages including the four minerals: quartz-potassium feldspar-muscovite-

sillimanite occur widely in the area.

The principal ferro-magnesian minerals in the gneisses are a greenish to brown, or less commonly, a bluish green to green amphibole and a light tan or green to medium reddish brown biotite. In the metagabbros, amphibolites and rocks of the Port Cartier igneous massif and associated rocks, ortho and clinopyroxene are present in addition to brown amphibole and medium to dark reddish brown biotite. Olivine is present in several specimens. In the syenites and quartz syenites it is fayalite. In the anorthositic rocks its composition could not be definitely determined, but it appears to have a relatively small negative 2v and is probably an iron rich variety.

Ilmenite and ilmeno-magnetite are the principal oxide minerals of the Port Cartier igneous massif. Hemo-ilmenite is restricted to the igneous rocks north of the Port Cartier igneous massif and to some of the gneisses.

Pyrite, pyrrhotite and chalcopyrite were identified in the Port Cartier igneous rocks and some of the banded gneisses, but only in accessory quantities.

Zircon is abundant in all varieties of banded gneiss with the exception of biotite-quartz-plagioclase gneiss.

STRUCTURAL GEOLOGY

Folds: Although the several intrusive massifs in the area render impossible the determination of a regional attitude of foliation, a regional fold axis coincident with a lineation is apparent at about 110° trend, plunge about 15 to 20° southeast. The uniformity of this attitude is most apparent in the large bosses of homogeneous gneissic granite where it takes the form of a lineation. In the banded gneisses fold axes quite commonly possess an orientation similar to this lineation and are accompanied by a lineation parallel to the fold axes. However, in places the structural behavior of the banded gneisses (particularly subunits 1 and 3) is conspicuously irregular. Axes of minor folds diverge markedly from the "regional" trend defined by gneissic granite and attitudes of banding lie far from parallel to the regional lineation in many cases. This aspect is so pronounced, in fact, that it is rarely possible to extrapolate the location of the subunits on the basis of observed attitudes of banding. In three outcrops local change in attitude of banding is knife sharp and suggests truncation. One such feature has the appearance of a sedimentary scour and fill structure, apparent top being in the direction outward from the mass of labradorite anorthosite. In several other exposures minor folds are restricted to particular horizons about 3 feet thick.

A range in fold types was observed: variable degrees of limb thinning occur in folded banded gneiss (figures 4 and 5). Zig-zag folding is accompanied by tension cracks in quartzite layers in one outcrop. In all cases micas parallel the foliation and banding surfaces and sillimanite tends to parallel the lineation.

Faults: Although no appreciable displacements could be demonstrated on the scale of mapping, silicified (fault) breccia material was found in Pasteur valley, a l'Anguille valley and the Marguerite river valley. No mineralization was noted although polished sections were prepared from the Anguille and Marguerite material. Only pyrite in minor amounts was identified.

Isotomi

ECONOMIC GEOLOGY

In the Port Cartier igneous massif there are extensive occurrences of gabbro and gabbroic anorthosite rich in magnetite and ilmenite. These rocks are particularly common in a band between Hall lake and route 15. Apatite rich gabbroic anorthosite occurs near the pier of the Quebec Cartier Mining Co. In view of their nearness to the road and coastline and the iron ore facilities of Seven Islands and Port Cartier, these rocks bear keeping in mind as, among other things, possible local sources of vanadium and phosphorous.

Much of the anorthosite along the coast line by the Quebec Cartier Mining Co. pier contains interstitial granophyric material which is locally rich in large, (up to 2 centimeters in diameter) black allanites (?) surrounded by radial percussion cracks.

The anorthosite and gabbroic anorthosite near the dam on the Marguerite river is of the same type used as a Building stone. Although the plagioclase is not labradorescent, the spotted distribution of milky white plagioclase contrasted with the black background is a pleasant effect.

Breccia zones trend north-south in three major valleys of the area but appear to be unmineralized.

In several ^proximately east-west trending gullies outcrops were observed of a dark, crumbly weathering (?lamprophyre) rock rich in ferro-magnesian minerals and possibly calcite. The rock was not further investigated.

Boulders of peridotite were encountered on traverses immediately east of Morin lake.

The larger valleys are walled by glacial clay which is not gritty to the teeth as a rule. The washing away of this clay accounts for the murky water of Pasteur lake. In some of the smaller valleys (eg. Anguille and upper Pasteur) small deposits of sand and pebbly gravel are present.

Reference:

Faessler, C., 1942: Sept-Iles area, Que. Dept. Mines. Rept. # 11.

TABLE 1a.

HIGH-ALUMINA GNEISS AND QUARTZITE

	Pc	Kf	Q	MUS	BI	AMPH	GAR	SILL	GRAPH.	Zr	AP	OPAQUES
A26	21,8	m,p	x	x		x	x			x		
A30	27		x		x	x	x			x	x	Py, Crp
A53	x	m,p	x	x	x			f		x	x	
A65	37		x		x		x			⊗	x	?RT, ?MT.
A66		m	x	x	x					⊗		?RT.
A68	34	m	x		x				x	x		
A70	44	m	x	x	x				x	x		
A75	25,5	m	x		x	x				x	x	?MT.
A80	70		x		x	x				x	x	?MT.
A95		m,p	x		x		x	f	x			
A99	22-16,10	m	x		x	x					x	
A125		m	tr.	x	x			x	x			
A150	x	m	x	x	x			(CHLORITE)		x	x	?MT ?IL.
A190		m	x		x			x	x	x	x	

TABLE 1b

BIOTITE - QUARTZ - PLAGIOCLASE GNEISS

	Pc	Q	BI	AMPH	GAR	AP	Zr	OPAQUES
A6	47	x	x			x		RT-IL, MT, HE
A8	50	x	x			x	x	HE-IL, MT, ?SERPENE
A105	80	x	x	x	x			?PY, ?MT, ?IL.
								(MUSCOVITE, ORTHOPYROXENE)
A136	70	x	x			x	x	?IL ?PY ?GRAPHITE

TABLE 1c

PORT CARTIER ANORTHOSITE AND GABBROIC ANORTHOSITE

	Pc	Kf	Q	AMPH	BI	CPX	OPX	GAR	OL	AP	Zr	OPAQUES
A32b	Z~47a			x	x	x						IL
A32c	51											IL
A32d	Z				x		x		x	(SPINEL)		IL, PY, MT
A34	Z~58		x	(calcite, clinzoisite, chlorite)						x		IL-MT, IL, PY.
A36	67		(zoisite, chlorite)	x	x		(?serpentine)					SPHENE
A160	28	x	?	x			x			x	x	?IL, ?MT.

TABLE 1d

SATURATED ROCKS OF THE PORT CARTIER IGNEOUS MASSIF

	Pc	Kf	Q	Amph	Bi	Cpx	Opx	GR	OL	AP	Zr	OPAQUES
A31	22,14	p	x	x	x	x	x			x	x	py, ph, il
A32a	36-17	p	x	altered						x		il,
A33	5	p	x	x		x			x		x	il, mt.
A41	33-45	p	x		x		x	x				il, il-mt.
A42	35a	p	x	calcite, chlorite				x		x	x	il-mt, il, py
A156	19	p	x	x						x	x	?il, ?mt, ?py
A157	19,10	p	x			x	x				x	
A158	z	p	x			x	x	spinel		x	x	mt

TABLE 1e

QUARTZ DIORITE AND GRANITE

	Pc	Kf	Q	Amph	Bi	Cpx	Opx		AP	Zr	OPAQUES
A92	36-56		x	x	x	x					?il, ?mt
A110	16-26	m	x		x		sphene		x	x	?mt, ?py
A112	22-33		x	x	x	x			x		he-il, ?mt
A122	42-21	p	x	x		x			x		?he-il, ?mt.

TABLE 1f

SYENITE

	Pc	Kf	Q	Amph	Bi	Cpx	Opx	OL	AP	Zr	OPAQUES
A0	25	m, p	tr	?(chlorite + Q + Opaque)					x	x	?he-il
A15	z	m, p	x	x		x					graphite, ?il
A16	11	p		x		x		x		x	il-mt, il
A23	z	p		x	x	x	x				il, ?rutile
59	x	m, p	?	x	x	?			x	x	il-mt, il

TABLE 19

METAGABBRO AND AMPHIBOLITE

	PC	Kf	Q	Amph	Bi	Cpx	Opx	Ol	Ap	Zr	OPAQUES	GAR
A1	45-25	p	X	X	X	X			X		il, py	X
A12	68-37			X	X	X	X		X		il, ph, cpy	X
A13	26			X	X				X		il, py, sphene	
A14	Z		?	X	X		X				il, py, cpx, ph	X
A39	58-25				X	X		X			il-mt, il, py	

TABLE 16

BASALT

	PC	Kf	Q	Amph	Bi	Cpx	Opx	Ol	Ap	Zr	OPAQUES
A40	X			?chlorite		Z		X			il, il-mt, py, cpx, ph
A70	X			?chlorite	X	Z					mt, py
A72	X			X	X			carbonatex			