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GEOLOGICAL EXPLORATION SERVICE

GEOLOGY OF THE FORT McKENZIE, SHALE FALLS (EAST HALF), MORAINE LAKE (EAST HALF) AND LA LANDE LAKE AREAS

NEW QUEBEC TERRITORY

INTERIM REPORT

BY

BURKHARD DRESSLER

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1974

Interim Geological report

on

FORT McKENZIE, SHALE FALLS (EAST HALF), MORAINE LAKE (EAST HALF) AND LA LANDE LAKE AREAS

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INTRODUCTION

Location and Access

The map-area is in New Québec, about 170 miles north-northwest of Schefferville. It covers approximately 970 square miles and comprises the following map-sheets:

1)	Fort McKenzie area:	lat. 56 30' - 56 45'
		long. 69 00' - 69 15'
2)	Shale Falls (East Half) area:	lat. 56 45' - 57 00'
		long. 68 30' - 69 00'
3)	Moraine Lake (East Half) area:	lat. 56 45' - 57 00'
		long. 69 00' - 69 15'
4)	La Lande Lake area:	lat. 57 00' - 57 15'
		long. 69 00' - 69 30'

Access to the area is from Schefferville or Fort Chimo. All large lakes and the Caniapiscau river are accessible to float- or ski-equipped aircraft.

Topography and Drainage

Almost all the area is hilly and rugged. The ground bordering the Caniapiscau river, however, is flat and covered by sand and moraine deposits.

The entire region drains into Ungava bay. The major rivers are Swampy Bay river and Caniapiscau river.

Fauna and Flora

The Caniapiscau river-valley and wind-sheltered areas are covered by subarctic forest. Spruce and tamarack are the most common trees. Birch are only found in a few sheltered places. All hilltops and high plains are barren or covered by caribou moss or arctic birch. Thick alders commonly grow on slopes.

Caribou, bear, wolf, otter and porcupine are common. Beaver and moose were also observed. Goose, duck and loon are plentiful. Trout are abundant.

Natural Resources

Hydroelectric power sufficient for mining development, for instance at Shale Falls on Caniapiscau river, is the only natural wealth in the area, except for its mineral resources. The woodland is not suited for economic purposes.

Touristic enterprises may play a greater role in the near future and could create employment for native people now living in Fort Chimo and Schefferville.

Previous Work

The region lies within areas mapped by Roscoe (1957)* and by Fahrig (1965) at a scale of 1 inch= 4 miles and north of an area mapped by Dressler (1973a) at a scale of 1 inch= 1 mile. Hashimoto's (1964) Jogues Lake Area (1 inch= 1 mile) adjoins the La Lande Lake map-sheet to the east.

Field Work

Field work was carried out during the summers of 1972 (19.06. - 14.09.) and of 1973 (16.06. - 10.09.).

Outcrops are generally plentiful. The sand covered areas bordering the Caniapiscau river were examined from an airplane before being traversed on foot.

Acknowledgements

The following senior assistants contributed to the mapping: A. Ciesielski (1972), M. Fontaine (1973) and B. Penrose (1972). Junior assistants were J.G. Barrette (1973), J. Daigneault (1973), P.Y. Larose (1972) and C. Mongeau (1972).

P. Avoine was dispatcher and cook in 1972 and 1973. The very competent canoemen - all from Betsiamites - were E. St-Onge (1972,1973), P.PH. St-Onge (1972), P.J. St-Onge (1972 and 1973) and J. Simon (1973).

Pilots and management of Laurentian Air Service provided excellent plane service from Schefferville.

* References at the end of the report.

GENERAL GEOLOGY

The map-area lies almost entirely within the "Labrador Trough". The Trough is part of the Circum-Ungava geosyncline (Dimroth et al., 1970).

All bedrock is Precambrian in age. The Aphebian Kaniapiskau Supergroup rests unconformly on the Archean basement. It consists of sedimentary and volcanic rocks and was tentatively subdivided by Dimroth et al. (1970) into three cycles. Sediments below the Wishart Formation belong to the first cycle; the Ferriman Subgroup, the Menihek Formation and siltstones probably equivalents of the Chioak Formation of the northern Labrador Trough - form the second one; and dolomites (Abner? dolomite) and siltstones above the Abner (?) dolomite form the third cycle in the area. Most of the volcanic rocks of the area are placed within the Montagnais Group.

The sedimentary rocks of the Kaniapiskau Supergroup, mainly in the miogeosyncline (the western part of the Trough), include conglomerates, arkoses, sandstones, siltstones, argillites, cherts, cherty ironstones and dolomites. Volcanics of the miogeosyncline are carbonatite breccias and olivine-melilitite tuffs.

The volcanic rocks of the eugeosyncline (the eastern part of the region) are basalts, gabbros, rhyolites, tuffs and agglomerates. Intercalated in these volcanics are argillites, siltstones and minor conglomerates.

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* Tentative classification, ** Not observed in map-area

PRECAMBRIAN

ARCHEAN

Basement Granites and Gneisses

1, Granites

Granite underlies four sectors within the map-area. Three are outside the Trough - one in the southern half of the Shale Falls map-sheet; one at the southern, and one at the western limit of the La Lande Lake (W) map-sheet. The fourth occurence forms an inlier south of La Lande Lake.

All granites of the area are pink and mostly coarse grained. They are massive or, rarely, foliated or cataclastic. Their mineralogy is normal: quartz, microcline, plagioclase, biotite and, in places, hornblende.

Quartz commonly exibits a wavy extinction. It makes up 20 to 30% of the rock. The "granite" south of La Lande Lake, however, in places is quartz monzonitic, containing only 10-15% quartz.

Microcline makes up 25 to 45% of the granite. It is xenomorphic or hypidiomorphic and commonly twinned. The inclusions in the K-spar are plagioclase, biotite and apatite.

Plagioclase (An 23-27%) makes up 25-40% of the rock. The quartz monzonitic portions of the granite south of La Lande Lake, however, contain up to 60%

plagioclase (An 27-30%). The feldspar is commonly highly saussuritized and contains such inclusions as apatite, biotite, rarely muscovite, zircon and opaque ore.

Biotite (brown - dark greenish brown) is mostly chloritized. It includes apatite, zircon and opaque ore. Completely chloritized biotite commonly exhibits sagenite.

Hornblende is green and was observed in few places.

Accessory minerals include radioactive apatite, muscovite, zircon, sphene and opaque ore minerals. Secondary minerals are epidote and carbonate.

West of the Trough the granites are somewhat less altered than the one south of La Lande Lake. They show a weaker chloritization of biotite and plagioclase is less saussuritized.

The granite south of La Lande Lake is not a pluton penetrating the overlying sediments, for:

a) the sediments that are in contact with the granite are unmetamorphosed;

b) fractures in the granite are, in places, filled with an arkose; and

c) the sediments dip outward from the granite body

2, Gneisses

Gneisses form inclusions at a few feet to some hundred feet in size in the granite of the southern half of the Shale Falls map-sheet. They are dark grey, poorly - or non-foliated, fine-grained rocks.

In thin-section, they appear to be panxenomorphic, granoblastic and to be composed of plagioclase (An 27-30%), hornblende (Z c= 16°; Nx= green; Ny= olive-green), almost colourless pyroxene (2Nz= 60°; Z c= 46°), few quartz, apatite and zircon. Opaque ore minerals are seen to mark growth-zones in pyroxene (fig.1).

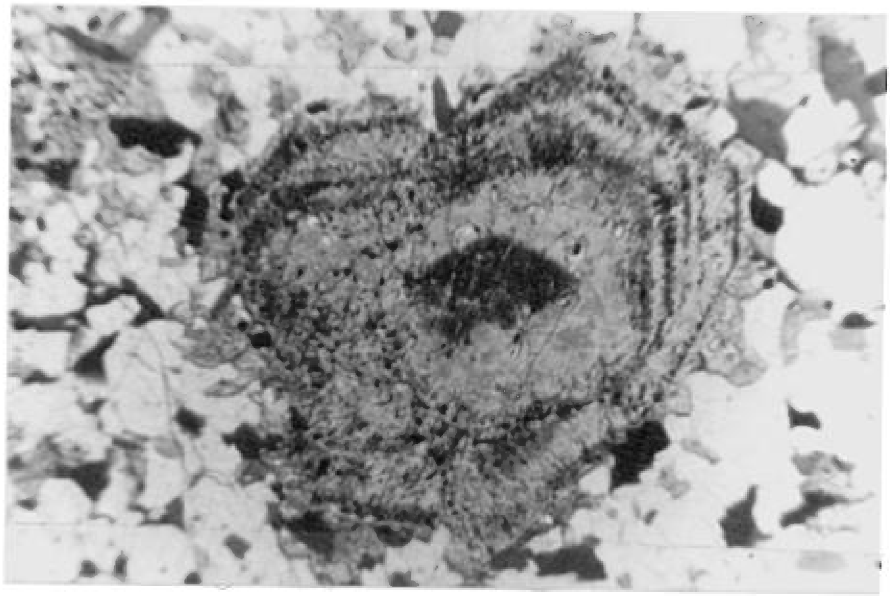

Fig. 1: Zoned pyroxene in gneiss. Scale 0.3 mm.

PROTEROZOIC

APHEBIAN

Kaniapiskau Supergroup

1st-CYCLE (non-subdivided)

Sedimentary rocks below the Wishart Formation outcrop only at a few places in the area studied:

1a) West of Canichico lake (= Le Moyne lake) and near the mouth of Swampy Bay river where it joins Caniapiscau river.

1b) East of Caniapiscau river in the southern part and west of the river in the northern part of the Moraine Lake map-sheet ($E\frac{1}{2}$).

1c) East of the granite at the southern limit of the La Lande Lake map-sheet ($W\frac{1}{2}$).

1d) South of the granite body south of La Lande Lake (La Lande Lake map-sheet, $E\frac{1}{2}$).

1a) Pink or red, fine-or medium-grained, commonly laminated arkoses can be classified either as Du Portage Formation or as Alder Formation.
They show such sedimentary features as crossbedding, ripple marks, small channel fillings and mud cracks.
In thin-section the arkoses are seen to be composed of angular to subrounded quartz, plagioclase and microcline. Accessory minerals are altered biotite, sphene and opaque ore. The chloritic and sericitic matrix makes up less than 5-10% of the rocks.
Close to the mouth of Swampy Bay river (east of the Caniapiscau river) me-

dium-to coarse-grained arkose and granitic conglomerate form the base of the formation and also make up thick layers in the fine-grained arkose.

1b) Grey or black, fissile argillites are classified as Savigny Formation because similar rocks - belonging to this formation and underlying the Wishart sandstones - were observed in an area just to the southeast (Patu Lake Area; Dressler 1973a).

1c) Also this - very small - occurence of argillite possibly belongs to the Savigny Formation.

1d) Reddish brown siltstones interlayered with medium-grained, white or pink sandstones occupy a narrow band between the granite and some outcrops of typical, dark grey sandstone of the Wishart Formation. These rocks belong either to the Du Portage or to the Alder Formation. Sedimentary features in the reddish brown siltstones are ripple marks and crossbedding.

2nd CYCLE

The second cycle comprises the Wishart, the Ruth, the Sokoman, the Menihek and the Chioak Formations. These formations underlie large areas and are found almost all over the region studied.

The Wishart, Ruth and Sokoman Formations belong to the Ferriman Subgroup of the Kaniapiskau Supergroup.

WISHART FORMATION

The Wishart Formation is composed mainly of sandstone and some arkose and in a few places it includes siltstones.

A possible time-equivalent of the Wishart sandstones is a dolomite observed in the northeastern part of the La Lande Lake map-sheet. It possibly corresponds to the "Lower Dolomite" of Auger (1954) and Owens (1955) in the northern Labrador Trough.

Most sandstones and arkoses of the Wishart Formation are medium grained. Commonly they are grey or dark greenish grey and weather light grey. In places fine pyrite specks have been observed. The arkoses may contain up to 15% feldspar.

The "Lower Dolomite" is aphanitic, grey and weathers light brown. It contains chert that fills thin irregular cracks in the rock or that forms bands up to 5 cm thick. On the weathered surface of the dolomite fine intraclasts were rarely noted. No stromatolites were observed.

In thin-section the sandstones and siltstones appear to be composed of quartz, plagioclase and microcline. Feldspars rarely make up more than 10% of the rock. Accessory minerals are pyrite, altered biotite and, only observed in one place, hornblende. All these minerals are angular to subrounded and set in a matrix of the above-mentioned minerals or of chlorite and a few carbonate.

RUTH FORMATION

The Ruth Formation is intercalated between the Wishart Formation and the Sokoman Formation. In general it consists of a lower chert member, a shale or argillite member and an upper siltstone member. In the northern part of the area, however, the shale member is thin or does not exist at all and the upper siltstone is interlayered with thin chert or with oolitic jasper bands that are up to 5 cm thick. In places the Ruth Formation possibly grades in a silicate-carbonate iron-formation.

The lower chert member is black, grey or red. It is 2 to 10 feet and rarely up to 30 feet thick. In thin-section it is seen to consist very small quartz granules ($\pm$ 0.5 mm in diameter) cemented together by quartz.

The shales are grey or greenish grey and commonly weather brown. In general they are well laminated. Silty laminae alternate with argillitic ones. In thin-section the shale contains angular quartz silt in a chloritic-argillitic matrix. Quartz may make up 25% of the shale and up to 75% of the silty layers.

The upper siltstone member is well laminated. Red, brown, greenish grey and light grey bands are a few millimetres or rarely one to three centimetres thick. The writer's field assistants named the rock "bacon", which it resembles. In thin-section it appears to be composed of varying amounts of angular quartz in an argillitic matrix.

SOKOMAN FORMATION

The Sokoman Formation crops out, as do the two other formations of the Ferriman Subgroup, mainly in the western half of the map-area. It is composed of cherty ironstones. Hematite iron-formation and silicate-carbonate iron-formation form the major rock units.

The hematite iron-formation consists mainly of oolitic and finely intraclastic, brown-red ironstone. Rock-forming minerals are quartz, hematite and magnetite and, in places and in minor amounts, carbonates, minnesotaite and stilpnomelane. Brick red jasper forms generally discontinous bands, up to 5 cm. thick, in the hematite ironstone. This jasper exhibits ooides and small intraclasts.

Quartz: In the jasper beds it is almost cryptocrystalline. In the ironstone itself intraclasts and ooides are bedded in a very fine grained matrix (grain size commonly around 0.05 mm.) and in a coarser grained, in places sparry cement.

Hematite: This mineral is the primary diagenetic iron oxide in the ironstone. In the jasper beds and intraclasts it forms very fine grains disseminated around particles of chert. In the ironstone itself hematite appears to be fine grained and xenomorphic.

Magnetite: It commonly forms single xenomorphic or hypidiomorphic grains or aggregates that, in places, form bands of a thickness of some millimetres. Magnetite replaced hematite and includes relicts of this iron oxide. In places it is the only Fe-oxide of the ironstone.

Minnesotaite, stilpnomelane and carbonate minerals: See description under "Silicate-carbonate iron formation".

The silicate-carbonate iron-formation consists of greenish-grey, grey or brownish chert-rich ironstone or of brown, in places pinkish-brown, carbonate-rich ironstone. Commonly it weathers rusty brown. It is composed of quartz, iron oxides, minnesotaite, carbonate minerals and rarely stilpnomelane.

Quartz and iron oxides: See description under "Hematite iron-formation".

Minnesotaite: The fine needles (0.01 - 0.06 x 0.05 - 0.18 mm.) of this mineral form sheaves, spherulites or dense felts in a cherty matrix. They are weakly pleochroic: X= colourless; Y=Z= light green.

Carbonate minerals: Dimroth and Chauvel (1973) determined the following carbonates in ironstones of the Labrador Trough: Siderite, ankerite and a calcite with high magnesia and variable iron content. All these carbonates commonly are xenomorphic. The grain size ranges from 0.01 to 0.5 mm and rarely to 1.0 mm.

The silicate-carbonate iron-formations contain varying amounts of carbonates. In places pure carbonate beds are interlayered with cherty ironstone. The uppermost portion of the Sokoman Formation is commonly made up by a pure, greenish-grey chert ("lean chert").

ROCK TEXTURES

Sedimentary Textures: In the ironstone, the hematite iron-formation and the silicate-carbonate iron-formation, the following sedimentary textures have been

been observed: Ooides, pisolites, oncolites, pellets, intraclasts, crossbedding and stromatolites.

Ooides, pisolites and oncolites are formed around small intraclasts, fragments of ooides or around one, two or even three smaller ooides. Oncolites, up to 7 cm. across, have been noted (figs. 2-4).

Pellets range from 0.1 to about 0.5 mm. in size and are composed of chert. They are elliptical or spherical and lack any concentric structure.

Intraclasts are fragments of ironstones or jasper "that have been eroded from adjoining parts of the sea bottom and redeposited to form a new sediment" (Folk, 1959). They are some millimetres to 15 centimetres in size and angular or subangular (fig. 4). Shrinkage cracks and deformations of the clasts have been noted.

Crossbedded layers of the ironstones are up to three feet thick (fig. 5).

Stromatolites in the iron-formations of the Labrador Trough are rare (fig.6). They are convex and rather flat. Figure 7 shows fenestral structures in a stromatolite.

Diagenetic features in the ironstones are deformation of ooides, dessication, styolites and migration of matter. An initial metamorphism is indicated by the growth of minnesotaite and stilpnomelane and by the concretionary recrystallization of hematite and magnetite. No grunerite has been observed in the area studied.

Fig. 2: Oncolite in grey-green chert of upper Sokoman Formation. Scale 1 cm.

Fig. 3: Oncolites in upper silicate-carbonate iron-formation.
Size of specimen 17 cm.

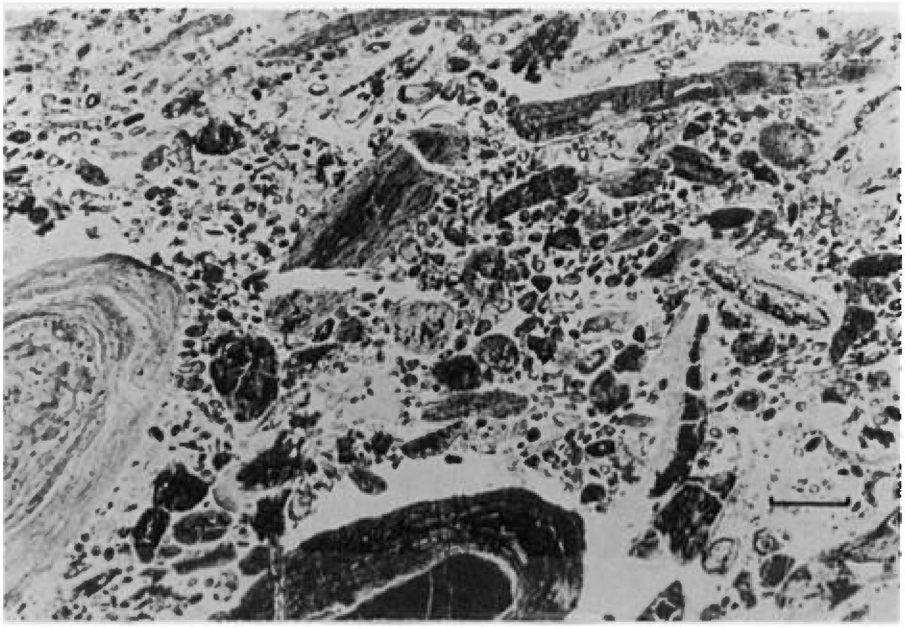

Fig. 4: Oncolites, ooides and intraclasts in iron-formation. Thin-section. Scale 2.5 mm.

Fig. 5: Crossbedded silicate-carbonate iron-formation.

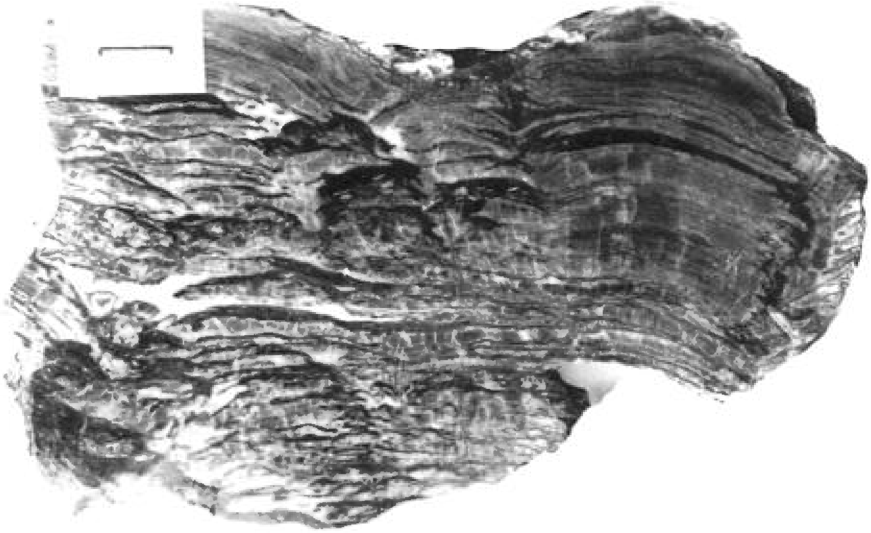

Fig. 6: Stromatolites in silicate-carbonate iron-formation. Scale 1 cm.

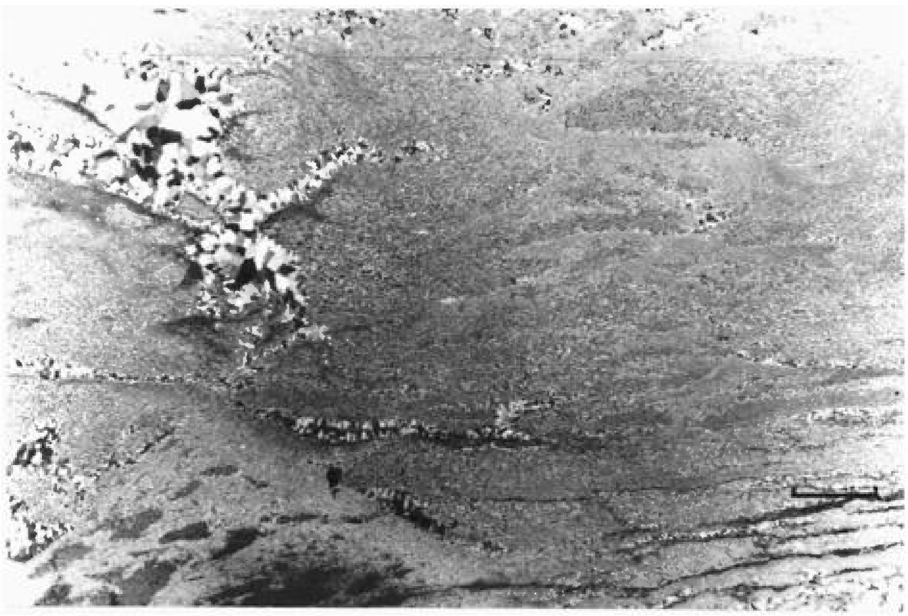

Fig. 7: Thin-section showing fenestral structures filled by quartz cement; stromatolite of fig. 6. Scale 6 mm.

Sedimentary Environment

Crossbedding and stromatolites, besides ooides, oncolites, pellets and intraclasts, prove that the ironstones - both hematite iron-formation and silicate-carbonate iron-formation - were deposited mainly in shallow water above wave-base. Thick and uniform laminated or almost structureless ironstone and chert, mainly of the upper Sokoman Formation, however, indicate a deposition in deeper water, below wave-base.

The alternation of beds of almost pure, massive or laminated chert and ironstone with highly intraclastic or oolitic and oncolitic beds, in both hematite iron-formation ans silicate-carbonate iron-formation, illustrates a sedimentary environment of sporadic turbulence. Times of quiet precipitation changed with sudden uplashes of the sea water.

In general one observes that the silicate-carbonate iron-formation thickens basinwards.

Stratigraphy of the Sokoman Formation

The stratigraphy in the northern part of the area, i.e. northern portion of the Moraine Lake map-sheet and La Lande Lake area, is commonly different from that found in the southern area.

In the south the Sokoman Formation can be roughly subdivided into four members:

d) Upper silicate-carbonate iron-formation

c) Upper hematite iron-formation

b) Lower silicate-carbonate iron-formation

a) Lower hematite iron-formation

Towards the north the facies changes. In the La Lande Lake area this subdivision into four members is applicable only at one place, i.e. just east of the granite occurrence at the southern limit of this map-sheet. Some few miles east of this sector, near Caniapiskau river, however, almost no hematite iron-formation crops out, and silicate-carbonate iron-formation rests directly on the Ruth Formation. In the southwestern La Lande Lake area almost all iron-formation is hematite ironstone.

Olivine-melilitite tuffs and carbonatite breccias

These rocks form a continuation of similar rocks found by the author (Dressler, 1973a) just to the south in the Patu Lake area and by Dimroth (1969) south of 56^{o} 30' parallel in the Castignon Lake area. Dimroth (1969) and Dressler (1973a) classified these rocks as post-Kaniapiskau. However, new evidence proves these rocks to be of Kaniapiskau age and to be older than the deposition of the Menihek Formation:

a) A specimen of a lamprophyre, found by the author in the Patu Lake area (1973a) and termed meimechite has been sent for radiometric age determination (Geological Survey of Canada; courtesy fo K.L. Currie). The result yields 1873 $\pm$ 53 m.y. (whole rock K-Ar). The age is surprisingly old. However, it coincides very well with an age determination by Fryer (1972). His Rb-Sr whole rock isochron studies of slates of the Menihek Formation support an age of 1870 $\pm$ 50 m.y. for the Sokoman Formation.

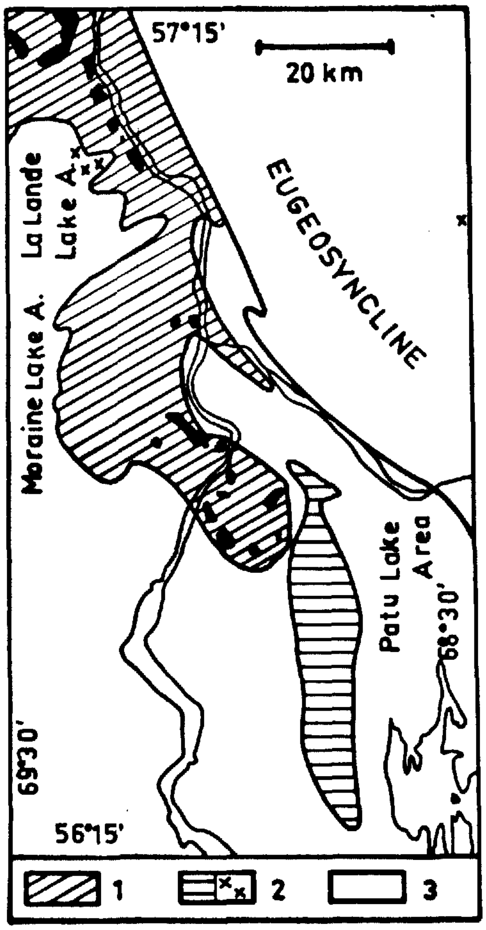

Fig. 8: Location map showing areas where lamprophyres, carbonatites etc. crop out, and where they are absent.

1 - Areas underlain by rocks of the Menihek Formation and by younger rocks; black are major outcrop areas.

2 - a) Areas where carbonatites, lamprophyres etc. outcrop.

b) Single outcrops of these rocks.

3 - Areas underlain by rocks older than Menihek Formation and eugeosynclinal rocks.

b) Carbonatites, carbonatite breccias, etc. have never been found in areas underlain by rocks of the Menihek Formation - for instance, in the Moraine Lake East map-sheet (this report). However, south of that map-sheet (Patu Lake Area, Dressler 1973a) and north of it (La Lande Lake Area; this report) they crop out in areas underlain by rocks of the Sokoman Formation (fig. 8).

The reason for initially classifying the lamprophyres, tuffs and carbonatites as post-Kaniapiskau was the lack of any obvious deformation of these rocks in areas studied prior to 1973. During the 1973 field-season, however, few occurences of olivine-melilitite tuff, identical to those found further south, show clear evidence of tectonic deformation. A lamprophyre of the same kind as the one of the Patu Lake Area has been found north of Aulneau lake (north of map-sheet Fort McKenzie (E);).

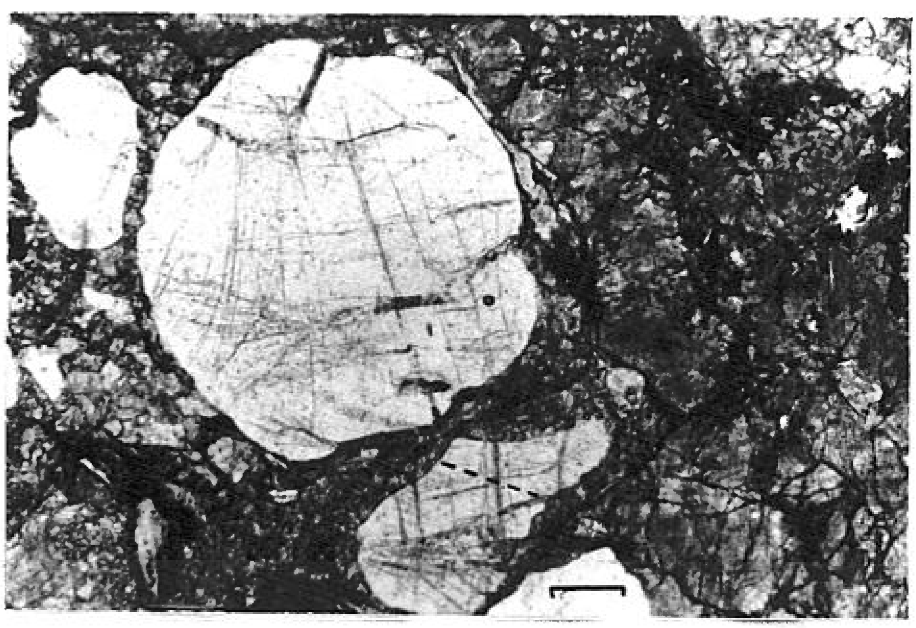

Fig. 9: Quartz with deformation lamellac in a carbonatite breccia. (Direction of lamellac indicated by dashed line). Scale 0.2 mm.

In this occurence the rock was obviously affected by the regional metamorphism, showing for instance such a metamorphic mineral as actinolite.

The olivine-melilitite tuff consists of black or very dark green lapilli cemented together by varying amounts of calcite. In thin-section, the lapillii appear to be composed of serpentinized, commonly idiomorphic olivine surrounded by pseudomorphosed melilite, carbonate and opaque minerals.

The carbonate breccia is a grey, brown-weathering rock that contains fragments of iron-formation, highly strained, subangular or rounded quartz, and olivine-melilitite lapilli, set in a carbonate groundmass. The rock fragments are up to 2 cm. in size, the quartz grains up to 2mm. The quartz exhibits deformation lamellae (fig. 9).

MENIHEK FORMATION

The Menihek Foramtion consists of argillite , siltstone and fine-grained sandstone. It crops out in large areas, mainly west of Caniapiscau river.

The argillite is grey or black and commonly fissile. It grades upward and possibly also laterally into a grey and in places laminated siltstone. This siltstone is overlain by a dark chocolate brown, very fine grained sandstone, that contains some small carbonate lenses in its uppermost portions.

In thin-section, the siltstone and the sandstone consist of angular quartz, few microcline and plagioclase. Chlorite has been observed in the siltstone.

The paleogeography of the Menihek Formations is shown in figure 10. Note that no chocolate brown sandstones were observed north of the 57^{o} 05' parallel.

Argillites and siltstones underlying areas east of the Caniapiscau river have been classified as Menihek Formation. However, they may include basin equivalents of older rocks.

Note: The classification of the following two formations as Chioak and Abner Formations is tentative. In the northern Labrador Trough these formations overlie an iron-formation. Sure correlations between those formations in the south and in this northern section of the Trough will be possible only after mapping is completed north of the present area.

CHIOAK FORMATION

The word "Chioak" means coarse sand in the Eskimo language and was introduced as a stratigraphic name by geologists of Fenimore Iron Mines Ltd. Bérard (1965) and Sauvé and Bergeron (1965) described as Chioak Formation a "horizontally and vertically variable sequence of conglomerates, sandstones, black and red argillites, shales and chlorite schists".

Rocks that are classified, somewhat arbitrarily as Chioak Formation in the present report crop out in very few places in the northwestern part of the region. They consist of argillites, siltstones, and siltstones interlayered with dolomite. No conglomerates were observed.

The classification of these rocks as Chioak Formation is based on stratigraphic evidence. They underlie a dolomite, probably the Abner dolomite.

Just north of the Lac La Lande map-sheet, on the western bank of Caniapiscau river at latitude 57° 00' 17'', a section through the Chioak Formation is exposed. Lower portions of the sequence described in table II may possibly belong to the Menihek Formation.

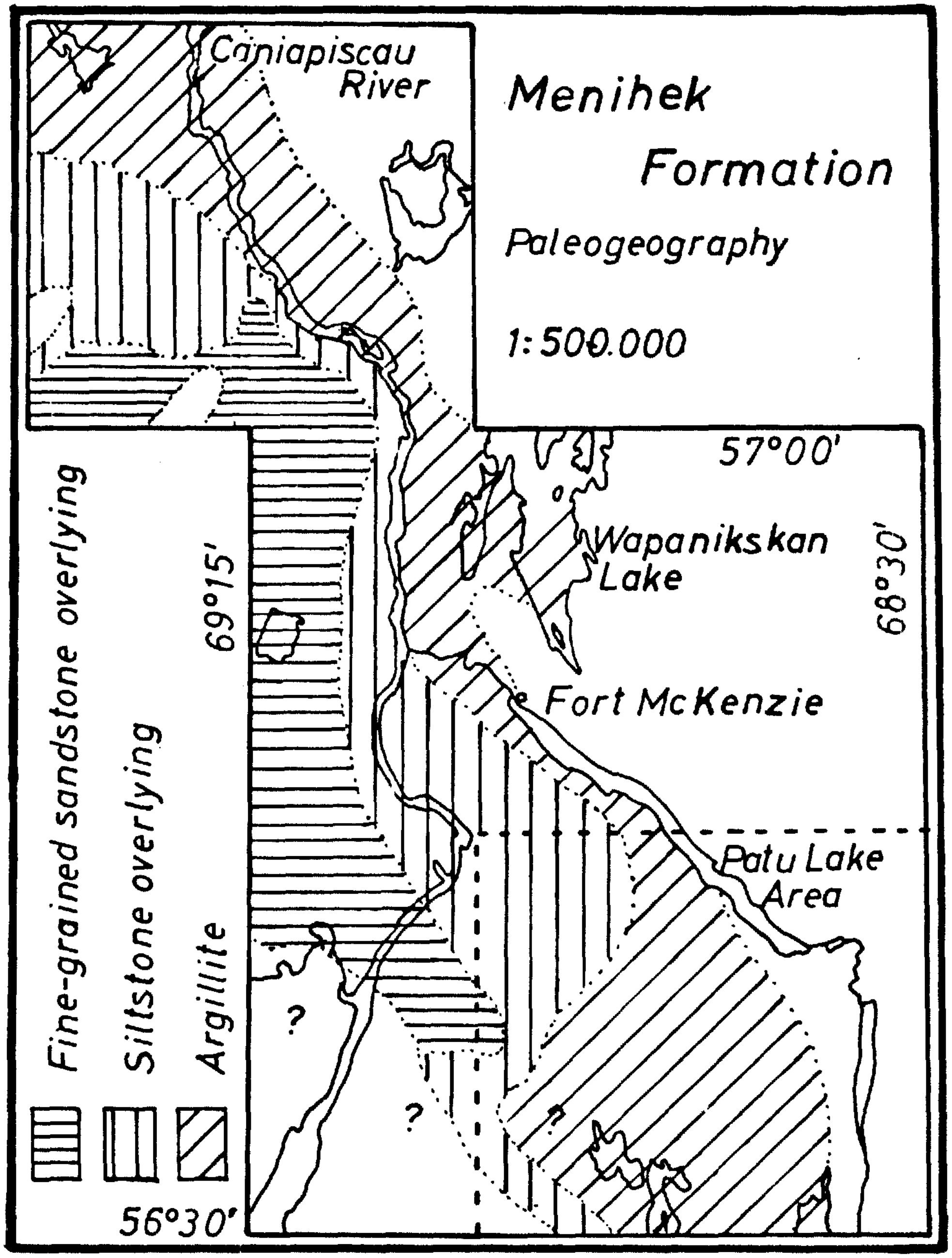

Fig. 10: Paleogeography of the Menihek Formation

TABLE II: CHIOAK FORMATION

Abner Formation	siltstone dolomite dolomitic sandstone dolomite	
Chioak Formation	(Repetition of part of the upper sequence due to drag-folding).	
	siltstone: red and grey, dolomitic	(±40')
	dolomite and argillite: pinkish-white, brown-weathering dolomite, up to 15 cm. thick, interlayered with silty, green, brown or red, laminated argillite	(±18')
	siltstone and dolomite: dolomitic siltstone, finely laminated, interlayered with dolomite bands up to 5 cm. thick	(±30')
	siltstone: grey, dolomitic	(±17')
	siltstone and dolomite: grey, dolomitic siltstone, dolomite lenses and discontinious dolomite bands	(±18')
	siltstone: grey, somewhat dolomitic, laminated; in places fine-grained sandstone	(±65')
	siltstone: dark grey	(±75')
	argillite: grey, in places silty and laminated	(>50')
? ?	? ? ? ? ? ? ? ?	?
Menihek Formation		

3 rd CYCLE

The third cycle of sedimentation in the Labrador Trough began, according to Dimroth at al. (1970) with the deposition of the Abner dolomite.

ABNER FORMATION

The Abner Formation crops out in the very northern part of the area, the northwestern sector of the La Lande Lake map-sheet. It consists of dolomite, a dolomitic sandstone interlayered with the dolomite and siltstone and argillite overlying the dolomite.

Abner Dolomite

a) Macroscopic description

The Abner dolomite is fine grained or aphanitic and, in places, recrystallized. Commonly it is grey and weathers light grey or buff, but pink, red light yellow, buff and white colours were also observed.

Terrigeneous material is common. Intraclasts are up to 30 cm. size (fig. 11). Laminated dolomite is rare.

Gebelein and Hofmann (1973) describe alternate thin algal layers and thick, light, coarse clastic layers in recent carbonate rocks of Florida and compare them with dolomite-calcite laminations of Devonian, Cambrian and Proterozoic rocks from different places in North-America

The laminated dolomite of the Abner Formation was stained with Alizarin Red S. All laminaes are composed of dolomite. The result was checked by x-ray diffraction.

Stromatolites in the Abner dolomite are abundant. Figure 12 and 13 show two examples. These algal structures commonly are turbinate or bulbous and contiguous (Hofmann, 1969). Topmost individuals of coalescent forms are up to 60 cm in diameter. In places the laminae of the stromatolites are marked by thin cherty layers.

b) Microscopic description

Terrigeneous inclusions show a wide range of sizes (up to 0.8 cm.). Most commonly they are composed of quartz, rarely of microcline, plagioclase and small fragments of quartzite (fig. 14.). (These quartzite fragments contain fresh microcline). Most terrigeneous constituents are subrounded;small grains, however, are angular.

Oolites are up to 0.3 mm. in size and, in places, hardly distinguishable from small pellets.

Intraclasts consist of oolitic, pellitic, laminated or sandy dolomite. They are subangular to subrounded. Some were still plastic during deposition; they are plastically deformed.

All allochems (intraclasts, pellets, oolites) lie in a very fine carbonate matrix or are cemented together by sparry carbonate.

Laminated dolomites, exhibit, in thin-section, alternate thin, dark layers and light,somewhat coarser laminae (fig. 15).

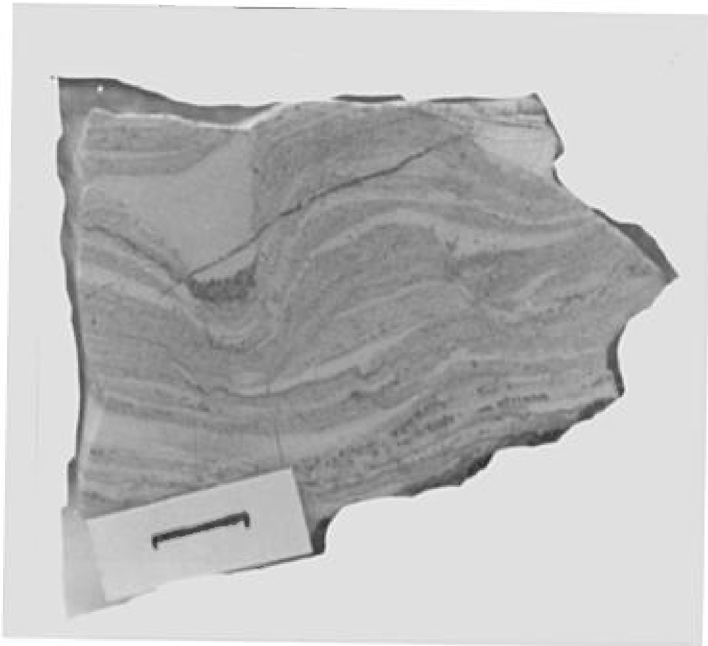

Fig. 13: Stromatolites in Abner dolomite. Scale 1 cm.

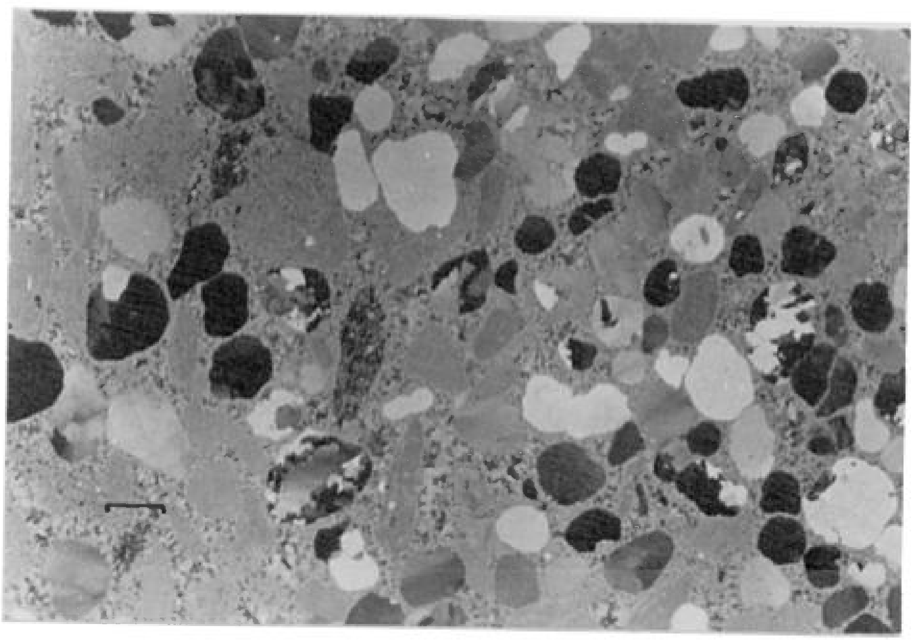

Fig. 14: Terrigeneous material in Abner Formation. Scale 1. mm.

Fig. 11: Intraclasts in Abner dolomite.

Fig. 12: Stromatolites in Abner dolomite

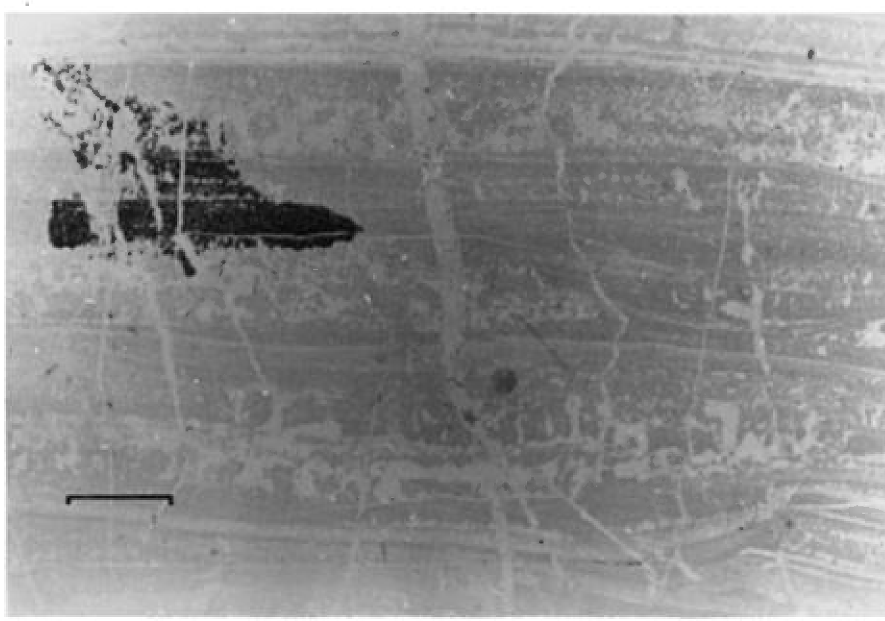

Fig. 15: Laminated Abner dolomite. Scale 2 mm.

Dolomitic sandstone

A band of dolomitic sandstone in the Abner dolomite is about 50 feet thick. In places two layers of this sandstone were observed. The quartz is medium or coarse grained, subangular to rounded, and is set in a grey or buff dolomitic matrix. The quartz and minor feldspar make up 60% or more of the rock. In places, the rock contains clasts, up to 4 cm in size, of dolomite or dolomitic sandstone.

Siltstone and Argillite.

The siltstone that overlies the Abner dolomite is tentatively classified as part of the Abner Formation. It is grey and weathers buff and is commonly inter-layered with beds of grey argillite. In a few places it grades into a fine-grained sandstone.

Non-Subdivided Kaniapiskau Supergroup

In the eugeosyncline (the eastern part of the map-area) sedimentary rocks, mostly minor thicknes, are intercalated with the volcanic rocks of the Kaniapiskau Supergroup. They consist of argillites, siltstones, sandstones, arkoses, dolomites and conglomerates in this approximate order of abundance. No correlation of these lithologically indistinct rocks with the well-defined stratigraphy of the miogeosyncline is possible at present.

No detailed description of these eugeosynclinal sediments is presented here. The mudstones are grey or black and contain, in places, much graphite or are highly mineralized (see section on economic geology). Sandstones and arkoses are fine or medium grained and form layers only a few feet thick underlying gabbros or basalts.

Dolomites are grey or buff and commonly weather brown. Conglomerates contain inclusions of volcanic or sedimentary origin. Granitic conglomerates are scarce. A boulder conglomerate, underlying rhyolite in the very northern part of the area, contains boulders up to 1½ feet long that are commonly elliptic and set in a fine-grained, black, silty groundmass. The boulders consist of a medium-grained sandstone that includes a few small volcanic fragments.

Volcanic rocks of the Kaniapiskau Supergroup

Montagnais Group

Volcanic rocks of the Kaniapiskau Supergroup consist of basalts, gabbros, rhyolites, tuffs and agglomerates. They crop out in the eastern part of the map-area.

It is to be noted that the Montagnais Group is not a stratigraphic unit. As used in this report, it comprises all volcanic rocks except the carbonatite breccias and olivine-melilitite tuffs described previously. One is tempted to classify the Montagnais volcanics with the sediments that they intruded or on which they extruded. However, uniform appearance, petrography and chemistry makes the approach faulty. Only the presence of rhyolitic flows might allow part of the volcanic sequence to be classified as Murdoch Formation (Baragar, 1967), as in the Schefferville district, where it overlies the Menihek Formation.

Metabasalts

Metabasalts underlie large areas in the eastern part of the map-region. They are aphanitic or fine grained and rarely porphyritic or vesicular. Their colour is dark grey or greenish grey. They weather greenish brown. In many places they are pillowed, the pillows being some inches to 10 feet across.

In thin-section the metabasalts commonly exhibit a texture of unoriented laths in a base of fine-grained, secondary minerals, for instance chlorite, actinolite and leucoxene. However, subophitic textures, flow textures (fig. 16) and cataclastic structures have been also observed.

Mineralogy of metabasalts

(Primary mafic minerals are absent in the thin-sections studied).

Plagioclase is commonly highly saussuritized. The An-percentage of "fresh" feldspars is 25-35% An. The lowest An-contents were determined as 2% An.

Actinolite is almost colourless. (Nx= almost colourless. Ny and Nz= very light green; $Z \wedge C$ 15-18^{o}; $2Vx=$ 78-80^{o}). It forms xenomorphic or hypidiomorphic needles or laths and makes up 5 to 40% of the rock.

Chlorite is found in the fine groundmass or replacing actinolite. It is almost colourless and only in vesicles does it form larger and twinned sheets.

Stilpnomelane is less common than actinolite or chlorite. It is in the groundmass or fills vesicles together with chlorite, calcite, pyrrhotite and chalcopyrite (fig. 17). It forms greenish brown sheets or needles.

Serpentine, observed in only one thin-section, may have been formed by replacement of olivine.

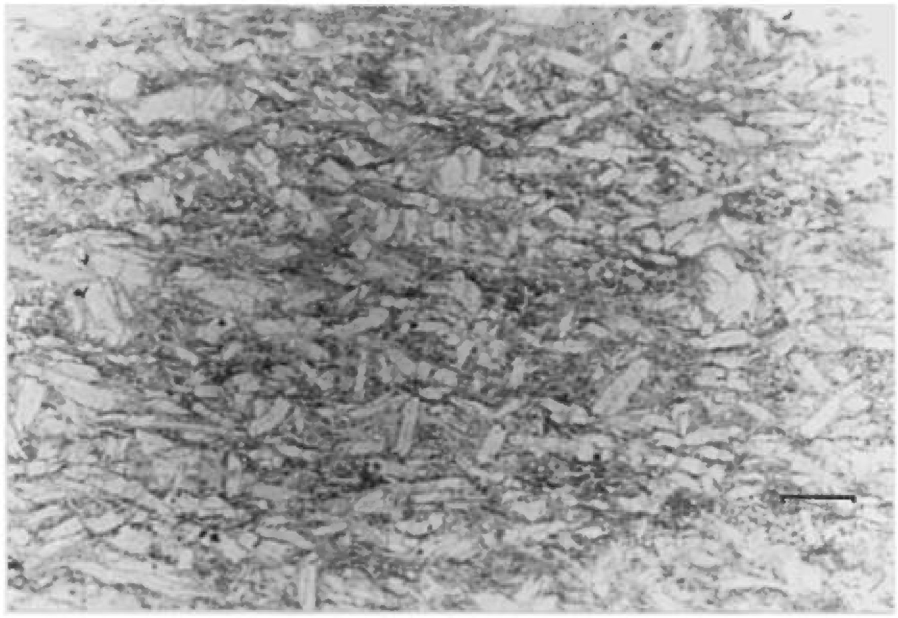

Fig. 16: Metabasalt. Some plagioclase laths are bent or broken. Scale 0.5 mm.

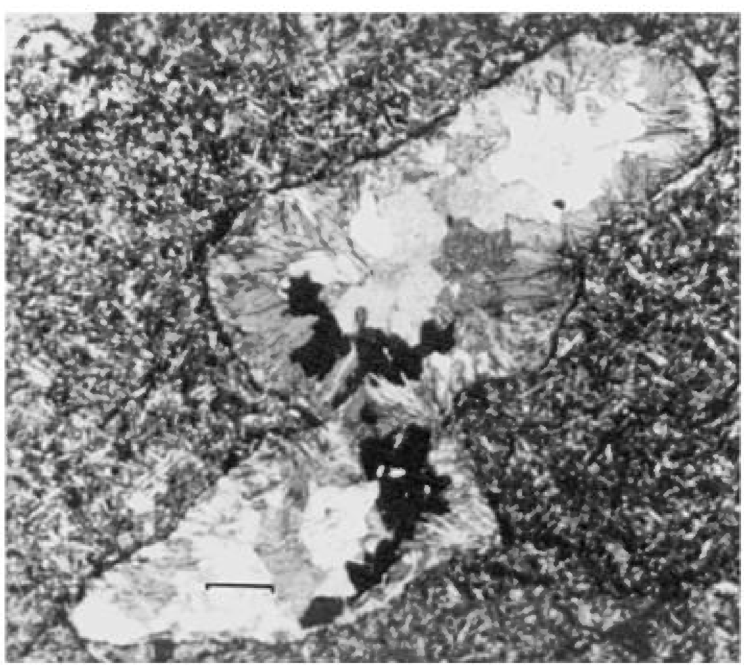

Fig. 17: Vesicle in metabasalt filled - from rim to centre of vesicle - by stilpnomelane, chlorite, ore minerals (pyrrhotite and little chalcopyrite) and calcite. Scale 0.25 mm.

Sphene and leucoxene are common. Magnetite, pyrrhotite, pyrite and chalcopyrite are the opaque minerals in the metabasalts.

TABLE III: CHEMICAL ANALYSES OF METABASALTS

No. of specimen	3K11B	5K14A	5K21	5K27	6K6B	7K3	23K15A	52K34	53K10
SiO_2	46.50	50.80	47.85	48.00	49.80	49.90	44.10	46.95	48.15
TiO_2	7.09	2.34	2.69	3.38	2.77	n.d	1.65	3.42	4.13
Al_2O_3	11.70	14.10	13.80	12.55	13.55	13.45	13.35	14.30	15.05
Fe_2O_3 (or Fe total)	9.62	1.80	1.75	2.28	1.30	n.d	1.26	17.44	12.95
FeO (as Fe_2O_3)		11.61	11.82	13.43	13.01	n.d	11.09		
MnO	0.10	0.15	0.16	0.19	0.16	n.d	0.13	0.17	0.12
MgO	6.03	5.32	5.66	4.46	5.60	7.76	8.56	4.50	2.45
CaO	13.08	4.30	7.00	6.76	3.79	7.34	6.56	3.35	4.71
Na_2O	3.00	3.00	4.22	3.48	2.00	3.50	2.80	2.96	6.06
K_2O	0.84	0.14	0.37	0.48	0.75	0.57	0.80	1.56	0.53
P_2O_5	0.32	0.21	0.56	0.32	0.60	n.d	0.17	0.40	0.50
H_2O^+	0.58	5.08	n.d	3.66	5.09	n.d	4.35	4.36	2.60
H_2O^-	0.00	0.02	n.d	0.03	0.11	n.d	0.08	0.00	0.12
CO_2	1.25	n.d	n.d	n.d	0.48	n.d	2.30	0.13	n.d
S	0.41	n.d	n.d	n.d	n.d	n.d	n.d	0.88	2.98

(For locations of analysed metabasalts, metagabbros and rhyolites see page 37b and 37c)

Metagabbros

Metagabbros of the area are fine to medium, rarely coarse grained, green, grey-green or dark grey. Commonly they weather brown or grey-green. Gradations from basalt to gabbro were observed along the strike of mountain ridges.

The chilled zones on contacts with sediments, mostly argillites, are thin, in places only few inches thick. Columnar jointing of gabbro tops is common, mainly around Aulneau lake.

The normal gabbros are even grained, ophitic or rarely pegmatitic. At few occurences of porphyritic or cataclastic gabbros were noted. Glomerophyric gabbros are absent. The chilled zones contain very small phenocrysts, mostly of plagioclase, set in an almost aphanitic groundmass.

Mineralogy

Plagioclase, in places, is completely saussuritized. Less altered feldspar yields An-values of 30-40%, highly altered ones values of 2-5% An.

Pyroxenes were noted only in very few of the 20 thin-sections of metagabbros studied. They are almost colourless; $2Vz= 52^{o}$. In most places pyroxenes are completely replaced by amphibole or by chlorite.

A brown hornblende, observed in only one thin-section, contains small relicts of clinopyroxene and few apatite. Its optical properties are: $2Vx= 63^{o}$; NX= light brown; NY= brown; NZ= brown.

Actinolite is very common in all thin-sections studied. It forms hypidiomorphic or xenomorphic laths or needles. In some thin-sections it is very fine grained and in the groundmass, in others it forms crystals up to 3 mm. in size. The optical properties of the actinolite are: $2Vx = 78 - 80^{\circ}$; $Z \wedge c = 15 - 17^{\circ}$.

Epidote is xenomorphic or hypidiomorphic and makes up 0-15% (estimation) of the rock.

Chlorite replaces pyroxene and amphibole. It is almost colourless or light green. Ott (1973) determined the chlorites of metagabbros of the central Labrador Trough as rhipidolites.

Stilpnomelane was observed in about one third of the thin-sections studied. It makes up 1 to 3 percent, in one case 10-15 percent of the rock. It forms yellowish-brown/dark brown pleochroic needles.

Quartz, in only a few thin-sections (pegmatitic metagabbro) and up to 5%, apatite, sphene, leucoxene and carbonate were observed. Opaque minerals are magnetite, ilmenite, pyrrhotite, pyrite and rarely chalcopyrite.

TABLE IV: CHEMICAL ANALYSES OF METAGABBROS

No. of specimen	1E15	25E1A	28E21	49E15	50E1	50E3	50E13A	50E13B	50E14	50E15	11K3
SiO_2	47.00	41.32	50.60	50.00	47.15	44.75	49.75	42.50	46.80	48.00	48.05
TiO_2	1.46	1.88	2.19	1.50	1.50	1.00	1.40	2.45	1.00	1.30	1.67
Al_2O_3	13.25	10.27	12.65	13.30	13.20	15.07	14.25	11.75	14.93	14.90	14.10
Fe_2O_3	4.10	25.45	2.45	2.80	2.80	2.47	3.78	4.22	2.63	2.50	1.27
FeO	8.46	8.36	12.48	9.80	10.47	9.00	9.74	14.92	7.95	8.65	13.05
MnO	0.17	0.07	0.17	0.18	0.18	0.14	0.16	0.17	0.15	0.16	0.15
MgO	9.96	2.41	3.04	6.60	6.80	9.60	4.95	6.46	8.20	6.00	6.35
CaO	8.20	3.30	5.30	9.40	12.00	10.85	8.60	10.80	11.50	9.90	4.59
$Na_2O\cancel{_3}$	2.90	5.60	4.06	2.40	1.70	1.95	3.60	1.40	2.25	3.15	2.62
K_2O	0.17	0.34	2.32	0.16	0.16	0.17	0.28	0.34	0.35	2.05	0.08
P_2O_5	0.10	0.09	0.85	0.15	0.11	0.14	0.16	0.06	0.22	0.16	0.14
H_2O^+	4.00	0.76	3.10	3.42	3.25	4.06	3.04	4.08	3.40	3.52	5.05
H_2O^-	0.10	0.02	0.20	0.08	0.10	0.10	0.26	0.20	0.12	0.08	0.00
CO_2	0.39	0.05	0.08	0.30	0.11	0.11	0.06	0.07	0.05	0.07	2.69
S	0.18	0.41	0.05	0.10	0.15	0.24	0.03	0.08	0.01	0.03	n.d
Ni ppm	86	n.d	28	86	90	270	28	74	120	92	n.d
Cr ppm	180	n.d	21	83	86	130	15	8.3	360	190	n.d

(All even-grained, medium-grained greenish-grey metagabbros, except 28E21, a black and coarse grained gabbro.)

Rhyolites

Rhyolites occur mostly in the northern most part of the area, north of La Lande Lake. A few outcrops were also observed just east of Wapanikskan (= Colombet) lake.

The most common type of rhyolite is a aphanitic, dark grey or black, light grey weathering and conchoidally fracturing rock. Fine-laminated, vesicular, perlitic or brecciated varieties are rare. Rhyolite pumice was observed at one place. On a peninsula in southeastern La Lande Lake a rhyolite breccia underlies a laminated rhyolite that, in turn, is overlain by normal rhyolite.

In thin-section the common type of rhyolite is seen to be composed of a fine-grained leucocrate groundmass and of few phenocrysts of plagioclase, of corroded quartz and possibly of k-feldspar. Chlorite, little stilpnomelane, apatite, sphene and leucoxene were noted. Opaque ores are magnetite, sparse pyrite and pyrrhotite. Fig. 18 shows a quench plagioclase and fig. 19 a perlitic rhyolite.

TABLE V: CHEMICAL ANALYSES OF RHYOLITES

No of specimen	8K10	8K18B	8K23B	8K29B	57K12**)
SiO_2	73.80	70.30	71.10	71.75	67.60
TiO_2	0.54	0.48	0.56	0.25	0.40
Al_2O_3	11.24	12.90	13.10	13.92	15.75
Fe_2O_3	1.41	3.37	1.30	1.10	4.80*)
FeO	2.15	1.85	3.66	2.25	
MnO	0.08	0.13	0.08	0.05	0.05
MgO	0.70	0.41	0.96	0.61	1.20
CaO	1.30	7.51	1.20	0.20	0.39
Na_2O	2.05	1.90	3.30	5.18	5.72
K_2O	3.85	0.20	1.88	2.58	2.28
P_2O_5	0.10	0.07	0.08	0.02	0.05
H_2O^+	----	----	1.84	----	----
H_2O^-	----	----	0.15	----	----
CO_2	----	----	0.60	----	----
S	----	----	----	----	0.42

*) Fe total as Fe_2O_3

**) Specimen 57K12 contains fine disseminated sulfides.

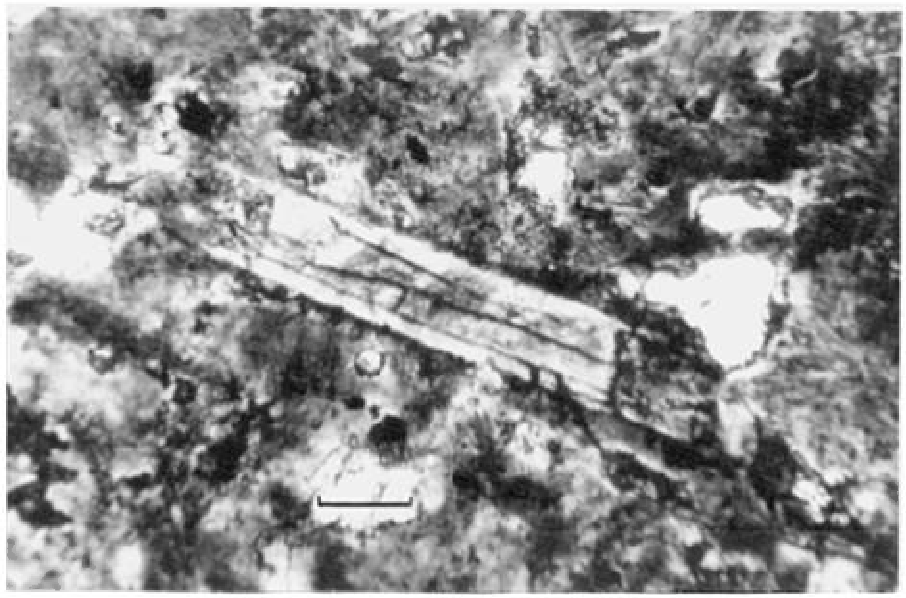

Fig. 18: Quench plagioclase in rhyolite. Scale 0.1 mm.

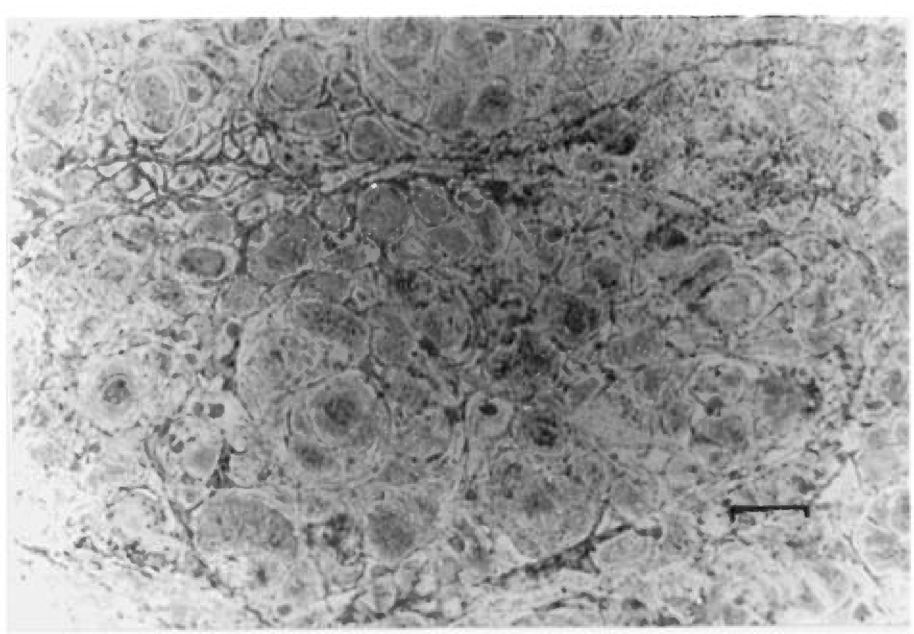

Fig. 19: Perlitic rhyolite. Scale 1 mm.

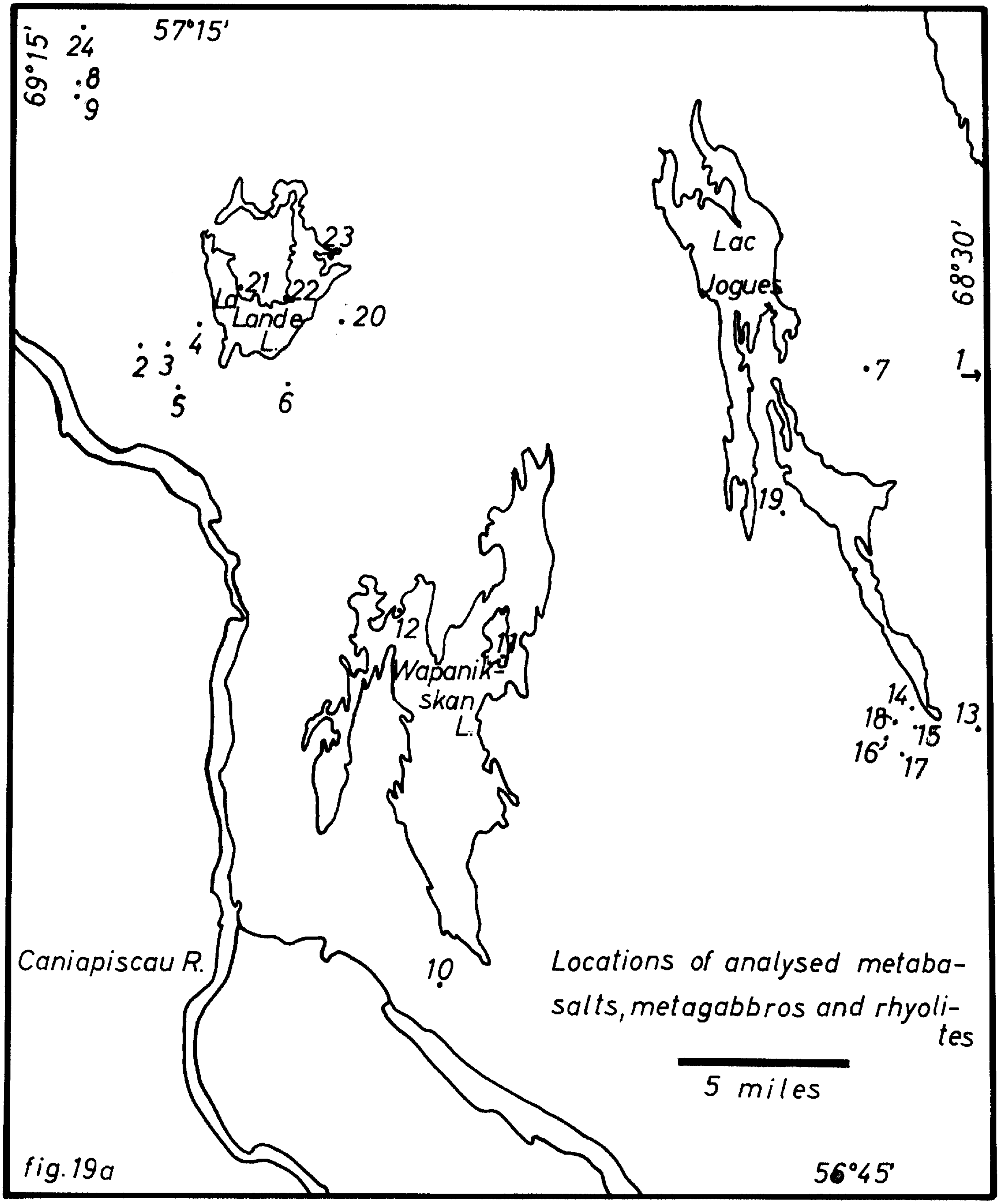

fig. 19a

see page 37c

Locations (fig. 19a):

Metabasalts	Metagabbros
1 - 3K11B (east of 68 30')	10 - 1E15
2 - 5K14A	11 - 25E1A
3 - 5K21	12 - 28E21
4 - 5K27	13 - 49E15
5 - 6K6B	14 - 50E1
6 - 7K3	15 - 50E3
7 - 23K15A	16 - 50E13A 50E13B
8 - 52K34	17 - 50E14
9 - 53K10	18 - 50E15
	19 - 11K3

Rhyolites

20 - 8K10	23 - 8K29B
21 - 8K18B	24 - 57K12
22 - 8K23B	

Pyroclastic rocks

Tuffs and agglomerates were mainly observed in the eastern most part of the map-area, around Aulneau lake. They form layers of a few inches to several feet thick and are green or greenish grey and commonly foliated or sheared. Greenschists derived from pyroclastic rocks are abundant.

All pyroclastics observed in the area are basic. Fragments range from some millimetres to 6 centimetres in size and are composed of green metabasalt. Commonly they are angular, subrounded or flattened parallel s.

In thin-section the tuffs and agglomerates are seen to be composed of chlorite, actinolite, albite, epidote, calcite, sphene, leucoxene and magnetite, a typical greenschist mineralogy.

Figure 20 shows a thin-section of a typical agglomerate.

Pleistocene and Recent

Large areas bordering the Caniapiscau river are covered by tills and stratified deposits. Stratified sand predominates in the Shale Falls (E) map-area and east of Caniapiscau river in the Moraine Lake (E) and the La Lande Lake areas. Loose material of all sizes is found on the high plains west of Caniapiscau river (Moraine Lake E and La Lande Lake map-sheets). Close to the river sand deposits reach thicknesses of more than 100 feet.

Active dunes close to Shale Falls are up to 10 metres high.

Fig. 23: Agglomerate. Scale 0.3 cm.

Glacial striae trend between 010^{o} and 120^{o}, mostly around 040^{o} . Wherever indicative they show the true direction of ice-movement to be northeastward.

Structural Geology

Almost all the area lies in the Labrador Trough and in general all rocks of the Kaniapiskau Supergroup trend north-northwest.

In the miogeosyncline the sediments are folded and thrust-faulted from the northeast. Close folding, overturning of folds and crossfolding were mainly observed in areas underlain by rocks of the iron-formation - for instance east and west of the Caniapiscau river in the Moraine Lake (E) map-area.

In the southern part of the La Lande Lake region two granite bodies acted as abutments for the strata of the Ferriman Subgroup and of the Menihek Formation. These sedimentary formations were compressed between the granites and form a U-shaped structure, the base of the U pointing southwestward and being a kind of bow wave. Part of the eastern granite body is thrust over sediments.

In the eugeosyncline the volcanic rocks and intercalated sediments in general form shallow and rather wide synclines separated by narrow anticlines or shear zones. A dominant thrust folds separates the eugeosyncline from the miogeosyncline in many places.

Economic Geology

The present map-areas are highly favourable for prospecting, especially for iron, copper and nickel.

A preliminary study on sulfide mineralizations and magnetic ironstones of the Fort McKenzie, Shale Falls (E) and Moraine Lake (E) areas was published by the author (Dressler, 1973b). Only few chemical analyses and few new results are presented here.

Some chemical analyses are presented on the following pages. All analysed samples are selected samples and were selected from an outcrop to determine whether or not the rocks contain any of the metal sought. Therefore, the chemical analyses and modal analyses are not representative for all the occurrences.

A, Magnetic Ironstones

Rocks of the Sokoman Formation are hematite ironstones, silicate-carbonate ironstones or "lean cherts". All these rock types are commonly very fine grained and may be termed taconites*.

Prospecting for direct-shipping iron ore has been carried out without great success by different mining companies. Mining of taconites, however, could become economic in the not-too-distant future. In many places these fine rocks are highly magnetic and contain up to 55% Fe.

Some chemical analyses of magnetic ironstones are presented in table VI (from B. Dressler, 1973b).

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* Taconites are very fine grained ironstones "that must be ground finer than 100 mesh screen size to liberate the bulk of iron minerals" (Gross, 1965).

TABLE VI: CHEMICAL ANALYSES OF MAGNETIC IRONSTONES

Sample	13E8	14E29	13E1A1	45E3	45E21	45E29	14E26	46E10	46E6	55E16
SiO_2	52.56	62.86	51.80	53.20	63.96	12.00	58.88	45.94	21.72	57.34
Al_2O_3	0.24	0.17	0.26	0.14	0.21	0.24	0.12	0.24	0.19	0.17
Fe_2O_3	32.10	20.45	38.53	40.75	20.37	58.05	26.81	31.95	53.62	32.60
FeO	11.32	10.16	5.92	4.37	9.91	24.83	8.17	16.47	22.19	8.62
MgO	1.86	1.22	0.41	0.05	2.90	0.97	4.78	1.04	0.11	0.02
CaO	0.05	1.31	0.47	0.14	0.02	0.08	0.03	0.05	0.03	0.02
S	0.01	0.01	<0.01	0.01	0.05	0.01	0.01	0.03	0.04	0.01
P_2O_5	<0.01	<0.01	0.08	0.01	<0.01	0.02	<0.01	0.02	<0.01	<0.01
MnO	0.31	0.14	0.49	0.25	0.21	0.07	0.06	0.24	0.09	0.12

(For locations and description see Dressler 1973b)

B. Sulfide Mineralizations in Sediments

Sulfide-bearing sediments in the area are sandstones, arkoses, siltstones and argillites. They were mainly found around Wapanikskan lake (- Colombet lake) and Aulneau lake.

At Wapanikskan lake prospection for copper was carried out by exploration companies. The targets were medium-grained, pinkish white sandstones and medium-grained, buff, dolomitic sandstones. In both rock types the sulfides are pyrite and a little chalcopyrite. In the dolomitic sandstone hematite makes up 2 to 4 vol.%. No traces of zinc and lead have been found.

The sulfide minerals are finely disseminated. Hematite forms thin bands or veins. The pinkish white sandstone is, in places, stained by malachite and shows more or less vertical joints filled with quartz, bornite, chalcopyrite and hematite. The basalt that overlies this sandstone also contains sulfides, finely disseminated and along joints.

Around Aulneau lake highly mineralized siltstones and argillites crop out. They are dark grey, rusty weathering and finely laminated. The ore minerals are pyrrhotite, pyrite and chalcopyrite and are enriched in the finest grained portions of the laminated rock (fig. 21). At one place, at the "Red Cliff" near Red Cliff lake, almost massive sulfide of 5 feet thickness was observed.

The chemical mean values of four grab samples of mineralized siltstones (sample numbers: 48E5C, 48E22B, 48E22C, 48E22D) are:

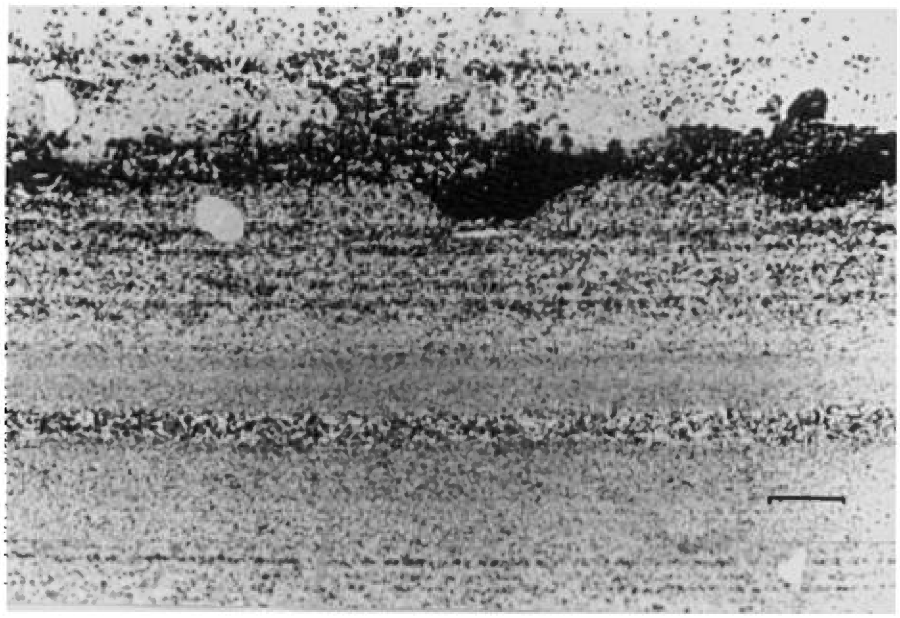

Fig. 21: Mineralized, laminated siltstone. Scale 2 mm.

S	28.81%	Zn	0.15%	Au	0.001 oz/t
Cu	0.05%	Co	0.007%	Ag	0.008 oz/t
Ni	0.03%	As	0.01%		

C. Mineralizations in Volcanic Rocks

Sulfides and magnetite are common constituents in gabbros, basalt and ryolites. Finely disseminated, they have been observed at numerous places throughout the area. In the following, mineralizations containing more sulfides than normal are mentionned.

a. Mineralizations in metabasalts and metagabbros

Highly mineralized gabbros and basalts were mainly observed around Aulneau lake. In this area the sulfides are believed to be consanguineous with those of the siltstones of the region. The gabbros overlying the mineralized sediments show a higher content of disseminated pyrrhotite, pyrite and chalcopyrite. Joints in these gabbros are quite commonly filled with sulfides and quartz.

The amount of sulfides in these mineralized gabbros varies from 4 to 9.5 vol.%, chalcopyrite making up only up to 0.2 vol.%. The bulk is pyrrhotite.

Close to the southern end of Aulneau lake a highly mineralized, mafic metagabbro contains up to 1.92% Cu and 1.03% Ni (Sample 49 E 27). The analysed selected sample was from a schliere or a layer of massive sulfide. (The area south of Aulneau lake is staked.)

At other occurrences, i.e. west of Aulneau lake, sulfide showings are less common.

Chemical investigations of the few interesting zones did not show any promising amount of the elements sought. For instance, a 2-foot thick band of massive sulfide in a metagabbro, cropping out on a small island in Wapanikskan lake (= Colombet lake), contains only 200 ppm Cu, 74 ppm Ni, 142 ppm Zn and 1 ppm Ag (Sample 28E31).

b. Mineralizations in rhyolites

North of La Lande Lake a few gossan zones in rhyolites have been observed. The sulfides are pyrrhotite, pyrite, little chalcopyrite and sphalerite (?) and are disseminated. Grab samples were sent for chemical investigation. The discouraging results are:

No of specimen	52K22B	57K12
Cu (ppm)	12	54
Zn	230	140
Ni	----	----
Au	----	----
Ag	----	----

Specimen 52K22B contains thin veinlets of pyrite. In specimen 57K12 the sulfides are disseminated.

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