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REPORT ON THE GEOLOGY OF THE HOWELLS RIVER AREA

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REPORT ON THE GEOLOGY OF THE HOWELLS RIVER AREA

Quebec - Labrador

Ministère des Richesses Naturelles, Québec

SERVICE DES GITES MINÉRAUX

No GM-

8195

PUBLIC

1000-foot mapping.

Detail party No. 5

Iron Ore Co. of Canada

November 1950

Geology by:



Guy Ferrault

Guy Ferrault

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I - SUMMARY AND CONCLUSIONS

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The contact unconformity between the Ashuanipi Grenville type gneisses is well exposed on the West shore of Howells River.

The gneisses are predominantly garnet biotite sedimentary gneisses. They form the basement complex on which the sediments of the Labrador trough have been deposited. They are quite thoroughly metamorphosed. Their foliation is generally vertical.

The Wishart formation immediately overlies the gneisses. The unconformity between the two has been actually seen. The Wishart formation generally dips northeast at an angle of 5 to 10 degrees. It may have an average thickness of 150 feet. It is composed principally of arenaceous sediments.

The Ruth Slate outcrops in the southern map area. It conformably overlies the Wishart formation. It may be as much as 20 feet thick.

A lengthy description of the different rock types of the Sokoman iron formation is given. The section of this Sokoman iron formation being rather well exposed, and the structure fairly straightforward, accurate information as to the stratigraphy of this group has been obtained. Its thickness may be as much as 1200 feet. It is composed mostly of cherty metallic iron formation. This latter rock type has been subdivided into three sub types: 1. jaspery metallic,

2. carbonate cherty metallic,

3. cherty metallic proper.

Some concretionary structures in the lean cherts are described. Their use as a horizon marker has been established in the Howells River area. Similarly an enriched horizon of ferruginous shales has served also as horizon marker.

The Menihok shales are also present. They overlies the Sokoman formation conformably. They are essentially black graphitic shales.

A major synclinal fold underlies the Howells River in the southern part of the map area. The Menihok shales which form the center of the fold being relatively soft, have been eroded by glaciation. The resulting land form is the valley through which the Howells River flows.

Faulting and folding are relatively unimportant to the West of the Howells River. Cross faults and oblique faults have been observed. Movement along each individual fault plane was small, and of minor importance.

As far as economic geology is concerned, no ore find of major importance is reported. There is no lead to an immediate trenching or drilling program. Some enrichment of ore grade is known to occur. However, the structure becomes more complex in the southern part of the area. Folding may have some importance in the southern extension of the map area. And perhaps with a more complex structural picture, probabilities of ore occurrences of commercial size are also better.

II - LOCATION OF THE AREA

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The area under consideration extends in a general N.30° W. direction from the northern tip of Fleming Lake to Louvain Lake. It averages 2½ miles in width. It is bounded on the East by the Howells River and the Goodwood River. Mapping has been done to the Ashuanipi gneisses.

A map showing its location is herewith included. On that map, it is seen that the area lies between 12 to 40 miles from Burnt Creek, the base camp of Iron Ore Co. of Canada. The latter is about 350 miles north of Seven Islands on the Gulf of St. Lawrence.

The area is at the present accessible by plane. Hollinger-Ungava Transport Co. has a landing strip about 10 miles east of the Burnt Creek base camp in Labrador. From the airport, roads lead to the seaplane^{base} at Knob Lake. In the Howells River area, the seaplanes landed successively on Harris, Kivivic, Giachimo, Rosemary and Elross Lakes. These lakes are large enough to permit a Norseman type seaplane to take off.

MAP SHOWING
LOCATION OF
HOWELLS R. AREA

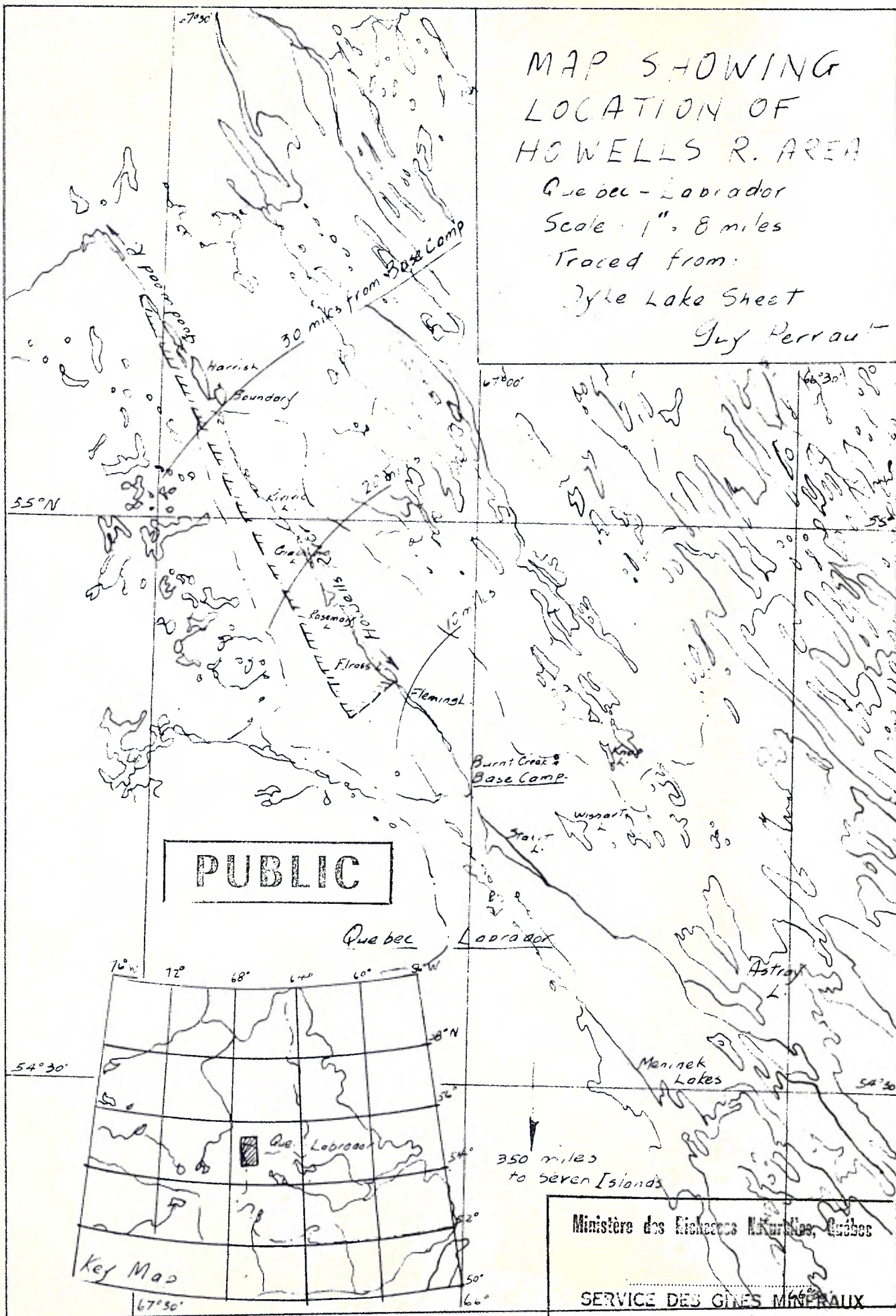
Quebec - Labrador

Scale: 1" = 8 miles

Traced from:

Lytle Lake Sheet

Guy Perrault



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Key Map

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III - TOPOGRAPHY AND PHYSIOGRAPHY

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A - GENERAL STATEMENT

The area under consideration extends from the northern tip of Louvain Lake, in a general south-southeast direction to the northern tip of Fleming Lake. Two major rivers drain the area:

1) The Howells River, draining Fleming, Elross, Rosemary, Giachimo, Kivivic and numerous other small lakes. It flows south to Astray Lake. This is part of Labrador.

2) Goodwood river draining Harris, Gillespie and Louvain Lakes. It flows north to end ultimately in the Kaniapiskau River. This is part of the Province of Quebec.

About 10 miles on the Quebec side was mapped this summer. The West shore of the Goodwood River slopes gently towards the river at an angle of about 3 to 4 degrees. It is sparsely timbered with spruce. Rock formations are well exposed only in the vicinity of Gillespie Lake. Elsewhere, overburden conceals bedrock. Swamps make up about 10% of that part of the area.

On the Labrador side, the Howells River starts in a chain of lakes with Brain Lake as the farthest north. It flows south through a broad valley. Generally the west shore slopes very gently to the river

at about 3 to 4 degrees, whereas the east shore is more abrupt especially in the Elross-Rosemary Lakes area. The river carries a very small and very variable volume of water.

The geological features of the area greatly influence the topography. Contacts, faults and foliation in the gneisses are clearly followed on aerial photographs.

The three series of rocks that outcrop in the area contrast remarkably in their properties. Each has given rise to very characteristic topography.

B - ASHUANIPI SERIES TOPOGRAPHY

The sedimentary gneisses of the Ashuanipi Series are quite hard, and therefore resistant to erosion. Their foliation is generally vertical. Also the rocks that make it up are probably generally slightly more acid than those that make up the Sekoman formation. These features combine to make the topography of the Ashuanipi Series distinct from the other parts of the area.

Close to the contact with the Wishart formation, the area is generally rather swampy. Cariboo moss is practically absent. And timber may locally be abundant, but it is more generally rare and of very small size. A considerable amount of tag alders may be present at the contact, making the area almost impenetrable. This is especially true in the area immediately south of Marcel Lake fault.

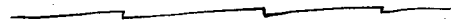
The vertical foliation in the gneisses has given rise to the countless number of little draws. Creeks may flow through these.

Generally the Ashuanipi Series terrain is rather greyish on the aerial photographs. It contrasts quite well with that of the Wishart quartzite and the Sokoman Iron formation which are whitish.

C - FERRIMAN SERIES TERRAIN

The Wishart quartzite and the Sokoman iron formation are generally quite hard, and have withstood erosion fairly well. They are more basic in composition than the gneisses. They are also comparatively flat lying.

They are generally fairly well exposed in the area. This is especially true of the Sokoman formation between the southern limit of mapping and Kivivic Lake.

The surface of the ground usually parallels the dips of the formation. It is broken here and there with little cliffs 5 to 10 feet high which generally face West. So that a cross-section of the surface would about be a line broken in this fashion: 

Cariboo moss and a very sparse growth of spruce trees are the characteristic vegetation of this ground. The cariboo moss shows up in a lighter shade on the aerial photograph. Tea bushes may be abundant

where exposures of bedrock are rare, and where glacial till contains much of that very fine grained red rock flour.

The contact between the Sokoman formation and the Menihok formation is usually marked by lakes, or creeks.

D - POINT SERIES TERRAIN

The Menihok Shales are the only member of the Points Series in the area. They are very soft. Consequently they are most easily eroded. In the area, the ground that covers them is quite generally swampy, with numerous small lakes and ponds. Timber is more abundant in this terrain than in the preceding two. It may reach a considerable size (see photograph No. 50-17-2, below).



Photo
No. 50-17-2

E - PHOTOGRAPHS

A selection of photographs we have taken of the area during the summer will probably be much more useful than any lengthy description of the topography.

Photograph No. 50-13-14 (1) is taken from the interprovincial boundary near Brain Lake, looking east. It shows the rolling hills of the height of land.



Photograph No. 50-13-14

Photograph No. 50-19-15 is taken in the same area. In the background are Brain Lake and Kolochuk Lake. This gives an idea of how sparse the wood is.

(1) For reprints, refer to that number.



Photo No. 50-19-15

Photograph No. 50-19-12 is taken in the Kivivic Lake area. In the background lies the main ore zone. Rock exposures are not abundant from the west shore of Kivivic Lake westward to the Grenville-type rocks. There are no trees but plenty of tea bath.



Photo. No. 50-19-12

Photograph No. 50-18-13 shows Giachimo Lake from the air. Note the occasional swamp, and fairly heavy forest.

Photograph No. 50-18-12, the southern part of Kivivic Lake. The contact between the Menihok and Sokoman formation would come in somewhere on the left side of the photographs where the swamps and muskeg begin. The forest is fairly heavy.

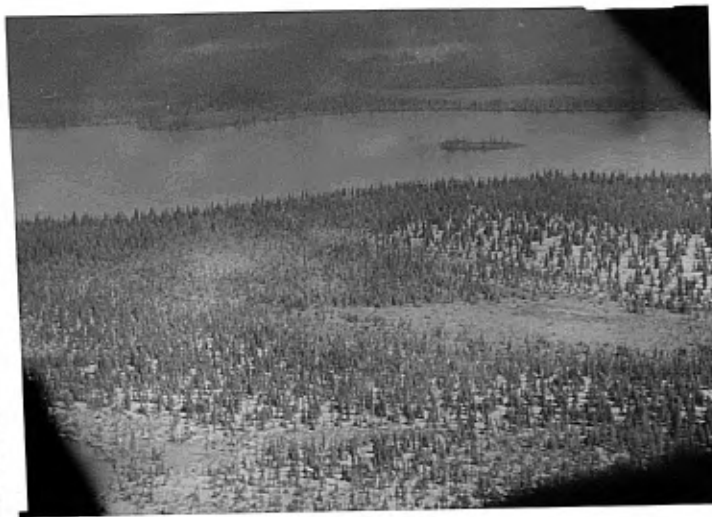


Photo. No. 50-18-13



Photo. No. 50-18-12

Photograph No. 50-17-6 shows Irony Mountain taken from the contact between Wishart quartzite and the Ashuanipi Series. The foreground shows what type of terrain to expect close to the quartzite. Actually, this is still in the iron formation. Usually the contact of the Wishart and Sokoman formations is marked by a little draw.



Photo. No. 50-17-6

Photographs No. 50-17-4 and 50-17-3 show what some of the better exposures of the map area look like. The bed rock is covered with little patches of moss. This type of exposure is very common in the Sokoman formation of the southern part of the map area.



Photo. No. 50-17-4



Photo. No. 50-17-3

Photograph No. 50-18-4 is taken from the air, in the area west of Rosemary Lake. Menihok terrain (muskeg) lies in the foreground. The line parallel to the base of the photograph, is the Menihok Sokoman contact in the foreground. The oblique line in the background is a diabase dyke.



Photo. No. 50-18-4

IV - GLACIAL GEOLOGY

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The effect of glaciation on the topography has not been too severe. It consisted mostly of eroding some of the Menihok shales, and so giving rise to the Howells River valley.

The lack of such features as eskers, kames, potholes, etc., typical of severely glaciated areas, is very suggestive. It seems to point out that the Howells River area was relatively close to the center of glaciation where erosion was not particularly severe.

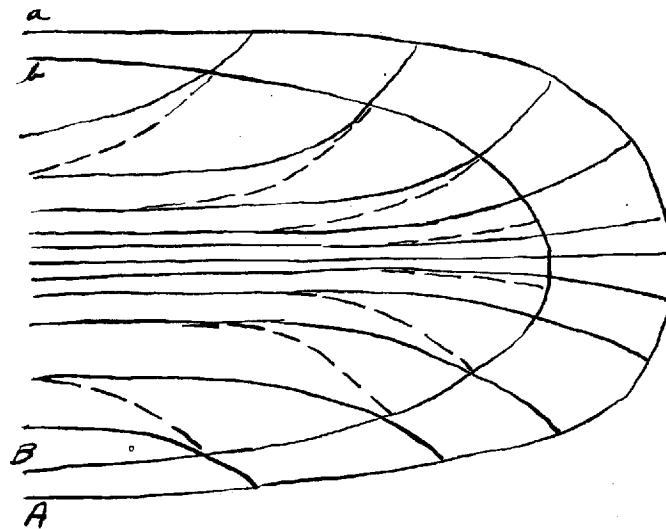
A - DIRECTION OF MOVEMENT OF GLACIER

On the basis of striae, it seems that the ice moved in a N. 20° W. direction.


Although N. 20° W. seems to be the predominant direction for glacial striae, it is also true that most of the places where striae were observed, two directions were shown, i.e. the striae were roughly parallel either to N. 20° W. or N. 50° W. Sketches showing the relation of these striae are abundant in the notes. Photograph No. 50-19-11 also shows this relationship (See page 21).

A number of suggestions have been made by different authors to account for these intersecting sets of striae. Lahee prefers to think

that they do not represent two periods of glaciation (or two advances of the glacier within the same period); he suggests that a retreating glacier might give rise to such. His ideas seem to be applicable in this case. In Sketch No. 1, as the ice lobe retreats from *aa* to *bb* at the front of the glacier, the striae change in direction, as indicated by the dotted lines. This explanation is probably more feasible. The striae are not likely to belong to different ice advances because the earlier marks would almost surely have been destroyed.



SKETCH, No. 1

Some authors suggest that glacial striae are often arrow shaped (). However they do not all agree on the direction of ice movement as inferred from such grooves (Lahse suggests that the arrow points the direction of glaciation whereas F.T. Thwaites claims that the reverse is more likely!!!). Whatever may be the case, the arrows pointed N. 30° W. in the Howells River area. But only in rare cases were they well developed.

Generally it is thought that glaciers have a grinding action on the stoss face of rock exposures, whereas on the lee side, the plucking of blocks of the rock material is more likely. On that basis, by observing the face of cliffs where striae are present, one may arrive at a guess as to direction of ice movement. In the Howells River area, such a guess would be N. 30° W.

West of Hross Lake, in that area underlain by the Menihok Shales, the topography shows a marked lineation in that direction (roughly N. 40° W.). However in the direction of Irony Mountain, this lineation gradually changes to N. 60° W. Perhaps Irony Mountain has had some influence in causing this swing. As the glacier overrode Irony, its bottom may have been deviated a little.

Photograph No. 50-18-19 (Page 21) shows an extreme size for a boulder. The boulder is gneiss. It sits on top of the Sokoman formation in the Rosemary Lake area. It is two miles distant from the closest gneiss exposure, and probably 10 miles if measured in the direction of ice movement.

The till deposited by the glacier will be described in the chapter on description of rock types.



Photo 50-18-19



Photo. 50-19-11

V - TABLE OF FORMATIONS

TABLE OF FORMATIONS

Pleistocene		Glacial till (unconsolidated)
Montagnais Intrusives (Keweenaw)		Diabase dykes
Point Series (UH or Keweenaw?)	Menihok Shales	Black shales
Ferriman Series (Middle Huronian)	Sekoman Iron Formation	Cherty carbonate Magnetite shales Lean cherts Ferruginous shales Thin-bedded jasper Thick-bedded jasper Cherty metallic Silicate carbonate
	Rath Slate	Ferruginous slate Interbedded cherts
	Wishart Quartzite	Black cherts Feldspathic quartzite Arkose Graywacke Quartzite Conglomerates
Ashuanipi Series (Grenville)		Gneisses

VI - DESCRIPTION OF ROCK TYPES

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The following pages are based on a megascopic study of the rocks. No microscopic work has been done on the specimens.

A - ASHUANIPI SERIES

The oldest rocks of the area are the Ashuanipi gneisses; they form the "basement complex" upon which the rocks of the Labrador Trough have been deposited. Several types are encountered along the western margin of the trough; the rocks are predominantly sedimentary gneisses.

1. Garnet biotite gneisses

The usual mineral composition of the sedimentary gneisses of this type is about the following: quartz 20%, biotite 20%, garnet 10%, feldspar 50%.

Bands of gneisses of the above composition are very frequently interbedded with quartzitic bands. These more acidic veins may be much coarser than the garnet biotite bands themselves, and may contain crystals of feldspars of considerable size (5mm. or more). The structure seems to suggest lit-par-lit injection.

The gneisses are usually light colored. However some darker,

probably more basic types, are also encountered. The weathered surface in the latter is grey. They are medium-grained.

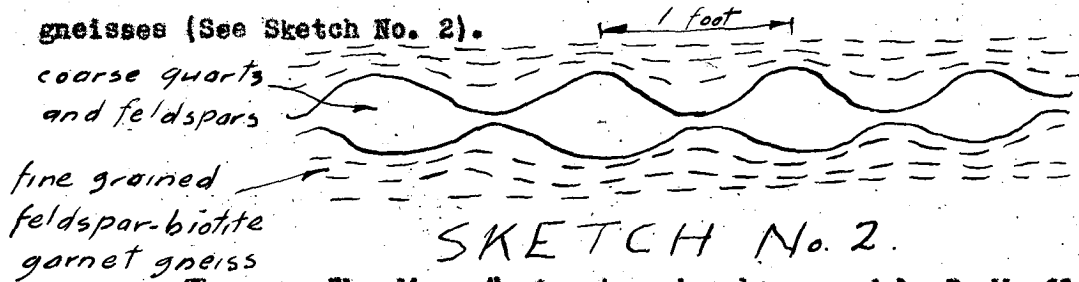
The feldspar content in these may reach 50 per cent. The garnet occurs in little purplish spots 5 to 10 mm. in diameter. Euhedral crystals are not frequent. The weathered surface of the garnet gneisses, is frequently rugged; the more siliceous bands seem to have withstood erosion better, and give the surface of the outcrop a washboard effect. The crystals of garnet also stand out on the weathered surface and give the rock a raisin pudding appearance. Some of the crystals (or aggregates of crystals) of garnet are as much as 3/4" in diameter. The weathered surface is generally light-colored and rather brownish.

The boundaries of the quartz-feldspar veins in the gneisses is usually very vague and would seem to suggest some reaction with the enclosing gneisses. The veins are usually injected parallel to the foliation. However, some occasional veins cut across the foliation, indicating that these are later than the gneisses. They may commonly make up about 10 per cent of the rock.

In sample P-24-50 (a garnetiferous quartz-biotite paragneiss), some original quartz grains (clastic) were recognized, clearly establishing the sedimentary nature of the gneisses.

Some of the gneisses contain light-colored plagioclase (probably near albite). Potash feldspars are no doubt also present.

One particular structure is of fairly wide occurrence north of Marcel Lake fault. It is a sausage like structure developed in the gneisses (See Sketch No. 2).



SKETCH No. 2.

The name "boudinage" structure has been used by P. Mauffette to refer to such structures in gneisses of southern Grenville areas of Quebec. It is apparently developed in sedimentary gneisses. Their structure is especially well developed ^{immediately north of Marcel Lake fault.} ~~on outcrop 16.~~ This structure definitely suggests plastic deformation of the gneisses.

These garnet, biotite gneisses, outcrop continuously from the southern limit of the map area to Lilian Lake fault, a distance of about 9 miles. Lilian Lake fault marks their contact with the granite gneisses which occupy the next 2000 feet. The garnet gneisses reappear on the other side of that granitic intrusive. There may be a major dome structure associated with them. The gneisses on either side of the intrusives are quite similar.

2. Lilian Lake Granitic gneisses

All the information presented regarding this granitic mass is derived from four outcrops.

In the first outcrop, the rock is coarse; its composition is about 60% quartz 40% white altered feldspars. The texture is granitoid. This may represent a pegmatitic phase.

The two outcrops in the center of this band are more massive. The foliation is not observable. The rock is medium grained, and contains quartz (20%), feldspars, biotite (20 to 30%). The weathered surface is whitish and rather rugged.

The outcrop near Lilian Lake fault, exposes similar material, probably somewhat more basic. The mass is jointed but the foliation is not apparent.

3. Kivivic Lake - Marcel Lake Gneisses

Under this heading we shall describe the gneisses that outcrop from the garnet gneiss contact West of Kivivic Lake to Marcel Lake fault.

From the exposures observed, it is difficult to state to what general category they belong. They seem to be a mixture of both granitic and sedimentary gneisses, and it is difficult to state which is the predominant type.

Moreover in most of the cases there is no positive evidence as to whether the rocks are of granitic or sedimentary origin.

The coarser gneisses of granitic composition are considered to be orthogneisses. They contain 30 to 50% assorted feldspars, 30 to 50% quartz, 10 to 15% biotite and accessories. Generally their weathered

surface is of greyish white to light brown color. The feldspar in them is commonly pinkish (orthoclase?) and somewhat altered.

Some more basic types are known to occur. They contain 40% amphiboles, 20% feldspars. But they are subordinate in importance.

Here again occasionally as already described for the garnet gneisses, a banding of quartz poor and quartz rich layers is conspicuous on the weathered surface of the outcrop. However, this banding is not as widespread in the area under examination as in the garnet gneisses.

Some injections in the gneisses are decidedly pegmatitic in nature. ~~Sample P-17-59 is a good example of such.~~ They are very coarse quartz biotite, feldspar granite.

All these hybrid types have been grouped together.

4. 4. Marcel Lake - Louvain Lake Gneisses

This area is composed predominantly of sedimentary gneisses.

Some of those have been termed quartzite. These are usually medium-grained. The weathered surface is greyish, the fresh surface is dark. These may be the result of high grade metamorphism in impure arenaceous sediments.

These quartzitic beds grade to more mafic beds, containing as much as 50% hornblende and mica, 30% feldspar, and 10% quartz.

Lit-par-lit injection is strongly suggested in this area too, by coarse bands of granitic material intercalated between the usually quartzitic bands. The composition of the former varies from 20% to 40% mafic minerals, 30% to 60% feldspars, 20% to 30% quartz. Generally these coarse bands make up less than 10% of any particular section.

There is no direct evidence that these gneisses are of sedimentary origin. They have much in common generally with the garnet gneisses of the Elfoss Lake area. And suggesting a sedimentary origin is based on that resemblance. Whatever their origin, they have been quite thoroughly metamorphosed, and probably soaked by granitic intrusives.

B - FERRIMAN SERIES

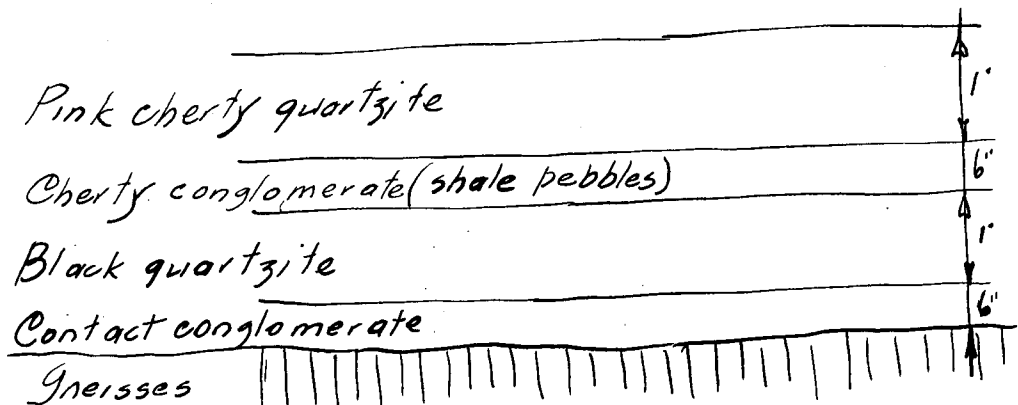
1. The Wishart Quartzite

The Wishart quartzite forms one continuous band throughout the area. It rests unconformably on the Ashuanipi gneisses. Its thickness varies from a minimum of 50 feet to a maximum of 275 feet, with an average thickness throughout the area of approximately 150 feet.

It is composed of numerous rock types. These will be described below, starting with those types more abundant in the lower part and ending with the top black chert.

a) The Contact conglomerates and quartzites

It has been possible to determine the contact relations of the Wishart formation with the Ashuanipi gneisses very accurately, especially in the Lilian Lake Area. The results are shown in Sketch No. 3, below.



SKETCH No. 3.

One of the characteristics of the contact conglomerate is the content of white chert pebbles in an arkosic matrix. The pebbles are not very big, usually $\frac{1}{2}$ " in diameter with an occasional pebble 2" in diameter. The pebbles are rounded. The matrix contains anywhere from 0 to 30% feldspar euhedral crystals, with recrystallized quartz grains, fine-grained to coarse. In the finer grained varieties, the feldspars are not identifiable, megascopically, and the rock is of a lighter color.

In the northern part of the map area however, the conglomerate is a bit different, and its stratigraphic position is not too clear. Here the conglomerate is composed of pebbles $\frac{1}{2}$ to 5" in diameter of gneisses, mostly in a coarse angular arkosic matrix. Patches of this material are exposed at the surface of the gneisses. Consequently they may perhaps be correlated with the lowermost white chert, pebble conglomerate found in the southern part of the area. The angularity of the pebbles in the conglomerate varies considerably. But as could be expected from gneiss pebbles, the sphericity is usually high.

The thickness of this bed of conglomerate is usually 6 inches to one foot.

It is usually overlain by about a foot of dark quartzite, in many ways similar to the quartzite found in great abundance higher up in the Wishart formation. The quartzite is medium-grained, dark, and very pure. It is not always present between the beds of conglomerate. This horizon may be about 1 foot thick.

More conglomerate reappears on top of this quartzite. It is slightly different from the previous conglomerate. The groundmass is pinkish, cherty quartzite. The pebbles are shale. These are flat, somewhat angular, and laid down parallel to bedding. Their thickness is from $\frac{1}{4}$ " to $\frac{1}{2}$ ". They are 4 to 5" long but usually about 2". This bed is not more than 6" to 8" thick. It grades to pinkish, cherty quartzite higher and the pebbles are absent. At least one foot of the latter has been measured in a number of exposures.

The flat shale pebbles may be of Attikamagen age, in which case it is felt that the pink cherty conglomerate is of post-Attikamagen age. The case for the white chert pebble conglomerate is more complex. There is no definite source of the white chert pebbles. Perhaps they are derived from the same source as the Fleming Chert Breccia or from the Fleming itself. Moreover in the Gillespie Lake area, a conglomerate which is correlated with the white chert conglomerate is known to contain gneiss pebbles (presumably from the Grenville-type gneisses). Therefore it can be stated that this basal conglomerate is not of any stratigraphic significance. It is here included with the Wishart formation.

b) Quartzites

Quartzites make up about 60% or more of the Wishart formation. These quartzites vary considerably in physical properties. The color of the fresh surface varies from light olive green, through dark grey, to pinkish, or reddish (rare in the area). The color of the weathered surface is generally whitish (glassy). A dark brown color has been noted, but

is thought that this color may be "secondary". The quartzites are generally fine-grained to medium-grained.

Chert lenses are not infrequently interbedded with the quartzites especially in the bottom part. These are from 1" to 5" in thickness, and many feet long.

Sometimes the grains of the quartzite are bound together by cherty material. Other times the grains form a recrystallised mosaic with no interstitial material.

One specimen of quartzite was thought to contain as much as 10% carbonate.

About 30 feet above the contact conglomerates and quartzites, a dark brown (weathered surface) cross-bedded quartzite occurs. This quartzite can be identified readily and is fairly continuous along strike. It has been observed in the southern-map-area only, from Glachimo Lake down. The dark brown color of its weathered surface is probably secondary, since the quartzite is quite pure. It is usually medium grained and rather dark grey on the fresh surface. The cross-bedding shows that the quartzite is in a normal position. Photo No. 50-18-18 (Page 35) shows this horizon.

The quartzites are composed usually of very pure silica. They do, however, rarely contain some biotite (in the thin laminated impure type, probably argillaceous) or feldspars, in the more arkosic types.

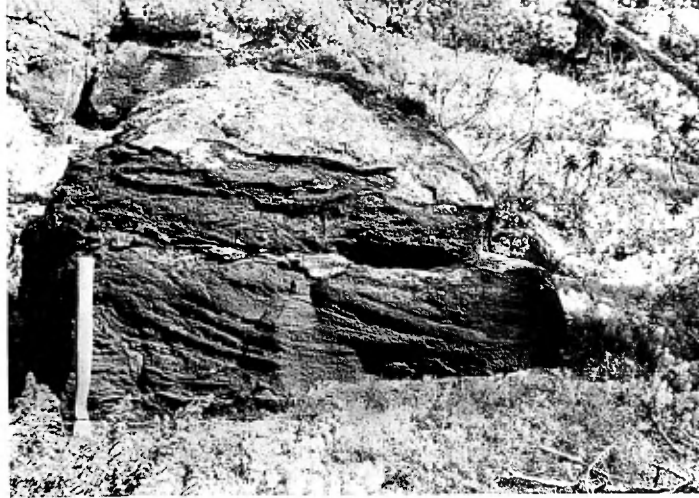


Photo. No. 50-18-18

c) Arkose and feldspathic quartzites

These are especially abundant in the upper part of the Wishart formation. They vary considerably in physical properties. The feldspar content in them may attain 50%. Quartz is about the only other mineral present although traces of mafic minerals have been noted here and there. The arkose sometimes has a reddish color, probably on account of minute quantities of iron oxides present. But the more general color is a light olive green. The feldspar is distributed through the rock in euhedral crystals, sometimes coarser than the quartz grains, sometimes of the same size.

All intermediate types between arkoses and quartzites have been found in the area. According to Petitjohn, the term arkose is recommended for a rock containing 25% or more feldspar. From 10% to 25% feldspar content, the term feldspathic quartzite is suggested. The terms as used here satisfy these requirements.

d) Siliceous Shales

There is evidence in the area of at least three argillaceous horizons within the Wishart formation. The thickness of each individual horizon is not great. A two foot bed of shaly material has been noted in the Kivivic Lake area. It is a dark grey, very fine-grained, fissile, siliceous shale. In the same section a minor 2" band of dolomitic material was observed within the quartzite. Similar material was observed at a number of places. Nowhere does it exceed 2 feet in thickness.

e) The Black Chert

This black chert is conspicuous by its massive character, and the total absence of any structure in it. It may, however, sometimes be considerably fractured. Secondary minerals are often associated with these fractures: goethite, pyrolusite, limonite, pyrite, pyrrhotite, chalcopyrite. These however are not abundant. The oxidation of the sulfides in the chert usually imparts to the weathered surface of the rock purplish and brownish colors.

Some peculiar ellipsoidal structures were noted in the black chert. Their origin is not clear. A queer aureole of whitish chert sometimes surrounds an elliptical chert mass about 4" long. This aureole may be $\frac{1}{2}$ " thick. At first sight it gives the chert a pseudo-conglomerate appearance. These concretions are not abundant in the black chert but they have been seen in at least 5 places.

It is generally accepted that the black chert lies at the top of

the Wishart formation. This relation seems to hold in the map area. The maximum thickness of the black chert is about 25 feet, and in some sections, it is suspected that it may be absent.

f) Stratigraphy

A typical section of the Wishart formation is given in Table I (Page 38).

This succession of the Wishart formation is tentative, but it summarises the information obtained in the area. However, considerable local variation in thicknesses exists, and the table must therefore be interpreted with this point in mind.

TABLE I

<u>Top</u>	<u>Thickness in feet</u>
Black chert	20
Dark gray quartzite	30
Feldspathic quartzite	10
Olive green m.g. arkose	10
Olive green coarse arkose	25
Dark gray quartzite	16
Shaly horizon	1
Dark gray quartzite	16
Cross-bedded quartzite	2
Dark gray quartzite	11
Siliceous shale	2
Dark gray quartzite	20
Siliceous shale	2
Dark gray quartzite	15
Contact conglomerates	3
 <u>Bottom</u>	
TOTAL	183

C - THE RUTH SLATE

Outcrops of Ruth slate are not plentiful in the area, and it has been difficult to get a good section of it for petrographic study.

So far as is known, the Ruth slate is a form of shaly iron formation. It is thin bedded to slaty. The fresh surface as well as the weathered surface are purplish, red, limonite colors, indicating high iron content.

In places, considerable chert is interbedded with it in beds $\frac{1}{4}$ " to 1" thick. The chert varies from white to black. At most the chert beds make up 60% of the complete section.

Siderite might have had some importance at one time in the composition of the rock. However, at the present time, its oxidation is about complete.

The Ruth slate was observed in five outcrops only, and these five outcrops were very small ones, showing not more than 3 to 4' of the slate. However, its width may be as great as 20 to 30 feet but not much in excess of that.

D - THE SOKOMAN IRON FORMATION

The lithology of the Sokoman Iron formation is undoubtedly very complex. The Howells River area is probably one of the best places to study it, because there has been little faulting and folding in this area. As a result the stratigraphic sequence is fairly reliable. The sequence closely approximates that which exists in other parts of the region.

1. Silicate Carbonate Iron Formation

This particular phase of the iron formation is the lowermost and it is probably continuous throughout the area.

The most characteristic feature of the silicate-carbonate iron formation is its orange weathered surface. The fresh surface is usually greenish. It is very fine grained. Magnetite occurs in it either as ~~fine~~ irregular pods, finely disseminated, or in thin pure beds. The rock is usually thin bedded, with well developed bedding cleavage. Carbonates are also common in it and probably account for the orange color of the weathered surface.

The magnetite content in this type of iron formation varies considerably. 90% pure magnetite beds may occur in individual beds but otherwise the magnetite content varies from 20 to 70%.

Pure black chert lenses are often interbedded with this group, especially in the lower part.

Generally the silicate-carbonate iron formation shows good glacial striae. Perhaps the fact that it outcrops right at the crest of ridges accounts for that, and also the fact that its weathered surface is rather soft. The surface of the outcrop also shows glacial polish at some localities.

Nodular structures were noted occasionally in the silicate iron formation. These attain a conspicuous size in one outcrop, west of Marquise Lake, where they measure $3/4$ inch in diameter. They are usually about spherical, but may be elongated slightly with their long axis in the plane of the bedding. These nodules are composed of limonite, a probable oxidation product of siderite. They are especially abundant in those sections where the silicate-carbonate iron formation is interbedded with the cherty metallic phase or is gradually changing its composition to the latter.

Sometimes the fresh as well as the weathered surface is of a limonitic brown color. Usually such beds occur in or close to the cherty metallic iron formation. The color of the fresh surface is probably evidence of the thoroughness of oxidation and an indication that the rock may have contained a considerable amount of carbonate at some stage in its history. This brownish form of the silicate-carbonate iron formation is generally not magnetic.

Although the silicate-carbonate iron-formation is more abundant near the bottom of the Sokoman member, it is not restricted to it. In the vicinity of Lilian Lake Fault, silicate-carbonate iron formation occupies the greater part of the section. It also reappears in thin beds

below the lean cherty phase of the Sokoman, which is more abundant near the top. It is impossible without the aid of structure to differentiate the silicate-carbonate rock from the lower part from that of the upper part of the iron formation. In the Howells River area, with very simple structural picture, it was easy to determine which was from the top and which was from the bottom. And they are quite similar. As a general rule, however, the carbonate content may be higher in the former.

When carbonate is present in the rock in nodules, the weathered surface is very generally pitted.

There exists all intermediate rock types between true silicate-carbonate iron formation and carbonate cherty metallic iron formation (i.e., cherty metallic iron formation containing disseminated carbonate), as is known from field evidence. It is impossible to prove the continuity of variation of the silicate of the two rocks types, because it is impossible actually to see the silicate without the microscope.

2. Cherty metallic iron formation

The cherty metallic phase of the iron formation is probably the most widespread type of rock in the iron formation. It may make up as much as 80% of the total section.

It is true that most of the horizons of the Sokoman formation are cherty, and it is also true that they are metallic in the sense that they contain magnetite and hematite in varying amounts. It would appear therefore that the term could correctly be applied to almost any rock in the iron formation.

Its usage here is a bit loose. It groups all those rocks, which cannot be classified under the other rock types. As all other rocks of the iron formation, these rocks are cherty and metallic.

Magnetite is more common than hematite in this type. Usually the metallic oxides total about 50% (minimum 30%, maximum, 70%). Limonite, a probable oxidation product of siderite, may contribute about 10% to the mineral composition.

Magnetite or hematite grains are commonly disseminated throughout a ~~the~~ cherty matrix. The reverse relation has also been observed in many places, where chert grains are disseminated in a groundmass of metallic oxides.

The weathered surface and the fresh surface of the rock are usually quite similar, unless some easily leached mineral such as siderite is present in the rock, in which case it is commonly different shades of brown. The surface of exposures may have been polished or striated by glaciation, although both these features are comparatively rare in the cherty metallic part of the Sokoman formation. The weathered surface is also commonly pitted, the pits varying in size from 4" to 1" in diameter. They are roughly spherical in shape.

Sometimes the cherty metallic iron formation is massive over a considerable thickness. More commonly, jasper-rich^{and} metallic layers are interbedded, the contact of the individual bands being diffuse. These bands may have a thickness of one inch. Sometimes this banding can hardly be observed. Sometimes the outline of separate bands is fairly sharp. Finally

when the individual layers are very sharp, the rock is called thin-bedded or thick-bedded jasper iron formation.

This rock type may occur either as beds relatively plane, or as wavy beds, the waves being about 5 feet from crest to crest. There seems to be no preferred orientation to these waves.

The chert and metallic oxides of this phase of the iron formation may have been recrystallized in certain areas. The resulting rock looks somewhat like an impure quartzite. The grain size however is never very great (smaller than 1 mm.). This rock type was formerly referred to as "hematite quartzite".

Some peculiar concretions have been observed in the iron formation. One such is shown on Photograph No. 50-17-12. The rock appears to be a conglomerate iron formation at first sight. But closer examination reveals that the boulder like structures, generally fairly well rounded, are

Photo.
No. 50-17-12



concentric bands of black or reddish chert and magnetite. The concretions occur about the center of the iron formation. They stand out well on the weathered surface.

Occasionally the nodules of the cherty metallic iron formation are not limonite, but some blackish probably manganiferous mineral. This mineral may be soft and dirty the fingers, in which case pyrolusite is probably the mineral present. Sometimes it is harder, and may perhaps be a manganese silicate. It is quite generally very fine grained.

The lower horizons of the cherty metallic iron formation have a tendency to be thin-bedded, i.e. bedding cleavage is well developed in them, and is closely spaced (1" or less).

Irregular blebs of pure bright red jasper are commonly present especially in the vicinity of the thin or thick-bedded jasper formations. However, unless these are especially abundant, or are more like thin beds of jasper, the rock is still grouped with the cherty metallic type.

A peculiar brownish weathered surface is very common in the jaspery metallic formation in the lower part of the Sokoman in the Elross Lake area. The weathered outcrop looks a bit like the cherty carbonate type. The color is probably secondary. It is best developed on very fine-grained jasper rich bands, in preference to mere metallic bands. This rock type has been traced for at least 3 miles along strike to the southern limit of mapping.

An attempt at a subdivision of the cherty metallic iron formation was made. The following sub-types were recognized:

1. jaspery metallic (JMIF),
2. cherty metallic proper (MIF),
3. carbonate cherty metallic (CBMIF).

The carbonate cherty metallic is distinguished by its content of altered carbonates. The weathered surface is usually light shades of brown. The fresh surface may also be brown. The carbonate is usually finely disseminated throughout the rock in this type. It is very common at the base of the formation, immediately overlying the silicate-carbonate phase. It is probably an intermediate rock type between the latter and cherty metallic proper.

The jaspery metallic phase is more abundant in, but not restricted to, the top. It is often observed in the vicinity of thin or thick-bedded jasper. It is characterized by the reddish color of the chert. It may show vague to very definite banding of jasper-rich and metallic layers. Also very common in it are irregular blebs of jasper. Quite often, both irregular blebs of pure jasper, and jasper containing as much as 5 to 10% metallic oxides are present in the cherty metallic groundmass. This would seem to suggest two ages of jasper.

The chert of the cherty metallic proper is usually white. In the early part of the field season, the preceding distinctions were not made. Consequently some rock types labelled MIF may in reality be JMIF or CBMIF. However, South of Kivivik Lake where the iron formation is better exposed, these distinctions do apply.

3. Thin-bedded and thick-bedded jasper

These two rock types are grouped together here, because they show common physical properties, the thickness of individual jasper bands being the only difference between them.

Theoretically, the lithology of this rock group is relatively simple. It is composed of two rock units interbedded; the bright red chert and the cherty metallic layers. The relative abundance of each varies considerably. However, in most sections, the metallic oxide layers are by far the most abundant. The jasper beds commonly make up 30% of the rock (in thickness).

The fact that all intermediate rock types between thin bedded jasper and cherty metallic iron formation exist, make the identification in the field more difficult. Evidently to distinguish between these two rock types, some arbitrary standard must be set.

The following are those which were used in this summer's field work:

1. The rock must contain at least 10% (thickness) of pure bright red jasper beds.
2. The boundaries of these beds must be sharp.
3. It is also a fact that these beds are discontinuous along strike. Therefore they can be compared to blebs of chert elongated parallel to bedding. But irregular blebs of jasper are encountered throughout the

Sokoman formation. Therefore the further restriction that these blebs in the bedded jasper iron formation be at least 10 times their thickness and that they lie parallel to bedding plane seems justified.

4. Finally it has been suggested in the classification of the iron formation as made by the company, that when the beds of jasper are between $\frac{1}{2}$ " and 2" thick, the working should be thin-bedded, whereas for greater thickness, the term thick-bedded be employed.

In as much as possible these requirements were met.

The metallic oxides in this member of the iron formation are magnetite and hematite. Hematite is the predominant type especially in the more thin-bedded types. The content of metallic oxide in the metallic bands may vary from 30% to 80%, whereas the cherty beds contain less than 10% metallic oxides, and commonly none at all.

Carbonate may be present in this rock type, but it is not abundant. It is also more usual to find it in nodular structures, the carbonate being altered to limonite with the usual pitted weathered surface.

Generally the chert is pinkish to red (jasper). Occasionally, however, it may be black, greenish, or even whitish.

The weathered and fresh surface are very much alike for this rock type. The metallic layers may be enriched, the iron content may reach 49%. Also the Manganese content may be as much as 8 to 9%. Usually when the manganese content reaches that value, the rock is considerably

darker than usual. The manganese minerals present are very fine grained.

The jasper bands may show very complex structures. Some of these are no doubt the result of dragfolding. As very little of such has been recognized in the area, it is more usual for the jasper beds to be relatively straight.

The supposedly metallic part of the thin-bedded jasper iron formation may be very lean. It may consist of a jasper containing 10 to 15% disseminated metallic oxides, in which pure bright red jasper bands are found. But such occurrences are rare.

A well developed slaty cleavage is usually a very general feature of the thin-bedded jasper.

As a general rule, both these types of rocks are more abundant in the upper half of the formation. In fact they are practically absent from the lower half.

4. Ferruginous shale

Special attention was devoted to this horizon of the iron formation because in part it was of ore grade. It is usually very thin probably always less than 10 feet. And its lithology is rather complex.

One sample from this horizon was sent in for assay. It gave the following results:

Iron	34.7 %
Manganese	19.95 %
Silica	9.66 %

Usually this material is very soft, and will chip fairly easily. The surface of the outcrop is generally littered with fragments about $\frac{3}{4}$ " to 1" in diameter. These have a rough pentagonal section, and are prismatic, their height being roughly equal to their base.

The smaller fragments are thoroughly altered, and of ore grade. In the larger fragments, the core is seen to be cherty carbonate. The alteration seems to have proceeded from joint planes, and was probably effected by circulating ground water. Consequently, where joint planes are closely spaced, the rock is thoroughly leached.

This material is interbedded with what has been termed altered, cherty metallic iron formation. The latter is usually a friable rock type, a considerable amount of the silica having already been leached out. The metallic oxide in this rock type is mostly hematite (10% to 60%).

In addition, rather massive chert lenses may be present with a maximum thickness of 1 foot or so.

These three rocks are interbedded in the 5 to 10 feet that make up this horizon. The first may account for 50% of the whole, the second for 40%, and the last for 10%. This band has been followed discontinuously along its strike from Giachimo Lake to the southern mapping limit, a distance of 9 to 10 miles. It occupies the central part of the Sokoman.

The term ferruginous shale may not be quite appropriate for it. The enriched portion is more like thoroughly leached cherty carbonate. The term altered cherty metallic may be appropriate to denote the rock

material associated with it. This horizon has been used as marker in the area. The peculiar chips of altered rock, littered all over the outcrops make it very easy to identify. No other rock type can be mistaken for that one in the area.

The economic possibilities of these beds are studied in that part of this report dealing with economic geology (pp.84-85).

5. Lean Cherts

The cherts of this rock type are characterised by a low content of metallic oxides. They are massive to thin-bedded, with subordinate cherty metallic, cherty carbonate and magnetite shale layers.

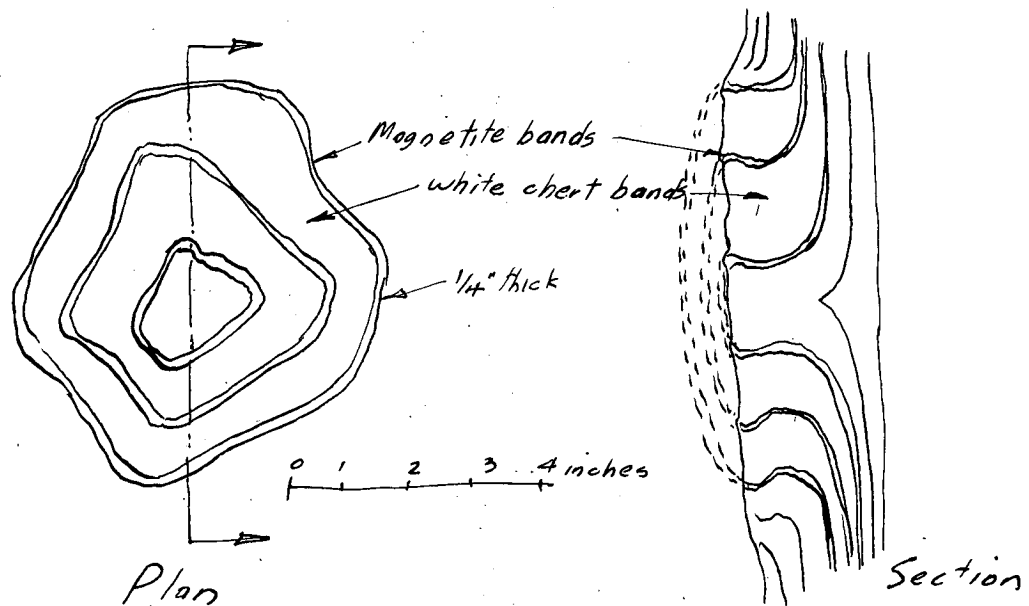
The chert is commonly greenish to black. Usually the color of the fresh and weathered surfaces is the same. However, if the carbonate content is sufficiently high, the weathered surface may be purplish or brown. In some species, carbonate is absent and yet the weathered surface is still brown to purplish. Usually this type of weathered surface consists of a very thin coating of limonite deposited on the smooth surface of the rock. It is referred to as "secondary" weathered surface.

As usual, intermediate rock types between lean cherts and cherty carbonates are known to occur. Consequently a content of 10% carbonate has been arbitrarily set as the dividing line between those two groups. Iron silicates may also be present in the greenish chert. They are microscopic in size.

A bedding cleavage is sometimes developed in lean cherts. In addition, jointing and miscellaneous fracturing have permitted circulation of solutions in the rock. Limonitic minerals have deposited along those fractured. Sometimes restricted horizons may even be slaty.

Brecciation is also apparent in some specimens. The fragments are black chert. They are angular, and average 1 to 2 mm. in diameter. Usually the larger fragments show better rounding. Some sulfide mineralization has been observed in the fragments, suggesting a period of mineralization earlier than the breccia itself. The matrix of the breccia may be a lean cherty carbonate of a dark grey to black color. The fragments constitute 30% of the rock mass.

Pure magnetite beds or impure magnetite shale beds may be banded with the chert too. The banding is generally fairly sharp. In the southern part of the map area, from Giachino Lake down, peculiar concretions have been found associated with these horizons. They are sketched below:



SKETCH No. 4.

During the course of field work, these structures were referred to as cryptozoons, in view of their resemblance to cryptozoons found in other parts of Precambrian rocks. Perhaps a better term can be assigned to them. Photo No. 50-18-17 also shows these structures.



Photo. 50-18-17

These are essentially mushroom like structures, considerably flattened along bedding plane. In plan they show concentric rings of white chert and magnetite bands, the chert being usually more abundant. The white chert may contain nodules of jasper (1 to 2 mm. in diameter). It is usually very difficult to get a good cross-section, let alone break one of these structures as a whole. The origin of these structures is unknown to us. Lean cherts have been found throughout the formation. These structures however are restricted to the lean cherts of the upper part. They have been followed discontinuously for a distance of 7 miles to the southern limit of mapping. They are quite easy to identify in

~~identify~~ in the field because they stand out quite well on the weathered surface.

At some localities, this cryptozoan horizon is known to overlie the brecciated cherty carbonate already described. Its thickness is probably not in excess of 5 feet.

Due to the very common interbedding of the lean cherts with the magnetite shales and the cherty carbonate, it has been difficult to distinguish between those several groups.

The lean cherts commonly overlie a jaspery metallic phase of the iron formation. It has been noticed also that a reddish color is usual for the cherts when they approach the jaspery metallic unit. So that the contact between the two rock types is a gradual one, in which the metallic oxides gain in importance, and the chert acquires a reddish color as the rocks grade into jaspery metallic iron formation.

The lean cherts may occasionally become crumbly, probably due to continued leaching.

To conclude, it can be stated that the lean cherts are most abundant in the upper part of the Sokoman, but may also occur in the central part. Their occurrence near the base, in the Howells river area at least, is decidedly odd.

6. Magnetite Shales

The magnetite shales are intimately banded with the lean cherts. The name was used to denote those rock sections where the chert is subordinate to them. Generally they seem to overlie the lean cherts. And they gradually pass into the cherty carbonate that overlies them.

These shales are decidedly high in magnetite (probably never below 40% magnetite, and commonly 70%). They also contain chert, iron silicates, carbonates, and some argillaceous minerals. Their weathered surface is generally dark brown to shades of dark green. The fresh surface may be grayish and metallic due to high magnetite content. Their density is also high. They are relatively soft. They show good bedding cleavage, closely spaced (1" or so).

They are never very thick. The thin beds of shales usually interbedded with lean cherts, may be predominant across sections up to 50 feet thick. But no continuous section of these without the chert band is known to be more than 5 feet.

7. Cherty Carbonate

This rock type is best developed near the contact of the Sokoman and Menihok formations.

Ideally it consists of interbedded chert and cherty carbonate. The chert is generally black, and may make up 5 to 50% of the thickness of the formation. The cherty carbonate is very fine grained, dark grey.

rather soft and its weathered surface is very generally brown to buff. The carbonate content in it, as already mentioned, should be higher than 10%. The rock is sometimes remarkably straight-bedded. The bands of chert stand out quite well on the weathered surface.

The brecciated horizon described in connection with the lean cherts is present in the cherty carbonate. In fact brecciation is more intense. The only difference between these two is the carbonate content of the matrix. If it is below 10% the rock is referred to as lean chert, over 10%, as cherty carbonate. Otherwise the two brecciated horizons (in fact, it may only be one changing in composition) are very much alike; angular fragments (2-4 mm. in size) of black chert in very fine grained dark grey cherty carbonate groundmass.

One sample of the cherty carbonate was assayed. It gave the following result:

Iron	26.5 %
Manganese	1.12 %
Silica	31.32 %

The thickness of the cherty carbonate may be quite considerable. Its dip is usually a little steeper than the other rocks of the Sokoman formation and may attain about 35 degrees. A minimum thickness would be of the order of 30 feet.

8 8. Stratigraphy of the Sokoman Iron Formation

In the preceding pages, an attempt has been made by the writer to present his views regarding the relative position of each member of the Sokoman formation. These will be supported by tables II, III, IV and V, which follow.

These four tables are not to be interpreted too literally. The thicknesses of individual members suggested are only approximate, as they have been computed on the basis of dips. They attempt to summarize the lithology of this very complex unit, as exposed on a one-mile stretch on each side of the sections. However, it was thought that in view of the large number of exposures in the southern part of the map area, such tables might be justified, and even called for.

TABLE II (Section 13
Elross Lake Area)

<u>Top</u>	<u>True thickness: feet</u>
Cherty carbonate	75
Lean cherts and cherty carbonate	50
Lean cherts and magnetite shales	50
Lean cherts	75
Jaspery metallic	125
Thin-bedded jasper	75
Jaspery-metallic	150
Thin bedded jasper and jaspery met.	150
Ferruginous shales, and altered MIF	10
Jaspery metallic	150
Cherty metallic	200
Carbonate metallic	75
<u>Bottom</u>	<hr/>
	TOTAL 1185 feet

The exact position of Section 13 is indicated on Sheet No. 5 of geological map.

TABLE IV (Section 11,
 Rosemary Lake Area)

<i>Top</i>	<u>True thickness: feet</u>
Cherty carbonate	50
Lean cherts	100
Cherty metallic and carbonate met.	100
Lean cherts	100
Thin-bedded jasper	30
Ferruginous shales, and altered MIF	10
Jaspery metallic	150
Cherty metallic	150
Jaspery metallic	100
Carbonate metallic	50
Silicate carbonate	100
<i>Bottom</i>	<hr/>
	TOTAL 940

The exact location of Section 11 is indicated on Sheet No. 4 of geological map.

TABLE V (Section 10,
Lilian Lake Area)

<i>Top</i>	<i>True thickness: feet</i>
Cherty carbonate	75
Lean cherts	100
Lean cherts, and silicate carbonate	100
Silicate carbonate	50
Jaspery metallic	100
Thin-bedded jasper	20
Ferruginous shales, and altered MIF	10
Lean cherts	50
Jaspery metallic	75
Cherty metallic	150
Silicate carbonate	100
<i>Bottom</i>	
	<hr/>
	TOTAL 830

The exact location of Section 10 is indicated on Sheet No. 4 of geological map.

E - POINT SERIES

The Menihok Shales

Only one member of the Point Series is exposed in the area. It is the Menihok Shales.

As a rule the Menihok Shales are black, graphitic, very fine grained shales. Their weathered surface is usually a light gray color, although it quite often shows a banding of whitish and greyish colors. They are usually well-bedded. Photographs No. 50-24-10 and 50-24-20 show this feature. The individual beds are 4 to 5" thick or the shale can be quite slaty. Very closely spaced jointing planes (occasionally much like a schistosity) may parallel the bedding planes or cut them

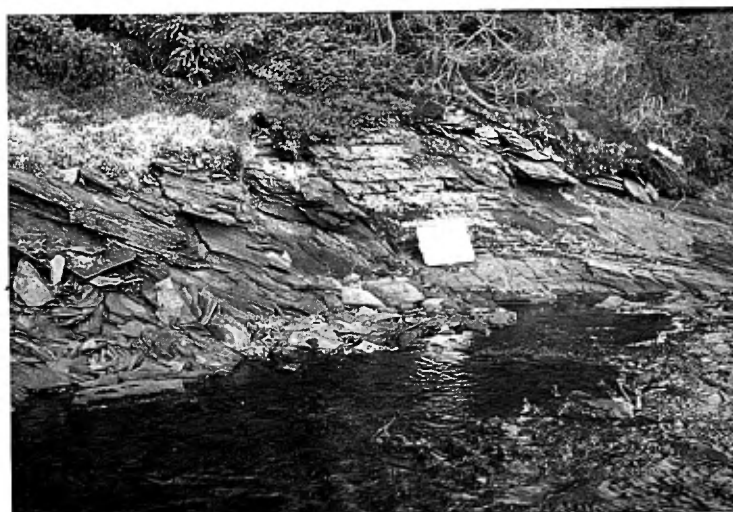


Photo. 50-24-10

obliquely (Photo. No. 50-24-10).



Photo. No. 50-24-20

Along the Howells River, north of Elross Lake, most of the outcrops examined show poorly developed bedding planes. On the other hand, schistosity is usually conspicuously developed. It may or may not parallel the bedding. These schistose shales usually have a brownish weathered surface. This consists of a thin coating of limonite at the surface of the exposure, and along the planes of schistosity. It may have been deposited by circulating ground water solutions.

Dolomite outcrops at one locality in the Elross Lake area. It is rather massive; it may be coarsely crystalline, but also fine-grained. Its thickness is unknown, but it may be three feet or more. The exposure is about 25 feet square.

F - MONTAGNAIS INTRUSIVES

Two diabase dykes have been correlated with the Montagnais intrusives. They occur in the Giachino Lake area and in the Rosemary Lake area. Their strike is about due north. They are vertical. Their maximum thickness is 100 feet. Their minimum thickness is about 30 feet.

The diabase is medium-grained showing usual ophitic texture; euhedral prisms of feldspars contained in a fine-grained dark ferromagnesian groundmass. The weathered surface is generally whitish to light brown.

Their texture and grain size is quite constant wherever they were examined. Their contact with the enclosing rock has not been observed.

G - QUATERNARY GLACIAL TILL

Not much till is present in the area. It is unconsolidated. And two extreme types are present and mixed in varying proportions.

1. Very fine grained rock flour, commonly reddish in color, probably a result of the abrasive action of the glacier. That is rather common in the area west of Kivivik Lake. Occasional pebbles and boulders are dispersed throughout this material.

2. Boulders with little interstitial material. The boulders may vary from 3" to 25 feet in diameter. This type of till is very abundant in Harris Lake area. The boulders are predominantly gneisses, but iron formation and quartzite are also present. They are usually quite angular. The boulders of gneisses have a tendency to be roughly equidimensional, whereas the iron formation and quartzite are quite frequently flat in the plane of bedding. Photograph No. 50-18-19 (Page 21) shows an extreme size for a gneiss boulder. The closest distance to the gneisses from that boulder is about $1\frac{1}{2}$ mile, while the distance to the gneisses in a direction parallel to glacial striae is more than 5 miles.

Deposits of gravel which might be suitable for road beds, or for mixing with concrete have not been encountered. There seems to be a scarcity of material of sand size in the till of the Howells River area.

VII - SENTIMENTALITY

VII- STRATIGRAPHY

The relation of the various rock types within the individual groups has been taken up in the section dealing with the description of those rock types. We shall here discuss the relation of the groups to one another.

A - THE ASHUANIPI-WISHART UNCONFORMITY

There is no doubt about the presence of this unconformity, as it has been observed at numerous places.

Generally the foliation in the gneisses in the southern part of the map area is close to vertical with an approximate east-west strike. The Wishart formation immediately overlies the gneisses and dips at a very low angle towards the Howells River (east of northeast). The angle of dip is usually from 2 to 10 degrees.

The contact is not exposed over any considerable length. In fact, a slight depression marks its position. But it is exposed in patches of conglomerate at the surface of the gneisses. These patches are of the order of 25 feet square. Their size and shape is very difficult to determine; only close sampling of the rock will reveal the unconformity. These are especially abundant in the Lilian Lake area. The contact is fairly well exposed in the Gillespie Lake Area.

- There is no field evidence to suggest any major thrust fault at that contact.

This great unconformity probably marks a long period of erosion during which time the Grenville-type gneisses were gradually brought to surface, and it seems reasonable to state that the rocks of the Ferrinian series resting on them are probably at their site of deposition, or very close to it.

B - THE WISHART-SOKOMAN CONTACT

The contact between these two formations has not been observed. Its position has been determined within 25 feet at four places. The black chert horizon is practically continuous at the top of the Wishart formation throughout the area. Silicate carbonate iron formation forms the lower part of the Sokoman formation, north of Lilian Lake fault. The dips of both are parallel near the contact.

The same is also true of the contact between the Ruth Slate and the Wishart formation, south of Lilian Lake fault.

It therefore seems reasonable to assume conformity along this contact.

C - THE SOKOMAN-MENIHEK CONTACT

Similar considerations apply to this contact. It is generally not well exposed and it has been difficult to place it accurately. It is

best seen in the Elross Lake area. Minor folding has occurred there. It is post-Menihok. Generally the strata of both Menihok and Sokoman formations are parallel. And the disconformity which has been suggested elsewhere between these two groups is not apparent here.

VIII - STRUCTURE

VIII - STRUCTURE

A - GENERAL STATEMENT

The structure of the west shore of the Howells River is very simple. The rocks are relatively undisturbed by folding. Faulting has not been of importance either; some cross and oblique faults are present, but the movement along these fault planes in each case is generally not great.

Complexities do arise however at the river. A generalized map of the area showing suggested correlations with the structure of the east shore has been prepared. From the latter, we recognize a major synclinal fold at the river.

Minor dragfolding has occurred in the Sokoman and Menihok in the vicinity of their contact.

B - FAULTS

It has been established that four faults are present on the west shore of the Howells River. These are:

1. Marcel Lake Fault,
2. Giachimo Lake Fault,
3. Lilian Lake Fault,
4. Cross West Fault.

1. Marcel Lake Fault

Exposures are very good in the vicinity of this fault. The Wishart and the Sokoman formations on the south side abut directly on the Ashuanipi gneisses. They reappear on the other side of the fault but 4200 feet closer to the River.

The plane of the fault is probably vertical. The gneisses on the north side form a somewhat rounded scarp. The north side of the fault moved up. The attitude of the Sokoman and Wishart formations are the same on both sides of the fault. Consequently the fault has not been a rotary fault.

The vertical distance between the beds of the Wishart formation on each side of the fault is of the order of 500 feet. The horizontal distance would be about 4000 feet.

Probably horizontal movement was not important along the fault. The apparent movement may be a result of erosion on the north side.

This fault may be one which affected Ashuanipi gneisses long before the Sokoman or Wishart formations were deposited, but along which movement has recurred after deposition of the latter.

2. Giachino Lake Fault

Giachino Lake Fault extends in an east-west direction from the center of Giachino Lake into the Ashuanipi Series.

It cannot extend very far on the east side of the river, unless it is pre-diabase in age because the continuity of the diabase dyke has been proved in that area (Bakins' map of 1949).

The Sokoman formation outcrops within 2000 feet of Giachimo Lake on the north side of that fault. Close examination of serial photographs reveals that the Sokoman-Menihek contact more or less follows the topography in that area. East of the contact, the terrain is muskeg, swamps and small lakes which are decidedly like terrain underlain by Menihek formation.

In addition, an outcrop on the central part of the western shore of Kivivic Lake is magnetite shale iron formation. This would indicate a position close to the top of that group.

Consequently it is believed that the top part of the Sokoman outcropping on the north side of Giachimo Lake Fault has been folded into a very broad open synclinal and anticlinal fold. The south side on the other hand seems relatively undisturbed.

There is little information available as to the nature of the movement along this fault. The south side remaining in place, the north side moved east and up. The magnitude of these components of the movement is not known accurately. However, the writer believes that the oblique and cross faulting in the area is post-diabase. The Lilian Lake diabase dyke suggests such a relationship. Assuming the same age for the Giachimo Lake fault, we conclude that the fault disappears very close to the river since the continuity of the dyke has been proved in that area. Consequently, movement along the fault must have been very small.

3. Lilian Lake fault

The position of Lilian Lake fault is well marked on the topography of that area by a creek that flows in a rather deep V-shaped valley. Generally the south side of that valley may be higher than the north side.

Lilian Lake fault has been assumed on the basis of considerable variation in elevation observed in the Wishart formation, probably of the order of 50 to 100 feet. It may also account for the break in rock types of the Sokoman formation in that area. Ruth Slate appears on the south side of the fault. It does not reappear on the north side. The deep, relatively straight valley that marks its position is also very suggestive of such a structure.

In the Ashuanipi gneisses, the fault marks the contact between garnet, biotite gneisses (south side) and granitic gneisses (north side).

The fault plane may somewhat parallel the foliation in the garnet biotite gneisses, i.e. vertical. Movement along it has probably occurred in Pre-Huronian time, but has recurred since the deposition of Ferrinian (Huronian) Series. Horizontal movement has probably not been very great, whereas vertical movement may have been of the order of 50 to 100 feet.

Elross West Fault

Another minor fault is known to occur in the area west of Elross Lake. It is marked by a deep (30 feet) gulley (Photograph No. 50-24-12). This fault is probably a well developed jointing plane along

which minor movement may have occurred. Apparently, the north side of the fault suffered minor dragfolding, whereas the south side remained undisturbed.



Photo. 50-24-12

Study of Jointing

Jointing sets are usually quite well developed in the area. Photograph No. 50-18-3 shows a fair example.

A statistical study was made of the jointing sets in the area. 405 jointing planes were recorded. The jointing planes being predominantly vertical, only their azimuth was studied. This reduced the amount of work in such a study considerably. The results are plotted in Diagram No. 1.

Azimuths are abscissae (0 to 180 degrees, azimuths from 180 to 360 were transformed to those). Number of jointing sets recorded are

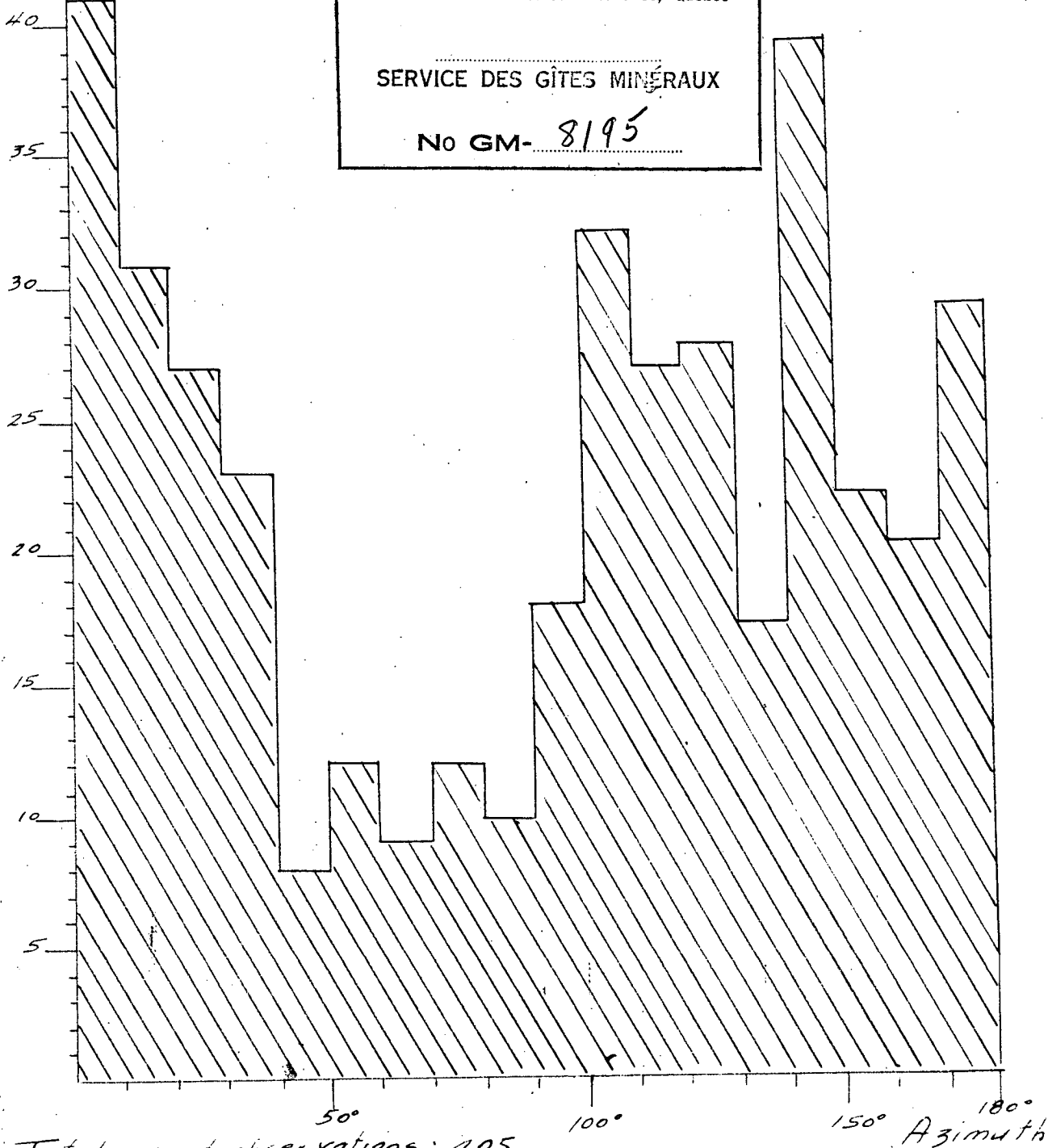
PUBLIC

Ministère des Richesses Naturelles, Québec

SERVICE DES GÎTES MINÉRAUX

No GM- 8195

No. of joints recorded.



Total no. of observations: 405.

ORIENTATION OF JOINTING PLANES.

Howells River Area.

Iron Co. of Canada.

Geology by: *G. P. Proulx*

Nov. 1950.

Diagram No. 1.

ordinates. The curve has three definite maxima, one at 0 to 10 (42 observations), one at 100 to 110 (33 observations) and the other at 140 to 150 (39 observations).

The maximum at 0 to 10 corresponds to the direction along which the diabase dykes were intruded. The 100 to 110 maximum is roughly parallel to the direction of Lilian Lake and Giachimo Lake Faults.

The origin of the 140 to 150 maximum is not clear. It may be of the same nature as the 100 to 110 one and may be conjugate with the 0 to 10 one. In that case the angle between the two directions would be quite high at 140 degrees.



Photo. 50-18-3

The grouping of jointing sets throughout the area in a single diagram is probably not a good practice. The computations of Diagram No. 1 have been done by the writer. It is felt that in the Northern part of the area, the two sets of jointing predominantly developed are the

0 to 10 and the 100 to 110 sets, whereas in the southern part, the 0 to 10 and the 140 to 150 sets are more predeominantly developed. The fact that the 0 to 10 set is developed throughout the area makes it the highest maximum and the fact that the 140 to 150 set is developed in an area where bedrock is much better exposed makes it second highest.

It is believed that the presence of the soft Menihok shales in the southern map area, and its absence in the northern map area may account for the fact that the angle between the jointing sets is 140 degrees in the south and 100 in the north.

Theoretical considerations of the strain ellipsoid indicate that the angle between maximum shear directions should always be the same (90 degrees). However, it is felt that the competence of the rock may have some importance in determining the maximum shear directions. The less competent overall section of the southern map area, comprising Menihok Shales, Sokoman iron formation and Wishart quartzite would give a greater angle between maximum shear directions, than the section exposed in the northern map area, which does not include the Menihok shales.

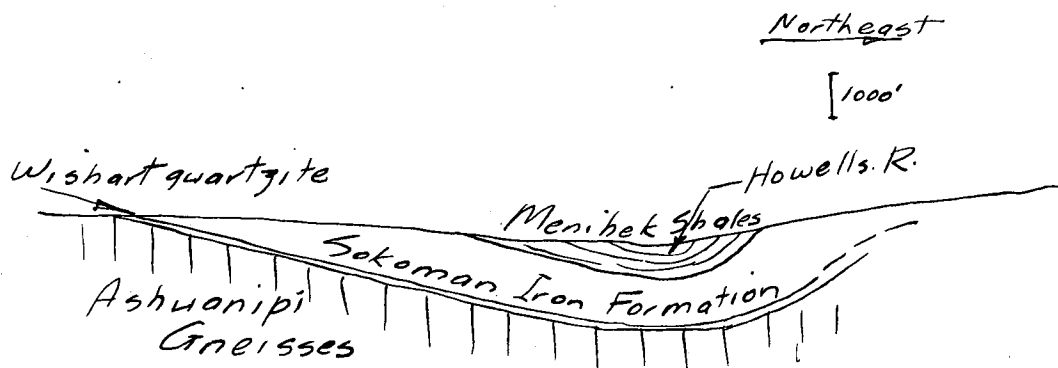
The compression forces as deduced from these considerations are in a general northeast-southwest direction.

Major Synclinal fold

Little can be said to strengthen this idea in this report which deals with only one half of that fold. Having done some mapping on the

east side of the river as well (1949), it is felt, however, that an opinion should be given regarding this major structural feature.

In the Lilian Lake-Giachimo Lake area, the synclinal fold is probably more of an open fold. A cross-section of the area would look somewhat like Sketch No. 5.

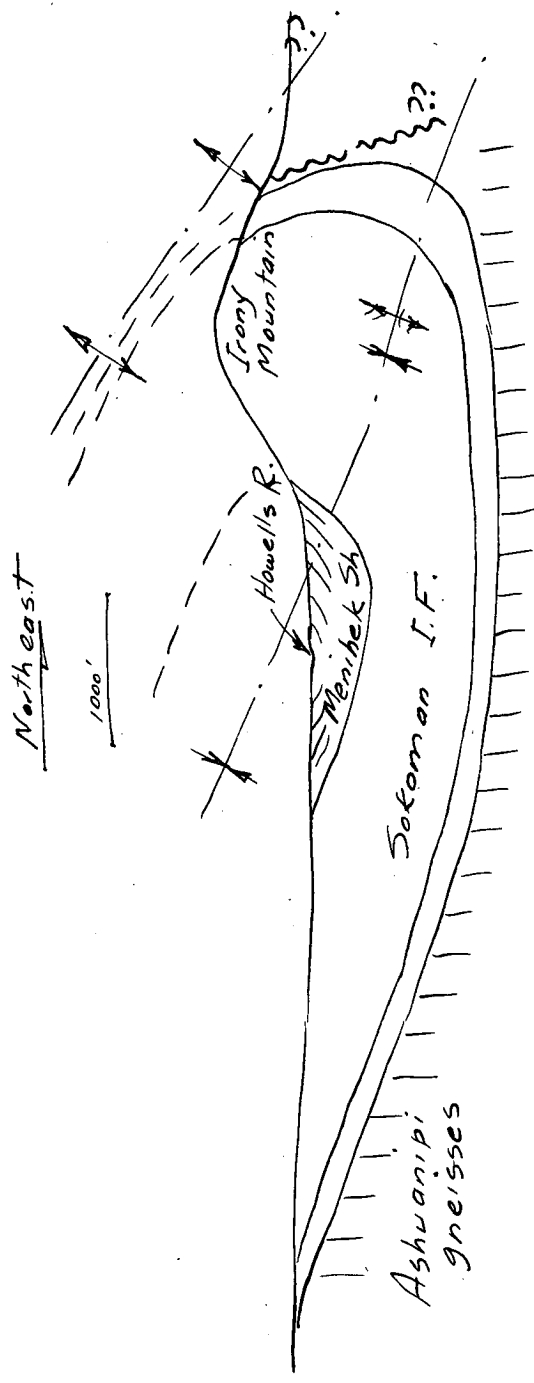


SKETCH, No. 5.

There may be dragfolding in the upper part of the iron formation on the east shore. The same occurs to a smaller degree on the west shore.

Then Irony Mountain is cut off from this set up by a cross fault, and farther south the fold becomes a closed and overturned one. This relationship is illustrated in Sketch No. 6 (Page 76).

East of Irony Mountain, it is not known what happens. Perhaps a major thrust zone! Perhaps another anticlinal fold occurs!



SKETCH No. 6.

IX - ECONOMIC GEOLOGY

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Enrichment of various type was found at 9 places during the summer. These are as follows:

1. Louvain Lake area
2. Brain Lake area (two occurrences)
3. Marquise Lake area
4. Citron Lake area
5. Kivivic Lake area (two occurrences)
6. Giachimo Lake area
7. Ferruginous shale and altered cherty metallic horizon between Giachimo Lake and Fleming Lake (14 occurrences)
8. Lillian Lake area
9. Elross Lake area.

1. Louvain Lake Area

In the Louvain Lake area, brown ore boiled to surface in a swamp. The surface of the boil up is about 5 feet square. However, it occurs in ground underlain by the Wishart quartzite. Closest distance to iron formation along direction of glacial striae is about 3000 feet.

2. Brain Lake Area

Two occurrences of enrichment are known from the Brain Lake area.

The first one is on an outcrop which is situated about 4000 feet southwest of the northern part of Brain Lake. The enriched exposure is on a creek. Dips are about 5 degrees at this locality. The amount of the enriched iron formation exposed is not in excess of 5 feet.

The rock type is thin-bedded jasper. The lenses of jasper make up about 10% (thickness) of the rock. The metallic material may contain 75% hematite and magnetite (mostly hematite) 25% chert.

The other occurrence is situated about 5000 feet southwest of the Howells River No. 1 portage. The exposure is massive. The rock shows the same kind of enrichment as that found in the previous place.

3. Targuise Lake Area

There is some enrichment, 2000 feet southwest of the Howells River No. 2 portage. Dips are slightly higher in that area, and attain 20 degrees east. The rock type is cherty metallic iron formation.

Sample 7577, a representative sample from that area, showed that the silica content in the rock is quite high. It gave the following

assay results:	Iron	40.1 %
	Manganese	0.66%
	Silica	38.34%

5. Citron Lake Area

Four outcrops exposed on the creek flowing into Citron Lake showed enrichment. These outcrops are spread over a distance of 1000 feet perpendicular to the strike. Dips vary between 3 and 5 degrees. Corresponding thickness of enriched strata would be about 50 to 100 feet.

The rock type is thin-bedded jasper. The jasper beds however constitute 5 to 20% of the thickness of this material. The metallic part is somewhat darker than the usual metallic bands. The Manganese content in two of these samples taken is 8.6%, considerably above average. The silica content in the same samples was 20 to 21%, and iron was 40%.

6. Kivivic Lake Area

The cherty metallic phase of the iron formation is enriched in an outcrop situated about 8000 feet southwest of the southern tip of Kivivic Lake. About 5 feet of this material is exposed. The closest adjoining outcrop is 2000 feet distant. The dip of the strata is 2 degrees.

Similar material outcrops about 8000 feet southwest of the Howells River No. 8 portage, in the vicinity of Giachino Lake Fault. Dips in the area are about 5 degrees and closest exposure is 600 feet away. Some peculiar carbonate concretions were observed in this type of rock. It is an enriched cherty metallic phase of the iron formation.

7. Giachimo Lake Area

An outcrop situated about 2 miles southwest of the center of Giachimo Lake also showed enrichment. The strata dips at 5 degrees to the east. The closest exposure is at 600 feet. The rock type is rather massive cherty metallic iron formation. It assayed:

Iron	44.6 %
Manganese	0.52%
Silica	33.70%

8. Ferruginous Shale and Altered Cherty Metallic Horizon

This horizon has been traced from Giachimo Lake down to southern limit of mapping, a distance of about 9 miles. Its maximum thickness is 100 feet.

The petrography of the rocks of this horizon has been given special attention in part VI of this report (pp. 49-51). Briefly the rock is composed of altered cherty carbonate and some altered friable cherty metallic types. An analysis gave the following result:

Iron	34.7 %
Manganese	19.95%
Silica	9.66%

Material giving that assay may make up as much as 50% of the section in thickness.

It has been established that enrichment in this rock type has taken place along bedding cleavage planes and jointing planes. Where the rock is well jointed, it is also quite thoroughly leached and enriched.

Photographs 50-17-9 and 50-24-18 show this relationship. On photo 50-17-9 in the center, a diamond shaped piece of rock bounded by two sets of joints. In this rock, manganiferous and ferruginous minerals have developed perpendicular to the joint planes. In Photograph No. 50-24-18 thin ($\frac{1}{8}$ to 1") layers of manganiferous material are present along joint planes. These layers flake off at surface and break into small pentagonal prisms about 1 inch high and 1 inch square on the base.



Photo 50-17-9



Photo. 50-24-18

9. Lillian Lake Area

A small outcrop of enriched iron formation occurred in this area about 1 mile southwest of the central part of Lillian Lake. The outcrop is only 5 feet square. A swamp occupies the next 250 feet to the northeast; thin-bedded jasper is present within 50 feet in the other direction.

The material is dark brown manganiferous bog limonite.

10. Elross Lake Area

An outcrop situated at the base of the iron formation, about 13000 feet southwest of the central part of Elross Lake, also shows enrichment.

Actually the outcrop consists of two smaller ones. The possible thickness of the enriched material assuming continuity between the two outcrops is about 30 feet. The dip is 10 degrees east and the closest exposure is about 300 feet away.

The rock material is cherty metallic iron formation. It is leached and partially enriched with goethite and pyrolusite.

CONCLUSIONS

A review of the enrichment found in the iron formation reveals the following:

1. There is no immediate lead to a drilling or trenching program.

2. Enrichment of ore grade has been found west of the Howells River.
3. It is not known to occur in any sufficiently great size and/or concentration to permit of profitable mining operations.
4. A more complex structure is anticipated in the southern extension of the map area with increased possibilities of finding orebodies.

In addition, sulfide occurrences are found in the black chert on top of the Wishart formation and in the lean cherts of the top of the Sokoman iron formation; but these occurrences are not of economic interest (see pages 36 and 52).

X - DISTRIBUTION OF TIME

X - DISTRIBUTION OF TIME

The area was mapped from 5 camp sites. These were on:

1. Harris Lake
2. Kivivic Lake
3. Giachino Lake
4. Rosemary Lake
5. Elross Lake.

From the first camp site, the area extending from Louvain Lake to Brain Lake was covered. The party arrived in the area on June 16th and stayed on Harris Lake until July 4th.

The next move was to the northern tip of Kivivic Lake. From that camp site, the area extending from the center of Giachino Lake to Brain Lake was mapped. This period was quite a rainy one and considerable time was lost on that account. The party moved from Kivivic Lake on August 11th.

The next camp was on Giachino Lake. During the week that followed, mapping was done south to the center of Green Water Lake.

On August 16th, the party moved to Rosemary Lake. Mapping from Rosemary Lake camp site during the period from August 16th to September 8th, was conducted as far south as the right angle bend in the Howells River about half-way between Rosemary Lake and Elross Lake.

The rest of the season to September the 25th, was spent on Elross Lake. The southern limit of mapping now stands at the northern tip of Fleming Lake.

Rainy days lost

A total number of 14 days were lost on account of rain, during the summer. The weather was especially bad during the middle part of July and the later part of September.

Proportion of work in Labrador and in Quebec

The period from June 6th to July 4th was spent almost entirely in the Province of Quebec. Only one day's work was done in Labrador. That is all the time we worked in the Province of Quebec. On the basis of work days, 17% of the party's work was done in Quebec and 83% in Labrador. That is approximately also the relation of respective areas.