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A REPORT ON THE GEOLOGY OF THE NASTAPOKA GROUP OF SEDIMENTS (HUDSON BAY) WITH ITS CONTAINED LEAD AND ZINC BEARING STRATA

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A REPORT ON THE GEOLOGY OF THE NASTAPOKA GROUP OF SEDIMENTS (HUDSON BAY) WITH ITS CONTAINED LEAD AND ZINC BEARING STRATA.

by

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Feb.1949.

MINISTÈRE DES MINES, QUÉBEC
May-1950
SERVICE DES GITES MINÉRAUX
No GM-679

PUBLIC

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Thesis presented at the University of Toronto for the degree of Bachelor of Applied Science

Presented February 21'st., 1949,

by Thurne Parks.

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A REPORT

ON THE GEOLOGY OF THE NASTAPOKA GROUP OF SEDIMENTS (HUDSON BAY) WITH ITS CONTAINED LEAD AND ZINC BEARING STRATA

PART 1

- INTRODUCTION -

Purpose and Character of the Report

Location and Area

Transportation

Previous Accounts

Purpose and Character of the Report

This report presents information obtained from an investigation of a strip of Precambrian sedimentary and volcanic rocks that fringe on the East Coast of Hudson Bay, opposite the Belcher Islands, in the vicinity of the Richmond Gulf. The material for this report was obtained during the field work of two seasons, while the writer was in the employ of Gulf Lead Mines Limited, who are actively interested in the lead, zinc, silver and copper values contained in a mineral-bearing horizon among these rocks.

The writer, accompanied by A.S. Ashton and N. Davis, covered part of the southern area of the concession during the summer of 1947, searching for a continuity of ore in the horizon. During that season considerable information was obtained about the topographical and geological features of the various stratigraphic units, later described in detail in this report. Gulf Lead Mines Limited conducted an extensive diamond drilling campaign during the 1948 season, recovering 40,705 feet of core from April 15th to September 22nd. The results of drilling have provided valuable data bearing directly on the economic aspects of the property, together with additional information concerning the geology and petrography of the Nastapoka group of sediments.

This report contains an account of the general geology of the area, with a detailed description of the stratigraphy and petrography of the Nastapoka group. Previous accounts of the area by A.P.Low and C.K.Leith are discussed.

The central part of this report is devoted to geologic structure, and the concluding section deals with the economic possibilities of the mineral-bearing horizon. The results of the diamond-drilling and prospecting program are outlined in this part of the report.

The writer is indebted to Mr. M.E.Holtzman, and those of the Board of Directors and others, who visited the property during the 1948 season, for their kind encouragement and interest. The writer is also indebted to the company's consultant, Mr.Lloyd B. Almond for his sincere interest, and to the resident engineer, Mr. G.P.Thoday for his assistance and advice. The maps accompanying this report are copies from Mr. Thoday's excellent maps, and the computations of value and tonnage are derived from his work.

Location and Area

The company's concession is located on the east coast of Hudson Bay, opposite the Belcher Islands in the vicinity of the Richmond Gulf.

It is part of a group of strata that occur at intervals on the islands bordering the east coast of Hudson Bay from Cape Jones to Portland Promontory, and which, in places, as around the Richmond Gulf, outcrop on the mainland itself.

This group of sidements extends westward to include the Belcher Islands, and thus forms a great basin-like sedimentary group, with associated basic sills and flows.

Gulf Lead Mines Limited's concession extends some sixty miles in length along the coast, from ten miles north of the entrance to the Richmond Gulf to opposite Schooner opening on Manitounuk Sound.

The area of the concession is approximately two hundred and eighty five square miles, and the layout may be noted on the accompanying map.

Transportation

Transportation

The property can be reached by rail and ship by way of Moosonee, by rail and ship by way of Churchill, by ship via the Hudson Straits, or by air from Moosonee or Senneterre. It is an average five hours flying time in a Norseman from Moosonee, including stops for refuelling.

The average cost of transportation, as computed from the past two seasons, is outlined below:-

Cost per ton by water from Churchill $50.00

Cost per ton by water from Moosonee $70.00

Cost per ton by water from Montreal $80.00

Cost per pound by air from Moosonee $00.22

It should be borne in mind that these figures are by no means indicative of the costs that would attend large scale operations, as with proper facilities and vastly increased tonnage such costs would conceivably be much lower.

Previous accounts

Previous accounts that deal with the general area in which the property lies are listed below:-

Bell, Robert - "Report on an Exploration of the East Coast of Hudson Bay, 1877". Geological Survey of Canada, Report of Progress 1877-78, Montreal 1879, pp. 1c-37c.

Low, A.P. - "Report on Explorations in the James Bay and Country east of Hudson Bay drained by Big, Great Whale and Clearwater Rivers". Annual Report Geological Survey of Canada, vol.3 (new ser.) pt. 2, 1888, pp. 1j-62j.

-"Report on Explorations in the Labrador Peninsula along the East Main, Koksoak, Hamilton, Manicuagan and Portions of Other Rivers in 1892-93-94-95". Annual Report Geological Survey of Canada, vol.8, (new ser.) 1897, pp. 1L-311L.

-"Report on a Traverse of the Northern Part of the Labrador Peninsula from Richmond Gulf to Ungava Bay". Annual Report Geological Survey of Canada, vol.9, (new ser.) Report L 1898, pp.43.

Low, A.P. -"Report on an Exploration of the East Coast of Hudson Bay from Cape Wostenholme to the south end of James Bay ". Annual Report Geological Survey of Canada, vol. 13, (new ser.) Report D, 1903, pp.84. Published separately 1902.

-"Report on the Geology and Physical Character of the Nastapoka Islands, Hudson Bay". Annual Report Geological Survey of Canada, vol. 13, (new ser.) Report DD, 1903, pp.31.

Leith, C.K. -"An Algonkian Basin in Hudson Bay - a comparison with the L. Superior Basin ". Economic Geology vol. 5, pp.227-246, 1910.

Flaherty, R.J. -"The Belcher Islands of Hudson Bay, Their Discovery and Exploration ". Geological Review, vol.5, no.6, pp. 433-458, 1918.

Moore, E.S. -"The Iron Formation on Belcher Islands, Hudson Bay, with special reference to its origin and its associated algal limestone". Journal of Geology, vol. 26, pp.412-438, 1918.

Woodbridge, D.E. -"Iron-ore deposits on Belcher Islands". Engineering and Mining Journal, vol. 42, pp. 251-254, 1912.

Young, G.A. -"Iron-bearing rocks of Belcher Islands, Hudson Bay". Geological Survey Summary Report 1921, part E.

Previous Accounts by A.P.Low and C.K.Leith

The area under consideration was explored by A.P.Low in 1898, 1899 and 1901.

Low outlined a thick assemblage of sediments and flows, and did not recognize any major erosion unconformity among these strata. He believed that the top member of this series was overthrust at a low angle, to take up its present position on the mainland. The Nastapoka chain of islands Low considered to be the middle member, overthrust over the top by member by another low angle thrust fault.

C.K.Leith explored the area in question to a point fifty miles north of the Richmond Gulf in 1909. He believed that the Nastapoka Islands, and the top formation exposed on the adjacent mainland, belonged to the same geological horizon, and named the top series the NASTAPOKA Group.

Both Low and Leith recognized a plane of structural discordance at the base of the Nastapoka group, as exposed at Richmond Gulf. Low believed it to be due to low angle thrusting, while Leith believed it to be an erosional unconformity, and named the underlying strata the RICHMOND Group.

Evidence was presented by both Leith and Low to substantiate their theories.

Additional data brought to light by diamond-drilling campaign, and by a more extensive exploration of the Nastapoka Group, led the writer to believe that an erosional unconformity does exist, and that a thrusting action has taken place.

This will be discussed in the general geology section of this report.

PART 11

- GENERAL GEOLOGY -

General geolofy
General section - Stratigraphy and petrography
- Division No.1 - flows
- Division No.2 - quartzites
- Division No.3 - limestones
- Division No.4 - Richmond Gulf

General Geology

The area from Cape Jones north to Portland Promontory, and westward to include the Belcher Islands, forms a great basin in Hudson Bay into which the Nastapoka groups of sediments were deposited, together with associated basic sills and flows.

The sediments and associated volcanics of the Nastapoka group rise gently from the waters of Hudson Bay, in a long rising slope to the East, terminating in a steep scarp facing inland. This same structure is present on the islands lying offshore, the scarp there facing the mainland, and descending to the water in a series of steep steps.

The sediments are believed to be of Animikie-Huronian age, Low, Leith and Moore all pointing out a strong resemblance to Lake Superior rocks of that age.

The NASTAPOKA Group

The Nastapoka group, as exposed on the Nastapoka Islands and the adjacent mainland, consists of a little altered series of mechanical and chemical sediments, with associated basic sills and flows, that dips gently seaward at a low angle, usually in the range of 5 to 10 degrees.

The Nastapoka group of sediments reaches its highest elevation at the Richmond Gulf, where it rests unconformably on the lower Richmond group. The maximum development inland is also attained at this point, the overlying Nastapoka group extending four miles, and the underlying Richmond group twenty miles, inland from the coast at that point.

From this point of highest elevation of the Nastapoka group (some 1700' a.s.l.), these sediments with their basalt capping plunge gently to the north and to the south, the line of plunge following a curve of greater convexity than the coastline, so that the width of the strip exposed on the mainland decreases to the north and to the south.

To the south the strip eventually passes from the coast to form the Manitounuk Islands. The Manitounuk Islands persist to within eight miles of Great Whale River, wit Manitounuk Sound lying between them and the mainland. Sedimentary outliers from the main formation form a coastal strip of sediments on the mainland adjacent to the Manitounuk Islands, these outliers resting on Archaean granite, the Richmond series having pinched out somewhere in the region of the head of the Sound.

From Great Whale River to Cape Jones, the Nastapoka group is represented by sedimentary strata occurring at intervals along the mainland. The last exposures to the south are seen at Long Island, just off Cape Jones, where the Nastapoka group of sediments and associated flows is again evident.

Returning to the point of highest elevation and proceeding north, the mainland is occupied by the Nastapoka group unconformably overlying the Richmond, and opposite Anderson Island resting immediately upon granite. The strip passes from the mainland at a point just south of the Nastapoka River.

The Nastapoka chain of islands with Flint Island, a few miles offshore and about six miles south of the entrance to the Richmond Gulf. They extend from Flint Island for 125 miles to the north, paralleling the coast. A 26 mile gap separates them from the Hopewell chain, which parallels the coast in a similar fashion, and which persists to Portland promontory.

Low reported a strong resemblance between the Hopewell and Nastapoka Islands, and believed that they belong to the same geological horizon.

Low believed the Nastapoka and Hopewell Islands to be the middle member of his group of strata, overthrust over the top member.

The writer believes their position to be due to thrusting but not of the magnitude outlined by Low; rather, that they represent the top member thrust over itself from farther out to sea.

General Section - Stratigraphy and Petrography

Nastapoka Group, descending:-

1. Thick basaltic flows and sills, showing columnar jointing, flow breccia, amygdaloidal and pillow structure, together with some thin interbedded pyroclastics, capping the sediments exposed on the coast from opposite Anderson Island south to Manitounuk Sound, and capping the Manitounuk and Hopewell Islands, and Long Island.

   Maximum measured thickness 350' (Nancy Island Drill camp.) This division represents erosional surface, and is therefore, of variable thickness.

2. A formation of sediments of wide lateral extent and of variable lithology. Predominantly quartzite. Present on the Hopewell, Nastapoka, Manitounuk and Long Islands, and on the mainland from north of the Richmong Gulf to Manitounuk Sound. Contains iron oxides and carbonates of Hopewell, Nastapoka, Manitounuk and Long Islands.

   The iron formation is not present on the mainland exposures, the division being there represented by sandstones and quartzites with interbedded argillaceous and tuffaceous sediments.

   Maximum thickness 960', as exposed on the southerly Manitounuk Islands.

3. Concretionary, cherty limestones and dolomites, esposed on the eastward facing scarp of the Nastapoka group as present on the mainland. Occurs at intervals along the coast from Manitounuk Sound to Cape Jones, as outliers of the main formation. Present on Long Island.

   Contains the ore-bearing horizon.

   Thickness is variable, and it does not always show the same relationship to the underlying plane of structural discordance. Rests unconformably on granite where the Richmond Gulf Group is absent.

   Maximum thickness 431' plus.

   Unconformity

4. Richmond Group (as outlined by Leith).

   Coarse arkose grading above into sandstone and argillites. Interbedded with basic flows, 1000 ft. Intruded by some of the red granites of the mainland against which the Nastapoka series lies.

   Exposed along the lower parts of the eastward facing scarps along the west side of Richmond Gulf, forming most of the islands and eastern shores of the Richmond Gulf. Low estimates 2,450 feet.

Division No. 1 - Basic Flows and Sills

The sediments of the Nastapoka group are overlain by a series of spilitic flows and a thick sill, with some associated thin beds of pyroclastics.

These volcanics form a capping for the sediments as exposed on the mainland, the Manitounuk Islanda and the Hopewell Islands. Possible representation on the Nastapoka Islands consists of some thin flows interbedded towards the top of Belanger Island.

The sediments of the Nastapoka group as seen at their southern-most exposure on Long Island are also capped with basaltic flows. Flows believed to be of the same age cap corresponding sedimentary formations of the Belcher Islands.

A wide areal distribution of these volcanics is established, having been noted overlying the Nastapoka sediments from Long Island to Portland promontory, a distance of some 350 miles, and capping the Belcher Islands lying some 60 to 100 miles off the coast.

Three main flows and a sill were examined at the Nancy Island sector of the concession, together with three thin interbedded pyroclastic members. The flows varied in thickness from 50 to 125 feet, and they all exhibited markedly similar structural features. General features exhibited by the flows are as follows:-

The upper portion of a flow to a depth of 5' to 10' shows flow breccia structure, with angular amygdaloidal or vescular fragments set in a very fine-grained matrix. Amygdules persist to about ten feet below the brecciated zone at which point they usually decreased in numbers and size to nil, giving an amygdule-free rock.

The texture of the rock coarsens towards the centre of the flow, and becomes finer grained again towards the bottom contact.

A few amygdules are sometimes present at the lower contact, and in one diamond drill log a breccia structure was noted in a thin zone at the bottom of a flow.

Where the various flows are exposed on the surface a general uniformity of surface features is also noted. Glaciation has scoured and polished the surface to a high degree. Pillow structure is generally lacking, being noted in relatively few localities. Columnar jointing is evident wherever a vertical scarp of one of these flows is formed by erosion. Evidence of columnar jointing may also be seen in the horizontal plane on some of the exposures in the Nancy Island area, where silica-filled cracks form a rough pentagonal pattern.

As this division represents an erosional surface, the thickness is variable. The greatest thickness was noted in D.D.H. N. 18 in the Nancy Island area, where 350' was drilled before encountering sediments.

A survey of the diamond drill logs in the Nancy Island area reveals that these flows conform to the underlying bedded structure, faithfully following local variations in dip, indicating that they must have been gently folded together with the underlying sedimentary strata.

#1 Division   Composite section from the Nancy Island area.

- in descending order -

Member	Depth	Thickness	
No. 1	0-1	1'	Thin fine grained green quartzite, showing ripple marks (1-1)
2	1-125	124'	Fine grained even-textured spilitic basalt with flow breccia and amygdaloidal structure towards the top. (1-2) to (1-8) inclusive (#1 flow).
3	125-127	2'	Thin tuffaceous sedimentary bed (1-9)
4	127-178	51'	Fine grained spilitic basalt with a slightly porphyritic texture given by small euhedral feldspar phenocrysts. Flow breccia and amygdaloidal structure towards the top. 1-10, 1-11, 1-13, 1-14, 1-15, and 1-34. (# 2 Flow).
5	178-235	57'	Fine grained spilitic basalt with a mottled appearance. Flow breccia and amygdaloidal structure in the top zone. 1-12, 1-15, 1-16- 1-17, 1-18. (#3 flow).
6	235-242	7'	Reddish green tuff (1-19
7	242-244	2'	Carbonated tuff and altered limestone.(1-20)
8	244-350	106'	Thick sill of albitized and carbonated basalt porphyry containing large and abundant feldspar phenocrysts.
		350'	

Detailed description of the members of No. 1 Division as examined from the Nancy Island area diamond-drill cores:-

No. 1 member - 0-1 1'

The first member of this division, as exposed in the Nancy Island sector of the property, is a fine grained greenish-black quartzite, showing ripple marks. This member was noted at this one locality only, having been removed by erosion in the other areas examined.

No. 2 member - 1-125 (#1 flow)

The second member of this division extends through 124', and appears to consist of one great basaltic flow. The upper 12' is brecciated, and contains grey-black vesicular rock fragments enclosed in a lighter coloured grey fine grained matrix. The vesicles are filled with the cement material.

Amygdules persist lower in the flow, and out of the zone of flow breccia, to a depth of about 20'. They are filled with chlorite, carbonate and agate. At a depth of 25' in the flow, the rock has a fine even grained texture, and contains a few scattered chlorite-filled amygdules and agate inclusions. In the centre of the flow the amygdules are no longer present, and the rock has become coarser in texture, taking on a roughly mottled appearance. The texture becomes finer towards the bottom of the flow, the basal contact being fine-grained and well defined.

Fifty feet of this flow has been noted five miles to the south in the Base Camp sector, where it represents the erosional surface. It is not exposed continuously throughout the district, as it has been eroded away in many places, in which case one or other of the underlying flows may be the surface member, depending on the depth of erosion.

No.3 member - 125-127 2'

A thin greenish banded bed occupies the position between the base of the proceeding memberand the top of the underlying flow. It is believed to be of tuffaceous origin. It contains small angular grains arranged in obscure bedding planes in a fine grained ash-like matrix.

This member was also noted in the Base Camp sector, where it is 3' thick.

No. 4 member - 127-178 51' (#2 flow)

The fourth member of this division is another thick flow, 51' in thickness in the Nancy Island area.

The top 6' consists of flow breccia in which greenish black amygdaloidal and vesicular rock fragments are contained in a pirple-green fine grained cement.

The texture is usually fine at the top, becoming coarser and porphyritic at the centre, and fine again towards the base. The basal section of the flow is usually not brecciated, but some breccia may occasionally be seen.

In some localized areas, the porphyritic texture may immediately follow the top brecciated zone, in which case the feldspar crystals are usually pink in colour, grading downwards into greyish-white phenocrysts.

Two thin sections were examined from this flow, one from the top zone and a second near the base of the flow. Hydrothermal alteration was more intense in the top zone, the rock being characterized by albitized feldspar phenocrysts enclosed in a ground mass of chlorite and lath-like albitized feldspar crystals. Sphene was present in large quantities as a hydrothermal alteration product.

The section cut near the base of the flow was not so highly altered hydrothermally. The feldspar was not albitized, and the pyroxene was not altered to chlorite. Some hydrothermal alteration forming saussurite was noted.

(see Appendix)

No. 5 member - 178-235 57' (#3 flow)

The base of the overlapping #2 flow rests directly on the brecciated and amygdaloidal top of a third thick spilitic flow, the fifth member of this division. The upper brecciated and amygdaloidal zone is present in this flow also. The texture is fine at the top, becomes coarser in the centre, there taking on a mottled appearance, and become finer again toward the base of the flow.

Snall pockets several feet in thickness of a lighter green rock were noted at varying levels in this flow. The rock is gradational in and out of these zones, which may be small epidote-rich zones.

Three thin sections were cut from this flow, from the top, centre and bottom. In general they showed albitized feldspar laths set in a matrix of chlorite and pyroxene. Hydrothermal alteration was more marked at the top and the base. The bottom section shows the contact between this flow and the underlying tuff.

(See Appendix)

No. 6 member - 235-242' 7'

The sixth member of this division is a fine grained reddish green tuff. Small elongated angular fragments are arranged in parallel bands in a very fine grained matrix. Under the microscope sharp angular fragments of quartz and feldspar are seen embedded in an indeterminable turgid fine-grained ground mass. There are numerous splotches of iron stain, believed derived from aggregates of epidote minerals.

This tuffaceous bed is very continuous over the area, as it has been noted in the Nancy Island and Base Camp drill cores, in surface ezposures at Little Whale River, and can be seen almost continuously on the surface from the Nancy Island area to the Ruby Lake area, first as a narrow black ledge then as the surface member of a plateau formed by the removal of the flow by erosion.

It weathers differentially, the more resistant laminae standing out in thin leaves from the main mass.

No. 7 member - 242-244 52'

The seventh member of this division is a carbonated tuff, variable in thickness from 0' to 9' in the Nancy Island sector. It underlies the tuff member constituting No. 6 of this division, and it also weathers differentially where exposed on the surface.

The rock is grey in colour, and weathers black or grey-blue. A parallel orientation is not as pronounced as is the case in the overlying tuff, and carbonaceous material has considerably altered the original quartz and feldspar.

It appears as if the volcanic ash was deposited contemporaneously with limestone, as the lithological characteristics are not everywhere uniform.

At the Base Camp the bottom of this thin bed is definitely limestone, and this is the case further eastward towards Ruby Lake, while at Nancy Island Camp the base of this member was noted to be unaltered tuff in some of the logs recorded.

An interesting feature on the seventh member is the presence of small nodules and concretionary-like forms of irregular outline which correspond very closely to Shrock's description of mud-balls in ash deposits. They are believed to be formed by an aggregation of falling particles of wet ash, and grow by concentric increments, much in the fashion of hailstones.

No. 8 member 244-350 106'

The eight and final member of this series of flows and sills is a thick porphyritic sill, intrusive between the overlying carbonated tuff and the underlying quartzite. This sill is younger than the flows and the sediments, and was probably intruded shortly after the outburst of vulcanism.

The thickness of this sill, as outlined in the Nancy Island sector by diamond drilling, varies between 90 and 110 feet, and averages 103 feet. In the Base Camp drill logs it was reported as 103 feet. It is of wide lateral extent, having been noted from the Richmond Gulf southward for 35 miles, and still open at the ends.

At Little Whale River the sill may be seen with apophyses extending into the overlying carbonated tuff.

The rock consists of large euhedral grey feldspar crystals set in a fine grained greyish matrix. The phenocrysts may be up to 2" across and are located in general in a gradational zone in the upper two-thirds of the sill.

A general cross-section of this sill, as compiled from an examination of the Nancy Island Camp drill logs is outlined below:-

The sill contains an upper "zone" usually about 4' to 5' thick in which feldspar phenocrysts are small (1/16 to 1/4"), roughly euhedral and not well formed. A considerable quantity of chlorite-filled amygdules are usually present in this zone.

This upper zone grades across a few feet into a main zone of large feldspar phenocrysts, up to 2" across, and constituting up to 60% of the rock mass.

This zone of large phenocrysts persists usually to about 2/3 of the depth of the sill, where the feldspar phenocrysts become gradationally smaller and fewer. Chlorite-filled amygdules may be scattered in variable zones of 1' to 2' thickness in this main zone of large phenocrysts. Usually where they are present, phenocrysts are absent.

The size and number of the phenocrysts vary locally within this zone, as do the zones where amygdules are present, and thus no two diamond-drill cores revealed the same specific textural features at the same depth of the sill, and the structure gives the impression of floating masses of phenocrysts which have cooled within the sill.

The lower third of the sill contains a few small phenocrysts and the rock becomes finer in grain towards the base of the sill. The lower contact is rarely sharp and well defined, but grades into a baked quartzite. The contact zone has a brecciated appearance, with pyritic mineralization filling the fractures. Occasionally, included slabs of quartzite are encountered before the contact.

Thin sections cut from the sill reveal a highly altered diabasic-textured rock consisting almost wholly of plagioclase, as albitized phenocrysts and lath-like crystals. Leucoxene is present as an alteration product, and carbonate alteration is extensive.

A section cut from the basal contact zone shows carbonate alteration to be so heavy that most of the original texture features are obscured. Some late carbonate and pyritic vein material are present.

(See Appendix)

The porphyry sill thus passes by way of a gradational and a baked quartzite into the quartzites and sandstones of Division 2.

Division No. 2

Division No. 2 contains the ferruginous beds of the Hopewell, Nastapoka and Manitounuk Islands, with the underlying sandstone and argillaceous beds, and is represented on the mainland by arkosic sandstone and quartzite interbedded with shale and argillite. The ferruginous beds are absent on the mainland.

Leith's first and third divisions are here grouped together, as they are believed by the writer to be the same horizon.

Leith believed that this division, as represented by the Nastapoka Islands, formed his No. 1 Division, overlying the flows and quartzite sandstone of the mainland.

Low, on the other hand, believed that the position of the Nastapoka Islands was due to faulting, being thrust up by a great thrust fault from what is now called the Richmond Group.

The writer believes their position is due to thrusting, but not of the magnitude outlined by Low, but rather a thrust of the top divisions over each other, bringing up the Nastapoka Islands, and further that Division No. 1 has been removed by erosion on the Nastapoka Islands.

This division is of wide lateral extent, and was found to vary considerably in thickness and lithological character where examined on the mainland exposures. Leith believed the contact with the underlying limestone to be gradational, but wherever examined by the writer the contact was found to be well defined. (See Photograph)

The following mainland sections were noted:-

Richmond Gulf - 75' of pink and grey quartzite.

Ruby Lake - 90-120' grey arkosic quartzite beds from 1' to 10' in thickness interbedded with thinner flaggy beds with shaly partings. Beds are ripple marked.

Nancy Island - (diamond drill core) 75'. Thin bedded dark grey arkosic quartzite with thin black and green shaly partings and interbedded. Baked, and with bedding planes obscured, for a distance of 10-15' below the porphyry sill.

Base Camp - 131' of thin-bedded arkosic quartzite with thin black shaly partings and interbeds.

The mainland exposures pass to the Manitounuk Islands by means of a peninsula.

The following section of this division was measured on one of the Manitounuk Islands in the vicinity of Boat Opening, by A.S. Ashton.

Descending -

15' reddish ferruginous sediments

20' cherty limestone (pinches out at North end of the Sound)

80' arkosic quartzite of varying shades of brown, red and grey, interbedded with thin beds of black shale.

G?A?Young reports a thickness of 960' for this division on one of the more southerly Manitounuk Islands, the division being there overlain by an iron-formation.

Young also reports a thickness of 400' on Long Island, similarly overlain by iron-formation.

A satisfactory correlation of this division therefore exists from the Richmond Gulf through to the head of Manitounuk Sound (where no iron-formation is present) to the Manitounuk Islands (by way of a peninsula, physically seen), and then down the Manitounuk Islands through to Long Island, this division containing the iron-formation on the southerly Manitounuk Islands and on Long Island.

On <u>all</u> of the foregoing exposures the flows lie <u>above</u> the iron-formation, wherever the iron-formation is present as the top member of this division.

Moore and Young report that they lie <u>above</u> the iron-formation on the Belcher Islands.

Low reports that flows very similar in character to those of the Richmond Gulf area lie above the ferruginous beds of the Hopewell Islands, which are also similar physically and lithologically to the Nastapoka Islands that he correlates the two chains of islands.

The importance of the foregoing facts becomes apparent when we consider the position of the Nastapoka Islands with respect to this division.

An examination of Belanger Island made by the writer showed 350' of grey and white sandstone and quartzite, interbedded with brown and green silicious shales, and passing insensibly towards the top of the division into a series of thin bedded ferruginous sediments, representing the iron-formation of the Nastapoka Islands.

These feeruginous sediments persisted for two hundred feet to the summit of the island. Some thin flows were interbedded toward the top of the quartzites.

Low reported 50' of limestone and dolomite at the base of his Belanger Island section, taken to the north of where the above described section was taken.

Low believed that the Nastapoka Islands took up their present position due to faulting, being thrust up from the underlying Richmond group. He based his argument partly on a general lithological similarity.

From an examination of the foregoing description of this division as represented on the mainland, Manitounuk and Long Islands it is evident that a strong general lithlogical similarity can also be drawn of the Nastapoka Islands sediments to those of the mainland, Manitounuk and Long Islands. Thin-section examinations substantiate this general similarity.

(See appendix)

Leith did not believe that the Nastapoka Islands had been upthrusted from the underlying Richmond group, pointing out that the structure of the Islands was not in accord with the secondary folded structure of the underlying Richmond group. The writer agrees with Leith on this point.

Leith then postulated that the Nastapoka Islands represent a newer, higher division, overlying the flows of the mainland. With this the writer does not agree. If this is so, it places the iron-formation of the Nastapoka Islands above the main thick series of flows, a condition that is not met with at any other section in this Hudson Bay basin.

To re-assess, the iron-formation of the Manitounuk Islands and Long Island is the top member of a quartzite division which may be seen to pass physically by way of a peninsula to the mainland, where the iron-formation is lacking. The division lies between the flows and the dolomites at these places.

The same condition holds on the Belcher Islands where the iron-formation lies at the top of a quartzite division that occupies a position between the main thick flows and the algal limestones.

The same condition holds on the Hopewell Islands, where the ferruginous beds lie at the top of a quartzite division that is capped by a thick series of flows.

This leads to the conclusion that the quartzite division with overlying iron-formation, as represented on the Nastapoka Islands, may be correlated with the iron-formation as seen at numerous other localities mentioned, and thus to occupy its present position must have been thrust up by a low angle thrust from farther out to sea, to take up its present position seemingly overlying the flows of the mainland. A further conclusion is made that the flows overlying this division on the Nastapoka Islands have been eroded away, a conclusion that is logical due to the fact that the flows of the mainland are in many places quite thin due to erosion.

Further evidence to justify the postulation of the thrust position of the Nastapoka Islands might be drawn from the fact that the Belcher Islands are folded into anticlines and synclines, and that a series of reefs exists from the Nastapoka Islands to the Belcher Islands. It is quite possible that these reefs represent the anticlinal tops of an intervening folded structube. The axes of the folds on the Belcher Island strike N-S indicating an E-W compressive force, the direction of force necessary to have thrust up the Nastapoka Islands as postulated.

Division No. 3

No. 3 Division consists of a series of concretionary cherty limestones and dolomites, exposed on the eastward facing scarp of the Nastapoka group as present on the mainland. It occurs at intervals along the coast from Manitounuk Island to Cape Jones as outliers of the main formation, and is present on Long Island.

This division contains the ore-bearing horizon, and is of variable thickness, not always showing the same relation to the underlying plane of structural discordance. It rests unconformably on the Richmond Group, and unconformably on granite where the Richmond group is absent.

The succession of beds, as outlined by diamond drilling and by examination of the eastward facing scarp on the mainland is as follows:

	Thickness	
1.	20-177'	Buff weathering silicious dolomitic limestone, generally thin bedded, and containing numerous black shaly partings and thin sandstone interbeds, together with cherty lenses and thin laminations of tuffaceouso origin.
2.	5-10'	Brecciated cherty limestone, sometimes carrying minor amounts of galena and sphalerite. Known as the TOP MINERALIZED BED.
3.	0-19'	Buff weathering silicious limestone, showing oolitic structure, with a thin basal green

3. 0-19' mudstone member called the <u>HORIZON MARKER</u> where encountered in the Nancy Island area.

4. 20-54' Massive cherty limestone. Weathers yellow-white and contains numerous stylolites.

5. 8-80' Greyish-brown weathering cherty limestone. Contains the galena and sphalerite-bearing horizon known as the <u>MAIN MINERALIZED BED</u>.

6. 0-90' Grey weathering cherty limestone, probably concretionary. Generally obscured by talus where present on the erosional scarp.

7. 0-20' Black and red masses of chert in a lighter-coulored sandy matrix. Seen only in the Ruby Lake area.

8. 0-80' Black weathering cherty limestone. Seen only in the Ruby Lake area.

Description of individual members of #3 Division:-

1. 20-177' The first member of this division is a buff-weathering silicious dolomitic limestone, generally thin-bedded, and containing numerous black shaly partings and frequent thin sandstone interbeds. Chert is present in minor amounts as thin lenses.

The member is of variable thickness as follows:-

30' at the Richmond Gulf drilling camp.
120'at Nancy Island drilling camp, and
177' at Base Camp.

The formation noticeably thickens from Richmond Gulf southward.

On the eastward facing scarp this member is usually obscured by talus from the overlying rocks. It shows many features indicative of shallow water disposition, such as mudcracks, sandstone interbeds, intraformational sharpstone conglomerates, and very highly contorted folded structure believed due to penecontemporaneous folding.

Samll vertical faults or joints with displacements not greater than ½" are frequently seen in the diamond drill core from the Nancy Island area. These small fault are usually tight, but occasionally the walls are separated, in which case carbonate or quartz vein material fills the fracture.

Under the microscope fine grained limestone may be seen, containing thin bands of apparently pyroclastic origin. The limestone is arranged in bands of variable texture indicative of cyclic deposition.

A chemical determination for insoluble residue indicated in excess of 50% of insoluble residue, believed to be mainly silica.

2. 5-10' The second member of this division was named the TOP MINERALIZED BED, as it carries minor amounts of PbS and Zns as a whole not sufficiently concentrated to be of commercial value.

This bed is very cherty, containing up to 50% of chert as thin black and white bands, which are crenulated, and sometimes appear to be severely deformed and brecciated. The crenulations are similar to those of the main concretionary limestone bed, and it is possible that this bed is of concretionary origin also.

Where exposed on the eastward facing scarp, this bed usually weathers as one with the overlying No.1 member of this division, and is usually obscured by talus.

3. 0-10' No. 3 member is a light grey siliceous limestone, often showing oolitic structure, and contains a thin basal green mudstone member called the HORIZON MARKER where encountered in the Nancy Island area drilling camp.

The bed is of relatively little importance, not having been seen at all on the eastward facing scarp, where No. 2 member rests directly on the No. 4 which forms the first broad ledge pf the scarp.

4. 20-54' The fourth member of this division is a massive silicified limestone, which weathers yellow-white, and forms the first broad ledge of the eastward-facing erosional scarp.

Blue black chert is present in large lenses up to 2" in thickness, and as thin crenulated bands. This bed contains numerous stylolites, and has the appearance of marble. It takes a high polish from the diamond drill bits.

The base of this member rests on the main mineralized ledge, sometimes carries minor amounts of galena and sphalerite as disseminations of the limestone.

The bed thickens from 20' at the Richmond gulf to 54' in the Nancy Island and Base Camp area, No measurements were made south of the Base Camp, but this member stands out continuously southward at the least as far as the head of the Sound.

5. 8-80' The fifth member of this division is a cherty concretionary limestone. It contains the main galena and sphalerite-bearing horizon, and is known as the MAIN MINERALIZED BED.

This mineralized limestone bed forms the second broad ledge of the erosional scarp. The limestone is grey weathering, but this colour is normally obscured by gossan, and the bed stands out due to the rich brown colour imparted by the oxidation of iron pyrite.

Pyrite mineralization, together with calcite and quartz, is heavy, filling fractures and forming gash veins in the limestone. The pyrite undergoes a chemical decomposition at a rapid rate, so that the veins weather out faster than the limestone in which they lie, leaving a rough hummocky surface covered with gossan which contains small clear residual quartz crystals, and, in places, cubes of galena.

This member is characterized by the algal concretionary structure described by Moore, and noted by him as being present on Long Island and the Belcher Islands. These algal concretions are circular or elliptical in plan, composed of concentric rings, and sometimes containing more silicious bands which stand out in weathering. They are usually less than one foot in diameter. For a full description of these algal concretions, A.S.Ashton's thesis on the subject should be consulted.

Pyrite selectively replaces some of these algal concretions, favoring certain of the concentric rings. Carbonate and quartz, with associated galena and sphalerite are sometimes present as a replacement material, replacing the core of the concretion.

Sketch of an algal concretion pitted with replacement pyrite.(plan view)

The bed is highly fractured, and contains numerous vugs and open cavities with quartz or carbonate crystals.

Galena and sphalerite are associated with the pyrite and carbonate, and are present as vein material with a carbonate gangue, as disseminations in the limestone, and sometimes as more massive lenses in the limestone. Fracturing and vein filling have been so pronounced in some areas that a mineralized breccia occurs, in which original structural features have been obliterated.

The main mineralized bed is of variable thickness throughout the district. Low reports it as 8' thick at the entrance to the Richmond Gulf, where it contacts the underlying Richmond Group. It thickens to the south to a maximum of about 80' in the Ruby Lake area, where it overlies three additional limestone members which constitute some 200' of limestone between the base of this member and the underlying Richmond Group.

An objection must be raised to Leith's description of this formation as " a continuous even member, always showing the same relationship to the plane of structural discordance".

At the entrance to the Richmond Gulf it is thin, and immediately contacts the underlying plane of structural discordance. In the Ruby Lake area it is considerably thicker, and is underlain by an additional 200' of strata before the underlying Richmond Group arkoses are reached.

It thins to the south, where the ledge on the scarp is much broader.

Due to the lithological similarity, contacts between the limestone members are difficult to place when logging core. In the Nancy Island area the upper contact of this member was defined generally in the zone that the massive stylolitic limestone member No.4 passed to the darker mineralized brecciated limestone of this member. The lower contact was tentatively defined by an 8" band of oolites, and the member outlined by these limits varied from 50' to 80' in thickness. Past the bottom contact as so defined 200' of additional drilling in a cherty limestone failed to penetrate the underlying Richmond group arkoses.

6. 0-90' The sixth member of this division is a grey weathering cherty limestone, probably concretionary. In the north end of the concession it usually forms one scarp with the Main Mineralized Bed, while in the south it forms a thinner broader ledge acting as a base for the Main Mineralized Bed.

The thickness of 90' was measured in the Ruby Lake sector. It thins to the south, where it forms a definite broad ledge as a base for the Main Mineralized Bed. It is present at Richmond Gulf drilling camp, where it and the overlying main mineralized bed have a combined thickness of 110'. It is not present at the entrance to the Richmond Gulf, Low reporting only 8' of the Main Mineralized Bed contacting the Richmond Gulf group there.

This member is characterized by the crenulated type of concretion.

7. 0-20' The seventh member of this division has been noted in one locality only, that of the Ruby Lake drilling camp. It consists of black and red masses of chert in a lighter coloured sandy matrix. The fragmental chert is angular and sharp cornered.

8. 0-80' The eighth member of this division is a black weathering cherty limestone. It was seen at one locality only on the erosional scarp, in the Ruby Lake area. The contact with the underlying Richmond Group arkoses was obscured by talus.

Due to the 6th, 7th and 8th members of this division lying below the Main Mineralized Bed, and in the main being obscured by talus, little work was done on them, and consequently little can be written about them without sacrificing accuracy. The same statement is true of the plane of structural discordance between the Nastapoka and Richmond Groups. No geological work has been done to try to solve the differences of opinion between Low and Leith as to whether an erosional unconformity or thrust fault exists between the Nastapoka and Richmond Groups.

Division No. 4

RICHMOND GROUP

The Richmond Group, as outlined by Leith from Low's work, is as follows:- "coarse arkose, grading above into sandstone and argillites. Interbedded with basic flows 1000'. Intruded by some of the red granites of the mainland against which the Nastapoka series lies.

Exposed along the lower parts of the eastward facing scarps along the west side of Richmond Gulf, forming most of the islands and the eastern shores of the Richmond Gulf. Low estimates 2450' ".

The writer examined a section of the Richmond Group on the west side of the Richmond Gulf, and this cursory examination verifed Leith's outline.

Low took his section at a different locality on the west shore of the Richmond Gulf than the writer, and the main difference found was in the thickness of the flows. Where examined the flows were several hundred feet thick and appeared to be intraformational between two arkosic series, near sea-level.

A detailed study would be required to solve the more complex structure of the Richmond Group. In the main it is an arkosic series. Where examined at the Richmond Gulf it contains at least three possible unconformities or thrust planes.

The secondary folded structure of the Richmond Group is definitely not in accord with that of the overlying Nastapoka Group, and is considerably more complex. Leith gave this point considerable prominence in his argument as to erosional unconformity vs. thrusting, and it appears to be a strong point in favor of the erosional unconformity theory.

Part 111

- GEOLOGICAL STRUCTURE-

General Features
    possibility no. 1 (Leith)
    possibility no. 2
    possibility no.3 (Low)
    possibility no. 4

Cross-folding in the area
Fracture-pattern

GEOLOGICAL STRUCTURE

GENERAL FEATURES

The accompanying structure sections, taken at right angles to the coast, are designed to show the different possibilities of the major structural features of the Nastapoka and Richmond Groups.

Possibility No.1-

C.K. Leith was the proponent of possibility No. 1. As has been previously pointed out, he believed that the Nastapoka Islands formed the top member of the Nastapoka Group. This has been doubted by the writer, due to the iron-formation correlation. At every exposure of the iron-formation in this Hudson Bay Basin where the flows are in evidence, the iron-formation has been found to underlie them. Leith's theory would put the Nastapoka Islands with their iron-formation capping above the flows. This argument has been dealt with more fully in the General Geology Chapter of this report under Division #2, in which the Nastapoka Islands are considered to represent Division #2, underlying the flows of the mainland.

Leith was opposed to Low's conviction that the Nastapoka Group as present on the mainland attained its position by virtue of a low angle thrust fault. Leith believed that the Nastapoka Group lay unconformably on the Richmond Group. The strongest of the arguments he advanced was that the local structural features of the Nastapoka Group were not in accord with those of the underlying Richmond Group. This argument is substantially correct, borne out by visual examination and by an examination of the aerial photography of the district. The underlying Richmond Group contains local folds and domes that are lacking in the Nastapoka group, and the regional dip of the Richmond Group is more to the south than to the west, as opposed to the westerly regional dip of the Nastapoka Group.

Possibility No. 2-

Possibility No.2, by virtue of which the quartzites and iron-formation forming the Nastapoka Islands are correlated to the quartzite division underlying the flows of the mainland, by way of folding, is not considered by either Leith or Low.

Deep water conditions are considered to prevail in Nastapoka Sound, a condition that might not be possible with the gentle folding outlined in possibility No. 2.

Another argument against this possibility lied in that if this possibility is the correct interpretation, several hundred feet of iron-formation capping the quartzite on the islands would have to pinch out across the few miles connecting the islands with the quartzite division of the mainland.

Possibility No. 3 -

Possibility No. 3 is outlined by A.P.Low. Low believed that two fault lines existed, one between the Nastapoka Islands and the mainland, and the other between the Nastapoka Group mainland exposures and the underlying Richmond Group.

Low noted that the Nastapoka Group does not always bear the same relationship to the underlying Richmond Group, and that thus the thickness of the limestone division contacting the Richmond Group is variable.

Leith denied this, claiming a continuous even limestone member. Cross-sectioned evidence, and photographs presented earlier in this report affirm Low's observations.

However, admitting the fact that a variable thickness of the basal division of the Nastapoka Group, is there any reason why this situation could not arise if the basal division of the Nastapoka Group was laid down on an erosional surface?

Leith's argument opposing the theory of fault because of minor structural dissimilarities between the two groups appears to be valid. Leith did admit, however, that there had been some movement. An examination of the aerial photographs indicates two breaks in the Richmond Group which appear to be low-angle faults, due to a thrusting from the west. These breaks show in the Richmond Gulf area, in the northward-facing cliff south of the entrance to the Gulf. If these breaks are low-angle thrust-faults, they indicate thrusting in the Richmond Group at least.

As has been previously pointed out, Low believed that the Nastapoka Islands were thrust up from near the top of the underlying Richmond Group, and he based his argument on a general lithological similarity. However, a strong lithological similarity exists of the quartzites of the Nastapoka Islands to the quartzite division of the Nastapoka group present on the mainland. In addition, the local structural features of the Nastapoka islands are not in accord with those of the underlying Richmond Group.

Possibility No. 4-

Possibility No. 4, outlined by the writer, would place the Nastapoka islands as thrust over the mainland divisions, the mainland divisions lying unconformably on the Richmond Group, with some movement of the mainland divisions of both groups due to an E-W compressive force. This force is believed to have been the same force that folded the Belcher Islands into long double-pitching folds, the axes of which strike in a northerly direction.

In short, possibility No. 4 is the same as No. 1 possibility, Leith's postulation, but differs with respect to the position of the Nastapoka Islands.

Leith would place the Nastapoka islands above the flows. The writer would place them geologically below the flows, attaining their seemingly overlying position by virtue of a thrust-fault. The main argument supporting this theory is one of correlation, and has been covered throughly in the general geology section of this report, under Division No. 2.

CROSS-FOLDING IN THE AREA

Evidence derived from topographical features, and from diamond-drilling in the Nancy Island area indicates the presence of gentle cross-folds, whose axes strike in a north-easterly direction. This cross-folding may be seen on one of the islands of the Manitounuk chain, where the eastward-facing scarp descends to the water. The sedimentary strata are seen to be gently folded, the limbs of the folds not departing from the horizontal by greater than 10 degrees.

A NW-SE profile across the Nancy Island drilling area, cutting holes N-16 and N-15, indicates a cross-dip superimposed on the westerly dip. The cross-dip appears to be gentle and regular, and was measured at 7 degrees, Hypothetically, the crest of the anticline would be in the region SE of D.D.H. N-16, and the axis would strike NE-SW.

Evidence of cross-folding is seen to be inconclusive, but it appears probable that gentle cross-folds do exist in the Nastapoka Group. An interesting feature of these cross-folds is that their axes (if the interpretation is correct) strike nearly at right-angles to the general direction of the main fractures of the district.

FRACTURE-PATTERN

An examination of the aerial photographs of the concession reveals a general parallel series of breaks striking N. 30 W., together with a secondary series striking S 40 W.

The strongest sets of fractures were found to be developed in the region between Base Camp and Little Whale River (which covers the Nancy Island and Ruby Lake drilling camps), and an area north of the Richmond Gulf. In each of these areas the general strike of the main fractures was N.30 W. The fracture-pattern in the ten-odd miles between Little Whale River and the strong set established north of the Richmond Gulf was less pronounced, and showed variations in strike from N. 30W. to N. 80 W.

In the Ruby Lake area these fractures may be seen to cut the Nastapoka Group, the underlying Richmond Group, and the granite that is intrusive into the Richmond Group.

Bodies A and B, outlined by diamond-drilling in the Nancy Island area, lie along one of these breaks. The break extends for several miles across the area. The strike is N. 20 W. in its southern part. It splits into two main fractures across the Nancy Island camp, and changes direction to N. 5 W., appearing to die out in a shear-zone spanning 500 feet, located about 1500 feet north of body "B".

There is no apparent vertical or horizontal movement shown by this break in the Nancy Island area. The dip is vertical or within a few degrees of vertical, a condition that holds for these fractures where seen cutting vertical cliffs elsewhere in the district.

Drilling in the Nancy Island area seems to indicate a connection between this break and the better values, but any interpretation as such should be used with caution until more evidence is at hand.

The mineralized limestone bed itself is more highly fractured into a more closely-spaced diamond shaped pattern of fractures. This may have had a bearing as a structural control of mineralization, providing easy channels for the mineral-bearing solutions to penetrate into the limestone strata.

The writer has not attempted to solve the conditions creating the fracture-pattern, nor its age-relationship. It would seem logical to connect the fractures with the forces that regionally folded the Nastapoka Group and the Belcher Islands into long doubly- pitching folds striking in a northerly direction. Readers are referred to T.A. Harwood's thesis on the area for a more detailed consideration of the fracture-pattern and its associated problems.

Part lV

- ECONOMIC CONSIDERATIONS -

General

Nature of the Mineralization

Paragenesis

GENERAL

The results of the diamond drilling campaign of 1948 may be noted on the accompanying maps. The tonnages noted are as outlined by the company's consultant, Mr. Lloyd B.Almond, and indicate 1,005,710 tons @ 1.06% lead and 1.36% zinc. This total was computed by adding the results from the three main drilling areas, which are as follows:

Nancy Island Area	294,460 tons @ 0.72% lead,	2.15%	zinc
Ruby Lake Area	578.690 tons @ 1.07% lead,	1.26%	zinc.
Lake Monte and Marge	132,560 tons @ 1.75% lead,	nil	zinc

All of these three areas are open to expansion. As the writer spent most of the summer in the Nancy Island Area, he may be excused of a slight bias in feeling that it is the more favourable of the three showings. In the opinion of the writer, tonnage in the Nancy Island Area could be materially increased by widening the drilling section at right-angles to the break, and by drilling, if possible, the overburdened gap between "A" and "B" bodies, lying along the break.

There is a possibility of additional good values being found in a frectured zone some 1400 feet north of "B" body in the Nancy Island Area. This fractured zone is a continuation of the main Nancy Island Area break, and the only unfavourable feature of the zone is a swampy valley lying between it and the "B" body, which might make it difficult of access with the drills.

In the event of mining in the Nancy Island Area, the artesian water might constitute a major problem, but similar conditions in the deposits of the Upper Mississippi valley did not present the difficulty that was expected. Again, in the event of mining in the Nancy Island Area, much of the operation would be conducted below sea-level. In this respect it may be pointed out that where artesian water conditions existed in the Nancy Island Area, the water was tested by the writer, and no salt water was encountered.

As before-mentioned, the other areas of the concession are also open to expansion, and the company's consulting geologist, Mr. Lloyd B. Almodn, undoubtedly has the situation well in hand as regards the future drilling. The writer has confined his remarks to the Nancy Island Area, as he feels competent to give an opinion only in that area, and because he feels that he has already transgressed too far on the ground of the consulting geologist.

NATURE OF THE MINERALIZATION

To date the interest of the company has been focussed mainly on one mineral-bearing limestone horizon of the Nastapoka group, which contains lead, zinc and silver values generally throughout the district, and which contains copper values in the Doris Lake Area.

Galena and sphalerite have been noted at other horizons of the Nastapoka group, the mineralization in those other horizons having so far been noted in minor quantities only. This covers the galena noted in a six-inch quartz-carbonate vein in the porphyry sill, and the minor amounts of galena and sphalerite noted in a thin vein cutting the sandstone-quartzite. Both of these occurrences were in the Nancy Island drilling area.

In general, work to date has shown the main mineralized zone to be confined to the limestone division of the Nastapoka group, with the better values concentrated in the No. 5 limestone member. The No. 5 member is a hard blue-grey limestone of algal concretionary origin. It is highly fractured and jointed, containing numerous small vertical breaks showing minor displacement. These fractures are sometimes tight, and sometimes separated and filled with carbonate and quartz vein material, with associated galena and sphalerite. The better values prevail in general in a mineralized breccia, with carbonate and quartz cementing the brecciated limestone fragments. Pyrite is present in considerable quantity as a fracture-filling and replacement material, and is itself replaced by galena, sphalerite, carbonate and quartz.

Galena and sphalerite are present in gash veins, as fracture - filling material, and as disseminated replacements in the limestone. Galena is sometimes present as massive lenses or slabs, but this condition so far has not been found to be common.

In the Nancy Island Area, as outlined by the diamond-drilling, the character of the mineralization appears to bear a resemblance to the flats and pitches characteristic of the deposits of the upper Mississippi valley.

Surface features of the mineralized limestone member may be easily examined on the eastward-facing scarp. Pyrite, present in considerable quantity as a fracture-filling and vein material, has eroded away more rapidly than the limestone host-rock, leaving a crumbly, hummocky surface, with the more resistant limestone hummocks standing out. The surface of the bed is covered with gossan, which contains numerous small very clear quartz crystals, and often white-coated cubes of galena.

Vugs and open fractures are fairly common, being noted on surface and in the drill-core. The vugs are lined with calcite and quartz crystals, and sometimes contain secondary pyrite which has formed on the carbonate or quartz crystals.

PARAGENESIS

The paragenesis of the ore was studied from five polished sections. The section showed a general similarity of features. The evidence is not conclusive, and the paragenesis outlined below is presented as an approach to the problem.

limestone
    fracturing
pyrite
    fracturing
carbonate
galena
sphalerite
    fracturing
quartz
carbonate
    fracturing
pyrite

The most striking feature noted in the polished-section examinations was the amount of fracturing and fracture-filling that had taken place at different ages. The characterists of the ore as seen in polished-section are as follows:

'The bulk of the pyrite is early, and is highly fractured into a grid-like fracture-pattern. These fractures may be filled with galena, sphalerite, carbonate or quartz. Fracture-filling of this grid-like pattern sometimes gives rise to a checkerboard effect containing squares of pyrite.

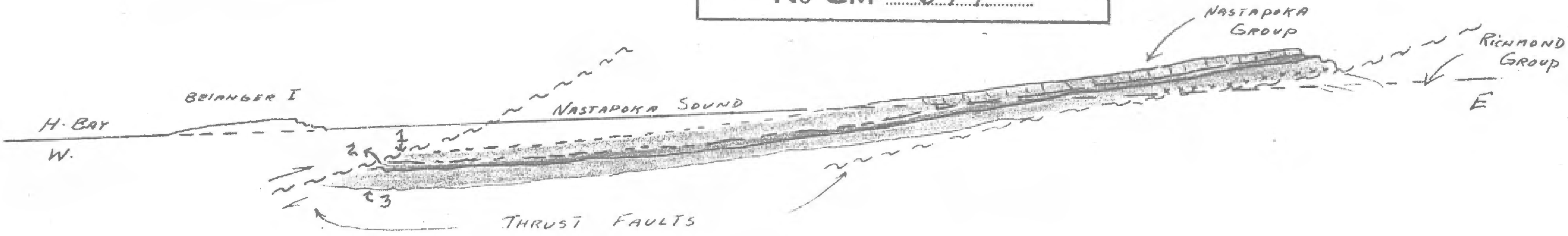
Galena and sphalerite fill pyrite and wall-rock fractures, together with associated carbonate. Galena and sphalerite also replace pyrite and carbonate, and are sometimes themselves replaced by carbonate of a later age.

Quartz fills fractures in galena, sphalerite and carbonate, and is itself replaced by a later age of carbonate. Finally, fractures are noted cutting all ages of minerals in the ore.'

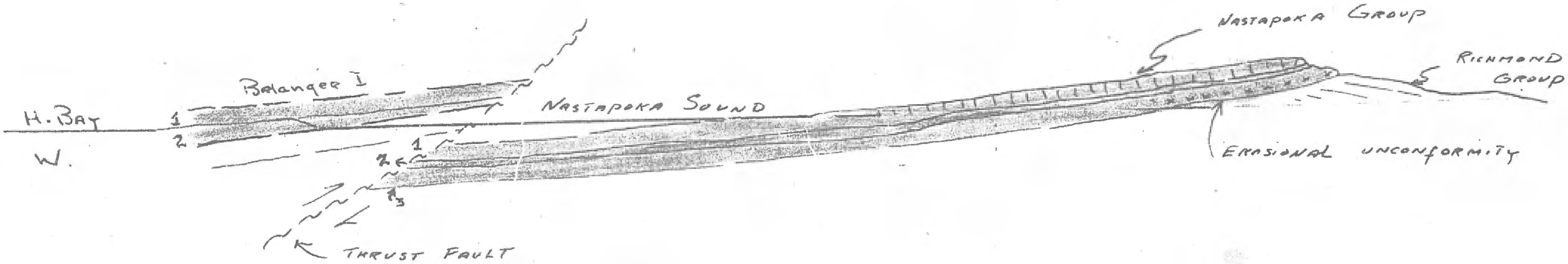
Ministère des Richesses Naturelles, Québec
SERVICE DES GÎTES MINÉRAUX
No GM- 679

PUBLIC

Possibility No 3 (Low)



Possibility No. 4.



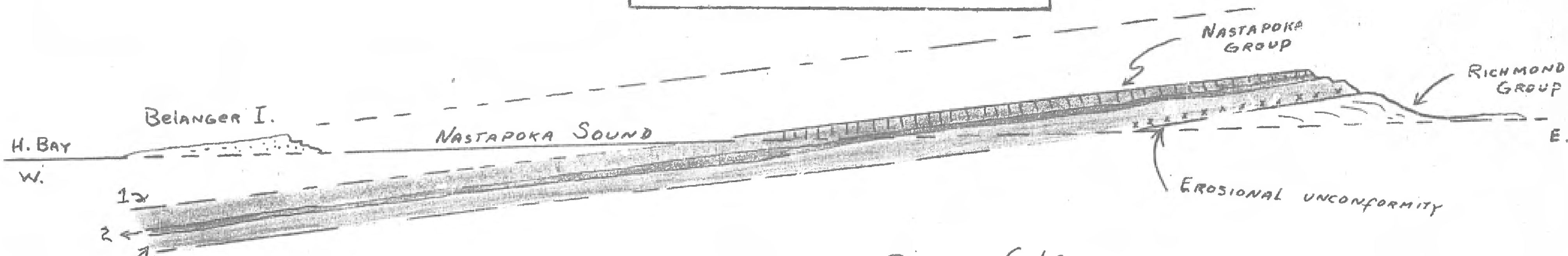
Ministère des Richesses Naturelles, Québec

SERVICE DES GÎTES MINÉRAUX

No GM- 679

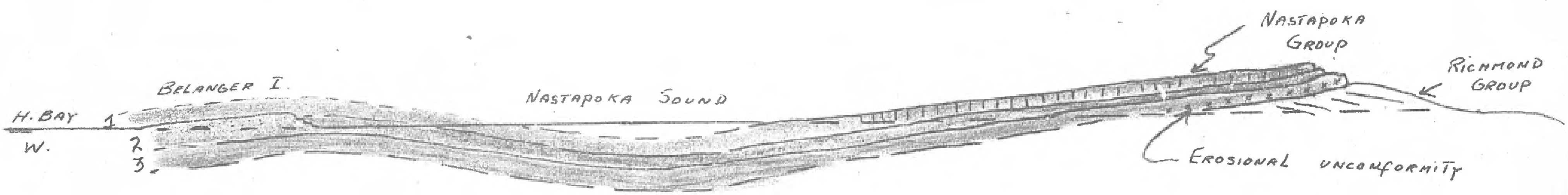
PUBLIC

Possibility No 1 (Leith)



E.W profiles:- Section just S. of Richmond Gulf

Possibility No 2



1 Flows + Sills

2 S.S. - Quartzite

3 Concretionary limestones

Scale: One mile to the inch