THE GEOLOGY OF
THE RANKIN INLET AREA
AND
NORTH RANKIN NICKEL MINES, LIMITED,
NORTHWEST TERRITORIES

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ABSTRACT

Rankin Inlet, on the west coast of Hudson Bay, is 200 miles within the Arctic barren lands. The surrounding area is underlain by a sequence of a lower volcanic unit, a middle sedimentary unit, and an upper volcanic unit. These rocks have been folded into an easterly plunging synclinorium at the west end of Rankin Inlet and into an anticlinal fold north of the Inlet. Granitic gneiss intrusions outcrop a few miles west and north of Rankin Inlet; the sediments and volcanic rocks adjacent to the gneisses have been granitized. All the rocks are of Archaean age.

Numerous basic and a few ultrabasic bodies occur within and between the sedimentary and volcanic units. A serpentinized sill on the northwest shore of the Inlet contains the nickel-copper deposit of North Rankin Nickel Mines, Limited. Some of the other basic and ultrabasic intrusions contain nickel and copper sulphide minerals; these were the only deposits of economic interest noted. Other minerals include pyrrhotite and pyrite along shear zones, in dolomitic beds, and as disseminations through tuff beds. Traces of gold have been recorded.

North Rankin Nickel Mines, Limited is mining a 500,000 ton high-grade nickel-copper deposit at the rate of 250 tons per day. The ore occurs within a depression on the floor of a serpentinized ultrabasic sill, and grades 3.3% nickel and 0.82% copper, with small amounts of platinum and palladium. The primary minerals of the ore are pyrrhotite, pentlandite, chalcopyrite, pyrite, and gersdorffite; secondary minerals include marcasite, violarite, and pyrite.

A sheet of massive sulphide minerals 3 to 15 feet thick along the base of the sill is overlain by 30 to 40 feet of disseminated sulphide ore. A thinner, lower-grade orebody occurs along and above a shear zone a few tens of feet above the bottom of the sill. The deposit appears to be a type example of a magmatically segregated ore within an ultrabasic sill.

The ore formed by the gravitational accumulation of drops of immiscible sulphide liquid; subsequently, some of the segregated liquid was injected out along the edges of the depression. Exploratory drilling, combined with magnetometer surveys, indicates that there are other depressions on the bottom of the sill which contain nickel-copper ore. Further exploratory drilling is recommended. From June, 1957 to July, 1958 the deposit has yielded 4,000,000 pounds of nickel and 1,200,000 pounds of copper in the form of concentrates.

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

PART I:

THE GEOLOGY OF

THE RANKIN INLET AREA

Frontispiece. Glaciated valley along a sedimentary bed (outcropping in the foreground) within the lower volcanic unit, on the west shore of Silent Cove.

PART I: THE GEOLOGY OF THE RANKIN INLET AREA

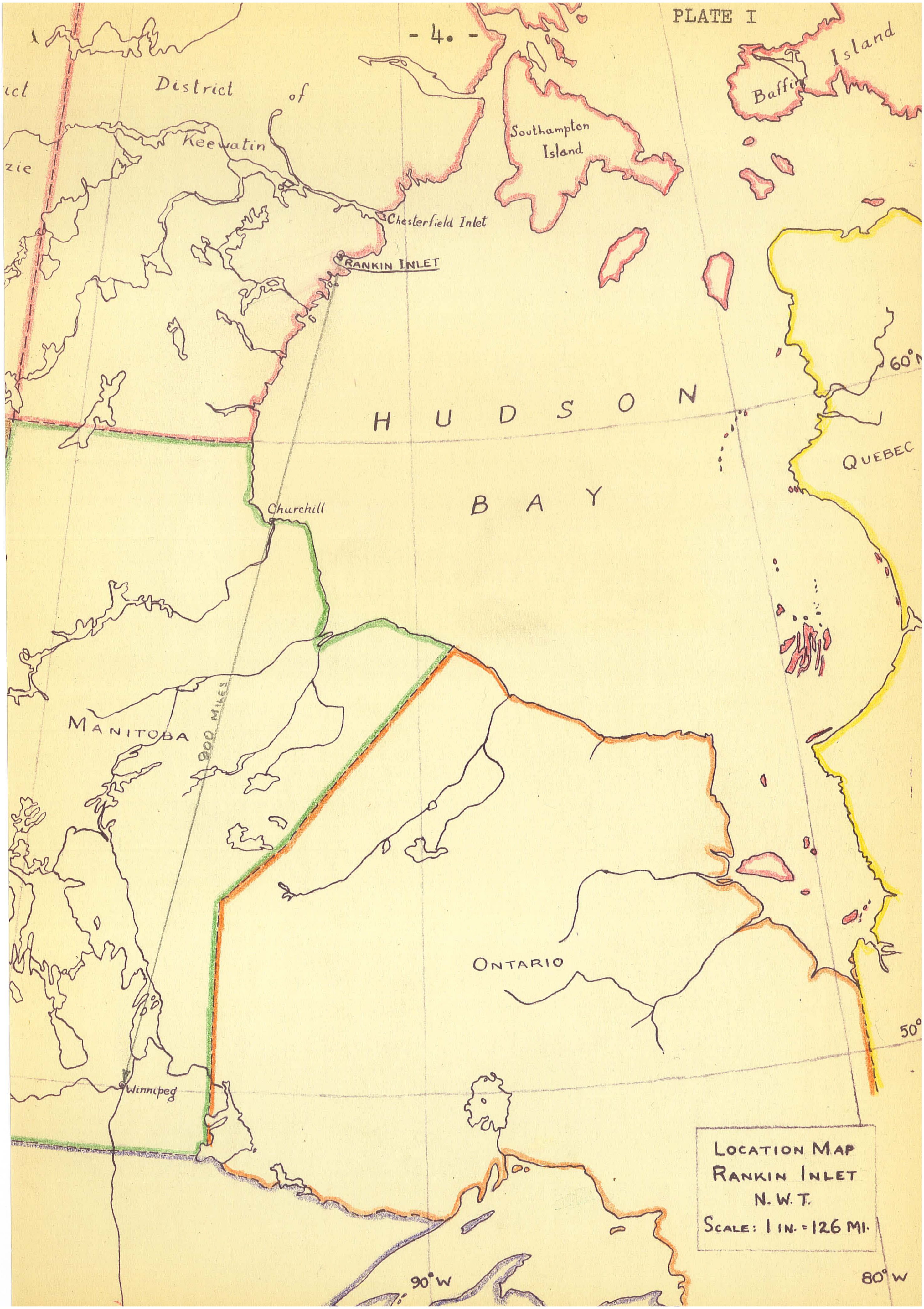
Introduction

In the field season of 1957, lasting from June 15th to September 15th, the volcanic-sedimentary belt of rocks around Rankin Inlet was prospected for economic mineral deposits. The results of this work, supplemented by the laboratory study of thin sections, are presented below. A geological map of the area was prepared from the field observations. The territory mapped has the greatest east-west dimension of 30 miles, and north-south, 13 miles; altogether, approximately 250 square miles were mapped.

Previous Work

This region has been prospected and mapped at intervals by various companies and individuals, but only a few records of the results of their work are available. The reports of Weeks (1931) and Drybrough (1931) contain some references to the geology of the Rankin Inlet area. The Geological Survey of Canada made a preliminary reconnaissance of the area as part of the helicopter surveys Operation Keewatin in 1952 under C. S. Lord and Operation Baker in 1954 under G. M. Wright. A part of their maps, adapted slightly, is shown in Plate II.

PLATE I


District of Keewatin
Baffin Island
Southampton Island
Chesterfield Inlet
RANKIN INLET
HUDSON BAY
60° N
QUEBEC
Churchill
900 MILES
MANITOBA
ONTARIO
50°
Winnipeg
90° W
80° W
LOCATION MAP
RANKIN INLET
N. W. T.
SCALE: 1 IN. = 126 MI.

Field Methods

The area was subdivided into four parts with a base camp set up in each. As almost all the outcrops are easily seen, no "pattern" survey was undertaken, but each outcrop was examined in turn. Aerial photographs were used for location control. The main object of the prospecting program was the finding of ore deposits, and the geological mapping was a secondary consideration.

Acknowledgments

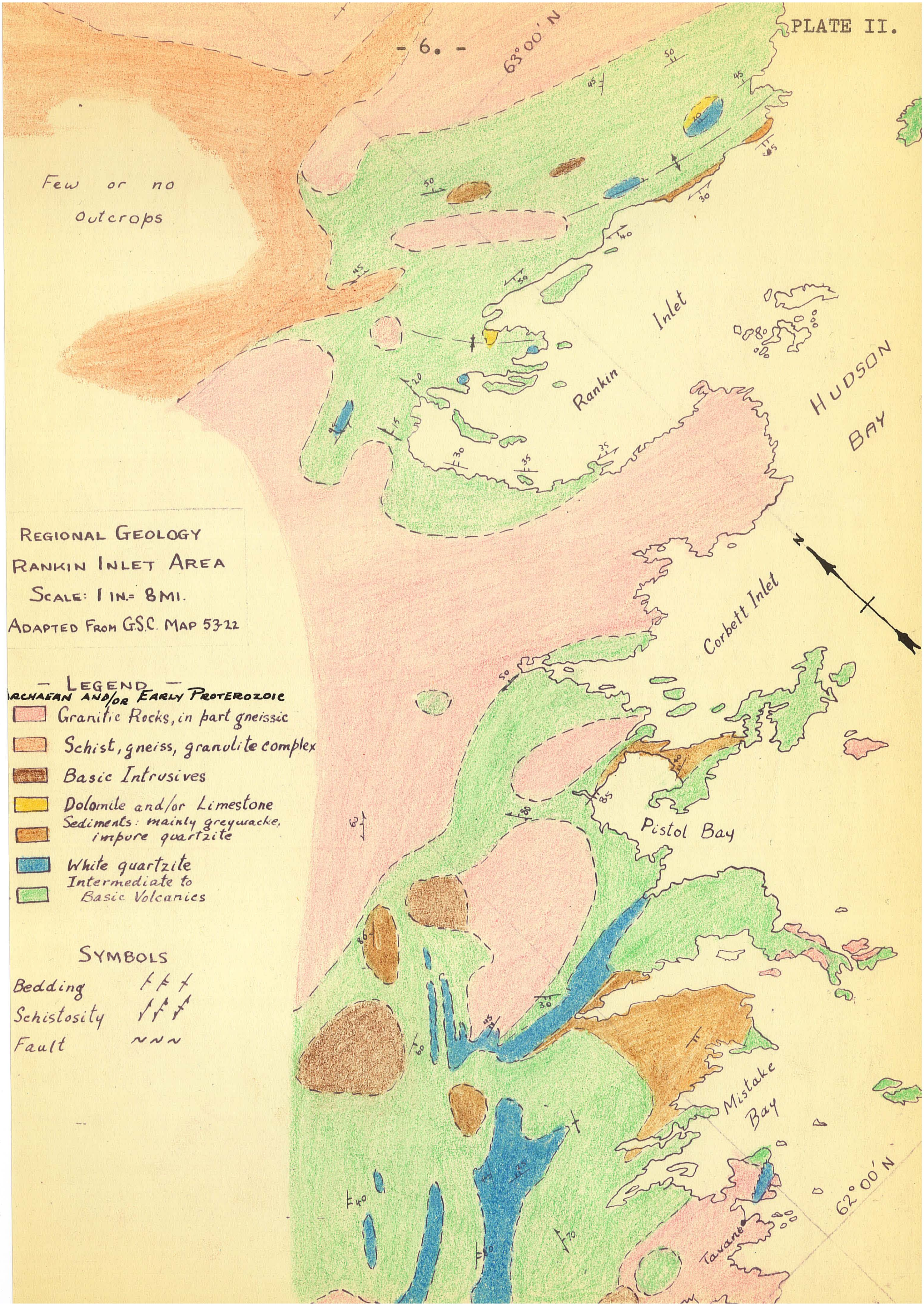
Three prospectors, Don Cranstone, Reg Foulser, and Bill MacDonald assisted in the field work. See also Part II, Acknowledgments.

Geography

The Rankin Inlet region is well within the barren lands, and thus is characterized by numerous lakes on relatively level tundra, broken occasionally by rock ridges. The outcrops are numerous along the shore of Rankin Inlet, but become rare a few miles inland. The area is on the boundary between the Arctic and sub-Arctic regions.

The winter is long and cold, characterized by strong winds, giving a high windchill value. The spring is short; most of the snow melts within a short period from about June 1st to June 15th. The summer

PLATE II.


63°00' N
Few or no outcrops
Rankin Inlet
HUDSON BAY
N
Corbett Inlet
Pistol Bay
Mistake Bay
Tavane
62°00' N
REGIONAL GEOLOGY
RANKIN INLET AREA
SCALE: 1 IN.= 8 MI.
ADAPTED FROM G.S.C. MAP 53-22
— LEGEND —
ARCHAEAN AND/OR EARLY PROTEROZOIC
Granitic Rocks, in part gneissic
Schist, gneiss, granulite complex
Basic Intrusives
Dolomite and/or Limestone
Sediments: mainly greywacke, impure quartzite
White quartzite
Intermediate to Basic Volcanics
SYMBOLS
Bedding
Schistosity
Fault

season is short but prospecting can be carried on from June 15th to September 15th. Animal life is abundant during this period, especially migratory birds such as geese, ducks, swans, and sandhill cranes. Sea life includes white whales, seals, and arctic char; land animals seen were caribou, fox, wolves, and numerous ground squirrels or "sik-siks". Rainfall is low, and electrical storms very rare. The fall is characterized by strong winds, and also by fog.

The topography is relatively level, with the highest elevation being about 200 feet above sea level. The area is a glaciated peneplain, elevated and eroded.

Glacial Geology

The terrane is dotted with many glacial deposits. Gravel ridges, drumlins, long eskers, roches moutonées, and an almost continuous cover of drift are the prominent features, aside from the rock ridges, of this tundra region. The permafrost has hindered drainage, and lakes occupy the hollows carved by the glaciers. The drainage in the area is controlled in large part by the underlying rock structure, but the glaciation has had a definite modifying effect especially in parts away from the shore. A long curving esker has controlled the course of the Meliadine River for several miles.

Numerous prominent raised beaches give evidence of the gradual step-like rising of the land which was submerged under Hudson Bay during the Pleistocene glacial period. The anticline on the north shore of Rankin Inlet controlled the ancient shorelines, as shown by raised beach benches stepping down to the north on the north side of the fold, and down to the south on the south side. The present height of land follows the axis of the anticline.

Glacial striae indicate that the central section of the great Keewatin ice sheet was located only 100 miles to the northwest and west.

Regional Geology

The area is underlain by volcanic and sedimentary rocks, with some metamorphic derivatives. To the north and west outcrops of granitic gneiss have been reported. East and west of the Meliadine River the volcanic rocks have been altered to hornblende gneiss and the sediments have been granitized to biotite schist and gneiss by the granitic intrusions.

The sediments, mainly white to grey quartzites, with interbedded tuffs and a near basal dolomitic member, outcrop between two volcanic formations of intermediate and basic lavas. The rocks present in the area are listed in the accompanying table of formations.

Table of Formations

Era	Group	Unit	Rocks
Pleistocene			Glacial deposits
		Great unconformity	
ARCHAEAN		Intrusive rocks:	Diabase Lamprophyre Quartz veins Granitic gneiss Gabbro Serpentine
ARCHAEAN			— Intrusive contact —
ARCHAEAN	RANKIN INLET GROUP	Upper Volcanic Unit:	Intermediate lavas: andesite, dacite. Tuff, agglomerate.
ARCHAEAN	RANKIN INLET GROUP		— Conformable contact —
ARCHAEAN	RANKIN INLET GROUP	Sedimentary Unit	Tuff: slaty, cherty. Conglomerate Quartzite, pure white and impure(greywacke?) Dolomite, siliceous. Derived schists and gneisses.
ARCHAEAN	RANKIN INLET GROUP		— Conformable contact, some interbedding —
ARCHAEAN	RANKIN INLET GROUP	Lower Volcanic Unit:	Intermediate and basic lavas: andesite, basalt; minor dacite. Tuff. Derived hornblende gneiss.

The whole assemblage has been folded into an easterly plunging syncline at the west end of Rankin Inlet, and into a westerly plunging anticline on the north shore of the Inlet. Elongate bodies of gabbro and serpentine, as well as narrow dykes of diabase and lamprophyre, have intruded the Archaean rocks and form the most economically promising rocks of the area. Several showings of base metal sulphides were found within the basic intrusions.

The field evidence indicates that there was no great time interval between the deposition of the sedimentary formation and the upper and lower volcanic beds, as these all appear conformable. These units would best be considered as making up a single group of rocks deposited during one of the Archaean periods, probably the Keewatin. The name "Rankin Inlet Group" is proposed for these three units.

The Rankin Inlet Group

The mapping and prospecting were confined almost exclusively to the sedimentary and volcanic rocks of the Rankin Inlet Group because they were considered the most promising host rocks for economic mineral deposits.

The intermediate and basic lavas of the lower and upper volcanic formations outcrop most extensively in the western synclinal area and on Thomson Island respectively. The sedimentary beds outcrop as an arcuate belt around the nose of the syncline, but are best exposed along the axis of the anticline on the north shore of the Inlet. Intrusions of granitic gneiss have altered the volcanic and sedimentary rocks in the northwest quarter of the map area.

The Lower Volcanic Unit (1)*

The rocks of this unit are best exposed around the west end of Rankin Inlet, and form almost continuous outcrops along the coast. Considered as a whole, the rocks in this western area have been but slightly altered.

Lavas make up more than 95 per cent of this unit, and they range in composition from andesite to basalt, with some possible dacite flows. A basalt flow outcrops a short distance north of the mouth of the Diana River, and is dark green to black on both the weathered and fresh surfaces. Some basalt flows occur also on the southwest shore of Melvin Bay. However, andesite is by far the commonest type. It has been weathered usually to a greenish-black, but some low outcrops along the shoreline have a light green surface. Some pillow lavas, fairly well preserved, were seen, and the attitude of the pillows indicates that the rocks have

* (1): refers to the number of the map unit, Plate III.

not been overturned.

Thin bands of tuff (4) are interbedded with the lavas at intervals, and two types are present. One type occurs as an extremely fine-grained smooth black rock, usually with streaks of pyrite throughout, and is common in the area west of Silent Cove. Its outcrops are made conspicuous by the development of a deep purple-red surface stain. The second type is schistose, and it is possible that some of these beds are sheared lavas. They are grey in color, finely laminated, and very fine grained, frequently with streaks of pyrite.

Two quartzite-dolomite beds (2) are also included within this formation. One of these outcrops on the west shore of Silent Cove, as shown in the frontispiece; the other outcrops three miles to the northwest. The sedimentary beds are estimated to be about 50 feet thick. Narrow flat-bottomed valleys, paralleling the regional structure, mark the extensions of these beds. The dolomite contains much quartz, mostly in the form of cross-cutting stringers.

In the area northeast of the Meliadine River, the hornblende gneisses (1a) are probably metamorphic products derived from the lavas of the lower volcanic unit.

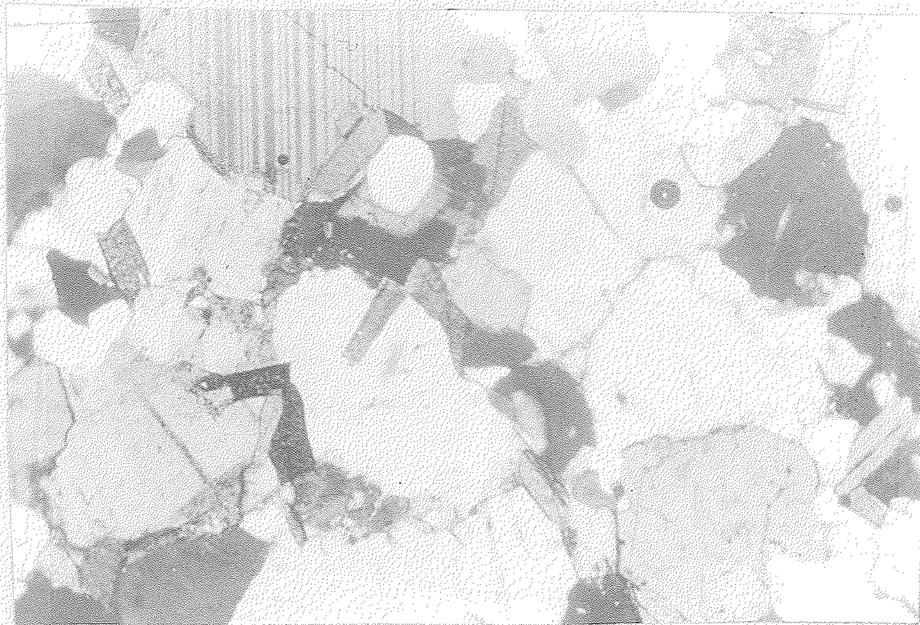


Figure 1. Photomicrograph of biotite granodiorite gneiss, from west of the Meliadine River. (Crossed nicols, x 30)

Figure 2. Outcrops of the lower volcanic unit around Silent Cove; looking west.

The Sedimentary Unit (2,3,4)

The sedimentary rocks are exposed in an arcuate belt around Kudulik Peninsula, and along the anticlinal axis north of Rankin Inlet. South and west of Atulik Lake, the sediments have been granitized.

The various rock types included in this unit are pure white quartzite, in places ripple-marked; impure quartzite; fine-grained dark schistose tuff; black "slaty" tuffs with wrinkled bedding surfaces; dolomite and quartzose dolomite; greywacke and shaly beds; conglomerate; and metamorphic products: quartz augen gneiss and granitic biotite schist. Included within this unit is a basalt flow located about 200 feet stratigraphically above the contact with the lower volcanic unit (1).

The sedimentary beds appear to lie conformably on the lower volcanic flows, and the occurrence of a lava flow within the sediments, and vice versa, suggest that the units are, in a sense, gradational. The two units were not seen directly in contact, but at the west end of Prairie Bay only a five foot strip of drift separates the dolomite from the volcanic rocks. The strike and dip of both units are the same there.

The dolomitic bed (2) is the lowest member of the unit. It is exposed intermittently in a narrow arc extending from the head of Prairie Bay to Melvin Bay; at its north end, it has been shifted westward along a fault striking parallel to the axis of the synclinorium. The dolomitic bed has a brecciated appearance caused by the intersection of quartz and sulphide stringers. In places, the stringers broaden to form pockets of massive sulphide minerals, mainly pyrite, with some pyrrhotite. The southern portion of the outcrop arc is more heavily mineralized, and claims have been staked there at least twice. Several trenches have been blasted across and along the bed. Samples taken during the present investigation were assayed for gold, silver, zinc, nickel, and copper, and except for 0.04% copper, the assays showed only traces or no values. The dolomitic bed is 100 to 150 feet thick.

A series of tuff beds(4), tuffaceous sediments(4), and quartzites(3) overlies the dolomitic member. Some previous workers* have recorded shaly beds and greywackes; it is possible that some of these are gradations between pure volcanic tuffs and quartzite, formed by the introduction of varying amounts of volcanic ash into the site of sedimentary deposition, and possibly mixed with some fine clastic sediment.

The quartzites(3) in the central part of the unit are fairly pure, translucent white, but include a few

* From maps on file, North Rankin Nickel Mines, Limited.

narrow tuff bands. The quartzite is cut by a stockworks of quartz stringers on one of the small islands in Melvin Bay, along the northeast shore. The results of drill holes located along the west limb of the syncline show that another dolomitic or "metamorphosed limestone" bed, about 100 to 150 feet thick, is present 125 feet below the contact of the sediments and the upper volcanic unit. In one drill hole a two-foot section of rounded quartz pebbles in a tuffaceous matrix was intersected slightly below this dolomite.

These drill holes have shown that the upper 500 feet of the sediments, in addition to the dolomitic bed, are composed of an alternating series of pure quartzite, impure quartzite, siliceous tuffs, and dense black banded tuffs. Some sections contain abundant pyrite and magnetite grains, and one section, 50 feet thick, is described in a drill log by R. M. Patterson as tuffaceous iron formation. He notes that the impurities in a series of interbedded quartzites and dolomites appear to be tuff beds ¼-inch to ½-inch thick.

Four thousand feet west of the mine, a small outcrop, previously mapped as conglomerate, is considered to be a quartz augen gneiss developed along a fault. The outcrop has a sheared appearance and the "pebbles" are all glassy quartz lenses. The strike of the shearing is

110°, on line of strike with the fault zone outcropping northeast of the Loon Pond, as shown in Plate IV..

The wide extent of the outcrop belt of the sedimentary unit to the west of the minesite gives an exaggerated idea of its true thickness. Field measurements show that, on the whole, the beds dip between 6° and 30° east, but low dome-like folds give some of the beds a slight westward dip. The true thickness of the sedimentary unit is probably between 3,000 and 5,000 feet.

North of Rankin Inlet the sedimentary unit has a wide outcrop extent also, but again this is caused by the low dips of the beds and not by any great thickness of sediments. The southern exposures can be easily divided into predominantly tuffaceous beds(4) and mainly pure white quartzite beds(3). A narrow band of conglomerate( ) outcrops within the rocks exposed on the shore of Rankin Inlet, north of the western tip of Falstaff Island. Fragments of quartzite, tuff, and dolomite occur within a tuffaceous matrix in which small bluish quartz porphyroblasts are scattered. The conglomerate has been sheared.

Northeast of Atulik Lake, where the sediments are exposed on the north limb of the anticline, bands of quartzite, tuff, and acidic lava alternate. These have been intruded by at least three long narrow sills of a diabase-textured gabbro(7). All these rocks have approximately the same attitude. Dolomitic beds were not seen north of Rankin Inlet.

The rocks of this sedimentary unit were probably formed under shallow to moderately deep water, within an area of intermittent volcanic activity.

<u>The Upper Volcanic Unit (5)</u>

The lavas of this unit outcrop on Kudulik Peninsula, Thomson Island, and Falstaff Island, and on the shore of Rankin Inlet north of these islands. The acidic flows northeast of Atulik Lake are probably associated with this unit. On the whole, the upper volcanic lavas appear to be more acidic than those of the lower unit, although both are predominantly andesitic. On Thomson Island, especially in the southern part, there are many light-weathering dacitic phases; stratigraphically these are the highest lavas exposed around Rankin Inlet.

A thin band of agglomerate( ) occurs near the base of the unit along the east shore of Melvin Bay. Rounded, light-weathering fragments, up to three inches in diameter, are enclosed in a fine-grained dark-weathering matrix. Another band occurs higher up in the unit, outcropping in the east central part of Kudulik Peninsula. A few thin tuff beds occur between some of the flows.

Intrusive and Metamorphic Rocks (1a, 3a, 8)

Granitic gneisses(8) outcrop in the area west of the Meliadine River, and Lord(1953) and Wright(1955) have mapped the entire region surrounding the volcanic-sedimentary belt as being underlain by granitic rock types, predominantly gneisses (see Plate II). An examination of a thin section from a sample taken west of the Meliadine River showed the rock there has a granodiorite composition(Figure 1.) The gneiss is pink, is fine to medium grained, [illegible], and has biotite as the principal mafic mineral. This is the only locality where granitic gneisses were seen in outcrop.

The granitic intrusions have extensively metamorphosed and metasomatized the adjacent volcanic and sedimentary formations. In a belt stretching from west of the Meliadine River to southeast of Atulik Lake two rock types compose the majority of the outcrops. One is a medium-grained dark green hornblende gneiss(1a), in places approaching a hornblendite; this type is best developed northeast of the Meliadine River. The second rock type is a fine-grained pink-white biotite gneiss(3a) of granitic composition. The gneissosity may be so fine that the rock is essentially a schist, and its appearance suggests that it was originally a sedimentary rock. The hornblende gneiss is a derivative of the volcanic rocks(1);

on the other hand, the biotite gneisses and schists have a wider distribution and seem to have been derived from a variety of sedimentary formations, and possibly from volcanic rocks also.

Several ultrabasic and basic intrusives were observed. The serpentinized sill(6) containing the nickel-copper deposit of North Rankin Nickel Mines is described in detail in Part II of this report. Another serpentine sill, very similar in outcrop appearance to the North Rankin sill, but having only half its width, has intruded the lower volcanic unit one-half mile west of Silent Cove. The sill is weathered a distinctive dull orange-green color, is composed of serpentine with bands of soapstone along shear zones, and is cut by calcite-talc-feldspar veinlets. The detailed features of this intrusion are discussed below under economic geology.

Hornblende gabbro(7) in a large outcrop to the northwest of the North Rankin minesite appears to transect the general trend of the sedimentary beds exposed at some distance from the intrusion, but the whole outcrop is composed entirely of the gabbro and no direct measurements could be made of its relation to the surrounding rocks.

Four long thin gabbro sills(7) outcrop north of

Rankin Inlet. One sill, which is exposed in three outcrops each a mile apart on the shoreline, is at the same horizon as the North Rankin sill: the contact between the sedimentary and upper volcanic units. Its composition varies between diorite and gabbro, and one small area within the easternmost outcrop aprroaches granodiorite. A few disseminated sulphide minerals, including chalcopyrite, occur in this body. The intrusion is conformable in attitude with the enclosing rocks.

Three separate gabbroic sills have intruded the sediments northeast of Atulik Lake. They are fairly thin bodies, ranging from 20 to at least 70 feet thick; but one of them outcrops at intervals over a length of four and one half miles, and may possibly be connected with similar bodies northwest of Atulik Lake, another five miles distant. These sills form prominent ridges. The rock is a medium-grained hornblende gabbro, consisting of hornblende prisms in a light green feldspathic matrix. The central part of the sill is massive, but towards the edges there is a definite flow structure with the gabbro having an oriented "diabasic" texture. Near the south contact the rock is finer grained and more schistose, while along the south contact it is a fine-grained dark hornblende schist. The rock is in contact with basic tuffs, in part altered to chlorite schist. The north contact is not exposed. Sulphide minerals were not seen in these sills.

Another small gabbro body, containing some sulphide minerals, outcrops on the shore of Rankin Inlet, north of the west end of Falstaff Island.

A diabase dyke(10) outcrops on four small islands south of Thomson Island, in the upper volcanic unit. The dyke has very irregular contacts, but it averages 15 feet in thickness. It strikes 85° and is vertical. Along the north contact several small areas contain disseminated sulphide minerals, the weathering of which has produced deep purple-red stains. The dyke has some very coarse-grained phases. Many calcite-quartz stringers cut the islands, and some minor faulting has occurred.

Narrow lamprophyre sills occur within all the map units. One of the most persistent sills outcrops near the base of the sedimentary unit within the dolomitic bed. The sills are of the biotite-rich variety.

Structural Geology

In general, the rocks of the southern part of the map area have been folded into a syncline, whereas those of the northern part have been anticlinally folded. The axes of these folds are shown in Plate III. In the western half of the area both folds plunge at a low angle to the east; in the eastern half the folds plunge west.

The rocks in the central area are nearly flat-lying. The major folds are actually an anticlinorium and a synclinorium.

Some faulting has accompanied the folding, and several faults, all striking parallel to the axes of the folds, are shown on the geological map. One major fault outcrops at intervals along the south shore of the two largest islands in Melvin Bay, across Tudlik Peninsula, along the south shore of the peninsula to the west, and at the mouth of the Diana River. As the islands in Melvin Bay appear to be of volcanic rock, only a narrow strip remains for the southeastward extension of the sedimentary beds. It is possible that the unit has a total thickness of only 2,000 feet, or that it has been dislocated by the fault. Mapping of the islands in Melvin Bay should solve this problem.

A fault at the head of Prairie Bay, near the southwest shore, has dislocated the dolomitic bed, shifting its northern extension several hundred feet to the west. The pattern of structure exposed here is the same as that proposed to explain the western extension of the North Rankin serpentine sill, where outcrop is poor (see Plate IV).

Another structural problem is the extension of the sedimentary beds across Prairie Bay. Careful examination of the islands in and the north shore of Prairie Bay may give evidence to show whether or not the sedimentary unit extends across the bay, as shown in Plate III.

Economic Geology: Prospecting Results

Base metal nickel-copper deposits are the most important type found to date in this region, and they are confined to the basic and ultrabasic rocks. Other sulphide minerals present are pyrite and pyrrhotite within the dolomitic beds, along shear zones, and within tuff beds. Traces of gold are found in nearly all the deposits. In the following descriptions, the numbers refer to the circled numbers on the geological map, Plate III.

1) Serpentine sill: North Rankin Nickel Mines:

The nickel-copper orebody within this sill is described in Part II. The sill contains also small amounts of platinum and palladium.

2) Pyrite-pyrrhotite stringers in dolomitic beds:

The dolomitic member extending from the head of Melvin Bay northward to Prairie Bay is cut by a network of quartz stringers containing pyrite and pyrrhotite. The mineralized bed is up to 100 feet in width, and outcrops intermittently over a length of three miles. Several trenches were blasted into the formation 20 to

25 years ago. Grab samples taken from the zone showed:

0.04% Cu; nil Zn; nil Ni; trace Au.

These beds have no economic value.

3) Chalcopyrite in diabase dykes:

The diabase dyke outcropping on the small islands south of Thomson Island ranges in width from 10 to 30 feet; it contains small patches of disseminated sulphide minerals along its north contact. Another small parallel dyke outcrops to the north. Selected samples assayed:

0.08% to 0.12% Cu; nil Ni.

The dyke is too small to be of value.

4) Copper-nickel sulphides in a serpentine intrusion:

An outcrop of serpentine was found one half mile west of Silent Cove, in the lower volcanics. The intrusion strikes due north whereas the regional strike is 345°; it is thus a dyke, but one of odd shape. The western contact dips from 5 to 10 degrees to the east at the widest portion, but is nearly vertical in other places; evidence suggests that the east contact, not exposed, dips 75° west.

The serpentine outcrops over a width of 60 feet on the south shore of a small lake, and extends 1,500 feet to the south, broadening to 200 feet. Further south, the intrusion outcrops as talc schist along the west side of a moss-covered valley which strikes toward the Inlet. No extension of the serpentine was found to the north. Along its entire outcrop area the eastern portion of the intrusion is covered with a strip of overburden, at least 30 feet wide. Samples from near the central part of the sill, showing only sparsely disseminated sulphide minerals, assayed:

0.12% Cu; 0.15% Ni.

Although metal contents of this order are not uncommon in serpentine sills, the area should be checked with a magnetometer, or other geophysical instruments.

5) Basic intrusion:

Along the west side of the peninsula to the east of the mouth of the Diana River, a concordant basic intrusion of varying compositional and textural phases (talc-chlorite schist, serpentine, gabbro) contains disseminated sulphide minerals. The sill strikes 335° and dips 45° northeast. The sill is narrow at its north end but widens to 200 feet near its southern end, and outcrops at intervals over a length of one mile. One grab sample assayed:

0.10% Cu; nil Ni.

However, the sill was not intensively prospected, and much of it is drift covered. The peninsula should be surveyed with a magnetometer.

6) Sulphide minerals in tuff:

Disseminated pyrite and pyrrhotite occur in the tuff bands throughout the area. These have no economic value.

7) Sulphide minerals in sediments:

The dolomitic beds and quartzite to the north of showing 5 contain some pyrite stringers over a length of several hundred feet. Some of the grab samples showed a trace of gold, but there are no ore deposits here.

8) Basic intrusions:

The various types of basic intrusions have been described. These bodies, though of large size, show extremely little sulphide mineralization, and do not warrant as much attention as the ultrabasic intrusions.

9) Quartz veins:

Quartz veins, ranging from small stringers to large veins 20 feet wide by 500 feet long, occur throughout the area and some contain small concentrations of sulphide minerals, commonly chalcopyrite. The widest veins are usually concordant but there are numerous cross-cutting stringers. A collection of grab samples from several veins assayed:

0.09% Cu; trace Au to 0.01 oz./ton Au.

Deposits of gold may be present in the area.

10) Disseminated sulphide minerals in hornblende gneiss:

The hornblende gneiss in the region northeast of the Meliadine River contains some narrow bands with disseminated sulphide minerals. Grab samples assayed:

0.05% to 0.08% Cu; 0.03% Ni.

The values are too low to merit further investigation.

11) Mineralized shear zone:

A shear zone within the upper volcanic beds on the shore of Rankin Inlet north of Thomson Island contains some narrow massive sulphide stringers. Several trenches have been blasted into the zone. A collection of grab samples including both massive and disseminated sulphide minerals assayed:

0.03% Ni; 0.15% Cu.

This area was only partially explored during the prospecting, and the area along the shore to both the east and west should be more carefully examined.

12) Silicified sediments:

Disseminated sulphides occur in foliated silicified sediments, probably orignally tuffs, close to showing 11. Grab samples with about 5% of sulphide minerals assayed:

0.06% Cu; 0.02% Ni.

It is doubtful that concentrations of ore grade occur within this rock type.

Conclusions: Part I

The Rankin Inlet area is underlain by a volcanic-sedimentary-volcanic rock sequence here designated the Rankin Inlet Group. These rocks appear to be of Archaean, possibly Keewatin, age. The volcanic rocks are predominantly andesites, with some interbedded basalt and dacite flows. The sediments consist mainly of a pure, white quartzite, with impure quartzite, dolomitic, and minor conglomerate beds. Tuff beds are prevalent throughout the sequence.

These rocks have been folded into an easterly plunging syncline at the west end of Rankin Inlet, and into a westerly plunging anticline to the north of the Inlet. Granitic gneisses, some of granodiorite composition, outcrop a few miles to the west and north of Rankin Inlet. These intrusions have granitized the sedimentary and volcanic rocks extending in a broad belt from west of the Meliadine River to Atulik Lake.

Numerous small mineral showings occur throughout the area but those which seem to have the most economic promise are nickel-copper sulphide deposits within the ultrabasic intrusions around the west end of Rankin Inlet. Several basic intrusions were mapped, but these have very little sulphide mineralization.

PART II:

THE GEOLOGY OF

NORTH RANKIN NICKEL MINES, LIMITED

NORTHWEST TERRITORIES.

Frontispiece: Aerial view of North Rankin Nickel Mines, Limited, looking north of west.

PART II: THE GEOLOGY OF NORTH RANKIN NICKEL MINES, LIMITED

Introduction

The property of North Rankin Nickel Mines consists of 19 claims along the northwest shore of Rankin Inlet on Kudulik Peninsula. The mine is 288 miles north of Churchill, Manitoba, and can be reached by boat from Churchill or Montreal during the short summer season. The main means of access throughout the year is by sea-plane or land-based aircraft from Churchill. There is a small natural harbor at the minesite, and an airstrip has been built one mile to the west. In winter, the planes land on the ice of the inlet.

In several respects, North Rankin Nickel Mines is unique among Canadian mines. It lies deep within the tundra region, the tree line passing some 200 miles to the southwest. The mine workings are entirely within the permafrost zone; underground drilling has shown the permafrost continues to at least 700 feet in depth. In addition, the mine employs from fifty to seventy Eskimos for both surface and underground labor.

North Rankin Nickel Mines is the first producing mine in the District of Keewatin, as well as the first base metal mine in the Northwest Territories.

History

The region is first mentioned in connection with mineral deposits in the accounts of the eighteenth century explorer, Captain James Knight, the founder of the Hudson Bay Company fort at Churchill in 1717. Captain Knight sailed from England in 1719 to trace Eskimo accounts of copper and gold at the head of a great bay northwest of Churchill. The expedition was driven ashore on Marble Island, 25 miles east of the present minesite, and the members subsequently perished.

The late James Burr Tyrrell and other officers of the Geological Survey of Canada completed a preliminary survey of this part of the Arctic barren lands in the summers of 1893 and 1894. They surveyed the greater part of the shoreline of Rankin Inlet, and landed on Falstaff Island. In their report, they outlined a belt of volcanic rocks of economic promise.

On the strength of this report, the Cyril Knight Company sent in a crew of prospectors in 1928; the discovery of the Rankin Inlet nickel deposit is credited to R. G. O. Johnston, one of these prospectors. Samples taken from the gossan, on an outcrop only a few feet above sea level, gave ore-grade assays. A drill crew was sent out in 1929, and an interesting report of their initial difficulties and final success is given by John

Drybrough (1931), the engineer in charge. Six drill holes were completed, and altogether 120,000 tons of ore grading 4.62% nickel, 1.22% copper, and 0.11 ounces/ton of platinum were outlined. At that time, further exploration resulted in additional claims being staked along a pyrite-bearing dolomite bed two to three miles west of the mine.

Further diamond drilling was completed by Nipissing Mines in 1936 and 1939. The property remained idle until 1951, when Rankin Inlet Nickel Mines Limited took over. Magnetometer and electromagnetic surveys helped to outline the extent of the ore. In 1953, this company built the first permanent camp on the property; the headframe was erected, and a shaft sunk to 331 feet. In addition, approximately 2,600 feet of cross-cutting and drifting were completed. Underground mapping and drilling, and surface mapping were also carried out in 1954. The ore reserves were officially set at 460,000 tons, grading 3.3% nickel, 0.8% copper, 0.03 oz./ton platinum, and 0.06 oz./ton palladium.

In April 1954, the company was re-organized and the name changed to North Rankin Nickel Mines, and in 1955, Mogul Mining Corporation of Toronto agreed to finance the mine to production. A 250-ton per day concentrating mill was erected, along with a crusher house, bagging plant, staff houses, Eskimo dwellings, and a concentrate storage plant. The mine was prepared for production, and the first ore passed through the concentrator on May 23rd, 1957. Four boatloads of bagged nickel-copper concentrate, totalling 5,000 short tons, were shipped from the property in the fall of 1957. These concentrates contained 1,200,000 pounds of nickel and 388,000 pounds of copper.

Late in 1957, diamond drilling outlined additional tonnage on the eastern extension of the main ore zone, and the reserves, after dilution, as of December 31, 1957, were calculated as follows:

Proven: 447,500 tons with 3.20% nickel, 0.93% copper.

Indicated: 64,500 tons with 3.21% nickel, 1.25% copper.

On June 1st, 1958, 9,572 tons of concentrate were stockpiled on the property.

Acknowledgments

Previous reports on the area which were consulted are listed in the bibliography. In addition, free use has been made of the geological maps and the diamond drill records prepared by R. M. Patterson and M.W.Good, geologists for Rankin Inlet Nickel Mines.

I would like to acknowledge both the assistance and advice during the practical work, and the permission for working on this report,given by the officials of North

Rankin Nickel Mines, Limited, namely Dr. W. Weber, vice president, and managing director of Mogul Mining Corporation; Mr. Andy Easton, the mine manager; and Mr. Harry Leavitt, mine superintendent. Mention should also be made of the three prospectors who are responsible for much of the field work: Reg Foulser, Bill MacDonald, and Don Cranstone.

The guidance of Dr. H. D. B. Wilson of the University of Manitoba Department of Geology during the preparation of this report is gratefully acknowledged.

Eskimos

From fifty to seventy Eskimos are employed by the company both as surface laborers and underground assistants. They have proved themselves to be very adaptable, and two have been sent to Alberta for mechanical training. There is a fast-growing Eskimo community with a population in the neighbourhood of 250 on the shore of a small cove to the north of the mine. The mine is building frame dwellings for them.

Present Work

This report is a compilation of data from various sources - published reports, drill results, underground and surface geological maps, and assay results - supplemented by observations in the new mine workings, the geological knowledge obtained while prospecting the surrounding region, a new magnetometer survey, additional assay results, and microscopic examination of thin sections and polished sections.

Special Conditions

The limitations of the short summer season are counterbalanced by the easily seen outcrops and the ease of traversing, the result of the lack of forest cover. However, time did not permit the mapping of the islands surrounding Kudlik Peninsula, where the mine is located, which would have given much needed information on the geologic structure. It is hoped that these will be mapped in the future. An intense magnetic storm during the last two weeks of April, 1957, delayed the magnetometer survey. The tides of the inlet, which have a maximum difference of 16 feet, must be taken into consideration whenever travel by boat is planned.

Underground, the permafrost, aside from maintaining a temperature of 23°F in the mine workings, quickly obscures new drift faces, and mapping should be carried out as soon as possible whenever new faces are exposed. For underground drilling, salt water with twice the salinity of sea water is used as its freezing point is 18° F. This water is obtained from a fracture intersected by one of the underground drill holes, and probably is concentrated sea water.

GEOLOGY

Introduction

The discussion in this section is confined to the geology of the North Rankin Nickel Mines, Limited ore deposit, and of the immediately surrounding area; the regional geology has been discussed in Part I. After the geologic setting of the ore deposit is defined, petrographic and mineralogic descriptions of the host rock, the wall rocks, and the ore itself are presented. Data on the structure of the area, the structural control of the ore, and the distribution of the nickel and copper within the ore, together with a description of the underground geology, are synthesized in a theory of ore genesis. The results of exploratory drilling, and geophysical results are combined with a knowledge of the geology of the main ore pocket for the purpose of outlining the possibilities of finding additional ore deposits within the serpentine sill.

Glacial Geology

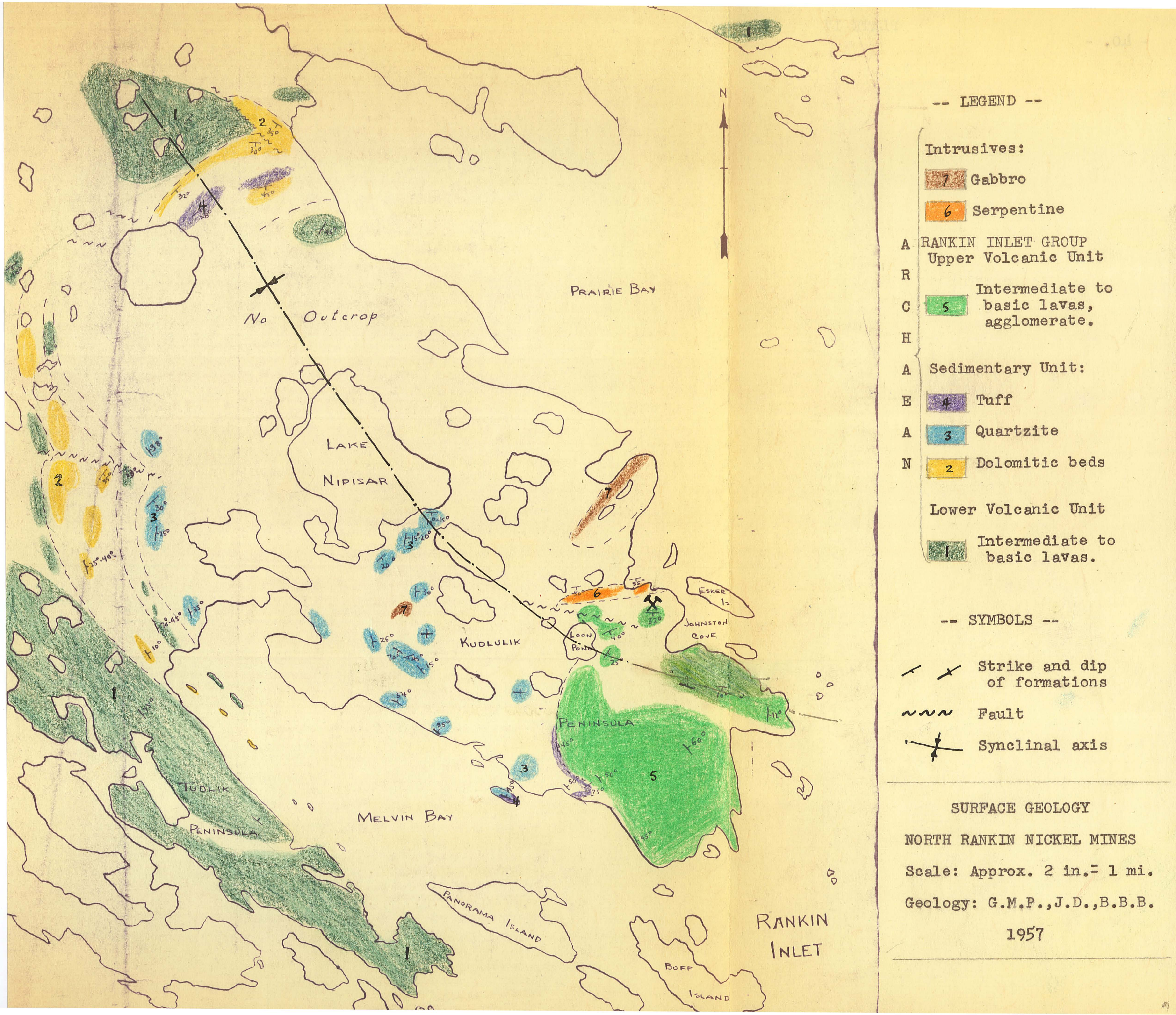
The glaciation of the Pleistocene has left a discontinuous cover of drift, numerous gravel deposits, long eskers, and drumlins scattered throughout the area. Glacial striae indicate that the movement of the ice was from the west-northwest. Most of the outcrops have been rounded and striated.

Regional Geology

The regional geology of the area immediately surrounding the North Rankin deposit is shown in Plate IV. The sedimentary rocks, along with the enclosing volcanic units, are folded into a synclinorium which plunges from 5° to 25° to the southeast and flattens out to the east of the mine. The axis strikes 110° and is located 1500 feet south of the shaft. The north limb, dipping 50° to 60° south, is steeper than the west limb, which appears to dip 30° to 40° east.

The axes of the minor rolls of the synclinorium generally parallel the strike of the limb on which they occur, but they may vary in pitch. Several faults, which strike parallel to the major fold axis, are associated with these minor rolls.

The major intrusion of the area is a 300-foot wide serpentinized ultrabasic sill located on the north limb of the synclinorium along the contact between the upper volcanic and sedimentary units. It has been traced for a length of 4000 feet by drilling, and magnetometer results indicate that it extends an additional 2,000 feet to the east under Rankin Inlet. The massive and disseminated nickel-copper sulphide ore is loc within a secondary roll on the footwall of the north limb of this sill.



N
PRAIRIE BAY
No Outcrop
LAKE NIPISAR
KUDLULIK
LOON POND
ESKER Is.
JOHNSTON COVE
PENINSULA
TUDLIK PENINSULA
MELVIN BAY
PANORAMA ISLAND
BUFF ISLAND
RANKIN INLET
-- LEGEND --
Intrusives:
7 Gabbro
6 Serpentine
ARCHAEAN
RANKIN INLET GROUP
Upper Volcanic Unit
5 Intermediate to basic lavas, agglomerate.
Sedimentary Unit:
4 Tuff
3 Quartzite
2 Dolomitic beds
Lower Volcanic Unit
1 Intermediate to basic lavas.
-- SYMBOLS --
Strike and dip of formations
Fault
Synclinal axis
SURFACE GEOLOGY
NORTH RANKIN NICKEL MINES
Scale: Approx. 2 in.= 1 mi.
Geology: G.M.P.,J.D.,B.B.B.
1957

The geological history of the area is, in outline:

1) Extrusion of the lavas of the lower volcanic unit, with deposition of tuff beds and thin sedimentary layers at intervals.
2) Deposition of quartzite, with minor dolomite, intercalated tuff beds, and at least one volcanic flow.
3) Extrusion of the lavas of the upper volcanic unit, with agglomerate.
4) Period of orogeny: folding and faulting of the pre-existing rocks, accompanied by ultrabasic, basic, and granitic intrusions; granitization; quartz veins. The intrusion of the serpentine sill, with the consequent formation of the sulphide deposits, appears to have occurred early in the period of folding.
5) Erosion to a peneplain.
6) Pleistocene glaciation; Recent uplift and erosion.

Geologic Setting of the Ore Deposit

The nickel-copper sulphide ore occurs as two lenses at and near the base of the serpentinized ultrabasic sill, being confined mainly to a secondary syncline on the north limb of the major synclinorium. The general strike of the sill is north 80° east, and the dip at the surface is estimated to be 55° to 60° south. The local secondary folds cause variations in both strike and dip.

The ore occurs both as disseminated sulphides in the lower portion of the sill, and, in one roll, as a thin tabular sheet of massive sulphides immediately adjacent to the footwall contact, but within the sill. This massive ore is separated from the underlying tuff formation by a narrow septum of talc schist.

The footwall formations are a complex of grey-black tuffs, grey chert-like tuffs, and grey quartzites. The rock overlying the sill is a medium-grained green-black andesite. The sill apparently pinches out to the west near the area of the intersection of the volcanic-sedimentary contact with the axis of the syncline; no serpentine intersections have been reported from the scattered drill holes on the west limb of the fold.

Description of the Mine

The various plans, cross sections, and longitudinal sections contained in this report show the location of the mine workings. A three-compartment shaft, 331 feet deep, is located 600 feet south of the two ore lenses; the top of the collar is 52 feet above sea level. The major ore masses extend from the surface to 225 feet below sea level, as shown in Plate V. Cross-cuts have been driven to the ore from the 200- and 300-foot levels, which are 145 and 245 feet below sea level respectively.

The ore mass is semi-circular in outline, being 500 feet long at the surface, and shortening to 150 feet long

200 feet below sea level. At present, the ore of the lower zone is being mined from both the 300 and 200 levels; the rill fill method is being used, with successive benches being removed by starting at the east and west extremities of the ore and working to the centre. A sea wall will have to be built across Johnston's cove before the upper portion of the ore can be removed.

Structural Geology

The bedrock in the mine area has been folded into a synclinorium, the major axis of which strikes 110° and plunges to the southeast at a low angle. The structure is well defined, and is easily detected on aerial photographs from the lineations of the islands and shorelines of the west end of Rankin Inlet.

The axis of the secondary roll containing the ore is for the most part horizontal, although it drops slightly at the west end and rises fairly sharply at the east end of the ore deposit; thus this axis plunges at a different angle to that of the major fold.

Faulting and jointing have accompanied the folding, and through a study of these some clues to the sequence of events can be obtained. Both the hangingwall and footwall contacts of the serpentine sill are fault zones, and accompanying drag-folding shows the relative directions

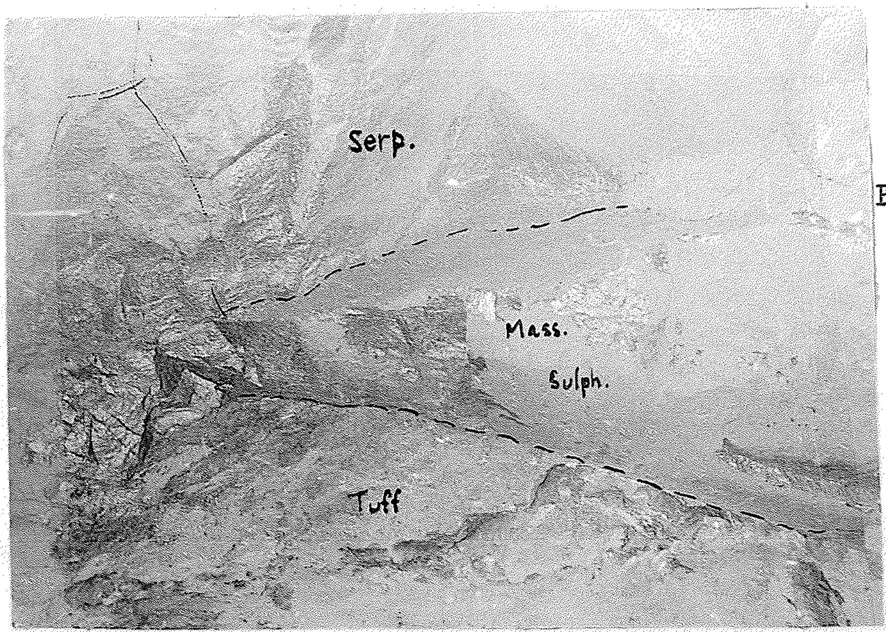


Figure 3. Intrusion of a massive sulphide vein along serpentine-tuff contact at the bottom of the main ore zone. Scale: 2 ins. = 3 ft.

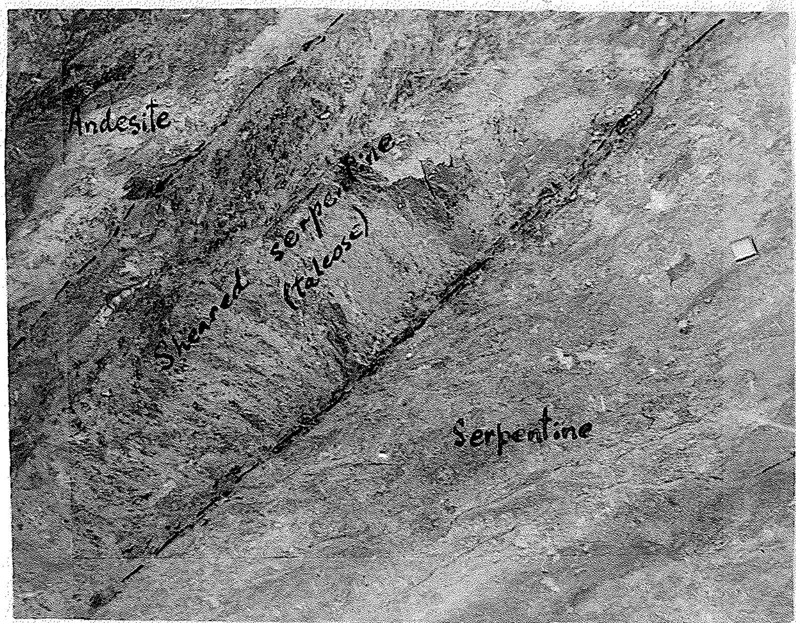


Figure 4. Sheared zone along hangingwall contact of the serpentine sill; andesite in upper left corner, serpentine on right.

of movement. The sill has moved up in relation to the underlying formations, and the overlying andesite has moved up relative to the sill. If the sill had been intruded after the synclinal folding, the sill would have moved up relative to the overlying andesite. The relations indicate that the sill was in place before the major part of the folding occurred.

Some previous workers had thought that the lower part of the main ore zone had been dislocated by a fault; however, observations in the new mine workings have shown that the ore mass is continuous, and that the apparent dislocation is caused by the presence of the secondary syncline.

The base of the lower-grade ore mass is a fairly well-defined shear plane; this has been determined from observations in the 200-level crosscut, and from the diamond drill results. This fact is of special significance in the interpretation of the origin of this lower grade zone, which is 80 feet above the base of the sill. It suggests that a further injection of the sill occurred, probably during the period of folding, and possibly with the injected material in a semi-solid state. The shear plane formed at the border of the injection passed well above the base of the original depression on a level with its "lip", and thus the essentially solidified ore within the depression was left undisturbed. The lower-grade ore mass may have formed from segregation of immiscible sulphides within the injected semi-liquid magma, followed by deposition on the previously solidified ore, i.e. along and above the shear plane.

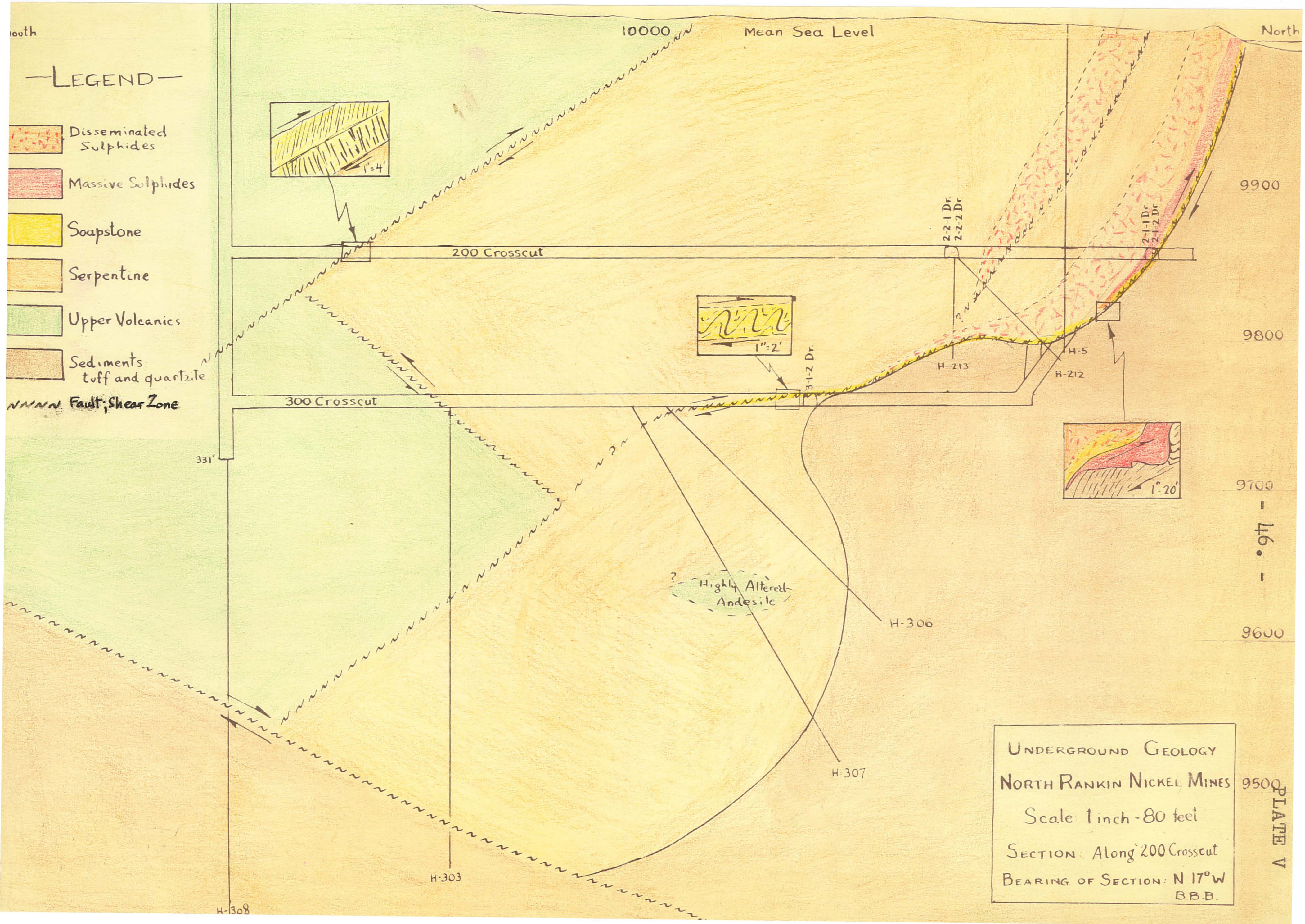

South
North
10000
Mean Sea Level
9900
9800
9700
9600
9500
LEGEND
Disseminated Sulphides
Massive Sulphides
Soapstone
Serpentine
Upper Volcanics
Sediments tuff and quartzite
Fault; Shear Zone
1"=4'
1"=2'
1"=20'
200 Crosscut
300 Crosscut
2-2-1 Dr.
2-2-2 Dr.
2-1-1 Dr.
2-1-2 Dr.
3-1-2 Dr.
H-213
H-5
H-212
331'
H-306
H-307
H-303
H-308
Highly Altered Andesite
Underground Geology
North Rankin Nickel Mines
Scale 1 inch - 80 feet
Section: Along 200 Crosscut
Bearing of Section: N 17°W
B.B.B.

PLATE V

Another possibility is that sulphide minerals previously segregated at a lower level were moved upward during the folding of the sill and strewn along the shear zone.

Plate V shows a cross section of the mine along the 200-level crosscut. This section shows that another secondary roll occurs directly beneath the one containing the main ore deposit. Of the few scattered drill holes which have penetrated this lower depression, some have given good ore-grade nickel assays. The results from the drilling indicate that there is a major fault transecting the lower depression. Drill hole 308 goes directly from andesite to tuff at a relatively shallow level. Other evidence suggests a major fault plane, striking 110° and dipping about 35° north, as shown in Plates IV and V. The lower part of the sill has been displaced upward and eastward beneath the fault plane.

There are no drill holes or outcrops on the area south of the mine where the fault should intersect the surface; there is however a small magnetic anomaly. The only outcrop of the fault plane occurs about 1,000 feet west of the minesite near the junction of the andesite-tuff contact within the north and south limbs of the syncline. The north limb has been displaced approximately 1,500 feet to the west with respect to the south limb.

The mapping indicates that this fault is the continuation of the fault which dislocates the lower portion of the sill. The outcrop area is extremely contorted and sheared, and contains thick quartz lenses in the sheared zone.

The hangingwall of the sill has been complexly faulted, but details are lacking because of the scarcity of drill results there.

The evidence indicates that the folding and faulting and intrusion of the serpentine sill were all penecontemporaneous. The following succession of events is suggested:

1) Preliminary minor folding of the horizontal volcanic and sedimentary strata with the formation of a depression along the upper volcanic-sedimentary contact.
2) Intrusion of the ultrabasic sill in a near horizontal position with the accumulation of sulphides within the depression.
3) Major folding of the area into a synclinorium. In the early stages, before the consolidation of the sill, some of the massive sulphides were squeezed out along the edges of the depression to form injected massive sulphide stringers. A shear zone formed above the depression, and the inner part of the sill moved upwards. A lower grade ore body was formed along the shear plane.
4) Additional faulting occurred, both along the hangingwall contact, and at the base of the second depression.

The ore is controlled by the geologic structure. The fundamental locus of ore is the bottom of the sill, and the richest accumulations occur in depressions in the bottom. This structural control is well shown when assay values are plotted on a structure contour map of the footwall contact, as in Plate X, in the pocket. The very direct relation between the ore values and the depth of the depression is easily seen; contours of the weighted assays would coincide, relatively, with the structure contours. A secondary locus of ore is a shear plane within the sill, where ore of lower grade has been deposited.

Host Rock: The Serpentine Sill

In some hand specimens, the sill appears as fine-grained fresh-looking dark green rock, but every thin section examined showed that the original mafic minerals have been completely altered to serpentine and, in some places, talc. Figure 5 shows a fine-grained chrysotile aggregate pseudomorphous after pyroxene. Thus the original rock was probably a pyroxenite, or possibly a peridotite.

All gradations are present from a fine-grained serpentine aggregate through talcose serpentine to talc schist or soapstone. The most prominent development of the talc schist occurs along fault zones within the sill.

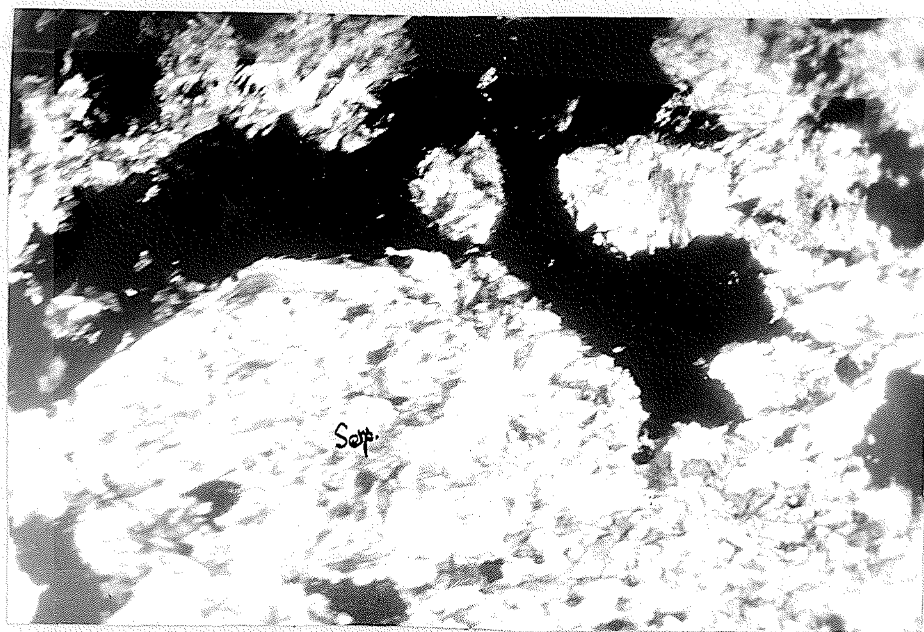


Figure 5. Serpentine (antigorite) pseudomorphous after pyroxene; disseminated sulphide ore. (x 45)

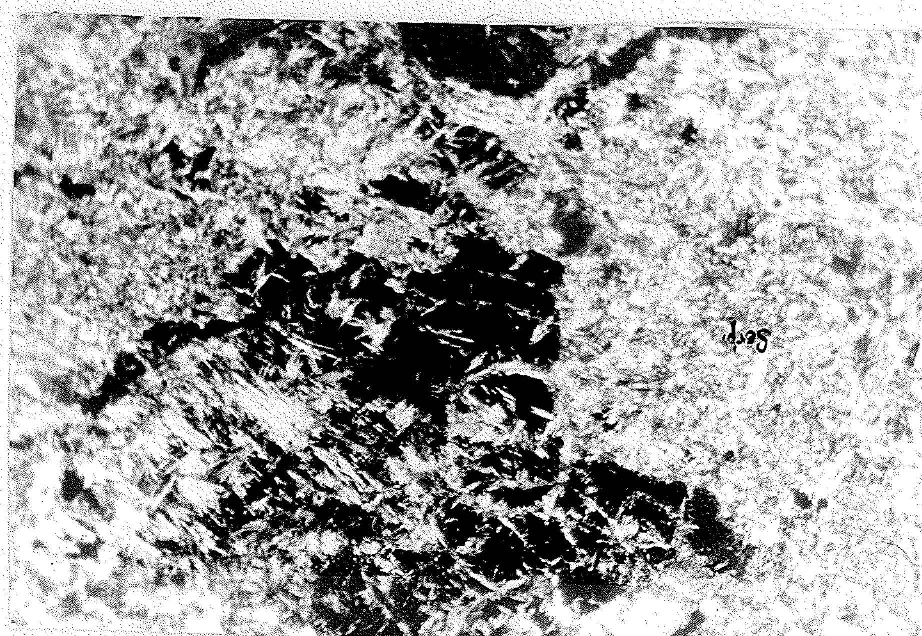


Figure 6. Sulphide grains cut by serpentine stringers. (x 40.)

The talcose serpentine is especially prominent in the area between the two ore zones.

The sill varies in thickness from 150 to 300 feet. It has been injected along the andesite-tuff contact, and most of the drill results show the sequence: andesite-serpentine-tuff. However, in hole 60, three 6- to 7.5-foot bands of tuff occur above the sill, under the andesite.

Another line of evidence suggests that the sill, before its alteration to serpentine, had a peridotite composition. Dr. H. D. B. Wilson (1953), in a study of the "Geology and Geochemistry of Base Metal Deposits," lists the maximum ore grade of various Scandinavian and Canadian nickel deposits, and shows that the maximum amount of nickel in the sulphide in an ore body is related to the rock type in which the ore occurs.* The high maximum per cent of nickel in the sulphide in the North Rankin deposit, over 10 per cent, would suggest that the original rock was a peridotite.

Wall Rocks

The hangingwall rock is the dark green medium-grained andesite, which may resemble diorite, of the

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* Maximum per cent nickel in the sulphide: Peridotite: range 7-10%, average 8.5%; Pyroxenite: 4.5-5.0%; Norite: 2.6-6.5%, average 4.1%; Diorite: 1.0%.

upper volcanic unit. It has been extensively jointed and in places sheared, and is cut by calcite-quartz stringers containing scattered sulphide minerals. The volcanic rocks may be massive, schistose, pillowed, or coarse grained, and range in composition from dacite to basalt, with andesite forming the greater part of the unit. Narrow tuff bands occur within the lavas, and a layer of agglomerate is present near the base of the unit.

The footwall formations are thin-bedded tuffs and quartzites. The tuffs are finely laminated, and have characteristic wrinkled bedding planes. Though the tuffs may be in contact with the sill, they usually are separated from it by a denser more acidic rock which seems to be of tuffaceous origin also. This chert-like rock could be the result either of the metamorphism of an originally acid tuff, or else of the addition of silica to the more common basic tuffs. A few narrow quartz veins cut these altered tuffs, and suggest that the latter process occurred.

Scattered sulphide minerals, mainly pyrrhotite, occur as platings along the bedding planes throughout the footwall formations. The mineralization is present at least to a distance of 500 feet from the sill, the greatest distance drilled. In addition, some of the quartzite beds contain scattered magnetite and pyrite cubes. The sulphides are probably the result of a sulphur metasomatism of the original iron oxide minerals of the sediment.

Ore Mineralogy

A detailed mineralographic study of a suite of specimens from the Rankin Inlet nickel deposit was made by E. Pelzer (1950). The specimens for his study were from surface samples and from core of some early shallow drill holes. Pelzer's study included the relationships between the primary ore minerals, and manner of occurrence of some alteration products, notably violarite, marcasite, and pyrite.

The present study included also polished sections made from fresh underground samples from the new mine workings. The results regarding the primary ore minerals and their relationships are substantially the same as those of Pelzer. It was found that marcasite occurs in abundance down to at least the 200 level, and also that violarite does not occur in fresh ore at depth. It is concluded that the previous samples had been exposed to many years of weathering, as were some of the present samples taken from old drill core. Violarite and marcasite are products of a recent supergene alteration.

Figure 7. General relationships of massive sulphide ore minerals: pyrrhotite, pentlandite, chalcopyrite, and magnetite. (x 70)

Abbreviations:
po: pyrrhotite
pn: Pentlandite
Cp: chalcopyrite
mg: magnetite
mc: marcasite
vi: violarite

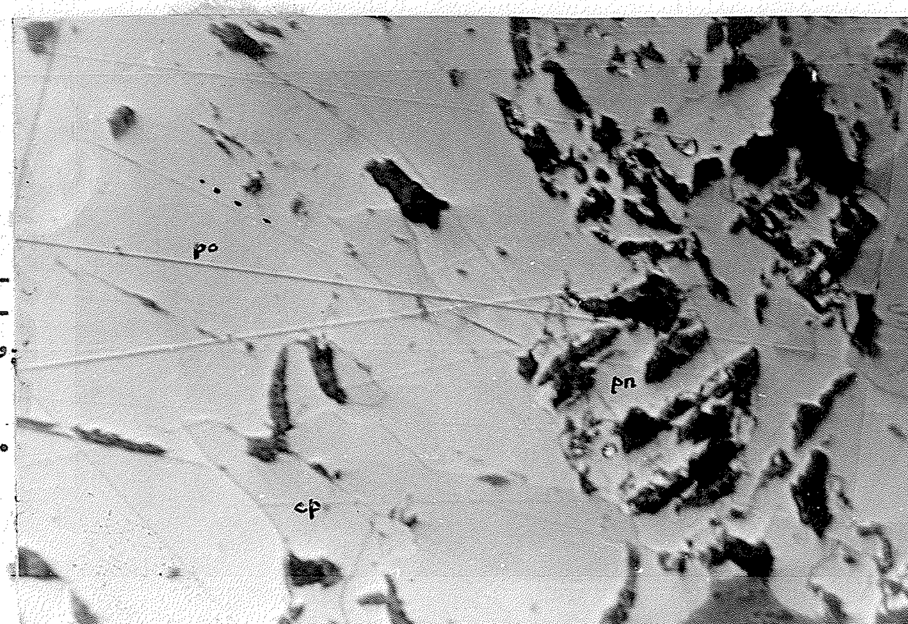


Figure 8. Mutual contacts between pyrrhotite and pentlandite, and pyrrhotite and chalcopyrite in the massive sulphide ore. (x 70)

The most abundant sulphides in the massive ore are pyrrhotite, pentlandite, and chalcopyrite, in that order. Pyrrhotite forms an almost continuous matrix in which the other minerals are embedded. Small remnants of both magnetite grains and pyrite cubes are enclosed within the above-mentioned sulphide minerals; they are the earliest crystallized of the ore minerals and have been much corroded by the later ones. The massive ore has a granular texture, fine to medium grained; coarse-grained sulphide minerals were not observed.

Figures 7 and 8 show the relations between the minerals of the massive sulphide ore; in particular, they show mutual contacts between pyrrhotite and pentlandite, and between pyrrhotite and chalcopyrite. Pelzer reports evidence indicating that some of the pentlandite is later than the pyrrhotite, and that some of the chalcopyrite is later than the pentlandite. In general, however, the periods of crystallization of these three minerals overlap one another considerably and they are, for the greater part, contemporaneous.

One feature of the massive sulphide ore which the present study has revealed is the occurrence, especially in the central part of the orebody, of a pronounced banding within the sulphide minerals, with

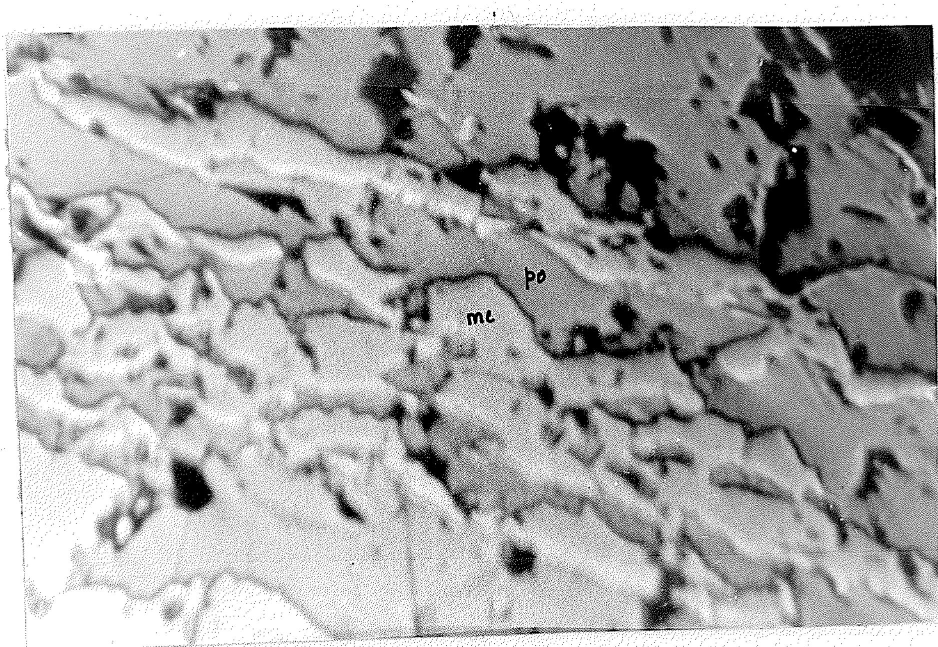


Figure 9. Edge of a marcasite band in massive sulphide ore. Marcasite lenses in a pyrrhotite matrix. Sample from 100W, 2-1-1 drift. (x 80)

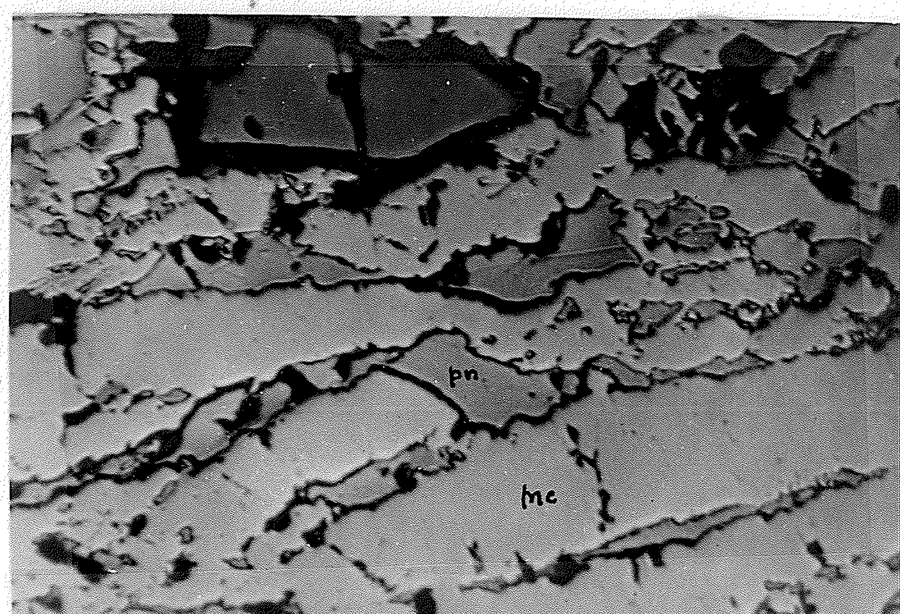


Figure 10. Centre of same marcasite band, with lenses of pentlandite only, in a marcasite matrix. (x 60)

the bands oriented parallel to the bottom of the sill. Figures 9 and 10 show two phases of one 5/8 inch wide band, both photomicrographs being taken from the same polished section. The bands are usually between 1/8 inch and ½ inch wide.

Figure 9 shows the edge or contact of the band, where the main mass of pyrrhotite, the host mineral, encloses discontinuous lenses of marcasite. The thin septa separating the marcasite lenses consist entirely of pyrrhotite. Figure 10 shows the central part of the band where marcasite forms the continuous matrix enclosing narrow streaks of pentlandite. A short distance within the band, in the area between the two shown in the figures, the lenses consist partly of pyrrhotite and partly of pentlandite. The pentlandite occurs as small masses along the edges, as shown in figure 11. It should be noted that none of the numerous pentlandite masses of this type which were studied showed any trace of violarite alteration. However, a large isolated grain of calcite was seen within this band.

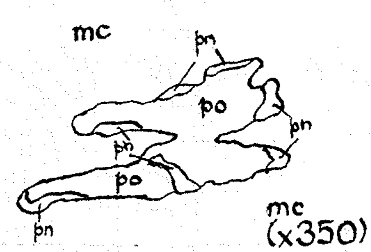


Figure 11. Pyrrhotite-pentlandite lens within a marcasite band.

Note: As the marcasite has replaced pyrrhotite, the banding must have been originally a feature of the pyrrhotite; the banding may have been impressed on the sulphide minerals within the depression during the folding when some of the sulphide ore was forced out along the edges of the depression.

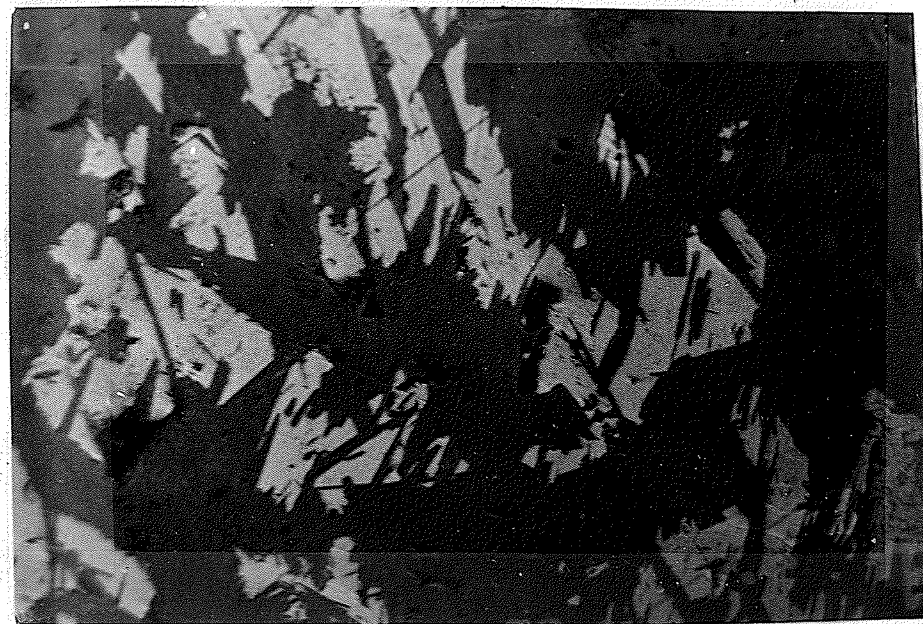


Figure 12. Disseminated sulphide ore; grains of pyrrhotite enclosed in silicate minerals (dark grey). (x 50)

Figure 13. Disseminated sulphide ore; euhedral silicate laths within the sulphide minerals. (x 50)

Figures 12 and 13 show two contrasting phases of the disseminated sulphide ore. The first shows the dark silicate minerals enclosing grains of the sulphide minerals. The second shows the sulphide minerals enclosing euhedral laths of a serpentine aggregate. Such reverse relationships indicate that the times of the formation of the silicate and sulphide minerals overlapped. It could be noted here that in the central part of the orebody the contact between the disseminated ore and the massive ore is gradational. However, around the edges of the orebody there is a sharp contact between the two as there the massive sulphides occur as narrow injected veins extending out from the main ore mass (see figure 3.)

The lower-grade upper orebody consists mainly of disseminated sulphide minerals in serpentine, but there is a narrow band of massive sulphides along the base of the zone. This band is usually only a few inches thick, but it attains a thickness of 3.5 feet about 40 feet above the 200 crosscut. The average thickness of the orebody is 30 feet; it is separated from the high-grade ore by 20 feet of waste rock. Chalcopyrite is relatively prominent in this upper zone, and is sometimes present as narrow stringers of massive chalcopyrite. Though the average nickel content of this zone is slightly more than one-third that of

Figure 14. Marcasite needles extending outward from a veinlet of violarite and replacing pyrrhotite. (x 240)

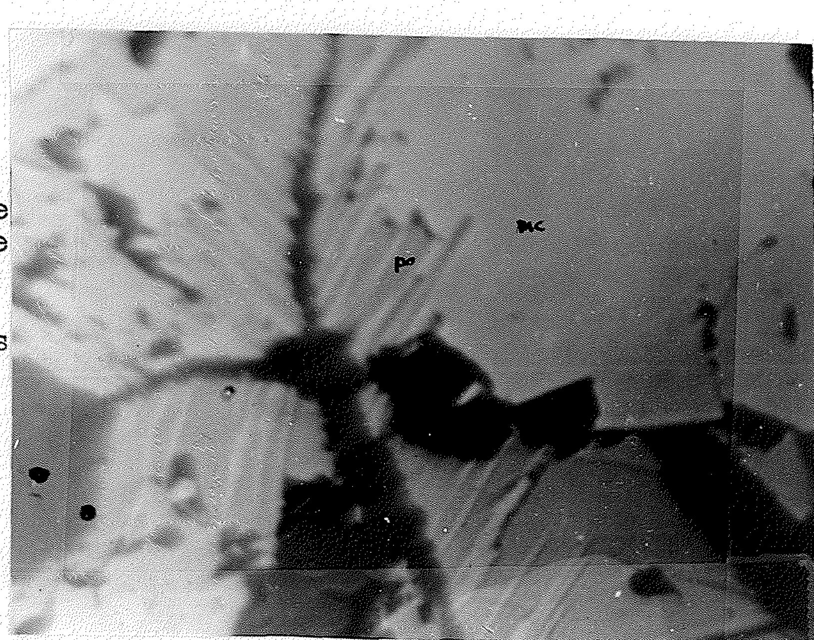


Figure 15. Almost complete replacement of pyrrhotite by marcasite. Note that pyrrhotite remnants appear as blunted needles (x 240)

the main ore zone, the copper content is almost one-half.

Violarite and marcasite occur commonly in small quantities throughout the sections made from old drill core. The violarite occurs as small grains within the pentlandite and along fractures cutting pentlandite. Marcasite occurs as feathery needles or "flames" extending outwards from calcite and violarite veinlets. The marcasite always replaces pyrrhotite, as shown in figures 14 and 15. Violarite and marcasite are products of a recent alteration, probably formed mainly during the weathering of the drill core.

The marcasite in the bands in the main ore zone also was probably formed by supergene alteration. However, there is a possibility that this marcasite may have been formed during the alteration which completely serpentinized the sill. It is noteworthy that the pentlandite lenses in these bands show no violarite alteration.

Gersdorffite, the nickel arsenide, occurs in small concentrations within the soapstone zone separating the massive sulphide ore from the underlying tuff beds. Four small pockets, from a few inches to a few feet in length, were observed in the course of underground mapping at widely spaced locations.

Precious metal content has been determined for some of the drill hole intersections of the massive sulphide ore. Values up to 0.31 ounces per ton of platinum have been obtained, but the average is 0.03 ounces. The average palladium content is 0.06 ounces per ton. In addition, a trace of gold has been noted.

Distribution of Values

The distribution of the nickel and copper values within the serpentinized sill can be shown in several ways. Plates VI and VII show the combined percentage of nickel and copper in cross section and level plan of the main ore zone. There is a definite increase in the grade of the ore towards the bottom of the sill. Separate charts were made of the nickel and of the copper content; the chart of nickel reflects the increase in grade toward the bottom, but the chart of copper shows a much more erratic distribution. Copper may occur in the same percentage range across the whole ore zone - i.e., it varies only slightly in abundance in both the disseminated and the massive ore.

The cross section Plate VI shows that the greatest thickness and the highest grade of sulphide ore occurs in the near-surface portion of the deposit. This would suggest that the sill was still in a horizontal position when the sulphide liquid accumulated in the depressions; otherwise, if the ore had been emplaced

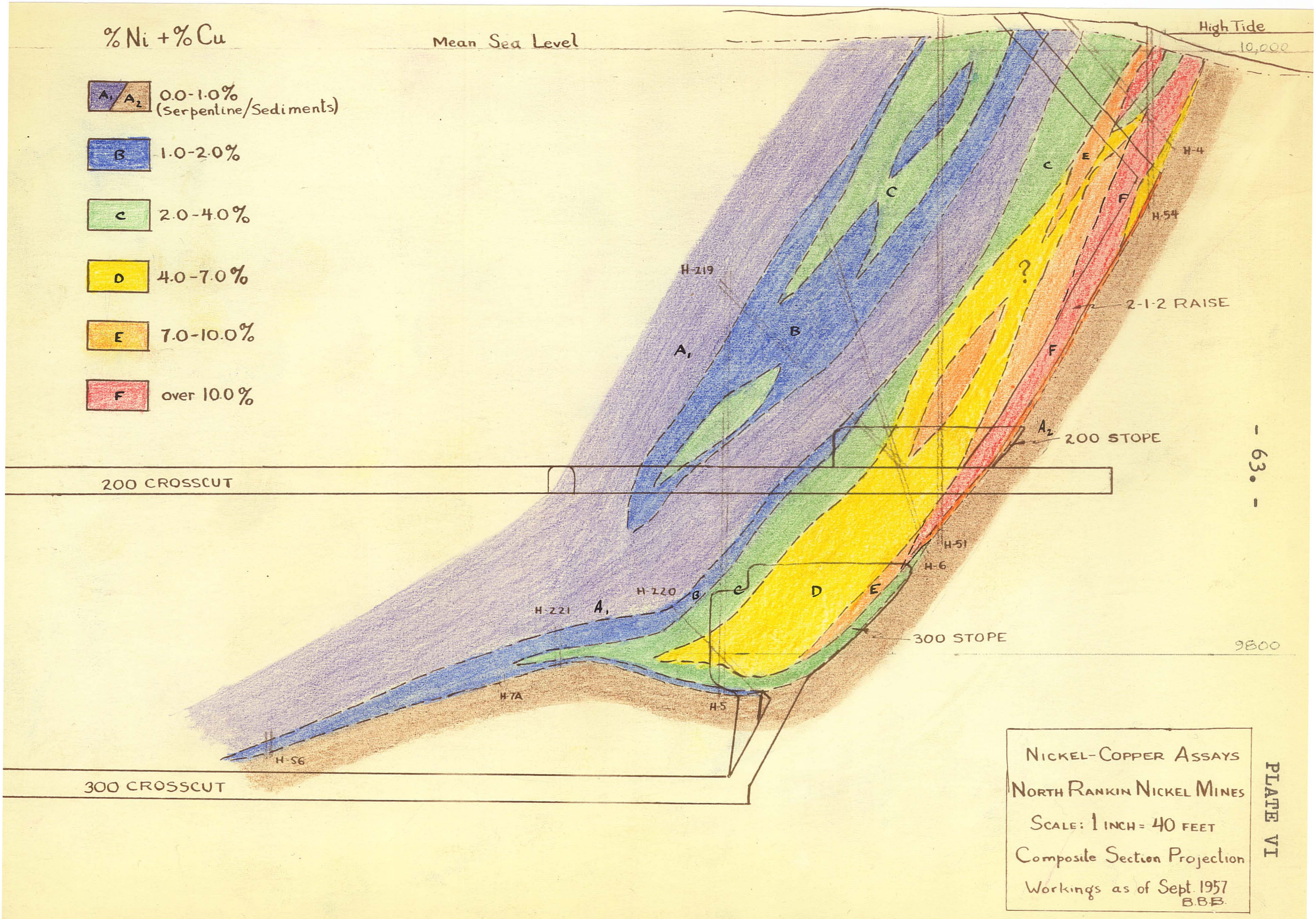

% Ni + % Cu
A1 / A2 0.0-1.0% (Serpentine/Sediments)
B 1.0-2.0%
C 2.0-4.0%
D 4.0-7.0%
E 7.0-10.0%
F over 10.0%
Mean Sea Level
High Tide
10,000
9800
H-4
H-54
H-219
H-51
H-6
H-220
H-221
H-7A
H-5
H-56
2-1-2 RAISE
200 STOPE
300 STOPE
200 CROSSCUT
300 CROSSCUT
NICKEL-COPPER ASSAYS
NORTH RANKIN NICKEL MINES
SCALE: 1 INCH = 40 FEET
Composite Section Projection
Workings as of Sept. 1957
B.B.B.

PLATE VI

when the sill was in its present attitude, the greatest concentration of ore should be expected near the 9800-foot level.

Throughout the part of the serpentinized sill which was drilled, either disseminated or massive sulphide minerals were found, always at or close to the bottom contact. Thus, a second method of showing the distribution of values is to plot the diamond drill hole assay results on a longitudinal section of the sill, as in Plates X and Xa. In addition, the structure contours of the foot-wall contact of this sill have been plotted, the heights given being the distance of the tuff-serpentine contact above the datum plane (which is located 100 to 250 feet north of the sill, having the same average strike, north 80° east, and the average dip, 55° south, as the sill.) The most striking feature of this projection is the very direct relationship between the height of the contact above the reference plane, or the depth of the depression, and the proportion of nickel and copper, which is plotted as a weighted assay: (%Ni + %Cu) times Width. In the main ore zone in particular, the contours of the weighted assays almost parallel the structure contours. This projection cannot be used to compare the value of one depression with another, as the reference plane has been chosen arbitrarily, and another orientation would give different results.

A third method of charting the nickel and copper

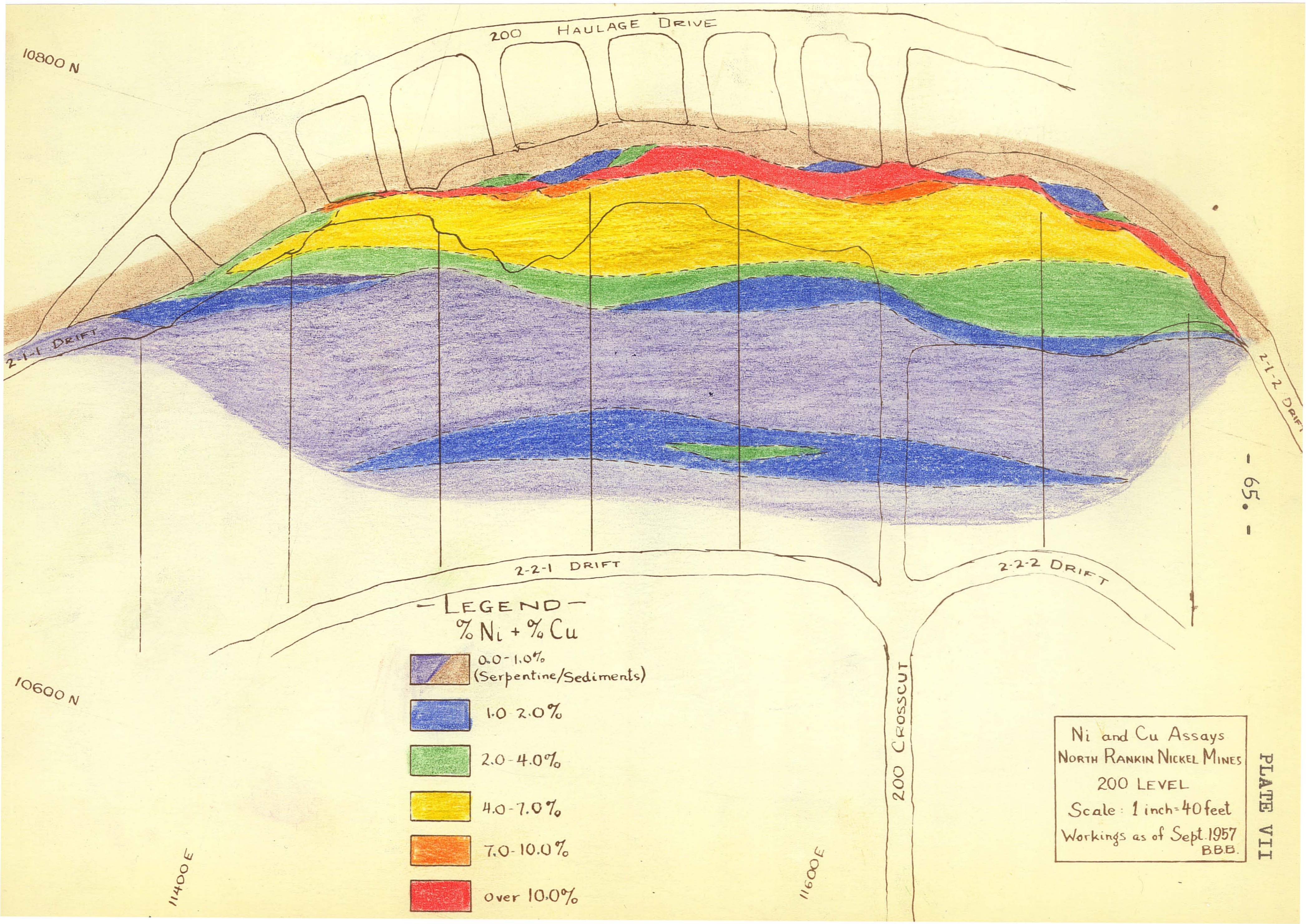

200 HAULAGE DRIVE
10800 N
2-1-1 DRIFT
2-1-2 DRIFT
2-2-1 DRIFT
2-2-2 DRIFT
200 CROSSCUT
10600 N
11400 E
11600 E
-LEGEND-
% Ni + % Cu
0.0-1.0% (Serpentine/Sediments)
1.0-2.0%
2.0-4.0%
4.0-7.0%
7.0-10.0%
over 10.0%
Ni and Cu Assays
North Rankin Nickel Mines
200 LEVEL
Scale: 1 inch=40 feet
Workings as of Sept. 1957
B.B.B.

PLATE VII

values is to plot the ratio: $\frac{\%\ \text{copper}}{\%\ \text{nickel} + \%\ \text{copper}}$ against various arbitrary ranges of nickel content. The above ratio was determined for over 1,000 assays from all parts of the sill. The ratios were divided into four groups, based on the nickel content, 0.01-1.00%; 1.01-3.00%; 3.01-7.00%, and over 7.00% nickel. The cumulative percentage of the assays within each range having a certain ratio were plotted at intervals of .1 (Plate VIII), using semi-logarithmic graph-paper which keeps the curves separated in the region of low ratios. This graph shows that as the nickel content of the ore increases, the above ratio (on the average) decreases regularly. This means that in the higher-grade ore there is a greater proportion of nickel to copper. This is shown also in figure 16, in

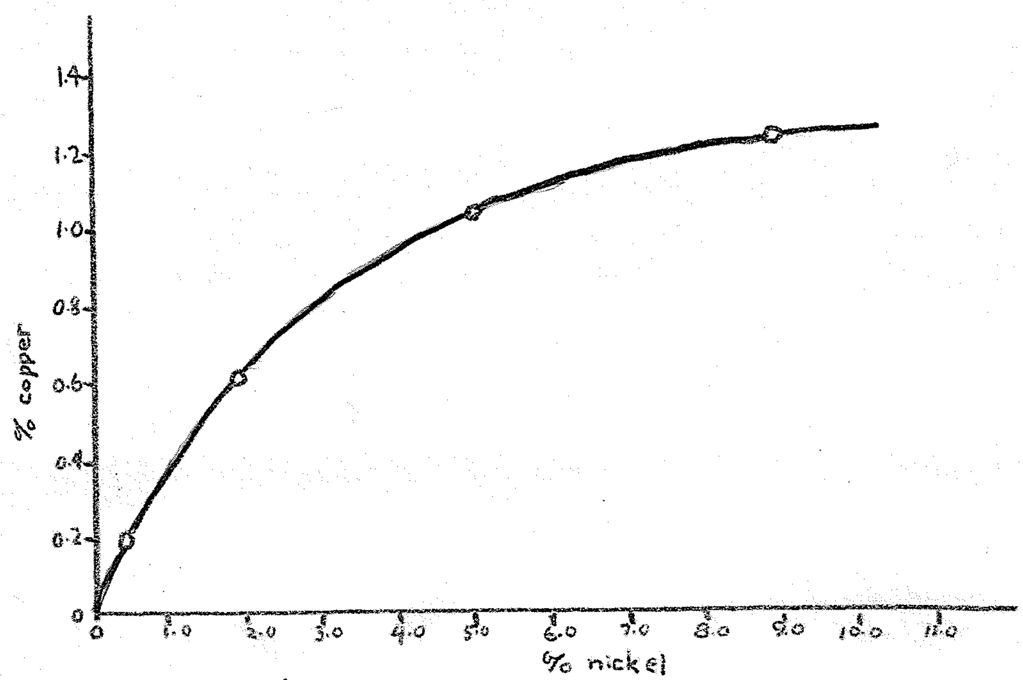


Figure 16. Variation of copper content with nickel content in the North Rankin Orebody.

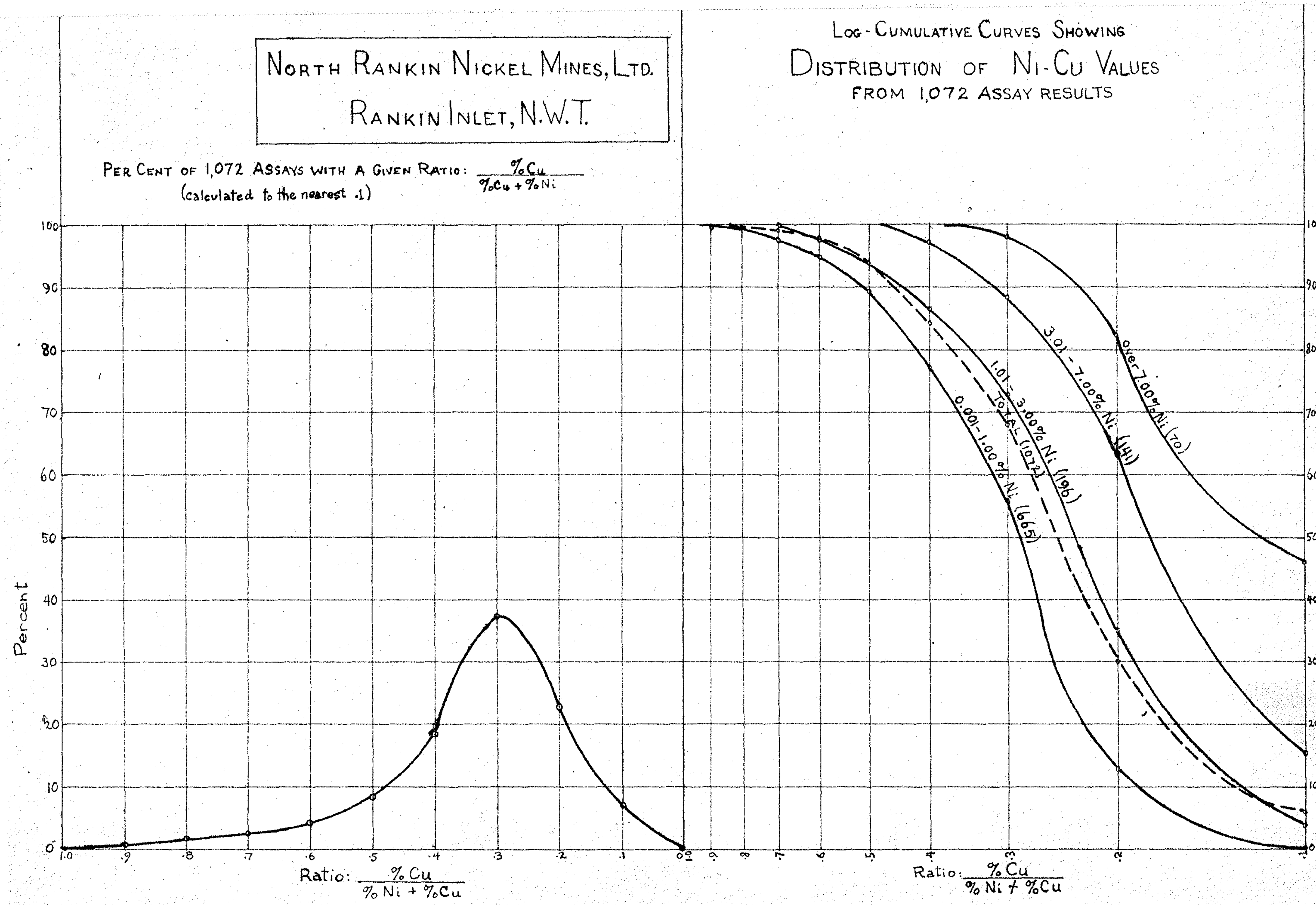

North Rankin Nickel Mines, Ltd.
Rankin Inlet, N.W.T.
Per Cent of 1,072 Assays with a Given Ratio: %Cu / %Cu + %Ni
(calculated to the nearest .1)
Percent
Ratio: %Cu / %Ni + %Cu
Log-Cumulative Curves Showing
Distribution of Ni-Cu Values
from 1,072 Assay Results
Cumulative Percentage
0.001-1.00% Ni (665)
Total (1072)
1.01-3.00% Ni (196)
3.01-7.00% Ni (141)
over 7.00% Ni (70)
Ratio: %Cu / %Ni + %Cu

PLATE VIII

which are plotted the mean values of copper and nickel content, calculated for each of the percentage ranges of nickel. It can be seen that, on the average, for values above 5 per cent nickel, the copper content is almost constant between 1.10 and 1.25 per cent.

The irregular distribution of the values within the near-surface portion of the main ore zone may be the result of secondary enrichment accompanying the supergene alteration of the upper part of the orebody.

Origin of the North Rankin Ore Deposit

The following features of the ore deposit must be explained:

1) The nickel and copper ore occurs exclusively within the serpentinized sill.
2) The ore occurs either within depressions in the sill floor, or along and above a shear plane a few tens of feet above the sill floor.
3) There is a regular increase in the total nickel and copper content as the bottom of the sill is approached. The nickel content shows this increase, but the copper values, when considered alone, show a more erratic distribution.
4) The highest grade ore and the greatest thickness occur at the surface of the main ore deposit, that is, well within the ore-containing depression.

5) The occurrence of violarite, pyrite, gersdorffite, and marcasite.

6) The absence of the sill and the presence of tuffs and quartzite at a shallow depth in the area to the south of the main ore deposit.

7) The presence of sulphide mineralization of economic interest within nearly every known depression of the sill floor.

A controversy exists in geological thought as to the origin of nickel-copper sulphide deposits in general, with two main theories being favored. The controversy arose over the origin of the extensive Sudbury nickel-copper deposits, and has since been extended to other orebodies.

One theory, that of a magmatic origin, considers the sulphides to have been introduced with the ultrabasic or basic magma and to have been coneentrated at the bottom of the intrusion by gravitational segregation of immiscible liquid sulphide drops, with possible subsequent injection of the sulphide liquid.

The second theory, that of a hydrothermal origin, considers the sulphides as having been introduced by hydrothermal solutions derived at depth either from the parent ultrabasic magma or from some extraneous source. Variations of both of the above theories have been proposed to explain special features of ore occurrence in different deposits.

The various features of the North Rankin nickel deposit, as listed above, are best explained by the magmatic segregation theory, and the deposit could be considered a type example of such an occurrence. The following origin is proposed for this deposit.

The mechanics of the intrusion of the sill have been previously discussed in the section on structural geology and the steps are summarized here:

1) Slight initial folding of the sediments and lavas.
2) Intrusion of the ultrabasic sill in a near horizontal attitude.
3) Segregation of the immiscible sulphide liquid and its concentration within depressions on the sill floor; movement during the period of consolidation caused the injection of massive sulphide stringers around the rim of the depression.
4) Folding of the enclosing rocks into a synclinorium, accompanied by the upward movement of the portion of the sill above the depressions; a shear plane formed 40 to 60 feet above the sill floor. Previously segregated sulphides were strung out on this plane, or, possibly, newly segregated sulphide liquid accumulated on the new depositional floor.

After the intrusion of the sill, the following sequence of events is proposed:

1) Concentration of the immiscible sulphide liquid containing some early magnetite, and possibly silicate crystals within depressions on the sill floor.
2) The contemporaneous consolidation of pyrrhotite, pentlandite, and chalcopyrite during the period of crystallization of the original basic silicate minerals.
3) An early alteration at depth, prpbably deuteric, resulting in the serpentinization of the basic silicate minerals to a rock consisting mainly of antigorite, accompanied by talc in areas of stress. The underlying formations were metamorphosed and the adjacent tuffs silicified. Fractures in the whole rock assemblage were filled with quartz, calcite-quartz, and calcite-talc-quartz stringers containing small amounts of sulphide minerals. The local development of actinolite and chlorite schist occurred.
4) Continuation of folding to the present attitude, accompanied by jointing of the sill and its enclosing rocks. The contacts of the sill were sheared, and a major fault dislocated the lower part of the sill.

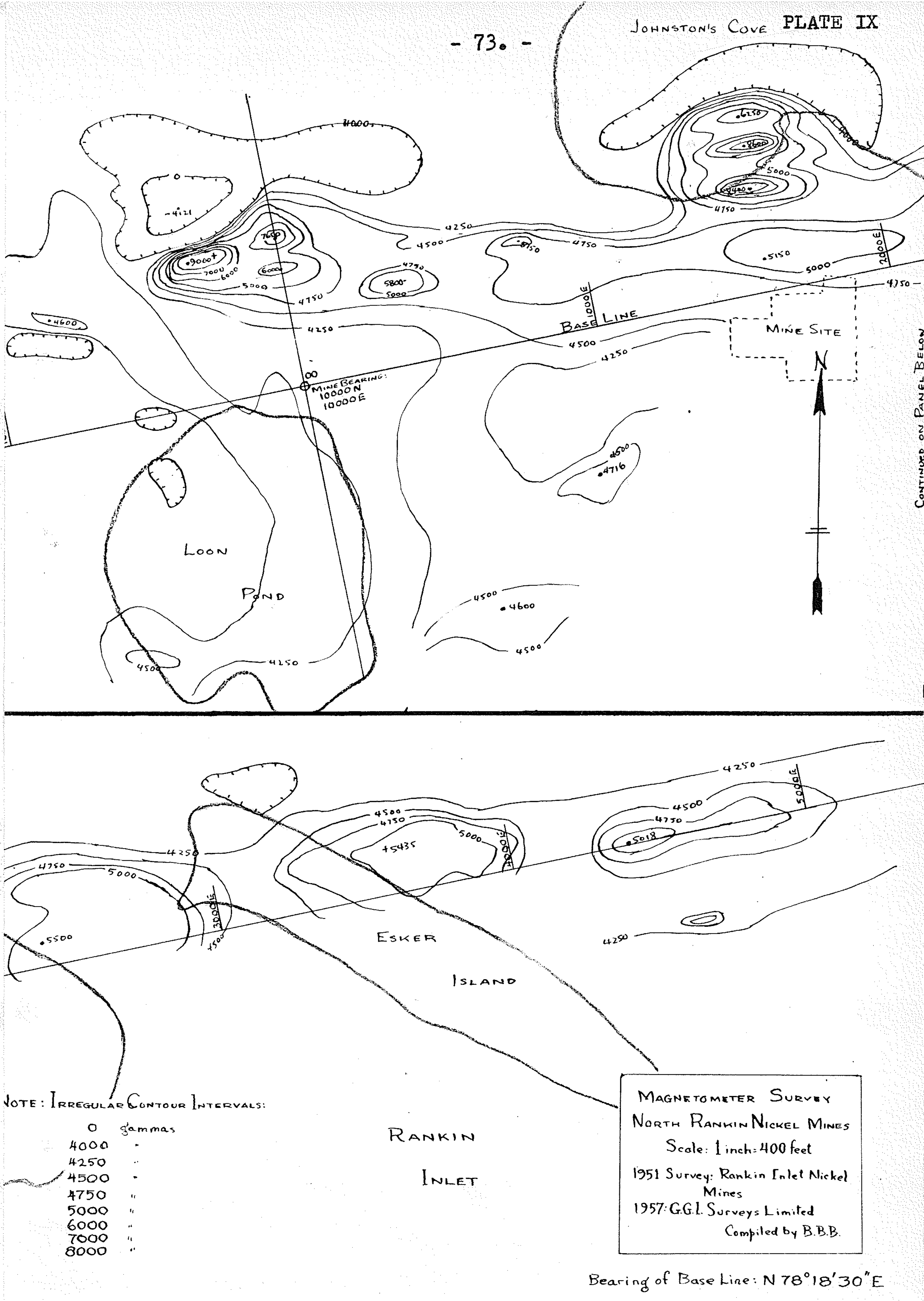
5) Uplift of the region and erosion, including glaciation, to the present state.
6) Weathering and accompanying supergene alteration, producing violarite, marcasite, and possibly pyrite.

Magnetometer Surveys

Two separate surveys have been made of the area around North Rankin Nickel Mines. The first, in 1951, was completed by Rankin Inlet Nickel Mines, and covered most of Kudulik Peninsula. In addition, an electromagnetic survey was conducted over the length of the horizon along which the serpentine sill was intruded. The second survey, in the spring of 1957, was carried out by Geological and Geophysical Investigations Surveys Limited, and covered the eastern extension of the nickel deposit under the ice of Rankin Inlet, and also the western extremity of the outcrop of the serpentine sill. The results of both surveys have been combined in Plate IX.

Several anomalies were outlined over the length of the sill, and it is noteworthy that the anomalies show a progressive decrease in intensity from the west end of the sill to the east side of Esker Island. The anomaly to the north of the Loon Pond shows a vertical intensity of over 9,000 gammas. The diamond drill results indicate that this anomaly is caused by

PLATE IX



Johnston's Cove
Continued on Panel Below
4000
4121
4250
4500
4750
5000
6000
7000
9000+
7650
5800
8150
5150
6250
8600
4600
4716
Base Line
1000E
2000E
3000E
4000E
5000E
Mine Site
N
00
Mine Bearing: 10000 N 10000 E
Loon Pond
5435
5018
5500
Esker
Island
Rankin
Inlet
Note: Irregular Contour Intervals:
0 gammas
4000
4250
4500
4750
5000
6000
7000
8000
Magnetometer Survey
North Rankin Nickel Mines
Scale: 1 inch: 400 feet
1951 Survey: Rankin Inlet Nickel Mines
1957: G.G.I. Surveys Limited
Compiled by B.B.B.
Bearing of Base Line: N 78°18'30"E

the presence of magnetite and magnetic sulphides at a very shallow depth. The difference in intensity between this anomaly and that over the main ore zone, which is underlain by a half million tons of high-grade ore, must be caused by a greater concentration of magnetite under the former as the drill results show that only a few tens of thousands of tons of ore can be expected under it.

The second anomaly, over the main orebody, is strong; the sulphide minerals there extend to 275 feet beneath the surface.

The anomalies to the east are fairly regularly spaced, but are of progressively weaker intensity. They could conceivably be caused by pockets of sulphide minerals located deeper and deeper along the contact because the axis of the syncline plunges a few degrees in this direction. Also, the presence of 20 to 70 feet of sea water over the anomalies furthest to the east would have an additional masking effect.

Drill holes in the area of the anomaly at 2500E indicate there is a slight concentration of magnetite in this area. There is another anomaly of similar proportions on the east side of Esker Island (3700E) with the highest reading obtained over the location of drill hole 77. This hole showed the presence of

10.5 feet of sulphide minerals along the bottom of the sill. The vertical depth of this intersection is 240 feet.

Another anomaly was picked up 600 feet east of Esker Island; GGI Surveys, in their interpretation of the 1957 survey, suggest that this anomaly is caused by magnetic minerals at a depth of only 90 feet.

The easternmost anomaly, located at 7200E, is much broader, of much lower intensity, and of different strike than the other anomalies. This anomaly strikes northwest for a distance of over 2000 feet, but the readings are only two to three hundred gammas above the surrounding readings. Its cause is unknown.

Possibilities for Further Ore Concentrations

Ore grade intersections in several of the exploratory diamond drill holes, combined with presence of magnetic anomalies along the sill, indicate that there are some areas worthy of further drilling. The various possibilities for additional ore concentrations are best discussed with reference to the structure contour map of the bottom of the sill, Plate X.

Nickel-copper sulphide mineralization close to or along the bottom of the sill occurs over the entire length which has been explored to date on the north limb of the synclinorium. Drill holes to the west, to the east, and below the main ore zone have all intersected short lengths of ore grade; the holes are too scattered to give accurate dimensions of the possible tonnage of the deposits, but a good indication of their nature can be obtained.

There appears to be little possibility of extending the main ore zone on its western edge. On the east side, however, indications are that the lower boundary of ore grade material angles upwards from the bottom of the roll to a point 275 feet east of the section along the crosscuts. Further drilling in this area in the winter of 1957 has already added approximately 40,000 tons of high grade ore to the reserves of the main deposit. Drill results indicate that any ore along the "lip" of the depression beneath the present workings is present as thin massive sulphide stringers located either above or within a fairly thick sheared zone of talc schist. The inaccessibility of these thin stringers from the present stopes may make all but the nearest portions uneconomical.

Five drill holes through the sill under the anomalies north of Loon Pond returned ore grade intersections. The structure contours indicate that this is the lowermost part of a large depression, the greater part of which has been eroded. If this depression also contained an orebody, then the grade and thickness of the remaining part should increase between the intersections of holes 17 and 18, and the surface. The tonnage of the ore present will depend largely upon the depth of erosion, that is, the thickness of overburden, but the figure of 50,000 tons of ore, comparable in grade to the present mine average, is proposed as a conservative estimate. Removal of the overburden in the pertinent area should reveal the thickness of any ore present, but difficulties would be encountered because of the permafrost.

The drill results in this area are:

Hole 17: 2.02% Ni; 0.45% Cu; over 15.5 feet
Hole 18: 6.22% Ni; 3.18% Cu; over 5.8 feet
Hole 20: 0.83% Ni; 0.36% Cu; over 7.5 feet
Hole 26: 2.43% Ni; 0.26% Cu; over 5.9 feet
Hole 66: 0.99% Ni; 0.34% Cu; over 10.0 feet.

Further east, drill holes 24A and 70 showed low ore-grade assays. As the mineralized sections are 25 to 35 feet above the bottom of the sill, this low-grade ore may be comparable to the upper ore zone in the present mine workings. The drill results are:

Hole 24A: 1.00% Ni; 0.50% Cu; over 10.0 feet
Hole 70: 1.45% Ni; 0.49% Cu; over 14.5 feet.

A depression in the floor of the sill is indicated around hole 29, but of the two holes within the depression, neither gave any ore-grade assays. The results are too few there to give an estimate of the possibilities of this depression.

A large depression, its exact dimensions unknown, is present below and to the east of the present workings. Five of the nine drill holes which have intersected this "roll" showed good ore-grade sections, while the other four contained lesser amounts of sulphide minerals. The shape and location of this lower depression is shown in cross section in Plate V and in long section in Plate X. The best results are:

Hole 58: 1.29% Ni; 0.46% Cu; over 21.3 feet
Hole 59: 1.09% Ni; 0.33% Cu; over 25.6 feet
Hole 57: 2.32% Ni; 0.27% Cu; over 12.2 feet
Hole 10: 2.25% Ni; 0.71% Cu; over 9.9 feet
Hole 36: 1.36% Ni; 0.83% Cu; over 12.0 feet.

Most of these holes are 200 to 300 feet apart, and extrapolating between them to give a tonnage estimate is inadvisable. Further drilling in this area is definitely recommended.

Drill hole 201, which assayed 1.08% nickel and 0.37% copper over 20.0 feet, intersected ore 14 feet above the 200 level, and about 150 feet east of the last ore observed in the 2-1-2 or east drift. The ore consists mainly of disseminated sulphides in soapstone, with a few small masses of sulphide minerals in calcite stringers. It is not known whether this ore is a continuation of the main ore zone, or whether it is connected with the lower depression just discussed. The results of the drill program of 1957, not available for this report, may give more evidence on the eastern extension of the main ore zone.

The drill results indicate that the sill extends at least to the east side of Esker Island, where it has a thickness of 170 feet. The drill holes are widely spaced, but almost all of them showed some mineralization present, some of ore grade. The most interesting intersection is that of hole 77, which assayed 1.33% nickel and 0.70% copper over 10.5 feet. The combination of ore grade assays, a possibility of a second depression, and the magnetic anomaly here make this an area worthy of more drilling.

Thus there are several possibilities for further ore deposits within the sill. However, other factors aside from the possible presence of ore must be considered if an exploratory drill program is undertaken. These include the possibility of a large ore deposit, the best method of reaching any additional deposits, and the location of the eastern extension of the sill under Rankin Inlet with the consequent danger of flooding of mine workings. The following program is designed to test the possibilities listed above, and is concerned only with the absence or presence of ore:

1) Extension of the main ore deposit: The limits of this orebody would be best determined by observations within the mine as the present stopes are extended.

2) Exploration of the depression below the present mine: Five critically placed drill holes, within the depression and between existing holes, should show if high grade ore is present. If favorable results were obtained, an additional five holes could outline the grade and tonnage.

3) Exploration of the west end of the sill: A few shallow drill holes would outline any orebody in the area north of the Loon Pond. The feasability of stripping the overburden should be considered; possibly two or three trenches could be excavated north of the large outcrop of the sill. If the ore values indicated are from the lower part of an eroded orebody, the best grade and thickness should be present immediately below the overburden.

4) East side of Esker Island: A few holes in the anomalous areas may indicate whether any complete ore-containing depressions existed there.

Conclusions

The nickel-copper sulphide ore is in a serpentinized ultrabasic sill intruded along the sedimentary-upper volcanic contact early in a Pre-Cambrian orogenic period; the sill now outcrops on the north limb of a synclinorium. The ore occurs within depressions on the bottom of the sill and shows a regular increase in grade toward the base of the depression; it is thought to have formed by magmatic segregation.

The primary ore minerals include pyrrhotite, pentlandite, chalcopyrite, magnetite, and minor pyrite. The original mafic minerals of the sill have all been altered to serpentine and, in areas of stress, talc. A later alteration has converted some of the pyrrhotite to marcasite, and weathering has altered some pentlandite to violarite. Weathering has likely caused some supergene enrichment of the near surface portion of the orebody.

The limits of the ore deposit now being worked have been fairly well defined. Structure contours on the bottom of the sill show several other depressions, and exploratory drill holes have intersected nickel ore in some of these. Magnetometer surveys traced a series of anomalies along the base of the sill. Further drilling is recommended to determine the grade and tonnage of ore in all of the known depressions.

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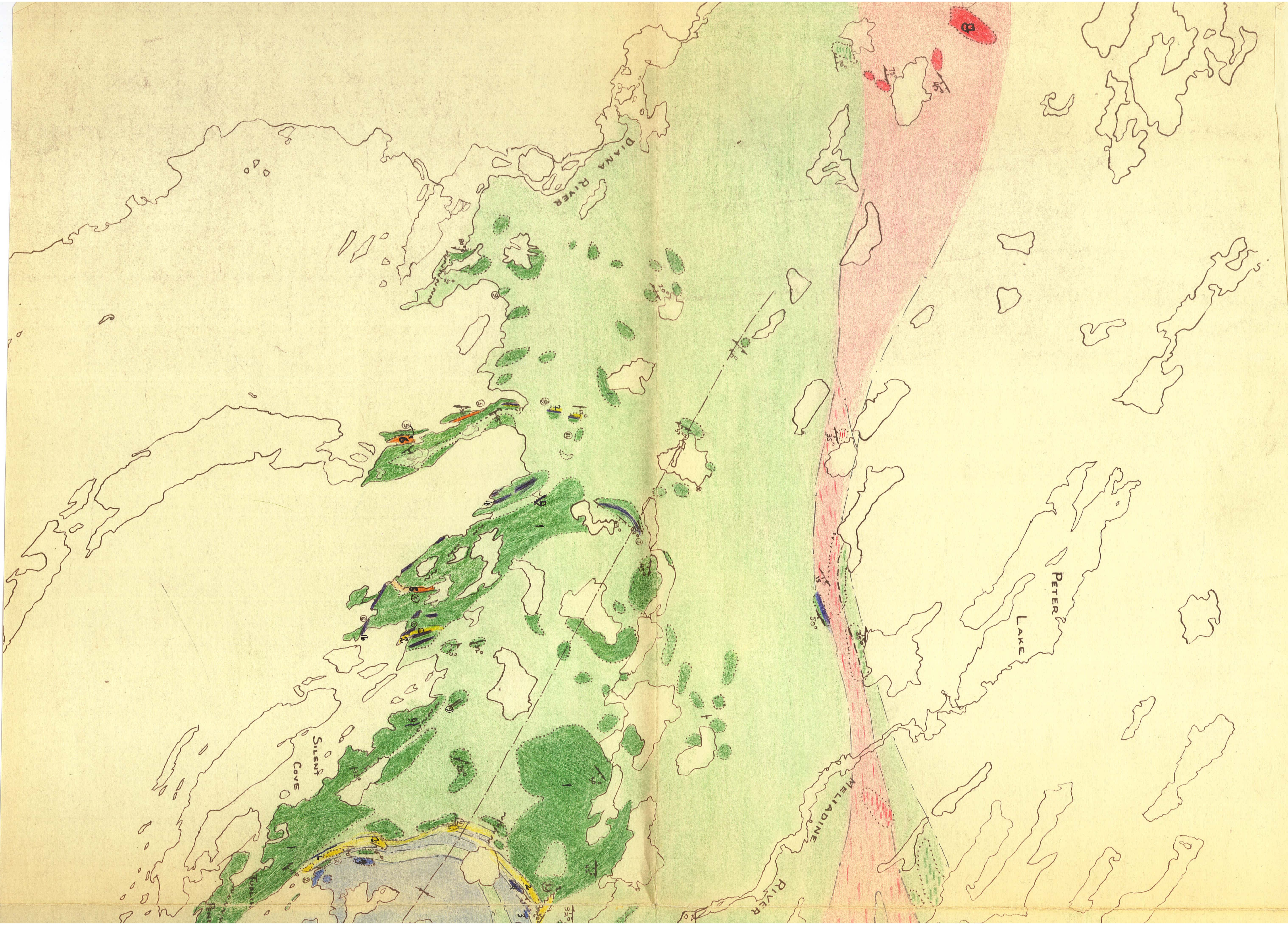
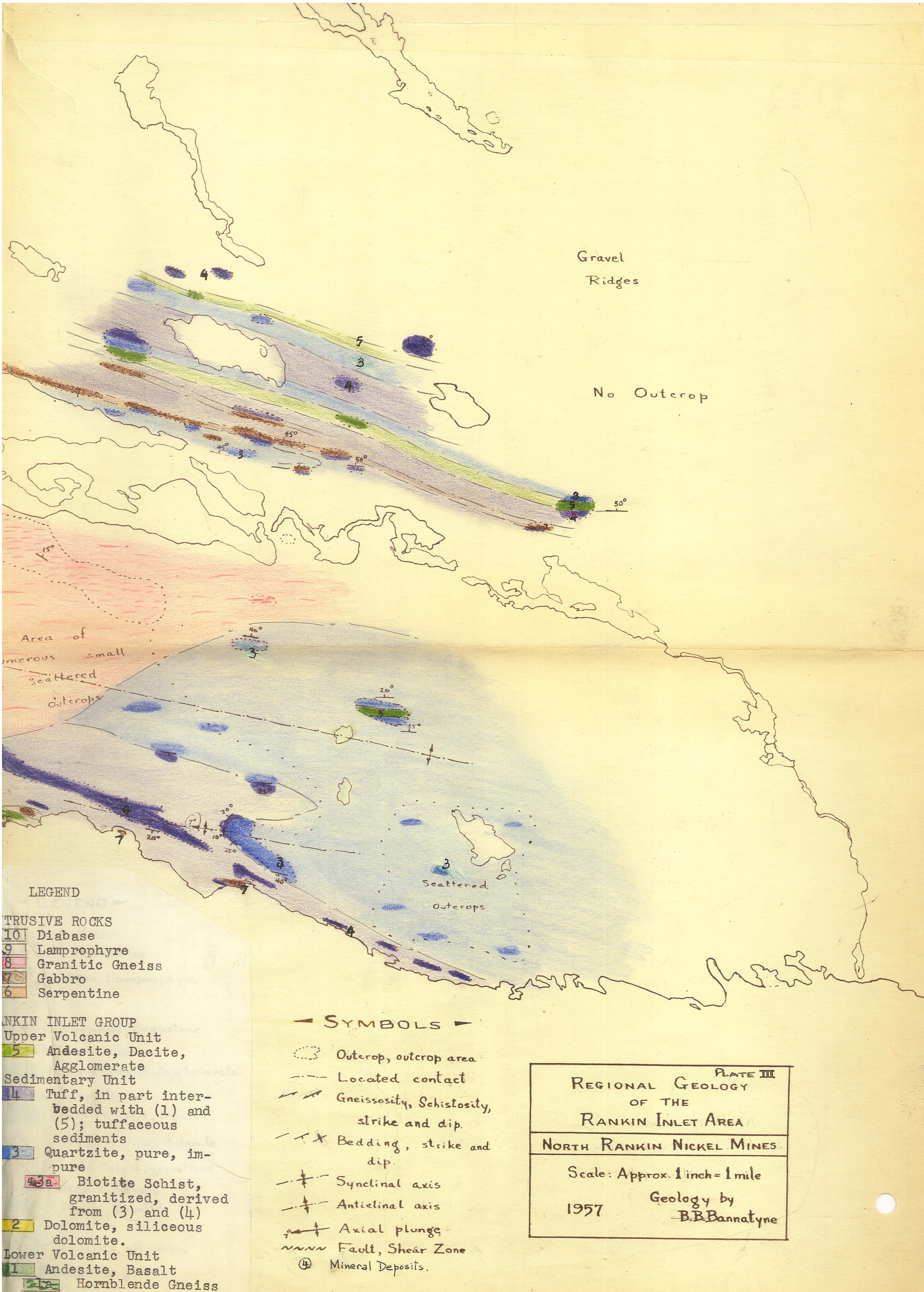
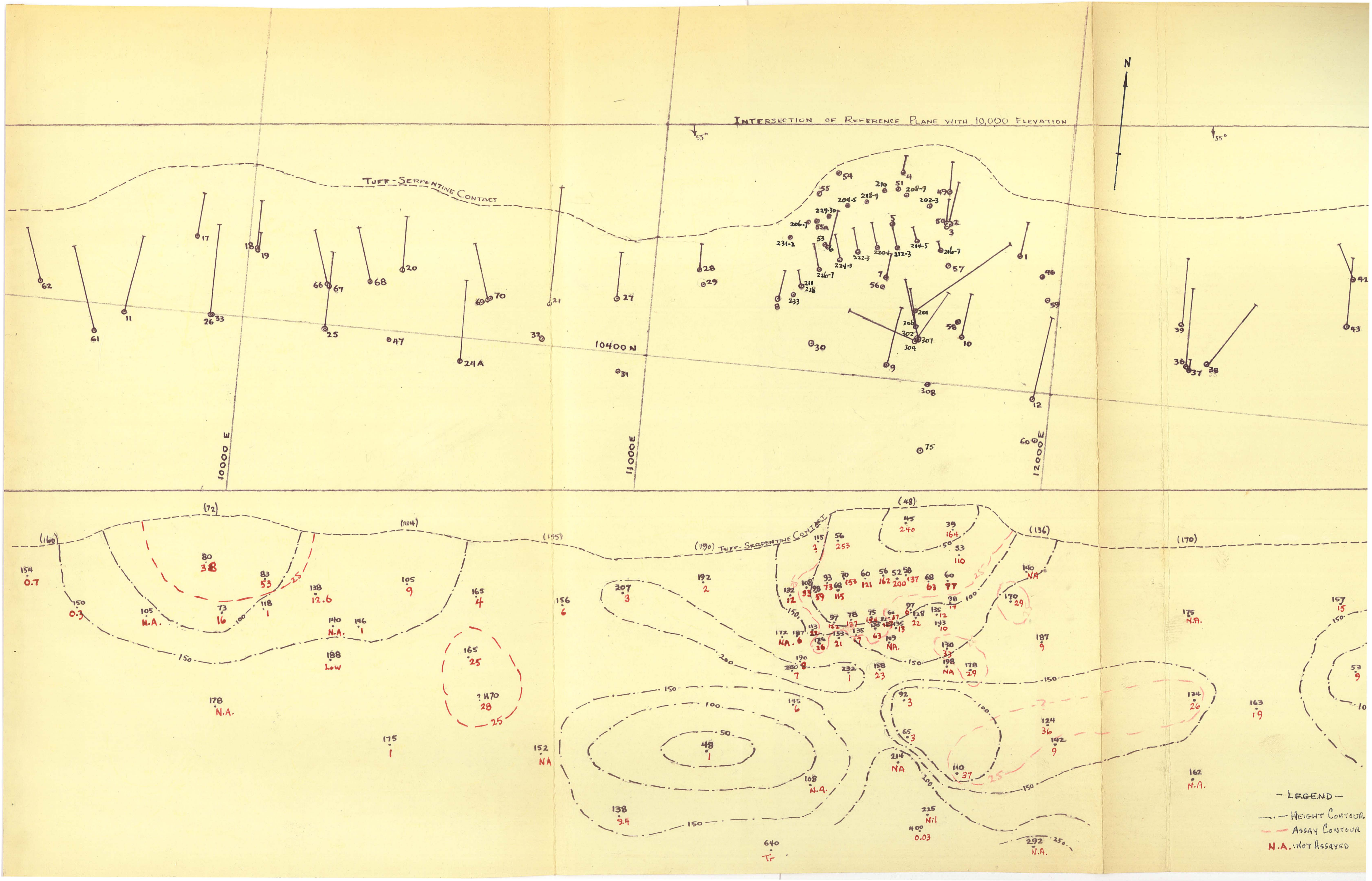

DIANA RIVER
PETER LAKE
MELIADINE RIVER
SILENT COVE

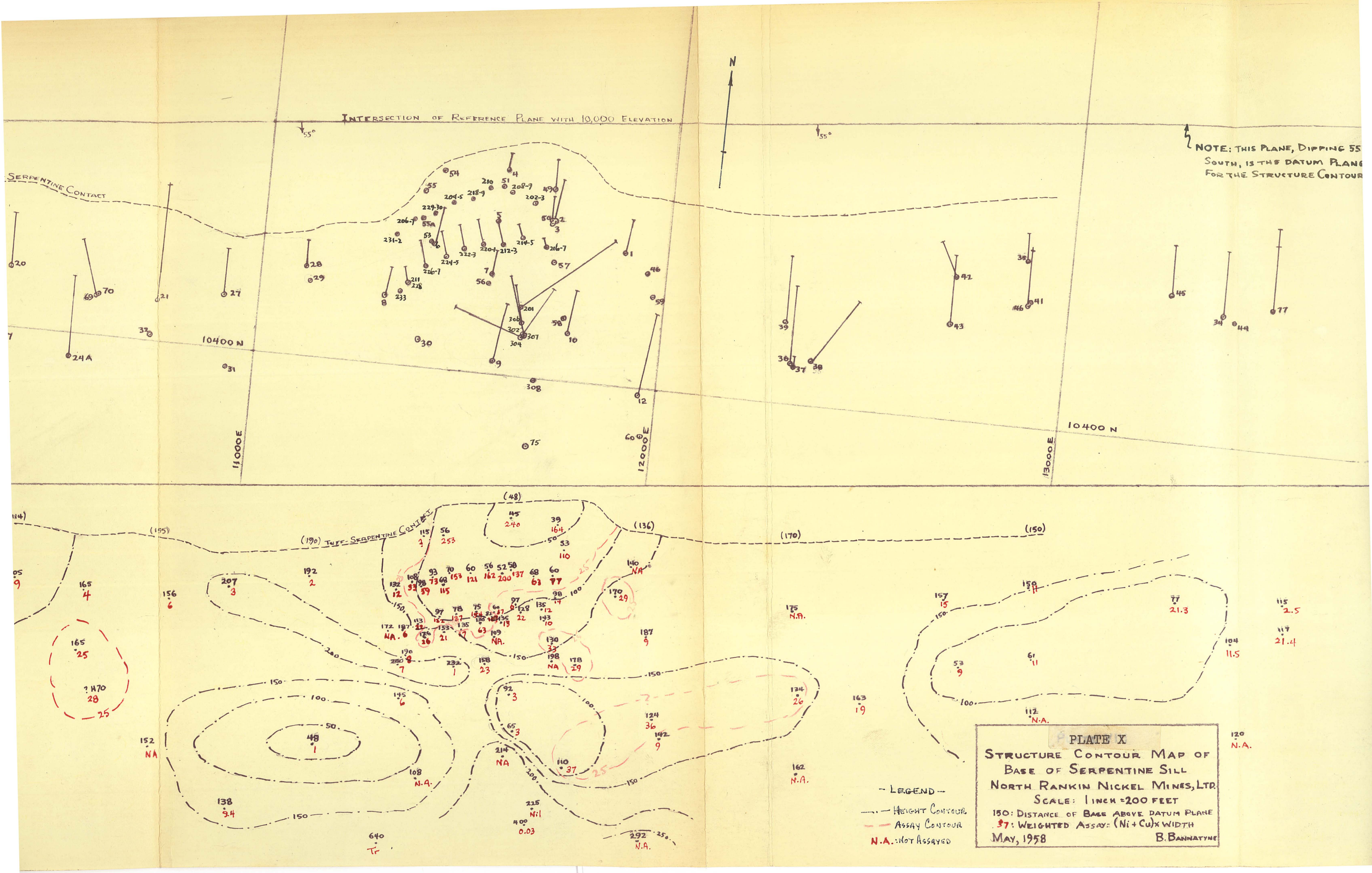

Atulik Lake
No Outcrop
Prairie Bay
Lake Nipisar
North Rankin Nickel Mines
Esker Island
Kudulik Peninsula
Melvin Bay
Bunting Is.
Thomsen Island
Falstaff Island
Rankin Inlet
Archaean



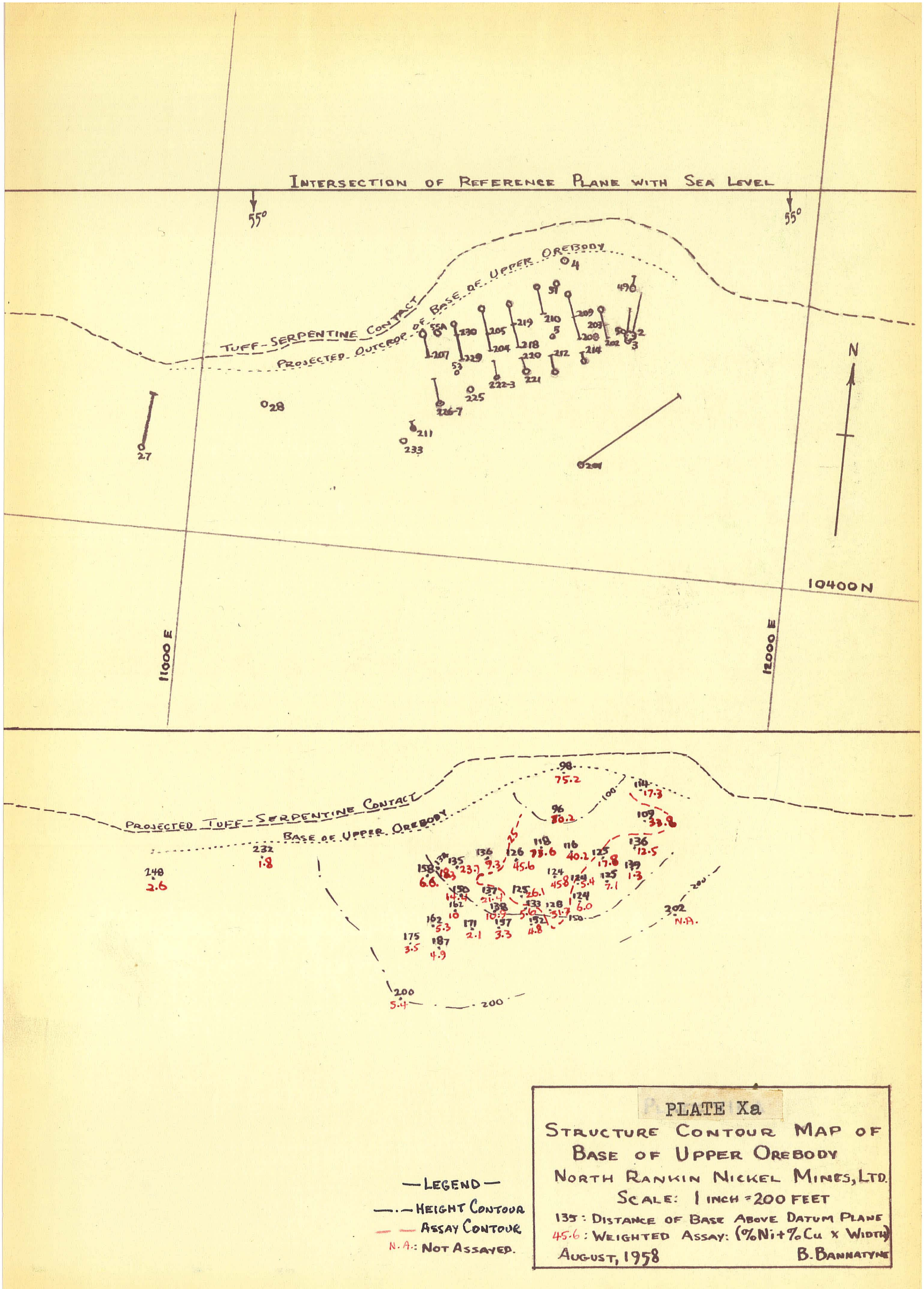
Gravel
Ridges
No Outcrop
Area of
...merous small
Scattered
outcrops
Scattered
Outcrops
LEGEND
...TRUSIVE ROCKS
10 Diabase
9 Lamprophyre
8 Granitic Gneiss
7 Gabbro
6 Serpentine
...NKIN INLET GROUP
Upper Volcanic Unit
5 Andesite, Dacite, Agglomerate
Sedimentary Unit
4 Tuff, in part interbedded with (1) and (5); tuffaceous sediments
3 Quartzite, pure, impure
4-3a Biotite Schist, granitized, derived from (3) and (4)
2 Dolomite, siliceous dolomite.
Lower Volcanic Unit
1 Andesite, Basalt
1a Hornblende Gneiss
SYMBOLS
Outcrop, outcrop area
Located contact
Gneissosity, Schistosity, strike and dip.
Bedding, strike and dip.
Synclinal axis
Anticlinal axis
Axial plunge
Fault, Shear Zone
④ Mineral Deposits.
PLATE III
REGIONAL GEOLOGY OF THE RANKIN INLET AREA
NORTH RANKIN NICKEL MINES
Scale: Approx. 1 inch = 1 mile
1957
Geology by B.B.Bannatyne



N
Intersection of Reference Plane with 10,000 Elevation
55°
55°
Tuff-Serpentine Contact
10400 N
10000 E
11000 E
12000 E
Tuff-Serpentine Contact
- Legend -
Height Contour
Assay Contour
N.A. : Not Assayed



N
Intersection of Reference Plane with 10,000 Elevation
55°
NOTE: This plane, dipping 55° South, is the datum plane for the Structure Contour
Serpentine Contact
10400 N
11000 E
12000 E
13000 E
(190) Tuff-Serpentine Contact
(155)
(48)
(136)
(170)
(150)
PLATE X
Structure Contour Map of Base of Serpentine Sill
North Rankin Nickel Mines, Ltd.
Scale: 1 inch = 200 feet
150: Distance of Base above Datum Plane
37: Weighted Assay: (Ni + Cu) x Width
May, 1958
B. Bannatyne
- Legend -
Height Contour
Assay Contour
N.A.: Not Assayed


INTERSECTION OF REFERENCE PLANE WITH SEA LEVEL
55°
55°
TUFF-SERPENTINE CONTACT
PROJECTED OUTCROP OF BASE OF UPPER OREBODY
N
10400 N
11000 E
12000 E
PROJECTED TUFF-SERPENTINE CONTACT
BASE OF UPPER OREBODY
100
200
— LEGEND —
HEIGHT CONTOUR
ASSAY CONTOUR
N.A.: NOT ASSAYED.
PLATE Xa
STRUCTURE CONTOUR MAP OF
BASE OF UPPER OREBODY
NORTH RANKIN NICKEL MINES, LTD.
SCALE: 1 INCH = 200 FEET
135: DISTANCE OF BASE ABOVE DATUM PLANE
45.6: WEIGHTED ASSAY: (%Ni + %Cu x WIDTH)
AUGUST, 1958
B. BANNATYNE