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A STUDY OF THE
KENNEDY LAKE IRON MINE

PROPERTY FILE

by

C.C. Sheng. M.M. Menzies.

31st March 1961.

A STUDY OF THE
KENNEDY LAKE IRON MINE
UCLUELET, B.C.
31 MARCH 1961.

92F001

PROPERTY FILE

M.M. MENZIES, P.Eng.
and
C.C. SHENG, Geologist

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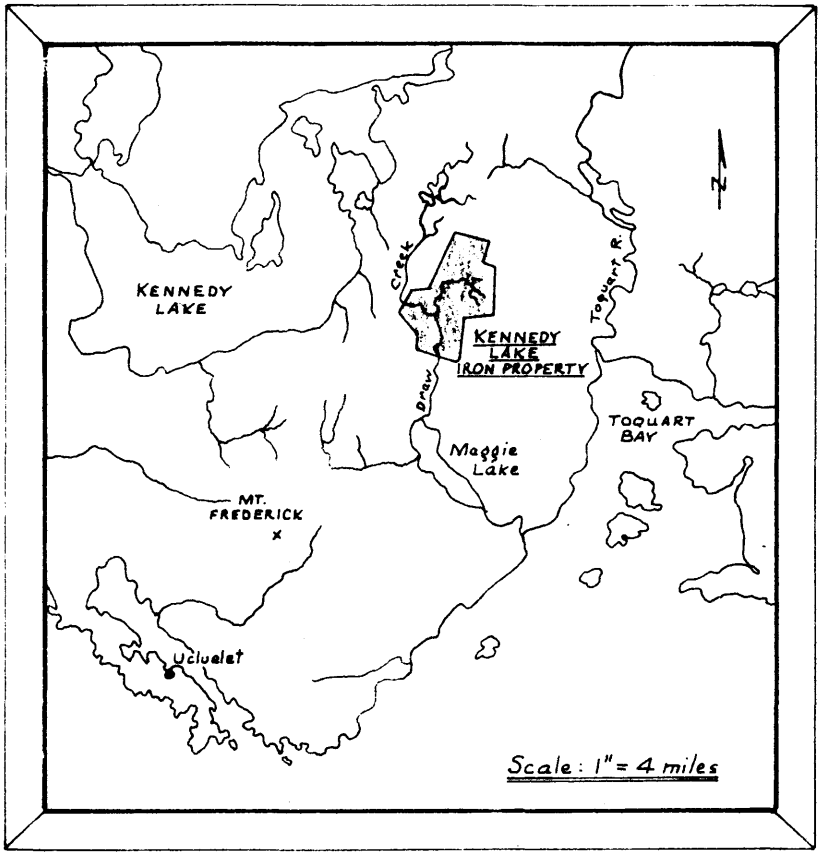
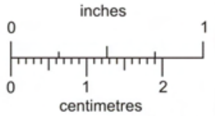


LOCATION MAP
SHOWING
KENNEDY LAKE IRON PROPERTY



MAPS TO ACCOMPANY REPORT

Scale: 1" = 100'

1. Surface Geology
2. 130 ft. Level Plan
3. Isometric View (Included in Report Appendix)

Scale: 1" = 50'

East-West Sections

1. .... 3800 N 3850
2. .... 3900 N ✓
3. .... 4000 N ✓
4. .... 4100 N ✓
5. .... 4200 N ✓
6. .... 4300 N ✓
7. .... 4400 N ✓
8. .... 4500 N ✓
9. .... 4550 N ✓
10. .... 4600 N ✓
11. .... 4650 N ✓
12. .... 4700 N
13. .... 4800 N
14. .... 4900 N ✓
15. .... 5000 N ✓
16. .... 5050 N ✓
17. .... 5100 N ✓

North-South Sections

1. .... 5000 E ✓
2. .... 5100 E ✓
3. .... 5200 E ✓
4. .... 5300 E ✓
5. .... 5400 E ✓
6. .... 5500 E ✓

4650
4700
4750
4800
4850
4900
4950
5000
5050
5100
5200
5300

KENNEDY LAKE IRON MINES

Ucluelet, B.C.

SUMMARY

A strong magnetic anomaly was found by Edwin Chase in Draw Creek between Maggie and Kennedy Lakes, Ucluelet District, Vancouver Island, in late January 1960. The property was staked and subsequent drilling by Colin Campbell indicated potentially economic tonnages of high grade, impurity free magnetite. Noranda Exploration Company, Limited optioned the property in the spring of 1960 and formally took over on May 15th.

The Alberni-Tofino highway and existing logging roads provide ready access to Ucluelet, the nearest community some 15 road miles to the west. A new mining road, less than 8 miles in length, will permit the trucking of concentrates to a well sheltered, deep sea port at Toquart Bay and ensure a year round operation. Daily air service between Vancouver and Tofino is provided by B.C. Airlines.

Daily rainfall records kept over the past six months indicate an annual precipitation well in excess of 200 inches. The summer dry season is short and heavy sea fogs keep the fire hazard to a minimum. Snow is rarely a problem as the mine lies between 250 and 450 feet above sea level.

The Kennedy Lake Iron Mine and the adjoining Hansen property, both under option to Noranda Exploration Company, Limited, consist of 65 claims and fractions. Claim data are compiled in Appendix "A". Legal surveys have been completed on about half of the claims and as work progresses the number of claims will be reduced by abandonment and the staking of fractions.

Eighty-nine diamond drill holes, totalling 27,328 feet, have been drilled on the Kennedy Lake property. Data are tabulated in Appendix "B".

A Sharpe A3 magnetometer survey has been made of the Kennedy Lake claims using a grid of 100 foot centres and of the Hansen claims using greater spacings. The survey has been one of the principle controls for diamond drill hole lay-out.

A northeasterly striking syncline of Triassic Vancouver Group limestone and tuff is surrounded by Jurassic quartz diorite intrusions and cut by andesite and feldspar porphyry dykes. Around the southwesterly nose of the northeasterly plunging syncline magnetite has replaced both tuffaceous rocks and limestone. This process was controlled by the tuff-lime contact, sharp drag-folding of the lime, faulting, proximity of the quartz diorite intrusion, and alteration and skarnitization of the sediments.

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Open pit reserves in short tons are tabulated in Appendix "C". Reserves above a 50 percent cut-off are 3,711,000 tons at 56.37 percent iron. Reserves between 40 and 50 percent are 562,000 tons at 42.82 percent iron. Impurities are negligible.

Underground reserves have not been calculated as much drilling is still required to reliably establish tonnage and grade. However, on the basis of preliminary drilling, reserves are expected to at least equal open pit ore in quantity and grade.

The limestone horizons in the Vancouver Group of rocks along the West Coast of Vancouver Island are very favorable to magnetite and sulphide mineralization and substantial ore reserves are already known. Prospecting is exceedingly difficult because of the ruggedness of the terrain, dense forest growth, and adverse climatic conditions. A carefully planned programme of prospecting, geological mapping and airborne magnetic surveying of the lime belts is the logical method of attack and gives much promise for new discoveries of economic importance.

MMMenzies P.Eng.

M.M. Menzies

A STUDY OF THE
KENNEDY LAKE IRON MINE
DRILL CORES

INTRODUCTION

A study of the Kennedy Lake Iron mine diamond drill cores was made by the writer between December 17, 1960 and March 31, 1961. Eighty four drill holes were logged, thin sections made, and 25 strucural interpretation maps prepared from the information obtained from logging and core thin section study.

GENERAL GEOLOGY

The area covered by this report is underlain by volcanic tuff and limestone of the Triassic Vancouver Group. The tuff and limestone are intruded by large bodies of quartz diorite and andesite. Numerous feldspar porphyry dykes cut all other rocks.

The tuff and limestone are folded into a syncline striking north-northeast and plunging at a shallow angle in the same direction. The younger limestone forms the core of the sedimentary series and is surrounded on all sides by tuffaceous rocks. Faults and drag-folds are common on the western flank and around the nose of the plunging syncline.

Feldspar porphyry is the most common dyke rock and was encountered in a large number of the drill holes. The dykes vary in thickness from a few feet to over fifty feet. They are very irregular and were probably emplaced along a fracture system with the flat, tabular body being the most common form. The dykes are younger than the sediments and quartz diorite intrusions and may be younger than intrusive bodies of andesite and andesite porphyry.

A large body of andesite and andesite porphyry occurs near the surface at the southwesterly end of the syncline. It appears to cut both the tuff and limestone. The most common attitude of the andesite is about the same as that of the feldspar porphyry. Thick bodies of andesitic rock were also found in diamond drill holes 142 and 145.

The limestone forms the core of the plunging syncline and may overlie the tuffaceous rocks conformably. Unless the Vancouver Group is overturned, for which evidence is lacking, the limestone is the younger rock. Estimated thickness of the limestone is 200 feet but minor drag folding and the attitude of the synclinal structure may exaggerate the true thickness. Thick bedding in the limestone has been identified in a few core specimens with dips ranging from 20 to 70 degrees. The wide variation of dip angles can be explained by the primary structure and local drag-folding.

A thick series of tuffaceous rocks directly underlie the limestone. It may be conformable to the limestone and is folded along with it into a synclinal structure. The true thickness of the tuff horizon cannot be measured but probably exceeds 150 feet. The rock appears to have been deposited in water as a few good bedding planes were found intercalated in the generally massive formation. The dip of the bedding planes range from 15 to 40 degrees.

Quartz diorite is a very common intrusive rock in the Kennedy Lake Iron mine area. A thick body of this rock was only cut in diamond drill hole 123 but narrow quartz diorite dykes were encountered in several other holes. However, regional mapping shows the Vancouver Group rocks to be bounded on the east and west by large intrusions and may be entirely surrounded by quartz diorite.

The tuff and limestone have been recrystallized and large bodies of skarn occur within them. Massive magnetite deposits, formed by replacement of both rock types, are related to the folding and faulting of the sediments and the intrusions of quartz diorite.

The following table shows the probable age relationship of the Kennedy Lake Iron mine rocks.

Young - Feldspar Porphyry
Andesite and Andesite Porphyry
Magnetite
Skarn
Quartz Diorite
Limestone

Old - Tuff

PETROGRAPHY

Feldspar Porphyry The feldspar porphyry is a light grey, fine grained rock, commonly massive in appearance. It is composed of subhedral to anhedral phenocrysts of feldspar and minor amounts of prismatic mafic minerals set in a fine grained groundmass.

Under the microscope, feldspar is seen as the major constituent. It occurs as large phenocrysts and as highly altered fine grains in the groundmass. Phenocrysts are mostly subhedral forms and range from oligoclase to andesine in composition. Zoned crystals were found in one section. Most phenocrysts are highly altered and clouded with sericite.

Antigorite, which occurs as aggregates of lamellar crystals, is found in most sections. The mineral is subhedral to prismatic in outline and is possibly pseudomorphous after pyroxene. Chlorite is commonly associated with the serpentine mineral and other accessories include calcite, magnetite, and a few grains of quartz.

Andesite The andesite is fine to coarse grained and varies from light grey to grey in colour. The coarser grained variety in some specimens has the appearance of a fine grained diorite but is seen to change gradationally into a fine grained andesite. Phenocrysts of light coloured feldspar occur in some of the rock.

Under the microscope, the andesite is composed of approximately 60 percent plagioclase, 35 percent augite, and 5 percent accessory minerals including chlorite, calcite and magnetite. There are two generations of plagioclase. The phenocrysts have a composition of An 48-50 and the groundmass crystals have a composition of An 34-39. Intergranular texture is predominant in the rock but subophitic texture is also common. Augite occurs as anhedral crystals and is commonly found as small grains between feldspar laths. Average grain sizes of plagioclase and augite in the groundmass are 0.17 mm and 0.045 mm respectively.

Amygdaloidal Andesite A two foot core section of amygdaloidal andesite was found in massive magnetite in diamond drill hole 36.

In hand specimen, the rock is dark grey and fine grained. Subrounded to rounded, black to greyish white amygdules form about 10 percent of the rock.

In thin section, the major constituents of the andesite are plagioclase 40 percent, basaltic hornblende 35 percent, and chlorite minerals 25 percent. The plagioclase occurs as large phenocrysts having an andesine composition. In the groundmass the lath shaped plagioclase crystals have a composition between oligoclase and andesine. The basaltic hornblende is brownish in colour and occurs mostly in prismatic and anhedral crystal forms. Chlorite is a common mineral in both the groundmass and the amygdules. It has a fibre-lamellar texture in the amygdules and is massive in the groundmass. The andesite is characterized by subophitic texture. The groundmass grain sizes of plagioclase and mafic minerals are 0.17 mm and 0.06 to 0.15 mm respectively.

Andesite Porphyry Andesite porphyry dykes cut the tuff and limestone. They are closely associated with the andesite.

In hand specimen, the rock varies in colour from grey to pale greenish grey. Large subhedral white feldspar crystals, forming 15 to 20 percent of the rock volume, are set in a pale greenish to grey aphanitic, siliceous groundmass.

In thin section, plagioclase and augite are the major constituents. The plagioclase phenocrysts are andesine with compostion of An 48-50, of subhedral form, and moderately altered. Some crystals show corroded edges. The lath shaped plagioclase crystals in the groundmass have the composition of An 39 and are mostly simply twinned. Pale greenish augite commonly occurs as anhedral grains interstitial with the plagioclase laths. Some anhedral grains of augite are poikolitically included in the plagioclase phenocrysts. Accessory minerals are calcite and magnetite. Average grain sizes of the plagioclase and augite in the groundmass are 0.16 mm and 0.075 mm respectively.

Quartz Diorite Quartz diorite drill core is a light grey, medium to coarse grained rock composed of greyish white subhedral plagioclase, transparent anhedral quartz grains, and black mafic minerals.

Under the microscope, the rock consists of about 60 percent plagioclase ranging in composition from An 32 to 40, 15 percent quartz, 10 percent pale greenish hornblende, 10 percent magnetite, and 5 percent orthoclase. Most of the feldspars are subhedral with zoned crystals not uncommon. Anhedral hornblende crystals are closely associated with magnetite. Irregular grains of quartz are interstitial with the feldspar. The rock is relatively fresh with the only apparent alteration being a slight mottling of the feldspars.

Limestone The limestone, depending on the degree of metamorphism suffered, is fine to coarse grained with the coarser variety approaching a marble in texture. The fine grained limestone is moderately hard and massive in appearance. The colour of the rock is generally greyish white but dark coloured patches, identified as brucite, were seen in some cores. Broad bedding was found in a few drill core sections.

Under the microscope, the fine grained limestone has a mosaic texture of calcite crystals. Grain size is uniform throughout individual sections with an average size of 0.1mm. Secondary veins of coarse calcite cut the rock. Brucite occurs as isolated masses of scaly mineral aggregates and suggests a minor magnesium content in the limestone.

Tuff The tuff is greyish white to light grey in colour with a dense, aphanitic appearance. Angular crystals of feldspar are sparsely scattered throughout the very fine grained groundmass. Greenish coloured, irregular patches are common in the rock. Well banded thin beds of darker tuff are found in a few drill cores. The rock is massive and very hard.

In thin section, the tuff is composed of 65 percent feldspar, 30 percent pyroxene, and minor amounts of magnetite and calcite. Feldspar occurs as large anhedral crystals and as fine grains in the groundmass. Some large feldspar crystals appear as shards with corroded edges. Most of the crystals are untwinned and mottled in appearance but carlsbad and albite twinning is found in some. Crystals with albite twinning are andesine in composition. Abundant fine anhedral grains and anhedral crystal aggregates of pyroxene are unevenly disseminated throughout the feldspathic groundmass. Veinlets of calcite and zeolites cut the rock.

The rock texture is of metamorphic origin. Grain size of groundmass feldspar averages 0.03 mm while the large shards average about 0.25 mm. Pyroxene in the groundmass is roughly the same grain size as the feldspar. Small pockets of coarser grained feldspar, about 0.25 mm in size, and aggregates of pyroxene crystals occur in the fine grained groundmass.

Under the microscope, the well banded tuffs are composed of 65 percent pale greenish anhedral hornblende. Other constituents are feldspar with minor magnetite and a few quartz grains. The banding is caused by increased mafic content in certain layers.

No index minerals have been identified but the tuff appears to have suffered medium grade metamorphism.

STRUCTURE

Folding of sediments and intrusions of quartz diorite were probably contemporaneous. The quartz diorite is likely related to the Coast Range intrusions of late Jurassic or early Cretaceous age.

Surface mapping and drill hole logging places the Kennedy Lake Iron mine at the southwest end of a northeasterly plunging syncline and along a limestone-tuff contact. The rocks along the westerly flank and around the nose of the syncline are steeply dipping, with angles in excess of 70 degrees in many places. Northerly along the flank dip angles are flatter. Accompanying structural sections indicate drag-folding occurred around the nose of the syncline with axial planes dipping gently away from the main synclinal axis. Drag-folds with steeply dipping axial planes occur farther to the north along the westerly flank.

Two sets of faults are inferred from core logging. The "Rotational" fault, as shown on the geological plans, strikes northwest-southeast and has a very steep to vertical dip. Rocks to the east of the fault are down relative to rocks to the west. Maximum displacement occurs at the south end of the orebody where ore east of the fault is 270 feet lower than ore to the west. As shown on the accompanying isometric drawing, displacement decreases rapidly in magnitude to the northwest along the strike of the fault. While the "Rotational" fault may represent a pre-ore break, the displacement is considered essentially post-ore for the following reasons:

1. On given east-west sections, ore widths on either side of the fault match closely.
2. All available evidence points to the ore ending abruptly at the fault plane.
3. Macroscopic and petrographic evidence strongly favors replacement by magnetite of both the metamorphosed tuffaceous sediments and limestone with replacement of lime predominating.

Three steeply dipping transverse faults are inferred by drill hole logging. The faults may have caused the movement of the ground between 4500 North and 5000 North to the west relative to ground north of 5100 North, and a narrow block lying between 4350 North and 4450 North. These appear to be essentially horizontal movement faults with displacements possibly in the order of 200 feet. Transverse faulting brings the limestone and tuff into direct contact along the formational strike as shown on the geological plans and sections. These faults may be pre-ore as ore in limestone can be traced across the assumed faults into ore replacing tuffaceous sediments.

Tension joints commonly occur in the crest of folds, the place of greatest curvature, as a result of relaxing pressures. (DeSitter: Structural Geology, P.100). Other joints, such as oblique joints, shear joints, concentric shear joints, and rotational joints, are also common in a folded strata. The tension joints in the crest of a fold generally has the same trend as the axial plane. It is possible that some of the numerous dykes of andesite and feldspar porphyry with flat, tabular forms around the nose of the plunging syncline are intruded into the sediments along gently dipping tension joints developed in the crest of the drag-folds. The development of microscopic and minor structures in folded strata normally accompany larger scale fracturing and jointing. Fractures undoubtedly served as important channelways for ore solutions.

METAMORPHISM

A thorough study of the metamorphic process in the tuffaceous sediments and limestone is essential to any structural interpretation of the Kennedy Lake mine.

The regional geological map shows the sediments to be bordered by plutonic rocks on all sides, except perhaps to the south where geological information is lacking. As expected, metamorphism of varying degrees of intensity has taken place in the sediments. Abundant skarns are found in both the tuff and limestone and a discussion of skarn development in the two rock types follows under separate headings.

Limestone: Skarn Development and Alteration

Limestone intruded by plutonic rocks has undergone mineralogical change, resulting in the formation of several metamorphic rock types.

Garnet Skarn - Specimens were collected and studied from beds where the original rock type was obviously limestone and the contrast between well developed garnet skarn and crystalline limestone was sharp. Large, irregular masses of garnet skarn also occur in the limestone.

The garnet is a dark brownish variety. In thin section, it is colorless with a trace of pale brown. It is found in anhedral forms and as large plates of fractured crystals. Augite ($r>v$) occurs as small grains in the garnet crystals and is also found as fine grains bordering the garnets. The amount of pyroxene may increase in the garnet skarn with the rock becoming a pyroxene-garnet skarn.

Mineralogically, these two variations of skarn are the same. The pyroxene grain size in the skarn ranges from 0.03 to 0.18 mm.

Pyroxene-Amphibolite Rock - The pyroxene amphibolite rock is intercalated with massive magnetite sections. It is pale greenish in colour, coarser grained, and composed of large prismatic crystals of pyroxene and black coloured patches.

Under the microscope, the rock is mainly composed of large, colourless subhedral to anhedral augite, greenish to olive greenish prismatic tremolite, and minor amounts of chlorite. The percentage of pyroxene is slightly greater than that of tremolite. The latter mineral normally occurs as anhedral crystals between grains of pyroxene and, in some cases, appears to be formed at the expense of pyroxene.

Marble - Coarse grained crystalline limestone is found in fine grained limestone beds in drill core sections. It does not form a definite horizon or zone but appears as lenses intercalated with and grading into the fine grained limestone.

Tuff: Skarn Development and Alteration

The tuffaceous skarn is commonly found in drill holes where thick beds of tuff are encountered. In the less altered tuff, pale reddish brown garnets are seen disseminated in a greyish white feldspar-pyroxene groundmass. With increasing intensity of alteration, the rock becomes a pyroxene-garnet skarn which in hand specimen is characterised by a greenish to pale greenish, fine grained groundmass disseminated with irregular masses of pale reddish brown garnet.

In thin section, the pyroxene-garnet skarn contains colourless pyroxene and pale brownish anhedral garnet with inclusions of fine grained augite. Unaltered shard-like feldspar crystals and lenses of very fine grained feldspathic minerals are commonly seen in the rock. The average augite grain size is 0.03 mm.

Skarn Comparison

The pyroxene-garnet skarns developed from limestone and tuff are similar in texture and mineral composition in so far as their mafic mineral content is concerned. In thick tuff beds the gradual transformation of the rock from a metamorphosed tuff to high grade skarn is clearly demonstrated. With increasing intensity of alteration and garnet content, the tuff gradually changes into a pyroxene-garnet skarn. The dark brownish garnets appear to be derived from limestone while the pale reddish brown garnets probably originated in the tuff. In hand specimens, the pyroxene-garnet is difficult to assign with accuracy to its original rock type. However, thin section study can determine the original rock type in most instances and this work can do much in solving the structure of the Kennedy Lake Iron mine in detail.

ECONOMIC GEOLOGY

The study of diamond drill cores and surface geology has shown the Kennedy Lake magnetite orebody to be located along the contact between Vancouver Group limestones and tuffaceous sediments which have been folded into a north-northeasterly striking synclinal structure, plunging at a shallow angle in the same direction. The orebody, although off-set by the "Rotational" fault, is continuous along the western flank and the southwesterly nose of the syncline at various horizons and seems likely to continue along the trough of the basin easterly towards the southeast flank of the syncline and down its plunge.

The intrusion of quartz diorite is genetically related to the formation of the orebody. Folding and fracturing, which were probably contemporaneous with the plutonic intrusion, provided the necessary channelways for ore solutions and other required mineralizing controls. Both tuff and limestone are favorable hosts with the greater proportion of ore replacing limestone.

Magnetite, the only ore mineral, is associated with skarns. Impurities in the magnetite include very minor amounts of pyrite, chalcopyrite, and pyrrhotite. The magnetite is massive and fine grained and inclusions of pale greenish pyroxene are not uncommon. In thin section, the magnetite, whether a replacement of the tuff or limestone, occurs as anhedral grains or irregular masses and is always associated with or included in grains of pyroxene. Narrow belts of pyroxene are found between the limestone and the magnetite formed by replacement of the lime. Rounded to subrounded magnetite crystals are also included in the limestone where they may have formed by the replacement of garnet.

Magnetite ore and skarn bodies are not clearly related to any given contact between the sediments and plutonic intrusions. However, the skarn mineral assemblage indicates a pyrometasomatic origin for the Kennedy Lake Iron Mine.

CONCLUSIONS

1. Careful, detailed geological mapping must be done during the stripping and open pit mining of the Kennedy Lake orebody, aided by petrographic work whenever necessary.

2. Drilling of the deep ore reserves should continue on the basis of short step-outs to the east from known ore intersections and controlled by the magnetic survey and the present structural interpretation of the Kennedy Lake mine.

3. A comparative study should be made of the Kennedy Lake geology with that of adjoining properties and of those in similar environments along the west coast of Vancouver Island.

4. An analysis should be made by a geophysicist of the Kennedy Lake magnetic pattern relative to presently indicated ore reserves.

5. An intensified and integrated programme of West Coast prospecting for magnetite and sulphide deposits should be resumed immediately using standard prospecting methods, reconnaissance geological mapping, and airborne magnetic surveying.

6. Despite great physical difficulties obstructing adequate coverage of the Vancouver Group lime belts along the west coastline of Vancouver Island, this work holds much promise for new discoveries of economic importance and should be pressed with determination.

Respectfully submitted,

C.C. Sheng

M M Menzies P.Eng.
M.M. Menzies

APPENDIX "A"

KENNEDY LAKE IRON MINERAL CLAIMS

(Kennedy Lake & Hansen Options & Noranda Claims)

Claim Name	Record No.	Tag No.	Staking Date	Record Date	Expiry Date	Option
C.C. #1	4938	400701	25 January/60	29 January/60	29 January/71	Campbell
#2	4939	400702	"	"	"	"
#3	4940	400703	"	"	29 January/66	"
#4	4941	400704	"	"	"	"
#5	4942	400705	"	"	"	"
#6	4943	400706	"	"	"	"
#7	4944	400707	"	"	"	"
#8	4945	400708	"	"	"	"
#11	4948	400711	"	"	29 January/71	"
#12	4949	400712	"	"	"	"
#13	4950	400713	"	"	"	"
#14	4951	400714	"	"	"	"
#15	4952	400715	"	"	"	"
#16	4953	400716	"	"	"	"
Molly #1	5100	323333	26 April/60	4 May/60	4 May/71	"
# 3	5102	323335	"	"	"	"
#4	5103	323336	"	"	"	"
#5	5104	323337	"	"	"	"
#6	5105	323338	"	"	"	"
#7	5106	274050	29 April/60	13 May/60	13 May/71	"
#8	5107	274051	"	"	"	"
#9	5108	274052	"	"	"	"
C.C. #6 Fr.	5740	383751	9 November/60	24 November/60	24 November/66	"
C.C. #3 Fr.	5160	405898	6 June/60	7 June/60	7 June/61	"
C.C. #4 Fr.	5406	400800	14 July/60	16 July/60	16 July/71	"
C.C. #5 Fr.	5407	400799	"	"	"	"

TOTAL - 26 claims and fractions.

Note: C.C. Fractions are re-staking of abandoned C.C. and Molly claims.

Claim Name	Record No.	Tag No.	Staking Date	Record Date	Expiry Date	Option
Maggie #1	5138	393611	15 May/60	28 May/60	28 May/63	Hansen
#2	5139	393612	"	"	"	"
#3	5140	393613	"	"	"	"
#4	5141	393614	"	"	"	"
#5	5142	393615	"	"	"	"
#6	5143	393616	"	"	"	"
#7	5144	393617	"	"	"	"
#8	5145	399708	18 May/60	"	"	"
#9	5146	399709	"	"	"	"
#10	5147	399710	"	"	"	"
#11	5148	399711	"	"	"	"
#12	5149	400492	17 May/60	"	"	"
#13	5150	400493	"	"	"	"
#14	5151	400494	"	"	"	"
#15	5152	400495	"	"	"	"
#16	5153	400496	"	"	"	"
#17	5154	400497	"	"	"	"
#18	5439	399703	27 August/60	27 August/60	27 August/63	"
#19	5397	399704	"	"	"	"
#20	5398	399705	"	"	"	"
#21	5399	399706	"	"	"	"

TOTAL - 21 claims.

Note: Several of the above claims will be abandoned and re-staked as fractions.

Claim Name	Record No.	Tag No.	Staking Date	Record Date	Expiry Date	Option
B.C. #1	5124	A66349	28 May/60	30 May/60	30 May/71	Noranda
#2	5125	A66350	"	"	"	"
#3	5126	A66351	"	"	"	"
#4	5127	A66353	"	"	"	"
#5	5128	A66352	"	"	30 May/66	"
#6	5129	A66354	"	"	"	"
#7	5130	A66355	"	"	"	"
#8	5131	A66356	"	"	"	"
H. #1	5953	353781	15 February/61	27 February/61	27 February/62	"
#2	5954	353782	"	"	"	"
#3	5955	353783	"	"	"	"
#4	5956	353784	"	"	"	"
#5	5957	353785	"	"	"	"
#6	5958	353786	"	"	"	"
#7	5959	353787	"	"	"	"
J #1	5960	383755	3 March/61	6 March/61	6 March/62	"
J #2	6013	353778	27 March/61	4 April/61	4 April/62	"
J #3	6014	353779	"	"	"	"

TOTAL - 18 claims.

Note: A number of the above claims will be abandoned and re-staked as fractions.

APPENDIX "B"

KENNEDY LAKE IRON MINE

Diamond Drill Holes

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections
1960	1	5000.00 N 5000.00 E	Vertical	300.00	10'	259'	10 - 220	210'
	2	4780.56 N 4979.18 E	-54° E	289.80	13'	231'	56 - 76 86 - 126 136 - 186 196 - 216	130'
	3	4780.58 N 4978.61 E	-70° E	289.60	11'	282'	117 - 137 137 - 147 147 - 246	129'
	4	4780.06 N 4973.90 E	-46° W	291.07	15'	175'	No Ore	-
	5	5028.59 N 5149.05 E	Vertical	270.65	12'	194'	No Ore	-
	6.	4607.81 N 5027.71 E	Vertical	286.33	12'	199'	162-172	10'
	7	4992.94 N 4920.56 E	Vertical	318.19	15'	271'	108 - 114 141 - 157	22'
	8	4587.81 N 4860.64 E	Vertical	344.50	13'	274'	72 - 129 179-189	67'
	9	4001.45 N 4954.54 E	Vertical	386.13	9'	288'	98-128 128-158 185-215	90'

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections
1960	10	4704.51 N 5027.64 E	Vertical	288.51'	20'	295'	185 - 275	90'
	11	3980.60 N 4814.58 E	Vertical	388.36'	12'	268'	139 - 149 149 - 169	30'
	12	4780.50 N 4978.17 E	Vertical	289.37'	14'	274'	112 - 122 129 - 149	30'
	13	4082.45 N 4906.38 E	Vertical	384.58'	13'	275'	90 - 100 157 - 197 225 - 246.5	71.5'
	14	4778.71 N 5122.84 E	Vertical	286.65'	25'	165'	No Ore	
	15	3916.36 N 5125.01 E	Vertical	403.77'	4'	283'	122 - 162 173 - 193 202 - 222	80'
	16	4778.74 N 5072.86 E	Vertical	288.07'	25'	125'	92 - 128	36'
	17	4900.47 N 5010.57 E	Vertical	292.25'	19'	229'	19 - 159 159 - 198	179'
	18	4999.20 N 4953.85 E	Vertical	313.09'	20'	234'	80 - 107 117 - 147 157 - 197	97'
	19	4996.45 N 5047.35 E	Vertical	298.5'	22'	275'	22 - 167 194 - 214 214 - 224	175'

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections
1960	20	5045.94 N 4998.36 E	Vertical	304,01'	16'	260'	38 - 51 105 - 205	113'
	21	4903.76 N 5049.65 E	Vertical	295.04'	28'	292'	28 - 35 70 - 266	203'
	22	5098.40 N 4990.14 E	Vertical	311.36'	16'	207'	70 - 130	60'
	23	5047.94 N 5048.21 E	Vertical	301.97'	25'	210'	25 - 111	86'
	24	4904.20 N 4948.88 E	Vertical	299.22'	21'	187'	21 - 31 31 - 97	76'
	25	3993.36 N 5044.92 E	Vertical	388.81'	9'	247'	81 - 101 111 - 142 161 - 201	91'
	26	4999.25 N 5095.53 E	Vertical	289.39'	28'	238'	74 - 97 129 - 136	30'
	27	3901.91 N 4999.80 E	Vertical	396.52'	14'	244'	147 - 197 197 - 214	67'
	28	4899.66 N 4903.15 E	Vertical	316.33'	35'	112'	35 - 48.5	13.5'
	29	5100.52 N 5044.37 E	Vertical	304.14'	27'	7'	49 - 59 121 - 125	14'

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections
1960	30	4899.98 N 5102.08 E	Vertical	287.69'	37'	311'	206 - 266	60'
	31	5048.46 N 5095.58 E	Vertical	291.54'	28'	155'	36 - 46 64 - 114	60'
	32	5049.95 N 4949.38 E	Vertical	319.24'	18'	232'	98 - 118 118 - 178	80'
	33	5098.06 N 4953.73 E	Vertical	323.27'	22'	203'	109 - 114 145 - 163	23'
	34	4705.55 N 5098.24 E	Vertical	288.07'	36'	310'	No Ore	-
	35	4603.35 N 4755.18 E	Vertical	364.00'	16'	243'	69 - 89 89 - 109 109 - 119 129 - 163	84'
	36	4549.01 N 4801.04 E	Vertical	356.17'	7'	232'	95 - 145 145 - 197	102'
	37	4636.52 N 4801.88 E	Vertical	340.37'	12'	212'	32 - 52 52 - 82 82 - 117	85'
	100	3799.31 N 5099.75 E	Vertical	419.13'	14'	329'	No Ore	-
	101	3850.74 N 5100.88 E	Vertical	411.45'	15'	263'	No Ore	-

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections
1960	102	3899.37 N 4900.52 E	Vertical	384.42'	21'	237'	130 - 146 155 - 165	26'
	103	4101.01 N 4999.35 E	Vertical	387.04'	19'	276'	164 - 192 209 - 229 229 - 251	70'
	104	3810.34 N 5222.01 E	Vertical	431.83'	3'	272'	149 - 169 189 - 198 221 - 241	50'
	105	4193.64 N 5004.76 E	Vertical	385.10'	8'	341'	143½- 185 265 - 305	71.5'
	106A	3801.82 N 5306.13 E	Vertical	424.18'	9'	195'	155 - 171	16'
	106B	3808.34 N 5305.34 E	Vertical	421.04'	17'	305'	162 - 179 202 - 218	33'
	107	3905.44 N 5398.14 E	Vertical	379.03'	3'	299'	152 - 223.5 227 - 257 257 - 267 267 - 287	131.5'
	108	3903.77 N 5303.15 E	Vertical	413.69'	7'	329'	171 - 286	115'
	109	4300.65 N 4904.27 E	Vertical	382.28'	38'	298'	276–295	19'
	110	3802.40 N 5397.57 E	Vertical	398.59'	5'	231'	138 - 182	44'

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth of Hole	Magnetite Sections	Total Mag. Sections
1960	111	3803.27 N 5502.05 E	Vertical	379.66'	70'	249'	No Ore	-
	112	3902.82 N 5198.66 E	Vertical	407.53'	8'	230'	122 - 152 152 - 161 161 - 211	89'
	113	4002.28 N 5198.97 E	Vertical	405.13'	14'	272'	135 - 150 204 - 253	64'
	114	3901.39 N 5503.78 E	Vertical	367.90'	57'	658'	347 - 405 412 - 566	212'
	115	4094.58 N 5088.82 E	Vertical	387.43'	10'	290'	116 - 123 212 - 232	27'
	116	4395.59 N 4914.07 E	Vertical	381.52'	34'	345'	209 - 281 286 - 319	105'
	117	3995.29 N 5421.36 E	Vertical	341.24'	19'	436'	286 - 319 350 - 436	119'
	118	4480.74 N 9400.23 E	Vertical	362.35	31'	353'	109 - 122 163 - 182 236 - 286	82'
	119	4497.85 N 4974.44 E	Vertical	326.04'	12'	368'	70 - 78 86 - 107 172 - 178 203 - 250 317 - 340	105'

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections
1960	120	3998.89 N 5292.37 E	Vertical	377.23'	21'	412'	84 - 94	10'
	121	4402.64 N 4999.62 E	Vertical	337.54'	14'	356'	173 - 206 210 - 319	142'
	122	4289.78 N 5096.43 E	Vertical	349.03'	5'	374'	293 - 342	49'
	123	3695.72 N 6706.10 E	Vertical	301.54'	39'	890'	160 - 162 171 - 183 227 - 231	18'
	124	4196.81 N 5386.11 E	Vertical	300.31'	12'	469'	343 - 361 389 - 406	35'
	125	4194.51 N 5197.64 E	Vertical	349.16'	4'	302'	248 - 258	10'
	126	4094.97 N 5197.87 E	Vertical	374.51'	12'	263'	78 - 98	20'
	127	4399.00 N 5096.23 E	Vertical	310.42'	10'	313'	164 - 235	71'
	128	4116.90 N 4806.15 E	Vertical	380.29'	51'	309'	No Ore	-
	129	4193.36 N 5089.65 E	Vertical	369.63'	21'	319'	51 - 59 65 - 78 280 - 286	27'
	130	4605.21 N 4942.64 E	Vertical	413.84'	2'	204'	18 - 64 88 - 150	108'

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections
1960	131	4498.16 N 4704.03 E	Vertical	382.32'	48'	325'	No Ore	-
	132	4384.79 N 4806.56 E	Vertical	384.62'	48'	326'	226 - 258	32'
	133	4699.91 N 4896.68 E	Vertical	307.90'	16'	283'	No Ore	-
	134	4689.23 N 4712.32 E	Vertical	346.20'	16'	156'	No Ore	-
	135	4604.48 N 4674.66 E	Vertical	368.62'	30'	181'	No Ore	-
	136	4760.91 N 4803.21 E	Vertical	313.72'	14'	160'	No Ore	-
	137	4176.43 N 4884.09 E	Vertical	381.56'	22'	332'	232 - 257	25'
	138	4207.22 N 4805.96 E	Vertical	384.24'	20'	356'	212 - 271' 282 - 287 308 - 323	62'
	139	4202.13 N 4687.05 E	Vertical	380.97'	37'	314'	No Ore	-
	140	4301.19 N 4801.44 E	Vertical	385.17'	47'	342'	212 - 217' 240 - 340	105'

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections.
1960	141	4508.24 N 5055.71 E	Vertical	309.16'	8'	339'	36 - 51 246 - 328	91'
1961	142	3909.43 N 5687.16 E	Vertical	298.65'	18'	564'	266 - 362 425 - 441 461 - 472	123'
	143	3999.59 N 5486.92 E	Vertical	339.70'	28'	548'	231 - 258 315 - 330 338 - 371 460 - 494 509 - 548	136'
	144	3802.83 N 5593.58 E	Vertical	329.15'	51'	557'	338 - 342 408 - 429 438 - 459	46'
	145	3893.97 N 5909.04 E	Vertical	264.41'	26'	402'	263 - 292 338 - 350	41'
	146	4108.63 N 5400.14 E	Vertical	336.89'	15'	559'	399 - 421 435 - 496	83'
	147	4302.04 N 5192.47 E	Vertical	306.68'	17'	576'	?	
	148	4093.26 N 5303.89 E	Vertical	357.14'	18'	567'	No Ore	-
	149	4406.31 N 5190.82 E	Vertical	276.50'	15'	530'	?	

Year	D.D.H. No.	Lat. & Dip	Attitude	Elevation	Depth O.B.	Depth Hole	Magnetite Sections	Total Mag. Sections
1961	150	4195.16 N 5293.01 E	Vertical	335.27'	9'	486'	?	
	Total - 89 Holes				Total Footage Drilled.......	27,328'	Total Footage in Ore.......	5,307'

Note: No assays have been received for D.D.H.'s No. 147, 149 and 150.

W.M. Menzies P. Eng.

APPENDIX "C"

KENNEDY LAKE IRON MINE

Ore Mineable by Open Pit (50% Fe Cut-off)

E - W Sections

Section	Area (sq.ft.)	Grade % Fe	Area x Grade	Width (ft.)	Volume (cu.ft.)	Volume x Grade
38 N	11,520	52.52	605,030	75	864,000	45,377,280
39 N	47,000	56.66	2,663,020	100	4,700,000	266,302,000
40 N	25,400	54.90	1,394,460	100	2,540,000	139,446,000
41 N	11,760	56.97	669,967	100	1,176,000	66,996,720
42 N	13,340	54.57	727,964	100	1,334,000	72,796,380
43 N	20,400	57.18	1,166,472	100	2,040,000	116,647,200
44 N	25,800	58.48	1,508,784	100	2,580,000	150,878,400
45 N	24,800	55.86	1,385,328	100	2,480,000	138,532,800
46 N	15,900	52.51	834,909	75	1,192,500	62,618,175
4650 N	3,600	61.50	221,400	50	180,000	11,070,000
47 N	6,200	62.75	389,050	75	465,000	29,178,750
48 N	12,500	59.24	740,500	100	1,250,000	74,050,000
49 N	25,200	55.61	1,401,372	100	2,520,000	140,137,200
50 N	20,600	57.06	1,175,436	75	1,545,000	88,157,700
5050 N	15,600	53.23	830,388	50	780,000	41,519,400
51 N	4,000	56.75	227,000	50	200,000	11,350,000
TOTALS	283,620 sq.ft.		15,941,080		25,846,500 cu.ft.	1,455,058,005

Using 7.1 cu.ft./ton - 3,640,352 short tons

Weighted Grades -	**by Areas**	56.21% **Fe**
	by Volumes	56.29% **Fe**

KENNEDY LAKE IRON MINE

Ore Mineable by Open Pit (50% Fe Cut-off)

N - S Sections

Section	Area (sq.ft.)	Grade % Fe	Area x Grade	Width (ft.)	Volume (cu.ft.)	Volume x Grade
54 E	17,000	55.73	947,410	75	1,275,000	71,055,750
53 E	15,500	53.72	832,660	100	1,550,000	83,266,000
52 E	19,700	55.14	1,086,258	100	1,970,000	108,625,800
51 E	43,100	58.19	2,507,989	75	3,232,500	188,099,175
5050 E	109,000	56.55	6,163,950	50	5,450,000	308,197,500
50 E	95,900	56.12	5,381,908	50	4,795,000	269,095,400
4950 E	70,600)	not used	—	50	3,530,000)	—
49 E	41,400	58.20	2,409,480	50	2,070,000	120,474,000
4850 E	31,600)	not used	—	50	1,580,000)	—
48 E	28,100	55.97	1,572,757	50	1,405,000	78,637,850
TOTALS	471,900 sq.ft.		20,902,412		26,857,500 cu.ft.	1,227,451,475
	- 70,600				- 3,530,000	
	- 31,600				- 1,580,000	
	369,700 sq.ft.				21,747,500 cu.ft.	

Using 7.1 cu.ft./ton - 3,782,746 short tons

Weighted Grades -	by Areas	56.54% Fe
-	by Volumes	56.44% Fe

Note - Sections 4950 E and 4850 E were not used in arriving at Weighted Grades by Areas and Volumes due to insufficient information.

KENNEDY LAKE IRON MINE

Ore Mineable by Open Pit (40% - 50% Fe)

E - W Sections

Section	Area (sq.ft.)	Grade (% Fe)	Area x Grade	Width (ft.)	Volume (cu.ft.)	Volume x Grade
38 N	—	—	—	—	—	—
39 N	3,420	39.52	135,158	75	256,500	10,136,880
40 N	7,500	41.15	308,625	100	750,000	30,862,500
41 N	5,400	42.05	227,070	100	540,000	22,707,000
42 N	3,200	48.50	155,200	100	320,000	15,520,000
43 N	300	47.20	14,160	100	30,000	1,416,000
44 N	8,380	40.97	343,329	100	838,000	34,332,860
45 N	2,000	46.60	93,200	75	150,000	6,990,000
4550 N	—	—	—	—	—	—
46 N	6,200	46.12	285,944	50	310,000	14,297,200
4650 N	6,600	40.23	265,518	50	330,000	13,275,900
47 N	—	—	—	—	—	—
48 N	1,600	48.13	77,008	100	160,000	7,700,800
49 N	660	47.29	28,374	100	60,000	2,837,400
50 N	5,200	45.47	236,444	75	390,000	17,733,300
5050 N	2,100	39.40	82,740	50	105,000	4,137,000
51 N	900	48.40	43,560	50	45,000	2,178,000
TOTALS	53,400 sq.ft.		2,296,330		4,284,500 cu.ft.	184,124,840

Using 7.5 cu.ft./ton - 571,266 short tons

Weighted Grades - by Areas 43.00% Fe
- by Volumes 42.97% Fe

KENNEDY LAKE IRON MINE

Ore Mineable by Open Pit (40% - 50% Fe)

N - S Sections

Section	Area (sq.ft.)	Grade (% Fe)	Area x Grade	Width (ft.)	Volume (cu.ft.)	Volume x Grade
54 E	520	38.40	19,968	75	39,000	1,497,600
53 E	—	—	—	100	—	—
52 E	3,000	43.54	130,620	100	300,000	13,062,000
51 E	3,600	43.51	156,636	75	270,000	11,747,700
5050 E	7,200	not used	—	50	360,000	—
50 E	20,600	44.14	909,284	50	1,030,000	45,464,200
4950 E	15,900	not used	—	50	795,000	—
49 E	13,600	40.25	547,400	50	680,000	27,370,000
4850 E	1,900	not used	—	50	95,000	—
48 E	6,500	40.24	261,560	50	325,000	13,078,000
4750 E	5,200	45.12	234,624	50	260,000	11,731,200
TOTALS	78,020 sq.ft.		2,260,092		4,154,000 cu.ft.	123,950,700
	- 7,200				- 360,000	
	-15,900				- 795,000	
	- 1,900				- 95,000	
	53,020 sq.ft.				2,904,000 cu.ft.	

Using 7.5 cu.ft./ton - 553,867 short tons

Weighted Grades - by Areas 42.63% Fe
- by Volumes 42.68% Fe

Note: Sections 5050 E, 4950 E and 4850 E were not used in arriving at Weighted Grades by Areas and Volumes due to insufficient information.

KENNEDY LAKE IRON MINE

Open Pit Ore

Average Tonnages and Grades

Ore - above 50% Fe		Tonnage (short)	Grades Weighted by Tonnage by Areas	 by Volumes
E - W Sections		3,640,352 tons	56.21% Fe	56.29% Fe
N - S Sections		3,782,746 tons	56.54% Fe	56.44% Fe
	TOTALS	7,423,098 tons	56.38% Fe	56.37% Fe
	AVERAGE	3,711,549 tons	56.37% Fe	

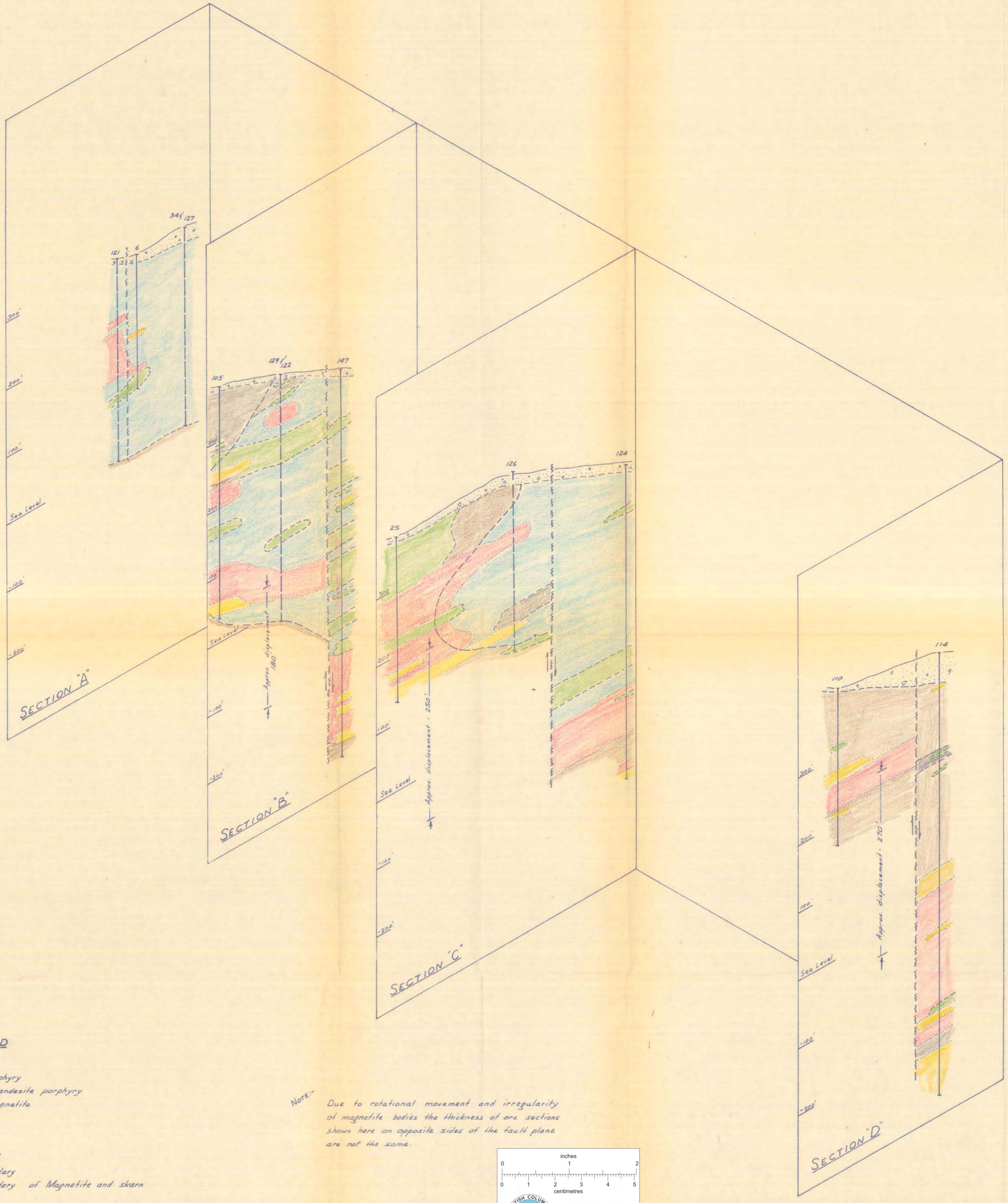
Ore - 40%-50% Fe		Tonnage (short)	Grades Weighted by Tonnage by Areas	 by Volumes
E - W Sections		571,266 tons	43.00% Fe	42.97% Fe
N - S Sections		553,867 tons	42.63% Fe	42.68% Fe
	TOTALS	1,125,133 tons	42.82% Fe	42.83% Fe
	AVERAGE	562,566 tons	42.82% Fe	

TOTAL ORE above 40% Fe - 4,274,115 short tons @ 54.58% Fe

M. MENZIES

MM Menzies P. Eng.

APPENDIX "D"



LEGEND

▭	Overburden
🟩	Feldspar porphyry
▨	Andesite & andesite porphyry
🟥	Massive Magnetite
🟨	Skarn
🟦	Limestone
🟫	Tuff
∿∿∿	Inferred fault
- - -	Inferred boundary
······	Inferred boundary of Magnetite and skarn
⊢	D.D.H

Note:- Due to rotational movement and irregularity of magnetite bodies the thickness of ore sections shown here on opposite sides of the fault plane are not the same.

PROPERTY FILE

NORANDA EXPLORATION CO. LTD.

KENNEDY LAKE IRON PROPERTY

ISOMETRIC VIEW SHOWING ROTATIONAL FAULT

SCALE OF SECTIONS 1" = 100'
SCALE OF DISTANCE BETWEEN SECTIONS - 1" = 50'

Drawn by - C.C. Sheng | Traced by - P.M. | March 1961

P. Eng.