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A Geological and Geochemical Report
on the Henderson Lake Claims of
Nootka Explorations Ltd.
based on work performed between
October, 1969 and July, 1970
Vancouver Island: lat. 49°02'N., Long. 125°02'W.

by

Lawrence F. Baum, M.Sc.
under supervision of
J. R. Woodcock, P. Eng.

Holder of the Claims: Nootka Explorations Ltd.

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Henderson Lake Exploration, Vancouver Island, B.C.

Introduction

The Henderson Lake property of Nootka Explorations Ltd. is on Vancouver Island, 35 miles southwest of Alberni. The property, bounded on the west by the very deep and glacially carved Henderson Lake, is approximately 2 miles up-lake from the almost sea-level outlet into salt water. The property contains two Crown Grants, two mineral leases, one leased claim, and 40 claims belonging to Nootka.

This report contains the results of field work carried out on Nootka Explorations Ltd. Henderson Lake claims during the period October, 1969 to July, 1970. The field crew consisted of a geologist and assistant. Work included geochemical soil sampling, rock chip sampling of existing workings and promising-looking outcrops, reconnaissance geologic mapping in areas adjacent to the claims, and detailed geologic mapping of the claims and workings. The work also included the tying-in of six different grid systems and the geophysical and geological work based thereon carried out by previous workers on the claims.

Exploration was carried out by L. F. Baum under the direction of J. R. Woodcock, P. Engr.

Previous Work

Alberni Mines Ltd. did geologic, magnetic, and topographic mapping on part of the present ground in 1965. That same year they drilled 12 short holes totalling 379 feet with 90% recovery. The available data on the Ocean Wave and Big Bear Crown Grants suggests that these holes were spotted on the basis of geologic mapping. Only two of the holes showed sufficient mineralization to justify assaying, although the logs show trace amounts of chalcopyrite throughout much of the core. Holes 3-A and 3-C were drilled adjacent to the lone shaft on the Ocean Wave, and assayed approximately five feet of 0.25% copper, trace silver, and 17 feet of 1.2% copper, 0.39 oz. silver respectively, (Fig. GM-2). From the location of hole 3-C, it is suspected that it was drilled approximately down the structure.

In 1967 Mt. Agnes Mines Ltd. covered much of the same ground as that covered by the magnetometer surveys of Alberni Mines Ltd. Mt. Agnes Mines also drilled five holes on the Rainy Day claim varying from 150 to 250 feet in depth, with excellent recovery (Fig. GM-2). Their data indicates that these holes were spotted almost entirely on the basis of magnetic anomalies. Judging by logs and assays of the core, the holes did not intersect ore-grade mineralization, the highest assay being two feet of 0.94% copper, and 0.15 oz. silver. Those holes entirely in diorite had the lowest assays. The core from this drilling program is in good condition and is presently on the Rainy Day claim beside each hole.

Regional Geology

Figure GM-1 presents the results of reconnaissance mapping along the shores of Henderson Lake and the northwest end of Uchucklesit Inlet. Also shown are the approximate boundaries of the diorite body where it crops out on the claim group.

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The diorite intrusive is approximately 2200 feet wide where it crosses the lake, and appears to have a definite easterly-westerly elongation. The maps by the Geological Survey of Canada (Muller and Carson, 1969) do not show any diorite in this area. However in the area of the southern contact of the diorite on the west side of the lake, they do show an approximately east-southeasterly trending fault contact between the Lower Jurassic volcanic division of the Bonanza Subgroup to the north and the more mafic volcanic and volcaniclastic rocks of the Upper Triassic Karmutsen formation to the south. On the east side of the lake, this fault is entirely in rocks mapped by Muller and Carson as Karmutsen volcanics. The similarity in strike of the diorite and the fault suggests a possible genetic relationship. Numerous other east-southeasterly trending faults are shown in the Henderson Lake area by these workers.

Although, in such a restricted mapping program it is not possible to distinguish unequivocally between Karmutsen and Bonanza rocks, several broad generalizations can be made regarding these rocks in this area. First, the limestones, which generally occur within the basalts, are more prevalent south of the diorite than to the north. The limestone occurs in discontinuous pods and lenses which appear to be crudely grouped in belts. According to Muller and Carson (op cit) a thin band of intervolcanic limestone occurs near the top of the Karmutsen, but it is uncertain if such is the case at Henderson Lake. It may be that both Quatsino and Karmutsen limestone are present in the area.

Second, along the west side of the lake the rocks do seem lighter colored and more silicic north of the diorite. However, there is the possibility that some may be altered diorite, rather than Bonanza volcanics. Along the east side of the lake, the rocks south of the diorite, and immediately to the north seem similar, and probably both belong to the Karmutsen.

The attitude of the limestone can be measured at several locations in Uchucklesit Inlet, and these are in agreement with those shown on Fig. GM-1 and attributed to Muller and Carson. However along Henderson Lake and in the claims area, the writer was unable to find any surfaces which could definitely be said to be primary bedding planes. According to attitudes plotted on Muller and Carson's map (op cit) the northwest of Henderson Lake, a number of open anticlines can be interpreted having axial plane traces striking approximately parallel to the faults mentioned above.

Claim Group Geology

Lithology

Karmutsen Formation. The oldest rocks seen to date on the claim group are believed to belong to the Karmutsen Formation of Upper Triassic age. This unit consists mostly of dark to light blue-grey aphanitic to very fine-grained, sometimes amygdaloidal basalt, fine-grained, black and white specked diabase, (easily mistaken for chilled diorite), and minor light blue-grey porphyritic aphanitic andesite. Minor amounts of hackley fractured, calcite veined, light to dark green mottled, tectonic and/or volcanic breccias occur within this unit. Lenses and discontinuous beds of white to light-grey limestone occur throughout the unit. Widespread bleaching of the extrusive rocks is apparent along the southern edge of the diorite, even where the nearest exposure of diorite is

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hundreds of feet distant; zones of pyritization, brecciation, and pervasive and vein silicification are also common in this area (Fig. GM-2). Close to the diorite limestone is recrystallized to marble with calcite crystals up to 2cm.

This unit commonly forms massive outcrops whose only planar fabric includes shears and fractures of varying spacing and orientation. Bedding seems to be absent, although it might be possible to determine structure by very detailed tracing-out of distinctive rock types.

The youngest bedrock in the area is the diorite intrusive. When fresh and unaltered it is a generally equigranular, holocrystalline rock with a color index of 5-10, and an average grain size of 1-3 mm. Dark minerals consist almost entirely of hornblende and pyroxene; biotite is seldom present. Light minerals are entirely feldspar; fresh rocks are quartz-free.

Structure

Diorite/Karmutsen Contacts. As shown on Fig. GM-1, the strike of the north and south contacts between these two rock types changes from approximately easterly at lake level, to southeasterly where they ascend on the east side of the lake. This change and the relatively uniform width of the diorite suggests that the intrusive is a sill or dike-like body dipping northward.

Mapping to date shows the northern contact to be simple, with no inclusions of Karmutsen rocks in the diorite. However the southern contact is complex judging by mapping done by Alberni Mines and by the writer. The diorite/Karmutsen contact is sharp and definite except where bleaching and silicification have effected both. Even at such places the contact is probably sharp, but difficult to discern in outcrop.

Previous work shows a jumbled map pattern of diorite, basalt, limestone, skarn, and sulfide mineralization on both the Rainy Day and the Orphan Boy claims; holes 1, 2, and 3 on the Rainy Day pass through skarn and Karmutsen rocks sandwiched btween diorite and light-colored, hard, fine-grained porphyries.

Mapping in the upper adit on the Rainy Day establishes the fact that these porphyries are intrusive, and not an altered phase of the Karmutsen rocks. Whether they are dikes of a late differentiate of the diorite, altered diorite, or perhaps dikes younger than and unrelated to the diorite is not known.

The data suggests that areas of complex map pattern of diorite and Karmutsen rocks could be areas of roof pendants and inclusions cut by dikes of porphyry. It may be more than speculative that this complex and altered (see below) contact zone is close to the Bonanza/Karmutsen fault contact mapped by Muller and Carson.

Fracturing and Shearing. The most prominent fractures and shears in both the Karmutsen and diorite rocks generally dip at high to vertical angles and generally strike either easterly-to-southeasterly, or northerly, (Fig. GM-2).

In the diorite, the disrupted zones tend to have sharp walls, with the alterations which accompany the breakage being limited to the immediate shear or fracture or dying-out within a short distance into the wall rocks. However near intensely mineralized areas, alteration is more pervasive (see below).

In the Karmutsen rocks shear zones tend to be wider and more cataclastic with disruption decreasing gradually into the wall rocks.

Alteration

Diorite. Over most of the area studied the diorite is a fresh, hard rock with only trace amounts of chloritized mafic minerals, bright vitreous feldspar, and thin, generally wide-spaced quartz and epidote veins. A relatively thin selvage of altered diorite is usually present along the contact with the Karmutsen rocks, but it is generally limited to a slight bleaching, minor chloritization, and a slight increase in the normally trace amounts of fine-grained disseminated pyrite.

However along the southern part of the contact zone, hydrothermal alteration of the diorite is more intense. Small amounts of matrix quartz, and patchy and vein epidote are common, probably both derived from a breakdown of calcic plagioclase. Mafic minerals are completely altered to chlorite, pyrite content of the rocks increases to 1-3%, and occasional trace amounts of chalcopyrite can be found. The areas of alteration in the diorite are associated with bleaching, fracturing, silicification, and pyritization in adjacent Karmutsen volcanic rocks.

Karmutsen volcanics. Where there is no limestone nearby to supply large amounts of calcium, alteration in the Karmutsen begins with patches of epidote (pistacite) replacing the calcic plagioclase groundmass in a still relatively dark rock. As alteration becomes more intense the rock is gradually bleached and converted almost entirely to epidote and actinolite. Zones of most intensive alteration are characterized by bleached, silicified, and extensively fractured or brecciated rocks with almost no epidote or actinolite and up to 5% pyrite.

Where limestone bodies are adjacent to shear or fracture zones, there are more complex calc-silicate and metallic mineral assemblages, as exemplified by the existing workings on the Rainy Day (Fig. WGM-1), Ocean Wave, and Big Bear claims.

As illustrated by figure WGM-1, concentrations of sulfides are closely associated with replacement assemblages of varying proportions of hornblende, actinolite, epidote, garnet (grossularite and andradite), and calcite. As distance to a sulfide body increases, the mineral assemblage becomes predominantly epidote (pistacite), with lesser amounts of actinolite, and subordinate hornblende and garnet. The outermost alteration envelope consists entirely of epidote replacement along closely spaced shears and/or fractures. Intense epidotization is common to both the Karmutsen and the diorite rocks; the other minerals form only in Karmutsen rocks.

It is worthwhile emphasizing that unreplaced limestone bodies occur very close to the most massive sulfides observed, and that the calc-silicate mineral assemblages frequently carry calcite crystals.

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Metallic Mineralization

Mineralization examined to date in surface showings and in core shows a striking consistency in that magnetite, hematite, pyrrhotite, and pyrite are the only metallic gangue minerals, and chalcopyrite the only ore mineral visible in handspecimen. Malachite and azurite are present as a surface alteration in the showings.

Assays consistently show as much as 0.6 ounces of silver per ton, some lead, and small amounts of zinc, and gold (Fig. GM-2). Core from hole #3 on the Rainy Day which assayed 0.30 ounces silver and 0.24% copper (137-145') gave a spectrographic analysis (T.S.L. report T09907/V-3343 to Mt. Agnes Mines Ltd.) which included in part: 0.01% Cr, 0.1 - 0.2% Cu, less than 0.01 oz. Au, 0.05% Pb, 0.001% Mo, 0.001% Ni, 0.2 oz Ag, 0.3% Ti, and 0.5% Zn. The writer's log shows the interval 139-145' to consist of massive pyrite, ± epidote and garnet.

Geophysics

It is not the purpose of this report to interpret the results of magnetometer work done by others on the claims. All of this work has been summarized and tied together on figure MM-1. Large scale copies of the magnetic data are in the Nootka files. No further geophysical work has been done by Nootka.

Geochemistry

During the present field work a reconnaissance geochemical sampling survey for copper was done in an attempt to interpret the magnetic anomalies outlined by previous workers (Fig. MM-1), and on the altered areas found during the present mapping (Fig. GM-2). The magnetic anomalies were defined on the basis of readings every 10 or 20 feet along lines spaced 100 feet apart; geochem samples on these anomalies were collected every 100 feet along alternate magnetic survey lines. Intervals of 100 feet were used along the trail and Line 4-West in the altered area. In most cases unweathered rock chips of outcrops were collected; in the few cases where outcrops were lacking, the B soil horizon was sampled. Analysis was by atomic absorption at Vancouver Geochemical Laboratories Ltd.

Correlation. In the A magnetic anomaly, a 100-200 ppm copper high seems to correspond to a magnetic low and to the diorite/Karmutsen contact in the area of a possible roof pendant of Karmutsen.

In the B anomaly none of the values exceed 50 ppm and there is no apparent correlation between copper values and either magnetics or geology. All of the holes drilled by Mt. Agnes Mines appear to be in an area of low rock copper values.

The C magnetic anomaly does not show any clear correlation with either the rock geochemistry or the geology. However there is a positive relationship between a 100-300 ppm geochem anomaly and an area of overburden probably underlain by the diorite/Karmutsen contact.

The D anomaly does not show any anomalously high geochem values.

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In summary, in two out of four cases the rock geochemistry shows anomalous high values over the diorite/Karmutsen contact, but in only one time out of four does the rock geochemistry seem to correlate with magnetics.

Along the Line 4-West and the trail in the area of altered rocks, the over-all values are lower than expected, although a shear zone in Karmutsen rocks, and Karmutsen rocks adjacent to the diorite contact show two to three times as much copper as in adjacent rocks.

Summary

1. Known copper showings are at or close to the diorite/Karmutsen contact, with the majority of showings occurring in areas of limestone outcrops and in shear and fracture zones that strike easterly to east-southeasterly.

2. All limestone outcrops observed to date are lensoid and discontinuous, although they tend to be grouped in an easterly-trending belt south of the diorite.

3. An area of hydrothermal alteration containing more than the average amount of disseminated pyrite is associated with the southern diorite/Karmutsen contact zone. However preliminary copper geochemical sampling shows low values except over easterly-striking shearing or over the diorite contact. This southern contact zone is close to the Bonanza/Karmutsen fault contact mapped by the Geological Survey of Canada.

4. The interior of the diorite is generally fresh, pyrite-free, and very unlikely to contain any mineralization.

5. Magnetometer surveys may show the general areas of skarn mineralization on the property, but the drilling to date suggests that collaring holes solely on the basis of magnetic anomalys is not the best way to proceed.

6. The limited geochemical survey carried out by Nootka suggests that this, together with geologic mapping of shearing, fracturing, and alteration may be better guides to mineralization.

Recommendations

The original conception of finding a large replacement body of 1-2% copper is somewhat dimmed by the failure to find sufficiently large or continuous bodies of limestone or other rocks hospitable to mineralization close to the diorite. However, the data suggests that there are a number of possibilities on the property that should be examined before rendering a final decision.

1. Alteration and pyritization in both the country rocks and the diorite is generally not sufficiently intense to suggest the existence of a porphyry copper deposit.

2. However, the existance of scattered, albeit uneconomic, contact metasomatic sulfide deposts in the presently mapped contact area is a definitely favourable indication. Some of these contact areas should be checked carefully, possibly with geophysics and geochemistry.

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3. Future decisions and hopes regarding this property should not be predicated on the basis of finding one large, mineable ore body. A number of moderate sized, separate ore bodies may be economically exploitable, as is being done successfully at the New Imperial Mine's Yukon Territory property. Here the ore reserves, prior to production decision, totalled 5.1 million tons with an average grade of 1.1% copper in six separate ore bodies spread over a strike length of 16 miles.

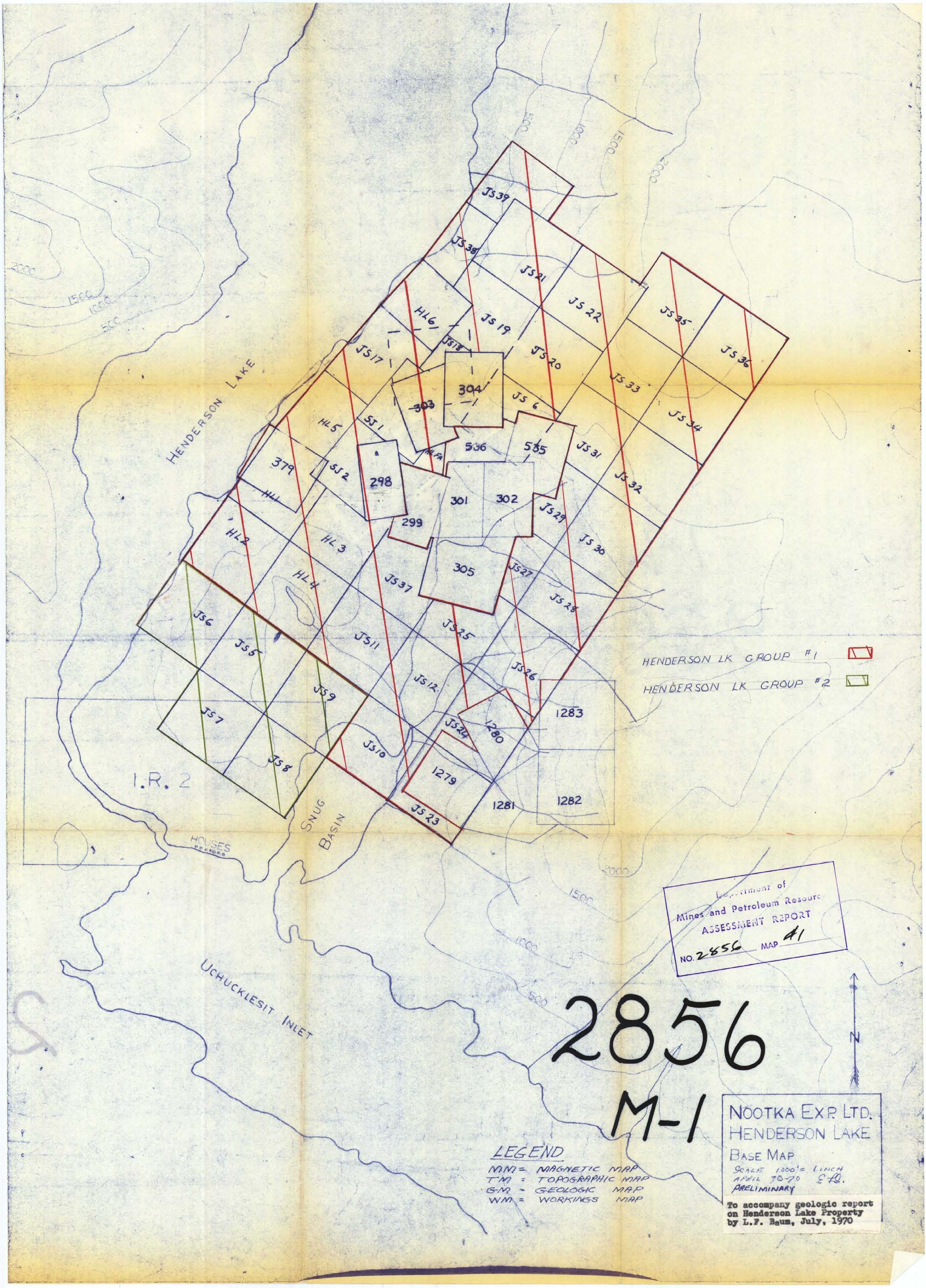
4. Although presently known areas of mineralization seem to be too small and discontinuous to be of interest, this may not necessarily be the case to the east where the diorite-country rock contact is as yet unmapped. This eastern contact zone should be reconnoitered, and mapped, a job which would involve no more than 4 field days. If a suitable eastern contact zone is found, with low relief and covered with some overburden, this would provide a target area for future geochemical and geophysical surveys. Such surveys should include geochemistry (copper in soil), magnetometer and induced polarization. Some consideration could also be given to electromagnetic techniques.

Respectfully submitted,

L. Baum 8/19/70

Lawrence F. Baum, M.Sc.

J. R. Woodcock


Henderson Lake
Uchucklesit Inlet
Snug Basin
I.R. 2
Houses
JS 39
JS 38
JS 21
JS 22
JS 35
JS 36
HL 6
JS 19
JS 18
JS 17
JS 20
JS 33
304
303
JS 6
HL 5
SJ 1
JS 34
536
535
JS 31
379
SJ 2
298
HL 1
301
302
JS 32
JS 29
299
HL 2
HL 3
JS 30
305
JS 27
HL 4
JS 37
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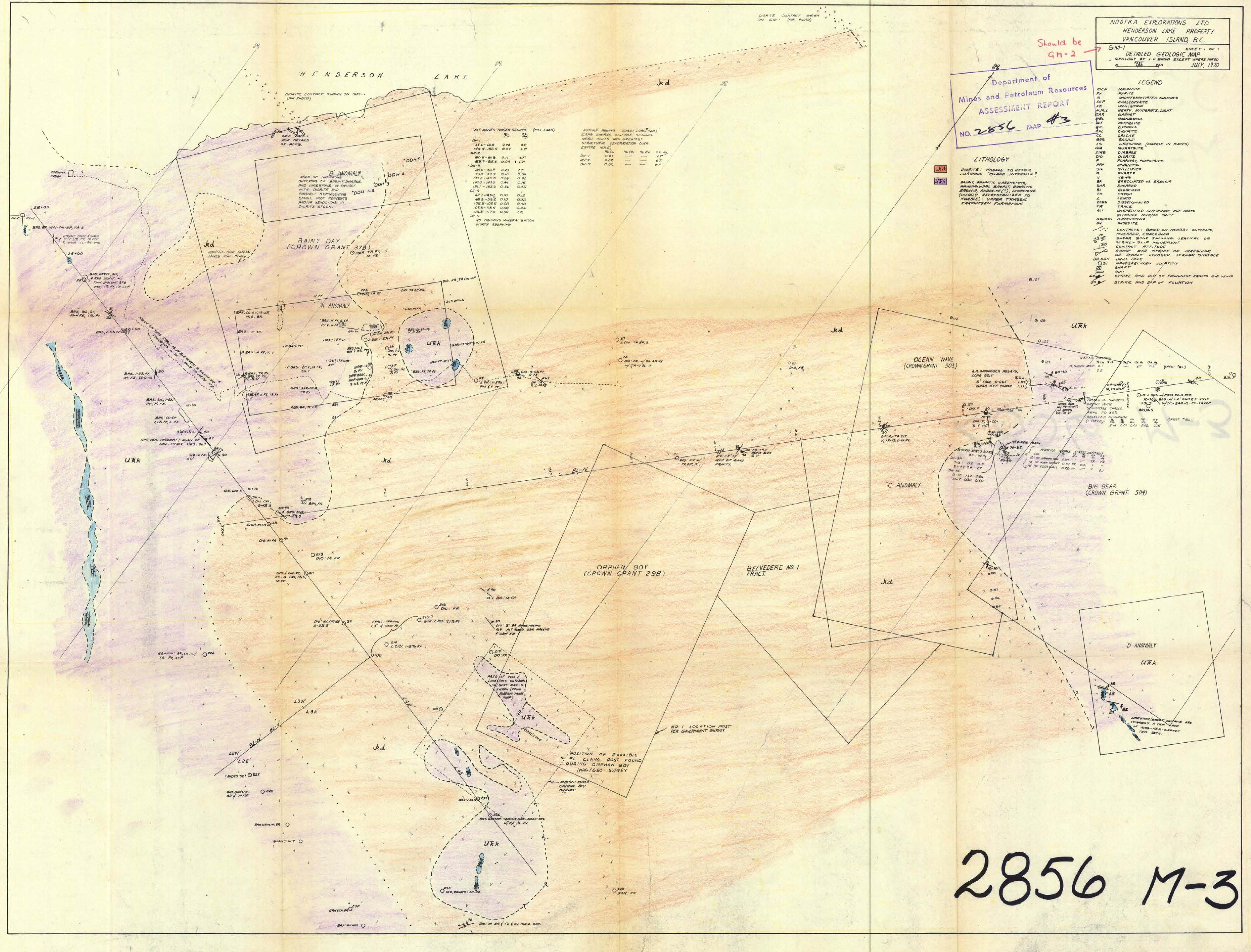
JS 6
JS 5
JS 11
JS 25
JS 26
JS 12
JS 9
JS 7
JS 24
1280
1283
JS 10
JS 8
1279
1281
1282
JS 23
2000
1500
1000
500
HENDERSON LK GROUP #1
HENDERSON LK GROUP #2
Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 2856 MAP #1
2856
M-1
N
NOOTKA EXP. LTD.
HENDERSON LAKE
BASE MAP
SCALE 1000' = 1 INCH
APRIL 30-70
PRELIMINARY
LEGEND
MM = MAGNETIC MAP
TM = TOPOGRAPHIC MAP
GM = GEOLOGIC MAP
WM = WORKINGS MAP
To accompany geologic report on Henderson Lake Property by L.F. Baum, July, 1970


NOOTKA EXPLORATIONS LTD.
HENDERSON LK. PROPERTY
VANCOUVER ISLAND, B.C.
DWG GM-1 REGIONAL GEOLOGY
JULY, 1970
GEOLOGY BY L.F. BAUM
2856
M-2



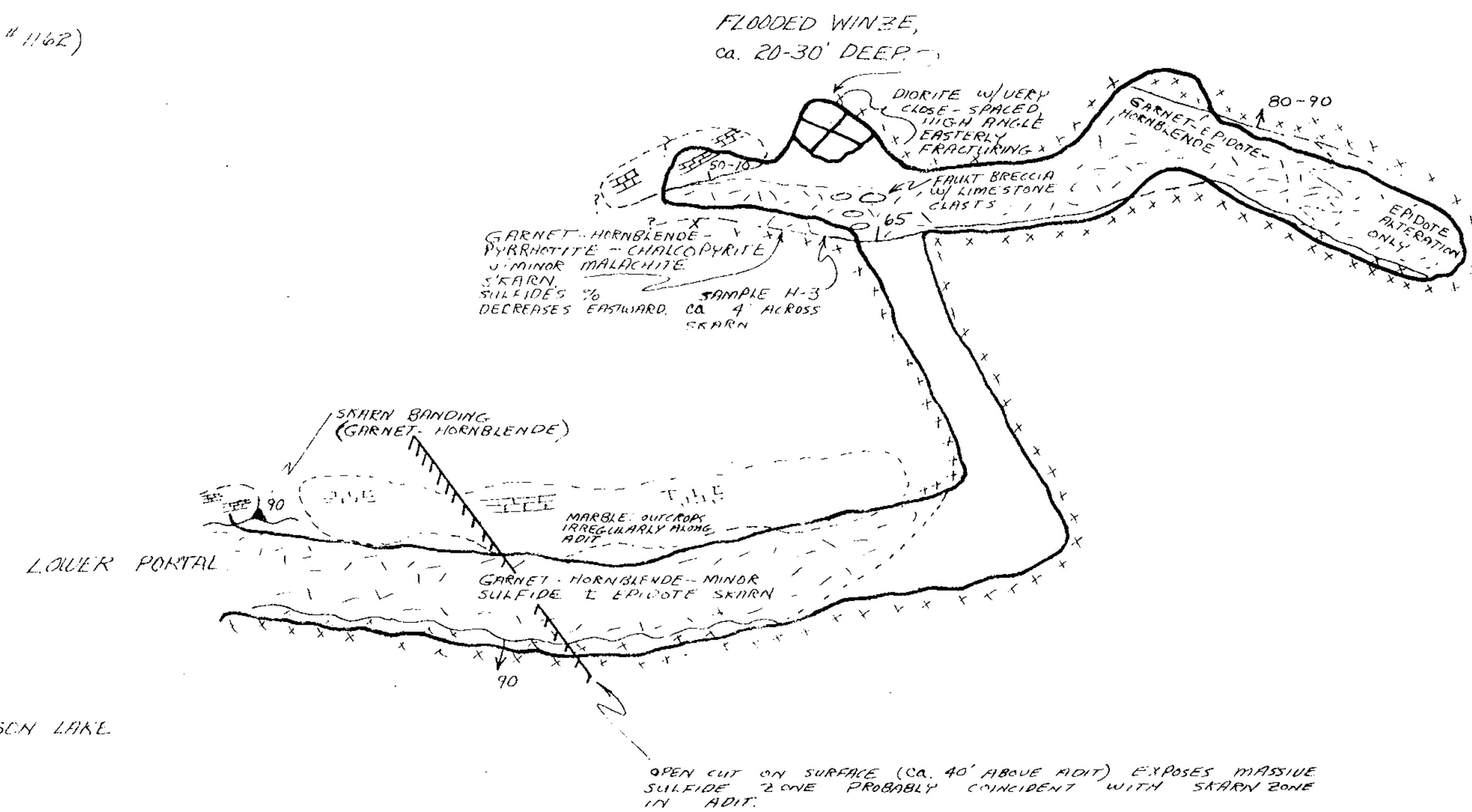
NOOTKA EXPLORATIONS LTD.
HENDERSON LAKE PROPERTY
VANCOUVER ISLAND, B.C.
Should be GM-2
GM-1
SHEET 1 OF 1
DETAILED GEOLOGIC MAP
GEOLOGY BY L.F. BAUM EXCEPT WHERE NOTED
0 FEET 100 200
JULY, 1970
Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 2856 MAP #3
LEGEND
MCH MALACHITE
PY PYRITE
S UNDIFFERENTIATED SULFIDES
CCP CHALCOPYRITE
FE IRON STAIN
H, M, L HEAVY, MODERATE, LIGHT
GAR GARNET
HBL HORNBLENDE
ACT ACTINOLITE
EP EPIDOTE
CHL CHLORITE
CC CALCITE
BAS BASALT
LS LIMESTONE (MARBLE IN PLACES)
QZ QUARTZITE
DIAB DIABASE
DIO DIORITE
P PORPHYRY, PORPHYRITIC
APH APHANITIC
SIL SILICIFIED
Q QUARTZ
V VEINS
BR BRECCIATED OR BRECCIA
SHR SHEARED
BL BLEACHED
FR FRESH
L LEUCO
DISS DISSEMINATED
TR TRACE
ALT UNSPECIFIED ALTERATION BUT ROCKS BLEACHED AND/OR SOFT
GRNSTN GREENSTONE
AN ANDESITE
CONTACTS: BASED ON NEARBY OUTCROPS, INFERRED, CONCEALED
SHEAR ZONE SHOWING VERTICAL OR STRIKE-SLIP MOVEMENT
CONTACT ATTITUDE
RANGE FOR STRIKE OF IRREGULAR OR POORLY EXPOSED PLANAR SURFACE
DH, DDH DRILL HOLE
HANDSPECIMEN LOCATION
SHAFT
ADIT
STRIKE AND DIP OF PROMINENT FRACTS AND VEINS
STRIKE AND DIP OF FOLIATION
LITHOLOGY
Jd DIORITE: MIDDLE TO UPPER JURASSIC "ISLAND INTRUSION"?
uTRk BASALT, BASALTIC GREENSTONE, AMYGDALOIDAL BASALT, BASALTIC BRECCIA, ANDESITE(?), LIMESTONE (LOCALLY RECRYSTALLIZED TO MARBLE): UPPER TRIASSIC KARMUTSEN FORMATION
HENDERSON LAKE
B ANOMALY
A ANOMALY
C ANOMALY
D ANOMALY
RAINY DAY (CROWN GRANT 379)
OCEAN WAVE (CROWN GRANT 503)
BIG BEAR (CROWN GRANT 504)
ORPHAN BOY (CROWN GRANT 298)
BELVEDERE NO. 1 FRACT.
NO 1 LOCATION POST PER GOVERNMENT SURVEY
POSITION OF POSSIBLE #1 CLAIM POST FOUND DURING ORPHAN BOY MAG/GEO SURVEY
2856 M-3

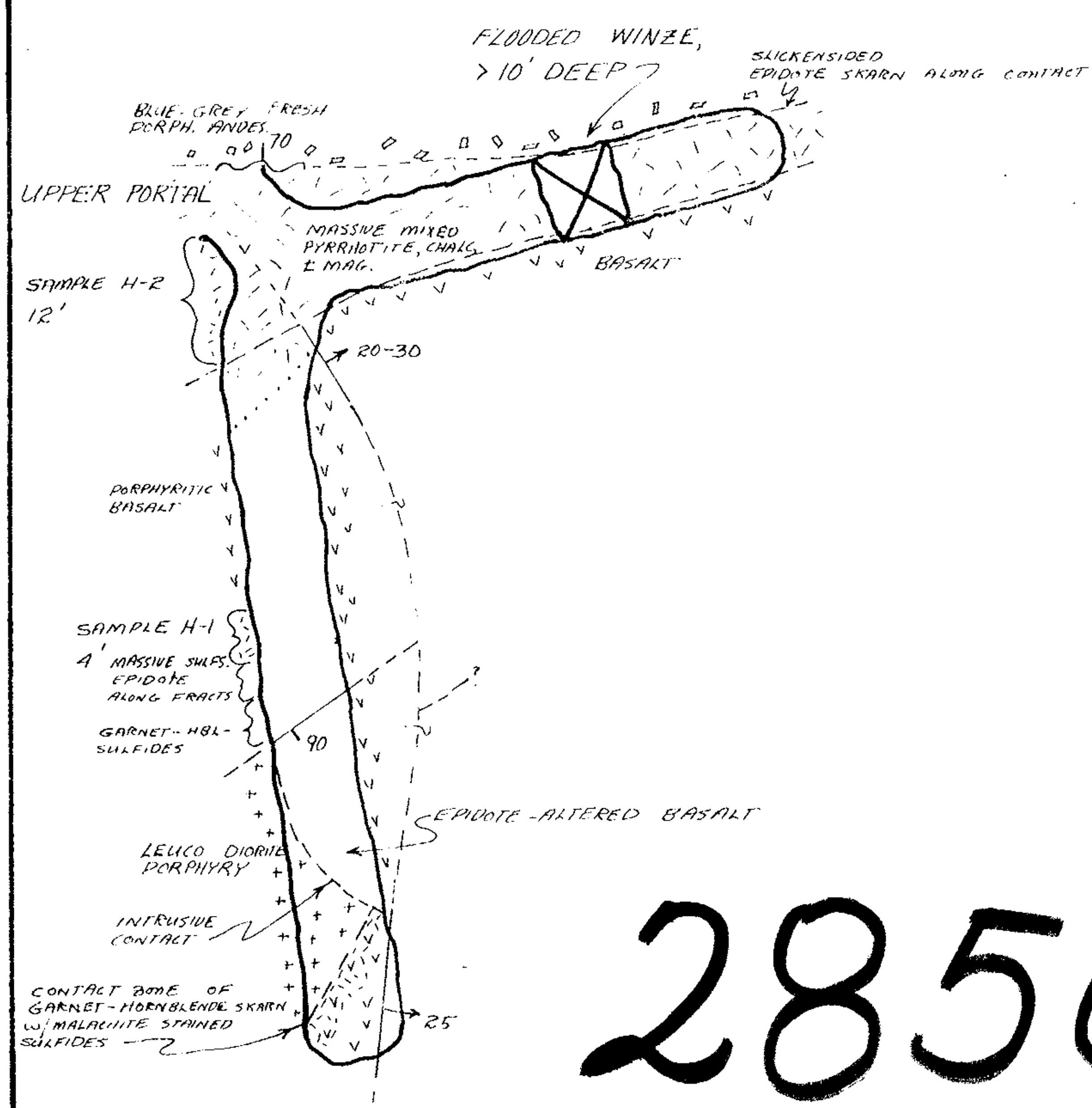

NOOTKA EXPLORATIONS
HENDERSON LAKE PROPERTY
VANCOUVER ISLAND B.C.
GCM-1 COPPER GEOCHEM MAP
JULY, 1970
DATA BY NOOTKA
FEET
0 100 200 300 400
N
COPPER IN PPM
MISC. OTHER ELEMENTS IN PPM
Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 2856 MAP #4
CAMP
TRAIL
B ANOMALY
A ANOMALY
RAINY DAY
CROWN GRANT 379
OCEAN WAVE
(CROWN GRANT 503)
BIG BEAR
(CROWN GRANT 509)
C ANOMALY
D ANOMALY
BELVEDERE NO 1
FRACTION
ORPHAN BOY
CROWN GRANT 298
BL-N
NO 1 LOCATION POST
BASELINE
POSITION OF POSSIBLE
#1 CLAIM POST FOUND
DURING ORPHAN BOY
MAG/GEC SURVEY
2856 M-4

NOOTKA EXPLORATIONS
HENDERSON LAKE PROPERTY
VANCOUVER ISLAND B.C.
DWG MM-1 MAGNETOMETER MAP
JULY, 1970
LEGEND
-DATA IN GAMMAS
-SOLID LINES FROM MT AGNES MINES 1967 SURVEY
-DASHED LINES FROM ALBERNI MINES 1964-65 SURVEY
0 FT 100 FT 200 FT 300 FT 400 FT
N
Department of
NO. 2856
#5
RAINY DAY
(CROWN GRANT 379)
A ANOMALY
OCEAN WAVE
(CROWN GRANT 503)
C ANOMALY
BIG BEAR
(CROWN GRANT 504)
BELVEDERE NO 1
FRACTION
ORPHAN BOY
CROWN GRANT 298
D ANOMALY
NO 1 LOCATION POST
POSITION OF POSSIBLE #1 CLAIM POST FOUND DURING ORPHAN BOY MAG/GEO SURVEY
TRAIL
BL-N
2856 M-5

NOOTKA ASSAYS (CREST LAB. # 1162)

SAMPLE #	% Cu	oz/ton Ag	% Pb	% Zn
H-1	0.30	TR.	0.02	0.02
H-2	0.40	TR.	0.04	0.04
H-3	0.45	0.2	0.03	1.04





N

1" = 10'

LEGEND

- x x x DIORITE
- + + + LEUCO DIORITE PORPHYRY
- v v v PROBABLE BASALT
- ▱ ▭ " ANDESITE
- SKARN ALTERATION, ± SULFIDES AND INCLUDING EPIDOTIZATION
- MARBLE
- 20 SHEAR OR FAULT ZONES
- 50 CONTACT
- CONCEALED
- INFERRED
- ? SPECULATED
- ⊠ WINZE

NOOTKA EXPLORATIONS LTD.
HENDERSON LAKE PROSPECT
VANCOUVER IS., B.C.

DWG WGM-1
RAINY DAY CLAIM
WORKINGS GEOLOGIC MAP

7/70 GEOLOGY BY Baum

2856 M-6