Property Examination
Ski Group 92-I-10

811506

TELEPHONE 685-4331

ATLAS EXPLORATIONS LIMITED

330 MARINE BUILDING
355 BURRARD STREET
VANCOUVER 1, B.C.

PROPERTY EXAMINATION #8

SKI GROUP

SUMMARY

The Ski Group of Claims was staked to cover the contact between Kamloops series of rocks and the Nicola Group and the area commonly referred to as the "mercury belt", roughly 8 miles wide by 23 miles long, north-south. An old mercury showing lies 3000 feet south of the boundary of the Ski Claims.

Some geochemical sampling was done by me to test an area of the claims underlain by an induced polarization anomaly. The samples gave negative results for copper, lead, zinc and molybdenum.

CONCLUSION

In the absence of more encouraging geochemical results, I would conclude that the anomaly is not underlain by economic base metal sulphides.

RECOMMENDATIONS

I would recommend that we not accept the property to do further work under option.

INTRODUCTION

The property was examined at the invitation of Ivan Greg. I spent approximately 2½ hours on the property collecting soil samples. The day when the examination was made was clear, sunny and hot.

LOCATION

The Ski Group is located on the Ashcroft map area in NTS quadrant 92-I-10. The approximate latitude of the group is 50°38' and

LOCATION (contd.)

the approximate longitude is 119°49'. (see location sketch map for exact location).

ACCESS

The Ski Group is accessable by road from Savona,B.C., a town approximately 10 miles north of the property.

PROPERTY AND OWNERSHIP

The Ski Group of 59 Claims was staked and is currently held by Newmine Development Ltd.,Vancouver. Geological mapping on the property was done by E.P. Sheppard & Associates Limited March 1969; an induced polarization survey was subsequently done on the property by Siegel Associates Limited, 750-890 West Pender Street, Vancouver,B.C., during the months of April and May, 1969. Copies of both the previous reports are appended.

TOPOGRAPHY

The terrain of which the Ski Group was staked is comprised mainly of rolling hills of sand and gravel, wooded with moderate of jack-pine and light underbrush. The Claim Group, in general, is well-drained and northward flowing stream
the trend of the geochemical anomaly detected by Siegel and associates.

GENERAL GEOLOGY

The Ski Group is underlain by Nicola volcanic rocks. The contact of the Nicola rocks with the Guichon Batholith lies approximately 3 miles west of the Claim Group. Mercury occurrences are found in a belt roughly 8 miles wide, extending from Leighton Lake on the south to Criss Creek, a distance of about 23 miles.

Cinnabar occurs in or at the edges of dolomite veins in the volcanics and also in small masses in chalcedony and silicified rock.

MINERALIZATION/

MINERALIZATION

No outcroppings were seen on the portion of the grid which I visited. A property several miles to the south was a mercury producer (Cimmabar).

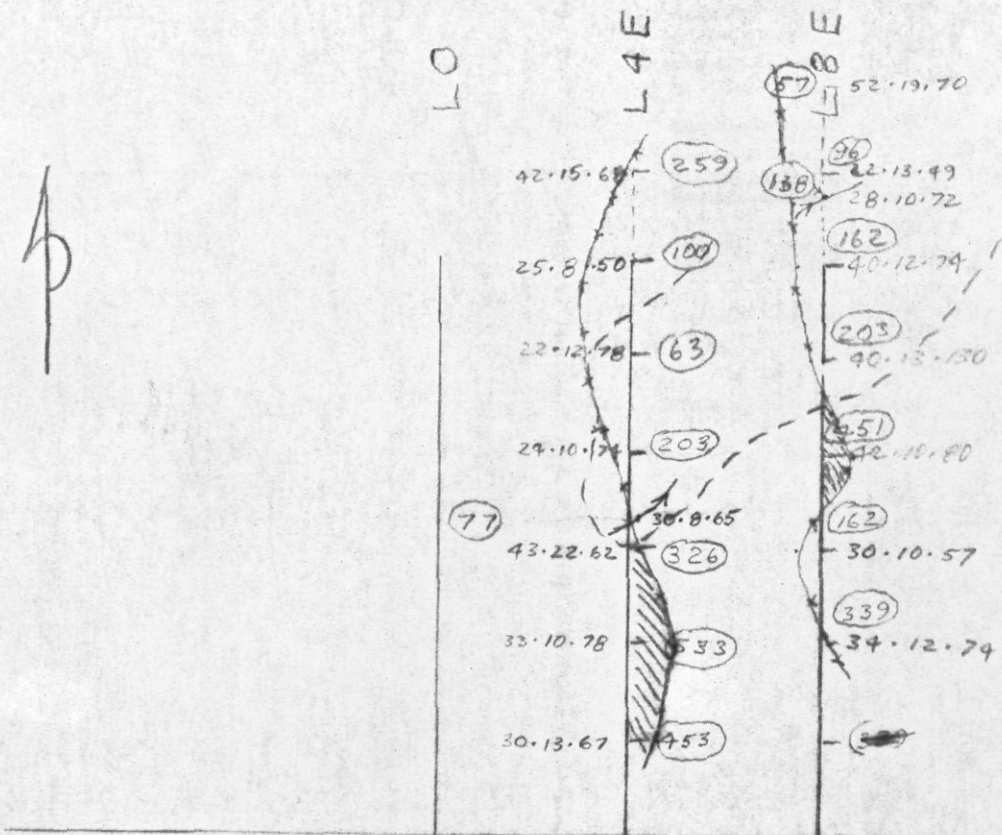
Note: Samples from the Ski Group (16), should be recovered from Chemex in Vancouver and shipped to Barringer in Toronto. Report results in ppb.

M.E. Coates
July 12,1970

MEC:js

SKI GROU

I. GREG



outlines of chargeability
5-10 m.l

Geochemical Value

N.T.S. 92 I/10

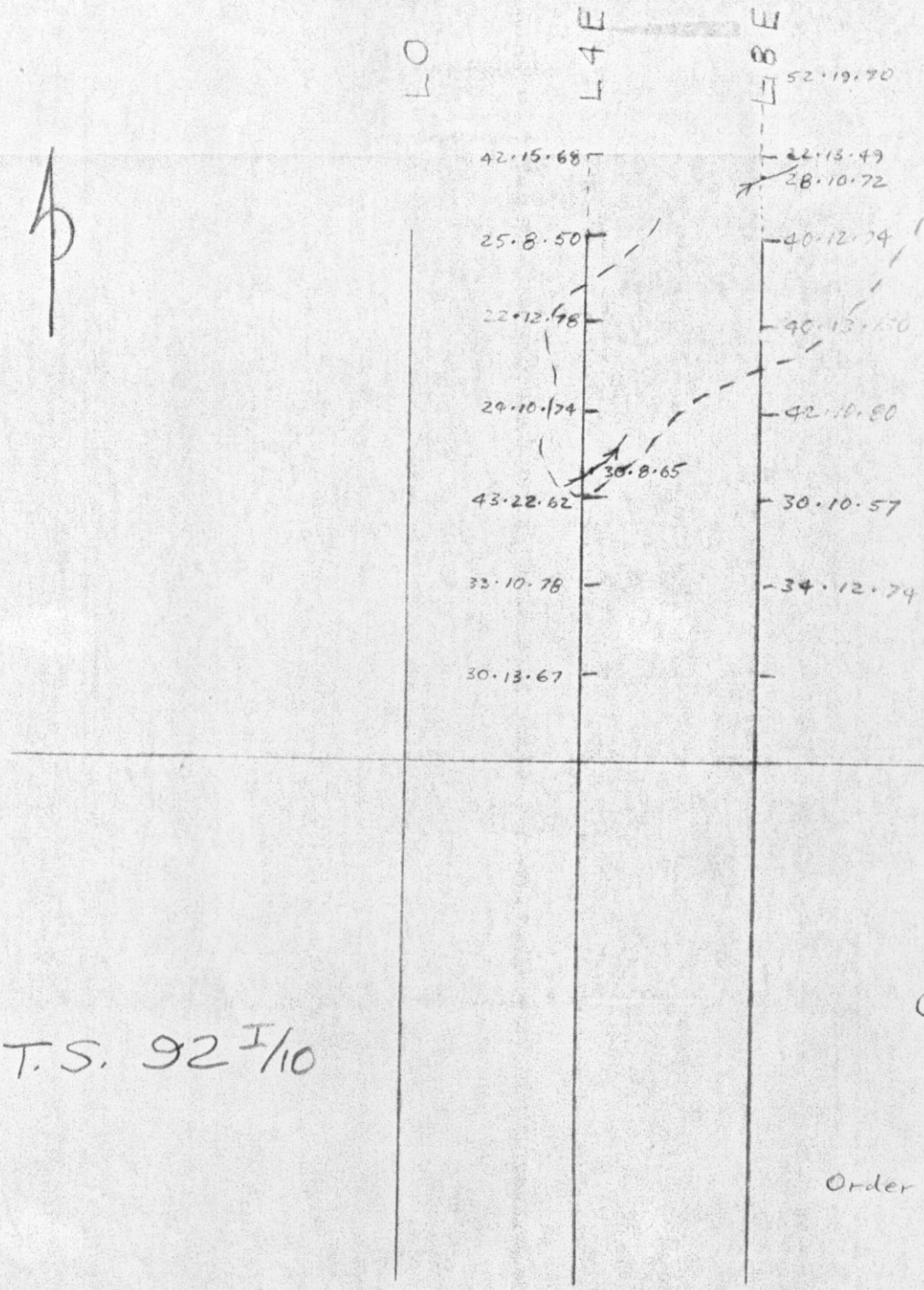
Order of Values
Cu · Pb · Zn
30 · 10 · 78

300 ppb Hg (For profiles)

300 ppb Hg (For profiles)

SKI GROU

I. GREG



...dth of chargeability ...
5-10 m.

Geochemical Value

N.T.S. 92 I/10

Order of Values
Cu · Pb · Zn
30 · 10 · 78

GEOLOGICAL REPORT
On The
SKI GROUP CLAIMS 1-12
Leighton Lake
Kamloops Mining Division, B.C.

Of

Newmine Development Ltd (N.P.L.)

By
E. P. Sheppard, P.Eng.
Consulting Geologist

March 19, 1969
Vancouver, B. C.

I N D E X

MAPS

Location Map
Claim Plan - Scale: 1" = 1000'
Aeromagnetometer Map 5217G

Reference: G.S.A. Memoir 249, W. E. Cockfield

* * *

GEOLOGICAL REPORT

SKI GROUP CLAIMS 1 - 12
Kamloops Mining Division, B. C.

SUMMARY & CONCLUSIONS

The Ski Group 1-12 is located 10 miles south of Savona in the Highland Valley area of British Columbia.

The claims lie on the contact between the Kamloops series of rocks and the Nicola group. This area is referred to as the "mercury belt", roughly 8 miles wide by 23 miles long, north-south. An old mercury showing lies 3000 feet south of the boundary of the Ski claims.

The area is generally covered with overburden; geophysical and geochemical methods of prospecting are therefore necessary in order to pinpoint mineralized areas. Airborne magnetic anomalies located on the property indicate the presence of iron-impregnated material, and possibly contact zones between the Kamloops and Nicola groups of rocks.

It is concluded that the mercury belt described herein has not been extensively or heavily prospected for economic mercury deposits.

The Ski Group of claims is well located and warrants careful prospecting.

GEOLOGICAL REPORT
NEWMINE DEVELOPMENT LTD (NPL)
SKI GROUP CLAIMS 1-12
Leighton Lake
Kamloops Mining Division, B. C.

INTRODUCTION

The following report is compiled from data collected during a one-day visit to the "Ski Group 1-12" property, by the writer, on March 15, 1969; a study of pertinent data in the form of geological reports, Department of Mines publications, and private company reports.

The primary interest in the area is for copper deposits of the "porphyry" type presently being worked in the Highland Valley. However, the Ski Group claims are held primarily for their mercury potential. Several old showings nearby containing appreciable amounts of mercury led to this investigation.

PROPERTY

The property consists of a block of 12 staked mining claims as follows:

Name	Numbers	Record Numbers	Expiry Date
Ski	1 - 12	75889-75900	Feb. 4,1970

OWNERSHIP

The Ski Group is held by right of staking by Newmine Development Ltd (N.P.L.).

LOCATION & ACCESS

The Ski group is located approximately 10 miles south of Savona, B. C., on Highway 1, at 121° -40' West Longitude, 51° - 27' North Latitude; elevation, approximately 3800 feet.

The claims are bounded by the "Way" claims to the north, and by staked ground on the east, south and west.

A good all-weather county road passes through the claims group. Leighton Lake lies approximately one mile west of the west boundary of the group.

HISTORY

No production is recorded for the Ski group. An old mercury showing, known as the Tunkwa Lake Mercury Group, located 3000 feet south of the south boundary of the group, is reported in Memoir 249, P. 83. Production from this property is reported to be less than 100 lbs of mercury, recovered from a small retort which still remains on the property.

GEOLOGY - General

The consolidated rocks of the area range in age from Carboniferous to Tertiary periods, and include both sedimentary and igneous types.

Carboniferous; Cache Creek group, is composed of slightly sheared greenstone, argillite, quartzite, hornstone, greenstone and serpentine, limestone, conglomerate, and breccia.

Triassic; Nicola group, consists principally of volcanic rocks, with minor amounts of sedimentaries, limestone, argillite and conglomerate. The Nicola rocks vary from fine-grained to very coarsely porphyritic. Green or greenish grey predominate but various shades of purple, red or brown also occur, together with rocks that are dark or nearly black. The rocks are chiefly andesites but include basaltic types. Much breccia and tuff are associated with the lavas. The latter are partly altered to chlorite, epidote and calcite, and the boundaries of individual flows are hard to detect. Limestone is the chief sedimentary, with argillite and conglomerate occurring sparingly. The limestone bands are generally lenticular in form rather than continuous beds.

Jurassic; Coast Intrusions, composed of granite, granodiorite or quartz diorite, but include more acidic or basic types. The Coast Intrusions are invariably intrusive into the Triassic. The Guichon batholith is now of major importance as a source of copper.

Cretaceous or Tertiary; Copper Creek intrusions, granite, granodiorite, granite porphyry are represented as minor occurrences cutting both sedimentary and volcanic rocks.

Miocene or earlier; Kamloops group, includes considerable thickness of volcanic and sedimentary rocks. Coldwater beds occur at the base of the group and, in places, appear to underlie the volcanics. They are similar to the Tranquille beds and consist of conglomerate, sandstone and shale. The volcanic rocks are chiefly dense, fine-grained, basaltic lavas. They exhibit a wide range of colors and are intercalated with a considerable thickness of breccias and agglomerates.

The mineral deposits of the area are of great importance, ranging from huge porphyry copper deposits in the Guichon batholith to mercury occurrences in the contact zones between the Kamloops group of rhyolites, andesites etc. and conglomerate, sandstone and shale.

GEOLOGY - Detailed

The Ski Group is underlain by the Nicola group of rocks composed of greenstone, andesite, basalt, agglomerate, breccia and tuff, with minor argillite, limestone, conglomerate etc. The contact of the Guichon batholith lies approximately three miles west.

Mercury occurrences are found in a belt roughly 8 miles wide, extending from Leighton Lake on the south to Criss Creek, a distance of about 23 miles NS. The occurrences are emplaced mostly in volcanic rocks of different ages and are accompanied in some cases by silicification with chalcedonic quartz, intense alteration of the rock to ankeritic carbonates, and the development of dolomite veins in shear and fracture zones. The cinnabar occurs in or at the edges of dolomite veins, also in small masses in chalcedony and silicified rock.

The largest number of deposits is exposed north of Kamloops Lake; however, there are many carbonate zones on the hills sloping north to the lake.

The Tunkwa Lake occurrences lie 3000 feet south of the south boundary of the Ski Group. Carbonate zones are exposed 50 feet east of the highway, carrying stibnite, tetrahedrite, malachite, azurite and cinnabar. The occurrences consist of volcanic rock,partly banded tuff altered to ankerite and veined with dolomite.

Most of the area is drift covered and the Ski Group will require close prospecting to determine the presence of cinnabar in the carbonate rock.

MAGNETOMETER SURVEY

An aeromagnetic survey was flown over the area in 1966 and the Ski Group claims were covered by this survey.

A strong, north-trending anomaly crosses the eastern portion of the claims with magnetic highs of over 2400 gamma. The central portion of the claims is occupied by the southern part of a closed anomaly also trending northward. This anomaly exhibits a magnetic high of 2300 gamma. A third anomaly touches the southwest corner of the group and swings south over the mercury showing 3000 feet south.

Cinnabar itself is non-magnetic; however, the mineralized volcanics carry magnetite in appreciable amounts. It is possible, therefore, that there may be a connection between the magnetic susceptibility of the volcanics and the occurrence of cinnabar. If such is the case, a prospecting criterion may be worked out for the detection of cinnabar occurring in covered areas.

EXPLORATION

The present search is being made for extensive low-grade bedded deposits which may be mined on a large scale, and the cinnabar concentrated, as are other sulphides such as copper, lead and zinc.

Soil sampling would be utilized in the covered areas as the presence of cinnabar is readily detected by geochemistry. Owing to the relatively heavy forest cover, a grid system of cut lines will be required to give control during the mapping of the claims. This grid system will also be utilized for control stations for geophysical and geochemical surveys, as well as for a possible drilling program.

ESTIMATED COST OF EXPLORATION PROGRAM - PHASE I

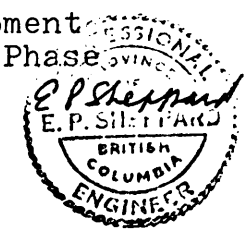
Grid lines, 24 mi. @ $80	$ 2000.00
Geological mapping, sampling.....	2400.00
Geochemical sampling, 1250 samples @ 80¢	1000.00
Geophysical Survey, I.P. pref...	6000.00
Assaying	400.00
Travel, living expenses	1200.00
	$13,000.00

Contingent on Phase I being successful in outlining satisfactory targets, Phase II would follow, to consist of diamond drilling, stripping, etc.

RECOMMENDATIONS

It is recommended that the claims be prospected by a two-phase exploration program consisting of geological mapping and sampling, geophysical surveying and geochemical sampling on a grid system.

It is further recommended that Newmine Development Ltd (N.P.L.) allocate the sum of $13,000 to implement Phase I of the work necessary to prospect the claims group.



E. Percy Sheppard.

E. P. Sheppard, P. Eng.
Consulting Geologist

March 19, 1969
Vancouver, B. C.

C E R T I F I C A T E

I, E. PERCY SHEPPARD, of the City of Vancouver, in the Province of British Columbia, hereby certify THAT

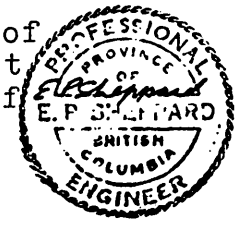
1. I am a Consulting Geologist with offices at 314-402 West Pender Street, Vancouver, B.C.;

2. I am a graduate of Dalhousie University with a B.Sc. degree in Geology, and have been active in mining exploration and geophysics for over thirty years;

3. I am a member of the Association of Professional Engineers of British Columbia, the Geological Association of Canada, the Society of Exploration Geophysicists, and the A.I.M.E.;

4. The information for the accompanying report was obtained from an examination of the property on March 15, 1969, and a study of records, publications, pertinent reports;

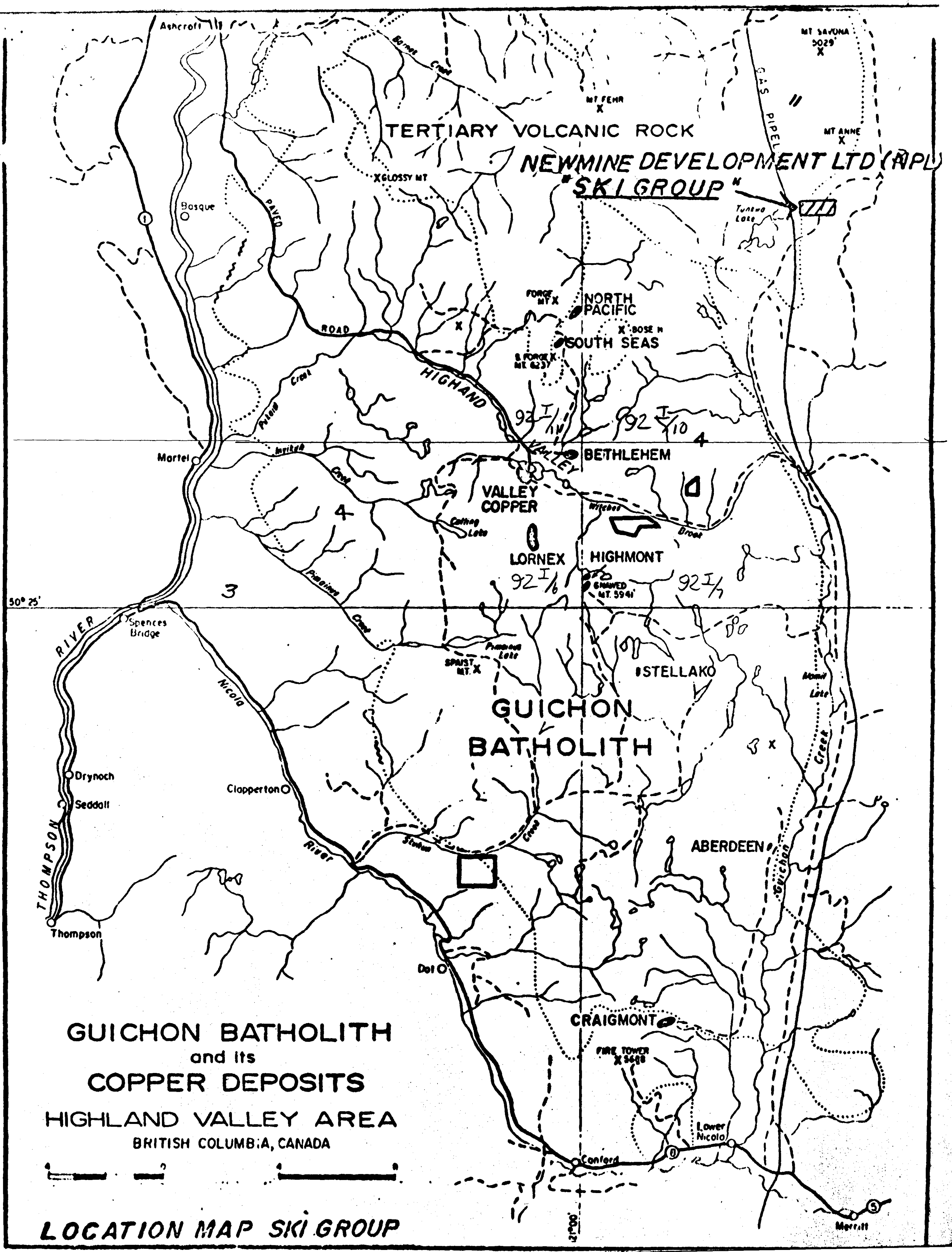
5. I have no direct or indirect interest in the property described herein, nor have I any direct or indirect interest in the shares of Newmine Development Ltd (N.P.L.). I do not anticipate any such interest as a result of writing this report.

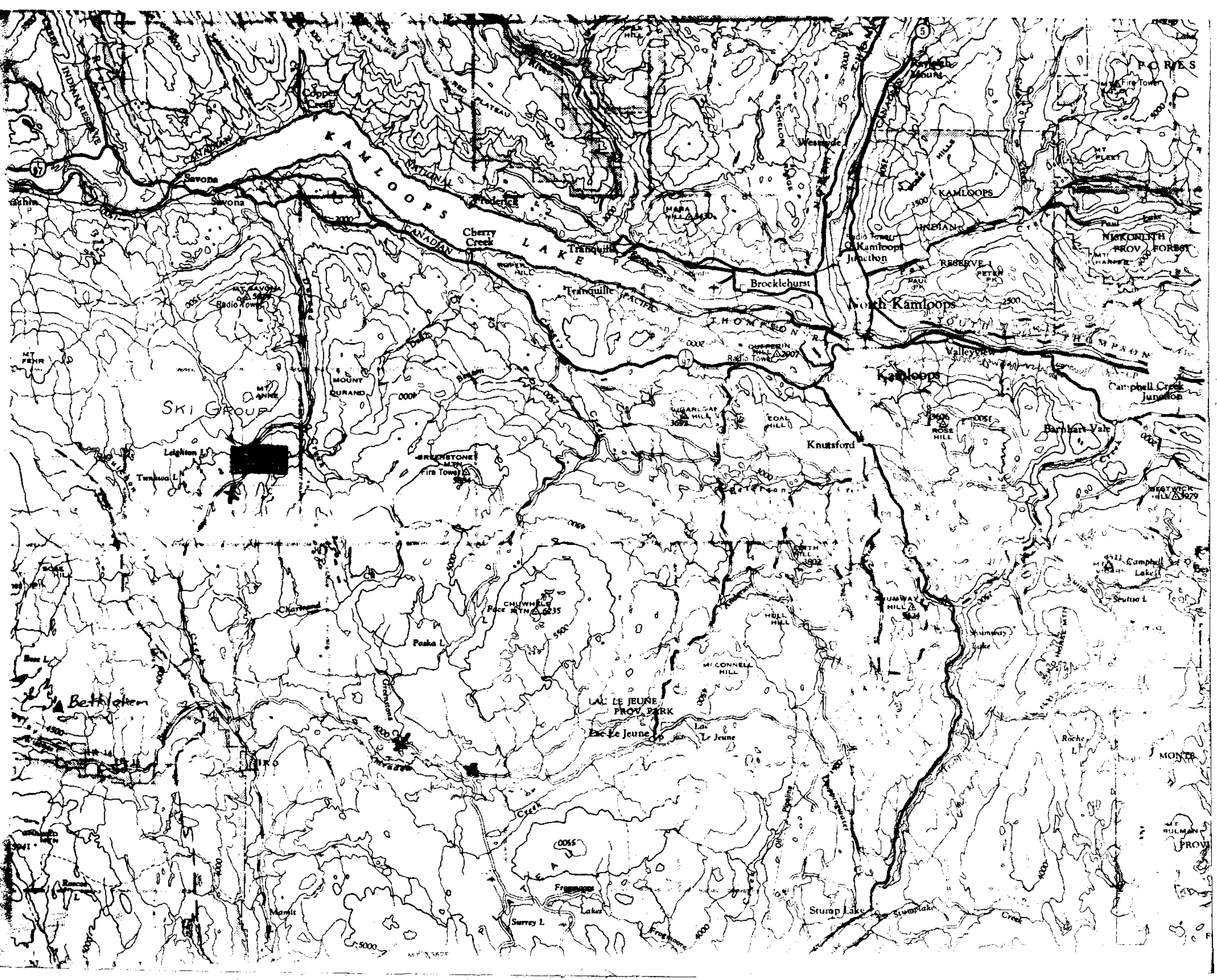


E. Percy Sheppard

E. P. Sheppard, P. Eng.

March 19, 1969
Vancouver, B. C.

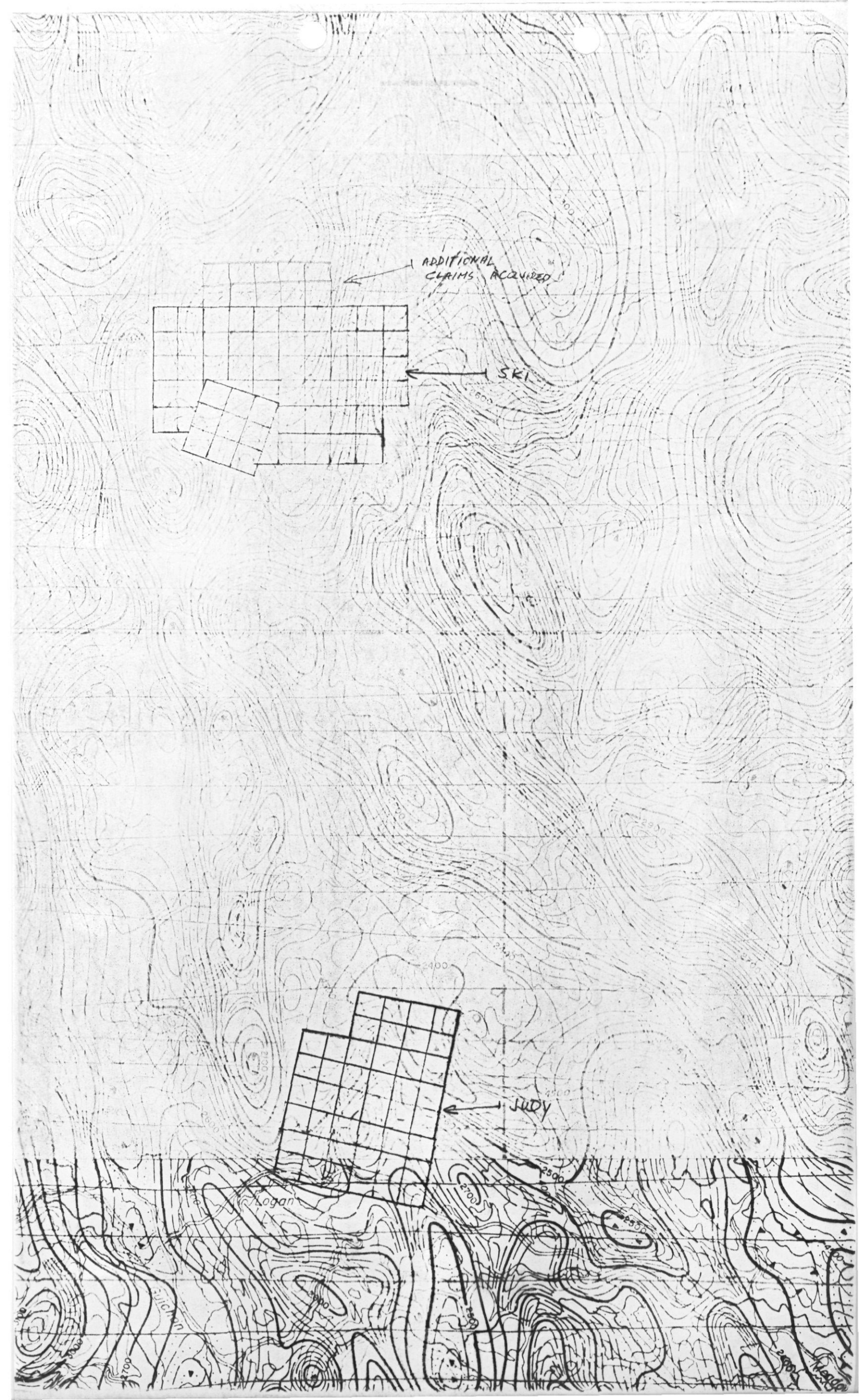

Ashcroft
Bonnet Creek
MT SAVONA 5029'
MT FEHR
TERTIARY VOLCANIC ROCK
GAS PIPELINE
MT ANNE
NEWMINE DEVELOPMENT LTD (NPL)
"SKI GROUP"
Tunkwa Lake
GLOSSY MT
Bosque
PAVED
ROAD
HIGHAND
VALLEY
FORGE MT
NORTH PACIFIC
BOSE M
SOUTH SEAS
S FORGE MT 6237
Pukaist Creek
Inkitsah Creek
92 I/11
92 I/10
4
Mortel
BETHLEHEM
VALLEY COPPER
Witches Brook
Calling Lake
4
LORNEX
HIGHMONT
92 I/6
GNAWED MT. 5941'
92 I/7
3
50° 25'
Spences Bridge
THOMPSON RIVER
Pimainus Creek
Nicola
Pimainus Lake
SPAIST MT.
STELLAKO
GUICHON BATHOLITH
Mamit Lake
Guichon Creek
Drynoch
Seddall
Clapperton
ABERDEEN
River
Thompson
Dot
CRAIGMONT
FIRE TOWER 5688
Lower Nicola
Canford
Merritt
GUICHON BATHOLITH
and its
COPPER DEPOSITS
HIGHLAND VALLEY AREA
BRITISH COLUMBIA, CANADA
LOCATION MAP SKI GROUP



KAMLOOPS LAKE
Savona
Copper Creek
Frederick
Cherry Creek
Tranquille
Brocklehurst
Westsyde
Kamloops Junction
North Kamloops
Kamloops
Valleyview
SOUTH THOMPSON
THOMPSON R
Campbell Creek Junction
Barnhart Vale
Knutsford
NISKONLITH PROV FOREST
KAMLOOPS INDIAN RESERVE 1
PAUL PK
PETER PK
MARA HILL
DUFFERIN HILL 2007
Radio Tower
MT SAVONA
MT ANNE
MOUNT DURAND
MT FEHR
SKI GROUP
Leighton L
GREENSTONE MTN
Fire Tower
SUGARLOAF HILL
COAL HILL
ROSE HILL
BESTWICK HILL 3979
SHUMWAY HILL
Shumway Lake
Campbell Lake
CHUWHELS MTN 6235
Paska L
MCCONNELL HILL
LAC LE JEUNE PROV. PARK
Lac Le Jeune
Bethlehem
Frogmoore Lakes
Surrey L
Stump Lake


ADDITIONAL CLAIMS ACQUIRED
2300
3000
2500


Copper Creek
Savona
Frederick
Cherry Creek
Tranquille
Brocklehurst
Westsyde
Raylogh Mount
KAMLOOPS
North Kamloops
Kamloops
Valleyview
Campbell Creek Junction
Barnhart Vale
Knutsford
Paska L.
Leighton L.
Tunkwa L.
Bethlehem
LAC LE JEUNE PROV. PARK
Lac Le Jeune
Stump Lake
Dandanelles L.
Roscoe L.
Surrey L.
Frogmoore Lakes
MONTE
KAMLOOPS NATIONAL CANADIAN PACIFIC RAILWAY
THOMPSON R.
SOUTH THOMPSON R.


ADDITIONAL
CLAIMS ACQUIRED
SKI
JUDY
Logan

REPORT ON
INDUCED POLARIZATION SURVEY
TUNKWA LAKE AREA, BRITISH COLUMBIA
ON BEHALF OF
NEWMINE DEVELOPMENT LTD. (NPL)

by

Jon G. Baird, B.Sc., P.Eng.

June 6, 1969

CLAIMS:

Name	Record Nos.
SKI 1 - 12	75889 - 75900

LOCATION:
About 10 miles south of Savona, B.C.
Kamloops Mining Division
120° 50° NW

DATES:
April 22 to May 2, 1969

SUMMARY

An induced polarization survey on this property has revealed two indications of moderately increased chargeability responses.

Geological and geochemical investigations are recommended for the anomalous areas. Predicated upon these studies, further induced polarization surveying may be warranted to allow accurate positioning of diamond drill holes or trenches.

TABLE OF CONTENTS

SEIGEL ASSOCIATES LIMITED
GEOPHYSICAL CONSULTANTS & CONTRACTORS
A DIVISION OF SCINTREX LIMITED

REPORT ON INDUCED POLARIZATION SURVEY TUNKWA LAKE AREA, BRITISH COLUMBIA ON BEHALF OF NEWMINE DEVELOPMENT LTD. (NPL)

INTRODUCTION

During the period April 22 to May 2, 1969, a geophysical field party under the direction of Mr. Tony Guernier executed an induced polarization survey in the Tunkwa Lake area, British Columbia, on behalf of Newmine Development Ltd. (NPL).

As shown on Plate 1, on the scale of 1" = 4 miles, the property lies approximately ten miles due south of Savona and one to two miles east of Tunkwa Lake. The property is reached by unimproved road from Savona. The elevation of the survey area is about 3700' above sea level and the terrain is rolling and treed. The claims covered by the present survey are listed on the cover page of this report and are held by Newmine Development Ltd. (NPL).

Seigel Mk VI time domain (pulse-type) induced polarization equipment has been employed on this property. The transmitting unit had a rating of 2.5 kw and equal on and off times of 2.0 seconds. The receiving unit was a remote, ground-pulse type triggered by the rising and falling primary voltages

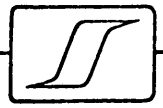
set up in the ground by the transmitter. The integration of the transient polarization voltages takes place for 0.65 seconds after a 0.45 second delay time following the termination of the current-on pulse.

The purpose of an induced polarization survey is to map the subsurface distribution of metallically conducting mineralization beneath the grids covered. In the present area such mineralization could include bornite, chalcopyrite, molybdenite, pyrite and other metallic sulphide minerals. As well, metallic conductors such as graphite and artificial installations such as pipelines, fences etc., can give responses not always distinguishable from sulphide mineralization. These latter anomalous sources are not expected to occur on this property.

The accompanying copy of H. O. Seigel's paper entitled "Three Recent Irish Discovery Case Histories Using Pulse Type Induced Polarization" gives a description of the phenomena involved in this type of survey, the equipment employed, the field procedures and the nature of the results obtained over various base metal ore bodies.

For the present survey a base line was laid out oriented east-west and grid lines were established perpendicular thereto at 400' intervals. The lines were 2400' in length.

The three electrode array, with electrode spacings of 400', was employed for reconnaissance purposes. Station intervals were 200'. On the north end of L 8 E, where a chargeability rise was noted for the reconnaissance spacings, profiles were executed using the three electrode array and electrode separations of 200' and 100'.



GEOLOGY

A description of the geology of the area including and surrounding the present claims is found in G.S.C. Memoir 249 "Geology and Mineral Deposits of Nicola Map Area, British Columbia" by W. E. Cockfield, 1961. Maps 886A and 887A, on the scale of 1" = 4 miles, show the general geology and mineral localities of the one degree quadralateral within which the survey area is located. The geology map shows that the property straddles a contact between volcanic rocks of the Upper Triassic Nicola group and the Cenozoic Kamloops group. Just east of the claim group Mesozoic volcanics are shown to occur. A mercury showing of cinnebar in carbonitized volcanic rocks occurs just south of the claim group.

The claims area has been covered by an airborne magnetometer survey flown at an altitude of 1000'. The results of this government survey are shown on G.S.C. Map 5217G, Cherry Creek. This map shows that most of the property is covered by a magnetic low centred just north of the property.

DISCUSSION OF RESULTS

Plate 2, on the scale of 1" = 400', shows the geophysical survey results in profile form. Two parameters are plotted, chargeability (the induced polarization characteristic of the rock) and resistivity. The vertical scales for these profiles are 1" = 10.0 milliseconds for chargeability and 1" = 1000 ohm-metres for resistivity.

Plate 3, also on the scale of 1" = 400', shows the survey results in contour form. In the upper plan the chargeability values

are shown in milliseconds and have been contoured with a 2.0 millisecond contour interval. Areas exhibiting chargeabilities in excess of 6.0 milliseconds have been shaded. The lower plan shows the resistivity values in ohm-metres and has been contoured with a 25 ohm-metre contour interval. Areas exhibiting resistivities in excess of 150 ohm-metres have been shaded.

The chargeability results reveal that the average chargeability level is about 4.0 milliseconds. This is well within the nonmetallic chargeability range for the rocks believed to underlie the survey area. With this background a uniform distribution of 1% by volume of metallically conducting mineralization in the subsurface would be expected to add approximately 6.0 milliseconds to the background level. Chargeabilities in excess of about 6.0 milliseconds are considered worthy of further investigation since deposits of very low concentrations of copper and molybdenum of sufficient dimensions may have economic significance. As well, the reconnaissance electrode separations and line intervals may not always indicate the peak chargeabilities of the anomalous sources.

Increased chargeability responses were observed on the north end of L 8 E for the 400' reconnaissance electrode spacing. The anomalous section of the line was covered by the three electrode array employing 200' and 100' electrode separations. The results of these traverses are shown in the detailed profile on Plate 2. Since the property boundary occurs near the north end of the line, it was not possible to traverse completely across the anomalous source. Quantitative interpretations are therefore somewhat difficult, however the present results seem to indicate that the anomalous body may

come within 50' or perhaps closer to the ground surface near 16N and either dip towards the south or strike at small angle to the line end. The anomaly is supported by readings of 6.5 and 6.2 milliseconds at stations 8 and 10N on L 4 E.

An additional high chargeability indication occurs near 4N on L 40 E. This indication has only been covered by the reconnaissance electrode spacing and quantitative interpretations are therefore not possible. The anomaly is supported by a readin of 5.5 milliseconds at 6N on L 36 E.

The resistivity contour plan reveals that the resistivi vary from below 25 ohm-metres to above 250 ohm-metres. The resistivity contour pattern may be influenced as much by changes the depth or type of overburden as by changes in the character of the bedrock. In the northwest corner of the grid for example, wh resistivities less than 75 ohm-metres correlate with low chargeabilities, it is likely that the overburden is noticeably thicker than in other parts of the survey area. Correspondingly the area of high resistivity may indicate areas where overburden is thin.

Part of the anomalous indication on L 4 E corresponds with resistivity measurements in excess of 150 ohm-metres, however the other chargeability responses above 6.0 milliseconds correlat with lower resistivity observations.

CONCLUSIONS AND RECOMMENDATIONS

The present induced polarization survey has revealed t localized areas of moderately increased chargeability response wh may be indicative of concentrations of polarizable mineralizatio

whose character is not as yet known. Such mineralization could consist of sulphides, magnetite, graphite, serpentine and other minerals which give induced polarization responses.

It is recommended that geological and geochemical examinations be made in the anomalous areas. If these studies are favourable or if no cause for the present responses can be seen, further induced polarization work may be considered to further define the anomalous sources. This would allow quantitative interpretation of the location, attitude, depth below surface, and possible metallically conducting content of the sources in order to best locate exploratory diamond drill holes.

Respectfully submitted,

SEIGEL ASSOCIATES LIMITED

Jon G. Baird, B.Sc., P.Eng.
Geophysicist

Vancouver, B.C.
June 6, 1969

Harold O. Seigel

President,
Harold O. Seigel & Assoc., Ltd.,
Downsview, Ontario

Annual General Meeting,
Toronto, March, 1965

Three Recent Irish Discovery Case Histories Using Pulse-Type Induced Polarization

Transactions, Volume LXVIII, 1965, pp. 343-348

ABSTRACT

In the intensive Irish exploration program which has followed the discovery of the Tynagh deposit (Northgate Exploration, Ltd.) in 1962, three base metal discoveries have been made to date. These include the lead-zinc-silver deposits at Silvermines (Consolidated Mogul Mines, Ltd.), which are now being readied for production, the copper-silver deposit at Gortdrum (Gortdrum Mines, Ltd.) and the lead-zinc deposits near Keel (Rio Tinto-Zinc Ltd.). Each of these discoveries is the result of a combined geological-geochemical-geophysical exploration sequence in which pulse-type induced polarization surveys defined the precise location and lateral extent of the near-surface metallic sulphide mineralization and guided the initial drilling program. Whereas the Silvermines mineralization is, in part, composed of massive sulphides, the other two deposits are characterized by generally less than 5 per cent conducting sulphides and constitute an excellent demonstration of the unique merits of the pulse-type induced polarization system.

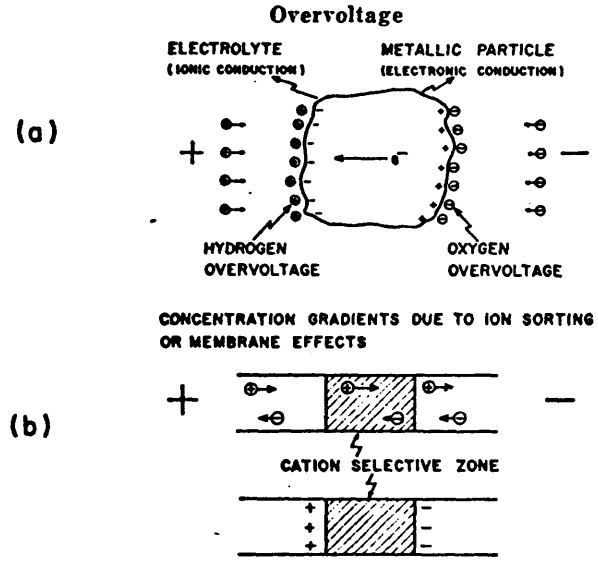


Figure 1.—Induced Polarization Agents.

Introduction

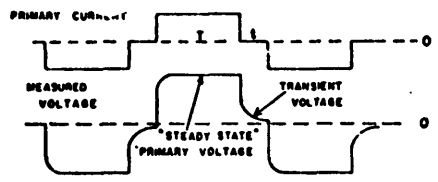
FOR the benefit of those who are unfamiliar with the induced polarization method in general or with the pulse-type method in particular, a few introductory remarks will be directed on the system employed in the present case histories. Those who wish a fuller treatment of the subject are directed to Seigel (1962),* which paper also includes an extensive list of references.

Induced polarization, in its broadest sense, means a separation of charge to form an effective dipolar (polarized) distribution of electrical charges throughout a medium under the action of an applied electric field. When current is caused to pass across the interface between an electrolyte and a metallic conducting body (Figure 1a) double layers of charge are built up at the interface, in the phenomenon known to the electrochemists as "overvoltage." This is the phenomenon which can be utilized for the detection of the metallic conducting rock-forming minerals such as most sulphides, arsenides, a few oxides and, unfortunately, graphite. In addition, effective dipolar charge distributions occur to some extent in all rocks, due to ion-sorting or membrane effects in the fine capillaries in which the current is passing (Figure 1b). Induced polarization responses may therefore arise from metallic or non-metallic agencies. Fortunately, the latter generally fall within fairly low and narrow limits for almost all rock types, although there is still no reliable general criterion for differentiating overvoltage responses from graphite and metallic sulphides, or for distinguishing between the responses of one type of sulphide and another. Despite these limitations, the induced polarization method has amply demonstrated its value in mineral exploration since its initial development as a useful exploration tool in 1948. (Wait *et al.*, 1953).**

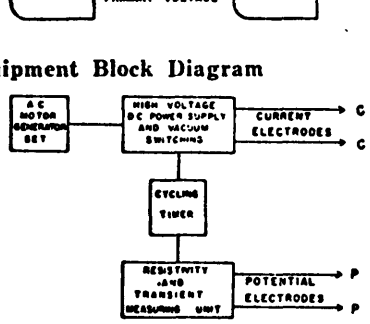
*Seigel, H. O., "Induced Polarization and its Role in Mineral Exploration," C.I.M. *Bulletin*, Vol. 55, No. 600, pp. 242-249; *Transactions*, Vol. LXV, pp. 151-158; 1962.

**"Overvoltage Research and Geophysical Applications," *Pergamon Press*, 1959, edited by J. R. Wait.

(a) V Forms



(b) Equipment Block Diagram



Three-Electrode Array

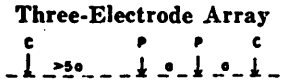


Figure 2.—The Pulse System.

Description of Method

For the present program, the pulse or time-domain system was employed. As shown on Figure 2a, the primary current wave form consists of square wave pulses of 1.5 seconds duration, separated by a 0.5-second gap and alternately reversed in direction. The polarization voltages established during the current-on time decay slowly during the current-off time. They are amplified, integrated over the current-off time and divided by the amplitude of the steady-state voltage measured during the current-on time. In this way, we determine the "chargeability;" i.e., the induced polarization property of the region under investigation. The units of chargeability are milliseconds. Normal (non-metallic) background chargeabilities in most rocks range from 1 millisecond to 5 milliseconds. A distribution of 1 per cent, by volume, of metallic conducting material of an average range of particle s may be expected to increase the response level by about 3 milliseconds, which is readily visible.

The pulse system provides an absolute measurement of induced polarization; i.e., the significant measurement is made in the absence of the primary field. As such, it is inherently more sensitive than the frequency variation system, wherein two measurements are compared, both of which are made in the presence of the primary field. This is a critical consideration when mineralized bodies of low sulphide content, small size or great depth are being sought.

Figure 2b shows a block diagram of the apparatus employed and the electrode array used. The spacing "a" of the three-electrode array determines the effective depth of penetration of the survey and is selected to give adequate penetration to the depth desired. By varying the electrode spacing over an anomalous area and comparing the responses on the various spacings, one may obtain an estimate of the depth of burial of the source and its dip, etc.

A photograph of the type of apparatus employed on these surveys is shown in Figure 3. This is known as Seigel Mk V equipment and consists of the following major components: (a) a 1,200-watt A.C. motor-generator set, (b) a power control unit capable of supplying up to 1000 volts and 2 amperes D.C. output current and (c) a measuring unit. All of these items are packboard-mounted for maximum portability.

Figure 4 shows a typical instrumental set-up in Ireland. In the normal operating procedure, the electronic chassis are set up in a tent and cables are fed out to the line being surveyed. As the line crew is prepared, both mentally and by apparel, to work under all types of weather conditions, the survey is not stopped by rain, etc. This is important in Ireland, where, traditionally, there are no more than 60 rain-free days a year.

For the primary survey coverage on most properties, an electrode spacing of 200 to 300 ft. was generally employed, with a station interval of 200 ft. and a line separation of 300 to 500 ft. On anomalous areas located by the primary coverage, more closely spaced stations and lines are employed, as well as additional spacings to supply the detail necessary for subsequent drilling, etc.

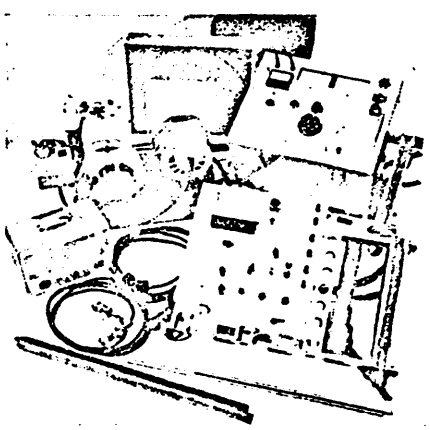


Figure 3.—(above)—The Seigel Mk V Induced Polarization Unit.

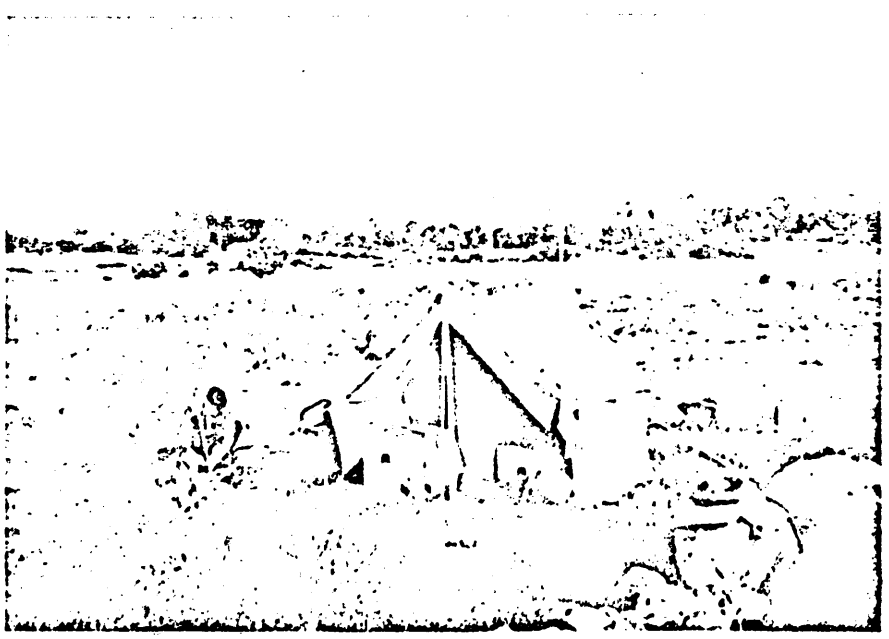


Figure 4.—(right)—Typical Field Operational Base in Ireland.

Case Histories

In presenting the three case h. ries that follow, it must be made perfectly clear at the outset that these mineral discoveries are the product of teamwork, involving geological, geochemical and geophysical phases. It is on the basis of the first two phases that the areas for geophysical investigation have been selected. As the writer and his organization have been concerned only with the geophysical phase, this paper will, naturally, appear to emphasize it. The contribution of others to the broader exploration program must not be minimized, however.

In January, 1962, a large lead-zinc-silver deposit of a very unusual type was discovered near Tynagh, Co. Galway, in the Republic of Ireland. This deposit includes both a supergene enriched, partly oxidized upper zone and a sulphide primary zone and lies in dolomitic reef limestones of Carboniferous age near a fault contact with Devonian sandstones. Similar rock types and contacts occur in many parts of Ireland, so that an extensive program of exploration was initiated by a number of mining companies, starting in the summer of 1962. Although the pace has slowed up somewhat from the hectic days of 1962 and early 1963, this exploration program continues to the present time.

The usual exploration sequence, although not followed in detail by all companies, is as follows:

1 . . . . . .

A selection of areas is made, based on the good government geological maps available. As nearly as possible, rock types and structures similar to those of the Tynagh deposit are sought. Those areas with known mineral showings are given high priority, of course.

2 . . . . . .

The stream sediments in the drainage pattern are sampled and analyzed for significant amounts of copper, lead and zinc. Soil samples may also be taken, often on a regular grid basis, and analyzed. In this fashion, areas of abnormal metal content may be broadly defined. In detail, such geochemical sampling has often been hampered by man-made contamination and confused by soil transport by glacial, fluvial or human agencies.

3 . . . . . .

Geophysical surveys, primarily the induced polarization type, are then conducted to map the subsurface distribution of sulphide mineralization and to provide guidance for a drilling program thereon.

This exploration program has already been remarkably successful, resulting, to date, in a new lead-zinc-silver mine-to-be at Silvermines, Co. Tipperary, for Consolidated Mogul Mines, Ltd., the probable copper-silver mine-to-be at Gortdrum, Cos. Tipperary and Limerick, for Gortdrum Mines, Ltd., and the interesting lead-zinc prospect at Keel, Co. Longford, for the Rio Tinto-Zinc group (Riofinex Ltd.). Figure 5 shows the location of the various recent mineral discoveries in Ireland. Despite a remarkable similarity in geological setting, the deposits are widely separated geographically, over a length of 80 miles, and no two are located on what can be called the same structure. This bodes well for the possibility of further discoveries being made in Ireland.

Each of the three case histories will be discussed below.

Silvermines Deposit

As the very name of the area implies, the Silvermines region had been known, for many centuries, as a locality mineralized with lead, zinc and silver. Metal production had taken place at several periods in the past, although at the time of the present investigations the mines were dormant. The very prominent Silvermines fault, striking about N 70°E, was known to be the significant control in the region, with the old mines and prospect pits scattered along its length over a distance of about 2 miles. Due to the past mining activity and transport by both drainage and man, a very extensive area gave rise to extremely high geochemical indications in lead and zinc. The induced polarization survey executed in late 1962 and early 1963 covered much of the concession area on 800-ft. sections and the geologically interesting portion thereof on 400-ft. sections. The three-electrode array, with 200-ft. electrode spacing, was employed on all lines, and spacings of 100 ft. and 400 ft. were also employed on the 400-ft. detail lines. In all, approximately 5 miles of the strike length of the Silvermines fault were covered by the present survey, 2½ miles in detail. At least ten distinct zones of abnormally high polarization were indicated, of which about half lay in the Silvermines mineralized belt and its extensions to the west and east.

One of these zones, designated the Garryard, has responded favourably to the subsequent drilling, resulting in the discovery of a mineable orebody.

To date, the announced proven tonnage figures include 12 million tons averaging approximately 8 per cent zinc, 3 per cent lead and 1 ounce of silver in the Garryard zone. This zone lies to the west of the zone from which the previous production had taken place.

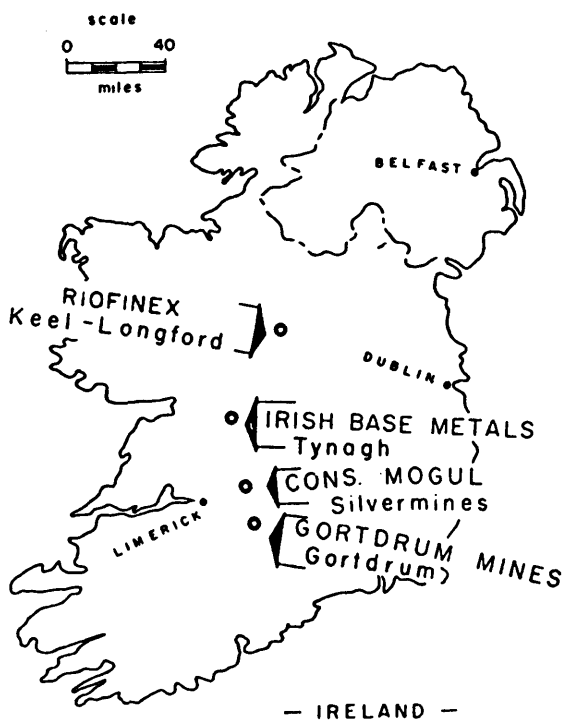


Figure 5.—Location Plan of Recent Mineral Discoveries in Ireland.

Figure 6 shows a typical discovery profile across the main ore zone, on the section 38,400E. The 200-ft. electrode spacing results, both chargeability and resistivity, are shown in profile form. The geologic section, as deduced from nine drill holes, is shown below the geophysical profiles. In a fashion almost identical to that of the Tynagh deposit, the Silvermines orebody is located in gently north-dipping dolomitic limestones adajacent to a fault contact with the Devonian "Old Red" sandstone. The mineralization here is composed of both massive and disseminated sulphides, with the former composed of a high percentage of pyrite. The mineralization is essentially conformable, in two distinct horizons, and is therefore flatly dipping except in the vicinity of the fault, where the dips are much steeper, perhaps due to "drag folding" on the fault.

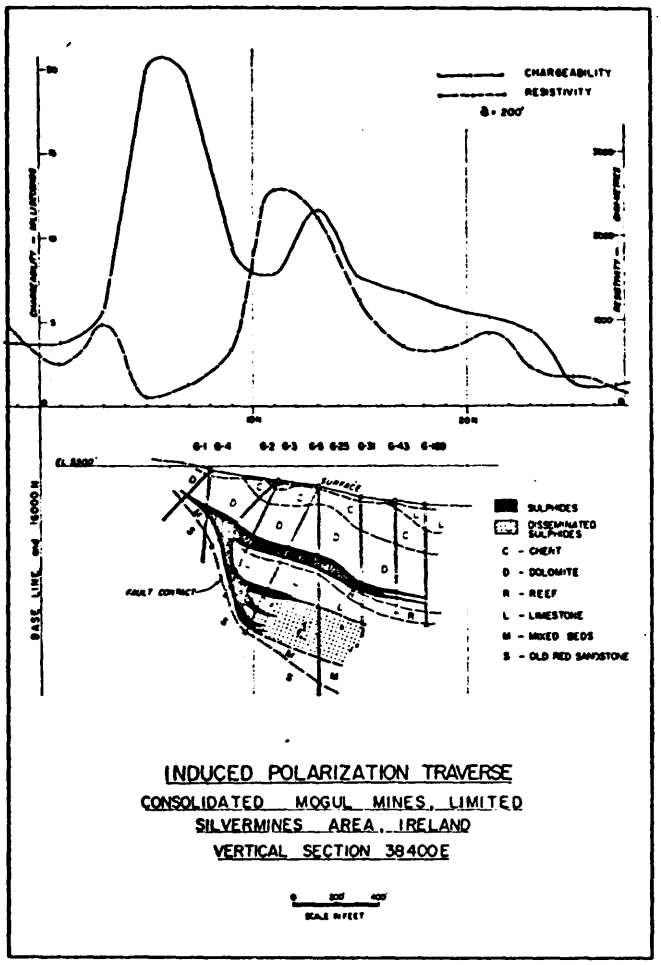


Figure 6.—Typical Discovery Traverse, Silvermines Deposit.

Because of the high pyritic content of the mineralization near the fault, along which it comes closest to the ground surface, we see both a marked increase in chargeability and a sharp decrease in resistivity in that vicinity. From a normal background of 2-4 milliseconds, the chargeability curve rises to a peak response of 20 milliseconds over the sub-outcrop of the body on this section. The subsidiary peak of about 12 milliseconds near 11N is believed to be due to disseminated pyrite in the chert horizon.

Figure 7 shows the multiple spacing chargeability results on the same section, using electrode spacing of 100, 200 and 400 ft. and the three-electrode array. On comparing the results with the various spacings, two items of interest may be noted; firstly, the progressive increase in peak amplitude with spacing, testifying to the increase of mineralization with depth, even down to a depth of 300 ft., and, secondly, the presence of buried material of high polarization at depth beneath section 10N to 18N on this line. The latter is undoubtedly due to the down-dip extension of the upper mineralized horizon, which is present at depths of 300 to 400 ft. over this region.

The induced polarization results on the Silvermines deposit were quite definitive and have provided good guidance for the exploratory drilling. It is true, however, that the massive sulphide portions of this deposit would be amenable to detection by the more conventional electrical methods, such as electromagnetic induction or resistivity. As such, it is not as good a test of the capabilities of the induced polarization method as are the two case histories which follow.

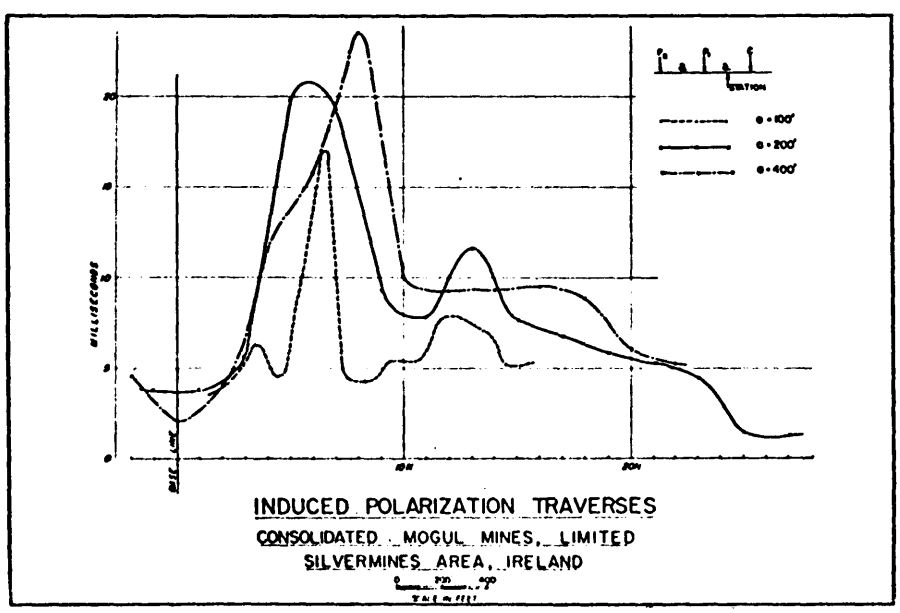


Figure 7.—Multiple Spacing Results, Silvermines Deposit.

Gortdrum Deposit

The Gortdrum area, near the mutual border of Cos. Limerick and Tipperary, was originally selected to cover the eastern extension of the former Oola Mines lead-zinc deposit, some 3 miles to the west. Regional geochemical sampling of the stream sediments in this area, followed by soil traverses, indicated a moderately strong copper soil anomaly. Induced polarization surveys were carried out in May, 1963, and January, 1964, leading to the localization of the sulphide mineralization associated with the geochemical anomaly. As there was a 300-ft. lateral displacement between the centers of the geophysical and geochemical indications and the surface topography is very gentle, it was initially queried as to whether the two indications

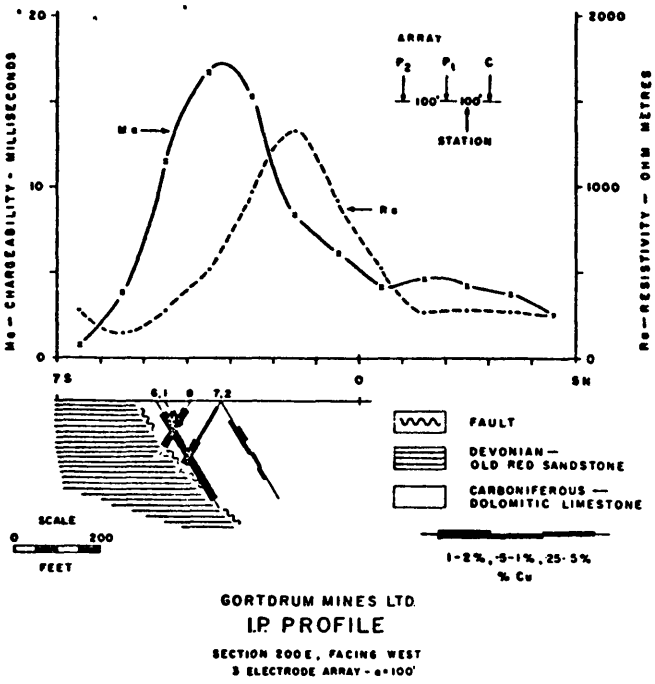


Figure 8.—Typical Discovery Traverse, Gortdrum Deposit.

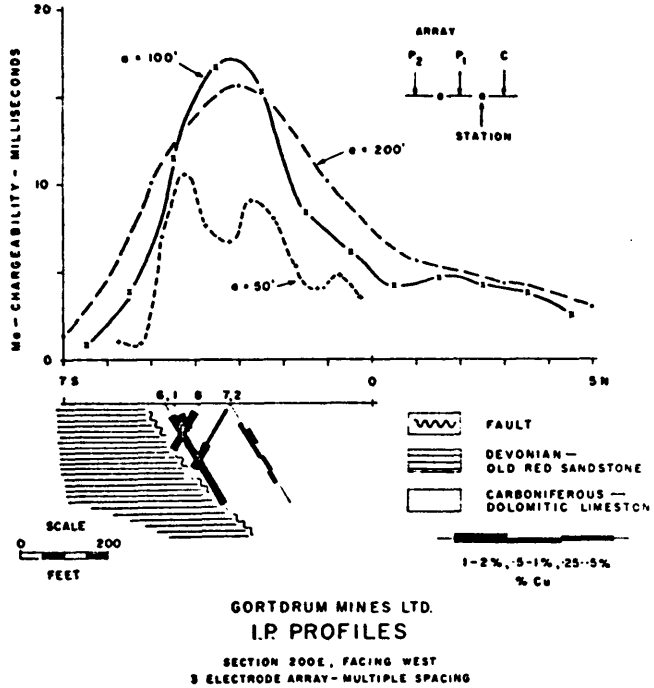


Figure 9.—Multiple Spacing Results, Gortdrum Deposit.

were related. The subsequent drilling has fully confirmed the geophysical predictions.

On the initial two geophysical programs, the three-electrode array with 100-ft. spacing was employed, as a relatively shallow source of the geochemical anomaly was expected. The survey lines were at 200-ft. intervals. Figure 8 presents a typical discovery traverse, showing both the chargeability and resistivity profiles as well as the corresponding geologic section. A peak chargeability of about 17 milliseconds is observed, rising from the normal background of 2-4 milliseconds. There is no resistivity expression of the mineralized zone, lying as it does on the flank of a high-resistivity area.

Figure 9 shows the chargeability profiles for electrode spacings of 50, 100 and 200 ft. Points of special interest deduced from these profiles include the following:

1.—The extremely sharp cut-off of the high chargeability levels on the south side of the area and the gradual drop-off in level on the north side. This was inconsistent with the thought of a bedded-type deposit conformable with the limestones, which are known to dip flatly to the south. A fault or other contact was postulated, dipping steeply, probably to the north. The initial drill holes on the section (Nos. 1, 2 and 6) were drilled to the north on the original geologic-dip premise, but the later holes (e.g., Nos. 7 and 8) have all been drilled to the south.

2.—The high-polarization material does not quite outcrop, but still comes within about 25 ft. of the ground surface across a width of about 200 ft., including two or more lenses. This material extends to at least 200 ft. in depth.

The actual drilling results confirm the presence of a zone of finely disseminated chalcocite and bornite, with very minor chalcopyrite, in dolomitic limestones. The mineralization is somewhat erratically distributed but, in general, increases as one approaches a north-dipping fault, which brings the limestones into contact with the Devonian Old Red sandstones. This fault has been found to strike about N 70°E. Geologically, therefore, this environment is almost identical to that of the Tynagh and Silvermines deposits. The mineralization in the Gortdrum area is quite different, however, both in type and amount. The average grade of the deposit is less than 2 per cent copper, with about 0.65 ounce of silver for each 1 per cent copper (although considerable potential open-pit tonnage may exist), so that the average sulphide content, by volume, is 3 per cent or less. The high chargeability responses observed over this deposit are a remarkable tribute to the sensitivity of the pulse-type induced polarization method, particularly when dealing with truly disseminated-type sulphide mineralization with a small average particle size.

As development drilling is still in progress on this deposit, no over-all grade or tonnage figures have as yet been released.

Keel Deposit

The deposits near Keel and Longford, Co. Longford, occur on a known limestone-sandstone contact, which is, no doubt, one of the reasons why exploration interest was attracted thereto. Soil sampling traverses by Riofinex Ltd., an exploration subsidiary of Rio Tinto-Zinc Corporation, Ltd., established the presence of anomalous lead and zinc concentrations. A horizontal-loop electromagnetic survey was initially executed in another attempt to determine the source of the geochemical indications, but with negative results. This was followed by induced polarization surveys in November and December, 1962. The three-electrode array, with an electrode spacing of 200 ft., was employed on the reconnaissance survey. Anomalous chargeability zones were indicated and exploratory drilling commenced shortly thereafter. Although no publication of results has been made, they are of some potential interest, as drilling has continued, at intervals, to the present time.

Figure 10 shows a typical section across the prospect, presenting the geophysical and geochemical results in profile form, as well as the geological section interpreted from three holes. The relationship between the mineralized horizon, the geophysical peak and the geochemical peaks is a matter of considerable interest. The sub-outcrop of the mineralized horizon and the geophysical peak are in good agreement (see also Figure 11). The lead peak is displaced about 400 - 500 ft. down slope to the south. The zinc peak is displaced still another 300 ft. to the south. The actual topographic slope is only 1-2 degrees to the south, so that this displacement is difficult to account for on the basis of soil creep. There is only a minor resistivity depression associated with the mineralization, indicating why the electromagnetic survey failed to give any positive response to it.

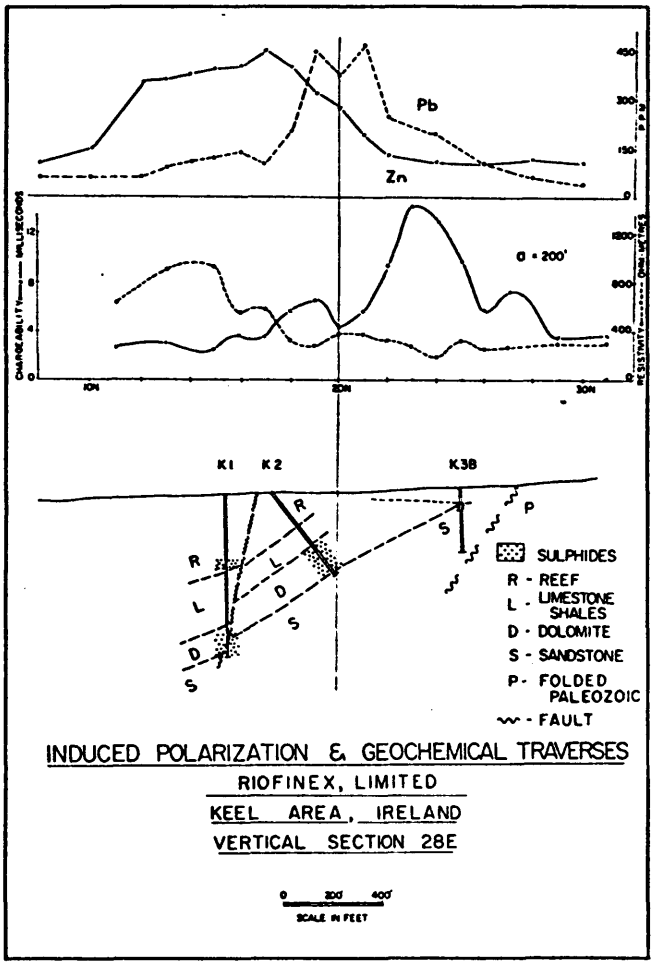


Figure 10.—Typical Discovery Traverse, Keel Deposit.

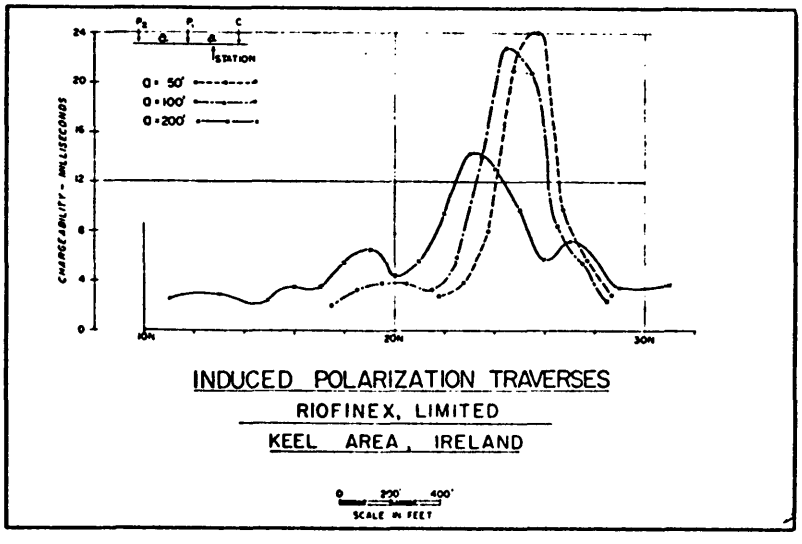


Figure 11.—Multiple Spacing Results, Keel Deposit.

The mineralization itself is primarily sphalerite, with some galena and, on the average, less than 5 per cent pyrite. It is found to lie primarily in a dolomite horizon adjacent to a contact with sandstone. In this case, the contact may be largely a depositional one and not due to a fault. Mineralization occurs to a minor extent in the sandstone as well.

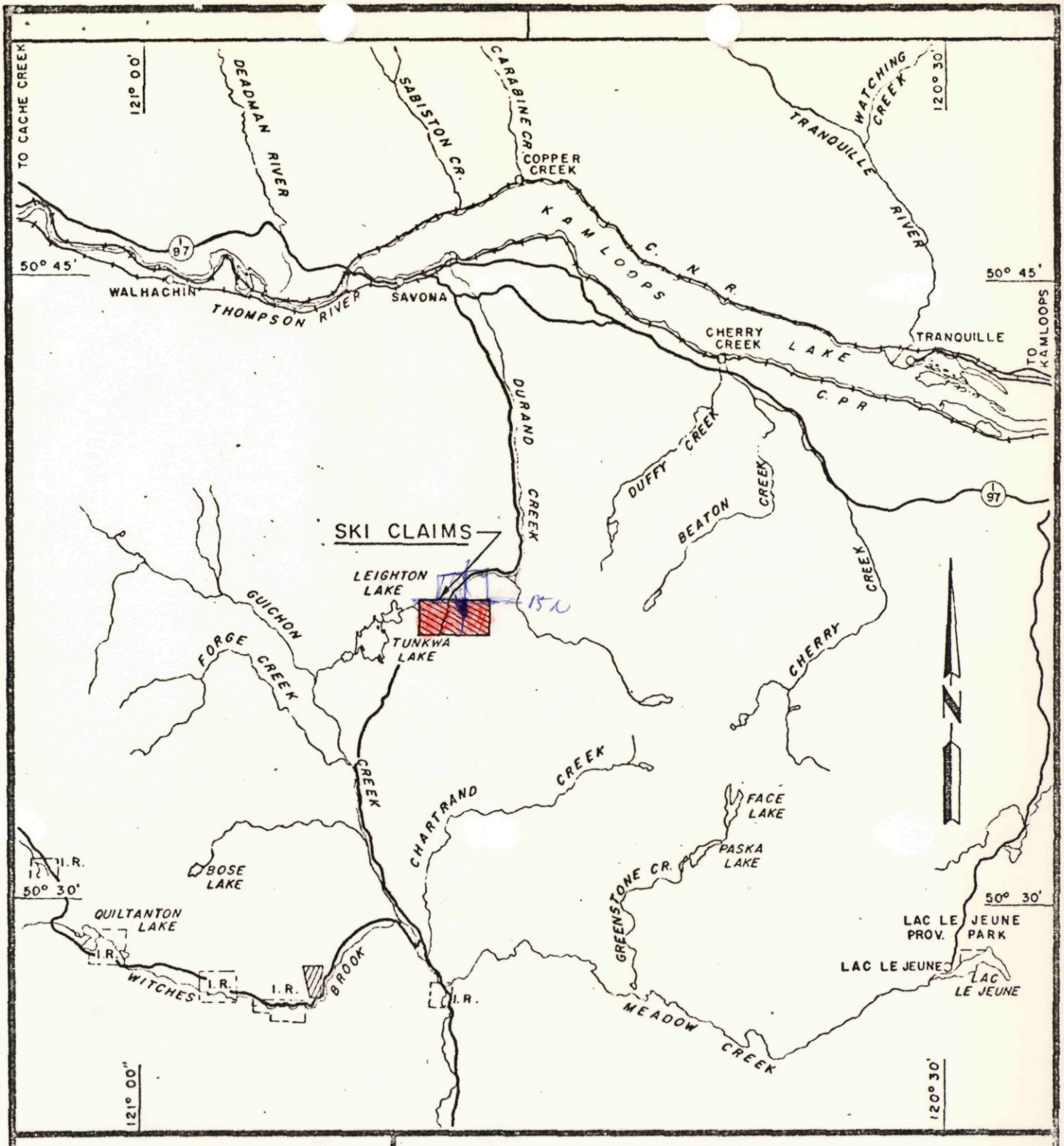
Figure 11 shows the chargeability results of the multiple spacing profiles on this section. Spacings of 50, 100 and 200 ft. were used. The progressive step-out of the peak values to the south with the increase in electrode spacing indicates the effect of the relatively flat dip to the south of the mineralization. The sub-outcrop of the mineralization is near station 26N, at a depth of less than 25 ft. As hole K3B, only 100 ft. away, intersected almost 60 ft. of overburden one must conclude that the bedrock surface is rather irregular in this area. The peak chargeability of 24 milliseconds would suggest a metallic conductor content of the order of 6 to 12 per cent, by volume, in this area.

It is the writer's hope that he has not given the impression that every induced polarization anomaly in Ireland inevitably defines an orebody, or that every exploration venture there is crowned with success. Aside from effects due to the many man-made conductors, such as grounded power lines, rabbit fences and buried pipe lines, there are certain carbonaceous sediments, in particular the Calp limestone, which overlies the ore-bearing dolomitic limestone in some places, which yield high polarization responses. Fortunately, the areal distribution of the latter is usually broad enough to suggest a formational origin. Also, fortunately, the Calp is, stratigraphically, sufficiently well separated from the ore-bearing limestones so that the effect from these two horizons may be resolved. With the geological and geochemical information available, one can usually determine whether a particular induced polarization indication warrants investigation by drilling. Despite its limitations, the pulse-type induced polarization method has well demonstrated its application to a broad range of base metal exploration problems in Ireland.

Acknowledgments

The writer wishes to express his thanks to Consolidated Mogul Mines, Ltd., and Dr. W. W. Weber, to Gortdrum Mines, Ltd. and Dr. D. R. Derry, and to Rio Tinto-Zinc Corp. Ltd. and Mr. Jocelyn Pereira, for their kind permission to present the geophysical and other details relating to their respective mineral discoveries. In addition, the writer wishes to acknowledge the able assistance of the staff of Canadian Aero Mineral Surveys, Ltd., with which our company, Harold O. Seigel & Associates Ltd., has acted on a co-operative basis in Ireland.

(*Reprinted from The Canadian Mining and Metallurgical Bulletin, November*, 1965)
Printed in Canada



BRITISH COLUMBIA

NEWMINE DEVELOPMENT LIMITED

LOCATION MAP

SKI CLAIMS

TUNKWA LAKE AREA, BRITISH COLUMBIA

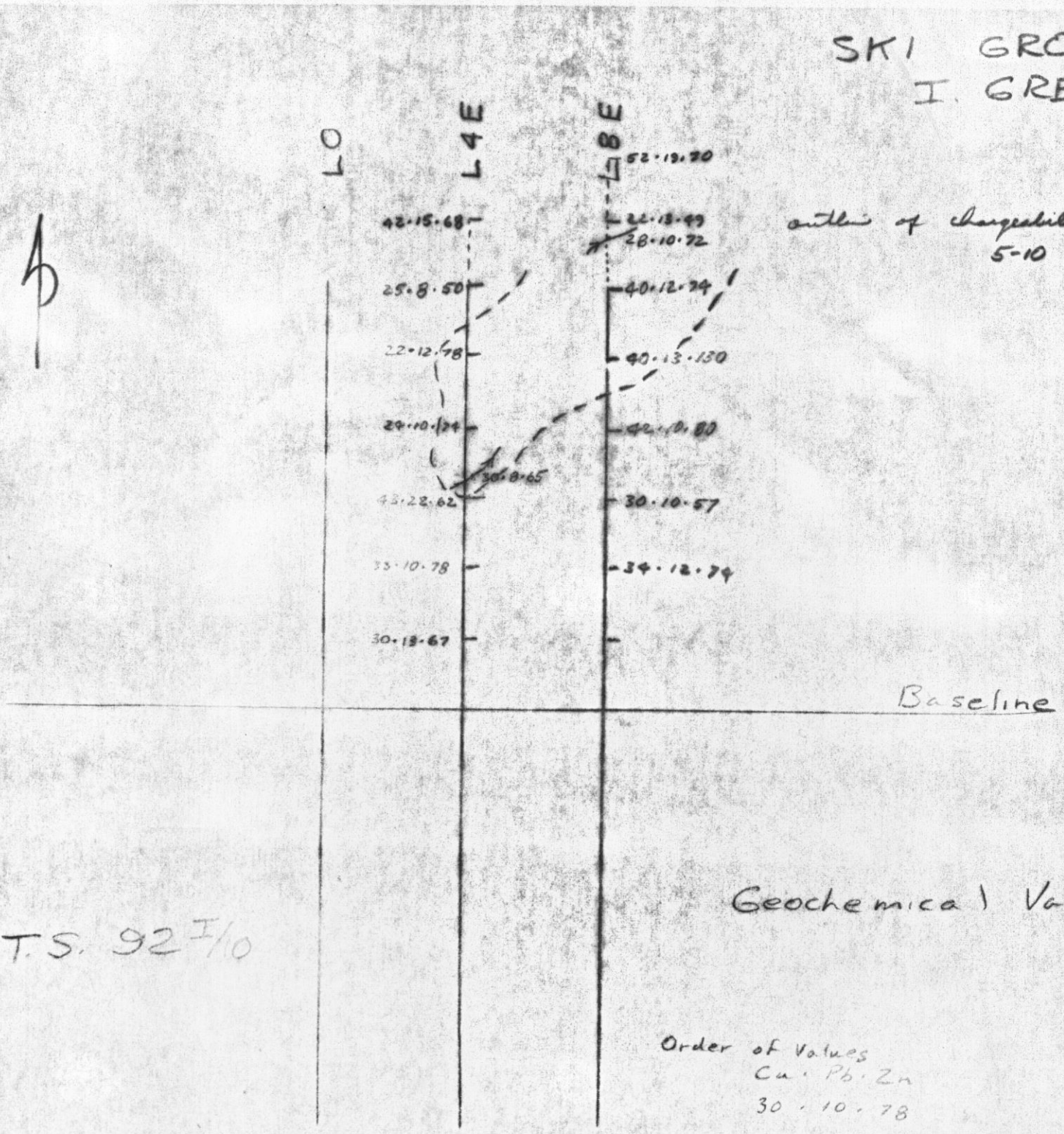
4 0 4 8

SCALE IN MILES

SURVEY BY SEIGEL ASSOCIATES LIMITED MAY, 1969

PLATE 1

SKI GROUP
I. GREG.

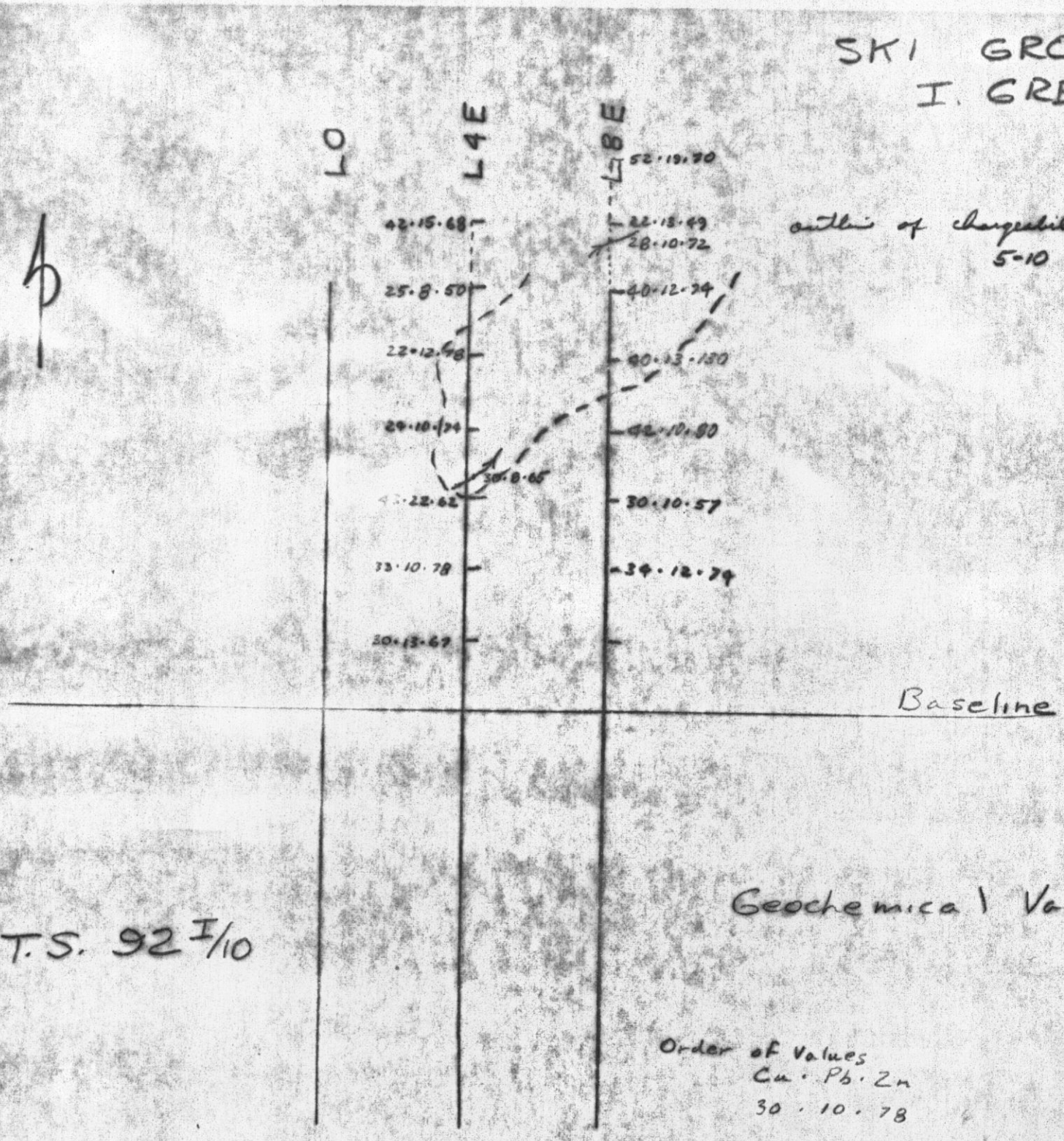


Geochemical Values

N.T.S. 92 I/0

Order of Values
Cu · Pb · Zn
30 · 10 · 78

SKI GROUP
I. GREG.



Geochemical Values

I.T.S. 92 I/10

Order of Values
Cu · Pb · Zn
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CANADA
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• CHEMISTS • GEOCHEMISTS • ANALYSTS • ASSAYERS

CERTIFICATE OF ANALYSIS

NO. 8147

TO: Atlas Explorations Ltd.,
330 - 355 Burrard St.,
Vancouver, B. C.

INVOICE NO. 2871

DATE RECEIVED May 26/70

DATE ANALYSED May 28/70

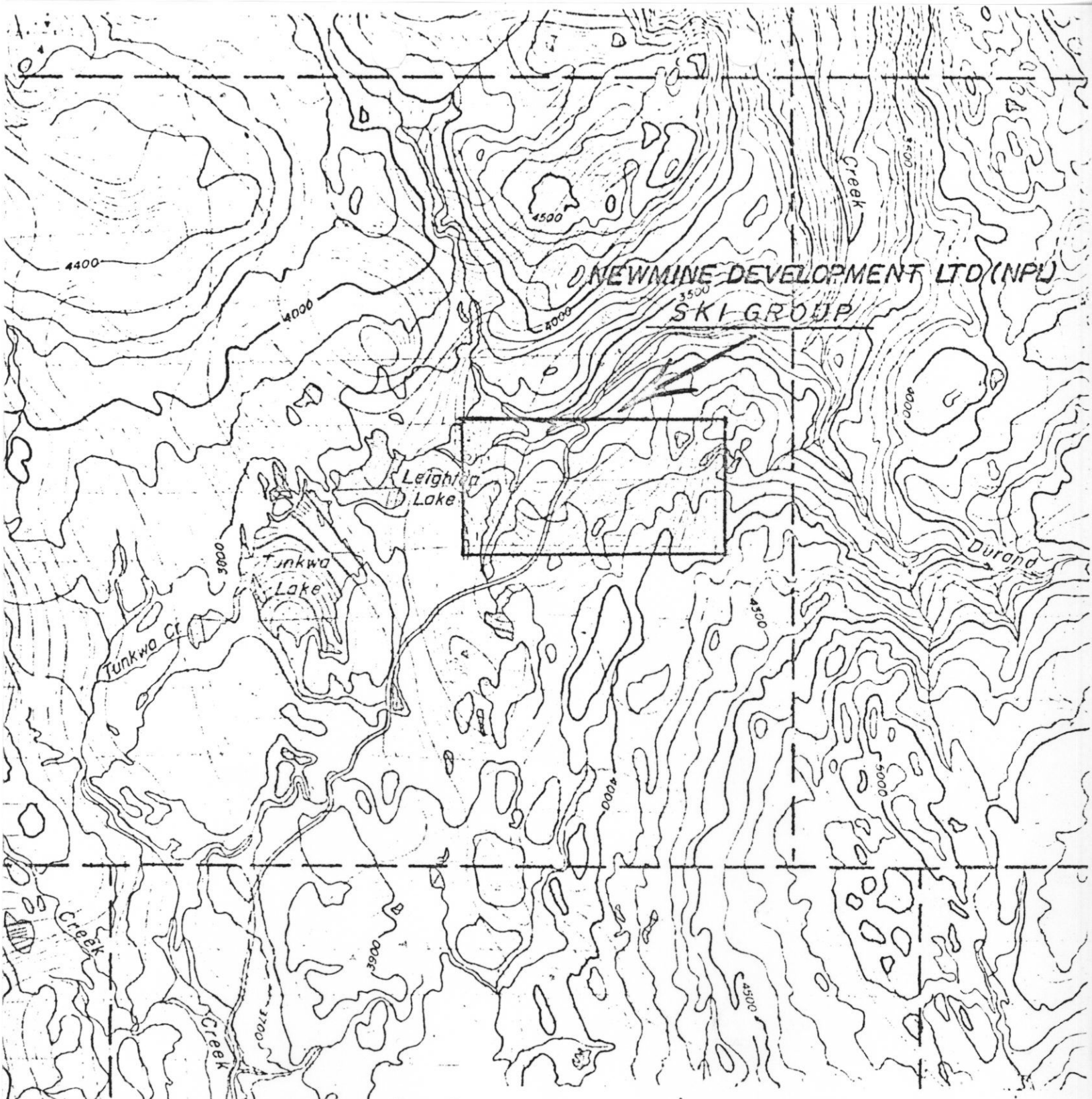
ATTN:

SAMPLE NO.:	PPM Copper	PPM Lead	PPM Zinc	PPM Molybdenum
AD 1	74	17	62	0
2	60	15	57	0
AD 3 Rock	148	19	70	0
SKI 4E 2N	30	13	67	0
4	33	10	78	0
6	43	22	62	0
6.5 Silt	30	8	59	0
8	24	10	74	0
10	22	12	78	0
12 Silt	25	8	50	0
SKI 4E 14N	42	15	78	0
SKI 8E 4N	34	12	74	0
6	30	10	57	0
8	42	10	80	0
10	40	13	130	0
12	40	12	74	0
13.50	28	10	72	0
14	22	13	49	0
SKI 8E 16N	52	19	70	0

"0" Molybdenum= <1 PPM

SKI-GROUP IVAN GREG

Certified by



MAP 5217G

CHERRY CREEK

BRITISH COLUMBIA

Scale: One Inch to One Mile = $\frac{1}{63,360}$

Miles

1 ½ 0 1 2 3

N

SAVONA 10 Miles

WAY 93	WAY 91	WAY 83	WAY 87	WAY 85	WAY 83
SKI 6 75894	SKI 4 75892	SKI 2 75890	SKI 7 75895	SKI 9 75897	SKI 11 75899
SKI 5 75893	SKI 3 75891	SKI 1 75889	SKI 8 75896	SKI 10 75898	SKI 12 75900

Leighton Lake

PROPOSED GRID SYSTEM 200' SPACING

STAK

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
E.P. Sheppard

NEWMINE DEVELOPMENT LTD (NPL)

CLAIM PLAN

SKI 1-12

LEIGHTON LAKE
KAMLOOPS MINING DIVISION BC
SCALE: 1"=1000'

E P SHEPPARD & ASSOCIATES LTD

May 1969