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REPORT ON INDUCED POLARIZATION SURVEY ON SOME SHUSWAP AND G.N. CLAIMS SEYMOUR ARM AREA, BRITISH COLUMBIA ON BEHALF OF GREAT NORTHERN PETROLEUMS AND MINES LTD.

by

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

October 24, 1968

CLAIMS:

Name	Record No
SHUSWAP 10 to 20	64266 - 64275
G.N. 15 and 17	60714 & 607[illegible]

LOCATION:

Sixteen miles northeast of Seymour Arm, B.C.
Kamloops Mining Division
118° 51° SW

DATES:

September 13 to October 20, 1968

TABLE OF CONTENTS

SUMMARY

An induced polarization survey on this property has indicated one extensive and two more localized zones of high chargeabilities. The largest zone is located just north of a narrow, well-defined magnetic high and the smaller zones also occur near magnetic features. The present observed induced polarization responses may be due to concentrations of from 2% to 3% by volume of disseminated metallically conducting material or possibly higher concentrations of interconnected metallic conductors.

A good deal of geological and geochemical information has been gathered on this property over the last fifty years. This information should be closely correlated with the present geophysical data to attempt to determine the causes of the present high chargeability zones. If such a study reveals that the present anomalies may be due to concentrations of commercial type sulphide mineralization, diamond drilling may be proposed on the basis of the present geophysical results.

REPORT ON
INDUCED POLARIZATION SURVEY
ON SOME SHUSWAP AND G.N. CLAIMS
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GREAT NORTHERN PETROLEUMS AND MINES LTD.

INTRODUCTION

During the period from September 13 to October 20, 1968 a camp was organized, lines were cut and a geophysical field party under the direction of Mr. Robert Michler and Mr. Armidas Lefebvre executed induced polarization and magnetic surveying on some Shuswap and G.N. claims in the Seymour Arm area, British Columbia, on behalf of Great Northern Mines and Petroleums Ltd.

The property lies near Blais Creek, about 16 miles northeast of Seymour Arm and 42 miles northwest of Revelstoke. Access was by helicopter based in Revelstoke. The terrain is very rugged and elevations range from about 2500' to 4500' above sea level. Heavy timber, steep hillsides and bad weather inhibited the work greatly. The mineral claims covered, in whole or part, by this survey are listed on the title page of this report and are shown on Plate 3 on the scale of 1" = 200'. These claims are held by Great Northern Mines and Petroleums Ltd.

Seigel Mk VI time domain (pulse-type) induced polarization equipment was 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 galena, chalcopyrite, pyrite and other metallic sulphide minerals as well as carbonaceous material, magnetite, and other minerals not always distinguishable from sulphides by their electrical characteristics alone.

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.

On the present property a base line was laid out oriented N 39° W and survey lines were cut perpendicular thereto at 400' intervals. The three electrode array, with electrode spacings of 200', was employed for reconnaissance purposes. Station intervals were 200'. In addition, five sections of profile were covered using the three electrode array with 100' electrode spacings for further detail.

The magnetic survey was executed using a Sharpe MF-1 fluxgate magnetometer which measures the vertical component of the earth's magnetic field to an accuracy of ±5 gammas. The magnetic values were tied to established base stations and corrections were made for diurnal drift. The normal station interval was 100'.

GEOLOGY

Descriptions of the geology of the area including and surrounding the present claims are found in the following publications:

- G.S.C. Paper 64-32 "Big Bend Map Area, British Columbia", by J. O. Wheeler, 1965.

- Reports of the B. C. Minister of Mines for 1922, 1926, 1927 and 1928.

- Report on a magnetometer survey of the Shuswap Group by B. I. Nesbitt dated April 18, 1967.

- A Geological Report by A. R. Allen dated May 21, 1968.

The general area is underlain by metamorphic rocks of the Shuswap Complex. These rocks include schist, paragneiss, quartzite, marble, scarn zones and other metamorphic rocks. Sulphide mineralization with magnetite occurs in limestone beds that are interbedded with schists and gneisses. These beds trend northwesterly conforming with the trend of the Shuswap Series.

Several veins containing good grade mineralization are known to occur in the area, however such veins have been found to be too narrow to be economic at existing metal prices and costs. The present survey was undertaken in an attempt to find wider zones which might be mined by modern large scale mining methods.

PRESENTATION OF RESULTS

Plate 1, on the scale of 1" = 200', is a contour plan of the observed chargeability values. The contour interval is 5.0 milliseconds. The values shown are for the three electrode array and 200' electrode spacings.

Plate 2, also on the scale of 1" = 200', shows the geophysical results in profile form. Two parameters are plotted separately; chargeability (the induced polarization characteristic of the rock) and resistivity. The vertical scales for these profiles are 1" = 10.0 milliseconds for chargeability and 2" = 1 logarithmic cycle with the base line taken as 1000 ohm-metres for resistivity. Different symbols explained in the legend are used to distinguish between readings taken using the 200' and 100' electrode spacings. In order to adequately accommodate the profiles, the interline spacing is not shown to scale.

Plate 3 is a compilation of magnetic observations taken during the present survey with work done under the supervision of B. I. Nesbitt in 1966. The parts of the grid where actual magnetic values are shown have been covered by the present survey while contours for the rest of the area have been taken from Nesbitt's map. The plan scale is 1" = 200' and the contour interval is 100 gammas.

DISCUSSION OF RESULTS

The chargeability contour plan on Plate 1 reveals that the chargeabilities over much of the grid range from a low of 4.3 to 10.0 milliseconds. This range is considered a normal non-metallic background range for most rock types. Chargeabilities in excess of 15.0 milliseconds are considered sufficiently above background to warrant further investigation.

Three generalized areas exhibiting chargeabilities in excess of 15.0 milliseconds have been denoted Zone A, Zone B and Zone C on Plate 1. The area inside the 15.0 millisecond contour has been shaded to accentuate these zones.

Zone A, which occurs near the base line, trends northwesterly for a distance of some 3,000' and is as yet not delimited on the southeast end where a peak chargeability of 33.3 milliseconds occurs at station 3 N on Line 4W. Some 100' electrode spacing observations have been taken across the zone on Line 8W. Interpretation of these profiles reveals that the polarizable material may occur within a narrow, steeply dipping body approaching to within at least 50' and perhaps closer to the ground surface near the base line. In addition, a second polarizable source at about 3 W is indicated. In places along strike the zone appears to be somewhat broader than on

Line 8W; however, additional detail profiles would be necessary to provide quantitative determinations of the possible distribution of conducting material. Since the response of a body containing metallically conducting mineralization depends, among other parameters, upon the relative geometry of the body and the measuring electrodes, a contour map is not the best guide to the size or location of a polarizable body. In the present case the mineralized body is probably somewhat narrower than the area encompassed by the 15.0 millisecond contour.

This present zone may contain an average of about 3% by volume of disseminated polarizable material. As well, higher concentrations likely occur at the south end of the zone. A well-defined magnetic anomaly indicative of a near surface, narrow dike-like body lies just south of and parallel to Zone A.

Zone B covers a small area with a peak chargeability of 18.3 milliseconds occurring on the south end of Line 24W. As well, an isolated high value at 31 S on Line 20W is noted. No detail observations have been taken on these indications so that precise interpretations are difficult; however, the zone possibly consists of a small body containing up to 3% by volume of metallically conducting material. One lens of magnetic material lies just north of the zone.

Zone C occurs on the south ends of Lines 0 through 8W and consists of three small areas exhibiting chargeabilities in excess of 15.0 milliseconds. The peak chargeabilities indicate a possible metallic content of about 3% by volume and detail observations indicate that near 14 S on Line 8W the source comes to within at least 50' of the ground surface. The western part of the zone is seen to occur near a magnetic distortion indicative of a narrow lens of magnetic material.

Most of the resistivity values are seen to lie in the 1000 to 5000 ohm-metre range, however, resistivity values of less than 1000 ohm-metres are seen over much of the lengths of Lines 36W and 40W. The correspondence of these low resistivities with low chargeabilities would indicate that different rock types or overburden may occur in this area. These observations may also be explained by a thickening of the overburden as may indeed occur in the valley of Blais Creek.

CONCLUSIONS AND RECOMMENDATIONS

The results of the present survey indicate that three areas of the property are underlain by volumes of rock containing metallically conducting mineralization. Most of the areas of high chargeability occur near magnetic anomalies, possibly indicative of the types of veins found to contain magnetite along with copper-lead-zinc mineralization. From the magnetic data the lenses are interpreted to be very narrow and hence have no induced polarization expression for the relatively large 200' electrode separations used for the survey. Since it is felt that the economic possibilities on the property may lie in zones of mineralization broader than the narrow magnetic lenses, the present induced polarization anomalies may be of potential importance. On the basis of the present geophysical data alone it is not possible to determine whether the indicated metallically conducting material may contain sulphides or whether it may consist of other conducting minerals such as graphite, conducting carbonaceous material, sericite etc.

A good deal of geological and geochemical investigation has been carried out on this property over the years and the writer has not had the opportunity to study this information in great detail. It is recommended that a compilation be made of all the available data to attempt to determine the possible sources of the present high chargeability zones.

If such a study reveals that one or more of the areas outlined in this report may possibly be underlain by commercial type mineralization, then diamond drilling or trenching would likely be warranted and could be based upon the present geophysical data.

Respectfully submitted,

SEIGEL ASSOCIATES LIMITED

Jon G. Baird

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

Vancouver, B.C.
October 24, 1968.

Richard O Crosby, P.Eng.

DOMINION OF CANADA:
PROVINCE OF BRITISH COLUMBIA. } In the Matter of a geophysical survey on behalf of Great Northern Petroleums and Mines Ltd.
TO WIT:

I, E. M. Flett for Seigel Associates Limited

of 750 - 890 West Pender Street, Vancouver

in the Province of British Columbia, do solemnly declare that an induced polarization survey has been executed on some SHUSWAP and G.N. claims in the Seymour Arm area, British Columbia between September 13 to October 20, 1968. The following expenses were incurred:

(1)	Wages			
	A. Lefebvre	35 days @ $35/day		1,330.00
	M. Bisang	38 days		
	R. McDougall	29 days		
	G. Bellefluer	23 days		
	D. Reid	15 days		
		105 days @ $27.50/day		2,887.50
(2)	Transportation & Shipping			231.39
(3)	Food & Living Expenses			855.89
(4)	Camp Facilities			2,850.00
(5)	Consulting Fees			
	18 days @ $155.28/day		$2,795.04	
	18 days @ $ 77.64/day		1,397.52	4,192.56
				$12,347.34

And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of the "Canada Evidence Act."

Declared before me at the City of Vancouver, in the Province of British Columbia, this 28th day of October, 1968, A.D.

E M Flett

[signature]

~~A Commissioner for taking Affidavits for British Columbia~~ or
A Notary Public in and for the Province of British Columbia.

★0

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.

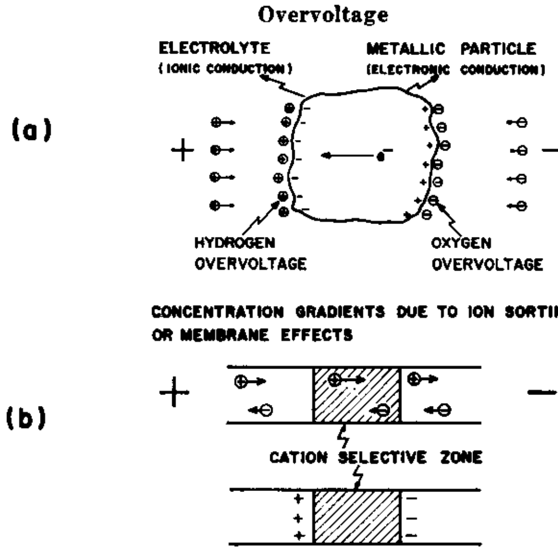

Figure 1.—Induced Polarization Agents.

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.

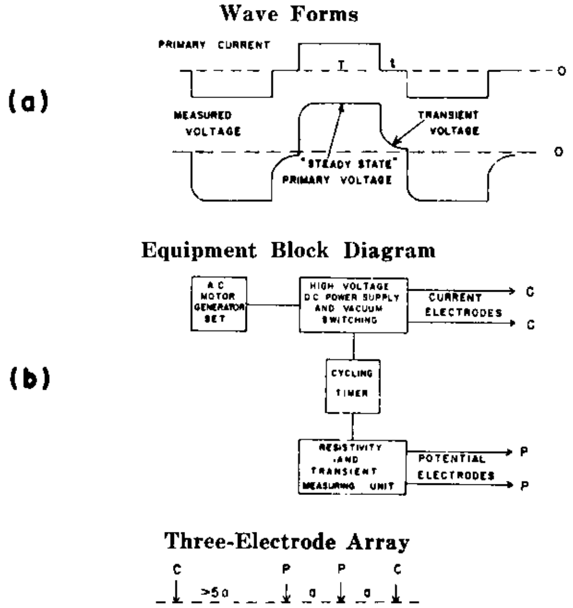

Figure 2.—The Pulse System.

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 size 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.

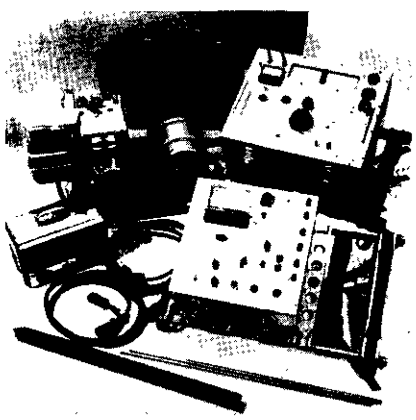

Figure 3.—(above)—The Seigel Mk V Induced Polarization Unit.

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

Case Histories

In presenting the three case histories 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.

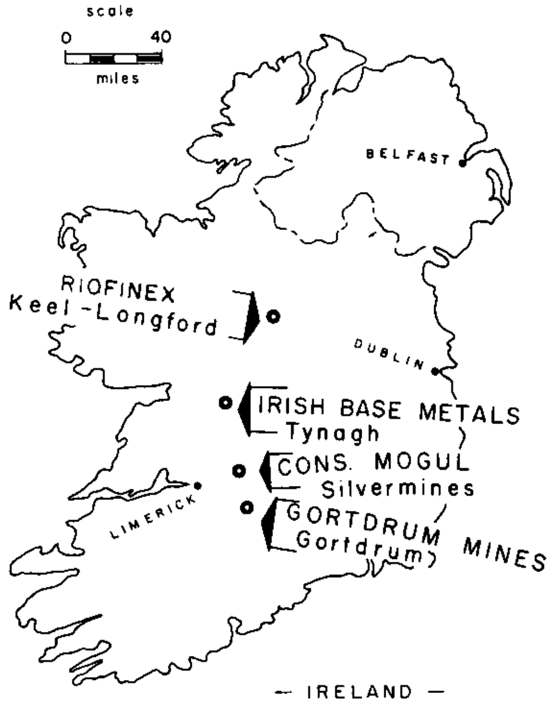

Figure 5.—Location Plan of Recent Mineral Discoveries in Ireland.

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.

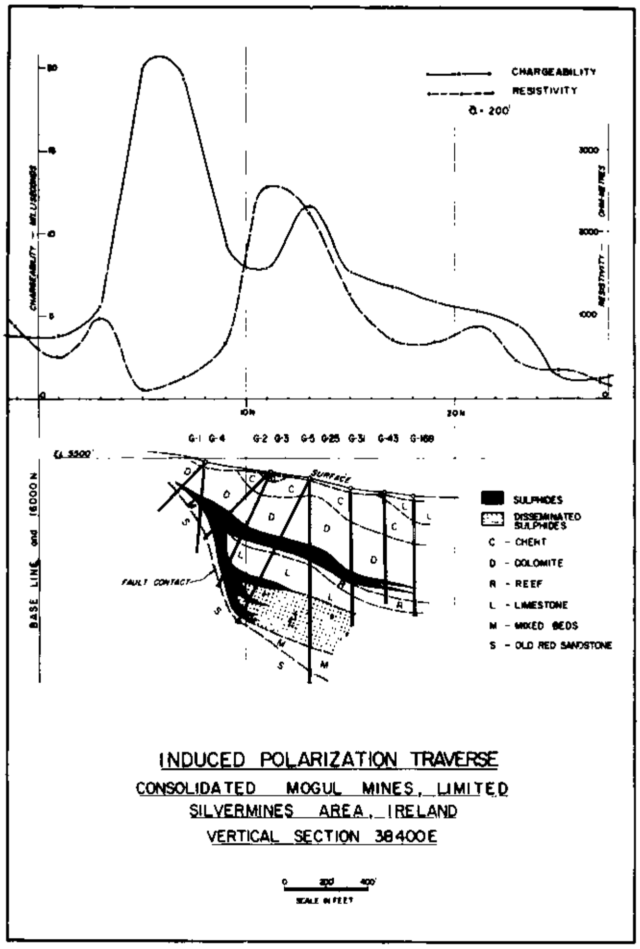

Figure 6.—Typical Discovery Traverse, Silvermines Deposit.

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.

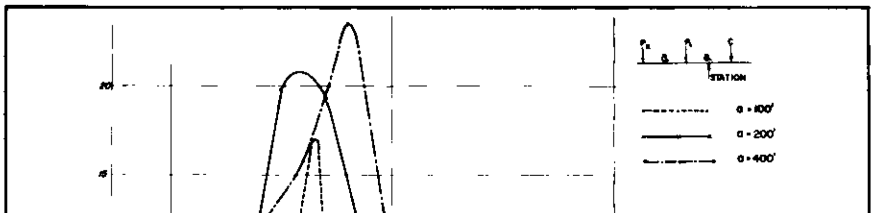

Figure 7.—Multiple Spacing Results, Silvermines Deposit.

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

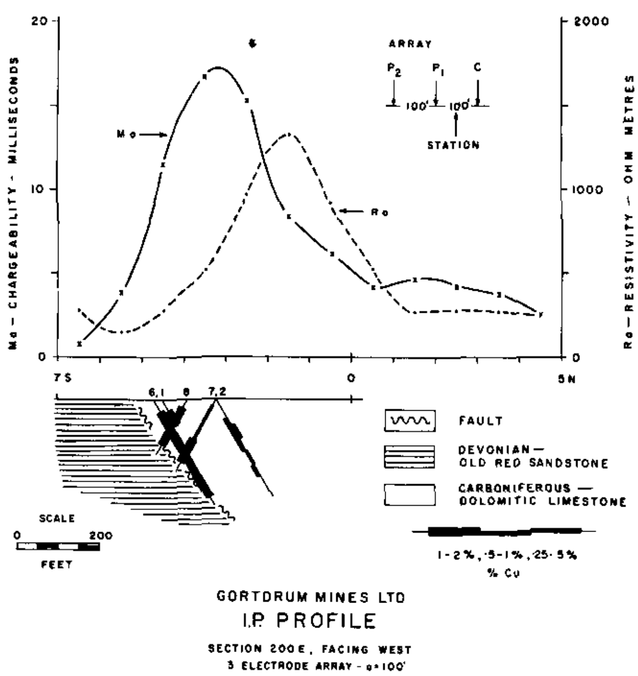

Figure 8.—Typical Discovery Traverse, Gortdrum Deposit.

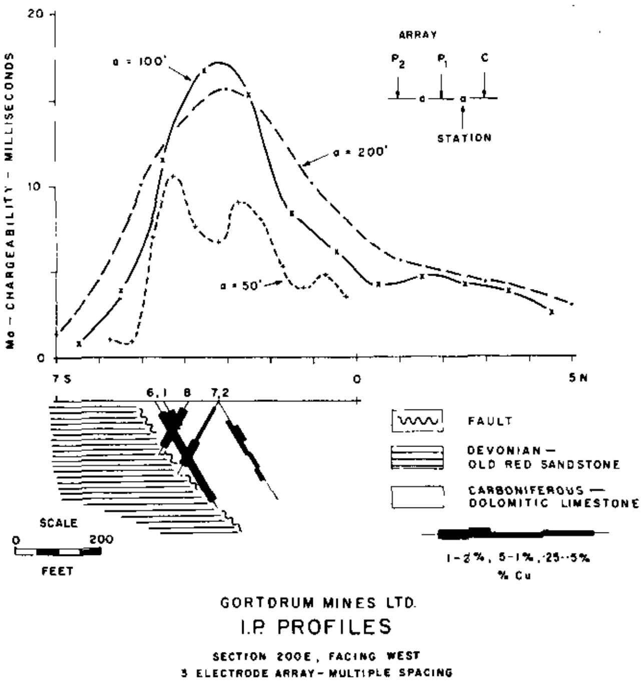

Figure 9.—Multiple Spacing Results, Gortdrum Deposit.

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.

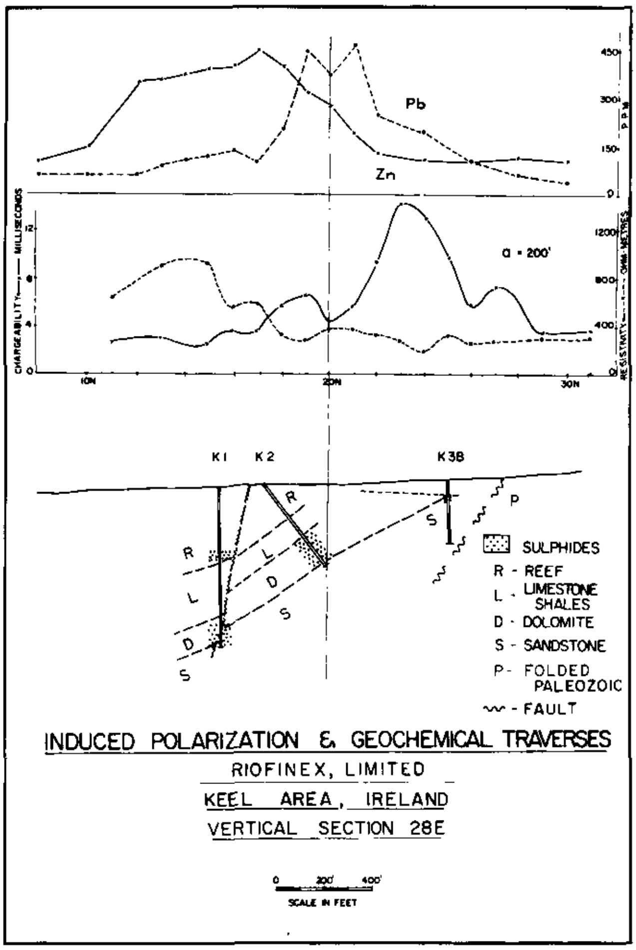

Figure 10.—Typical Discovery Traverse, Keel Deposit.

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 stepout 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.

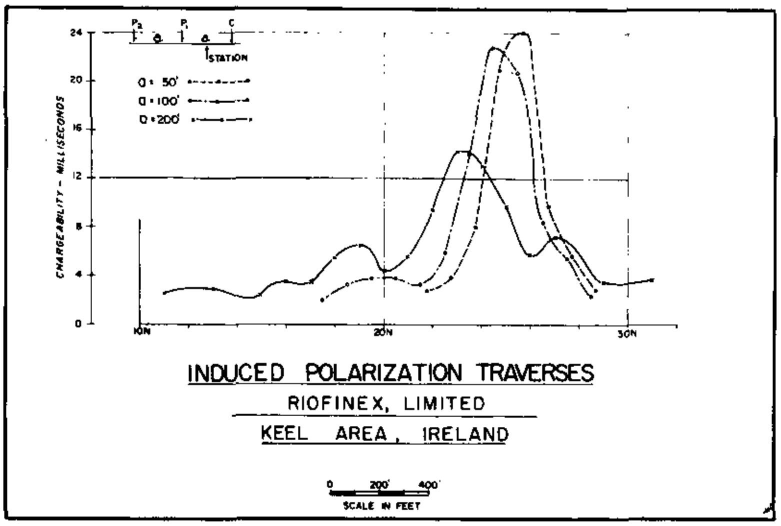

Figure 11.—Multiple Spacing Results, Keel Deposit.

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)
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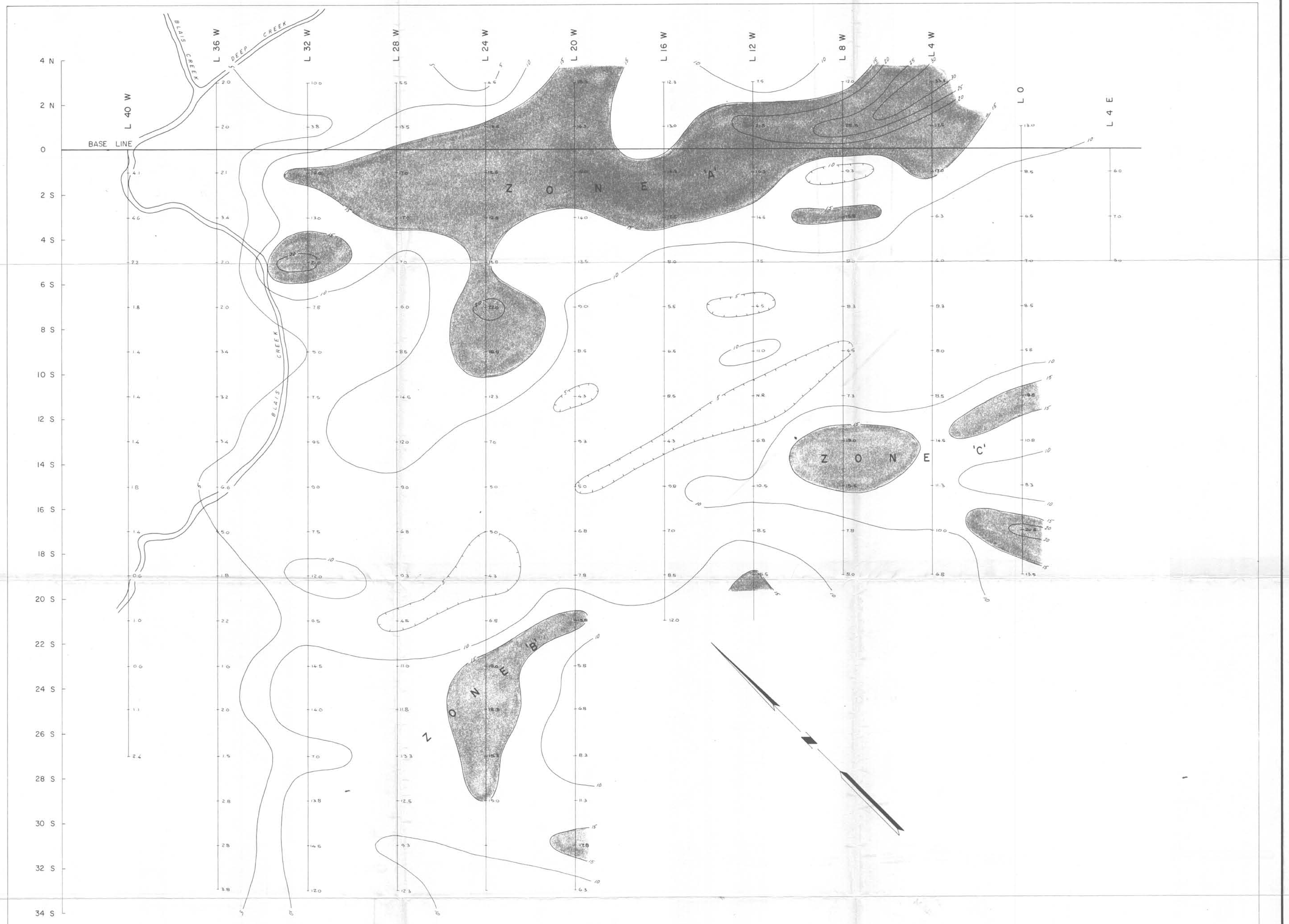


LEGEND

LINE TRACE WITH CHARGEABILITY VALUES IN MILLISECONDS

5, 10, 15, 20, 25 AND 30 MILLISECONDS CONTOURS

NOTES: SEIGEL MK VI INDUCED POLARIZATION DATA
THREE ELECTRODE ARRAY
ELECTRODE SPACING a = 200'

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 1768 MAP 1

PLATE I

GREAT NORTHERN PETROLEUMS AND MINES LTD.
SEYMOUR ARM AREA, BRITISH COLUMBIA
INDUCED POLARIZATION SURVEY
CHARGEABILITY CONTOUR PLAN
SCALE: 1" = 200'

TO ACCOMPANY A GEOPHYSICAL REPORT
BY J.G. BAIRD DATED OCTOBER 24, 1968

1768

SURVEY BY SEIGEL ASSOCIATES LIMITED
SEPTEMBER - OCTOBER, 1968

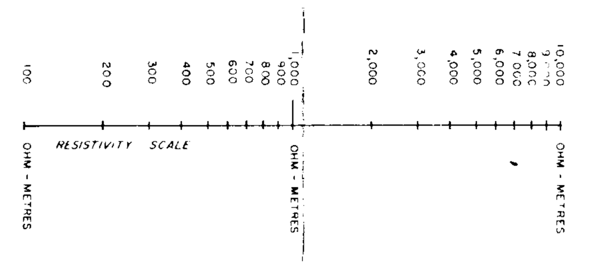
REGISTERED PROFESSIONAL ENGINEER J. G. BAIRD PROVINCE OF ONTARIO

LEGEND

CHARGEABILITY SCALE : 1" = 10 MILLISECONDS
ELECTRODE SPACING a = 200'
a = 100'

RESISTIVITY SCALE : 2" = 1 LOGARITHMIC CYCLE
ELECTRODE SPACING a = 200'
a = 100'

NOTES : SEIGEL MK VI INDUCED POLARIZATION DATA
THREE ELECTRODE ARRAY
INTERLINE SPACING NOT TO SCALE



TO ACCOMPANY A GEOPHYSICAL REPORT
BY J.G. BAIRD DATED OCTOBER 24, 1968

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 1768 MAP 2

PLATE 2

GREAT NORTHERN PETROLEUMS AND MINES LTD.

SEYMOUR ARM AREA, BRITISH COLUMBIA

INDUCED POLARIZATION SURVEY

CHARGEABILITY AND RESISTIVITY PROFILES

SCALE: 1" = 200'

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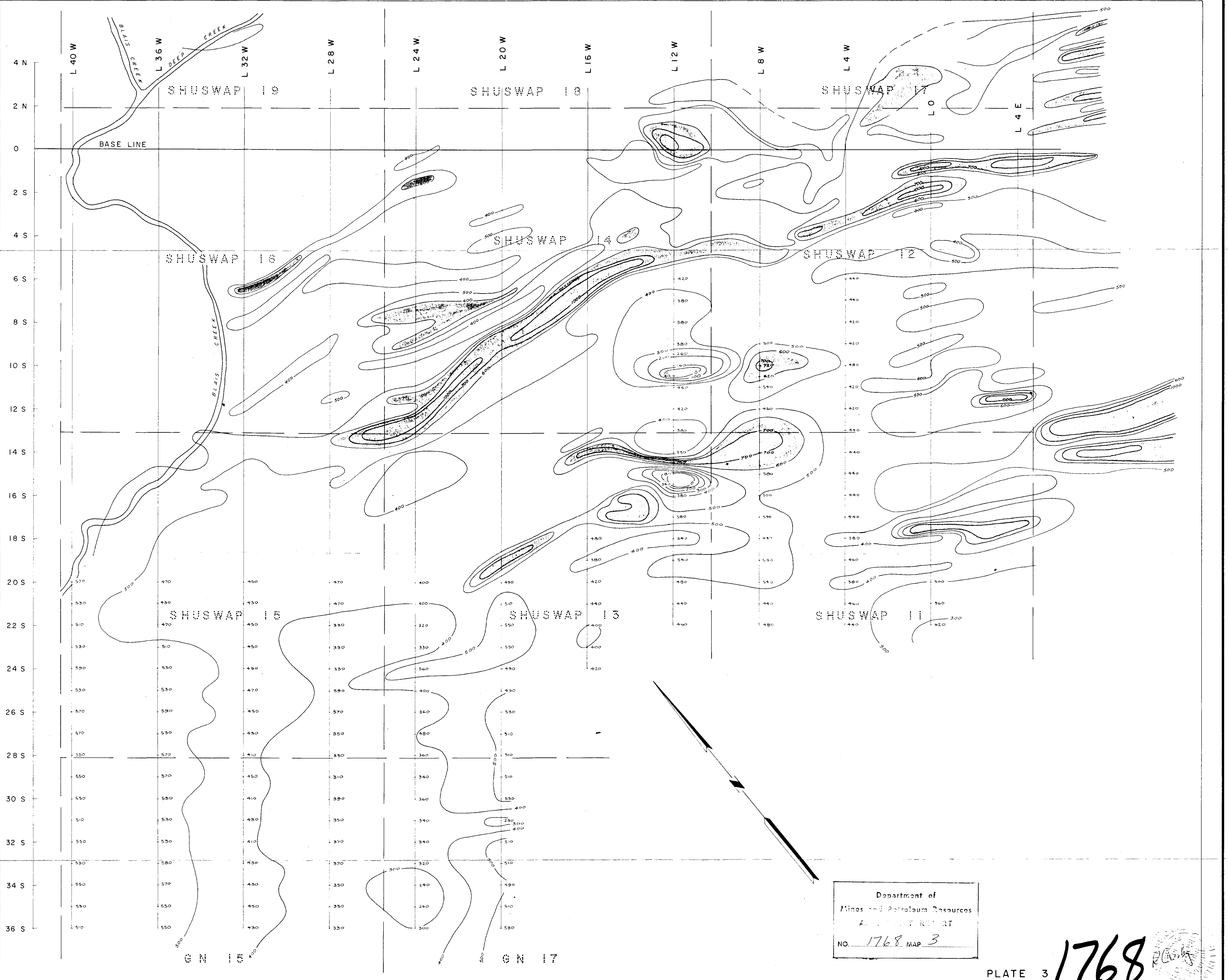
2



LEGEND:

LINE TRACE WITH MAGNETIC VALUE IN GAMMAS

ISO MAGNETIC CONTOURS, 100 GAMMA CONTOUR INTERVAL

NOTES: IN AREAS WHERE MAGNETIC VALUES ARE SHOWN SURVEY AND CONTOURS ARE BY SEIGEL ASSOCIATES. THE REMAINING INFORMATION IS TAKEN FROM A MAP ACCOMPANYING A REPORT BY B.I. NESBITT DATED SEPTEMBER 1966.

TO ACCOMPANY A GEOPHYSICAL REPORT BY J G BAIRD DATED OCTOBER 24, 1968

Department of Mines and Petroleum Resources
A... REPORT
NO. 1768 MAP 3

PLATE 3 1768

GREAT NORTHERN PETROLEUMS AND MINES LTD.

SEYMOUR ARM AREA, BRITISH COLUMBIA

MAGNETOMETER SURVEY

SCALE: 1" = 200'

SURVEY BY SEIGEL ASSOCIATES LIMITED
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3