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REPORT ON GROUND AND AIRBORNE GEOPHYSICAL SURVEYS ON BEHALF OF LEWES RIVER MINES LTD.

by
Jon G. Baird, B.Sc., P.Eng.
July 24, 1968

CLAIMS:

	Name	Record Number
Grid One:	BC 3	Y23024
	BC 5 to 8	Y23030 to 33
	BC 9 to 14	Y23034 to 39
	BC 16, 45, 47, 49, 50, 51	Y23041, 66, 68, 70, Y23071, 72
	PUTA 1F	
	HULK 7F	
	HULK 8F	
	HULK 9 to 13	Y24871 to 75
Grid Two:	AC 1, 2	Y21921, 2
	CC 1, 3, 5, 7	Y23153, 4, 5, 6
	CC 2, 4, 6	Y23161, 2, 3
	CC 31, 33, 35	Y23165, 6, 7
	CC 32, 34, 36	Y23199, 200, 201
	CC 91 to 94	Y23157 to 60

LOCATION:
Whitehorse area, Yukon
Approximately 60° 30' north latitude and 135° west longitude

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(in text)

Plate 5 - Resistivity Depth Determination

SUMMARY

The present report is a compilation of airborne magnetic, ground magnetic, induced polarization and resistivity data taken on the Lewes River Mines property in the Whitehorse area.

The induced polarization surveys have revealed one area of above normal chargeabilities on which an exploratory diamond drill hole 500' in length is herein recommended.

Several areas for further exploration by ground magnetometer and induced polarization surveys are suggested.

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REPORT ON GROUND AND AIRBORNE GEOPHYSICAL SURVEYS ON BEHALF OF LEWES RIVER MINES LTD.

INTRODUCTION

During the period April to July, 1968, airborne magnetic, ground magnetic and induced polarization-resistivity surveys were carried out in the Whitehorse area on behalf of Lewes River Mines Ltd. The programme was under the overall direction of Archer, Cathro and Associates, Ltd. Seigel Associates Limited executed the detailed airborne magnetic and induced polarization-resistivity surveys while the ground magnetic surveys were carried out by Eagle Geophysics Limited.

The survey area is a belt of claims approximately 2 miles wide and 17 miles long trending northwest. The nearest point on the edge of the area is about one mile east of the town of Whitehorse. The Lewes (Yukon) River and the Alaska Highway run west of and parallel to the length of the claim group except at the south end where they turn eastwards across the property. Access to most of the property is by foot from the Alaska Highway.

The terrain is hilly and wooded and dotted with lakes. Elevations range from approximately 2100' above sea level to about 2500'. Rock outcrops are scarce.

In April and May, 1968, Seigel Associates executed a low level airborne magnetometer survey designed primarily to locate a favourable

contact between igneous and sedimentary rocks. The results of this survey have been discussed by R. O. Crosby, P.Eng. in a report dated July 8, 1968. On the basis of these airborne magnetics, two areas were chosen for ground magnetic and induced polarization-resistivity surveys.

The latter surveys were executed during the period June 19 to July 15, 1968, under the direction of Mr. Ron Sheldrake of the staff of Seigel Associates and are the basis of this report.

Seigel MkVI 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 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 chalcopyrite, bornite and other metallic sulphide minerals as well as magnetite, graphite and other minerals not always distinguishable from sulphides.

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.

Two grid systems, labeled Grid One and Grid Two, were cut with grid lines at 400' centres oriented east-west and baselines oriented north-south. In Grid One, 14.7 line miles, and in Grid Two, 13.6 line miles, were chosen for induced polarization coverage. The three electrode array, with electrode separations of 300' and station intervals of 200', was employed for reconnaissance purposes. Certain areas of interest revealed by the reconnaissance work were covered in detail employing the three array and electrode spacings of 100', 200' and 400'.

In one place on Grid Two a sounding using the Wenner expanding electrode array was made to attempt to determine the depth and characteristics of the overburden.

The claims covered in whole or part by the ground surveys are held by Lewes River Mines Ltd. They are listed on the title page of this report and shown on Plates 3 and 4.

GEOLOGY

The Lewes River Mines claims cover an area about 2 miles wide and 17 miles long trending in a northwesterly direction parallel to and about 4 miles east of the geologic horizon known as the Whitehorse Copper Belt. This horizon is approximately delimited by the boundary of the claims held by New Imperial Mines Ltd. as shown on Plate 1.

Sedimentary rocks of the Triassic Lewes River Group (largely limestone, dolomite and quartzite) have been intruded by the Cretaceous Coastal Intrusive batholith consisting of granite, granodiorite and dioritic rocks. In the Copper Belt, where the sedimentary and intrusive rocks come into contact, the sedimentary rocks have often been metamorphosed to scarns which in places contain copper mineralization.

Two types of mineralized scarns are distinguishable:

1 - Bornite and chalcopyrite associated with magnetite

2 - Bornite and chalcopyrite associated with silicate gangue minerals and low magnetite content.

In addition, "Porphyry type" deposits with bornite and chalcopyrite disseminated in the intrusive rocks may occur.

The contact zones between limestone and granite are the most favourable locations for the formation of the scarn deposits although scarn mineralization often extends into the sedimentary rocks as much as 500' from such contacts. Roof pendants of limestone, embayments in the granite-limestone contact, and places where faults cross the contact are considered to be the most favourable locations for prospecting.

The best published description of the economic geology of the area is contained in G.S.C. Paper 63-41 "Copper and Iron Resources, Whitehorse Copper Belt, Yukon Territory" by E. D. Kindle, 1964. The report includes Map 49-1962, on a scale of 1" = 1 mile, which is a geological map of the region including and surrounding the present survey area.

G.S.C. Memoir 312 "Whitehorse Map Area, Yukon Territory" by J. O. Wheeler, 1961 and the accompanying map 1093A on the scale of 1" = 4 miles covers the geology of a large region around Whitehorse including the Copper Belt.

The following G.S.C. 1" = 1 mile aeromagnetic maps cover the Lewes River claims and surrounding area: Map 1342G - 'Cap Creek', Map 1341G - 'MacRae', Map 3376G - 'Whitehorse', and Map 3377G - 'Upper Laberge'. These four maps have been compiled into Plate 1 of this report. The surveys were flown with a 1000' nominal terrain clearance and a three quarters of a mile to one mile interline spacing.

PRESENTATION OF RESULTS

Plate 1 shows the results of the reconnaissance (high level) airborne magnetic survey and the disposition of the Lewes River Mines Claims with respect to Whitehorse, the Alaska Highway and other pertinent features.

Plate 2 entitled "Detailed Airborne Magnetometer Survey" is a reduction of the five aeromagnetic maps presented by R. O. Crosby. The original five plates were on the scale of 1" = 1000' while the reduced scale is 1" = $\frac{1}{2}$ mile.

Plates 3 and 4 show the results of the reconnaissance and detailed induced polarization surveys on Grids One and Two respectively. The reconnaissance chargeability and resistivity values are presented in plan contour form on a scale of 1" = 400'. A 2 millisecond contour interval was chosen for the chargeability data while the resistivity data were contoured at a logarithmic contour interval. The 200, 400, 800 and 1600 ohm-metre contours are shown.

The results of the ground magnetometer surveys are shown in simplified form superimposed on the chargeability contour plans while the detail survey data in certain areas are shown in profile form. The vertical scales for these profiles are 1" = 5 milliseconds for chargeability and 1" = 500 ohm-metres for resistivity.

Plate 5 shows the results of a resistivity depth sounding using the Wenner expanding array centred about station 10 E on line 82N, Grid Two.

DISCUSSION OF RESULTS

A. Airborne Surveys

Plates 1 and 2 show the magnetic character of the rocks as mapped

from altitudes of 1000' and 200' respectively. Both plates have been annotated to show interpreted magnetic lineaments which may represent faults. On Plate 2 the interpreted distribution of igneous and sedimentary rocks in the area of the Lewes River claims has been outlined.

An excellent correspondence is seen in the magnetic features displayed by the two maps. Long lineaments show up best on the high level magnetics while short lineaments are best revealed by the detailed survey. The major contact between igneous and sedimentary rocks is seen on Plate 1 and in much greater detail on Plate 2. Small embayments or warps in the contact as indicated on Plate 2 may be very important in the localization of ore bodies.

The igneous-sedimentary contact is, in most places, interpreted as lying close to the 1500 gamma contour on Plate 2, with the igneous rocks underlying the areas of high magnetic intensity. The major contact is seen to trend northwesterly across the map with the igneous rocks lying on its southwest side. Two distinct embayments into the igneous rocks are seen at localities A and B. These areas have been subjected to ground magnetic and induced polarization surveys. A sharp northeasterly trending warp of the main contact into the sedimentary rocks is seen at locality C, coupled with a southwesterly warp of a possible igneous body lying to the northeast. These features may represent a northeasterly trending axis of an upwarp in the basement igneous rocks.

A magnetic low about $2\frac{1}{2}$ miles by $\frac{3}{4}$ miles in plan occurs within the general igneous area at locality D. This area of rocks of low magnetite content may indicate a body of sedimentary rocks lying within the igneous rocks, perhaps as a roof pendant. The steep magnetic gradients in the southwest side of this low and the northeasterly trending

Fault C are features worth noting. A similar area of low magnetic susceptibility is noted at locality E.

Localized igneous bodies, all of which have some expression on the high level magnetics, are indicated at localities F through J.

The high intensity magnetic field distortions near K are characteristic of high susceptibility rocks such as the Miles Canyon Basalts which may occur within the survey area.

B. Ground Surveys

On the basis of the detailed airborne magnetometer survey the localities A and B were selected for ground coverage. The areas covered by induced polarization surveys are shown as 'Survey Grid One' and 'Survey Grid Two' on Plate 2.

a) Survey Grid One

Plate 3 shows the induced polarization, resistivity and simplified magnetic data in this area. The magnetics clearly define the embayment in the contact. The chargeability contour plan reveals that chargeability values vary from about 2.0 to 5.0 milliseconds, a range considered normal non-metallic response for the rock types expected to underlie the grid under conditions of variable overburden depth. Responses in excess of 6.0 milliseconds are considered worthy of further investigation.

An area of anomalous response is centred at about 59 E on line 20N. Profiles 16 N and 20 N have been covered in detail. The chargeability responses on line 16N reveal a broad zone of above normal values extending for about 1200 feet from 52 E to 64 E. The source comes to within 50' of the surface at about 58 E. The profiles on line 20N reveal nearly coincident peaks on all electrode spacings. The depth to the

upper surface of the body may be somewhat deeper than on line 16N and the anomaly is centred about station 59 E. The amplitude of chargeability response indicates that the polarizable source likely contains of the order of 1% average by volume of metallically conducting material.

The resistivity plan indicates an area of values in excess of 800 ohm metres in the northwest corner of the grid. This may indicate an area of shallow overburden or a change in rock type. The igneous rocks are expected to have higher resistivity than the sediments.

b) Survey Grid Two

The background chargeability values in this area are much the same as over Grid One. Several localized indications of chargeability values in excess of 6.0 milliseconds are noted and the highest amplitude observed is 7.8 milliseconds on line 74 at 24+50E. Several profiles have been covered in detail and the results are shown on Plate 4. Changing the electrode spacing did not increase chargeability response in any case.

One area of high resistivity is seen centred about 16 E on line 86 and another occurs at the south end of the grid. Again, these high resistivities may be due to a change in rock type or to a decrease in overburden depth.

The ground magnetics do not show a well defined gradient characteristic of the contact as revealed by the ground magnetics on Grid One or by the detailed airborne survey, however it would appear that much of the survey area may be underlain by igneous rocks.

An attempt was made to determine overburden depth using the Wenner expanding array centred about 10 E on line 82. The 3 array resistivity profile on line 82 shows a sharp high on the line near the location of the

test. This may reveal sharp lateral changes in resistivity such that an interpretation based on horizontal layers may not be valid. On the basis of only the shorter spacing values there is probably less than ten feet of overburden near 10 E, however the overburden appears to deepen considerably immediately to the west.

CONCLUSIONS AND RECOMMENDATIONS

Interpretation of the two airborne magnetic surveys has revealed structural and geologic features which warrant further investigation. Two of these, embayments in the igneous-sedimentary contact, have been partially explored in the areas of Grids One and Two. The anomaly on Grid One warrants an exploratory diamond drill hole collared at 62 E on line 20N and drilled westwards in the plane of the grid line at an inclination of 45° for a minimum length of 500'. No drilling is presently recommended for Grid Two.

Many possibilities are evident for exploration within the area of the magnetic survey shown on Plate 2. Although extensive overburden precludes geological investigations over most of the area, such studies should be undertaken wherever conditions permit.

The following is a list of possible exploration targets, the priority of which is subject to discussion and may be controlled as much by logistics and cost as by geological inference. The exploration procedure in all areas would appear to be to cut grids, execute ground magnetic surveys and then cover selected areas with induced polarization surveys.

1. The contact embayment at location A which appears to coincide with Fault A could be explored farther to the south. One induced polarization anomaly has already been located in this area and it is noted

that the New Imperial Cowley Park deposit lies near the southern extension of the fault.

2. A grid of survey lines has been cut in the vicinity of the intrusive at F and a ground magnetic survey has located the source of the airborne anomaly. Induced polarization surveys appear to be warranted.

3. The warp in the contact associated with Fault B could be investigated.

4. The areas of low magnetics at D and E may be associated with roof pendants of sedimentary rock. These structures have been found to be most favourable for formation of scarns in the Whitehorse Copper Belt. Attention could be focused at the south end of magnetic low D where it is crossed by Fault C.

5. The areas of the outlying intrusives G, H, I and J should be studied.

6. The distortions of the contact at locality C may reveal a favourable environment for ore deposition.

Considerable comment has been made about the possibility that great depths of overburden overlie the area, however little evidence of this is seen in the geophysical data to date. The low level magnetics indicate that in many places the magnetic sources are very close to ground surface. In addition, the background level of induced polarization chargeabilities generally indicates that there is not much more than 50' of overburden in the areas of Survey Grids One and Two. Further tests employing Wenner expander arrays may be used to provide more precise interpretations of overburden depth.

Respectfully submitted,

SEIGEL ASSOCIATES LIMITED

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Geophysicist

Vancouver, B.C.
July 24, 1968

Harold O. Seigel

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

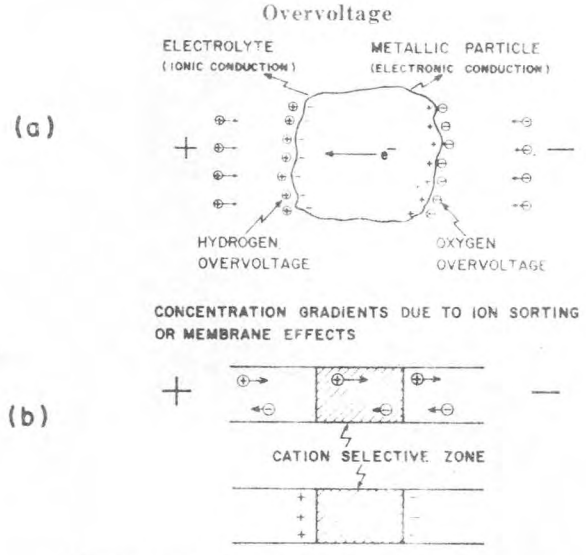


Figure 1.—Induced Polarization Agents.

Introduction

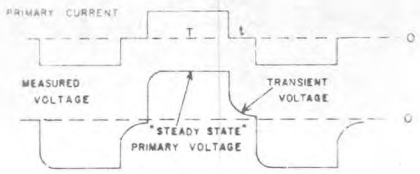
FOR the benefit of those who are unfamiliar with the induced polarization method in general or with the pulse-type method in particular, a few introductory remarks will be directed on the system employed in the present case histories. Those who wish a fuller treatment of the subject are directed to Seigel (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.

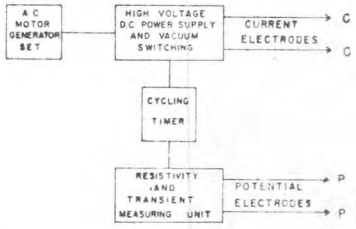
**"Overvoltage Research and Geophysical Applications," *Pergamon Press*, 1959, edited by J. R. Wait.

(a)



Equipment Block Diagram

(b)



Three-Electrode Array

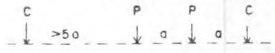


Figure 2.—The Pulse System.

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 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.

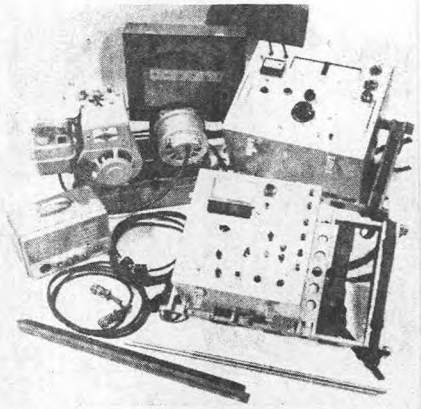


Figure 3.—(above)—The Seigel Mk V Induced Polarization Unit.

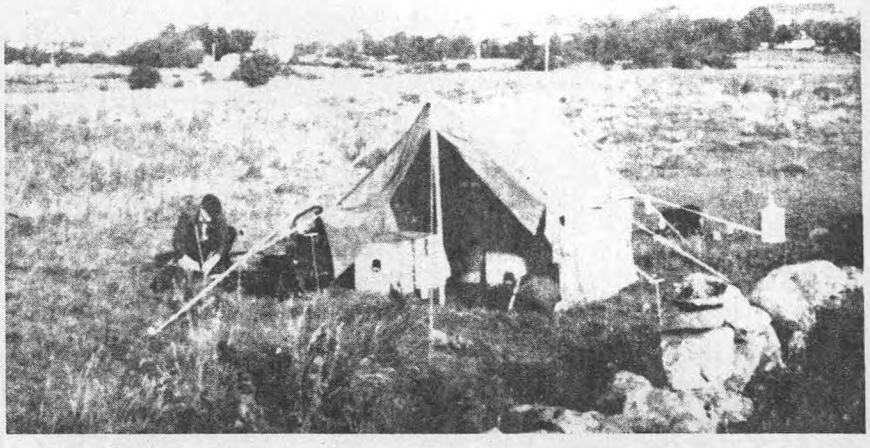


Figure 4.—(right)—Typical Field Operational Base in Ireland.

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.

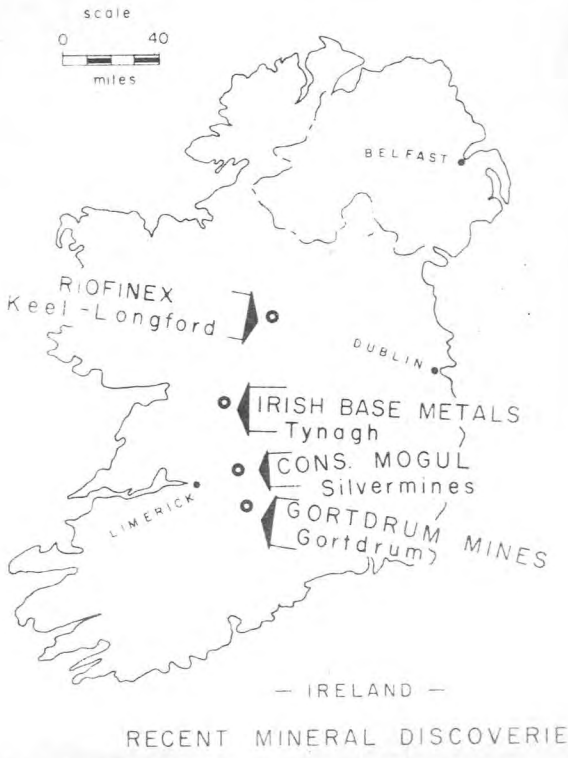


Figure 5.—Location Plan of Recent Mineral Discoveries in Ireland.

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 adjacent 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.

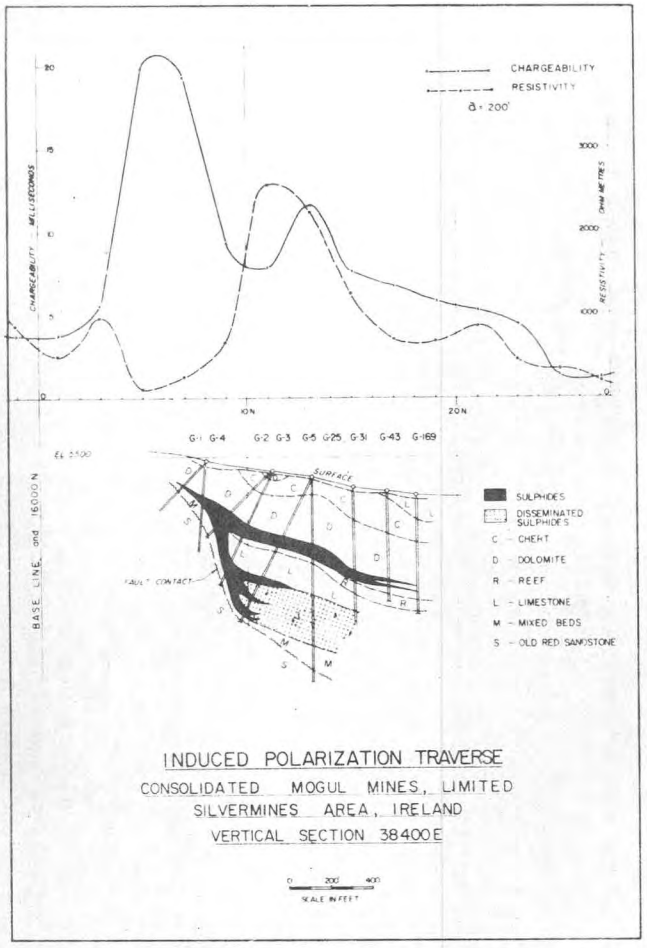


Figure 6.—Typical Discovery Traverse, Silvermines Deposit.

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.

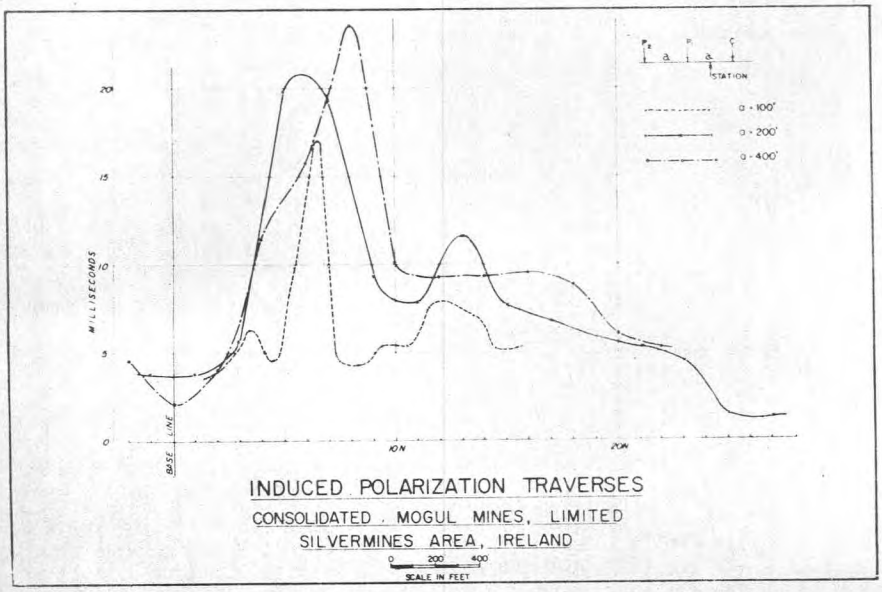


Figure 7.—Multiple Spacing Results, Silvermines Deposit.

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

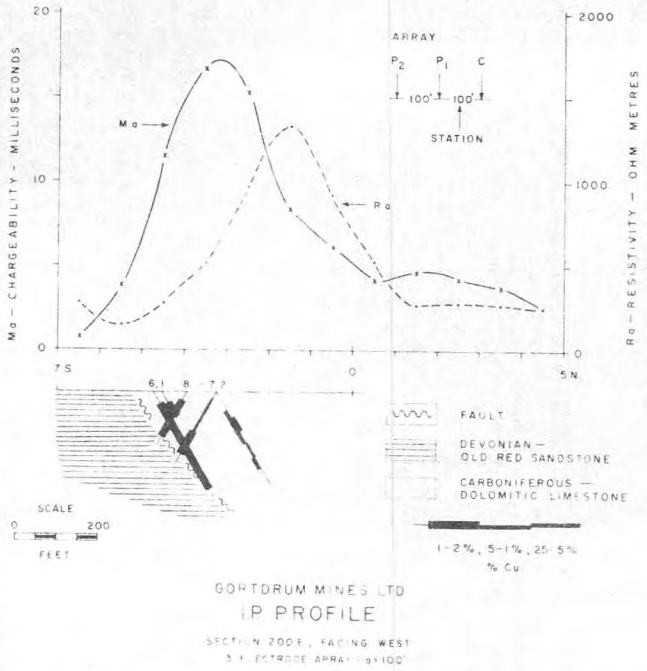


Figure 8.—Typical Discovery Traverse, Gortdrum Deposit.

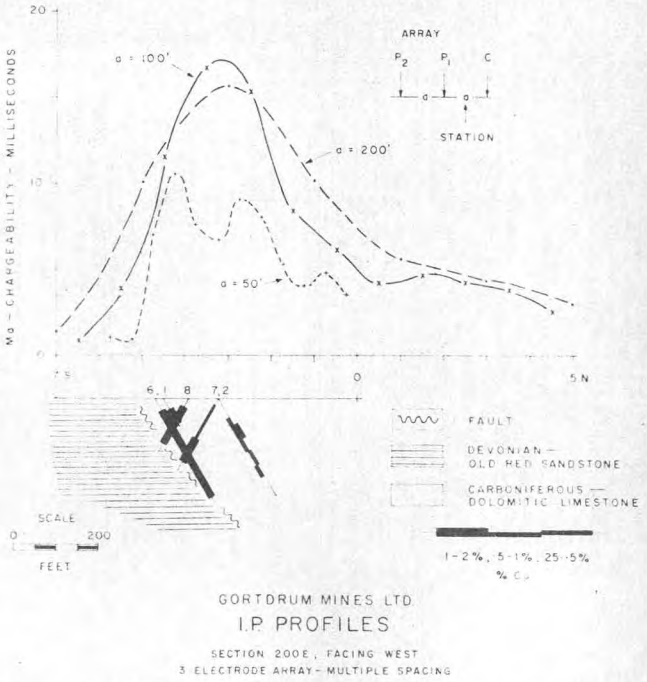


Figure 9.—Multiple Spacing Results, Gortdrum Deposit.

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.

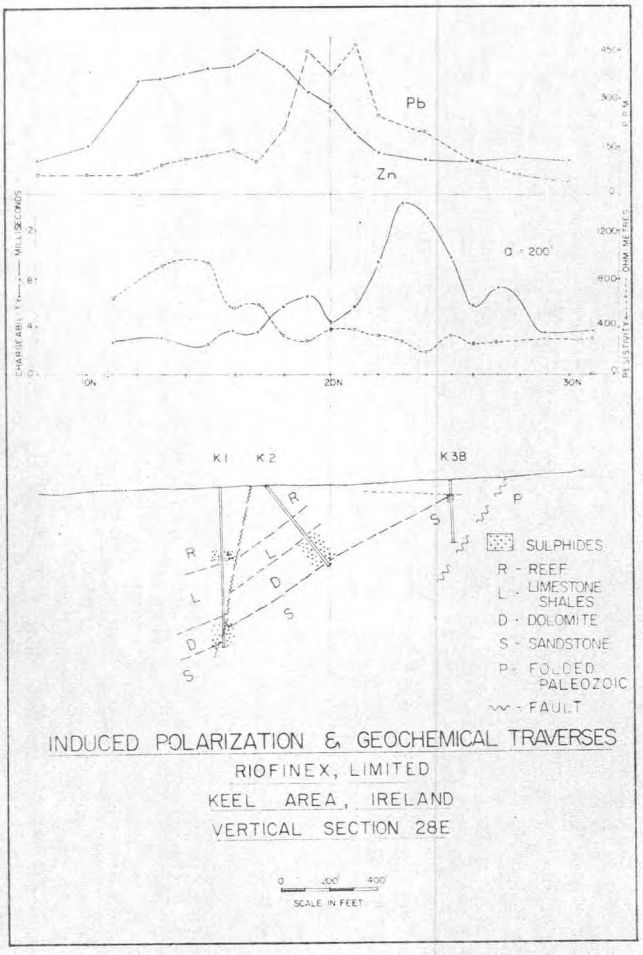


Figure 10.—Typical Discovery Traverse, Keel Deposit.

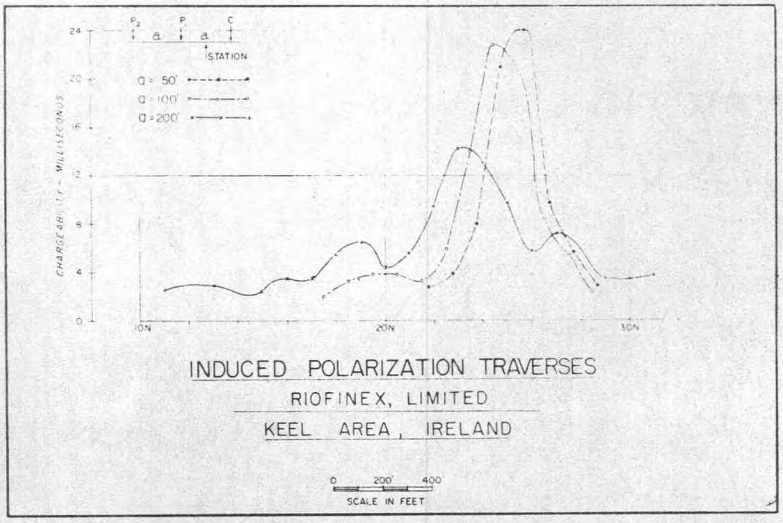


Figure 11.—Multiple Spacing Results, Keel Deposit.

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.

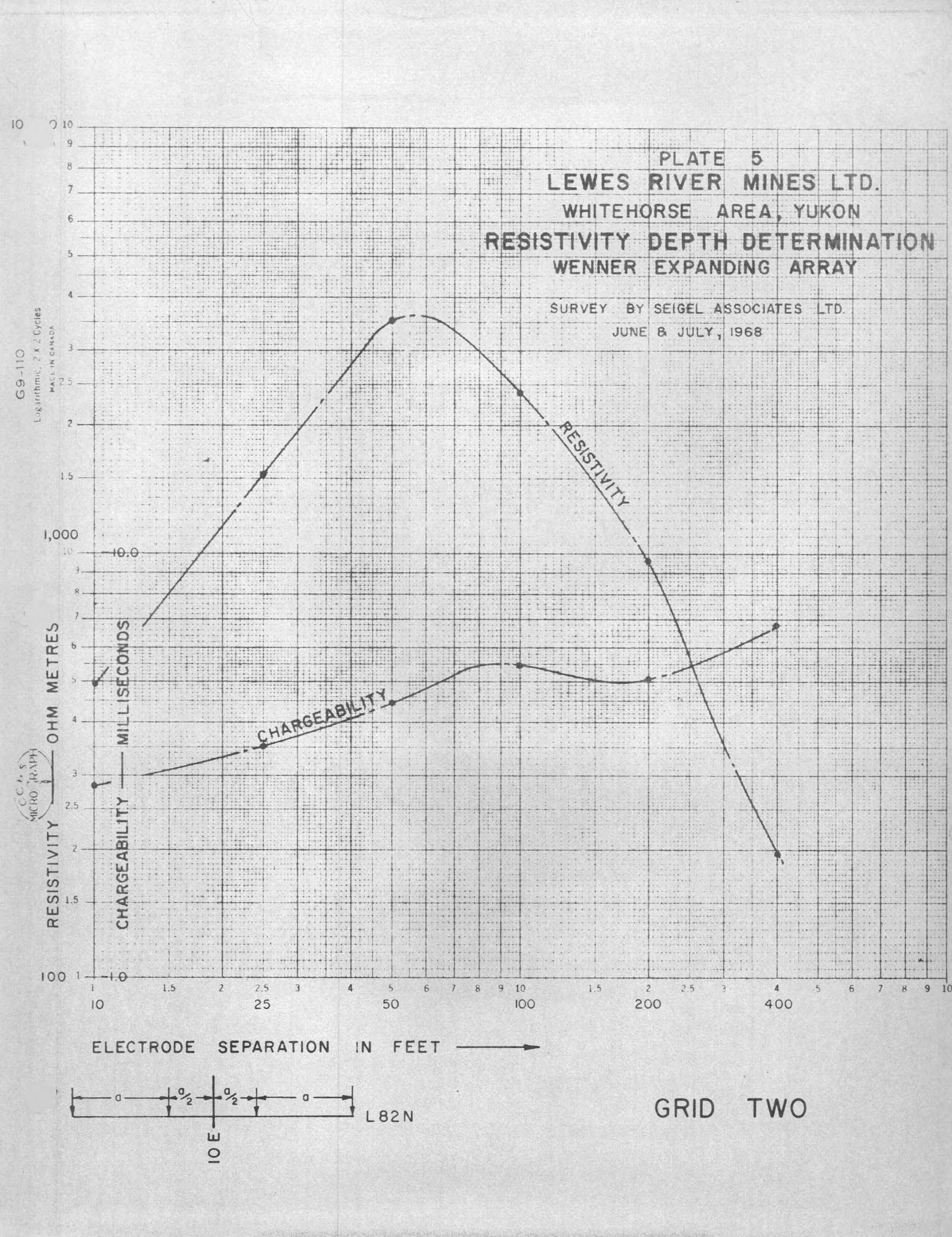


PLATE 5
LEWES RIVER MINES LTD.
WHITEHORSE AREA, YUKON
RESISTIVITY DEPTH DETERMINATION
WENNER EXPANDING ARRAY
SURVEY BY SEIGEL ASSOCIATES LTD.
JUNE & JULY, 1968
RESISTIVITY
CHARGEABILITY
RESISTIVITY — OHM METRES
CHARGEABILITY — MILLISECONDS
ELECTRODE SEPARATION IN FEET
a
a/2
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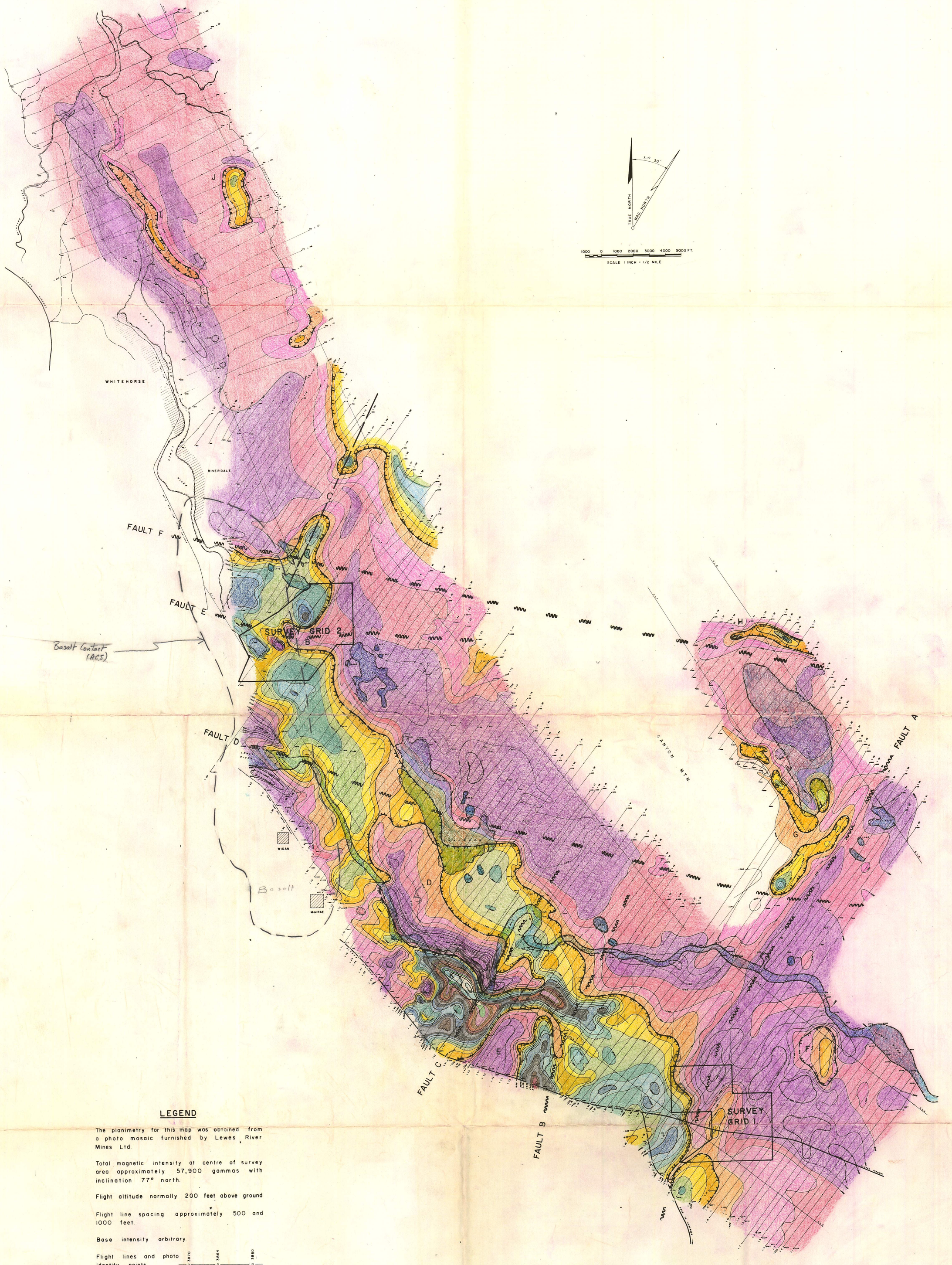
a
L82N
10E
GRID TWO
G9-110
Logarithmic, 2 X 2 Cycles
MADE IN CANADA



LEGEND

The planimetry for this map was obtained from a photo mosaic furnished by Lewes River Mines Ltd.

Total magnetic intensity at centre of survey area approximately 57,900 gammas with inclination 77° north.

Flight altitude normally 200 feet above ground

Flight line spacing approximately 500 and 1000 feet.

Base intensity arbitrary.

Flight lines and photo identity points 3870 3864 3860

Isomagnetic contours: 500 Gammas
100 Gammas
Mag. Dep.

Interpreted contact ..... Igneous rocks / sedmentary rocks

Magnetic lineaments, Possible Faults .....

Possible upwards warping of Igneous rock .....

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

inches 0 1 2
centimetres 0 1 2 3 4 5

YUKON GEOLOGICAL SURVEY

This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

PLATE 2

LEWES RIVER MINES LTD.

WHITEHORSE AREA, Y. T.

DETAILED AIRBORNE MAGNETOMETER SURVEY

SCALE: 1"= 1/2 MILE

COMPILED FROM PLATES 1 THROUGH 5 OF A REPORT BY R.O. CROSBY, SEIGEL ASSOCIATES LIMITED, JULY 8, 1968