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REPORT ON

AN INDUCED POLARIZATION SURVEY

HANK AND DOMINO GROUP OF CLAIMS

HIGHLAND VALLEY, BRITISH COLUMBIA

(50°, 121°, SE)

for

BRITMONT MINES LIMITED

by

HUNTING SURVEY CORPORATION LIMITED

Toronto, Ontario

September, 1962

INTRODUCTION

From July 12th. to August 2nd., 1962, an Induced Polari- . on (I.P.) survey was carried out by Hunting Survey Corporation :nited over part of the Hank and Domino group of mineral claims ned and operated by Britmont Mines Limited.

This group of mineral claims is located a few miles to the .st of Merritt in the Highland Valley district, British Columbia .0°, 121°, SE). The survey extended over the following mineral aims: Hank Numbers 1 through 6, 11 through 16, 19, 21 through ', and 29 through 32; Domino Numbers 9 through 14; and Freda umbers 2FR and 3FR.

The survey was performed by a seven-man crew. The roject geophysicist in charge of the survey and the technician- perator were E. L. Gregotski and F. H. Faulkner, respectively, f Hunting Survey Corporation Limited. Britmont Mines Limited provided the following personnel:

W. M. Sharp, Engineer in Charge

L. Olson, Assistant Engineer

A. G. Seale, Engineering Assistant

D. A. Foreman, I. P. Assistant

R. D. MacKay, I.P. Assistant

The geophysical survey was carried out along pre-cut and chained picket lines. These lines are grouped into three grid systems labelled Blue, Red and White grids. These grids are independent of each other but have been adequately surveyed to permit the preparation of a common base map. Each grid consists of parallel lines turned off at right angles to the base line of that grid system. The stations are labelled North and South from these base lines. The lines are arbitrarily and non-consecutively numbered.

The Red grid system consists of five lines at intervals of 800 feet, labelled from east to west, Lines No. 1, 3, 5, 7 and 8. The I.P. survey of the Red grid system provided 12,200 feet or approximately 2.31 miles of I.P. profiles.

The Blue grid system consists of eight lines with an azimuth of approximately N45°W. From northeast to southwest, these lines are labelled Lines No. 7, 4, 2A, 2, 1, 3, 3A and 5. The interval between these lines is 400 feet except between Lines 7 and 4 where the interval is 800 feet. The survey of these lines provided 22,600 feet or approximately 4.28 miles of I.P. profiles.

The White grid system consists of three lines, labelled from east to west, Lines No. 6, 4 and 2. The interval between lines is 1,600 feet. The survey of the White grid provided 9,300 feet or 1.76 miles of I.P. profiles.

The basic coverage of the survey consisted of readings at 100-foot intervals along the lines of the grid systems just described. The relative locations and orientations of these systems is shown on the map in the pocket at the end of this report. Thus, a total of 44,100 feet or approximately 8.35 miles of lines were surveyed.

The data were obtained using the "three electrode array". This array consists of one current electrode (C_1), two potential electrodes (P_1 and P_2), the second current electrode (C_2) remaining fixed at "infinity". To avoid trespassing onto neighbouring properties, the three moving electrodes were so orientated that the current electrode C_1 was leading the potential electrodes P_1 and P_2 when moving southward during the survey of the White and Blue grids. During the survey of the Red grid, this procedure was reversed so that the current electrode C_1 was leading the potential electrodes P_1 and P_2 when moving northward. Generally speaking, this reversal in procedure does not appreciably affect the results of the survey. However, this point may become significant in the detailed analysis of double peaked anomalies.

The data were obtained using basic electrode spacings of 200 and 400 feet. Additional data were obtained where required with electrode spacings of 100 and 800 feet. The basic station or reading interval was 100 feet. This interval was decreased to 50 feet for the 100-foot electrode spacing to increase the resolution of the data. The station interval was increased to 200 feet for the 800-foot electrode spacing and for some of the readings obtained with the 400-foot electrode spacing in non-anomalous areas. This increase in station interval where applied, increased the speed of the survey while still providing adequate data under those conditions.

The Hunting pulse-type instrument is similar in design and operation to those described by R. W. Baldwin in "A Decade of Development in Overvoltage Survey", A.I.M.E. Transactions, Vol. 214, 1959. Power is obtained from a Volkswagen motor coupled to an 18 kw., 400 cycle generator which provides a maximum of 10,000 watts d.c. to the ground. The cycling rate is 1.5 seconds current on and 0.5 seconds current off, the pulses reversing continuously in polarity. The data collected in the field consists of careful measurement of the current (I) in amperes flowing through electrodes C_1 and C_2, and of the primary voltage (V_p) in volts appearing between P_1 and P_2 during the "current on" part of the cycle. Also, the secondary voltage or overvoltage appearing between electrodes P_1 and P_2 during the "current off" part of the cycle is integrated electronically with respect to time, to provide a measurement of polarization (V_s) in millivolt-seconds. The "apparent chargeability" in milliseconds is calculated by dividing the polarization (V_s) by the primary voltage (V_p). The "apparent resistivity" in ohm-meters is proportional to the primary voltage (V_p) divided by the measured current (I), the proportionality factor depending on the geometry of the array used. The resistivity and chargeability obtained are called "apparent" as they are the values which that portion of the earth sampled by the array must have if it were homogeneous. As the earth sampled is usually inhomogeneous, the calculated "apparent resistivity" and "apparent chargeability" are functions of the "true" resistivities and chargeabilities of the various sections of the earth sampled and of the geometry of those sections.

The results of the survey and their interpretation are shown on the individual profiles in the Appendix of this report. These profiles have a horizontal scale of 1 inch to 100 feet. The "apparent chargeability" is plotted at a vertical scale of 2.0 milliseconds per inch. The "apparent resistivity" is plotted on a vertical logarithmic scale of 2 inches per logarithmic cycle. The interpretation is presented also in the form of a map at a scale of 1 inch to 200 feet, showing the three grid systems used and the lines surveyed by the I.P. method. This map is located in the pocket at the end of this report.

PREVIOUS WORK

The previous work over this claim group includes geological mapping, trenching, ground magnetometer, dip needle and geochemical surveys. The results of these previous works were made available to the interpreter in various forms. The bulk of the data were presented in the form of a report and accompanying map (1 inch to 400 feet) by W. M. Sharp, entitled "Report and Recommendations Following Britmont Mines Assessment-Exploration Program, Lower Nicola, B.C., September to November, 1961". This map was superceded by a new map at 1 inch to 200 feet, which included all additional geological data obtained up to, and during, the I.P. survey. Henceforth, in this report, this newer map will be referred to as the geological map of the property. This geological map also shows the location of geochemical anomalies and the outlines of the magnetic anomalies.

The magnetic anomaly on mineral claims Hank Nos. 25 and 27, was also presented in the form of a contoured map at a scale of 1 inch to 200 feet.

Topographic profiles of each of the lines surveyed by the I.P. method were presented at the vertical and horizontal scales of 1 inch to 200 feet.

The results of these previous works outlined three zones of potential significance which have been tested by the I.P. method.

Thus, the White grid covers the Hank 19-13 zone, the Blue grid tests the Hank 1-4 zone, and the Red grid surveys the Domino Zone. These zones are summarized by W. M. Sharp as follows, quoting:

"(a) Hank 19-13 Zone: A favourable zone of mixed limey porous tuff with appreciable chloritic alteration and visually small amounts of disseminated, fine-grained chalcopyrite and specularite, and containing three geochemical anomalous areas ....

"(b) Hank 1-4 Zone: A favourable zone located at a major contact flexure and cross fault intersection, showing extensive cherty-epidotic alteration and considerable soft chloritic alteration. Appreciable amounts of disseminated chalcopyrite and minor specularite has been exposed at the site of the old Taylor trenches ....

"(c) Domino Zone: A zone of fair potential situated apparently on the southwesterly extension of the formations which were briefly tested in 1958 in the vicinity of the Hank 30 magnetic anomaly. This zone, approximately 3,500 feet long, is marked by strong chert-epidote and green skarn types of alteration, and with sparse but widely scattered occurrences of chalcopyrite and minor specularite as disseminations and fracture fillings ...."

The I.P. method was chosen to test these three zones on the basis of its ability to detect disseminated sulphides and of its great depth of penetration. Serpentine, which has been known to respond to the I.P. method, is not present.

INTERPRETATION

There are basically two types of interpretative approaches in I.P. The first is based on the assumption of a layered earth; the second recognizes the limited or small widths of the bodies.

The first type of interpretative approach permits the direct calculation of physical properties and dimensions of the layers through the use of theoretical curves such as described by Dr. H. O. Seigel ("Mathematical Formulation and Type Curves for Induced Polarization", Geophysics, Vol. XXIV, No. 3, July, 1959). However, this approach is valid only if the body is wider than the electrode spacings used. An attempt was made to apply this method of interpretation to the chargeability and resistivity data on the Red grid but the behaviour of the results indicated that the approach was not validly applied in this case. However, the attempt to use this approach was useful in obtaining the limits of the various physical properties of the bodies as indicated in the interpretation.

The second type of interpretative approach was applied to the White and Blue grids as the anomalies observed are relatively narrow as compared with the electrode spacings used. The complex problem of the combined effects of depth of burial, width, dip and true chargeability of a vertically mineralized zone plus the effect of the physical characteristics of the overburden and of the country rock have not been solved practically. However, the type curves over a sphere, published by Dr. H. O. Seigel (see previous reference), plus certain rules-of-thumb and the experience gained from test surveys over known ore bodies, permit certain rough estimates to be made. Thus the maximum possible width of the causative bodies are indicated on the accompanying profiles and map with the understanding that the body most probably is narrower than indicated. Rough depth estimates are possible in some cases but it is necessary to know the electrode spacings at which the maximum response is obtained; thus a minimum of three electrode spacings across the anomaly is required. In the cases where the smallest electrode spacing shows the highest response, a maximum depth usually can be estimated. Dip of the mineralized zone may be indicated by displacement of the anomaly at the different electrode spacings.

The interpretation of the survey data consists of careful analysis of each individual profile. The results of this analysis are shown by appropriate symbols on the I.P. profiles in the Appendix of this report. These results are also transferred to the interpretation map in the pocket at the end of this report using the same symbols. Due to the high degree of complexity of the interpreted I.P. results and to the absence of geological data in certain parts of the property caused by the presence of overburden, no attempt was made to outline in plan form the various zones by the use of contact or similar symbols. Instead, possible relationships between zones on different lines are shown by long arrows. The often-curved trend of these arrows attempt to show the relationship of the I.P. anomaly to the geology. Considering the complexity of both the geological and I.P. data, it is quite apparent that the inter-relationships shown represent only one out of many possibilities.

The symbols used warrant some further discussion. The "zones of special interest" (cross-hatched) represent the causative bodies of a specifically recognizable anomaly at the shallowest depth observed by the electrode spacings used. Thus, the width indicated is the maximum width possible and the location is not necessarily the proper one at bedrock surface or at large depth if the body has a shallow dip. The "zones of possible interest" (single-hatched) are anomalous zones which cannot be broken down into individual bodies, or zones which show lower chargeability (less mineralization) or greater depth. Special features of the I.P. data are indicated by arrows between limiting marks along the profile and are explained by notes, both on the profiles and on the map.

Estimated depth (h), or the limits thereof, are shown in feet. Where a maximum value of depth is shown, it is believed that more often than not, the actual depth will be found to be one-half, or less, of the maximum shown. It is to be noted that these depths would be more properly called distances to the body, said distances being measured in a plane perpendicular to the line and to the ground surface. This is due to the fact that the I.P. method samples a certain volume of the earth and therefore the causative bodies do not necessarily lie beneath the lines surveyed but could be located to one or the other side of the line. Such an occurrence is called "side effect".

As previously explained, the mathematical problem of the relationship between the width, the depth and the true chargeability is not solved in the case of bodies of limited vertical cross sections. Thus, only a minimum chargeability in milliseconds is shown. Past experience shows that one percent sulphide by volume will cause a chargeability of 3 to 8 milliseconds. In other words, a minimum chargeability of 12 milliseconds indicates an absolute minimum sulphide content of 1.5% but the sulphide content could also be greater than 4%. The sulphides may or may not be economical as the I.P. method does not differentiate between chalcopyrite and pyrite for example.

The resistivity data obtained over the three grid systems show no significant correlation with the I.P. anomalies. The variations in the resistivity values obtained are ascribed mainly to changes in the overburden thickness and in overburden and bedrock resistivities. The overburden appears to have a resistivity varying between 100 and 300 ohm-meters whereas the bedrock resistivity may be as high as 900 ohm-meters.

The interpretation of the I.P. data, based on all the available data, is presented in the following paragraphs.

(a) <u>Red Grid:</u>

The chargeability data indicates two separate zones of mineralization which may merge eastward. The southernmost of the two zones coincides with the northern half of the Domino zone of alteration, whereas the southern part of the Domino zone causes little or no I.P. anomaly. The northern I.P. zone is definitely located north of the northern limit of the Domino zone as suggested by Sharp on his geological map of the area. On the other hand, there is little or no outcrop in that part of the property and, therefore, it is impossible to determine whether or not the I.P. zone is part of the same lithological unit as the Domino zone of alteration.

Generally, the depths are large (100 feet or more) and, considering the estimated depth of overburden of 10 to 15 feet indicated on the geological map of the property, the sources of the anomalies most probably do not reach bedrock surface. One exception to this large depth occurs on Line 7. There, the northern zone of mineralization is located between 13+50N and 15+50N, with a maximum width of 200 feet and a minimum chargeability of 19 milliseconds (minimum sulphide content of 2.5%). The depth is the shallowest depth obtained on this grid and is definitely less than 100 feet and may be sufficiently shallow to be trenchable.

Part of the southern zone on Line 7, between 3+50N and 5+50N, is also very shallow but it is questionable whether it can be reached by trenching.

There are indications, becoming more definite eastward, that the southern contact or limit of the southern zone is gradational in nature. If the mineralization is of the fracture filling type rather than the truly disseminated type, the term gradational is meant to imply a gradual increase in the number of fractures or veins for a given volume of rock.

On Line 8, the northern zone shows definite indication that the true chargeability is greater at a large depth. As indicated on the accompanying profiles and map, the minimum chargeability of 5 milliseconds at the shallower depth is estimated to be almost equal to the true chargeability, whereas the minimum chargeability of 10 milliseconds at the larger depth is probably much less than the true chargeability at that depth.

b) Blue Grid:

The I.P. survey of the Blue grid indicated a number of anomalies on each line. The minimum chargeabilities indicated vary from 5 milliseconds to as high as 16 milliseconds. Considering the narrow widths of the anomalies and therefore of the bodies, these observed chargeabilities can be very significant. The trends of the individual bodies are difficult to asses due to the complexity of the pattern and the number and closeness of these bodies on each line. The accompanying interpretation map shows a possible trend pattern based on the geological information available. Generally speaking, it is fairly well established that these zones of mineralization coincide with the tuffs or limy tuff beds indicated by the geological map of the property. Both the relationship between the chargeability anomalies and the rock types, and the trend pattern, could change significantly if and when additional geological information is available.

The I.P. data indicates various depths, from very shallow to relatively deep bodies. The following is a list of the shallowest indications with the minimum chargeability in milliseconds in parentheses. There depths are estimated at less than 100 feet on the basis of the available data but in many cases it is suspected that the depth is actually much shallower:

Line 1 : 5+50S (9)

Line 2 : 5+00N (13)

Line 2A : 0+00 (6)

Line 2A : 5+00S (12)

Line 4 : 6+00N (12)

Line 7 : 10+00N (9)

Some of the best indications observed in this grid system originate at depth and are not believed to be trenchable. Some of these are:

Line 2 : 6+00S (10)

Line 2A : 6+00N (12)

Line 2A : 9+00N (16)

Line 4 : 10+00N (13)

The Hank 4-30 fault zone is traced onto the accompanying interpretation map from the geological map. The I.P. data suggest that a fault may exist but displaced slightly to the northwest. There, it cuts off the I.P. anomalies trending eastward from the White grid into the Blue grid on Lines 5 and 3A. On the other hand, there is a possibility that this fault is not the main break. This is indicated by the strange behaviour (for this grid system) of the I.P. data on Line 3. On this line, a broad anomalous zone is observed extending from 13+00S to 7+00N, with clear indications that the causative body or bodies are at large depth to the extent that the individual bodies cannot be resolved from the data. Thus, it is possible that a deep trench in the bedrock surface may indicate a major break or that the faulting itself may have destroyed the sulphides. West of the fault as shown on the geological map, an increase in depth is suggested by the I.P. data, eastward from Line 5 to Line 3A. On the basis of the available data, the northern zone on Line 5, with a minimum chargeability of 12 milliseconds, may be quite shallow.

It is worthwhile to note that the ground magnetometer anomaly on the mineral claims Hank Nos. 25 and 27 which is situated just north of these I.P. anomalies, causes no appreciable response to the I.P. method. Thus, it is fairly well established that magnetite is not the cause of the observed I.P. anomalies. Furthermore, it is possible that the spatial relationship between the magnetite and the sulphides may be singificant from the point of view of the origin of the mineralization.

(c) White Grid:

The I.P. survey of the three lines, 1,600 feet apart, of the White grid explores the Hank 19-13 zone. All three lines show significant anomalies with intensities higher than those of the previous grids discussed. The easternmost line, Line 6, which would cross into the Blue grid if it were extended, shows four zones with minimum chargeabilities between 9 and 13 milliseconds. The northernmost zone of this line is incompletely surveyed and may actually be composed of two narrower bands. The southern end of the line is still anomalous. All the estimated depths are considered to be too great for trenching.

The central line, Line 4, also shows four zones, some at depth, others trenchable, with minimum chargeabilities between 10 and 18 milliseconds. The northernmost zone and the one straddling the base line are most probably composed of more than one band.

The westernmost line, Line 2, indicates five zones with minimum chargeabilities of 10 to 19 milliseconds. The two zones centered at 0+50N and 6+50N, could possible be reached by trenches. The section of the line extending from 11+00N to 15+50N appears to be anomalous although incompletely surveyed, but the source of these anomalous conditions is located at a very large depth or at a fair lateral distance. Thus, it is possible that these anomalous conditions are a side effect from the western extension of the northernmost zone observed on Line 4 unless this zone extends westward at very large depths only.

The geological information available over the Hank 19-13 zone is fairly detailed and relatively straightforward. Thus, the possible trends indicated on the accompanying interpretation map are most probably correct. Although the trends of the mineralized zones may be considered to be fairly well established, their lateral extent and position is still open to question due to the possibility of side effects. Thus, it must be remembered that the mineralized bodies indicated may or may not reach a specific line, and may become more or less significant in between the lines.

SUMMARY AND CONCLUSIONS

The I.P. survey over part of the Britmont Mines Limited property in Highland Valley, uncovered a number of high chargeability zones on each of the three grid systems. As the known magnetic bodies gave little or no response to the I.P. method and as no serpentine has been reported in the geological mapping of the property, it appears quite probable that the high chargeabilities encountered are due to the presence of sulphides, mainly within the tuffs and limy tuffs.

The limited width of the mineralized zones which are narrow with respect to the electrode spacings used, preclude the calculation of the true chargeability of these zones although the maximum apparent chargeability obtained can be considered as a minimum true chargeability for each zone. However the highest chargeabilities are associated with the widest zone and therefore, no priority can be assigned to the different grid systems. Thus, each of the grid systems should be considered as a problem by itself.

The economic significance of these mineralized zones must be determined by visual examination as the I.P. method cannot differentiate between economic and non-economic sulphide minerals. The probability of finding a deposit of economic grade appears good based on the presence of the geochemical anomalies on all three grid systems.

RECOMMENDATIONS

There are two possible approaches to follow-up on the results of the I.P. survey. The first is to complete and detail the present survey to properly define the anomalies detected so far and thereby to determine their strike extent and lateral position with respect to the lines surveyed. However, this approach may run the risk of outlining one or more pyritic bodies of no economic significance. Also in the case of the Blue grid, the actual trend of the bodies may be obtained by geological investigation. Thus, the second approach consisting of trenching and a limited amount of drilling to determine the nature of the sulphide mineralization may prove to be a less costly method of eliminating those zones which are not of economic significance. Thus, the following recommendations will follow this second approach.

Due to the absence of data from electrode spacings smaller than the 100 feet, it is not possible to guarantee that any particular zone is close enough to the surface to be trenchable. It is possible only to list those zones which may be very shallow. However, depth of overburden determinations by shallow refraction seismograph over each proposed trench location would, quickly and at low cost, indicate the feasibility of trenching to bedrock. In drilling, it must be remembered that due to the wide intervals between lines on some of the grid systems, it is possible that the causative body does not reach the particular line on which the anomaly is observed. However, this uncertainty can be eliminated only by detailed I.P. survey.

Proposed Trenching:

Depth to overburden permitting, the following zones are recommended to be trenched:

(a) Red grid	: Line 7	at	14+50N
(b) Blue grid	: Line 1	at	5+50S
	Line 2	at	5+00N
	Line 2A	at	0+00
	Line 2A	at	5+00S
	Line 4	at	6+00N
	Line 7	at	10+00N
(c) White grid	: Line 2	at	0+50N
	Line 2	at	6+50N
	Line 4	at	1+00S
	Line 4	at	6+00N

Proposed Drilling:

Where the proposed trenching proves to be unfeasible or does not provide the required information, drilling may be necessary. It is hoped that the trenching which will be done will provide sufficient information to determine the advisability to attempt drilling at this stage.

In addition to the trenching targets as outlined above, the following zones are considered to be worthwhile targets for drilling:

(a) Red grid	: Line 1	at	13+50N
	Line 3	at	9+00N
	Line 8	at	12+00N (deep hole)
(b) Blue grid	: Line 2	at	5+50S
	Line 2A	at	6+00N
	Line 2A	at	9+00N
	Line 4	at	10+50N

(c) White grid : Line 4 at 2+50N
Line 4 at 15+00N (deep hole)
Line 6 at 0+50S
Line 6 at 16+00N

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