REPORT ON A GEOPHYSICAL SURVEY

FOR THE

COPPER PRINCE MINES LIMITED

TORONTO ONTARIO

in

FALCONBRIDGE TOWNSHIP

by

GEOPHYSICAL EXPLORATIONS LIMITED

TORONTO CANADA

OCTOBER - DECEMBER 1952

TABLE OF CONTENTS

MAPS

Bound in back of report

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INTRODUCTION

A contract was entered into on October 13, 1952 between Geophysical Explorations Limited of Toronto and Copper Prince Mines Limited, also of Toronto, whereby the geophysical company undertook to make a geophysical survey of a group of claims held by the mining company near Falconbridge in the Sudbury district of Ontario. This contract was amended by an exchange of letters dated Nov. 14th, 1952 to Copper Prince Mines and Nov. 20th, 1952, to Geophysical Explorations Ltd. whereby the magnetic survey was extended to cover additional claims. Under these agreements an electrical survey was carried out on 17 claims, and a magnetic survey on 5 of the 17 claims.

For the electrical survey, the spontaneous polarization method was employed, which depends upon observing the electrical currents spontaneously generated by sulphide bodies. Detailed electrical observations were carried out on portions of three of the claims.

The field observations were conducted by J. H. Evans, field engineer for Geophysical Explorations Ltd.

He arrived at the property on Oct. 15th and completed the survey on Dec. 12th, 1952.

Electrical reactions indicative of sulphide deposits were observed in the central and western portions of claim S 51303 extending into the eastern portion of claim S 52307 and the northeastern portion of claim S 52306. The magnetic observations indicated that some of the sulphide deposits thus outlined would contain pyrrhotite, and that some of the deposits would be lacking in the magnetic variety of pyrrhotite.

The geological information entered on the accompanying maps was derived from a geological map by W. Hammerstrom, kindly furnished to us by Copper Prince Mines Limited. The diamond drill data shown were also furnished by the mining company.

This introduction is followed by a chapter in which descriptions are given of the geophysical methods employed. This in turn is followed by a chapter describing the results obtained, the interpretations thereof, and the recommendations for further exploration by diamond drilling.

Four maps are bound in the back of this report.

SPONTANEOUS POLARIZATION TECHNIQUE

Concentrations of sulphide minerals can readily be discovered by geophysical methods, under suitable circumstances, because such deposits spontaneously assume an electrical polarity. This electrical polarity is a result of electro-chemical reactions identical with those which take place in a galvanic cell. These reactions produce an electric current from the galvanic cell, and produce an electric current from most sulphide bodies. The essentials for this reaction consist of a metallic conductor in contact with contrasting electrolytes, or two different metals bathed in one electrolyte. The generation of a strong current therefore requires one or more metallic conductors in contact with one or more electrolytes. The metallic conductors commonly encountered in nature are most of the sulphides, the manganese oxides pyrolusite and psilomelane, graphite and anthracite coal (but not bituminous coal). Not all sulphides are metallic conductors, and the general rule is that those sulphides which possess metallic lustre will also possess metallic conductivity. Sphalerite is therefore not a metallic conductor. The only exception that I know of to the above rule is stibnite, which is a non-conductor in spite of its metallic lustre. The presence of non-conductive sulphides in a mineral body does <u>not</u> inhibit the conductive ones from reacting in the normal manner.

A metallicly conductive mineral body is usually surrounded by somewhat acid ground moisture near the surface, the acidity of which may be due to the carbonic acid formed from carbon dioxide of atmosphere and humus, and especially to sulphuric acid resulting from the oxidation of sulphide minerals. This acid moisture will usually show a low pH figure, as low as 1 to 3 where sulphides are undergoing active oxidation. At depth, the electrolytes are of neutral or alkaline character, with a higher pH figure commonly in the neighborhood of 7.5 or 8. It is these solutions of contrasting pH in contact with a metallic conductor, that produce the current.

The current which is generated by the electrochemical reactions described above, flows down the sulphide mass, out into the country rock wherein it passes to the surface and completes the circuit by returning to the apex of the sulphide body. Over the apex, at the surface of the ground, there is thus produced an area of electrical activity within which the potentials (voltages) may register as high as several hundred millivolts (1 millivolt equals 0.001 volt).

There is an interesting corollary to this electrochemical phenomenon which deserves attention by geologists. The flow of current generated by the reactions described is such as to reduce the contrasts which give it birth. Thus, metallic ions are liberated at the points of inflow of current to the metallic body. These ions may be hydrogen, or they may be metals. The presence of such metals as native copper in gossan may be the result of this action. At the other end of the battery, where the currents flow out of the conductive body, oxygen ions are released. The nascent oxygen thus produced may account for some of the phenomena of deep oxidation, occasionally observed in sulphide bodies, far below the water table.

For a mineralized body to produce the above described potentials, it is necessary for it to offer a practically continuous path of electrically conductive sulphides for the passage of the current. This usually requires a total conductive sulphide content of approximately 5% or more (sphalerite, stibnite, and cinnabar are non-conductors, and therefore do not contribute to the reaction). If the percentage falls below this figure, the potentials generated are usually weak, but cases are known where much lower percentages have given interpretable reactions. The sulphide mass must also extend from a region where the ground moisture is acid (near the surface), to a region where it is less acid, or neutral or alkaline (deeper down in the rock formations), since it is the contrasting electrolytes, reacting with the metallic conductor, which generate the current. Therefore, if the sulphides occur in small pockets, gash veins, or otherwise exhibit but a short vertical extent, the potentials generated are weaker, and are confined to a narrow zone. Deep overburden reduces the potentials observable at the surface, and spreads the activity over a wider area. Under normal circumstances, a well-mineralized body can be detected by its electrical reactions if its apex comes within about 300 or 400 ft. of the surface.

Electrical resistivity methods, in which an electric current from an outside source is passed through the ground in order to measure the resistances of the sub-soil formations, have sometimes been used to prospect for sulphides, but are not as direct as the spontaneous polarization technique. They also suffer from the somewhat similar, and sometimes confusing effects of strongly conductive shear zones. For this reason, the spontaneous polarization method is to be preferred in prospecting for sulphide mineralization, except beneath lake waters, in which case the resistivity method must be employed.

Appropriate apparatus is used to make a systematic study at the surface of the ground, or in drifts and cross-cuts, of the naturally occurring electrical potentials; where unusually strong potentials are observed at the surface, the presence of underlying sulphides is indicated. Where strong potentials are observed underground, sulphides may be anticipated close by, and a detailed study in the immediate vicinity may yield data indicating the direction in which the causative mass lies.

The results of the field observations may be depicted in several ways, two of which are usually adopted. In the first place, the readings obtained along a given line of measurements are plotted opposite the corresponding observation station. The negative potentials are plotted up, so that the resulting profile rises to a peak at the stations over the apex of the body generating the current. Where a series of such profiles have been read at close intervals, they may be used to draw a contour map of the electrical activity. This map shows, in plan, the distribution of the electrical current by a system of equipotential lines. Each such line joins all points showing the same electrical potential, and is thus a "contour line" of electrical activity.

While it is not possible to distinguish what kinds of sulphides are responsible for generating the electrical activity thus mapped, the method is valuable for indicating the locations for putting down trenches, spotting drill holes, or driving drifts or cross-cuts in order to determine the type of sulphide mineralization, its value, and tonnage. In this manner money can be saved by eliminating useless exploration of barren areas, and further efforts can be directed at the most promising locations with the least waste of time, effort and money. Of still greater importance is, - that deposits which might otherwise never be discovered, can readily be revealed by this technique.

MAGNETIC TECHNIQUE

Magnetic methods of geophysical exploration rely upon making delicate measurements, at the earth's surface, of slight variations in the strength of the earth's magnetic field. Where the sub-surface formations contain such naturally magnetic minerals as magnetite or pyrrhotite, the resulting increase in the strength of the magnetic field, observable at the surface, is quite pronounced. Except where these minerals are present in appreciable amounts, however, the effect is not strong, but different rock formations nevertheless have their characteristic influence upon the earth's magnetic field. In general, the basic rocks and ferruginous sediments, characterized by high magnetic permeability, produce an apparent increase in magnetic attraction in their vicinity. Such formations are called paramagnetic. On the other hand, rocks high in silica or calcite usually have the reverse effect, and produce a decrease in the strength of the surrounding magnetic field. Such formations are called diamagnetic.

By taking suitable observations, systematically arranged, it is possible to measure the variations in the strength of the earth's magnetic field from place to place. The resultant picture is purely of how the earth's magnetic field varies within the area explored, and it then becomes necessary to correlate these variations with what is known of the geology of the area, and with the formations which may be expected beneath the overburden. The application of the principles described above must be made with discrimination, because conditions may arise which will upset preconceived judgments as to the effects of given formations. Any magnetic anomaly must be interpreted in the light of available geological data before deciding upon its significance.

In general, it may be said that the magnetic technique is efficacious, among other things, for tracing igneous-sedimentary contacts, for following faults where the fault has displaced rocks of differing magnetic characteristics, for locating concealed igneous intrusions, and for discovering deposits of such magnetic minerals as magnetite and pyrrhotite. It should be noted, however, that more and more cases are being discovered of bodies of pyrrhotite which are practically non-magnetic. The absence of a magnetic reaction can therefore not be interpreted to mean the absence of pyrrhotite. In other words, it is sometimes impossible to discover pyrrhotite from the results of a magnetic survey.

The instruments usually employed for measuring variations in the magnetic field are of the Schmidt magnetic balance type. In these, the effects of the magnetic field are recorded by the deflections of a magnetic needle mounted on knife edges to swing in a vertical plane. The magnitudes of the deflections are translated into gammas, a unit of magnetic measurement roughly equal to 1/60,000th of the earth's magnetic field. These values may then be plotted as magnetic profiles, and where a number of magnetic traverses have been run at close intervals, the points of equal magnetic intensity may be joined by magnetic contours, called "isogams". A plan map of the isogams then depicts, like a contour map, the variations in magnetic intensity within the area surveyed. It should be noted that when using instruments of this type for magnetic prospecting, it is not the total strength of the earth's field which is recorded and mapped, but the variations in that field referred to an arbitrarily chosen datum station.

The magnetic results, plotted either as profiles or isogams, will then depict the variations in magnetic intensity, as influenced by the formations beneath the lines of observations. As a rule, the basic rocks and ferruginous sediments will produce higher readings, and the acid rocks, quartzite, sandstone and limestone will produce lower readings. Mineral formations containing such highly magnetic substances as magnetic pyrrhotite and magnetite will usually be characterized by particularly high readings. This phenomenon makes the magnetic method useful for checking electrical surveys on sulphide deposits to determine which ones may contain pyrrhotite, provided the pyrrhotite is magnetic.

In the discussion above, the statement is made that pyrrhotite is not always magnetic, and that as geophysical work is applied on an ever broadening scale, more and more cases are discovered in which the pyrrhotite is of the non-magnetic type. The exact reason for this phenomenon is still unknown, but its practical effect is to render the magnetic technique useless when prospecting for this variety of pyrrhotite.

DISCUSSION OF RESULTS

The claims designated for geophysical survey lie in Falconbridge township, Ranges II and III, Lots 5, 6 and 7, and consist of claims S 52069, S 51548, S 52070, S 52071, S 51549, S 51303, S 52307, S 25731, S 51550, S 51304, S 52306, S 25668, S 58007, S 56015, S 56017, S 56016 and S 56018. All of these claims were designated for electrical survey, but magnetic observations were conducted only on claims S 51549, S 51303, S 52307, the north half of S 52306, and the south portions of claims S 52071, S 52070 and S 51548.

In the north block of 12 claims, profile lines previously cut for an earlier electro-magnetic survey were utilized in the present work. New lines were cut in the south block of 5 claims. All these lines were at 200 ft. intervals. New lines were cut for detail work, half way between the old lines, thus giving a line interval of 100 ft. in the area covered by detail observations, on claim S 51303 and on portions of claims S 52307 and S 52306. Four base lines were established, to which observations along the profile lines could be referred. The base lines were run east and west, and the profile lines north and south. Base line A coincides with the range line between Ranges II and III and constitutes the south boundary of claims S 51549 to S 25731 and the north boundary of claims S 51550 to S 25668. Base line B corresponds to the north boundary of claims S 51548 to S 52071 and the south boundary of claim S 52069. Base line C is the south boundary of claims S 58007 and S 56015 and the north boundary of claims S 56016 and S 56017. Base line D is the south boundary of the last two claims mentioned above and the north boundary of claim S 56018. The profiles were numbered east and west from the lot line between lots 6 and 7, which constitutes the west boundary of claims S 52069 to S 51304 and the east boundary of claims S 52071 to S 52306. The profile along this line was numbered 0; those east of it were numbered 2 E, 4 E, etc. indicating they were 200 ft. and 400 ft. respectively east of the 0 line, while those west of it were numbered 2 W, 4 W, etc. Observations were taken along the profiles at 50 ft. intervals, except that a 25 ft. interval was used on the detail electrical profiles, 1 E to 9 E and 1 W to 3 W, as well as along portions of some of the even numbered profiles in this area. The plan of the survey is shown on Figs. 1 and 2, bound in the back of this report.

The plan of the survey, shown on the accompanying maps, is based upon the plan submitted for the earlier, electro-magnetic survey, and is an idealized system of line lay-out. It should be noted that observations made in the field indicated that some of the lines may be expected to deviate from this idealized scheme.

To facilitate correlating the present geophysical results from the earlier, diamond drill findings, the old diamond drill base line is shown on Fig. 1, together with the locations of the drill holes previously put down. It will be observed that most of the old drilling was conducted in an area which the electrical survey indicates lies principally east of, and outside the area of mineralization, although the drilling does overlap somewhat into the eastern end of the mineralized zone.

The electrical survey on the southern block of 5 claims, the results of which are shown on Fig. 2, revealed only weak and scattered zones of electrical activity, with one isolated spot yielding a reaction of slightly over 200 mvs. The results indicate the presence of very thinly disseminated sulphides in the bedrock, with one small pocket of heavier mineralization which yielded the strong electrical reaction. This pocket is too small in size to be of interest, and the other, weak reactions indicate sulphides of too low a percentage to be of importance. Therefore, no further investigation of this block of 5 claims is warranted. It should be kept in mind, however, that the geophysical methods have a depth limitation, in this case about 300 ft., and therefore no opinion can be expressed as to what might be found at depths considerably greater than that.

On Fig. 1, reactions of high intensity and interest are recorded. The area wherein they were observed lies between profiles 14 W and 14 E, extending about 1,400 ft.

north of base line A and about 300 ft. south thereof. Within this area there are numerous zones wherein the potential values rise over 200 mvs., sometimes to a maximum of nearly 450 mvs, Most of the reactions are found in the range of 200 mvs. to 350 mvs. however, indicative of fairly heavy sulphide mineralization. The equipotential contours can be expected to indicate the general strike of the underlying sulphide bodies, and by their own extension in length to give a relative idea of the lengths of the causative lenses or veins.

The elongation of the equipotential contours shown on Fig. 1, strikingly demonstrates two pronounced trends. The clearest trend is along a northeast-southwest strike, with another, less clearly marked one very nearly at right angles to the first. There are actually two zones, nearly parallel, which follow the northeasterly trend and lie about 800 ft. to 1,000 ft. apart. The area of strongest and most interesting electrical reactions is where the northwest trend intersects the two northeast ones.

The strongest northeast trend crosses base line A in the zone between profiles 1 W and 8 W. The mineralized zone in this vicinity is roughly outlined by the 200 mv. contour which extends from a point about 150 ft. south of the base line on profile 8 W, one thousand feet in a northeasterly direction to profile 2 E, 350 ft. north of the base line. It is within this zone that the highest reaction, of nearly 450 mvs. was recorded at an old pits wherein heavy to massive sulphides were exposed. Three, short drill holes had been put down in this area, but they are far from adequate to test the mineral bearing possibilites here. Several sulphide lenses are indicated here, arranged en echelon and cutting the main trend at a slight angle. The southernmost lens lies within the 200 mv. contour extending from profile 8 W, 150 ft. south of the base line to the vicinity of the intersection of the base line with profile 2 W. The northernmost lens is probably a small pocket on profile 4 W, 400 ft. north of the base line. Three other lenses are distributed between these two, as indicated by the centers of strong reactions on profiles 1 W, 2 W and 1 E. These electrical centers lie within the quartzite, as shown on Hammerstrom's geological map.

Some 1,000 ft. to the northeast of the above described area of electrical reactions there is another area of less intense activity, marked by 200 mv. contours on profiles 4 E, 6 E, 7 E and 8 E. These apparently lie in an area of conglomerate and the strength and extent of the electrical reactions is such as to indicate weaker sulphide mineralization in somewhat more scattered bodies. It is in this area that the northwest trend, previously mentioned, intersects the northeast trend now under discussion.

The northwesterly trend, just mentioned, is well outlined by the elongation of the 150 mv. contour which parallels the old diamond drill base line as far southeast as the old drill holes 4 and 5. Within this contour there are some 200 and 250 mv. contours which indicate the centers of higher sulphide content. It will be observed that the sulphides intersected in the old drill holes 4 and 5 lie within, or close to the 200 mv. contour on profile 10 E, 500 ft. north of the base line. The sulphides intersected in holes 3 C, 4 C and 5 C lie just outside the 150 mv. contour, but within the general area of electrical activity. Holes 6, 4 B, 5 B and 6 B failed to encounter sulphides, and lie outside the main area of electrical activity.

The second northeasterly trend is probably marked by rather scattered pockets of mineralization, as indicated by the disconnected character of the centers of electrical activity. They lie along a strike which extends from profile 12 W, 650 ft. north of the base line, 1,100 ft. northeasterly to profile 2 W, 1,200 ft. north of the base line. Reactions of 200 mvs. to something over 300 mvs. were recorded, but appear to occur in isolated patches. Detail work in this area would probably have modified the picture only a little, and was actually scheduled, but bad weather prevented carrying it out.

The northeasterly trend just described would intersect the northwesterly one previously mentioned, in the vicinity of profile 2 E, some 1,400 ft. north of the base line. It is between this point of intersection and the intersection of the first northeasterly trend with the northwesterly one, that one of the most interesting areas of electrical activity was discovered. It lies between profiles 2 W and 5 E, in the area 800 ft. to 1,300 ft. north of the base line. Three or four separate, northeasterly striking trends are observed in this zone, marked by potentials of 250 mvs. and over. Lenses of fairly heavy sulphides may be expected to underlie this zone of electrical activity, which again occurs in the quartzite. Three old drill holes, 6 C, 7 C and 9 C had previously been drilled for short distances, but in each case were pointed the wrong way to find any sulphide mineralization as now electrically indicated.

The magnetic map, Fig. 3, offers some interesting comparisons and contrasts with the electrical results depicted on Fig. 1. In carrying out the magnetic field work, base stations were established on base line A at the intersections of profiles 8 W, 4 E and 16 E. The base at 8 W was first established, and the subsidiary bases at 4 E and 16 E were tied to it. Check readings were taken at one of the bases at two hour intervals, and corrections made accordingly for diurnal variations. No corrections were made for temperature changes, as the instrument employed (Sharpe magnetometer) is temperature compensated. In contouring the profiles, a broad area of flat magnetic relief, particularly prominent in the northwest and northeast portions of the magnetic survey area, was arbitrarily chosen as the zero, or datum to which the contour values would be referred. Dividing these two areas of minor magnetic relief, there is a zone wherein the observed magnetic reactions are very strong.

The zone of increased magnetic intensities corresponds, in rough outline, to the zone of spontaneous polarization reactions, although there are differences in detail which are quite significant. An outstanding feature of the magnetic contours is the prominent northeasterly trend of magnetic highs which extends from profile 10 W, 350 ft. south of the base line, northeasterly to profile 14 E, 1,600 ft. north of the base line, and beyond out of the area of the magnetic survey. This trend is marked by a number of centers of magnetic activity which, individually, do not show great over-all continuity.

The above mentioned northeasterly magnetic trend is the most prominent one on the map, but two subsidiary ones, approximately parallel thereto, are also observable. One of these lies across profiles 10 W to 6 W, 800 ft. to 1,150 ft. north of the base line. This is the only clear cut magnetic indication of the parallel trend at this location, which was also picked up on the electrical contours. The second subsidiary trend lies southeast of the main one, at a distance of some 1,200 ft. It occurs in the southeast corner of the magnetic survey area, and is marked by a scattering of magnetic contours, mostly of 250 gamma values but going as high as 1500 gammas. The high values occur only as isolated spots and indicate very local magnetic attraction. This trend is not clearly discernible in the electrical contours.

The northwesterly trend, discussed in connection with the spontaneous polarization results, is also evident on the magnetic map. As in the case of the electrical contours, the outlines of this trend are less distinct than are those of the main northeasterly trend, but a general tendency for the magnetic centers to be distributed along a northwesterly band is evident. The axis of this alignment may be said to extend from the 1,500 gamma contour on profile 14 E, 150 ft. north of the base line, to the 1,500 gamma contour on profile 4 E, 800 ft. north of the base line.

The above discussion emphasizes the points of similarity in the contour maps of the electrical and magnetic survey. There are also some contrasts or differences which are equally significant. The most striking of these contrasts is the lack of any significant magnetic reaction in the vicinity of the impressive zone of electrical activity extending across profiles 3 W to 5 E, which lies between 800 and 1,400 ft. north of the base line. The minor electrical reactions cutting across profiles 12 W to 2 W, between 650 ft. and 1,200 ft. north of the base line, are also unaccompanied, with one exception, by any significant magnetic reaction. On the other hand the strong magnetic reactions on profile 14 E, 150 ft. north of the base line, on profile 22 E, 500 ft. north of the base line, and the minor zones of magnetic activity in this general area, are in a zone where the spontaneous polarization reactions are unimpressive. No opinion can be expressed as to whether or not the magnetic reaction on profile 12 E, 1,400 ft. north of the base line, would be marked by strong electrical potentials, because heavy swamp prevented making electrical observations in that immediate area. By the time the magnetic work was carried out, the swamp had frozen to some extent, and it was possible to traverse portions of it. It should be noted, however, that the north end of profile 12 E, on Fig. 1, is in an area not much below a potential of 100 mvs.

The significance of the above similarities and contrasts is discussed below.

INTERPRETATIONS AND RECOMMENDATIONS

In discussing the significance of the electrical and magnetic results obtained in the present survey, one important general principle should be kept in mind. This principle refers to the fact that a combination of magnetic and electrical methods can frequently be used to permit a closer evaluation of the possible composition of the underlying sulphide bodies. The spontaneous polarization reactions arise from bodies of sulphide minerals possessing metallic conductivity for electricity, while the magnetic reactions are naturally caused by minerals of high magnetic permeability. The only common sulphide which exhibits ferromagnetism (strong magnetic attraction) is pyrrhotite, and it should be parenthetically remarked that more and more cases are being observed where pyrrhotite is actually non-magnetic; in the following discussion we shall refer only to the magnetic variety of pyrrhotite. With these phenomena in mind, it is evident that at those locations yielding both electrical and magnetic reactions, the causative sulphides can be expected to carry magnetic pyrrhotite. Where electrical reactions are recorded, but no magnetic ones, the causative sulphide bodies can be expected to lack magnetic pyrrhotite. Where magnetic reactions alone are observed, the causative magnetic material must be something other than pyrrhotite, presumably magnetite. The presence of magnetite mixed with sulphides could also give rise to magnetic reactions which coincide with electrical ones, and thus might lead to the erroneous deduction that pyrrhotite was responsible for the magnetic and electrical reactions. With due regard to this last named exception, it nevertheless remains true that a combination of the two methods can be expected normally to yield some information as to the character of the concealed sulphide deposits.

Applying the above reasoning to the results submitted on Figs. 1 and 3, it becomes evident that the sulphide deposits lying along the main northeasterly trend, extending from profile 8 W, 150 ft. south of the base line, northeasterly in the direction of profile 14 E, 1,600 ft. north of the base line, are characterized by mineral deposits carrying a magnetic mineral, probably pyrrhotite. In view of what is known of the sulphide occurrences in this area, it seems probable that the sulphide deposits will consist of pyrrhotite with some admixture of either pyrite or chalcopyrite, or both. The same deduction applies to the northwesterly trend in that section lying between profile 10 E, 450 ft. north of the base line, northwesterly to profiles 4 E to 7 E between 700 ft. and 1,000 ft. north of the base line.

The end of the last named zone, lying across profile 4 E to 7 E, marks the intersection of the main northwest and northeast trends. Northwest of this intersection, a change occurs in the mineralization. The interesting area of electrical reactions which extends 800 ft. from profile 3 W to 5 E, between 800 ft. and 1,400 ft. north of the base line, is characterized by a marked lack of magnetic reactions. From this it is to be concluded that the underlying causative sulphide bodies are nearly completely lacking in magnetic pyrrhotite. They would thus be either pyrite or chalcopyrite, or a mixture of the two, on the basis of what is known of the mineralization in this area.

The minor, weakly marked northeasterly electrical trend extending across profiles 12 W to 2 W from 650 ft. to 1,200 ft. north of the base line, is characterized by almost a complete lack of magnetic reactions. The causative mineralization may therefore be expected to consist largely of pyrite or chalcopyrite. At one point, however, there is a magnetic reaction, on profile 8 W, 1,100 ft. north of the base line. Here, both electrical and magnetic reactions are fairly strong, but are of limited extent; therefore, a small pocket of mineralization carrying pyrrhotite and possibly other sulphides, may be expected to underlie this point.

In the southeast portion of claim S 51549 there are a number of centers of magnetic activity, previously referred to, which occur in an area where electrical reactions are lacking or are noticeably weak. The magnetic contours faintly indicate a northeast trend, and the indications may therefore be expected to correspond to local concentrations of magnetite with only occasional and very weakly disseminated sulphides.

Reference has previously been made to a strong magnetic indication, lying in the main northeasterly trend, and extending from profile 10 E, 1,300 ft. north of the base line, to profile 14 E, 1,600 ft. north of the base line. An insufficient number of electrical observations were taken in this vicinity to show whether this center of magnetic activity is caused by sulphides or by magnetite. Since it lies on the main trend which is characterized by sulphide mineralization, it may be presumed to be underlain by sulphide mineralization. This presumption is strengthened by the fact that on the same strike, there is a center of 200 mv. electrical activity on profile 22 E, 2,650 ft. north of the base line. The magnetic indication is therefore worth drilling. The electrical center near the north end of profile 22 E is, however, too small to warrant further interest. It does suggest that the trend continues in that direction, and if there is another, corresponding structure crossing it further north, or further south, such as the northwesterly trend on claim S 51303, another center of mineralization might be discovered.

In the above discussion attention has been called to several trends of magnetic and electrical contours, related to mineralization as geophysically predicted in the underlying bedrock. While no firm conclusions can be arrived at, in the absence of underground investigation, concerning the origin and control of these trends, it may nevertheless prove useful to attempt to correlate them with available geological data in the area. To begin with, the main northeasterly trend is the most clear cut of those depicted on Figs. 1 and 3. It is therefore probable that the causative mineralization lies along a well defined fracture zone. The subsidiary trends which parallel this one probably lie in local, parallel fracture zones of less importance, and which probably did not reach the main source of mineralization.

The northwesterly trend, although quite evident, is not as clearly defined as the main northeasterly one. Furthermore, a good many of the contours within this zone appear to take a nearly east-west direction instead of one parallel to the trend itself. This pattern leads one to suspect that the causative sulphide bodies here lie within a shear zone, and occur en echelon in fractures cutting the main trend of the zone at an angle. On the magnetic map, the northwesterly trend, as outlined by the magnetic contours, appears to be cut off abruptly where it intersects the northeasterly trend. On the electrical map, on the other hand, the cut-off is not abrupt and there is some evidence that the trend may continue northwest out of the survey area. Based on this electrical and magnetic evidence, it appears that the sulphides carrying pyrrhotite lie along the northeast trend and to the southeast of it; on the northwest trend, however, the sulphide deposits will be deficient in magnetic pyrrhotite on the northwest side of its intersection with the main northeast trend.

The records of the old diamond drill holes, furnished us by Copper Prince Mines Ltd., indicate that the holes put down off the old diamond drill base line, on claims S 51303 and S 51549, nearly all encountered sheared or slightly sheared conglomerate, usually carrying scattered sulphides. The geophysical results and the diamond drill results thus point in the same direction, namely that this is an area of weak shearing. The few, scattered holes (6 C, 7 C and 9 C) in the northwest portion of claim S 51303 on the other hand, recorded fractured quartzite, with shearing also noted in 9 C. This reinforces the conclusion that there is a fracture zone in this vicinity.

It seems reasonable to expect that the mineralization in these structures has travelled upward and outwards along the postulated fracture zones or shear zones, from the norite mass which lies not far away to the north. The map of the Sudbury district which accompanied D. R. Lockhead's article "Sudbury - A Fabulous Treasure House" in the annual review issue, 1952, of the Northern Miner, shows a fault or shear zone through the Falconbridge Mine trending in approximately the direction of the northwesterly trend which has been described above. It is possible that this northwesterly trend, believed to correspond here to a weakly sheared zone, may represent the playing out to the southeast of the shearing through the Falconbridge area. No structure appears on the above mentioned map, nor on map No. 43 D "Part of the Sudbury Nickel Area" (accompanying a 1934 report by A. G. Burrows and H. C. Rickaby of the Ont. Dept. of Mines) corresponding to the northeasterly trend geophysically outlined. This trend, believed to be a mineralized fracture zone, may therefore represent a hitherto undiscovered fault, possibly along or close to the contact between conglomerate and quartzite. It might be interpreted as mineral deposition along a formational contact except for the fact that Hammerstrom's geological map shows that the structure passes entirely into quartzite in the southwestern portion of claim S 51303 and the eastern portions of claims S 52307 and S 52306.

Since the direction of this northeasterly trend, or presumed fracture zone, is such that it could not pass close to the norite along its strike, then to have reached the source of mineralization it would have to dip towards and intersect the norite in depth. From this, it would be logical to deduce that the mineralization could be expected to become heavier and more voluminous with depth.

The individual zones of mineralization within each of the principal trends which have been described above, are indicated on Fig. 4. The extent of the cross hatching is not meant to indicate the width of the mineralization nor its exact length. What the symbols are intended to show is the general extent of each zone which should be investigated by drilling to determine the nature of the sulphides, the values to be expected and in what tonnages they occur. We have also indicated on that map the zones which we believe should be cross-sectioned by drilling. The further expansion or modification of the program will then depend on the results of such drilling. If values and tonnages encountered in these recommended drillings are below commercial grade, further drilling for near surface mineralization will not be advisable, as we have recommended investigating the points where the best mineralization can be anticipated. At this stage of the program, it would then be necessary to envisage drilling for deeper portions of the deposit, beyond the range of the geophysical investigation techniques. This would be a logical extension of the program, because the electrical and magnetic indications may well correspond to the attentuated apices of sulphide bodies which might carry better mineralization and bigger tonnages at depth. If the recommended cross section drilling shows commercial values near the surface, then the comparatively shallow drilling should be extended laterally, to cut additional cross sections until the limits of commercial mineralization are established.

We suggest that each zone recommended for cross section drilling be investigated by a series of diamond drill holes, drilled to the south, on the assumption that the structures have a northerly dip. These holes should be collared to give at least two intersections beneath each important center of electrical activity. In this manner the dips of the structures in both trends can be determined. With this information, the dip of the intersection of the northeast with the northwest trend can be calculated. This is an important feature, as it seems reasonable to expect that the best mineralization will be found by following such an intersection downwards, towards the source of the mineralizing solutions.

If you would be good enough to keep us closely in touch with the results of your further exploration, we would like to correlate such results with the geophysical indications in the expectation that the interpretations could be expanded and modifications made in our recommendations for drilling and other exploration work, to your benefit.

Respectfully submitted

GEOPHYSICAL EXPLORATIONS LIMITED

Sherwin F. Kelly

Feb. 3,1953

Sherwin F. Kelly, President

FOR ADDITIONAL

41110SE0201 0030 FALCONBRIDGE

900

INFORMATION

SEE MAPS:

FALCONBRIDGE.0030 #1-4

GEOPHYSICAL EXPLORATIONS LIMITED

620 FEDERAL BUILDING • EMPIRE 4-7815
TORONTO 1, CANADA

June 2, 1954

Details of Geophysical Survey on Copper Prince Mines Limited, Claims Nos. S-56016 - 17 & 18 to accompany report dated February 3, 1953.

Line cutting, under supervision of Percy R. Jarvis, 693 Lorne St.S. Sudbury, and J.H.Evans, Geophysical Explorations Ltd., 620 Federal Bldg. Toronto - 6 miles -- 30 days x 4 --- 120

Spontaneous Polarization Survey, using Nicholls & Roe Potentiometer, by J.H.Evans, 496 Readings ----------6 days x 4 ------- 24 ✓

Field plotting, drafting and report writing 2 days x 4 - 8

Total days credit ------ 152

GEOPHYSICAL EXPLORATIONS LIMITED

J. H. Evans

per J.H.Evans,
Director

120

GEOPHYSICAL SURVEY

by

SPONTANEOUS POLARIZATION TECHNIQUE

for

COPPER PRINCE MINES LTD.

TORONTO, ONTARIO

in

FALCONBRIDGE TWP.

ONTARIO

by

GEOPHYSICAL EXPLORATIONS LTD.

TORONTO CANADA

October - December 1952

FIGURE I

Plan and Equipotential Contours on North Portion of Property

Scale : 1" = 200'

0 100 200 300 400

LEGEND

Lines along which observations were made

BL.A Base lines

Equipotential contours of spontaneous polarization potentials. Interval = 50 mv.

Depression contours

Quartzite

Conglomerate

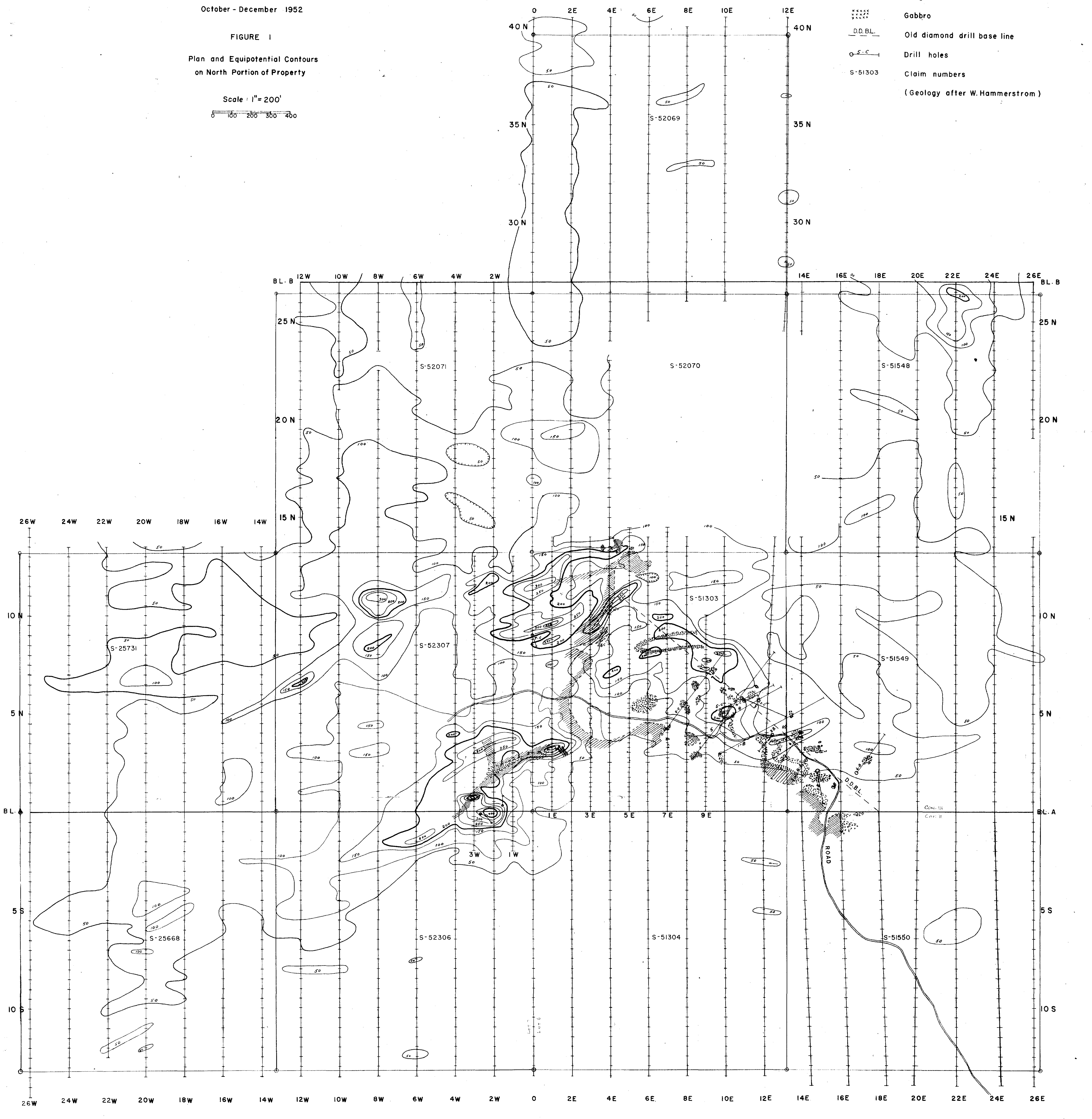
Gabbro

D.D.BL. Old diamond drill base line

Drill holes

S-51303 Claim numbers

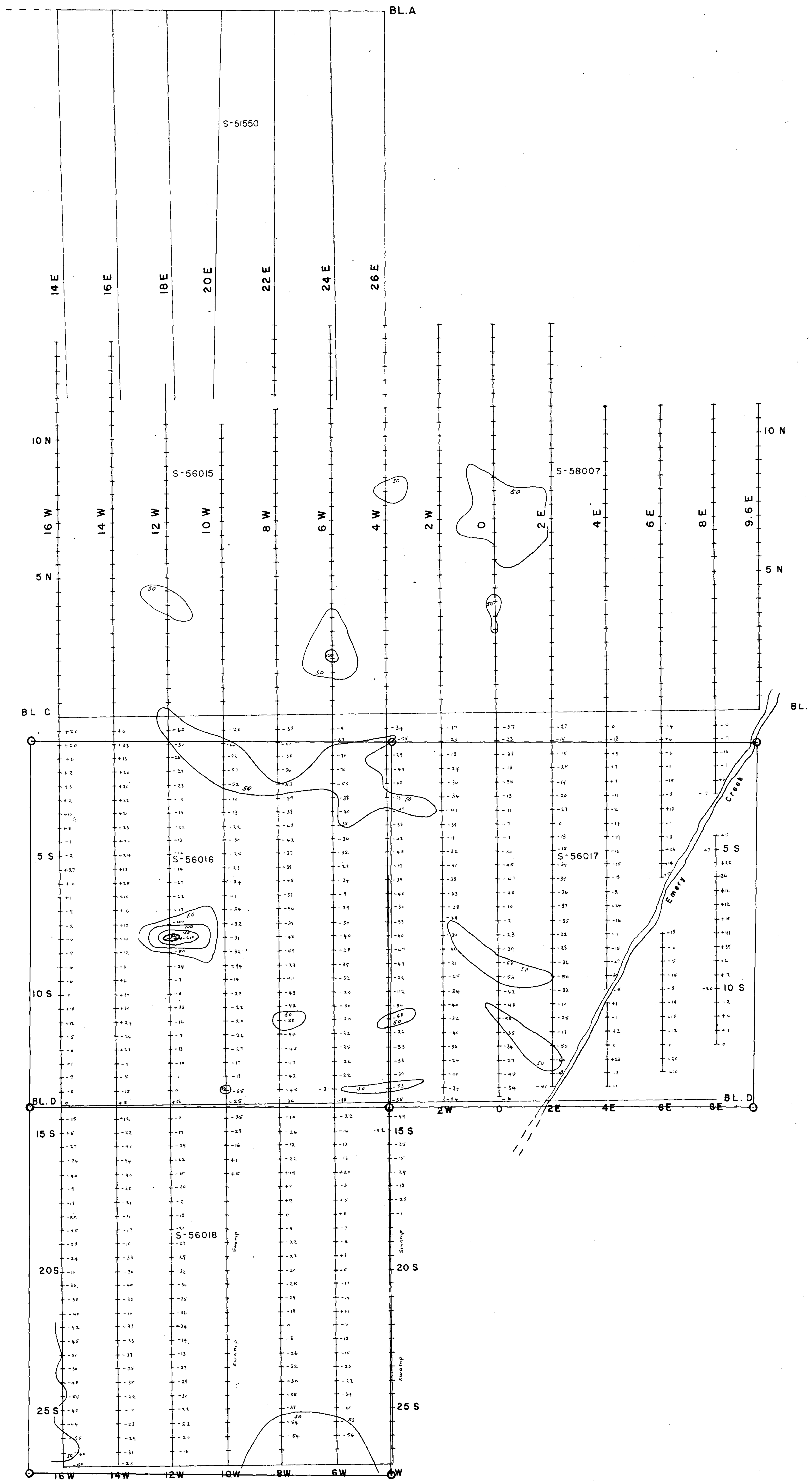
(Geology after W. Hammerstrom)



FALCONBRIDGE - 0030 - #1

41I10SE0281 2030 FALCONBRIDGE

200



GEOPHYSICAL SURVEY

by

SPONTANEOUS POLARIZATION TECHNIQUE

for

COPPER PRINCE MINES LTD.

TORONTO, ONTARIO

in

FALCONBRIDGE TWP.

ONTARIO

by

GEOPHYSICAL EXPLORATIONS LTD.

TORONTO CANADA

October - December 1952

FIGURE 2

Plan and Equipotential Contours on South Portion of Property

Scale: 1" = 200'

0 100 200 300 400

LEGEND

Lines along which observations were made

BL.C Base lines

Equipotential contours of spontaneous polarization potentials, interval = 50 mv.

(1mv. = 0.001 volt)

S-56015 Claim numbers

Claim posts.

Reading values in millivolts

FALCONBRIDGE-0030-#2

1

210

GEOPHYSICAL SURVEY

by

MAGNETIC TECHNIQUE

for

COPPER PRINCE MINES LTD.

TORONTO, ONTARIO

in

FALCONBRIDGE TWP.

ONTARIO

by

GEOPHYSICAL EXPLORATIONS LTD.

TORONTO CANADA

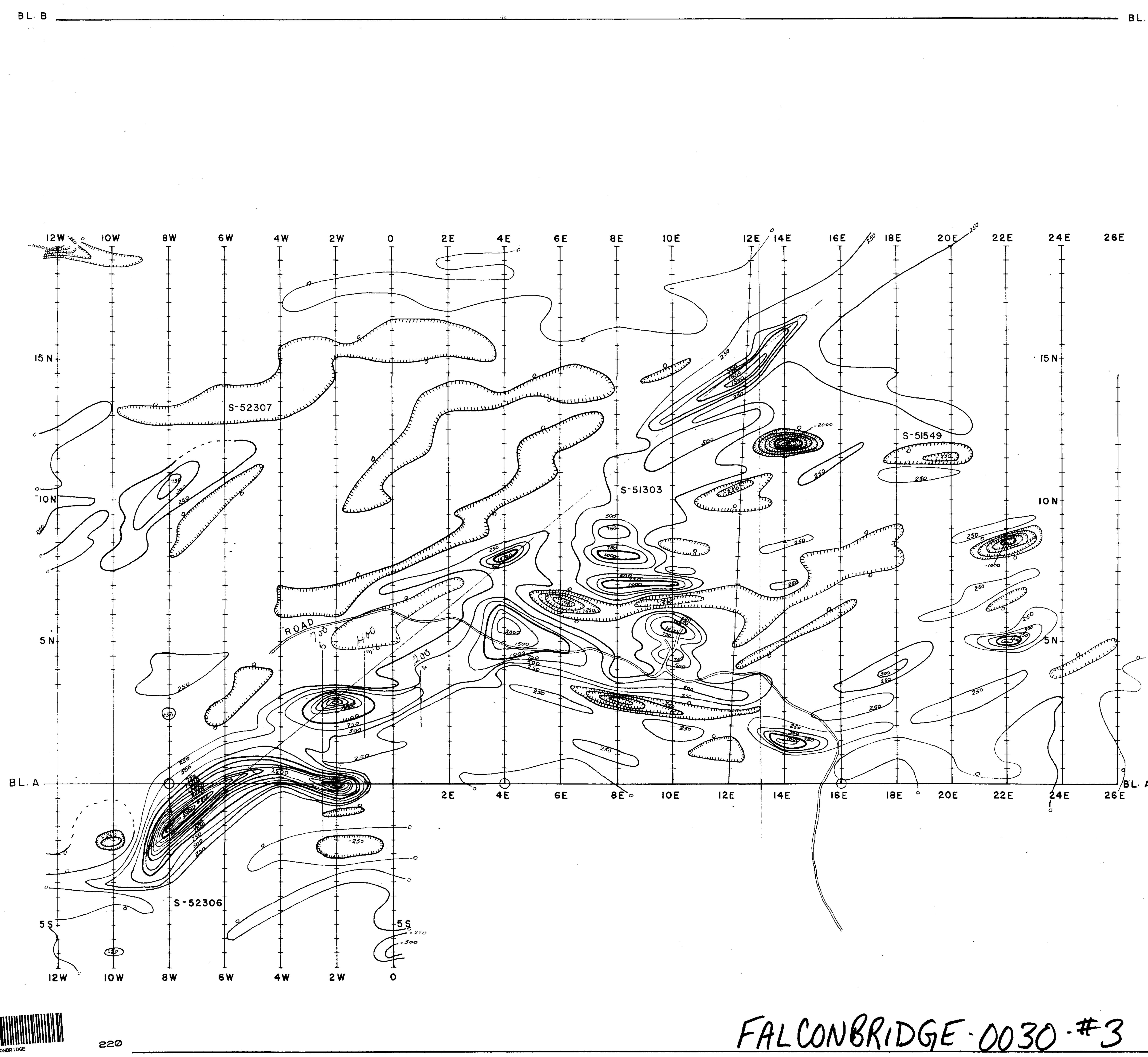
October - December 1952

FIGURE 3

Isomagnetic contours

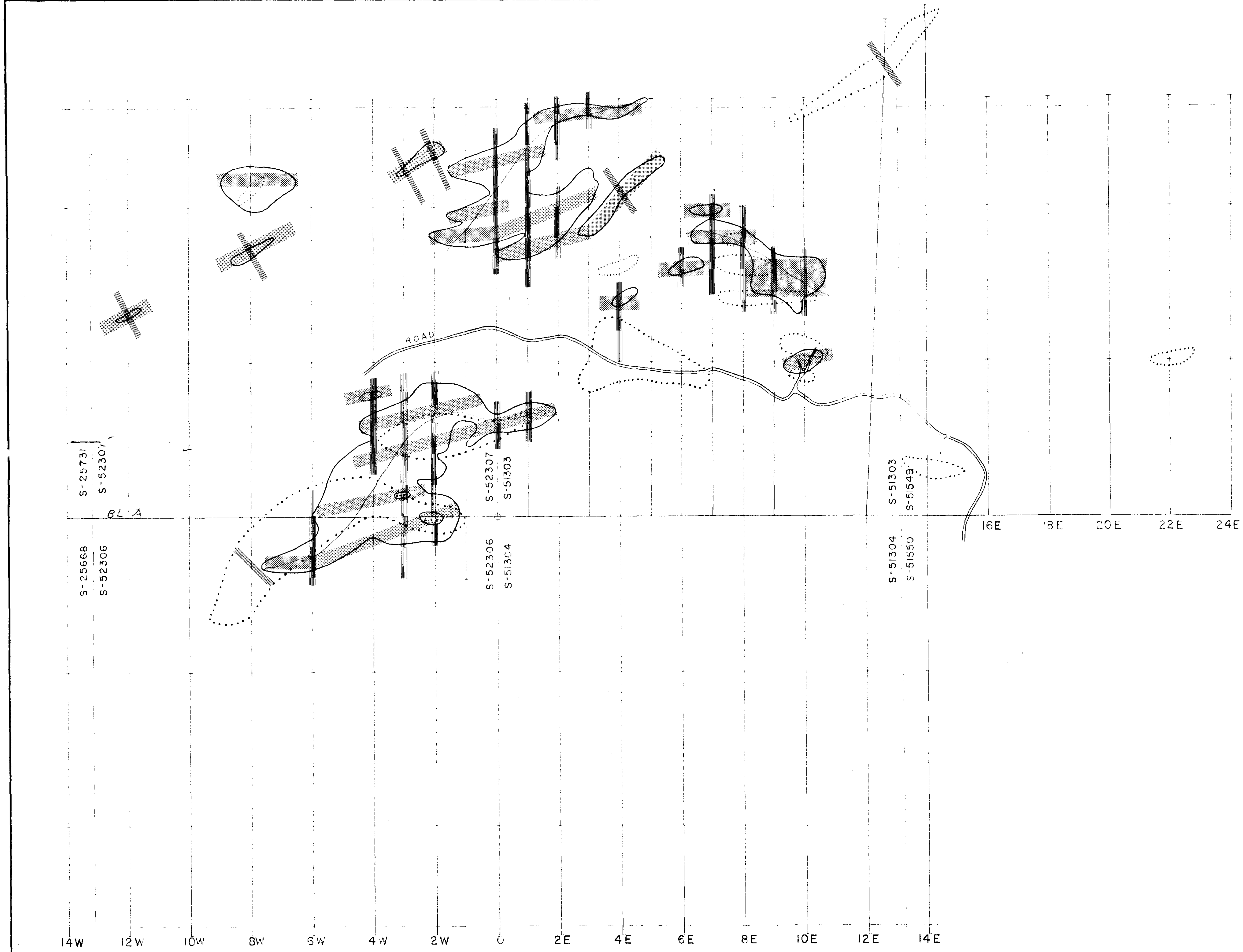
LEGEND

5N	Lines along which observations were made
BL. A	Base Line
250	Isomagnetic contours (isogams)
	Interval = 250 gammas below 1000
	500 gammas above 1000
250	Depression contours
	Base stations
S-52307	Claim numbers



220

FALCONBRIDGE-0030-#3



GEOPHYSICAL SURVEY

by

ELECTRICAL & MAGNETIC TECHNIQUES

for

COPPER PRINCE MINES LTD.

TORONTO, ONTARIO

in

FALCONBRIDGE TWP.

ONTARIO

by

GEOPHYSICAL EXPLORATIONS LTD.

TORONTO CANADA

October – December 1952

FIGURE 4

Interpretations & recommendations

Scale 1" = 200'

0 100 200 300 400

LEGEND

- Lines along which observations were made
- Spontaneous polarization equipotential curves of 200 mv. value
- Magnetic isogams of 750 gamma value
- Zones of sulphide mineralization geophysically indicated
- Recommended cross-section drilling
- S-51303 Claim numbers

FALCONBRIDGE-0030-#4