G.P. 6707 NTS 104 I

Review of Geophysical Surveys on
Turnagain River Project,
Laird Mining Division, B.C.

June 5th. 1967 H.D.MacLean.

Falconbridge Nickel Mines Limited,
P.O. Box 125,
Noranda, Que.

June 5th.1967.

Mr.S.N. Charteris,
Falconbridge Nickel Mines Limited,
1112 West Pender Street,
Vancouver 1, B.C.

re: Turnagain River Project,
Laird Mining Division,
Pease Lake Area,
G.P. 6707 NTS 104 I

Dear Mr.Charteris:

This letter report has been adopted as a vehicle for communicating some comments and opinions pertaining to the geophysical programme near the Turnagain River Area. Thank you for bringing the matter to my attention. Since there will doubtless be an extensive follow up to this survey, it will eventually provide an interesting case history and check of interpretational techniques.

INTRODUCTION

Geophysical surveys consisting of magnetometer and E.M. work, were carried out on selected portions of the Turnagain River project in conjunction with an intensive field investigation there during the 1966 season. The prospect itself and such matters as location, access, geological setting and work performed are adequately described in a report by McDougall.[1]

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1. McDougall, J.J.; Preliminary Report on Turnagain Copper Nickel Prospect B.C., December 1966.

This report is concerned only with certain aspects, methods and techniques of the geophysical surveys, and an interpretation of the causes of some of the anomalous values. Only the Ronka MK 1V and magnetometer surveys will be considered hereunder. It is understood that an E.M. 16 survey was also conducted in the area. The results of this survey are not presently available but when they are an addendum dealing with their interpretation will be attached hereto.

COMMENTS ON SURVEY METHODS

Since this is an internal report a description of the survey method is omitted. This has been covered adequately elsewhere and the interested reader can persue the topic in these other reports.[2]

In regard to the E.M. survey the only significant observation made is concerned with the "noise" level. The in phase and out of phase components of the secondary field are measured in terms of percent of the primary field. The observed readings are presented on maps of the area in analogue form, such as on the plan of the Horsetrail Showing area which is bound herewith as figure 1. In areas en-

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2. Magnetometer Survey, MacLean,H.D. G.P. 6620
   Magnetometer Survey, North Courtenay Grid
   C B S 3 Compulsion River Area, Saskatchewan, November 9th.1966.

   E.M. Survey, MacLean,H.D. G.P. 6702
   Ground Follow up to airborne Geophysical Surveys
   Fort Portal Area, Uganda for Killembe Copper Mines, Uganda, East Africa.

tirely free from conductors these readings should be 0 or some other constant value dependant on the instruments circuitry. The analogue trace should then be a smooth line of constant height and would show anomalies only when conductors are crossed. Random deviations of the analogue trace reflect noise. This can be geologic in origin or it can be entirely spurious, being caused by variation in coil spacing or attitude. The former is caused by minor bedrock conductors, or more frequently by variations in overburden thickness or conductivity. Noise from this source has been largely eliminated by the Ronka MK 1V E.M. by the use of large diameter coils, (1 meter) large coil separations, (200 feet) and a low primary frequency (876 Hz) which couples well with low resistivity metallic conductors and quite poorly with the higher resistivity overburden conductors. However, noise from the latter source can be appreciable where terrain is rough. The coils must be exactly co-planar or variation in the in phase and out of phase reading will occur. Occasionally where terrain is rough, proper allignment of the coils is impossible due to the one being obscured from the other by intervening topography. Further, the signal strength varies inversely as the cube of the coil separation. Hence, a 1% change in separation (two feet) causes a 3% change in the amplitude of the in phase component.

The records show a considerable noise level in some areas of plus or minus 10% but are generally quite stable. The high amplitude of the anomalies permits the use of a very small scale in the plotting of the data (1" = 80%) which effectively obscures minor fluctuation in the trace. However, it would also obscure weak anomalies in the area. Where records are good, conductors have been identified by anomalies of 5% to 10%. Where overburden is deep or sulfide content drops to lower than 20% this type of anomaly becomes important. Small anomalies should not be ignored simply because their amplitude is much lower than that of other anomalies in the area. The amplitude fall off might be explained by thickening of overburden or by a decrease in the percentage of sulfides contained in the conductor zone. Sections of a grid which are relatively unresponsive should be examined closely for these subtle anomalies. A first class operator like Steve Presunka would be able to obtain sufficiently noise free records to identify small anomalies; the procedure might however slow up the rate of progress of the survey. Anomalies located to date of course are of such high amplitude they could not possibly be missed.

GEOPHYSICAL REMARKS

The E.M. survey in the vicinity of the Horsetrail showing has been re-plotted and is attached hereto as figure 1. At least six major anomalies are immediately apparent and have been numbered HT 1-6. The only map of the magnetic survey available was a photo reduced contour map. The information has been superimposed on the E.M. map as an overlay (figure 1 M) but it is necessarily quite inaccurate.

Anomaly H 1 appears to extend from (35 ≠ 00W, 18 ≠ 00S) to 30 ≠ 50W, 20 ≠ 00. It is a quite narrow south dipping sheet; though some increase in width is evident at line 31 ≠ 00W. Ratios of in phase to out of phase suggest a very highly conductive body, such as would be caused by massive sulfides. The strong magnetic anomaly with pole reversal at the east end of the conductive zone suggests pyrrhotite, though the lack of magnetic highs or lows to the west suggests that this mineral comprises only a small portion of the conductors in that area. Overburden is very shallow.

Anomaly HT2 is caused by a thick south dipping conductive sheet. The conductive zone is fifty feet wide in places and suggests several parallel sheets. Overburden would be very light; it is not possible that there be more than about ten feet vertically above the conductor. There does not appear to be a significant magnetic anomaly associated with the conductor. This may be obscured however, and individual profiles would be required to establish the presence or absence of magnetic minerals.

Anomalies H3-H6 all appear to be south dipping. The conductor dimmensions are roughly defined on figure 1. Magnetic information is too inconclusive to establish whether or not there is associated magnetite or pyrrhotite. Conductivity size factors for all of these anomalies appear high and chances are exceptionally good that there is silfide associated with at least some of the conductors. HT 1 may be graphite at its west end but HT 2 is almost certainly a sulfide anomaly.

There is some evidence of a conductor near the discovery showing at (0 +00, 2 + 00E) unfortunately the lines could not traverse the area due to topography. The strong magnetic anomaly with negative polarity suggests pyrrhotite. The pole reversal phenomenon is frequently associated with weakly ferromagnetic substances like pyrrhotite. A continuation of the anomaly westward is not indicated by the E.M. survey but thick overburden may tend to obscure any anomaly. The readings over the conductor could be obscured by the noise.

Interpretation of the magnetic and E.M. data is complicated both by the difficulty of transposing the data from the photo reductions, and by an apparent discrepancy in the numbering of the grids for the magnetometer and E.M. surveys. The base line on the E.M. map is clearly marked as 26 S. comparison with other maps and with the magnetic contour map indicate that this line should be 20 + 00S, one of the two is clearly in error, since the position of the river varies by six hundred feet on each map. If the E.M. map is in fact numbered incorrectly it would have the effect of removing the magnetic association entirely from anomaly HT 1. One would then conclude that this conductor represented a shear, or graphite or pyrite. The magnetic association with anomaly H2 would be difficult to realize also, since there is at least a two hundred foot discrepancy between the source of the magnetic anomaly and the electrical axis. Since the conductors are south dipping, this may be accounted for by geologic conditions, such as the magnetic minerals, pyrrhotite and magnetite, being located south, or down dip from the conducting minerals. The discrepancy might also be explained by errors introduced in the blow up process. Evidence of pyrrhotite in the conductors from magnetic information is much less if allowance is made for positioning error. Actual magnetic profiles would be necessary to state more positively whether or not there is evidence of pyrrhotite, and therefore sulfides. Since some of the conductors cannot be more than a few feet deep, a direct test by sampling seems to be indicated. Further attempts to establish the presence of sulfides in the conductors by geophysical criteria would unfortunately be pure speculation.

RECOMMENDATIONS

Sulfides are indicated in most of the conductors. Testing of these anomalies commensurate with recommendations in McDougall's report should be carried out.

More geophysical work is indicated in the area, as chances are very good that similar conductors may be located elsewhere in the geologically favourable area. Exploration could proceed as in the Discovery-Horsetrail area. That is, lines could be cut at two hundred foot intervals and surveyed with the Ronka MK 4. The use of this instrument may be compromised in areas of strong topographic relief. Since sulfides in the area are quite massive and conductors are strong, it may be adviseable to use the Crone J.E.M. in these rough areas. The J.E.M. instrument is not as sensitive as the Ronka MK 4 but is useful for certain purposes.

The simple vertical loop may be useful in defining conductor axes in the vicinity of the Discovery showing.

The best method of surveying the Turnagain River area would be by a helicopter E.M. survey. The system operated by Lockwood Surveys or the new Barringer Helicopter E.M. would be ideal for this job. The immediately geologically favourable area should be investigated by this method as chances of it detecting sulfide bodies similar to those at the Discovery and Horsetrail Showings are excellent.

OTHER RECOMMENDATIONS

The E.M. survey of the anomalous areas would be most interesting, an inspection and interpretation of that survey could be added to this report whenever it becomes available. It would be most interesting to see the subsequent investigation of these anomalies from trenching and drilling operations. Corelation of the E.M. and magnetic profiles with the conductive material would be of considerable use both for case histories and for general interpretation experience. This information could be appended to the interpretation remarks in this report for the sake of completeness.

Respectfully submitted,

H.D.MacLean, P.Geoph.

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June 5th.1967.

Mr.S.N. Charteris,
Falconbridge Nickel Mines Limited,
1112 West Pender Street,
Vancouver 1, B.C.

re: Airborne E.M. Survey, Turnagain Project
N T S 104 I

Dear Mr.Charteris:

The quickest and most efficient method of covering the area of interest at Turnagain River would be by a helicopter E.M. survey. Fixed wing airborne surveys usually require specially adapted aircraft; hence, it is not possible to avoid large ferrying charges. The small mileage involved in this survey would make the ferry charge unrealistically disproportionate to the cost of the actual survey. The "button on" systems which are adaptable to various aircraft are not yet proven to be satisfactory. The Aero Services Helicopter E.M. requires a special aircraft. Hence, ferry charges would be high.

A preliminary shopping effort indicates that there are two satisfactory helicopter E.M. survey systems available from companies operating out of Toronto. Both systems are adaptable to the Hiller 1100 helicopter which you will have available. Both survey systems are operated and maintained by an engineer supplied by the contractor. We would be obliged to do our own flight path plotting and preliminary field interpretation; the engineer would assist in these operations. The contractor would of course provide a final "official"interpretation.

The only commercially operable system available this summer that I know of so far is the Helicopter E.M. Survey from Lockwood Engineering. This airborne survey technique comprises an E.M. and magnetometer system. Included in these is an A.T.N. altimeter for record correction and a camera for flight path recording. The E.M. system, which consists of 2 co-axial coils is contained in a thirty foot bird slung underneath the helicopter. Also, there is a magnetometer contained in the bird. In phase and out of phase, E.M. field components, magnetic intensity and altitude are recorded continuously on a chart. The recorder is synchronized with the camera so that ground position as revealed on the photograph can be related to chart position.

The engineer of course operates the equipment from the helicopter. He is also obliged to act as navigator since there is no space for a third man. Our experience with this system in the North West Territories suggests that it is a fast reliable survey. It is easy to interpret and flight information is available immediately upon completion of the flying. To minimize down time due to dammage or malfunction, a duplicate of each component of the system is available on the survey site. Thus in case the bird is dropped, the survey need not fold up while spare parts are located in Toronto.

The system is air freighted from Toronto to the helicopter base nearest the survey location. It is then attached to whatever suitable aircraft is available. It is necessary to get D.O.T. approval for flying the contraption since the weight and balance of the machine are altered slightly by the attachments and other modifications. Once approval has been obtained for a particular aircraft model however it applies to all machines of that model. Hence, approval could be obtained for a helicopter similar to yours in Vancouver, or even Toronto, if one could be located. Once the bird mountings on the aircraft are approved the bird is flown to the survey area and need not be removed until the end of the survey.

The Lockwood system rents for $3,100.00 per week or $11,100.00 per month, part periods being pro-rated. This includes rent for all the systems listed above, and the operator engineer. It does not include the latter's living or travelling expense which we are also obliged to pay. Neither does it include air freight charges. The operator usually accompanies the equipment when it is shipped to ensure that no dammage is sustained in loading and unloading operations. Rental will apply then while the unit is fitted to our helicopter and for the period required for D.O.T. approval of the modifications. We would also be paying rental at the full rate if inclement weather or a high electrical noise level (from thunderstorms) prevented flying.

The area you mentioned in our recent telephone conversation could be covered in about one day of flying. Hence, the bulk of the charge for the system would be included in a form of ferrying. Of course Lockwood might give us a break on the freight and installation charges if other work for the system would develop in the area. This would be a matter for you to work out in detailed bargaining. As a matter of fact they do have commitments in Western Canada, if not in the Turnagain River Area, but they are reluctant to tie up one of these systems on a small amount of flying. A combination of bad weather, noise, government red tape and shipping delays could tie up the equipment for as much as three to four weeks. Lockwood is unwilling to risk this as it would involve the loss of several thousand line miles of flying. A system as yet uncommitted for work will be available August 1st. If this is not too late, I would recommend that you arrange to obtain this system as it will probably be the easiest to install and the most trouble free. It will adequately detect conductors of the type located by the ground survey.

Costs will have to be negotiated but as a rough guide the rental plus air freight return to Toronto can be used as a guide. I would think a minimum of two weeks would be required. One for the freighting and one for the survey. Bad weather or noise conditions would conceivably extend the period. You might get a significant cost reduction if transit and freight costs,- the rental being chief among them,- could be shared.

If you are interested in this survey you might contact Mr.John Skinner or Mike Turner at Lockwood Surveys Ltd., 1450 O'Connor Drive, Toronto, Phone 755-1141.

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Barringer Research, in a recent advertisement in the Northern Miner described a new helicopter E.M. Its basic operation is similar to that of the Lockwood system but improved electronics and coil mounting techniques make the system much more stable. It can be flown in the vicinity of thunderstorms with hardly a ripple of noise. This would be a signal advantage in the Yukon where noise levels are high more often than not in the summer. Unfortunately, commercial type surveys will not be available till September.

The prototype of the instrument which I am assured is fully operable is available to anyone who would like to conduct surveys with it on a cost plus basis. The unit rents for $7,000.00 per month. In addition, two engineers are required and we would pay their salaries on a cost plus basis; probably $2,500.00 per month, for the two men. Contingencies etc. would put the cost of the Barringer system to just about the same as the Lockwood survey. The same deal as above would apply concerning rental for transit time, weather and installation.

The advantage of the Barringer system is of course its high stability. This is partially offset by Lockwood's many thousands of hours of experience with interpreting the data from their system. Since basic costs are roughly similar it would depend what sort of a deal could be worked out to share the transit costs. Barringer seemed reasonably certain that there were other groups in your area that would be interested in participating in a pilot survey.

If you are interested in the Barringer system, you might contact Mr.D. Whiteman, Barringer Research Ltd., 304 Carlingview Drive, Rexdale (Toronto) Phone 677-2491.

It would appear that barring a cost sharing deal the cost of the survey will be in the $10,000.-$12,000. range. A cheaper survey may still be available through the use of "button on" systems. I will continue looking for such a system and if one is suitable will let you know about it as soon as possible.

Regards,

H D MacLean

H.D.MacLean.

c.c.Dr.A.S.Dadson.