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R. A. GONZALEZ

REPORT ON
THE GIANT NICKEL MINE
1974

Lloyd: G.M. - Geology

INTER-OFFICE CORRESPONDENCE

Any thoughts are appreciated

TO L.P. STARCK

DATE FEBRUARY 19, 1974

CC:

FROM R.A. GONZALEZ

SUBJECT MINE EXPLORATION PROPOSAL

The following is a brief summary of a number of projects that could be undertaken in an attempt to work out the complex nature of the mine. Since we all have slightly different thoughts on what is to be done it would be beneficial if we could get together soon, so as to clarify our various ideas.

I think the best approach to unraveling the mine would be a two part study consisting of the detail mapping of a small section of the mine and an in depth study of one or more mineralized bodies. The object being to understand a small area and relate that area to the rest of the mine and finally to the ultramafic as a whole.

I visualize this type of study being strongly geared toward a petrographic examination, with the idea being to determine the distribution of rock types and their contact relationships as well as textures. Combining this with our structural information should give some indication of the genetic and tectonic history of the area.

One study that can be initiated would be to study the foliation in the foliated diorites bordering the ultramafics. The direction of foliation will resemble the shape of the upper surface of the ultramafics. Generally, it would be expected that the foliated minerals would be elongate in a direction parallel to the contact and by determining this the original configuration of the contact should be apparent.

In conjunction with this petrographic work there should be a study of a mineralized zone for the purpose of examining the textural relationship of the sulfides. A number of specific projects can be undertaken. As an example, in a number of nickel bearing ultramafics, such as the Sudbury and Muskox intrusions, it has been found that sulfides attributed to a magmatic origin have nearly constant and similar sulfide ratios. That is the

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sulfide ratio of pyrrhotite to pentlandite to chalcopyrite, formed by magmatic segregation, is constant within a given body, and this ratio is similar to other magmatical segregated bodies; this ratio is a consistent eight pyrrhotite to one penlandite to one chalcopyrite. This is a more refined technique than the Ni - Cu ratios previously used at the mine. In a magmatic deposit this 8:1:1 ratio is a function of equilibrium between the sulfides and the remaining liquid; this ratio is variable depending on the final rock type but the variance cause by different rock types is slight. With any great deviation from this ratio, higher or lower, the source of the sulfide would be other than a magma. Generally speaking, if the ratio is low you would expect that the sulfur and/or copper came from outside the magma since copper is more chalcophile than nickel.

It seems to me that any detail study has to be oriented toward a petrographic study. With that in mind, I have made arrangements to use the facilities at U.B.C., and as soon as the spring term ends we will be allowed to remove whatever equipment we require.

In conjunction with the above proposals may I also recommend that we strongly consider at least two long holes below the 2600 level. The idea behind this is to drill a steep hole to test this ground as well as determine if there is a bottom to the ultramafics and any rock type changes with depth.

Yours truly,

R.A. Gonzalez

RAG/mm

SM-MP-173

INTER-OFFICE CORRESPONDENCE

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DATE FEBRUARY 22, 1974

TO MR. R.A. GONZALEZ

CC: MR. L.P. STARCK
MR. L. de ROUX

FROM FRANK HOLLAND

SUBJECT GIANT NICKEL - GEOLOGY

Your memo to Mr. Starck dated February 19, 1974 contains some interesting thoughts relative to developing a hypothesis concerning the emplacement of the ore bodies, and hence the greatest probability of locating further deposits.

Should we be able to develop such a hypothesis it will be of value at the Nickel Mine, and also in the evaluation of other ultra mafic rock emplacements, for their ore bearing potential.

As far as is known at the present time, this ultra basic plug is unique, in the coast orogenic belt, in that it contains economic deposits of nickel/copper sulphides.

The foregoing is however, a half truth, as if one considers mineralization, strictly in the sense of nickel/copper sulphide mineralization, of a tenor to give it the classification of "ore", disregarding tonnage. There are within sight of the the Nickel Mine, other ultra mafic "plugs" containing ore grade mineralization, so that perhaps it is the area that is unique.

Most of the ore controls are fairly well known, on an empirical basis and the utilization of these empirical relationships has resulted in the definition of several ore bodies.

The approach you are suggesting has to a greater or lesser degree been carried out over the years, which remark, does not imply that we can't improve upon and amplify the existing groundwork. From early delineation, and throughout most of its mining period, Walter Clarke kept detailed mapping, structurally, and with reference to rock types, of the 4300/4600 ore bodies. The purpose of this was quite broad, being intended to determine structural conditions, and rock type distribution.

The associated assay plans, give in detail, the nickel, copper, cobalt distribution. The drill core logs, give a great deal of detail on the rock types, that is not apparent from the plans, due to limitations of scale.

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GEOLOGICAL, GEOCHEMICAL & GEOPHYSICAL REPORT ON THE GIANT NICKEL MINE

by

R.A. Gonzalez

January 1974

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INTRODUCTION

This report is to summarize the results of geological, geochemical and geophysical surveys carried out at the Giant Nickel Mine. The work was done from June to November, 1973, under the supervision of the geological staff of Giant Mascot Mines.

At the Giant Nickel Mine the ultramafic complex has been investigated by numerous people since nickel-copper bearing mineralization was first discovered in 1923, but as yet the ore controls have not been accurately explained. The 1973 surface exploration program was the first phase of a four phase program to assess the ore potential of the mine and to outline areas favourable to hosting economic mineralization. For the most part, the area investigated by surface exploration was confined to 1,000 feet on either side of the underground workings.

All previous information, both surface and underground, were used as an aid for correlation and interpretation of the final geological map. In addition, frequent discussions were held with the mine geological staff to ensure that petrological identification, by the exploration staff, was in agreement with present mine terminology.

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We do not have another ore body under development where such a study is possible.

Eastwood, did a detailed mapping and analysis of rock types approaching the 1600 ore body, to determine rock type variations as an ore body is approached. From his initial work he carried out a fairly comprehensive analysis of horne blende variations in the vicinity of an ore body, and also, to a degree considered the ramifications of the "Crumbly Alteration" which he called "Pervasive Shearing", in recognition of the apparent foliation within these rocks.

Other investigators, Cheyney, University of Washington; Naldreh, University of Toronto; Muir, University of Toronto, have carried out studies relating to sulfurization, trace elements, rock zoning, etc.

I believe Muir's paper summarizes a lot of this work, and summarizes in my opinion, the conditions that can be observed around an ore body, as well as anyone has. There are, of course, all the early investigators.

I think that before we embark upon further detailed studies of the type you are suggesting, you should review all of the available literature and attempt to set out the conclusions reached by all these people, in a manner that will enable us to summarize the work done and conclusions reached to date, and from this we should then be able to determine what further work is necessary to amplify and coordinate all of the accumulated knowledge to date, and hopefully eventually define the ore controls sufficiently to assist in the further search.

With regard to the deep holes you are suggesting, Lloyd will be drilling a deep hole in the 1500 area shortly, following it up with one closer to the portal.

Lloyd has been involved with all of the recent investigators and is familiar with their work. I would suggest that in the very near future you spend several days with Lloyd to discuss what is known to date, so as to assist you in developing this summary. You would probably have till about the middle of April to get this material together.

Yours truly,

Frank Holland

FH/mm

PETROLOGY

General

As an aid to future interpretation, the following is a brief description of the rock types as defined in the course of the mapping.

Peridotite

This rock occurs sporadically as small bodies exposed in creek beds and occasionally along road cuts. Because olivine weathers rapidly, peridotites are not expected to exist as outcrops except in areas of recent exposure, i.e., the bottom of creek beds. Therefore, in areas of poor rock exposure it may be overlooked.

Peridotites are usually black or dark greenish-brown and composed of equigranular olivine and pyroxene. The pyroxenes are distinctly larger than the olivine crystals. Hornblende, equal in size to the pyroxenes, may or may not be identifiable. One variety of peridotites contains ghosts of hornblende, up to 3 cm. across, poikilitically enclosing grains of olivine. In this rock the hornblende varies in its development from being totally obscure to readily visible, and this texture suggests a later metamorphism of the peridotite. The peridotite weathers to a buff colour.

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One variety of peridotite found near the surface breakthrough of the "512 Raise" and near the base of the cliff north of the 3550 East Portal can be termed a poikilitic hornblende peridotite porphyry; large ghosts of hornblende are surrounded by a matrix of fine-grained olivine. Scattered grains of olivine and minor pyroxene are poikilitically enclosed in large, up to 3 cm. across, crystals of hornblende.

Fine grained, weakly disseminated pyrrhotite is almost always associated with the peridotite.

Hornblendic-Pyroxenite

This rock type is the most abundant ultramafic, and it is found mostly in the northern half of the mine property; it also covers a small area near the headwaters of the south fork of Texas Creek.

This unit can be divided into two groups, based on textural differences. The first and most common is a hornblende pyroxenite, composed of medium-grained pyroxene crystals and hornblende crystals of various sizes. Olivine may or may not be visible. The ratio of pyroxenes to amphiboles varies with no apparent pattern but generally the hornblende content increases as one approaches hornblendite, and locally the hornblende pyroxenite-hornblendite contacts are gradational, whereas at other locations the contacts are sharp.

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The second variety is a poikilitic hornblende pyroxenite in which olivine and pyroxene are poikilitically enclosed in large, but varying in size, crystals of hornblende. Pyroxene, amphibole and olivine make up the ground mass.

Pyroxenite

Although two types of pyroxenite, olivine pyroxenite and bronzititic pyroxenite, are recognized, they were grouped as one unit since no apparent correlation existed.

The bronzititic pyroxenite is mainly composed of fine-grained and equigranular crystals of brown (bronzite) pyroxenite. The content of hornblende is low, and olivine, when visible, appears to consist of only trace amounts.

Hornblendite

This rock consists of an aggregate of over 95% black medium to coarse-grained crystals of hornblende with interstitial filling of fine-grained hornblende and/or white plagioclase. Some sections show pegmatitic features composed of long, up to 15 cm., prismatic crystals of hornblende.

With only one exception the hornblendite occurs adjacent to diorite and generally the hornblendite/ diorite contact is sharp, but a gradational contact has also been observed.

It has generally been accepted that since the hornblendite exhibits a cross cutting relationship to the surrounding country rock, that it is a later stage residual development of the parent ultramafic mass, and generally it was implaced along structural weaknesses mostly along the diorite/ultramafic contact.

The hornblendite is generally massive, but it is also the only ultramafic rock which locally shows a gneissic structure.

Metamorphic Rocks

Several varieties of metamorphic rocks were observed, but since they are not known to host Giant Mascot type ore bodies and are of no real economic importance, no attempt to differentiate the unit was made. Schists and quartzite are the most common; they cover a broad range of metamorphic facies, ranging from the lower grade quartz-albite-biotite-muscovite subfacies to the higher grade garnet-staurolite-kyanite subfacies. All of the subfacies of the metamorphism are regional metamorphic features. The only effects of the intrusions are a slight coarsening of grain size and the formation of muscovite and chlorite porphyroblasts near the contact.

Structurally this unit appears to be a roof pendant, and in the Pass area this roof pendant extends downward over a thousand feet.

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Plutonic Rocks

Two major rock types were recognized - diorite and norite.

Diorites are the most common plutonic rock and several varieties are present, but for mapping purposes only two varieties are described - diorite and pink diorite. The diorite is a medium-grained rock composed of feldspars and mafic minerals, predominantly hornblende, with varying amounts of pyroxenes. In the southwestern part of the map the diorites have been subdivided into diorites and pink diorites. The pink diorite is similar to the diorite except the feldspars (plagioclase) take on a pink colour.

Norites, similar to the diorites, are divided into two classes: norite and pink norite. The norite is a medium-grained rock composed of feldspar and pyroxene (bronzite); hornblende, when visible, represents only trace amounts. The pink norite is medium to coarse-grained with pink coloured plagioclase.

The pink coloured plagioclase has been explained as being due to minor amounts of ferrous oxide in the plagioclase crystal lattice.

MINERALIZATION

No massive sulphide occurrences were encountered but several disseminated zones were noted. Vein type mineralizations, to a lesser extent, have also been observed. For location of mineralization refer to Geology Map.

Half way up the south side of the cirque, a one foot wide sulphide vein ("A") was located in norite. The vein outcrops in two locations 1,000 feet apart. The attitude of the vein is east-west and dips 45^{o} to the south. The vein material was 10% pyrrhotite and 2% chalcopyrite in a pyroxene ground mass.

On the ridge of the cirque good-grade float was found ("B") in a pyroxenite. This float was well rounded and was underlain by barren diorite bedrock. Pyroxenite float, some of which is mineralized, is common. Generally they are well rounded boulders and do not appear to have come from any nearby source.

In Cabin Creek, below the Cabin Showings and east of the Carlson Showing, are good exposures of weakly mineralized pyroxenite and olivine pyroxenite. Two chip samples (C & D) were taken across 20 feet in the creek bed in the better mineralization. They assayed .09% nickel and .06% copper; and .07% nickel and .02% copper, respectively.

Minor sulphide mineralization was located in peridotite and pyroxenite in the vicinity of the 2200 and 1800 ore bodies ("E"). An area was trenched in the vicinity of angular well-mineralized float. In the bedrock minor mineralization associated with a north trending fault assayed .25% nickel and .23% copper over five feet.

This area has been subsequently drilled with no additional sulfides outlined.

A well mineralized ("F") area exists east of the Climax ore body, as reflected in the geochemical survey. Weakly mineralized pyroxenite is scattered over an area approximately 1,000 feet in diameter. The area is poor in rock exposures but certainly represents one of the best areas found for underground exploration.

A well mineralized zone is exposed in Camp Creek between the water storage tanks and the Chinaman level ("G"). This zone is rather extensive and at one location a three foot zone of 5% sulphide mineralization was noted.

Two hundred feet north of the largest water storage tank ("H") is an area of abundant mineralized float. No mineralized outcroppings were seen. From the angular nature of the float it appears that the source area is in the vicinity of the float.

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Up slope from the old bunkhouse near some old trenches is abundant well-mineralized float which assayed better than 1% nickel/copper.

Peridotite in Texas Creek, south-southwest of the 2600 portal ("K") was found to contain at least 5% visible sulphides. This area is believed to be an extension of the main peridotite body known as the "Portal zone". From underground and surface drilling it appears that the portal zone is associated with a synclinal structure.

Along Texas Creek approximately half way between the mill and Texas Pond ("L"), mineralized pyroxenite is exposed in the creek bed. Both vein and disseminated sulphides are present, and the disseminated zone extends intermittently over four hundred and fifty feet.

Disseminated sulphides are common in the ultramafic ("M") along the South Fork of Texas Creek. Total sulphide content is well under 1%.

Northwest of the Chinaman ore body is a surface exposure of mineralized breccia. The mineralization is in trace amounts but the rock type is of interest.

The "Road Showing" ("P") is an extensive area of mineralized hornblende pyroxenite and warrants additional work, preferably bulldoze stripping and trenching.

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ALTERATION

Scattered throughout the ultramafics are three types of alteration:

1. iron oxide
2. crumbly alteration
3. actinolite alteration

Iron oxide is the most widespread alteration product, and it is common in the north half of the mapped area, and especially common around the Chinaman portal. This alteration shows no relationship to ore or structures but does appear to be confined to the pyroxenites.

Crumbly alteration is a common mine alteration product. Surface exposures confine the alteration to the peridotite, but a variety of crumbly alteration is reported from underground work to be found to a lesser extent in pyroxenites. This alteration product does not stand up to weathering, therefore it is seldom visible except along road cuts and occasionally in stream beds.

Actinolite alteration is clearly related to faults and fractures, and it extends a fraction of an inch to a few feet into the wall rock on either side of the fractures. The intensity of the fracture does not appear to control the degree of alteration of the wall rock.

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In addition to the above alteration it is noted that the hornblende diorite is altered at the contact with the ultramafics. This alteration consists of chloritization of the ferromagnesian minerals, often to approximately 100 feet into the diorite.

STRUCTURE

Although topographic expressions of faults are common, the actual fault plane is seldom seen. Three major fault orientations have been noted: 295 - 340°/30 - 60°; 50 - 80°/60 - 75°; and 135°/45° to 65°. Many contain gouge carying in thickness from one to five inches. The northwest fault trend is the most prominent and appears to be either the result of rejuvination along a regional zone of weakness or superimposed on this zone.

Folding within the ultramafics and surrounding plutons and metasediments has not previously been reported. Where possible the attitude and orientation of the folds was determined by one or more of the following criteria, used with discretion:

1. pitch of the c-axis of hornblende crystals in foliated to gneissic diorites (good)
2. orientation of vein sets (poor)
3. banding or layering within the ultramafic (good)
4. schistosity with the metasediments (good)
5. geological contacts

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The criteria used for outlining folds is not generally obvious and great care should be taken in interpreting the structures. Many structural geologists believe that at least 30 percent rock exposure is required before absolute delineation of structural features is possible. The average density of outcrops on the property is less than five percent.

Correlating the surface information with underground work increases the confidence in interpreting these fold structures. Generally the folds have a very narrow frequency in relation to their amplitude. The fold limbs dip very steeply and probably extend below the lowest level on mining. Formation of these folds is a combination of intense compression with relief or stress in the vertical plane. These same forces may also have been involved in the movement or accumulation of the ore bodies, especially if it can be demonstrated that the ore bodies are parallel and within a limb of a fold. Additional interpretive work is necessary to substantiate this idea.

In addition to the faults and folds, three strong shear zones were noted. One zone near the Pass anomaly is confined to the diorites, and it appears to be a hingeline of a broad fold or the remnant of the top of the intruding ultramafics. Two shear zones are located on the eastern end of the property; one near the Dolly showing and the

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other on the Pioneer Crown Grant 2,000 feet east of the Chinaman portal. Both zones strike in a northwest direction and the Pioneer shear zone is the most intense and is accompanied by extensive rock alteration.

Interpretation

By interpreting some of the detail structures as a reflection of the entire ultramafic complex, an interesting theory has developed. It appears that the ultramafics are part of a broad regional dome. The following evidence is sighted:

1. Several folded structures near the pond have axises which are radially distributed about a common centre;
2. Texas Creek, as it leaves the pond, forms a broad arch;
3. Diorite to the north and northwest of the property is underlain by ultramafics, and it is suggested that the contact dips to the north and northwest; and
4. If the surface map is divided into quarters, the northeast and southwest quarters are dominated by northwest trending faults and the northwest and southeast quarters are dominated by northeast trending faults.

The above evidence strongly suggests that the ultramafics, and possibly the surrounding diorites, have been folded into a broad dome-like structure.

In addition, an east-west cross section showing the distribution of known ore bodies, in a general way, suggests that the tops of known ore bodies form a gentle arch with the Brunswicks and Pride of Emory being the highest,

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followed by the slightly lower 4300, 4600, 1900, 1600, 1500 and 1400 ore bodies. They are followed by lower ore bodies, 2200, 2000, 1800, 1700 and Climax, and the Portal zone and Dolly ore bodies are the eastern-most and lowest. The Chinaman is north of this cross section and below the crest of the dome, and it is expected to be slightly below the Climax--which it is.

GEOCHEMISTRY

General

In the three target areas mapped, detail geochemical soil sampling was completed along the grid lines. Soil samples were collected every 100 feet along lines 200 or 400 feet apart.

It was our intent to collect soil samples from the B horizon, although the soil horizon is generally poorly developed and often impossible for anyone less than a soil expert to separate the various soil horizons. This poor development of the soils should be kept in mind while attempting to interpret the results of the survey.

Initially the soil samples were sent to Fraser Laboratories for assay by atomic absorption, but were later assayed by the mine assay office.

Determination of threshold, anomalous and most anomalous values

Nickel and copper assays for each soil sample are plotted and contoured on the geochem maps. Threshold, anomalous and most anomalous values, were determined by the following methods. Two techniques were used as a check to verify that the threshold anomalies were reasonable. The first technique used was to construct a histogram (Fig. 1) showing the relative frequency plotted against assay values. Threshold is considered any value above the medium to the first standard deviation; anomalous is any value between the first and second standard deviation; and most anomalous is any value above the second standard deviation.

To check the threshold value levels a graph (Fig. 2) showing cumulative percent distributions was made. This graph is plotted by determining the ratio of the number of samples with assay values below a certain value against the total number of samples. Then the ratio is plotted against the value on a logarithmic paper. The plotted points become a cumulative percentage distribution. The graph of cumulative percent distribution for nickel consists of four linear segments (five for copper) joined successively, and therefore has three discontinuity points. The discontinuity points correspond to assay values and also define the limits of "threshold", "anomalous" and "most anomalous" values. The two graphs were compared and the threshold value levels

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corresponded closely. From this the threshold value for this area was taken at 40 p.p.m. for nickel and 60 p.p.m. for copper; anomalous values for nickel were 100 p.p.m. and 100 p.p.m. for copper; and most anomalous is considered any value over 300 p.p.m. for both nickel and copper.

Interpretation

Throughout the property soil profiles have generally been poorly developed. This presents a double problem in interpreting the geochemistry. Firstly, because the profiles are not fully developed, near surface mineralization may be represented only by a slight increase in the soil-metal content; and secondly, any local slight increase in soil-metal content can easily be discounted as being local or false anomalies not related to mineral deposits. Both the nickel and copper geochemistry maps outline anomalous conditions over four known ore bodies: Climax, "1800", "2200" and possibly the Chinaman. The anomalies can be rated as moderate to intense. Extrapolating this information from known ore bodies to other locations, several areas stand out as targets.

Three areas seem to have the greatest interest:

1. east and northeast of the Climax ore body;
2. east and southeast of the Dolly Showing; and
3. east of the "Road Showing".

The area east and northeast of the Climax ore body is a prime target because this area recorded the highest geochem values, and also ore bodies seem to exist in cluster when near the contact with diorite. The surface geology indicates favourable rock type, and weak sulfide mineralization is present in many outcrops. In the vicinity of the Dolly Showing, a large area of anomalous geochemistry exists. This area is adjacent to the eastern contact between ultramafics and diorite. Southwest of the surface stripping and including the area east of the road showing is an area of moderately high soil geochemistry. Geologically, little is known due to lack of outcrops. In addition to the geochemistry, this area is of note because of an I.P. high located on the eastern edge.

Two additional areas are worth noting:

1. south of the "1800" ore body, and
2. west of the 3550 east portal near the "Cabin Showings".

The "1800" area anomaly may only be the down slope migration of metals from the "1800", "2000" and "2200" ore bodies, as well as contamination from the old 3550 dump, except for the fact that sulfide mineralization has been observed in this area. The "Cabin Showing" area is of interest because of its favourable geological setting - ultramafic nose within diorite - as well as sulfide mineralization. In addition, this area is also outlined in the 1952 Pulse I.P. survey and in this summer's I.P. survey as being anomalous.

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GEOPHYSICS

Introduction

A magnetometer survey, using a McPhar M600 magnetometer, was completed along the grid lines at stations 100 feet apart. Any anomalous readings were followed up by saturating the area with line spacings of 20 feet and stations every 20 feet along the lines until the anomaly was completely outlined.

Interpretation

Interpretation of the magnetometer results, as a direct tool for locating ore deposits, is nearly impossible. Its indirect value, as an aid to interpreting I.P. results, justified the survey. The problem of interpreting the results is mainly due to the fact that the known ore zones do not fit into a specific magnetic response. For example, the mineralogy of the ore bodies are such that one would expect to have a mag high over an ore body, yet the areas around one-half of the ore bodies in the Texas Creek drainage give a low magnetic response. This low magnetic response is also not due to the fact that these areas are mined out since both the "Climax" and the "1800", which either are being mined or being prepared for mining, both reach the surface or are very close to it, and give a low magnetic response. Also, some of the deep ore bodies,

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"4600", "4300", "1900" are below areas of magnetic highs, yet the "4600" and the "1900" are essentially mined out, and the "4300" is 50 percent mined. The "512" ore body, which comes to the surface, is mined out with the exception of a 40 - 50 foot thick crown pillar and is beneath a mag high. This is the only ore body which is correlated to a magnetic response. The response must be due to sulfides in the crown pillar.

In conclusion there does not seem to be a correlation between magnetic response and ore bearing mineralization.

CONCLUSIONS

A slightly mofidied geological map is presented with the main difference, from previous maps, being the addition of major folded structures and a more detailed outlining of faults and fracture systems. Rock units are slightly different than those of other authors since the mapping was to conform to current mine terminology. Generally outcrop patterns and geologic boundaries correlate with previous authors.

A number of favourable areas have been outlined for additional work. The most interesting lies east and northeast of the Climax ore body. This area is readily accessible to underground drilling and should be of primary interest.

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The second area of interest is the large geochemical anomaly around the Dolly showing. This area is so large as to make it impossible to pick specific drill targets, therefore it is recommended that additional close spaced lines be cut to be followed up by a detailed soil geochem survey.

The area east and northeast of the Road showings is of some interest. This area has corresponding magnetometer and geochemical highs in a rather restricted area. It is also in the vicinity of an I.P. anomaly. This area is readily situated for either bulldoze stripping and trenching or for diamond drilling.

Another area, but of low priority, is located south to southeast of the "1800" ore body. This area, poor in outcrop, is outlined by high geochemistry and magnetic response similar to those over the "1800", "2000" and "2200" ore bodies. The main interest here is that sulfides have been found on the north end of this anomaly but the area covered by the anomaly has yet to be prospected.

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THEORY OF ORIGIN OF THE ULTRAMAFIC BODY

From the recent work carried out at the mine, as well as current research being conducted at the University of British Columbia and elsewhere, sufficient information is available to theorize the origin of the ultramafic body surrounding the mine.

On a regional basis, all the ultramafic bodies within a twenty mile radius of Yale, B.C. have several features in common. Generally they are all associated with regional zones of weakness, either in a northwestern direction or a northern direction. The vast majority of the bodies are serpentinized or altered in such a manner that the original rock type is obscured. Only one large ultramafic body (Giant Mascot) is enclosed in crystalline rocks; the remaining bodies are surrounded by regionally metamorphosed pelitic rocks. There are a number of small, isolated, ultramafics adjacent to or enclosed within crystalline rocks and the petrology is similar to the Giant Mascot ultramafics.

Recent published work indicates that an amphibole-enstatite-olivine rock can be regenerated from a serpentinized mass at a temperature of 700^{o}C and a pressure of 1000 bars. Previous work at the mine has indicated that such temperatures were present. Pressure required is common to those existing within the earth's upper crust.

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What I am proposing is that the regional distributed ultramafic bodies existed as shallow bodies which were metamorphosed into serpentinites during regional metamorphism; probably during the Middle Cretaceous (100 - 115 million years B.P.). During the Upper Cretaceous (80 million years B.P.) the area was intruded by the Spuzzum Batholith. During this intrusion the Spuzzum engulfed the Giant Mascot ultramafic (as well as some other ultramafics; notably Area 4 and Area 7 ultramafics on the Nickel Syndicate Claims along Cogburn Creek). The Giant Mascot ultramafic is surrounded on at least three sides; the southern contact of the ultramafics is obscured, but metasedimentary rocks are very close to the contact. Enough heat and pressure were available from the crystalline rocks to metamorphose the serpentinite to produce the present regenerated ultramafic.

Many of the present structural features are a result of this intrusion. As the intrusive engulfed the ultramafic the two bodies moved upward; this vertical movement accounts for the long, nearly vertical, limbs of the surface folds; i.e. the folds are stretched in a vertical plain and probably compressed in the horizontal plain. This upward movement also accounts for the doming of the ultramafic as well as the zone of weakness along the diorite/ultramafic contact. The ultramafic, as it moved upward, would be expected to be more mobile, and as the surrounding rocks cooled the upward movement would continue until the cooling effect would overcome the upward movement, and a slight relaxation would be sufficient to cause a weakening along the contact margins.

A number of petrographic problems are also explained; especially the origin of poikilitic hornblende crystals. The hornblende within a pyroxenite is not compatible as a primary mineral; it can exist as a secondary mineral, i.e. as a product of some metamorphic process. Hornblende pyroxenites are present in the northern half of the ultramafic (with a few exceptions). Remember also that the pluton surrounds the ultramafic on at least three sides, the southern contact of the ultramafics is obscured, with metasediments to the south. The main heat source is from the north and west. Consequently, this heat source was sufficient only to produce hornblende near the source of heat; i.e. the north half of the ultramafic. As we explore west of the Brunswicks and closer to the heat source we should encounter more hornblende pyroxenites. ?

Ralph Gonzalez

RAG/lg

Ralph Gonzalez, Geologist

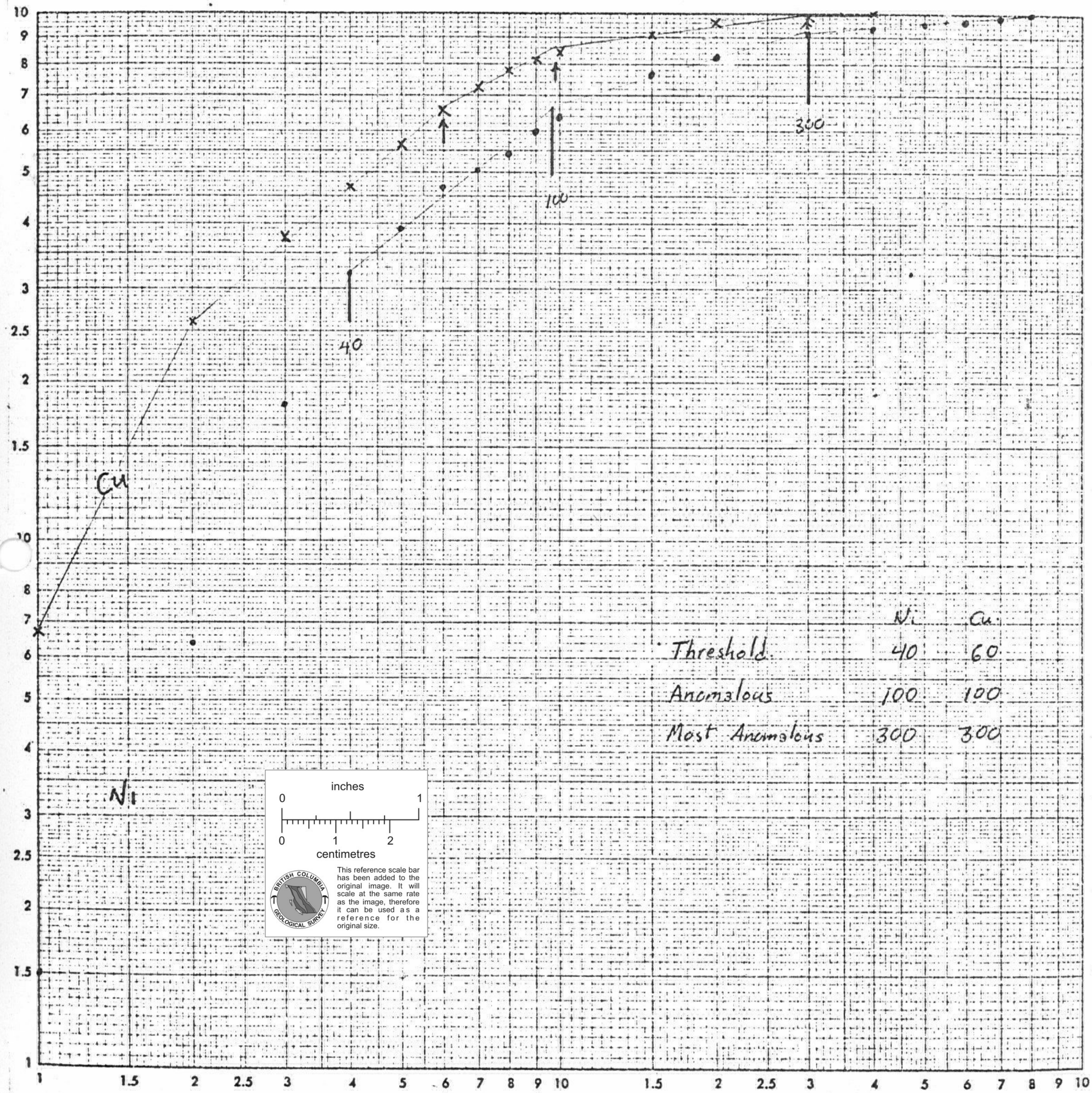

Figure 2 Cumulative % Distribution of Ni and Cu Contents.

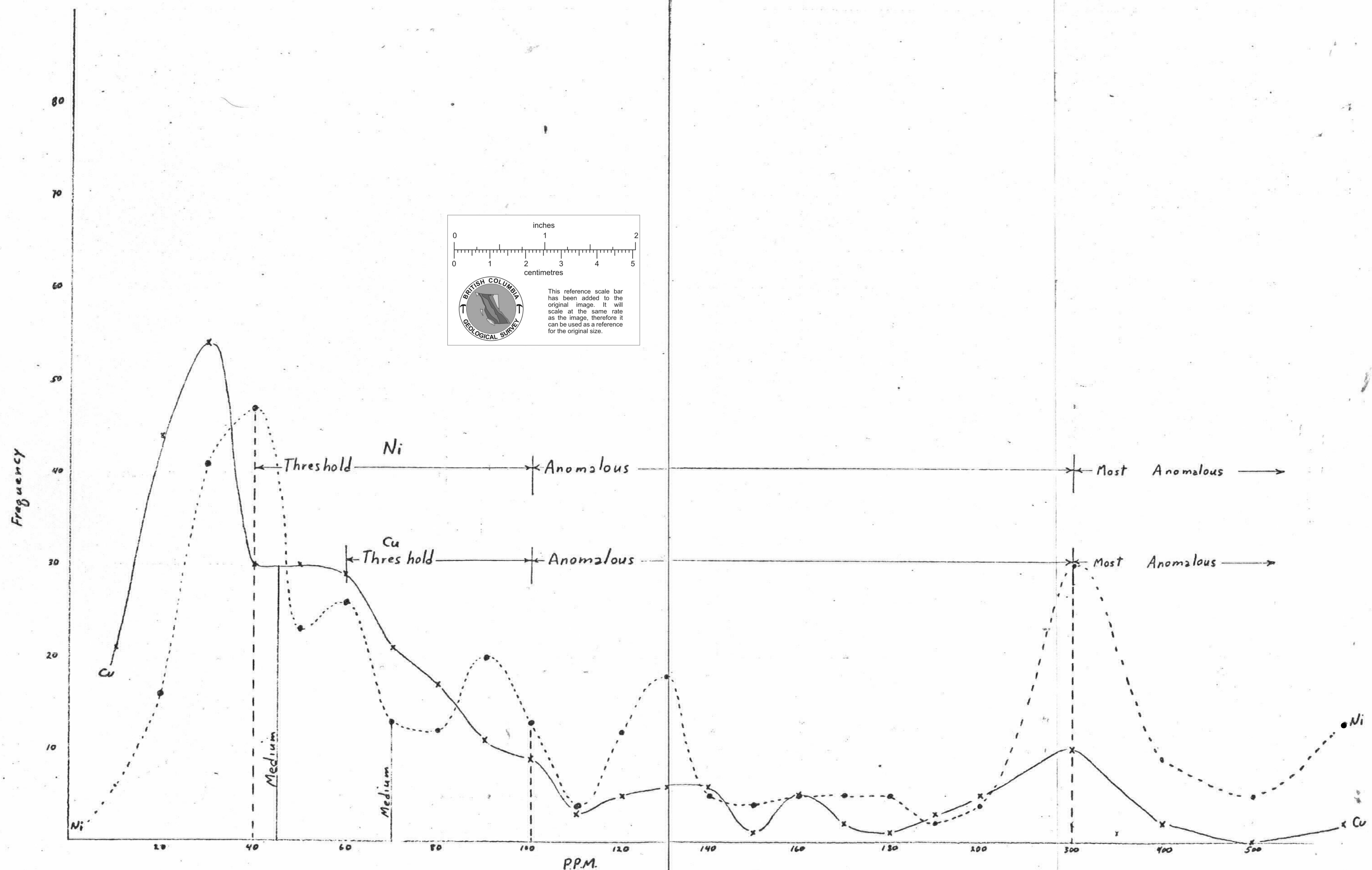

Figure 1 Histogram showing the relative frequency of Ni-Cu in Ultramafics