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ASHLAND OIL CANADA LIMITED

Subject: Assessment of Della Mines Ltd. (NPL) Property.

Location: Mt. Haskin, Cassiar Mining District, B. C., Canada.

Date: July 5, 1973

By: Neil Campbell, Consultant

SUMMARY

The Mt. Haskin property of Della Mines Ltd. situated in rugged terrain in the extreme northern part of British Columbia consists of 135 mining claims on which considerable surface exploratory drilling and underground testing has been done. Viewed broadly, the geology may be characterized as typical of a "porphyry copper" environment with a body of granite porphyry intrusive into siliceous and limy sediments resulting in local concentrations of mineralization of two general types. Disseminated molybdenum and copper are found in and near the intrusive body. Whether sufficient testing has been done to determine whether commercially viable ore bodies of this very important type do exist is not clear from the records at hand but if not, appropriate exploration is warranted. The second type of mineralization (known as skarn, contact metamorphic or pyrometasomatic deposits) are represented by several discoveries. General experience elsewhere shows that ores of this type are commercially valuable in some instances but are characterized by heavy sulphide content, a large variety of metals and high but commonly erratic distribution of values. There are indications that these generalizations apply to the Mt. Haskin skarns.

The Della "B" skarn zone has been tested by a total of 2524 feet of underground headings and 5911 feet of underground core drilling. Making no allowance for dilution in mining nor reduction of high erratic values, the

reserves indicated by this drilling are estimated at 370,000 tons averaging 0.47% Cu, 2.16% Zn, 0.23% Bi and 1.72 oz. Ag/T. It might be inferred from the drill data that an additional like amount or reserves exist while the total possible or potential reserves contained in all skarn type discoveries may be many times the "indicated" reserves.

The detailed testing of the Della "B" zone disclosed complex mineralization containing disappointingly low values in copper, lead and zinc but with appreciable silver and extraordinary values in bismuth. The base metals and silver are insufficient to support profitable mining by themselves, but taken together with bismuth, the possibility of commercial grades must be considered seriously.

The Free World demand for bismuth is 5.3 million pounds annually. The supply, mainly derived as a by-product in the production of other metals, is relatively inflexible. This tends to make the price highly sensitive to demand which, owing to its major use in pharmaceuticals and cosmetics, is relatively volatile. It is believed, nevertheless, that a realistic long range price may not be far from its current level of $4.75 to $5.00 per pound. Cominco Limited, the probable market for bismuth concentrates, pays less than 60% of bismuth contained in lead concentrates.

A rather superficial analysis of the economics of production indicates that the net smelter returns from ore of the undiluted Della "B" grade would be about $18.52 per ton. As operating costs at an arbitrary 3,000 T/D level would be in the same range, production of ores of this grade appear marginal. Accordingly, efforts to develop additional tonnage is not warranted.

It is recommended that surface surveys to determine the disseminated Cu-Mo possibilities for ore in close association with the intrusive be considered. Other studies which would firm up the economic outlook for ore of Della "B" grade are suggested.

PROPERTY

The Mt. Haskin property of Della Mines Ltd., consisting of 135 mining claims, is situated in the Cassiar Mountains of extreme north British Columbia, Canada, about 15 miles east of the mining community of Cassiar and 75 miles south of Watson Lake. It is about five miles from a highway and truck traffic. Della Mines Ltd., is a private company, the ownership of which is described in the following excerpt from the July 1, 1972 notes of Mr. C. M. Evans.

	No. of Shares	% Equity
Ashland Canada	598,012	27.31
Airth Grubstake Syndicate	48,488	2.22
Iso Mines Ltd.	646,751	29.53
R&P Metals Ltd.	646,751	29.53
Vendors: Krysko	200,000	9.13
Coutts	50,000	2.28
	2,190,002	100.0

1) Participation in the venture was originally secured through the Airth Grubstake Syndicate who, by written agreement, are entitled to 7-1/2% of any share interest acquired by Ashland. Between the Ashland and Airth interests, then, Ashland, R&P and Iso have virtually the same equity interest in the company.

2) Ashland's equity interest has been acquired as follows:

   a) 230,000 shares acquired in a "stock take-down" in 1969 for expenditures of $250,000 ($1.00/share for first $150,000 and $1.25/share for the remaining $100,000).

   b) 70,000 shares on a "stock take-down" for exploration of $70,000 in 1971 ($1.00/share).

   c) 346,500 shares acquired from Iso and R&P for a total of $2,00. This concession was arranged in order that the three major participants would have equal interests from this point.

3) The Vendors' share interest is limited to the present maximum of 250,000 shares from the total authorized 5,000,000 shares. The Vendors are the original prospectors who staked the claim blocks.

4) An exploration program in the amount of $100,000 to $135,000 will be carried out this summer by the major participants, and shares will be "taken down" at the rate of 2 shares for each $1.00 expended. This will increase the shares held by each of Ashland, Iso and R&P by 60,000 to 90,000 shares, but will not significantly alter the equity interests.

5) Iso and R&P have acquired their equity in Della Mines over a period of five years in exchange for exploration moneys spent on the property.

The claims cover part of a typical "porphyry" copper-molybdenum geologic environment comprised of deposits of disseminated Cu-Mo mineralization and several related but outlying contact metamorphic zones mineralized with copper, zinc, silver and bismuth. Early diamond drilling had tested a small disseminated molybdenum deposit reported to contain 13 million tons averaging 0.17% MoS_2. The outlying zones include The Della "A", "B" and "C" zones, The Dako, Chopper Pad, Snow and Dalziel zones. In addition to surface trenching and sampling, these zones were tested by 55 diamond drill holes totalling 26,096 feet in 1969 and seven holes totalling 3,211 feet in 1970. Of these, The Della "B" zone seemed most attractive and was selected for detailed diamond drilling and underground test work in 1971 and 1972. An adit was driven on the 5060 foot level and underground drilling was done. According to a communication dated October 10, 1972 from Mr. Andrew Robertson, the work done on this level totalled:

Drifting	1,325.1 ft.
Crosscutting	590.5 ft.
Slashing	161.6 ft.
Total	2,087.2 ft.
Drill footage	5,900 ft.
Drill holes	45

A second adit started on the 4,790 foot level was not carried far enough to fulfill its intended purpose but did involve an additional advance of 437.0 feet. Other work was done on surface showings and samples were submitted for metallurgical testing. Expenditures of Della Mines Ltd. to date have totalled ______

GEOLOGIC MODEL

The geology of the Mt. Haskin area conforms in so many ways to that of the typical "porphyry copper" environment that it may be useful first to describe this important mode of ore occurrence. Common characteristics of various features within this environment will be mentioned and their practical, economic significance will be described briefly. Using this composite, hypothetical model as a guide, the features one should look for at Mt. Haskin and their commercial significance can be better understood.

In figure 1,* an intrusive stock which may range composition from monzonite to granite, cuts sedimentary beds including some limestone horizons which are folded and faulted. Dykes of similar composition commonly cut both the stock and the invaded sediments. One or more breccia pipes may be observed. Two related kinds of chemical changes connected with the intrusion are found: changes in the composition of the silicate minerals resulting in new rock-forming minerals and deposition of metallic minerals, mainly as sulphides. The distribution of both the various new silicates and the metallics tends to relate to the center of heat and mineralizing solutions, resulting in a zoned relationship of

* S. E. Jerome; Geology of the Porphyry Copper Deposits, Titley and Hicks 1966, pp 75-85.

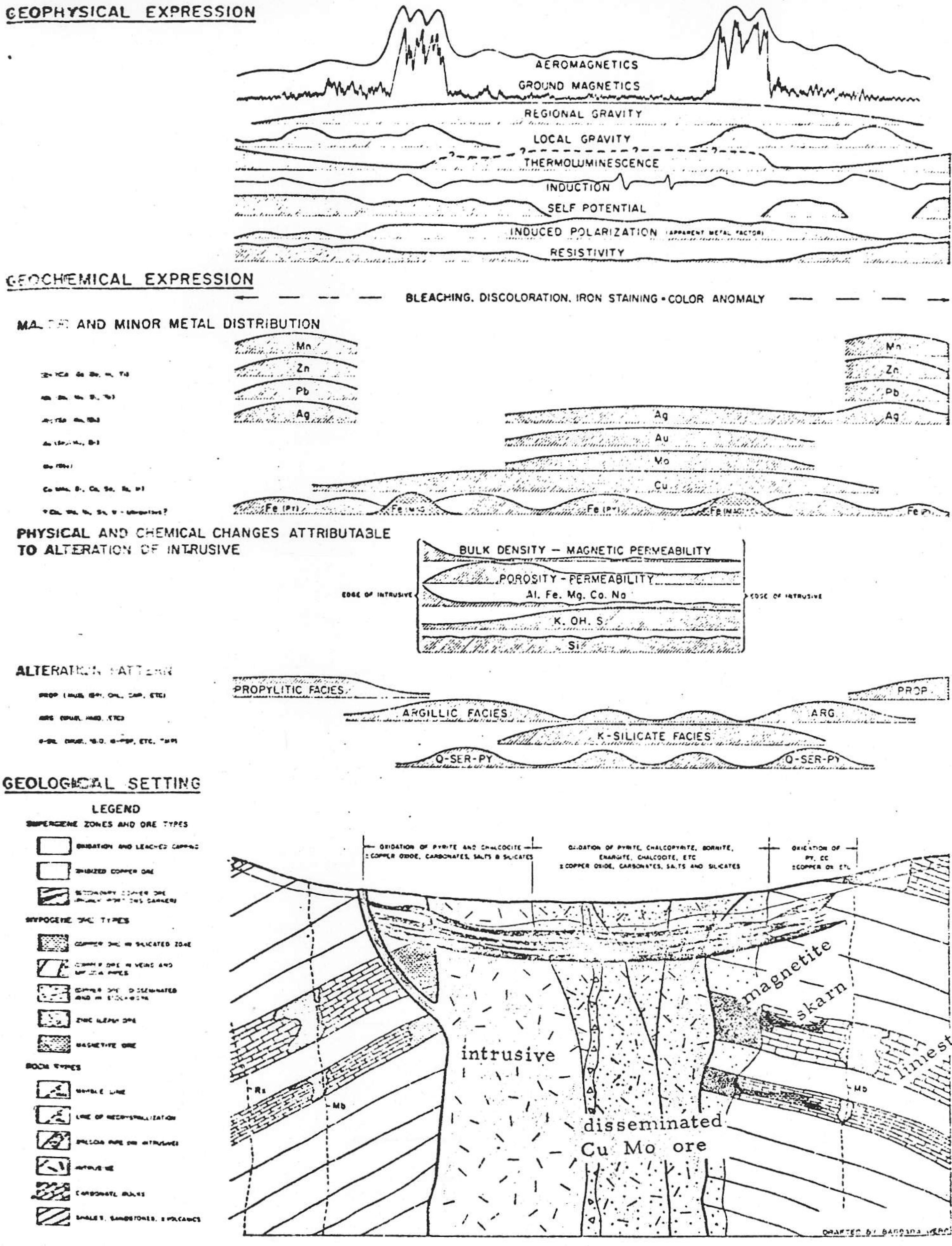

Figure 1: Generalized "porphyry copper" environment

several features. The center of activity (which post-dates the intrusion) may be in the intrusive itself or in the nearby invaded sediments. The center is commonly characterized by relatively abundant secondary potassium-rich feldspar (orthoclase) around which is a zone rich in secondary silica and potash mica (sericite). This passes outwards into a zone of chloritic or proplytic alteration. Where the invaded rocks are limestone (which is chemically reactive) magnetite may develop at or near the intrusive contact and, in close association with it, the "skarn" minerals including abundant garnet, epidote and various pyroxenes. Although the latter "contact metamorphic" minerals may be found along the intrusive contact, they relate primarily to sources of heat, solutions and structures which facilitate the introduction of solutions. Skarn zones may, therefore, be found at places remote from the intrusive contact.

The metallic minerals also tend to show a zonal distribution relative to the center of mineralization. Iron sulphides (pyrite and pyrrhotite) tend to be pervasive throughout all altered zones and to form a conspicuous halo around the entire complex. Disseminated molybdenite tends to be more closely associated with the center of mineralization but it is overlapped by disseminated chalcopyrite which comprises typical "porphyry copper" ores. Copper may also be found in other types of ore bodies. Chalcopyrite may be disseminated in the magnetite facies of the skarn zone. It may also occur in the silicate facies where it is commonly associated with heavy concentrations of iron sulphides notably pyrrhotite and minor values in lead and zinc. Beyond the skarn zone, limestones are commonly replaced by abundant silica resulting in cherty rock. This borders in turn on limestone which has been recrystallized or changed to marble. At the outer edge of the marble zone, bodies of zinc and lead sulphides may occur. Small quantities of gold may be associated with the copper zones but silver tends to be much more widely distributed. Antimony arsenic and bismuth also tend to have wide distribution in small amounts. Rhenium tends to occur in the molybdenite zone and cadmium with zinc. Figure 1 shows the effect of surface enrichment and also the geophysical and geochemical phenomena to be expected with various facies of the mineralization.

Close conformity to the above model is not always found in the field. Mineralization may accompany an expanding pattern of heat and hydrothermal introduction but if mineralization continues as temperatures recede, there may be telescoping or overlapping of various zones of mineralization. Furthermore, the source of heat and mineralizing solutions may not be strong enough to develop ore bodies although other manifestations are present. Also some mineralized facies may be well developed whereas others are weak or absent. Nevertheless, the model is widely used by explorationists in searching for and recognizing desired types of ore bodies.

Although individual ore bodies of various kinds within the "porphyry" environment may differ greatly from one mining camp to another, empirical observations show characteristic tendencies a few of which shall be mentioned. The disseminated "porphyry" ore bodies such as those in the Highland Valley, B. C. area tend to be very large, low grade and minable by open pit. Molybdenum may be present locally in the copper zone but tends to be more erratic in distribution. In some places, molybdenite is dominant. Magnetite iron ore bodies such as those mined at Texada and Tasu may contain significant copper values whereas nearby iron ores contain none.

Contact metamorphic or "skarn" type deposits commonly have a heavy iron sulphide content such that the term "massive sulphides" is often applied. The copper values may be exceptionally high but it is perhaps fair to say that the distribution of copper (and of lead and zinc) may be so erratic that profitable mining may be impossible. This is not to say that contact metamorphic copper deposits may not be valuable and worth searching for as indicated by the highly profitable Craigmont deposit in B. C. and the Mission deposit in Arizona. Even the smaller deposits such as Cominco's Coast Copper mine on Vancouver Island are of merit but throughout the Cordillera of North America there are countless skarn deposits where the discovery of high copper values preceded attempts at production which were disappointing because of the irregularity in distribution of values. Skarn deposits commonly contain small but commercially significant quantities of gold and/or silver. Lead, zinc and tungsten are commonly present with copper in concentrations too small to be of economic value. Ordinarily, bismuth and antimony are present but in quantities much too small to be commercially significant.

Having briefly discussed the more common features of a porphyry copper environment, the specific features of the Mt. Haskin area can be considered.

MT. HASKIN AREA-GENERAL GEOLOGY

An excellent description of the geology of the project area is given in the March, 1970 report by George L. Lamont which is reproduced as an appendix to the present report. To briefly paraphrase Mr. Lamont's descriptions, the geology of the area is dominated by an intrusive stock nearly circular in surface outline, 4,000 feet in diameter and with steeply-dipping contacts. The intrusive has a coarse-grained porphyritic granite core which grades to fine-textured, locally silicified granite marginal phases. A few dykes are seen, particularly in underground operations.

The granitic stock (see figure 2) penetrates a sequence of sediments at

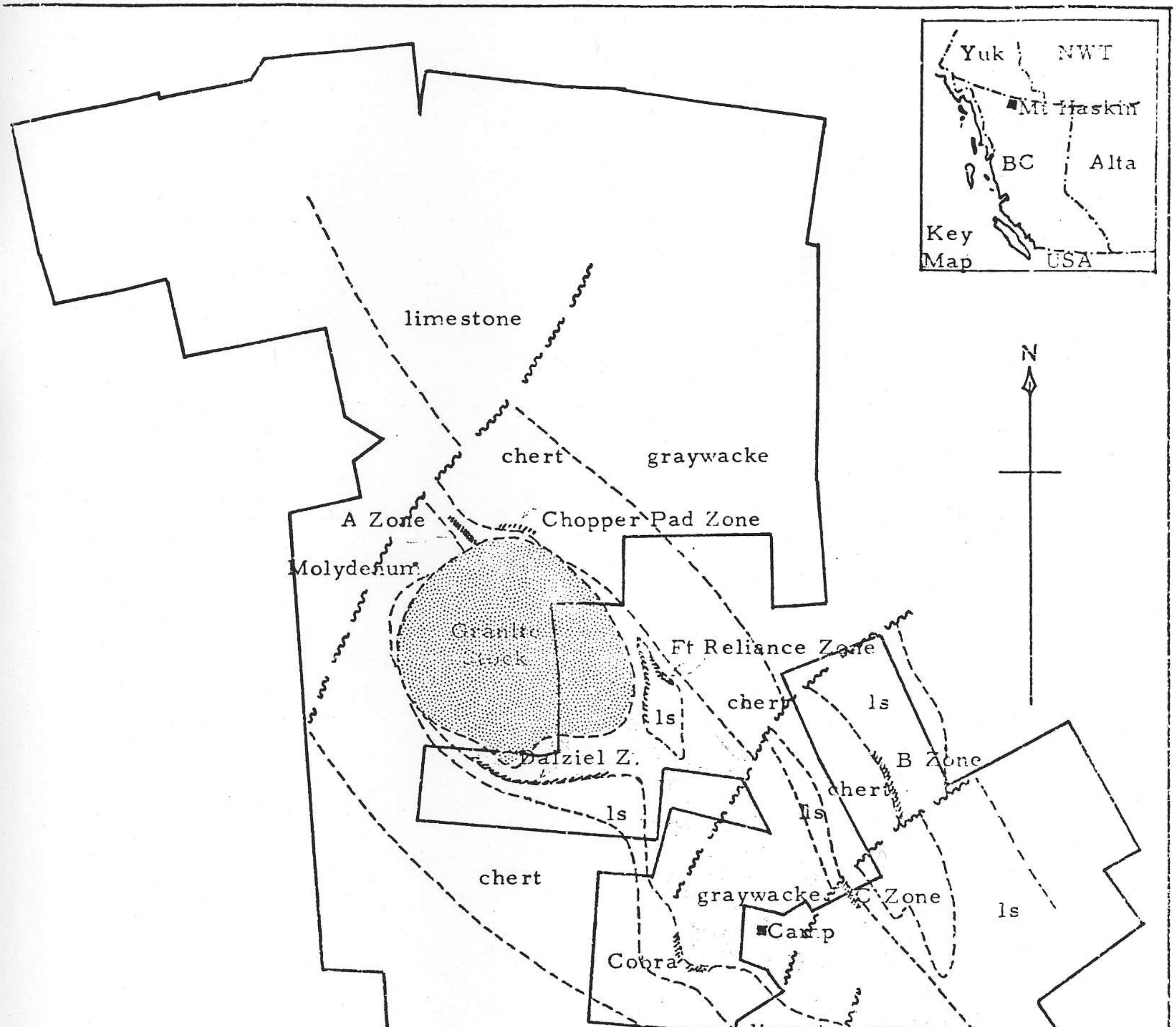

Figure 2: Property boundaries and general geology of Della Mines Ltd. claims, Mt Haskin Area, BC

the axis of a southeasterly trending anticline. The important sediments are three members of the Lower Cambrian Atan group. The stratigraphically lowest member consists of graywacke, shale and quartzite altered to hornfels near the granite contact. This is followed by a limestone member which is highly folded and locally altered to skarn or is recrystallized. The upper member is composed of chert and interbedded limestone. The chert is thought to be primary in part but may include limestone which has been completely silicified as a result of granitic intrusion. These three horizons are involved in mineralization and are of immediate importance. Younger and older sediments are found in the project area but are of no commercial interest.

In addition to the anticlinal fold producing dips averaging between 50° to 70°, the mapping of F. T. Graybeal suggests a possible syncline to the northeast. A system of northeasterly trending faults is also recorded which complicated the surface distribution of the various sedimentary horizons and may have some influence on the location of mineralization. Mr. Lamont's underground mapping shows that small, post-ore faults are very abundant and have a serious effect in breaking the continuity of the mineralization thus creating practical problems which would be difficult to solve in mining. Some intense jointing in the intrusive has been described but how well developed this feature (which is commonly associated with mineralization elsewhere) is unknown.

Metamorphism on a regional scale appears to be of a low grade but, local metamorphism associated with the granitic intrusive is expressed by conversion of the graywacke to hornfels, silicification of the limestone and other features. The most important metamorphic change is that related to the development of mineralized skarn zones in carbonate rocks and corresponding changes in siliceous sediments.

MINERALIZATION

Sulphide mineralization is reported in all members of the Atan group. However, the focus of attention to date has been on relatively thin skarn (or contact metamorphic) zones in limestone along the margins of the granitic intrusive and elsewhere on or near the contacts between the limestone and the two other sedimentary members. The degree of intensity of mineralization appears to relate to the proximity to the intrusive. At Della "A" zone, for example, massive magnetite at the contact passes outward into concentrations of iron sulphides containing copper, lead and zinc sulphides. Heavy sulphide concentrations are reported in association with skarn at the Fort Reliance zone a few hundred feet from the contact. Other mineralized zones more remote from the contact are characterized by a less well-developed skarn and disseminated sulphides. These may relate to dykes representing offshoots of the main intrusive mass. They include the Della "B" and "C" zones.

Details as to dimensions and grades are somewhat sketchy but reference is made to the lenticular and erratic distribution of values which is typical of deposits of the contact metamorphic type.

The Della "B" zone has now been tested by an adit with underground diamond drilling at 100 foot intervals along strike. As mentioned in the reports of Mr. Lamont, the limestone containing the mineralized zone is overlain by chert and argillite trending N 20° W and dipping 40° W. These sediments are cut by syenite dykes up to 31 feet thick mineralized with pyrite and molybdenite. (It is speculated that the limestone may be mineralized in the vicinity of these dykes as if the latter had been the conduit for local ore-bearing solutions. If so, repetition of the Della mineralized shoots would depend on the existence of other dykes). The sediments and mineralized zones are cut by numerous cross faults most of which show small displacement. Two of these may, however, have had sufficient movement to break up an otherwise reasonably continuous mineralized zone into lenses of mineralization referred to below.

The mineralized zones consist of skarn and interbedded carbonate sediments commonly but not consistently situated at the contact with the chert-argillite. Within the skarn, iron sulphides are pervasive but the distribution of copper, lead and zinc sulphides is more erratic.

Significant quantities of silver and bismuth are found by assaying but their relation to the other sulphides is not mentioned. The lead sulphide (galena) is presumably scant in most places and few assays have been made. This is unfortunate as it seems likely that in metallurgical concentration the bismuth and possibly the silver might report with the galena.

CRE

There exists some latitude in the approaches that might reasonably be taken to estimating ore reserves disclosed by the diamond drilling. The writer, ignoring the effect of small faults, could recognize three shoots of more-or-less continuous mineralization, each 300 to 400 feet long and tested roughly 100 feet along the dip direction. Assuming that mineralization extends 25 feet down and up-dip from drill hole intercepts and that it is continuous, except for two breaks, for the 100 foot horizontal distance between drill holes, the "indicated" reserves are estimated at:

> 370,000 tons averaging 1.72 oz. Ag/T, 0.47% Cu,
> 2.16% Zn and 0.23% Bi.

Deep holes such as U-38 and U-39 have shown that mineralization continues at least as deep as 200 feet below the adit. Furthermore, there

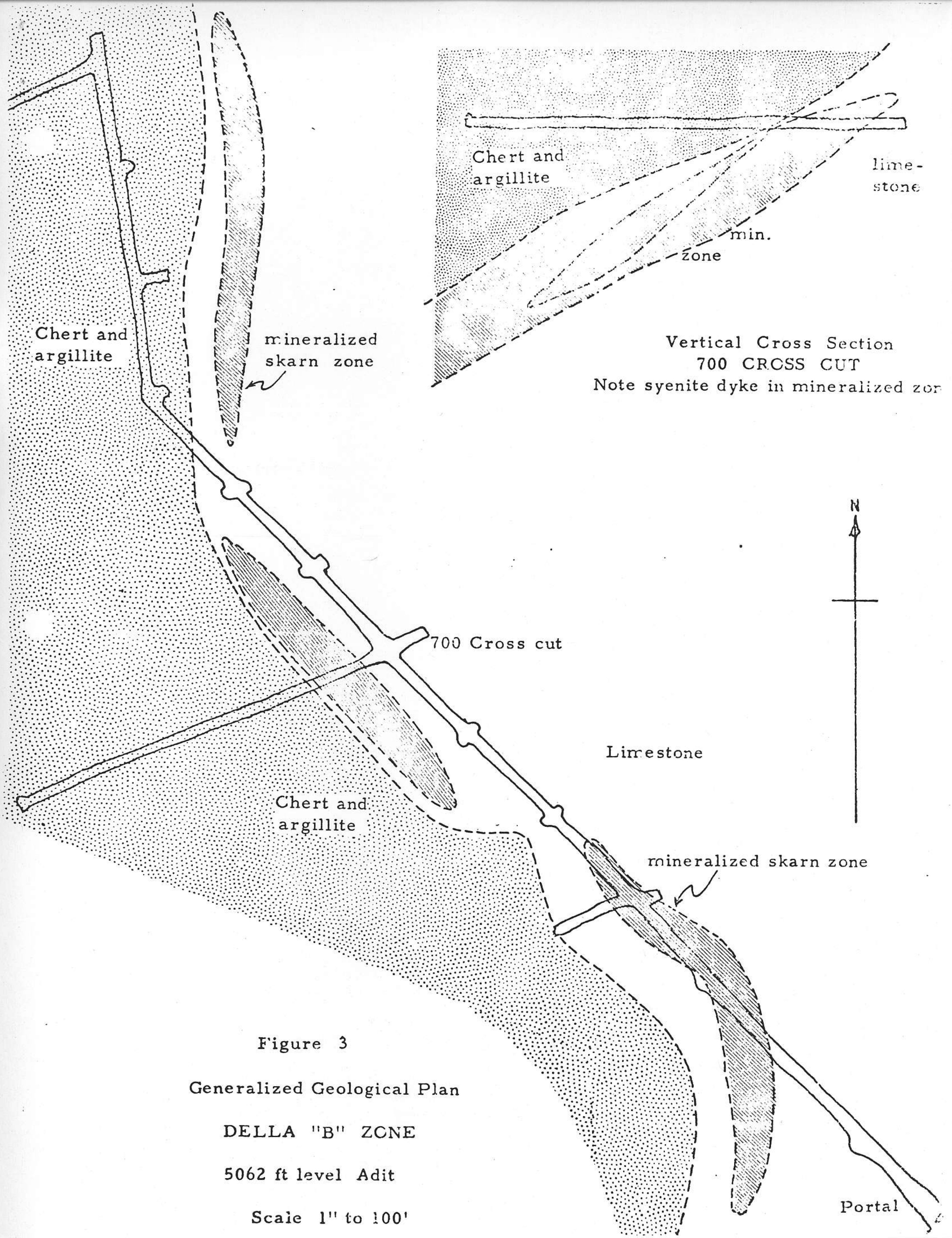

Figure 3

Generalized Geological Plan

DELLA "B" ZONE

5062 ft level Adit

Scale 1" to 100'

is no indication of a termination of mineralization in the most northerly underground drilling. Additional reserves of the same tonnage and grade as the indicated reserves may be inferred.

The above figures are believed to represent the maximum grade (but not tonnage) that may exist in the area explored by drilling. Careful attention should be directed to matters which suggest that considerable dilution and corresponding decrease in grade may be expected if production were attempted. The above grade figures make no allowance for dilution by unavoidably mining hangingwall and footwall waste nor have any of the assays been "cut". Because of the tendency toward erratic distribution of values within a given shoot and the practical problem of controlling dilution due to severe faulting, extracting ore without also taking barren rock would appear impossible. Ordinarily, an allowance of 10% to 20% waste is added in estimating the grade of reserves. Also, where average grades are supported by a comparatively small number of exceptionally high assays, it is common practice to reduce or cut the high assays to 1.5 or 2.0 times the un-cut average and re-calculate to obtain a "cut" average.

The effect of dilution may be illustrated by the experience at an actual mine on Vancouver Island where geologic conditions are similar. Here, the skarn zone (approximately half the width of the Della "B" zone) is situated in limestone along the contact with other bedded rocks, all of which are cut by numerous cross faults. Exploratory underground work and extensive drilling at 100 foot centers showed indicated grades of 3.06% Cu. When production commenced, the average grade of mill feed produced during the first year was 1.78% Cu. The grade for the second year was 2.10% Cu. It has been found that production grades can be controlled only by drilling at 25 foot centers and leaving much lower grade material as unmined pillars, thus reducing the earlier estimated reserve tonnage figures substantially. Similar adjustments were necessary for silver which assayed 1.5 to 2.0 oz. Ag/T in the concentrates.

Briefly, both the physical evidence at hand and experience elsewhere shows that the quoted average grades of Della drill-indicated reserves should be reduced to allow for unfavorable dilution in production. For purposes of economic evaluation, however, the undiluted average may be used in order to determine the upper limit of financial return from mineralization now in sight.

ECONOMICS

The metallurgical processes applicable to ore of the Della "B" type and the kind of concentrates that would be produced have yet to be determined but for purposes of a very rough evaluation of the economics of production one might assume that a copper concentrate, a lead-bismuth-silver concentrate and a zinc-cadmium concentrate would be produced. The two latter concentrates would be sold at Cominco's Trail, B.C. smelter whereas the copper might be shipped U.S. or Japanese smelters. As the ore is complex, recoveries seem unlikely to be particularly high but for copper it might be 93%, for zinc 85% and Bi 80%. One might assume a long-term price for copper at 55¢/lb., for zinc 18¢/lb, for silver $2.50/oz. and for bismuth (see later discussion) $4.25/lb. The cost of transporting concentrates from the mine to Trail, B.C. might be estimated at 6¢/T mile to railhead at Grimshaw and 2¢/T mile thence by rail or approximately $60 per ton. Freight on copper concentrates is estimated at $30 per ton. Using these extremely rough figures and equally inexact figures for smelting and refining costs, it is estimated that an ore grading 1.72ozAg/T, 0.47% Cu, 2.2% Zn and 0.23% Bi would provide a net smelter return to the mine of

Metal	Value at Smelter	Transport.	Net Smelter Return/ton ore
Cu	$ 4.37	$ 1.83	$ 2.54
Zn	4.38	2.04	2.36
Ag	3.82	---	3.82
Bi	9.80	---	9.80
Total net smelter return			$18.52

This is to say, the revenue F.O.B. mine to be received from the sale of concentrates from a ton of average-grade ore under the specified conditions would be $18.52. From this would have to be recovered operating and capital costs and provision for taxes.

Operating costs vary widely with the kind and scale of mining, location etc. Assuming five to six million tons of ore could be developed, operations on a scale of 3,000 tons per day might be contemplated. Typical Canadian mining costs at this rate where stopes are 20 to 30 feet wide are about $3.50 per ton of ore and milling about $1.85 per ton. Typical overhead costs are $0.85/T bringing the total operating cost to $6.20/T. Because of adverse geographic and climatic conditions, however, costs at Mt. Haskin might be a multiple of this figure. (Operating costs at Giant Yelloknife in 1971 for example were $18.84 per ton.)

The foregoing figures are advanced, not in any way to take the place of a preliminary feasibility study, but rather to provide a perspective on the economics of commercial production at Della "B" if it should be possible to increase known indicated reserves 10 to 20 fold. A more detailed and time-consuming analysis would be required in order to obtain firm figures.

BISMUTH

As bismuth would appear to be the most valuable constituent of the

Della "B" mineralization and because it is one of the less common metals, some background information may be of interest. Bismuth, found in many parts of the world, occurs as the native metal alone or associated with other ores. The commercially important minerals include the sulphide (bismuthenite), the oxide (bismite), the carbonate (bismutite) and complex sulpho-salts.

Except for parts of China where substantial deposits of the oxide are believed to exist, a few deposits of bismuth alone are of commercial value. Rather it is most often recovered as a by-product from the ores of other metals. It is recovered from some Bolivian tin ores, from the flue dust of copper and copper-silver ores in Peru, U.S.A., Mexico, Japan and Sweden, from Australian gold ores and in the refining of lead bullion. South American and Japan produces 79% and Canada 10% of the Free World bismuth output. At the Cominco smelter in Trail, bismuth is contained in the silver-bearing slimes produced in the electrolitic refining of lead.

The 1971 Free World consumption of bismuth fell (as reported by E.M.J.) into the following categories.

Pharmaceuticals	56.7%	2.975 million lbs.
Fusible alloys	21.7	1.141 "
Catalysts	10.4	.550 "
Metallurgical	9.9	.520 "
Others	1.3	.070 "
Total	100.0%	5.256 million lbs.

The North American producers of bismuth are as follows:

Producer	Purity	Approx. selling price range/lb. * 50 lb. lots and over
Cominco Limited	High	$7.00-$13.00
Asarco	High	$4.05-$5.00
Materials Research Corp.	High	$35.00
Cerro De Pasco	High	------
United Refining & Smelting Corp.	Commercial	$4.00
Belmont Smelting & Refining	Commercial	------

* Depending on kinds and amounts of impurities, forms and sizes, etc.

In considering uses of bismuth, about 60% of the consumption in 1965 were metallurgical, chiefly in the manufacture of fusible alloys. The latter are employed in a great variety of safety devices, precise castings and an additive to alloys of aluminum, iron and steel. These uses dropped relatively to 22% in 1971 due in large measure to increased demands in the pharmaceutical industry. Here it is used for indigestion remedies, wound dressing and cosmetics. The increase in pharmaceutical demand may relate to current popularity of certain kinds of women's facial preparations which is a function of transient fashionable taste.

Between 1950 and 1964, the average price ranged from $1.95 to $2.25 per pound. The current price is $5.00 per pound (Cominco) and $4.75 (Asarco). Current feeling is that a relatively safe long-range price lies between $4.00 and $5.00 possibly averaging $4.25. The fact that bismuth is produced as a by-product of other metals results in a relative inflexibility in supply which means that a comparatively small increase in demand produces a large increase in price. On the other hand, the major current use (pharmaceuticals) is vulnerable to change which exposes both demand and price to extraordinary uncertainty. Furthermore, early increases of 1.8 million pounds per year in production are expected from Australia and Mexico which adds to the risk in price fluctuation any new Canadian mine must face.

Briefly, the selling price of bismuth seems relatively secure in the $4 to $5/pound range for the next few years but the risk of increased supply and diminished demand and price in the long term appears to be a risk greater than that faced by the common base metals.

It has been mentioned that bismuth-bearing concentrates from Mt. Haskin probably would seek a market in Cominco Limited at Trail, B.C. An indication of the purchase terms is suggested by the

June 9, 1972 open smelter schedule for lead concentrates. Payments for bismuth are made as follows:

> Deduct 2.0 lbs. bismuth per ton of concentrate.
>
> Pay for 60% of the balance.
>
> Price: average "Metals Week" published price for ton lots of bismuth less 40¢ per lb.
>
> Normal deductions for impurities, moisture in lead concentrates, etc. are also made.

This smelter schedule was used in estimating the net smelter return from bismuth in ore of Della "B" grade.

It should be noted in particular that the smelter pays for less than 60% of the bismuth it receives. If a long term source of bismuth were available, it is conceivable but by no means certain that a more favorable smelter contract could be negotiated. It is also conceivable that other smelters would offer a more favorable contract.

CONCLUSIONS AND RECOMMENDATIONS

1. Political: The new operative and pending legislation of the recently elected Provincial Government of British Columbia need not be discussed here. However, several major companies have reacted by curtailing mineral exploration and postponing plans for production. It might be con-

cluded that from a political viewpoint, the present may be a good time to watch for highly favorable opportunities made available by companies which have over-reacted to the crisis. On the other hand, the consensus in the mining industry seems to be that caution and restraint should be exercised in planning any new expenditure related to the mineral industry in B.C. at this time, particularly in the area of production.

2. Regional Geology: As indicated early in the present report, the Mt. Haskin area presents a classic example of a "porphyry copper" environment. In the writer's opinion, the possibility of a large, low-grade disseminated Cu-Mo deposit in the intrusive stock and adjacent rocks should be investigated carefully. Some work along these lines has already been done and it is not clear from the reports at hand whether the ore possibilities have been enhanced or disproven. Surface mapping, geochemistry and I.P. geophysical surveys, if encouraging should eventually be followed by drilling. With encouraging results, additional land may be required.

Other deposits of the Della "B" type appear to exist in the general vicinity. There is at hand no firm factual evidence to show whether these discoveries are richer or leaner than Della "B" but in the absence of information it might reasonably be assumed that a vigorous program of exploration and development might substantially increase reserves in a range of grades similar to that found at Della "B". There seems to be no indication that the new reserves would be substantially richer.

3. Della "B" Economics: The economic analyses offered in this report are necessarily somewhat superficial but on the basis of a first approach, they do suggest that production from ore bodies of Della "B" size, physical characteristics and grade would be economically marginal. Accordingly, the writer feels that although it seems quite likely that additional reserves of similar material could be developed, the expense of actually confirming these reserves is not justifiable.

Although further underground development and drilling is not recommended at this time, other steps are warranted. More concrete data on the cost of mining and milling involving modest engineering studies should be obtained. Markets for bismuth-rich concentrates should be investigated. The essential claims should be held in good standing until these data are compiled.

4. Other Suggestions:

(a) The lead content of the mineralization is probably quite low but as both silver and bismuth may report with the lead in concentration, the analysis of composite samples for lead should be carried out.

(b) Zinc-rich material should be checked for its Cadmium content which often adds significantly to the value of the concentrates.

(c) If routine check analyses have not been run by a second, reliable assayer, this should be done. As a rule, the assays from one sample from every fifty should be checked against assays made by an independent assayer. The values in bismuth particularly should be checked.

ACKNOWLEDGEMENTS

As the writer has not visited Mt. Haskin, the factual data used in this report are drawn from communications kindly made available by Della Mines and Ashland Oil Canada. The professional quality of the Della reports and the manner in which field operations were conducted inspires confidence in Della's management and technical capability. Information was also drawn from published literature and personal sources.

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APPENDIX

Geology

General Features

The bedrock in the area comprises a series of altered sedimentary rocks ranging in age from late Precambrian to Ordovician. They have been intruded by a granite porphyry stock outcropping on the western slope of Mount Haskin. Recently on the neighbouring property to the south, a similar intrusive has been mapped within a similar sedimentary sequence. No volcanic rocks have been recognised in the area..

All the sedimentary rocks appear to exhibit some degree of alteration resulting from regional metamorphism. Locally this has been greatly intensified by intrusion of the granite and accompanying infusion of mineralizers. The limestones have been particularly susceptible and, adjacent to the granite are completely altered to skarn.

East of Mount Haskin faulting has given rise to both repetition of some sedimentary units and lateral displacement.

All known mineralization occurring on the property is associated with members of the lower Cambrian Atan group.

Lithology

The oldest rocks occurring on the property belong to the Good Hope group of late Precambrian age. They are exposed only on the northeast slope of Mount Haskin and consist of a series of limestone beds with lesser amounts of interbedded sandstones. A central limestone unit is characterised by red shale partings. No mineralization has been found in this group.

The Lower Cambrian Atan group conformably overlies the Good Hope. Together with the granite porphyry it forms the backbone of Mount Haskin. The group is comprised of three distinct rock types all of which are important as host rocks of mineralization. They are exposed at all the higher elevations and ridges, and distributed in several northwest striking bands.

The lowest member, graywacke, consists of micaceous graywacke interbedded with shale, grading upwards into light coloured, fine to coarse cross-bedded quartzites, with interbedded limestones in the upper 50 feet. In closer contact with the granite the graywacke shows gradual alteration to a massive dark reddish-brown hornfels type of rock with local development of knotty textured cordierite and andalusite. At the granite contact sericite schist zones are prominent. Except for finely disseminated pyrite, surface exposures are barren. Drilled intersections of the hornfel phase however have revealed considerable fine quartz-molybdenite mineralization.

The central limestone member is the least competent rock type in the area, showing intense flowage and folding close to the granite intrusive. Repetition and offsetting of this member is extreme and shows abrupt changes in thickness, but careful mapping is essential as it is the host for the massive sulphide mineralization. Metamorphism of the limestone adjacent to the intrusive has locally been very intense with complete alteration to a series of skarn minerals.

The upper Atan member comprises a very resistant ridge-forming chert. It is distributed in two prominent northwest striking bands but has not been recognised north of an apparent fault zone traversing the northern part of the map area. This may be due to a lack of understanding concerning the origin of this rock type rather than to fault offsetting. In general, the unit consists of a very siliceous cryptocrystalline rock, dark gray, green and brown at the base, grading upwards into pale gray, green and buff beds. Thin limestone interbeds generally occur in the basal and central beds which west of the intrusive, increase considerably in thickness. Although some beds of this member are undoubtedly composed of true chert, many have the appearance of silicified shales and siltstones. Bedding, although obscure on surface, is well developed ih drilled sections. The brittle competent character of the chert member has resulted locally in strong fine fracturing and the focal point for the most of the molybdenite mineralization.

The chert member is overlain by the Kechika and Sandpile groups respectively. The former comprises calcareous phyllites with interbedded limestone, siliceous beds and fissile shales; the latter poorly bedded sandstones and dolomites. They are poorly exposed in the valley west of Mount Haskin. They are regarded at this time as unimportant with respect to mineralization. Several sulphide shows, reported to occur on a ridge near Long Lake, could not be located.

Mount Haskin Intrusive

Underlying the main peak of Mount Haskin the sedimentary sequence has been intruded by a granite porphyry stock, roughly circular, about 4,000 feet in diameter. It is probably an outlier of the Cassiar Batholith 15 miles to the west. It is exposed on the western slope of the mountain but the outcrop for the most part is obscured by coarse talus and a heavy overburden. No dykes are observed on surface but a few have been intersected by the drilling.

Contacts of the intrusive are generally very steep, that is in the order of 70° to 90°, but there is a noticeable decrease in dip on the northwest side. On geological map, figure 4, structural contouring of the granite subsurface shows a distinct nosing feature. This may be indicative of the direction of the forces exerted during the period of intrusion.

All evidence points to a single phase intrusive exhibiting a chilled peripheral zone grading inwards to a coarse porphyritic core. In general the peripheral zone consists of a gray, fine to medium sugary granite with aligned biotite, extending for about 70 feet from the contact. Towards the centre, smoky quartz phenocrysts appear followed by pink orthoclase phenocrysts. Typically the core is a very coarse porphyry of quartz and orthoclase set in a groundmass of sugary quartz, orthoclase and minor biotite.

The peripheral zone of granite at the structural nose is locally highly silicified. At the diagonally opposite contact the periphery is also highly silicified for about 20 feet, giving way inwards to a banded quartz aplite interbedded with alaskite, the latter persisting for about 300 feet. This zone has been traced along the contact for about 1,800 feet. Both silicified areas are closely associated with molybdenite mineralization.

There seems to be no question that the granite is the source of all the mineralization in the area. Restriction of sericitic alteration to radial joints strongly suggests they were conduits by which hydrothermal solutions were able to reach the contact area and the surrounding wall rocks.

Structure

From a structural view the property is located on the eastern limb of a broad northwest striking geosyncline having dips of 25° to 60° to the southwest. Deviations to this pattern occur close to the intrusive where the limestone in particular has been squeezed and folded into a series of tight anticlines and recumbent dragfolds. Immediately northeast of the intrusive, chert and graywacke beds dip steeply to the northeast.

To the west of Mount Haskin bedrock in the geosyncline consists of relatively undisturbed Devonian and Mississippian rocks; to the east older rocks for 15 miles have been repeatedly tilted and lifted to the surface on a complex series of northwest striking bedding faults. A later period of transverse faulting has resulted in lateral displacement of the tilted beds. Locally around the intrusive, and probably as a direct consequence of relief of stresses set up by the solidifying mass, are numerous steep faults angling off from the contact area.

Jointing is common to all rock types in the area. The wide distribution suggests an origin based on regional factors possibly predating intrusive activities. Several sets of joints occur within the intrusive and result from contraction in the final stages of solidification.

Breccia zones of various types have been intersected during drilling in the granite and wall rocks near the contact. They formed during intrusion and are often cemented with secondary quartz, and are occasionally mineralized.

Mineralization

Mineralization occurs in all members of the Atan group, and to a lesser degree in the peripheral zone of the intrusive. Occurrence is more prevalent in the sediments close to the granite and in general decreases with distance. However the persistance of mineral shows to the southeast of the granite for at least one mile may be indicative of additional intrusives and mineralized zones as yet unrecognised or buried at shallow depths beneath the sedimentary outcrops in the southeastern part of the property.

The metallic minerals which have been identified include pyrite, pyrrhotite, molybdenite, sphalerite, magnetite, galena, chalcopyrite, arsenopyrite, silver, gold, and jamesonite in approximately that order of abundance. Geochemical analyses of rock chips have disclosed indications of tungsten, but only rarely has scheelite been detected under ultraviolet light, and consequently there has been no assaying of cores for this metal. The alteration mineral powellite is locally abundant in cored sections.

Four main types of mineral association have been recognised: massive sulphides carrying pyrrhotite, sphalerite, chalcopyrite, argentiferous galena and arsonpyrite; massive magnetite with pyrrhotite; quartz-molybdenite stockwork; and disseminated sulphides of pyrite, pyrrhotite, sphalerite, galena, arsenopyrite and jamesonite.

The massive sulphides occur exclusively in the middle limestone member of the Atan, associated with skarn alteration. Massive magnetite is found adjacent to the granite contact; farther out this is replaced by predominantly lead-zinc sulphides. A number of these zones in the area of the intrusive are owned by several operators in addition to Della Mines, as shown on figure 2.

In Zone A (Della Mines Ltd.) figures 2 and 4, several parallel highly faulted lenses and pods have been traced intermittently on surface for a distance of 600 feet. They dip to the southwest about 40° and plunge to the southeast, terminating against the granite and strong transverse fault. Sampling in pits had yielded values as high as 12.8% lead, 7.6% zinc and 2 ounces of silver. There was one silver erratic of 51 ounces. Drilled intersections showed very spotty distribution and substantiated the high pit values only occasionally.

A realistic appraisal of the zone from a geometrical calculation would give a maximum of about 300,000 tons grading no more than 5.0% zinc, 3.0% lead, and one ounce or less of silver. At today's metal prices, ignoring the silver, the zone would have an apparent in-place value of $25.00 per ton, or $7.5 million.

The Fort Reliance Zone, located at the peak of Mount Haskin, occurs at the base of a horizontal limestone bed and is limited by erosion in all directions. It was mapped and drilled several years ago and is still owned by the same group. An estimate of this zone shows reserves of slightly in excess of 426,000 tons grading 1.94% lead, 5.54% zinc and 1.36 ounces silver.

The Dalziel Zone was optioned to Spartan Explorations Ltd. during the past season. It also occurs at the base of a limestone. A series of parallel trenches over a distance of almost 3,000 feet revealed a zone of mineralization up to 30 feet wide assaying about 10% combined lead and zinc. It dips about 45° to the south to an unknown depth. Several drill holes near the east end gave erratic results. It is understood that Spartan dropped the option because of an excessively high option payment, before a conclusive evaluation was made of this zone.

Zone B (Della Mines Ltd.), comprising sulphides and skarn, has been traced on surface for a north-south distance of 2,000 feet. Scattered pit assays gave values in zinc up to 6.5%, copper 1.4%, and 4 ounces silver. Of two drill holes the southern one, H-41, showed no mineralization that merited assaying; the other hole H-40 gave interesting values in copper and silver. Further work is proposed for the northern part of this zone.

Zone C (Della Mines) was trenched during the past season, revealing several parallel narrow sulphide-skarn zones. Mineralization appeared to be very poor and spotty, and was not sampled. Previously, pit samples assayed up to 5.7% zinc and 4.3 ounces of silver with traces of lead and copper. A drill hole intersected three separate zones (DDH #H-41). Assays were disappointing and the zone does not warrant further work.

Molybdenite mineralization has been found in all members of the Atan sediment, close to the intrusive, and in the peripheral zone of the granite. Almost invariably it occurs as fine flakes, within and on the surface of fine quartz veinlets associated with late phase silicification. In the granite it is seen as fine disseminations and coarse "books" up to 1" across. Except in the granite it is very inconspicuous in outcrops.

The only interesting concentration found to date is a zone on the northwest slope of Mount Haskin, which sweeps in an arc through chert, and skarn into the granite for a length of about 2,000 feet, figure 4. The molybdenite mineralization occurs as a stockwork of fine quartz-moly veinlets apparently controlled by fine fracturing. The brittle chert would have been particularly susceptible to fracturing which may have resulted from slight warping over the intrusive nosing structure. There is a conspicuous absence of other sulphides in the molybdenite zone.

Significant values of molybdenite were intersected in 19 holes. To determine potential reserves a calculation was made, based on diagrammatic limitations shown by the map and a set of cross sections inserted at the end of this report. This indicates the zone to contain 13,482,000 tons grading .157% MoS_2 above a cut-off of .050%, and is therefore considered to be sub-economical on two factors.

Disseminated sulphides are to be found in all the sedimentary rocks near the granite contact where they tend to have a halo effect around the intrusive. Pyrite and pyrrhotite are the most prevalent minerals but all the others are present locally. They generally occur as fine sparsely disseminated grains and only rarely as fine lenses or veinlets. An overemphasis in assaying this type of mineralization was due to its persistence, the possibility of containing obscure precious metals, including antimony, and undue delay in receiving assay returns.

The widespread occurrence of a silvery white mineral believed to carry antimony, in chert outcrops, and the recognition of a similar mineral in cores, led to assaying for this metal. Yields of 3. 22% over 40 feet in hole H-25 and 1. 1% over 259 feet in H-17, caused considerable interest. However, the original high assays were not confirmed in re-checks nor repeated in other drill holes. Moreover there was no visible evidence of a mineral in amounts that would conceivably account for the high assay reported in H-25. However, antimony is present and the possibilities of this and other minerals, i. e. tungsten, must not be ruled out in any future program.