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ASSESSMENT AND EXPLORATION POTENTIAL

OF

DOLLY VARDEN RESOURCES LIMITED

B. & C. LTD.


C. E. Michener, Ph.D.

Toronto, Ontario
December 29, 1977

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SUMMARY AND CONCLUSIONS

Dolly Varden Resources Limited is the owner of the four major properties described in this report and is also the owner of other claims in the Kitsault River district, some of which are Crown grant claims and others are held under lease. No attempt was made to verify the ownership of the claim groups which are shown on the claim map attached to this report.

Geological research carried out on the Dolly Varden properties would indicate that the district as a whole is favourable for the occurrence of additional vein type deposits which have hitherto been concealed by the extensive overburden. Forest cover has made it difficult to prospect these areas and possibly 80% of the whole district being considered is still relatively unexplored. This report recommends the exploration of these areas by geochemical methods and by detailed geological mapping followed by diamond drilling. The budget for the first phase is \$200,000 and the budget for the preliminary drilling phase is \$250,000. It is anticipated that the complete programme could be carried out in one field season from May to November.

The Torbrit and the Dolly Varden Mines produced a little under 1,500,000 tons of relatively high grade silver-lead-zinc ore and there remains possibly 800,000 tons which could be salvaged from the workings of the two mines, if mining and milling facilities existed in the district. The North Star or the Wolf properties contain 700,000 to 800,000 tons of geologically indicated mineral reserves and this could probably be extended by additional drilling at depth and along the strike of these two deposits.

(ii)

In order to create a feasible and profitable operation, it would be desirable to add to the above tonnages, possibly by developing some of the known showings in the district of which there are many, or possibly by finding new deposits through the exploration programme recommended in this report.

With the development of additional tonnage in the district, something in excess of 1.5 million tons, it would be feasible to rehabilitate the road system in the valley of the Kitsault River and engage in mining on those vein systems which lend themselves to trackless mining either on surface or underground.

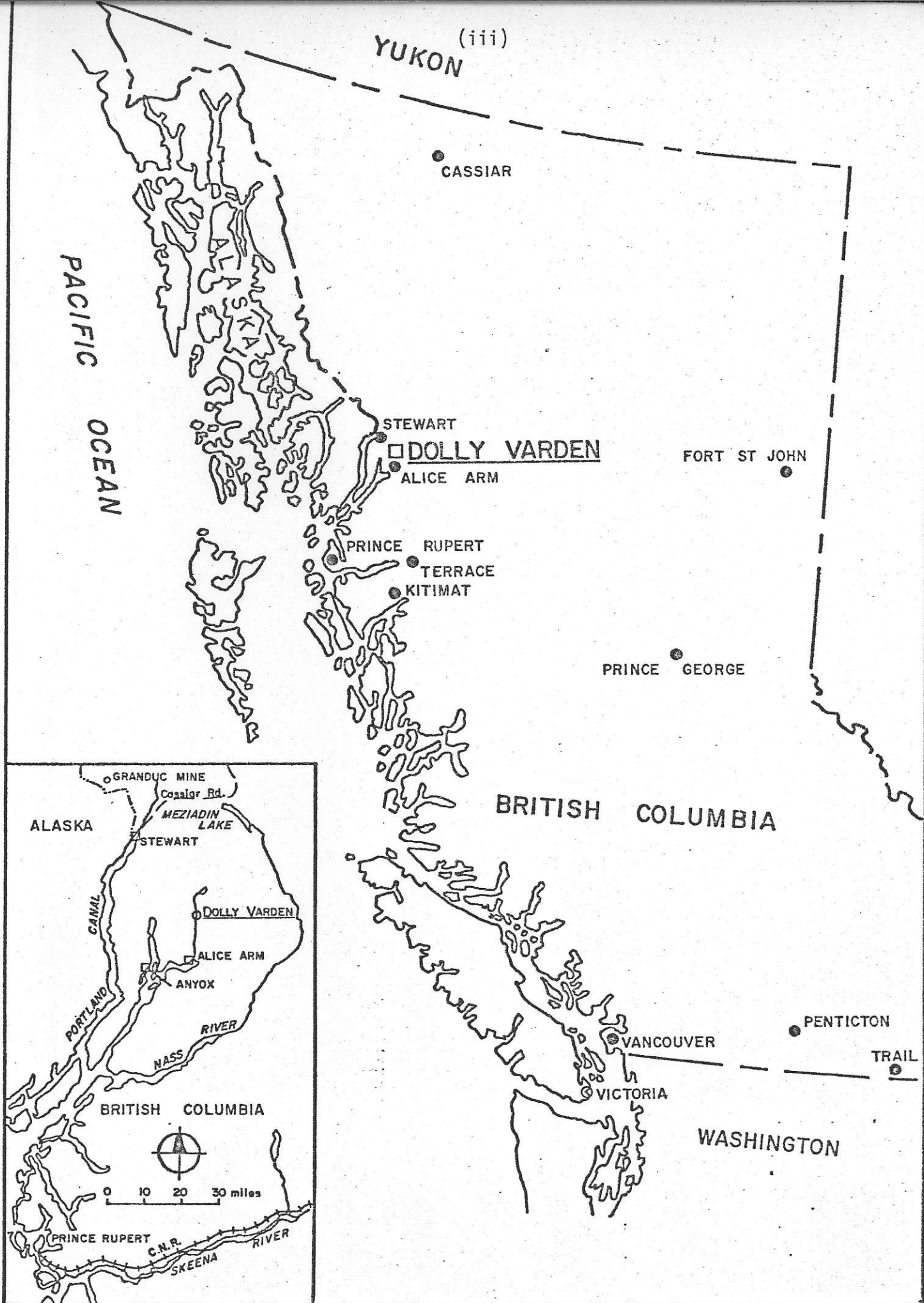
Under current metal prices the net smelter return from these ores would be in the neighbourhood of \$40 per ton of ore mined and would, of course, increase very markedly with the expected increase in the price of silver.

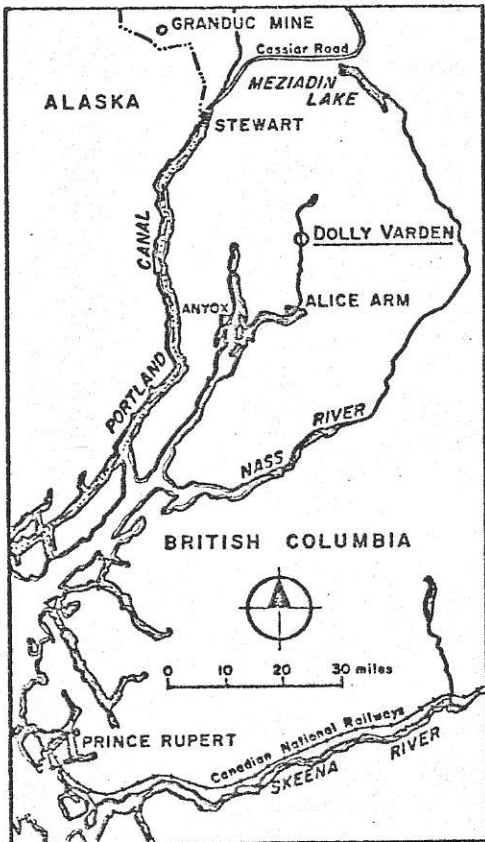
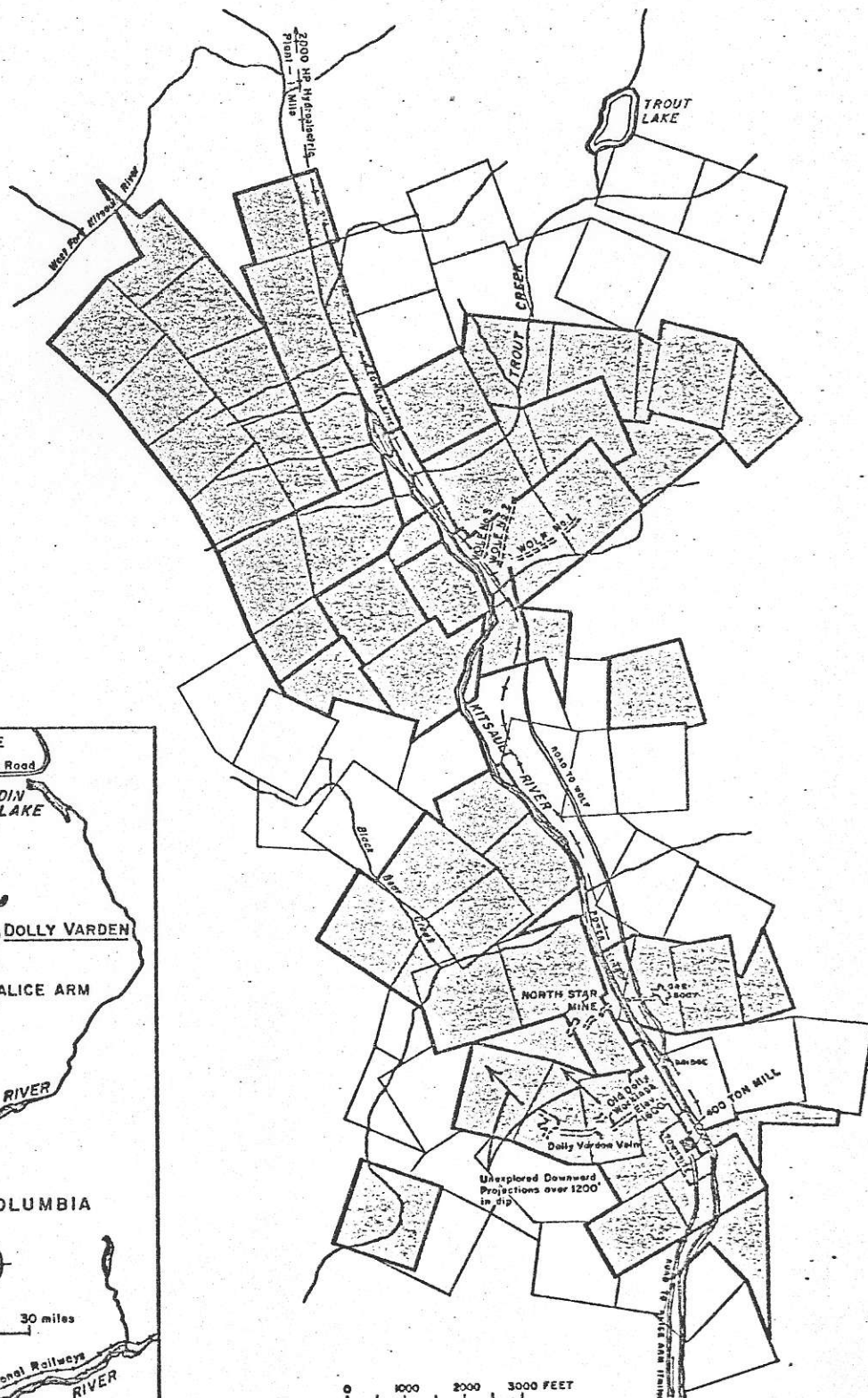
There is a strong probability that the B.C. Molybdenum property which lies on the other side of the Alice Arm will be placed back into production because of the apparent short supply of molybdenum in the world markets. This operation would provide a pool of skilled labour and equipment in the district which would facilitate the Dolly Varden operation.

Although there is no guarantee that the programme proposed for this district during the coming field season will be completely successful, it is anticipated that additional ore reserves will be developed and that a favourable opportunity exists for the commencement of a commercial operation in the area.


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GEOLOGICAL REVIEW

The engineering and financial data and all other miscellaneous material pertaining to Dolly Varden Resources Limited is stored at Room 700 in the Pemberton Building, Vancouver. This material was reviewed in the latter part of November 1977 and at the same time visits were made to the property at Alice Arm and to the Department of Mines in Victoria where several individuals familiar with the property were interviewed. Visits were also made to the Department of Mines in Prince Rupert and Vancouver. The material is stored in an orderly and well kept manner and properly filed.

The silver ores of the Dolly Varden district occur as low temperature replacement veins and in folded structures which are locally controlled by existing geological structures and post ore faulting. Often the vein appears at the contact of two varieties of the volcanic series. The district as a whole lies just east of the coast range batholith margin. The rocks are volcanic-sedimentary series of the Hazelton group.

Between the volcanics and the coast range batholith there are a series of porphyritic intrusives known variously as feldspar porphyrys, monzonite porphyrys and also called the copper belt series. Copper gold mineralization is associated with these rocks as opposed to the silver-lead-zinc mineralization which occurs in the volcanic rocks. Since the two types of mineralization lie side by side in the Kitsault River Valley, it is logical that both should be explored at the same time. Gold has not been a factor in the Dolly Varden or the Torbrit ore bodies, but gold is associated with the copper mineralization in the copper belt. Superimposed

on the local geology are swarms of dykes consisting mainly of lamprophyre. There is also a great deal of brecciation in the area and this rock often forms a host for the mineralizing solutions.

The mineralogy would indicate that near surface enrichment has taken place. For example, at the Dolly Varden mine the richest ores were found near surface and they included the following: native silver, ruby silver and argentite, with banding and crustification quite common consisting mainly of quartz and barite. The high grade ore of this nature did not extend below the 200-foot level. At the Torbrit mine, which is the other major producer in the area, near surface enrichment is not so evident and the ore was more uniform. However, in this case the ore body did not come completely to surface and this probably accounts for the lack of the exotic secondary minerals.

VEIN STRUCTURES

This report will discuss in some details four deposits: the Dolly Varden, the Torbrit, the North Star and the Wolf. The first two deposits accounted for practically all the production in the Dolly Varden area which totalled a little over a million tons. The latter two deposits have been drilled and are ready for development, but were never placed in production. Each of these properties will briefly be reviewed as follows.

Dolly Varden Mine - The vein system at the Dolly Varden has a known length of about 1,500 feet and is broken in many places by post ore faulting. Over the eastern part, the vein system has been mined as the ores were much higher grade in this area. The western part remains to be

explored, but from drilling and surface samples taken to date, this part of the vein system appears to be lower grade. The vein seems to occur at the contact between the red and green brecciated volcanics. The veins have ore shoots within them and high values are concentrated in the first 250 feet below surface. Values as high as 1,200 ounces per ton have been reported. It is considered by the author that these veins have been subject to secondary enrichment. Nevertheless, the western portion of the vein system is where the exploration situation should be followed up in any overall programme in the area.

The Dolly Varden Mine was operated from five different adits with a difference in elevation of about 400 feet. Three of the largest stopes came to surface and were mined as glory holes. The tonnage taken out was 36,620 and that was during a three-year period. These glory holes all occur in the easterly part of the vein system.

Exploration for additional ore reserves of the Dolly Varden has to be done by flat diamond drill holes which would probe the lower extensions under the old producing area and also the extension of the vein system on the west end of the mine. It seems altogether likely that additional ore reserves could be found at this property and that these could be profitably mined if other treatment facilities were already in existence in the area.

The Torbrit Mine - The Torbrit ore in contrast to the Dolly Varden occurs at the crest of a sharp fold and the position of the crest plunges at a rather flat angle. The ore body is blind to the surface and tops at 1,300 feet elevation and bottoms at 700 feet elevation, a total plunge length of 1,600 feet. The ore is brecciated and has many phenomena

which are characteristic of low temperature ore bodies with structural control. It is also cut by many minor faults. The rocks are volcanic sedimentary series of the Hazelton group as is the Dolly Varden. It is considered by students of the area that ore minerals result from mineralizing solutions given off by the coast range batholith or possibly a volcanic centre whose origin is not known.

There is considerable known ore at the bottom end of the plunging structure which has not been mined, that is below the 700-foot elevation level. This could be a target for renewed exploration activity, but it is rather difficult to carry out because of the physical problems involved in getting drilling sites.

The average grade of the ore at the Torbrit was 17 ounces in silver and .42% lead. A total of 1,000,000 tons have been mined from the property and put through a 400-ton mill which recovered the ore by flotation and cyanidation. About 80% of the total silver was recovered by flotation and is in the form of pyrargarite. Various estimates for the unmined reserves at the Torbrit range from several hundred thousand up to 800,000 tons. This ore could possibly be economically mined if other developments in the area provided economic handling facilities for the ore.

The old workings at the Torbrit Mine are believed to be caved as there was no provision for filling the stopes.

The potential for additional ore at the Torbrit would appear to depend on the known ore extending down the plunge from the 700-foot elevation. At this level the silver values appear to decrease with depth, but the zinc values increase. Since the mine is flooded below the 1,000-foot elevation it would be necessary to make provision for dewatering the mine before any

mining activity could take place. However, diamond drilling could be used to explore the potential of the mine below the 700-foot level which would appear to be the most logical step.

The North Star Mine - The vein system here extends to surface and has been explored by trenching, diamond drilling and a limited amount of development work. Proven ore at the property from the limited amount of work done varies between 200,000 to 250,000 tons, grading 10 ounces of silver, 1.2% lead and 3.0% zinc. There is not much doubt that these ore reserves can be enlarged by drilling the downward extension of the vein system.

Geologically the deposit is a single vein system which has been faulted by minor displacements into six segments which occur along a strike length of about 500 feet. The ore potential for drilling at depth would appear to be in the order of 1,000 to 1,500 tons per vertical foot. There is some indication that certain parts of the vein system will carry much higher lead-zinc values. The North Star vein is located immediately north of the Torbrit Mine.

Wolf Mine - This property is probably the most encouraging from the standpoint of future production. The veins are quite wide and the number two vein, which is the largest, is faulted into four segments varying from 20 to 50 feet in width. The surface exposure of this system is about 1,600 feet long and diamond drilling has located ore down to a depth of 1,800 feet. The vein material exhibits all the characteristics of the other veins in the district with the main vein system related to a central shear zone and with quartz, carbonate, pyrite, marcasite, barite, argentiferous galena,

sphalerite, pyrargyrite and native silver. There is also some ruby silver found at this property. It would appear likely that this ore body could be mined by load-haul-dump equipment.

The ore reserves at the Wolf Mine are variously estimated from 400,000 to 600,000 tons, grading 9.8 ounces silver per ton, .39% lead, and .12% zinc per ton. This reserve estimate is fairly accurate as far as the development has gone, but it is quite certain that it could be enlarged by additional work.

EXPLORATION POTENTIAL

This part of British Columbia is a highly mineralized area. Across Alice Arm is the very large and well mineralized B.C. molybdenum property. Further down the inlet is the old camp at Anyox, B.C., which contained a smelter and was the birthplace of the Ganby Mining and Smelting Company. On another branch of the inlet, Portland Canal, is a mining district around the town of Stewart, and further inland, the famous Granduc copper deposit.

In the Kitsault River Valley four properties are known to have calculated ore reserves. Two of these have been mined and the district as a whole has produced more than a million tons of silver ore.

There are many showings in the immediate area which have never been developed and never fully explored. These are briefly described later in the report. Some of these showings have been partly explored, but the majority only opened up at surface. The B.C. Department of Mines also lists a number of showings, probably fifteen in all.

In studying the history of the area it has been found that all the prospecting carried out has been by ordinary surface methods with the

exception that Mr. Mitchell carried out a geochemical survey of the copper belt rocks and in this case had assays done for copper and gold only. The rocks in this district contain a great deal of pyrite and for this reason ordinary geophysical surveys are not recommended. The ordinary induced polarization methods and the lower frequency electro-magnetic methods would similarly pick up this pyrite and make it difficult or impossible to distinguish between conductors caused by pyrite and those caused by lead-zinc-silver mineralization.

As a result of the above studies it was concluded that the geochemical approach would be the best and this should be combined with a careful geological mapping job.

STRUCTURAL CONTROL

Though the vein systems do not seem to follow a definite pattern they are definitely controlled by rock types and by faulting, and in the case of the Torbrit, the ore body is controlled by a tight fold. If a careful mapping job were carried out and the structures were carefully plotted, this information together with the information resulting from a geochemical survey should provide drilling targets. If, for example, it was found that an anomaly occurred at a structurally favourable point, then this particular anomaly would take precedence over other anomalies which did not have similar structural control. To carry out a close and careful geochemical survey, together with a detailed mapping job requires many manhours of work and the economics of this would have to be assessed. With a programme of this sort it is almost certain that drilling targets would be obtained.

ECONOMICS OF THE TORBRIT AREA

As in the case of the Wolf and the North Star, it is anticipated that any new veins found in the district would come to surface and that they may be possible candidates for open pit mining. The general tenor of the ore in this district (aside from the upper levels of the Dolly Varden which was very rich), would appear to be in the range of 10 ounces of silver per ton with an additional by-product in lead and zinc. We are therefore considering a recoverable product of from \$40 to \$50 per ton, taking silver at \$4.50 per ounce. It is possible to make a good profit from ore of this grade with trackless mining methods underground or with open pit methods. However, for underground mining and under the current high labour costs prevailing in B.C. and the difficulty of getting miners to work in small vein systems underground, the costs of mining, milling and shipping concentrates is expected to be about \$40 per ton. It is therefore essential that mining be considered from the standpoint of open pit work or trackless mining on wide vein systems which are relatively straight and have sufficient width and length in which to operate load-haul-dump equipment. It is anticipated that by the use of small open pits and large stopes trackless mining could be carried out for less than \$30 a ton. This would leave a substantial profit, considering the average tenor of the ore.

The Wolf and the North Star certainly lend themselves to the type of operation described above. We are therefore starting with an anticipated tonnage of between one-half million and one million tons of good grade material. This tonnage represents a threshold figure for an economic operation in the district and, though it might pay for itself with some salvage

from the Torbrit and the Dolly Varden mine, the operation would not make the substantial profits which would be inherent in this ore if two or three million tons were available.

Statistically it would seem likely that the additional tonnage required could be developed by careful exploration methods. The rocks exposed at surface to the prospectors of the early part of the century represent possibly 10 to 15% of the total area which is potentially ore bearing. The balance of unexplored areas lying under timbered sections or under slides might then, on a statistical basis, produce enough tonnage to warrant a commercial operation.

COPPER BELT ROCKS

Between the coast range batholith and the Kitsault River is a belt of rocks locally known as the copper belt. This appears to be an intrusive monzonite porphyry or feldspar porphyry which occupies a belt some 15 miles in length and 1,500 to 3,000 feet in width running more or less parallel with the Kitsault River. There is widespread mineralization in these rocks, mainly pyrite and there is also copper and gold which have been located at numerous points. The early prospectors were looking for high grade veins and possibly failed to realize the potential of large low grade copper mineralization. The intrusive shows much rusty staining due to weathering of small quantities of pyrite. Most of the feldspar or monzonite porphyry is rather uniform, but it is cut by quartz stringers. In the eastern part of the copper belt there seems to be an increase in the amount of sulphide. Most of the showings which have been discovered to date are in this area. The veins in the copper

belt porphyry are in silicified and chloritized shear zones and contain pyrite, chalcopyrite and minor sphalerite and galena together with gold and some minor silver values.

Because of the widespread mineralization in the copper belt rocks a number of claims were staked in the early period of exploration but no mining work was done. Altogether there were fifteen or more claims on which discoveries had been made. It is quite evident from the work that the early prospectors were looking for high grade veins and paid little regard to the large low grade possibilities of the copper belt series.

OTHER SILVER-LEAD SHOWINGS

Mr. M. A. Mitchell who was a geologist in the area for about ten years, in 1971 listed a number of veins and showings containing lead-zinc-silver values. In each case these veins are named in accordance with the name of the claim on which they occur and may be located on the claim map which accompanies this report. The following items are merely listed to show the size and the number of occurrences and are taken from Mr. Mitchell's report.

- 1) The South Musketeer - 900 feet long and 15 feet wide; assays as high as 25 ounces of silver per ton.
- 2) Kitsol - 275 feet long and 15 feet wide.
- 3) The Moose-Lamb - 800 feet long and 20 feet wide.
- 4) The Mitchell - 400 feet long and 5 feet wide.
- 5) The North Musketeer - 100 feet long and 20 feet wide.
- 6) The Surprise - 500 feet long and 20 feet wide; the mineralization is mixed copper, lead, zinc and silver and may be properly classified as a copper belt showing.

- 7) Other occurrences are the Maude-McPhee containing copper, lead, zinc and silver values. The David Copperfield "V" vein, the York vein, the Dart showing.

In addition there are a number of veins not owned by Dolly Varden and these include the Tiger which has a length of 500 feet and a width of 15 feet; the Moose group are a lead-zinc-silver showing.

Altogether the above mentioned veins and discoveries have a considerable potential but have never been really opened up or developed.

PROPOSED EXPLORATION PROGRAMME

Background - Geochemical sampling of surface and glacial soils has been one of the key components to exploration campaigns in British Columbia in the past 15 years and is recommended as the most suitable technique by which extensions to known veins or new veins could be found in the Dolly Varden area. Geophysical surveys are considered to be of little value because of the pervasive pyrite mineralization, a large number of shear zones and also because of the topography.

Area - The area selected for prospecting and geochemical sampling is 27 square miles, 9 miles long and 3 miles wide, running in a northwesterly direction, oriented to and covering the Kitsault River Valley. Sampling would be extended 1 mile east and 2 miles west of the river. This allowance is general and certain portions may be eliminated during the season by geological mapping. The area is extended 2 miles to the west of the river in order to include the copper belt rocks.

Geological Mapping - As part of the overall exploration programme a detailed geological mapping job would be completed over the same area outlined for geochemical work. It is obvious that there is structural control of the ore deposits in the Kitsault River area and it is therefore essential that certain major structures should be known when the time comes to select drill targets resulting from the geochemical survey. A drill target which has both geochemical anomalies and favourable structural setting would have a far better chance of success than geochemical anomalies without the structural features. It is planned to have the geological mapping and the geochemical surveys completed at about the same time and correlation could take place right in the field.

The Geochemical Targets -

- (a) Silver-lead mineralization in quartz carbonate veins.
- (b) Copper-gold mineralization in quartz vein lying in the copper belt series.

A typical vein would be up to 45 feet wide, including the alteration zone, and the strike length would be from 300 feet to 1,500 feet in length. The relatively short strike length dictates a close sampling interval.

The vein mineralogy is simple and thus the geochemical indicator elements for copper-gold veins is copper and, of course, silver and lead will indicate the more significant and formerly productive silver veins of the Dolly Varden - Torbrit model.

Sample Programme - Initially an orientation survey should be carried out over and adjacent to one of the typical veins in the district

where mine dumps and tailings disposal areas can be avoided. Samples at close spaced intervals along and across the length of the vein and including the alteration halo would be collected and analyzed for silver-lead-zinc-copper. In this manner an acceptable model could be developed for the geochemical campaign. Samples would also be taken at various depths in the soil profile to determine which horizon exhibits the optimum contrast between background and anomalous metal content. Preferred horizon commonly lies between 4 to 12 inches below grass roots.

For budget purposes we have determined that due to the extreme relief and heavy timber it is preferable to sample along the contour lines, that is in a north northwest and south southeast direction or parallel to the original strike of the host rocks. On the average at about 40 degrees to the strike of the known veins. Reconnaissance sample traverses would accordingly be run each 250 feet of vertical elevation from the 1,750 to the 3,000-foot of sea level or at an equivalent horizontal distance of 500 feet. Soil samples would be collected at 200-foot intervals along each line, resulting in a good pattern of 200 x 250 feet which should detect any veins large enough to be of economic interest.

In the 27 square mile area there would be 30 lines each 9 miles long or 270 line miles in all would be traversed. At a frequency of 26 samples per mile about 7,000 samples would be collected. At a daily rate of 1.5 miles effective traverse per day, 40 samples could be collected. This works out to 7,000 samples collected in 175 mandays. Samples of stream silt would also be collected since they can quickly outline areas of high metal content on which soil sampling can be undertaken in the season to

prepare for detail sampling and prospecting. There are 40 known streams in the area, each about 1 mile long and there are probably two and a half times as many which are not shown on the published maps. Overall one could estimate 100 creeks at 10 samples per creek which would result in 1,000 silt samples.

If an anomaly were located, then detail soil sampling would be done over anomalous areas. This would possibly result in additional 5,000 samples and would require 100 mandays.

Final delineation of targets for drilling can be achieved by sampling at the base of the overburden. In rugged terrain of this type any anomalies in the soil are displaced down the slope due to soil creep. Samples taken at the silt bedrock contacts show increasing metal content up slope towards the bedrock source where the overburden is 5 or 50 feet thick. In the Keno Hill area of the Yukon, United Keno has used this system successfully for the past ten years and have located extensions of the silver veins or additional veins in that area. This refinement may not be required in this particular case. It requires the use of portable percussion sampling equipment designed for the purpose. To take care of this contingency an additional 5,000 samples have been added to the total.


C. E. Michener, Ph.D.

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BUDGET

Phase I - Geochemical/Prospecting (Field Season May - August 1978)

Salaries - Pre-Season, Field Season and Post-Season Compilation

Chief Geologist, 6 months @ \$4,000.	\$24,000.	
Geologist, 1 for 6 months @ \$2,500.	15,000.	
Prospector, 1 for 4 months @ \$2,500.	10,000.	
Geological Assistants, 4 for 4 months @ \$1,500.	24,000.	
Cook, 4 months @ \$1,500.	6,000.	
Drafting, 200 hours @ \$12.00	2,400.	
	<u>\$81,400.</u>	\$ 81,400.

Geochemical Sampling

Power Sampling equipment, 2 units @ \$2,000. each	\$ 4,000.	
Recce Soil Samples, Cu, Pb, Ag, 7,000 @ \$2.50	17,500.	
Detail soil samples, Cu and/or Ag, 5,000 @ \$1.35	6,750.	
Silt Samples, Cu, Pb, Zn, Ag, 1000 @ \$3.50	3,500.	
Freight Charges, bags, etc.	750.	
	<u>\$32,500.</u>	\$ 32,500.

Travel and Transportation

Scheduled Carriers	\$ 6,000.	
Charter Ferry, Freight, etc.	2,000.	
Helicopter - 100 hours x \$250. (casual)	25,000.	
(Jet Ranger) - Fuel - 25 gal/hr x 100 hrs. x \$1.00/gal	2,500.	
	<u>\$35,500.</u>	\$ 35,500.

Camps, Food and Daily Supplies

36 man months or 980 days @ \$25.00		\$ 24,500.
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Communications

Radios - 8 walkie-talkies x 3.5 mos. @ \$100.	\$ 2,800.	
Telephone and telegraph	1,000.	
	<u>\$ 3,800.</u>	\$ 3,800.

Administrative Support Services -

5% of exploration costs exclusive of personnel		\$ 4,600.
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Supervision & Management by D.M.B. Partners -

Est. 30 days @ \$375.		<u>\$ 11,250.</u>
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Total Phase I Geochemical Program		\$193,550.
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Allow for		<u><u>\$200,000.</u></u>
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Phase II - Scout Drilling (Field Season September - November 1978)

2 Portable Drilling Units and 2 crews		
Rental of drill; 2 drillers and 2 helpers		
\$500/drill/day x 180 days	\$90,000.	
Mobilization of drills, equipment and 4 men	6,000.	
Helicopter, 3 months (for drill moves) (contract)	<u>74,250.</u>	\$170,250.
Chief Geologist, 4 months @ \$4,000.	\$16,000.	
Geologist, 3 months @ \$2,500.	7,500.	
Prospector, 3 months @ \$2,500.	7,500.	
Cook, 3 months @ \$1,500.	4,500.	
Drafting, 100 hrs. @ \$12.00	<u>1,200.</u>	\$ 36,700.
Camps, Food - 4 men x 90 days @ \$25.00	\$ 9,000.	
Supervisory Travel	<u>1,500.</u>	\$ 10,500.
Communications - 4 walkie-talkies for 3 mos. @ \$100.	\$ 1,200.	
- Telephone, \$500/mo.	<u>1,500.</u>	\$ 2,700.
Assays - Silver/Copper 1,000 @ \$5.00		\$ 5,000.
Property Acquisition		Nil
Administrative Support Services -		
5% of exploration costs exclusive of personnel		\$ 11,250.
Supervision & Management by D.M.B. Partners (4 mos.)		
Est. 25 days @ \$350.		<u>\$ 8,750.</u>
Total Phase II		\$245,150.
Allow for		<u>\$250,000.</u>
Summary		
Phase I	\$200,000.	
Phase II	<u>\$250,000.</u>	
Total Exploration Cost 1978	<u>\$450,000.</u>	