ASSESSMENT - GEOPHYSICAL REPORT

on the

AIRBORNE MAGNETOMETER
AIRBORNE ELECTROMAGNETIC
AIRBORNE RADIOACTIVITY

of the

DENISE 1 - 21 MINERAL CLAIMS

LORNE LAKE - PRINCETON AREA

SIMILKAMEEN MINING DIVISION

BRITISH COLUMBIA

Latitude: 49° 23' North; Longitude 120° 25' West

GEO-DYNE RESOURCES LTD. (NPL)
VANCOUVER, BRITISH COLUMBIA

Airborne Surveys by: Waterton Airex Ltd.
Interpretation by: Weymark Engineering Ltd.

20 July 1972

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
No 4553
ASSESSMENT - GEOPHYSICAL REPORT

LORNE LAKE - PRINCETON AREA

DENISE 1 - 21 Mineral Claims
SIMILKAMEEN MINING DIVISION

BRITISH COLUMBIA

CONTENTS

1.0 Property .......................... 1
2.0 Location .......................... 2
3.0 Geology .......................... 2
4.0 Mineral Zones ..................... 2
5.0 Geophysical Surveys ............... 2
6.0 Results .......................... 2
7.0 Summary Conclusions ............... 3
8.0 Recommendations ................. 3

APPENDICES

Annex - A  Geology of the Ingerbelle and Copper Mountain Deposits at Princeton B.C. by T.N. Macauley
Annex - B  Descriptive Details, Waterton Airx Ltd., Methods and Equipment
Annex - C  Cost Distribution

ILLUSTRATIONS

Figure: 1#1  Frontispiece, General Location
Figure: 2#1  Denise 1 - 21 Claims, Location
Figure: 3#1  Access and Topography
Figure: 4#1  Regional Geology
Figure: 5#1  Geophysical Surveys Field Readings
Figure: 6#1  Geophysical Survey, Flight Lines
Figure: 7#1  Geophysical Surveys, Anomalies
INDEX MAP

LOCATION

GEO-DYNE RESOURCES LTD. (N.P.L.)
DENISE MINERAL CLAIMS GROUP

LORNE LAKE, PRINCETON
SIMILKAMEEN MINING DIVISION
BRITISH COLUMBIA

Mines and Petroleum Resources
ASSESSMENT REPORT

NO. 4553  MAP #1

VICTORIA

Ocean

VANCOUVER


1.0 Property: The area covered by the aerial geophysical surveys involved the Denise 1 - 21 Mineral Claims. Designation details are given in the following table and shown on Figures: 1 and 2.

<table>
<thead>
<tr>
<th>Claim Name</th>
<th>Staking Date</th>
<th>Number</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denise 9</td>
<td>22 Aug. 1971</td>
<td>34153</td>
<td>24 August 1971</td>
</tr>
</tbody>
</table>

The claims were located by Rudolf Tuschek of Vancouver and subsequently transferred to Geo-Dyne Resources Ltd. (NPL).

No surveys have been made of the claim lines, posts or tags, so compliance with the Regulations of the Mineral Act of the Province of British Columbia cannot be verified at this time. There are no structures or buildings on the property belonging to the claims holder.
Geo-Dyne Resources Ltd. (NPL); Assessment Geophysical Report, Denise

2.0 Location: The claims area is situated about six air-miles south-easterly from Princeton at the southwesterly end of Lorne Lake, see Figure: 3. They are located in the Similkameen Land District with Registry Office in Penticton and the Similkameen Mining Division with Recording Office in Princeton. The geographic Reference is Longitude 120° 25' and North Latitude 49° 23'. Elevations on the claims range from 2300' of Lorne Lake to over 5,000 feet above sea level. Agate Mountain with an elevation of 5222' is the dominant feature.

Access to the claims is either from the Princeton-Copper Mountain partially paved road or via the Wolfe-Lorne Lake road which connects to Highway No. 3 with turn-off about nine miles east of Princeton. Access is restricted during off-summer months.

3.0 Geology: The presented interpretation of the geological formations of the area are given on Map 92H (East Half) Hope, 1960, Geological Survey of Canada.

Referring to Figure: 4, it will be noted that the area is underlain mostly by granites - syenites of the Coast Intrusions complexes bordered by Nicola volcanics.

Details about local geology are scanty because of the few outcrops. Detailed mapping is required.

4.0 Mineral Zones: Copper sulphides are visible as scattered disseminations and along fracture and joint planes in the form of chalcopyrite and as secondary malachite. Copper mineralization also appears in the skarn zones as blebs and disseminations associated with garnet and magnetite.

5.0 Geophysical Surveys: The area was surveyed by an airborne geophysical consisting of aeromagnetic, electromagnetic and radioactivity. This was conducted by Waterton Airex Ltd., of Sidney, B.C. on 9th July 1973. Flight readings were taken, see Figure: 5 and covered the claims area.

The survey involved 15 runs, 14,000 feet in length. These runs were 500 feet apart and were flown to a true bearing of North-South. The plane was captained by Claude Waterton, VRS-536 Senior Commercial, the co-pilot was G. Toews, both of Sidney, B.C. The flight plan was filed with the D.O.T. Vancouver. Figure: 6 gives the readings for each of the surveys submitted by Waterton Airex Ltd.

Annex B contains the details relating to the aircraft and the instrumentation used.

Referring to Figure: 6, it will be noted that:

- the variation in Radioactivity readings ranged from 0 to 3/100 MR²Hr
- the variation in Electromagnetic readings ranged from 0 to 20 (x.1 microamps)
- the variation in magnetometer readings varied from 10 to 25 (x 100) gammas. Background average was set at "20"
- for the radioactivity and electromagnetic tests, background was dialed out.

6.0 Results: Referring to Figure: 7, it will be noted that there is a strong northwesterly trend in the northern claims,
considering magnetometer, electromagnetic and radioactivity reading response. Claims 12 - 17 inclusive, similarly exhibit strong anomalous conditions. Another anomalous feature is exhibited on claims Nos. 18 - 21. These latter two portray an east-west trend. See Fig: 7.

Increased radioactivity is exhibited on Claims Nos: 2, 3, 5, and 8.

7.0 Summary Conclusions:

The results of the surveys, as presently interpreted are:

1. There is a coincidence in the magnetometer : "High" and "Low" zones as portrayed on Figure: 7 in three separate zones.

2. Interesting "overlaps" between "EM" and Magnetometer "High" and "Low" zones are revealed on Claims Nos 1, 2, 3 and 10; 12, 13, 14, 15, 16, and 17. The marginal fronts provide zones of interest for further investigation.

3. Increased radioactivity concentrations about the "High" Magnetometer and "EM" readings on Claims Nos: 1, 2, 3, 4 and 8 provide interesting features.

4. Interpretation of the geophysical relationships cannot definitively be resolved from the information base available. Further ground geological-geophysical - geochemical information is required.

8.0 Recommendations:

On the bases of the results obtained from the relating geophysical surveys referred to in this report, it is considered that further field investigations are warranted and that successively ground geo-chemical and geological and geophysical, - magnetometer, electromagnetic and induced polarization surveys should be initiated in order to provide the requisite information base so that assessment of the metalliferous possibilities of the Denise 1 - 21 Mineral claims can be undertaken. First attention should be directed toward the anomalous zones indicated on Figure: 7.

Respectfully submitted,

[Signature]

William J. Weymark P. Eng.
President

Weymark Engineering Ltd

30 July 1973
CERTIFICATE

I, William James Weymark, P. Eng., Consulting Engineer, President of Weymark Engineering Ltd., of the District of West Vancouver of the Province of British Columbia hereby certify that:-

1. I am a graduate of Mining Engineering of Queen's University, Kingston, Ontario, B. SC., 1940 and have been practising my profession for twenty-five years.

2. I am a practising Consulting Engineer and reside at 3310 Westmount Road, West Vancouver, Province of British Columbia.

3. I am a member of the Association of Professional Engineers of the Province of British Columbia and also of the Consulting Engineers' Division of the Association of Professional Engineers of British Columbia.

4. I am a member of the Canadian Institute of Mining and Metallurgy, of the American Institute of Mining, Metallurgical and Petroleum Engineers and of the American Geophysical Union.

5. I have no direct or indirect interest whatsoever in the holdings of Geo-Dyne Resources Ltd (NPL), the Denise Claims, or do I expect to receive any interest direct or indirect from the aforesaid company or in the said claims.

6. The findings of the accompanying report are based on my personal knowledge of the Denise Mineral Claims and study of the geophysical field test readings and the relating geological-mineralogical information. The geophysical readings and studies were made together with William Chang, M. Sc. Geophysics, McGill University.

DATED at West Vancouver, British Columbia, this 30th day of July 1973

[Signature]

W. J. Weymark P. Eng.
Geology of the Ingerbelle and Copper Mountain Deposits at Princeton, B.C.

T. N. MACAULEY, Geologist,
Newmont Mining Corporation of Canada Limited, Vancouver, B.C.

ABSTRACT

The Ingerbelle and Copper Mountain deposits are located near Princeton in southern British Columbia. They are owned by Newmont Mining Corporation of Canada Limited, a wholly owned subsidiary, Similkameen Mining Company Ltd. The property includes the Copper Mountain mine, a former producer.

 Ore reserves recoverable by open-pit mining are estimated at 76 million tons containing 0.33% copper. Production commenced during 1972 at a rate in excess of designed capacity (15,000 tpd).

All of the known major copper deposits in this area lie in a 14,000-by-3,250-foot belt of Triassic volcanics (Nicola Group) that is situated between a well-defined syenite-monzonite-diorite stock on the south and a variable intrusive complex on the north. The Nicola rocks consist of andesitic tuffs and agglomerates with lesser amounts of flows and some lessesilicate layers.

The orebodies are essentially disseminated sulphide deposits, although fracture-fillings are also important in many areas. Total sulphide content is usually less than 2%. At Ingerbelle, and at Pit 2 and most of Pit 1 at Copper Mountain, the sulphides are chalcopyrite-bornite. In part of Pit 1 and most of the former underground mine they are chalcopyrite-bornite.

At Ingerbelle the predominant alteration associated with mineralization is a pale greenish-gray bleaching of the dark andesitic rocks. This has been identified as albization, with lesser amounts of epidote, chlorite, biotite, scapolite and calcite. This bleaching is plentiful at Pit 2, but K-feldspathization is also evident here.

These orebodies can better be classified as syenomassive deposits than with typical porphyry copper. Their relationship to intrusives, the probably extensive metamorphic replacements, the evidence of pneumatolytic activity, the formation and redistribution of magnetite, and the irregular distribution of mineralization are all characteristic of this class. Deep-seated faults probably acted as channels for mineralization; fracturing, faulting and rock contacts influenced ore localization in detail.

INTRODUCTION

The Ingerbelle and Copper Mountain deposits are located 10 miles south of the village of Princeton in southern British Columbia, and 112 miles east of Vancouver. The Hope-Princeton Highway crosses the Ingerbelle property, and Copper Mountain lies about 1 mile to the east on the opposite side of the Similkameen River. Elevations in the vicinity of the deposits range from 3,500 to 4,000 feet, with the river situated in a steep-sided valley at the 2,500-foot elevation.

Copper mineralization was first discovered at Copper Mountain 80 years ago, with exploration and development being carried out during the early 1900's. In the periods 1925 to 1930 and 1937 to 1939 the Granby Mining Company extracted 34,780,000 tons of ore containing 1,085,000 Cu. Most of this ore came from glory hole and underground mining, but also includes 2,377,000 tons at 0.76% Cu from several open-pit operations during the last five years. Production amounted to $13,139,846 lbs of copper, 187,294 oz of gold and 3,834,800 oz of silver.

In January, 1966, Newmont acquired a group of claims opposite Copper Mountain, and exploration and development work carried over the next three years proved up the Ingerbelle orebody. During this time, drilling by Granby was adding to their known reserves of open-pit ore, and in December, 1967, Newmont purchased their Copper Mountain property. Both properties are now held by Newmont's wholly owned subsidiary, Similkameen Mining Company Ltd.

Ore reserves recoverable by open-pit mining are estimated at 7% million tons of 0.63% Cu. Of this amount, slightly more than half is in the Ingerbelle orebody and the remainder is in two Copper Mountain orebodies, designated Pits 1 and 2. The grades of all three orebodies are close to the 0.53% average. The stripping ratio at Ingerbelle is 2.6 tons of waste to 1 ton of ore, but it is less at the shallower Copper Mountain orebodies, so that the over-all ratio is 2.9 to 1. A possible third open pit at Copper Mountain is in the area of the old underground mine. The Ingerbelle orebody is being mined first at a rate in excess of 15,000 tons per day, and then mining operations will shift to Copper Mountain.

The geology of the Copper Mountain area and the former mine is well documented in the references cited at the end of this paper. However, a considerable amount of new information has been made available through the recent exploration and some of the earlier geological interpretations.

GENERAL GEOLOGY

Wolf Creek Formation, Nicola Group

The geology of the Ingerbelle - Copper Mountain area is shown in Figure 1; for coverage of a somewhat larger area see the maps produced by Rice

TERRENCE N. MACAULEY was born in Sudbury, Ontario, and studied geological engineering at Queen's University (B.Sc., 1958) and Michigan Technological University (M.Sc., 1962). Following positions with Sher-nitz Gordon Mines Ltd. at Lynn Lake, Manitoba, and with Franc R. Joulin and Algoma Central Railway in the Algoma district of Ontario, he joined Newmont Mining Corporation of Canada Ltd. in 1963. In the period 1966-1970 he was employed in the exploration and development of Newmont's copper deposits near Princeton, B.C.
Amphibolite-sized particles of plagioclase and pyroxene suspended in a matrix of clays, chlorite and non-descript silt particles. With increasing fragment size the tuff can grade into agglomerate. The fragments may be up to 4 inches in diameter, sub-rounded to sub-angular in shape, and composed of volcanic rock of variable composition and texture. The andesites are dark-coloured, fine-grained porphyritic rocks, usually characterized by enclaves of plagioclase and augite in a microcrystalline groundmass.

The siltstone at the Ingerbelle property is a very fine-grained, light-coloured rock usually possessing excellent bedding. The main bed is 50 to 120 feet thick and underlies an area of 2500 by 1200 feet. This discontinuous beds of siltstone are also found at depth in this area. At Copper Mountain these rocks are somewhat more variable, but still appear to be either water-lain tuff or siltstone derived from volcanic rocks.

Correlation of individual units in the Wolf Creek Formation over any appreciable distance is usually quite difficult, as their recognition is often obscured by intense alteration, intrusions or faulting. It is also apparent that many of these units are of limited extent and that their characteristics may change in a lateral direction. Therefore, it is impossible to construct a stratigraphic column for the whole area, or to correlate units across the Similkameen valley.

West of the Boundary Fault are found argillite, agglomerate and flows from higher in the Nicola series.

Copper Mountain Intrusions
Cutting the Nicola Group are the Copper Mountain Intrusions, best known through the work of Dolmage (1934) and Montgomery (1967). To the south of the copper orebodies lies the Copper Mountain stock, measuring about 5 by 2½ miles in size. It is concentrically differentiated, with diorite and minor gabbro forming the outer zone, monzonite the intermediate zone, and syenite and perthosite pegmatite the core. The smaller Smelter Lake and Voigt stocks, composed of undifferentiated diorite, lie about 1 mile to the north and northeast, with some areas of flat dipping in the southeast portion of the deposit (Fig. 2). At Copper Mountain the Nicola rocks generally form an uneven undulating pattern. The lower bedded unit is almost flat in the area between Pits 1, 2 and the underground mine, but warps steeply downward near the contact of the Copper Mountain stock (Fig. 3b) and lies parallel to the longitudinal section (Fig. 3a). North and west of Pit 1, some steep folding with NW-SE axes has occurred in an area complicated by several fault blocks.

Faulding
Extensive faulting has taken place, with several periods of movement being indicated from pre-mineralization through to Tertiary time. The faults may be classified into the following categories.

1. NW-SE faults. The Main Fault at Copper Mountain, being the principal example, had considerable influence on the location of ore and also appears to have had an extended history.

2. NE-SW faults, forming a series of "breaks" through the area, also influenced ore location and were involved in the structural adjustments along the Main Fault.

3. The N-S Boundary Fault has been traced for 7 miles and has been shown by drilling to dip 60 degrees west. It is important because it cuts off the belt of Nicola rocks containing copper mineralization. The rocks to the west of this fault are more metamorphosed, they have a higher proportion of sedimentary units.

Age-dating by Sinclair and White (1968) and Preto, White and Harakal (1971) gives an average age of 193 ± 8 million years (Upper Triassic) for both the Copper Mountain and Lost Horse intrusions. As the Nicola Group is also known to be Upper Triassic, a relatively short interval between volcanism and emplacement of the intrusions is indicated.

Felsite Dykes
A group of felsite dykes, locally referred to as "Mine" dykes, cut the Triassic rocks and the orebodies at Copper Mountain. They are Upper Cretaceous to Early Tertiary in age. They are chiefly creamy-coloured quartz and feldspar porphyries, along with a few more basic varieties.

Princeton Group
Lavas, agglomerates and sedimentary rocks of the Princeton Group (Eocene) overlie the Triassic rocks to the north and southwest of the mine area. A small trough of basal conglomerate lies along a fault over parts of the Pit 1 and 2 orebodies.

STRUCTURAL GEOLOGY
Folding
The lack of a distinctive marker bed that can be traced through the area has made it difficult to get a good structural picture of the Nicola rocks. However, the siltstone and bedded tuff are useful locally. At Ingerbelle the bedding generally dips 15 to 25 degrees to the north and northeast, with some areas of flat dips in the southeast portion of the deposit (Fig. 2). At Copper Mountain the Nicola rocks generally form an uneven undulating pattern. The lower bedded unit is almost flat in the area between Pits 1, 2 and the underground mine, but warps steeply downward near the contact of the Copper Mountain stock (Fig. 3b) and lies parallel to the longitudinal section (Fig. 3a). North and west of Pit 1, some steep folding with NW-SE axes has occurred in an area complicated by several fault blocks.

Faulting
Extensive faulting has taken place, with several periods of movement being indicated from pre-mineralization through to Tertiary time. The faults may be classified into the following categories.

1. NW-SE faults. The Main Fault at Copper Mountain, being the principal example, had considerable influence on the location of ore and also appears to have had an extended history.

2. NE-SW faults, forming a series of "breaks" through the area, also influenced ore location and were involved in the structural adjustments along the Main Fault.

3. The N-S Boundary Fault has been traced for 7 miles and has been shown by drilling to dip 60 degrees west. It is important because it cuts off the belt of Nicola rocks containing copper mineralization. The rocks to the west of this fault are more metamorphosed, they have a higher proportion of sedimentary units.

Bulletin for April, 1973 107
and they exhibit only low-grade metamorphism. They bear little resemblance to the intruded, highly altered and mineralized volcanics to the east. Evidence suggests a normal (west side down) movement on this fault, and an unknown lateral displacement.

**Fracturing**

Detailed study at Ingerbelle has shown that fractures are mainly steeply dipping but of random orientation. Preferred trends are present locally, but rarely persist over larger areas. It is evident that these rocks were thoroughly shattered prior to alteration and mineralization. Post-mineral fractures are coated with calcite and traces of pyrite.

Fracturing at Copper Mountain has long been recognized as an important ore control. The "ore fractures" in the old mine area strike northeast at right angles to the stock contact and dip steeply NW. In some places they may have considerable associated K-feldspar, biotite and coarse chalcopyrite-bornite; in others they may carry only a film of sulphides. In the hard fine-grained tufts these parallel fractures may be quite numerous, but in the more granular volcanics and intrusives they are not as plentiful and are more irregular.

**Breciation**

Brecias occur to a minor degree at several localities within the Lost Horse Intrusive complex. They are characterized by a dark matrix containing magnesite and usually a little chalcopyrite-pyrite. The largest known is a pipe 300 feet in diameter and at least 550 feet deep at the north side of the Pit 2 orebody.

**MINERALIZATION**

**Ingerbelle**

The Ingerbelle mineralized zone is crudely L-shaped. The southwest arm is about 1000 feet wide and tails off to a narrow erratic zone of low-grade mineralization. After narrowing as it wraps around the angle of the L, the zone broadens to a width of 1500 feet as it trends southwesterly to the Similkameen River. A 900-foot width of Nicola volcanics lying between the orebody and the Copper Mountain stock is practically devoid of copper mineralization. On the northwest side mineralization terminates abruptly against highly altered volcanics, but small patches of it are scattered through the less altered volcanics extending to the north and east.

The Ingerbelle orebody, lying within this large mineralized area, can be divided into three zones. The Southwest zone measures 800 by 900 feet at its top and decreases to 250 by 700 feet at a depth of 650 feet. Stratigraphic control is exerted here where (a) the ore tops against the base of the main sillstone unit at a depth of 100 to 200 feet and (b) a thick higher-grade section occurs at depth with the same gentle northerly dip as the host rocks. The North zone includes all of the ore lying north of the Gully Fault, and has maximum dimensions of 1700 by 900 feet. The top of this zone contains some of the better mineralization found during the early exploration, but again the bulk of the ore lies 200 to 700 feet below surface. The Southeast zone lies south of the Gully Fault and is the lowest-grade portion of the Ingerbelle orebody. It may represent the downward continuation of the North zone, indicating a normal displacement on the Gully Fault.
of 700 feet (Fig. 2). This interpretation envisaged two large lenses of ore striking E-W and dipping steeply south. However, exploration has not been carried deep enough to determine if the North zone definitely terminates against the fault. In summary, it can be said that the overall shape of the Ingerbelle ore zones is crudely pipe-like in some areas and lens-like in others.

An important feature of this orebody is the very irregular distribution of copper mineralization within these zones. Although much of the orebody has been drilled off at 100-foot spacing, it is often difficult to correlate individual ore intersections from one hole to another. An analysis of vertical, inclined and flat drill holes, and 5000 feet of drifting, within the orebody was made to see if mineralization followed a preferred orientation that had not been recognized (Table 1).

The criteria of 30 feet for a minimum ore length and 0.50% Cu cutoff were used. This study indicated that no matter from which direction this orebody was drilled, the results approximated the average ore length of 72 feet at a grade of 0.69% Cu. Waste sections between the ore intersections average only 0.15% Cu, and after determining bench grades and allowing for lateral dilution the average grade expected in mining is reduced to 0.53% Cu. Ore boundaries are usually sharp, with little marginal material noted in drill core samples.

The mineralogy of this ore is relatively simple. Chalcopyrite and pyrite are the dominant sulphides, but the ratio can change abruptly from predominantly chalcopyrite to predominantly pyrite. Total sulphide content of the ore varies from 2 to 5%, but some of the more pyritic material on the fringe carries 10 to 12% sulphides. Pyrrhotite occurs in the southeast zone. Sulphide mineralization at Ingerbelle occurs largely as fine disseminations, accompanied by fine discontinuous fracture-fillings and some coarser blebs. Sulphide veins up to several inches thick are rare. A later generation of epidote-pyrite veins cut the chalcopyrite. The host rocks are mainly altered tuffs and agglomerates. Massive anodesite, although mineralized, is less favourable for ore-grade material. Less than 70% of the ore is in small irregular masses of Lost Horse monzonite or diorite.

### Table 1 — Ingerbelle Ore Intersections

<table>
<thead>
<tr>
<th>Type of Hole</th>
<th>Number of Intersections</th>
<th>Feet</th>
<th>Average Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical</td>
<td>333</td>
<td>23,918</td>
<td>0.68% Cu</td>
</tr>
<tr>
<td>Surface Angle</td>
<td>85</td>
<td>6,264</td>
<td>0.75% Cu</td>
</tr>
<tr>
<td>U.G. Flat</td>
<td>70</td>
<td>8,246</td>
<td>0.83% Cu</td>
</tr>
<tr>
<td>U.G. Angle</td>
<td>E - W</td>
<td>641</td>
<td>0.91% Cu</td>
</tr>
<tr>
<td>U.G. Flat</td>
<td>N - S</td>
<td>32</td>
<td>0.65% Cu</td>
</tr>
<tr>
<td>U.G. Angle</td>
<td>S - W</td>
<td>2,282</td>
<td>0.72% Cu</td>
</tr>
<tr>
<td>Drill Flat</td>
<td>Venous</td>
<td>19</td>
<td>1,912.57% Cu</td>
</tr>
<tr>
<td>TOTAL</td>
<td>584</td>
<td>42,104</td>
<td>0.68% Cu</td>
</tr>
</tbody>
</table>

### Pit 1

The Pit 1 orebody at Copper Mountain measures 2300 feet long and up to 900 feet wide, with open-pit ore extending to a maximum depth of 550 feet. Previous production from this deposit amounted to 1,066,000 tons of 0.96% Cu. Several types of ore and different controls are evident here. The bulk of the ore is situated along the Main Fault in coarse tuffs and fine agglomerates, with minor flows and vague porphyritic intrusives. The orebody appears to terminate at the lower bedded tuffs. A post-ore normal offset of 250 feet is indicated on the Tremblay Fault (Fig. 3b). Mineralization in this central part of the deposit consists of finely disseminated pyrite and chalcopyrite, with lesser blebs and stringers. Along the Copper Mountain stock and in the bedded tuffs at the west end of the orebody, the ore is in the typical contact type consisting of fine bornite-chalcopyrite fracture-fillings with some adjacent disseminations. The divergence of the Main Fault and the rock contact may account for the diminishing amount of ore toward the western end of the deposit.

### Pit 2

Previous open-pitting in this deposit extracted 1,921,000 tons containing 0.77% Cu. The orebody as now known is 3000 feet long, 350 to 1200 feet wide, and appears to have a maximum mineable depth of about 540 feet. It lies along a vague irregular contact zone between the Lost Horse intrusive complex on the north and the volcanics to the south. Part of the northern boundary of the orebody is formed by a broad zone of crushing and argillic alteration termed the Ada Fault, and ore-grade mineralization fingers out to the west in the vicinity of the Tremblay Fault. The southern margin is fairly straight, but is not related to any known geological structure. Within the limits of the orebody, the ore-grade material is irregularly distributed with varying amounts of inter-ore waste, but several local trends and centers of copper mineralization occur. The sulphides in this deposit are almost entirely chalcopyrite-pyrite, with bornite occurring in only a few places where the pyrite content diminishes to zero. As in the other deposits, sulphide disseminations are either associated with minute healed fractures or diffused through the microcrystalline groundmass in the altered volcanics. However, a much greater proportion of the sulphides at Pit 2 are in the form of coarse blebs and veins.

### Alteration

Alteration of the volcanic rocks and the Lost Horse complex varies from moderate to extreme. In general, the finer-grained tuffs and siltstones have been "hornfelsed", with recrystallization of the feldspars and the development of biotite. Some secondary pyroxene has also formed at the contact of the Copper Mountain stock. Albite is the chief mineral affected by actual K-feldspathization is limited to late-stage fracture-coatings. Pink feldspathization is also shown at the contact of the Copper Mountain stock.

At Ingerbelle the most prominent alteration associated with copper mineralization is a pale greenish bleaching of the dark andesitic volcanics. This alteration involves a conversion of andesine plagioclase to albite, together with the formation of considerable epidote and lesser amounts of chlorite, scapolite, calcite and occasionally hornblende. The recrystallization has converted the host rock into a fairly hard, tough rock, with many of the original fractures healed together. Potash feldspathization is very minor at Ingerbelle, despite the occurrence of large amounts of porphyritic alteration, mainly at the north side of the orebody. Albite is the chief mineral affected by this pink coloration, and staining techniques have shown that actual K-feldspathization is limited to inter-stage fracture-coatings. Pink feldspathization is also intense in some areas at Copper Mountain, but here a major
part of it is potashfeldspathization. Ingerbelle ore
contains only 1½ to 2% potash versus 5% at Pit 2.
A little secondary biotite is noticeable in the altered
volcanics and intrusives of the Ingerbelle area. Coarse
biotite is found in many of the pegmatitic ore frac-
tures at Copper Mountain, where it is at the center
of the vein and may be intergrown with bornite or
chalcopyrite. The age of this latter biotite has been
shown to be virtually the same as the primary biotite
in the intrusions, within the limits of experimental
error (Sinclair and White (1968); Preto, White and
Haraskal (1971)). Argillite alteration on a substantial
scale is evident adjacent to some of the major fault and
felsite dyke zones. At Ingerbelle, the Gully Fault
has a wide zone of heavy argillite alteration and pink
feldspathization. Mineralization is usually weak or
absent where this type of alteration is most intensely
developed.

Epode is prevalent in the Ingerbelle and Pit 2 deposits,
and occurs to a lesser extent far beyond the confines of the mineralized areas. Scapolite occurs at
Ingerbelle as networks of narrow steeply dipping veins
with minor replacements in the adjoining rock. It is
most common along the heavily altered northwest side
of the orebody and is found sparingly elsewhere through the mineralized zone. Scapolite is rarely rec-
ognized at Copper Mountain. Quartz is absent from
most of the rocks in the area, but traces of it have
been seen in thin sections and in the scapolite-albite
veins at Ingerbelle. The pale alteration often described as "cherty" is primarily very fine albite.

Accessory magnetite is present in the intrusives and
less-altered volcanics, but magnetite of secondary
origin also occurs in a variety of forms. Rides or vein-
lets of it, sometimes carrying a little pyrite or rarely
chalcopyrite, are found over the whole Ingerbelle
-Copper Mountain area, but are not common. Local
concentrations are known within the Lost Horse com-
p lex, sometimes with associated copper. Magnetite is
usually absent from the pale albitized volcanics that
comprise most of the host rock for copper mineral-
ization, and it is totally absent in the most intensely
altered rocks.

MINERAL ZONING

Mineral zoning in and around these deposits can
only be crudely defined, but the following points are
of interest. Chalcopyrite is the main copper-bearing
mineral at Ingerbelle, and is the predominant one at
Pits 1 and 2. Only a trace of bornite is found at Pit 2,
but important concentrations of it were mined along
the contact of the Copper Mountain stock. Minor chal-
copeite was also reported in some of the contact ore.
At Ingerbelle, pyrite concentrations occur outside the
south and west sides of the orebody, but not the
more intensely altered north side. At Copper Moun-
tain, small amounts of chalcopyrite, pyrite and occa-
sionally pyrrhotite are found all through the volcanics,
but do not form halos to the orebodies.

Farther away from the orebodies, widespread but
weak occurrences of chalcopyrite-pyrite-magnetite are
in the Lost Horse complex and its incorporated
inclusions. Small but better-grade deposits of pyrite-hematite are associated with a long breccia-
zone in the Voigt stock. The Copper Mountain stock
urges much less sulphide than the Lost Horse
one, and it usually occurs as chalcopyrite-pod or fracture-coatings associated with the
mineralization. Even farther away from the ore

deposits, traces of chalcopyrite in the Nicola volcanics
have an affinity for pyrrhotite rather than pyrite.

Molybdenite, in sub-economic quantities, is most
prevalent in the heavily altered north end of the Inger-
belle orebody, much less common to the south and very
rare at Copper Mountain. Where this type of alteration is most intensely
developed.

ORE GENESIS

It is believed that these copper deposits are related
spatially and genetically to the Copper Mountain In-
trusions. However, all of the information now available
suggests that the Lost Horse intrusive complex has
had a much more important part in the formation of
these deposits than had previously been recognized.

Zoning at Ingerbelle appears to be in a direction
outward from the Lost Horse complex. A zone of high
alteration separates the intrusive from the orebody,
then there is the north part of the orebody with chalco-
pyrite predominant, then the south part with pyrite
predominant, then some pyritic areas around the frin-
gets on all but the north side, then decreasing altera-
tion into the dark volcanics with some secondary
magnetite, and then into the Copper Mountain stock
with no known copper mineralization on the contact.
The heavily altered Gully Fault area, which appears
to have had a channelway for mineralization, dips
70 degrees north towards the Lost Horse complex.

At Copper Mountain, the Pit 2 deposit lies on the
indistinct contact zone with the Lost Horse, and has
no alteration or mineralization tie-ins with the Pit 1
deposit 1,000 feet to the southwest. The importance
of faulting and fracturing as ore controls for those
deposits close to the Copper Mountain stock has al-
ready been mentioned. The stock itself shows little
sign of the fracturing, alteration and mineralization
present in the volcanics, and it probably acted as a
barrier to mineralizing fluids moving along the vari-
cious faults. The orebodies end on the east side ap-
proximately where the Lost Horse complex and the
Copper Mountain stock diverge. The apparent absence
of orebodies around the east and south sides of the
Copper Mountain stock can perhaps be related to the
absence of the Lost Horse rocks in those areas.

It could be argued that the source of the copper
might be the volcanic rocks that have undergone ex-
cessive assimilation and alteration by the Lost Horse
intrusive complex. However, the amount of meta-
somatic replacement that the volcanics have undergone
is not well known; perhaps a rock geochemical study
now in progress will shed more light on this.

These deposits are not readily classified into com-
monly accepted systems. However, they appear to lie
closer to pyrometasomatic deposits than to typical por-
phyry copper. Their relationship to intrusives, the
probably extensive metasomatic replacements, the
evidence of pneumatolytic activity, the formation and
redistribution of magnetite, and the irregular distri-
bution of mineralization are all characteristic of this

ACKNOWLEDGMENTS

The contributions of all my fellow geologists in
W. J. Tough Elected President of B. C. Mining Association

W. J. Tough, vice-president of Wesfrob Mining Ltd., has been elected president of The Mining Association of British Columbia. He succeeds W. Clarke Gibson, chairman of the board of Giant Mascot Mines Ltd. The election took place at the annual meeting of the Association in Vancouver on February 26. Vice-presidents elected were J. D. Little, executive vice-president, Placer Development Ltd., and Edgar Kaiser, Jr., executive vice-president, operations, Kaiser Resources Ltd.

Mr. Tough graduated as a mining engineer from the University of British Columbia in 1933 and has been involved in mining in several provinces of Canada, as well as Greenland, Africa, South America and the South Pacific.

In 1942, he joined Ventures, which is now Falconbridge Nickel Mines, a company he has worked with ever since, and began a career of managing and developing new mines in several parts of the world. He came back to Vancouver in 1961 and, in addition to being vice-president of Wesfrob Mines, is also an officer and director of several other mining and exploration companies within the Falconbridge group.


Queen’s to be Centre for Resource Policy Studies

A CENTRE FOR RESOURCE STUDIES to carry out research and analysis on important questions of Canadian resource policy will be established at Queen’s University, Kingston, Ontario. This was announced jointly by The Honorable Donald S. Macdonald, M. P., minister of Mines and Resources, Dr. J. J. Deutsch, principal of Queen’s University, and P. F. Todd, the retiring president of the Mining Association of Canada, on the occasion of the Association’s 29th annual general meeting.

The basic funding for the Centre will be provided by the Government of Canada and the Canadian mining industry. Queen’s University will supply the required academic capabilities and physical facilities under University procedures and directed by a board to include representatives from the Federal Government, industry and the University.

The studies to be carried out at the new Centre will make a valuable contribution to the development of future resource policies, particularly those having a significant bearing on the husbanding of resources and on the nature and direction of mining and its related activities. For some considerable time, it has been the feeling both of the Department of Energy, Mines and Resources and the mining industry that a greater degree of primary research is needed to measure accurately such important matters as: the national impact of mining; its balance sheets and effect on other significant sectors of the economy, on the environment, and on employment in secondary manufacturing and service industries; and its effect on regional development, and on Canada’s balance of payments.

The Centre will concentrate initially on studies relating to metals, non-metals, and some industrial minerals such as asbestos and potash.
Proven in Western and Northern Canada for the highest degree of accuracy at the lowest cost, $10. per lineal mile including base and positioning expenses on average surveys. Oil assessment in the North at $12. per lineal mile. A 400 square mile area at 1,000 foot spacing would cost $20,000 and could be completed in three weeks. This should put your ground party a year or more ahead in their exploration program.

By the use of this combination method 80% of the unproductive anomalies can be calculated out of the survey which results in keeping the ground follow up costs to a minimum.

Electromagnetics: Waterton quadrature system.
Trans. on 1,000 CPS. Receive in units of $1 microamperes.

Magnetometer: Flux-gate Sharpe PFM-3 or McPhar M700,
Proton, GeoMetrics C-806. (Modified to our system.)
Receive in units of 10 to 100 Gammas.

Radioactivity: Detectron - DR299 24 tubes,
Receive in units of $0.001 MR/HR. (Total count.)

Threshold: McPhar TV-3B, three inch crystal.
Positions 1.3 - 1.63 - 2.3 Mev.

Grid supplied in scales of 1,000 to 2,000 feet per inch, with clear overlays showing the anomalous areas.
Ground checks over mountain areas have found the accuracy to be within 500 feet on a 500 foot grid.
Over 15,000 lineal miles of reconnaissance and assessment assistance completed in 40 different areas by the end of 1970.
Operation range up to 400 miles from base.
Aircraft type: Cherokee 235 - Twin Comanche.
Computer processing available.
Our patented method incorporates the combined readings from a magnetometer, a nuclimeter and a miniaturized electromagnetic unit. The readings are recorded instantly on film and timed electrically to enable the readings to be entered on a grid of a chosen scale. Strip recording is available.

To obtain anomalies of most value level lines are flown in a certain plane and a fixed wing aircraft is chosen as the most suitable vehicle for this purpose.

Any inaccuracy in the timed readings due to airspeed error is calculated out before the readings are entered on the grid.

The instruments are set on "0" over a predetermined spot near the survey area and this adjustment is made after each 1½ hours. The survey flying is done in certain condition and at certain times of the day.

Station-keeping is accomplished by electrical counter, reference to topographical features, directional gyro set from the compass or astro compass and a set flying technique. Ground checks from over twenty mountainous areas have found the accuracy of this method to be between 250 and 500 feet on a grid scale of 500 feet.

Anomalies are plotted from the grid on to transparent sheets and the resulting overlows give us the combination anomalies which, in our experience, have been the most successful.

Magnetometer: PMF-3 Sharpe or McPhar M-700 flux-gate or Proton unit is used when adjusted to our method. Readings are in units of 100 gammas for mineral reconnaissance and in units of 10 gammas for oil reconnaissance.

Electromagnetic: Developed by ourselves to a miniature scale to enable us to use small aircraft to keep the cost of survey to our rates.

With the sensitivity set at 30% disseminated sulphides usually read in the 3 to 5 range and heavy sulphides in the 10 to 15 range on a scale division of 25.

The transmitted electrical field is from 200 feet of copper wire attached to the bottom of the aircraft in the horizontal plane and power is taken from the aircraft generator and built up to required strength by the field transmitter which operates in the 1,000 CPS range.

A small 10 oz bird is drawn behind the aircraft powered by its own mercury cell and its receiving coil is in the vertical, 90° to the transmitted field. A booster receiver in the aircraft produces the received signal in units of .1 microamperes.

Nuclimeter: Detectron - DR299, 24 tubes suited to airborne work to obtain total radioactive readings in units of .001 MR/HR, milliroentgens per hour. Threshold readings are taken with a 3" crystal unit. 1.3 - 1.63 - 2.5 Mev.

Gravity Change Indicator: Developed by ourselves to assist in selecting anomalous areas when requested.

Computer processing is available when requested and for this the magnetometer average in the area is set at 3,000 gammas.

Address: Box 2002, Sidney, B.C. Canada. Phone: 656-5045
ANNEX - C

Cost Distribution

1. Waterton Airex Ltd., conducting airborne Aeromagnetic, Electromagnetic and Radioactivity readings at 500-ft intervals, 40 miles approx. flight lines, Denise 1-21 Mineral Claims, Similkameen Mining Division ........ $880.00


Total ........................................ $2100.00

[Signature]

W. A. Weymark, P. Eng.
President

Weymark Engineering Ltd
<table>
<thead>
<tr>
<th>Lat: 49° 23'</th>
<th>Long: 120° 25'</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Denise-11</strong></td>
<td><strong>Denise-10</strong></td>
</tr>
<tr>
<td>34155</td>
<td>34154</td>
</tr>
<tr>
<td>Tag 989096M</td>
<td>Tag 989095M</td>
</tr>
<tr>
<td><strong>Denise-13</strong></td>
<td><strong>Denise-12</strong></td>
</tr>
<tr>
<td>34157</td>
<td>34156</td>
</tr>
<tr>
<td>Tag 989098M</td>
<td>Tag 989097M</td>
</tr>
<tr>
<td><strong>Denise-15</strong></td>
<td><strong>Denise-14</strong></td>
</tr>
<tr>
<td>34159</td>
<td>34158</td>
</tr>
<tr>
<td>Tag 99778M</td>
<td>Tag 997M</td>
</tr>
<tr>
<td><strong>Denise-17</strong></td>
<td><strong>Denise-16</strong></td>
</tr>
<tr>
<td>34161</td>
<td>34160</td>
</tr>
<tr>
<td>Tag 99780M</td>
<td>Tag 99779M</td>
</tr>
<tr>
<td><strong>Denise-21</strong></td>
<td><strong>Denise-20</strong></td>
</tr>
<tr>
<td>34165</td>
<td>34164</td>
</tr>
<tr>
<td>Tag 99784</td>
<td>Tag 99783</td>
</tr>
</tbody>
</table>

**Note:** Location of Claims Approx.

---

**GEO-DYNE RESOURCES LTD.** (N.O. G.)
**SIMILKAMEEN MINING DIVISION**

**WEYMARK ENGINEERING LTD.**
CONSULTING ENGINEERS
WEST VANCOUVER, BRITISH COLUMBIA, CANADA

**DENISE MINERAL CLAIMS**
LOCATION

**DATE** 30/Jul/1973  **SCALE** 1" = 1500' approx

**SUBMITTED** CW  **FILE No.** GD-1
**CHECKED** WJW  **CONTRACT** GD-1
**DRAWN** WJW  **FILE No.** GD-1
**TRACED** WAW  **CONTRACT** GD-1

Ref: B. C. Minister of Mines: 92H8W
GEO-DYNE RESOURCES LTD
DENISE 1-21 CLAIMS
Tuff, Volcanic Breccia, arg. cong.
Coast Intrusions
Granites, Granodiorites, Qtz Diorites; Gabbro

\[\text{Note: Location of Claims - approx.}\]

\[\text{DATE 20 JULY 1973}\]
\[\text{SCALE 1 inch to 4 M.}\]
\[\text{CHECKED W.M.}\]
\[\text{DRAWN W.M.}\]

\[\text{WEYMOUTH ENGINEERING LTD.}\]
\[\text{WEYMOUTH ENGINEERING LTD.}\]

\[\text{DENISE MINERAL CLAIMS}\]
\[\text{REGIONAL GEOLOGY}\]

\[\text{GEO-DYNE RESOURCES LTD.}\]
\[\text{SIMILKAMEEN MINING DIVISION}\]

\[\text{JOINS MAP 538A, KO}\]
ILLUSTRATIONS