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(Ingerbelle)
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鉱山地質 (MINING GEOLOGY), 26, 179 ~ 190, 1976

On the Exploration and Structural Control of the
Ingerbelle Deposit, British Columbia, Canada

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Abstract

The writer would like to stress the importance of the detailed geological mapping on primary porphyry copper or porphyry molybdenum deposits in the inconclusively explored area. It is a useful tool for delineating irregular zones of concentrated mineralization for targets to be checked in the advanced exploration stage and also, for revealing the structural control for the purpose of a more accurate evaluation.

The case of the Ingerbelle deposit is discussed in this paper as an example of time-saving and efficient exploration work for the assessment of areal mineral potential by means of the writer's special mapping technique, as well as the geologically interesting features of the deposit.

1. Introduction

Exploration on the optioned Ingerbelle property with known weak mineralization was commenced in February 1966 by the Newmont Mining Corp. of Canada Ltd. The writer was assigned to execute a program of detailed geological mapping during the periods of early 1966 and the whole of 1968, which resulted in the delineation of the Ingerbelle-Red Buck deposits and the successful analysis

* The author is the recipient of the "Society of Mining Geologists of Japan Prize" for the work reported in this paper. Paper presented at the annual meeting of the Society, Tokyo, February 3, 1976.

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Key words: Ingerbelle mines, Porphyry copper deposit, Lost Horse Intrusives, Copper Mountain Stock, Structural control, Exploration

of the structural control of irregular shaped, primary sulphides zones, respectively. Extent of the deposit outlined on the surface could be projected to depth as a pipe-like body due to the nature of control by steeply dipping fractures, developed in the intensely deformed metavolcanics as host.

Those who wish to have further details on exploration, geological geophysical, petrological works and radiometric dating, may refer to the literature listed as references because, in this paper, the writer wishes to discuss mainly the practical theme in detailed geological mapping and structural control of the modified occurrence of porphyry copper deposits in assimilated metavolcanics.

It is a significant feature that the radiometric dating for the Copper Mountain Intrusives and the associated mineralization indicated Upper Triassic age, which is earlier than most parts of the Coast Range Batholithic complex.

2. Location and Physiography

The Ingerbelle Mines of the Similkameen Mining Co. Ltd. (a subsidiary of the Newmont Mining Corp., U.S.) is located at the southernmost part of the eastern porphyry copper-molybdenum belt in British Columbia and 184 km east of Vancouver (49°20' north latitude and 120°33' west longitude) (Fig. 1)

The Similkameen River flows northerly in the deeply incised valley which separates the new Ingerbelle Pit and the dormant Copper Mountain Mine, lying approximately 1.5 km east of the former.

A blanket of glacial till of several meters thick on average, limits natural bedrock exposures to more or less 1% of the total mapped

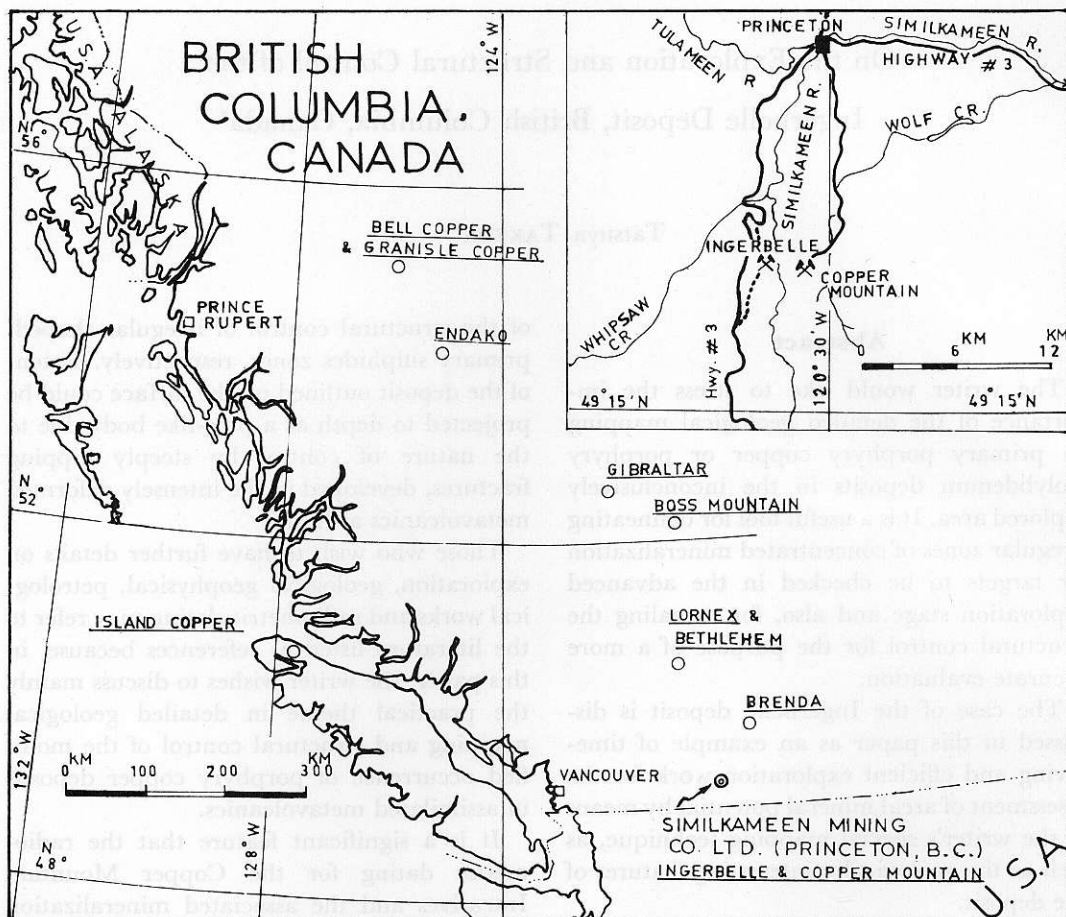


Fig. 1 Index map.

area. Canyon walls and steep slopes provide most of the fair-sized exposures with very meager copper mineralization (Fig. 2)

The mine lies in the semi-arid Interior Plateau Belt with typical continental climate. Minor snowfall during winter barely maintains sparse growth of conifers. Due to the lack of underground water, water supply to the mill depends on the Similkameen River which is under strict international control as a tributary of the Columbia River in the United States.

3. Particular Viewpoint in Geological Mapping

Even when classifying rocks on the basis of

units which have been well established by the old Granby geologists, detailed geological mapping in the Copper Mountain area is very difficult for the following reasons:

- (a) Occurrence of major copper mineralization in the highly fractured meta-volcanics which display neither prominent alteration zoning nor mineral zoning.
- (b) Transitional facies changes in the host and overlapping alterations in complicated combination which produces numerous varieties of derivatives.
- (c) Obliteration of original texture of rocks by assimilation or intense alteration.

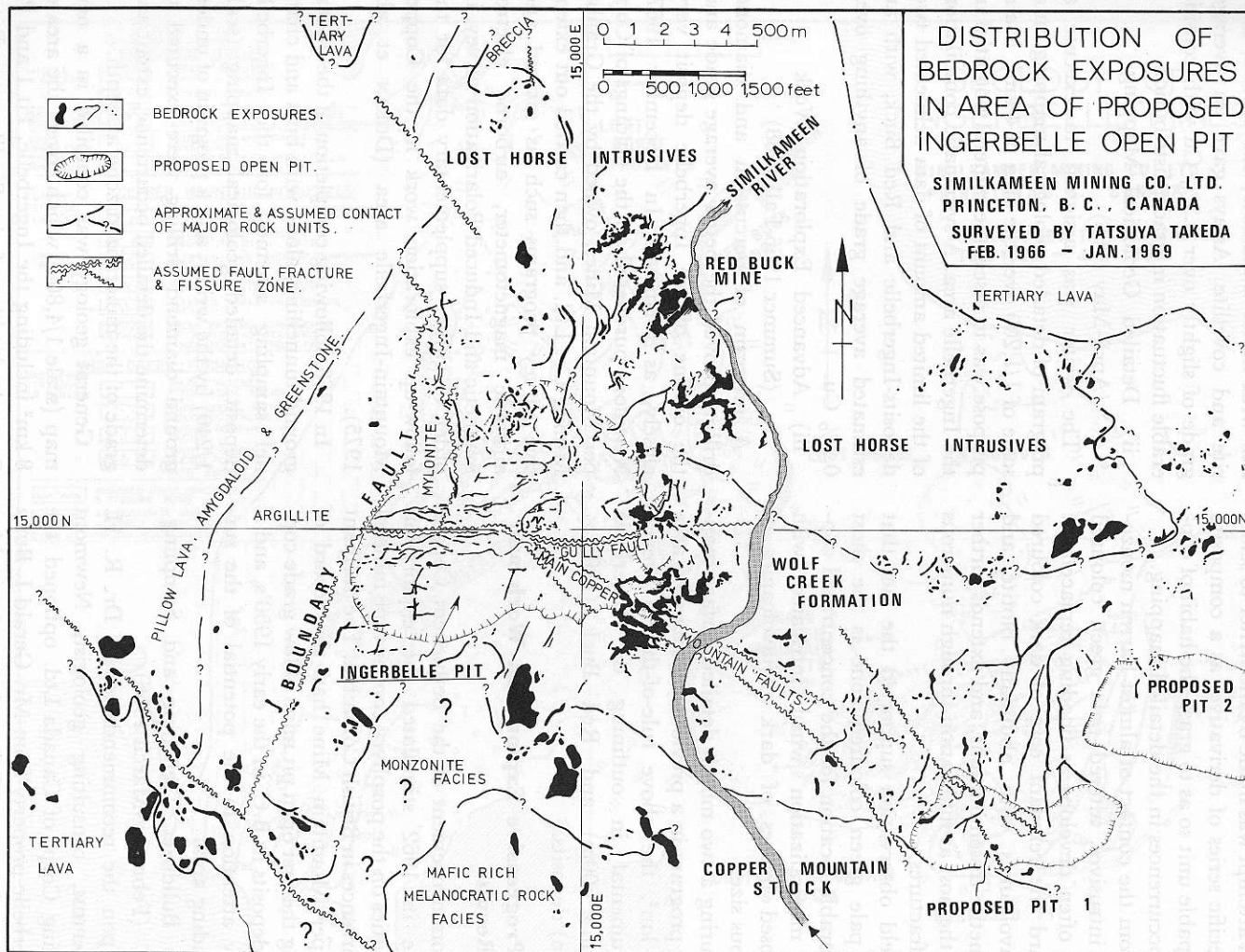


Fig. 2 Distribution of bedrock exposures in area of proposed Ingerbelle open pit.

- (d) Extreme paucity of bedrock exposures and weathering of rocks in semi-arid climate.

An attempt was made by the writer to select a specific series of derivatives as a composite mappable unit so as to grasp the habit of copper occurrences in the detailed mapping.

From the contact of almost barren monzonite intrusives, altered pale green coloured rock often develops as flooding replacement toward the remnant core of dark coloured metavolcanics with abundant biotite and magnetite disseminations, and extends further into the host as infiltration through numerous fine fractures.

Field observation supported the fact that this pale green coloured zone is the most favourable location for the concentrated copper mineralization when intricated with enclosed masses of dark metavolcanics of various size.

During a two month detailed surface mapping program in a previously unmapped area of 4 km², the above rule-of-thumb proved instrumental in outlining the Ingerbelle (300m × 600m) and Red Buck (100m × 250m) deposits.

4. Progressive Exploration Work and Results

Commencement of the Bethlehem Copper Mine in 1962 stimulated the exploration activities on the porphyry copper type mineral occurrences in British Columbia. The dormant Copper Mountain Mine had the record of being the first open pit mine of low grade copper deposits in B.C. in the early 1950's, and it drew attention to the potential of the surrounding area.

- i) Bulldozer Trenching and Sampling (February-March 1966)

Upon the recommendation of Dr. R. H. SERAPHIM, consulting geologist, Newmont Mining Corp. of Canada Ltd. optioned the Ingerbelle property from Mr. Gerald I. BURR et al. in Princeton, B.C. and started trenching by bulldozer over the known area of scattered, weakly mineralized showings.

Sampling on the bedrock exposures indi-

cated a mineralized zone with north-south and east-west axes of 200m and 500m respectively. Copper mineralization consists of chalcopyrite with minor malachite, chrysocolla, azurite and covellite. Assays gave an average grade of slightly over 0.3% Cu with considerable fluctuation in grade distribution.

- ii) Detailed Geological Mapping (April-May 1966)

The writer was assigned to execute a program of detailed geological mapping on a scale of 1/1,200 over the area of 4 km². Main purpose was to assess the mineral potential in the Ingerbelle area. A systematic compilation of the limited amount of data delineated two deposits-Ingerbelle and Red Buck, with an estimated average grade of anything over 0.3% Cu.

- iii) Advanced Exploration Work (Summer 1966-Fall 1968)

A program of percussion and diamond drilling proved the better average grade and the outline of the Ingerbelle deposit very closely, as predicted. In December 1967, Newmont purchased all the holdings of Copper Mountain Mines, owned by the Granby Mining Co. Ltd. and then carried out extensive survey programs such as ground and airborne magnetometer, airborne electromagnetic and Induced Polarization survey, in order to gather supplementary data for the follow-up exploration work in the Copper Mountain-Ingerbelle area (DOLAN et al., 1975).

In 1968, following completion of the underground tunnelling, along with bulk and channel sampling schemes for the Ingerbelle deposit, detailed geological mapping (scale 1/240) by the writer, and a program of underground diamond drilling were executed to determine the detailed occurrence, extent and grade of the mineralized zone at depth.

General geology was compiled in a new map (scale 1/4,800) which covers the area of 8 km² including the Ingerbelle, Pit 1 and Pit 2, on both sides of the Similkameen River (Fig. 3).

The internal structure and deformation of the metavolcanic complex, the progressive

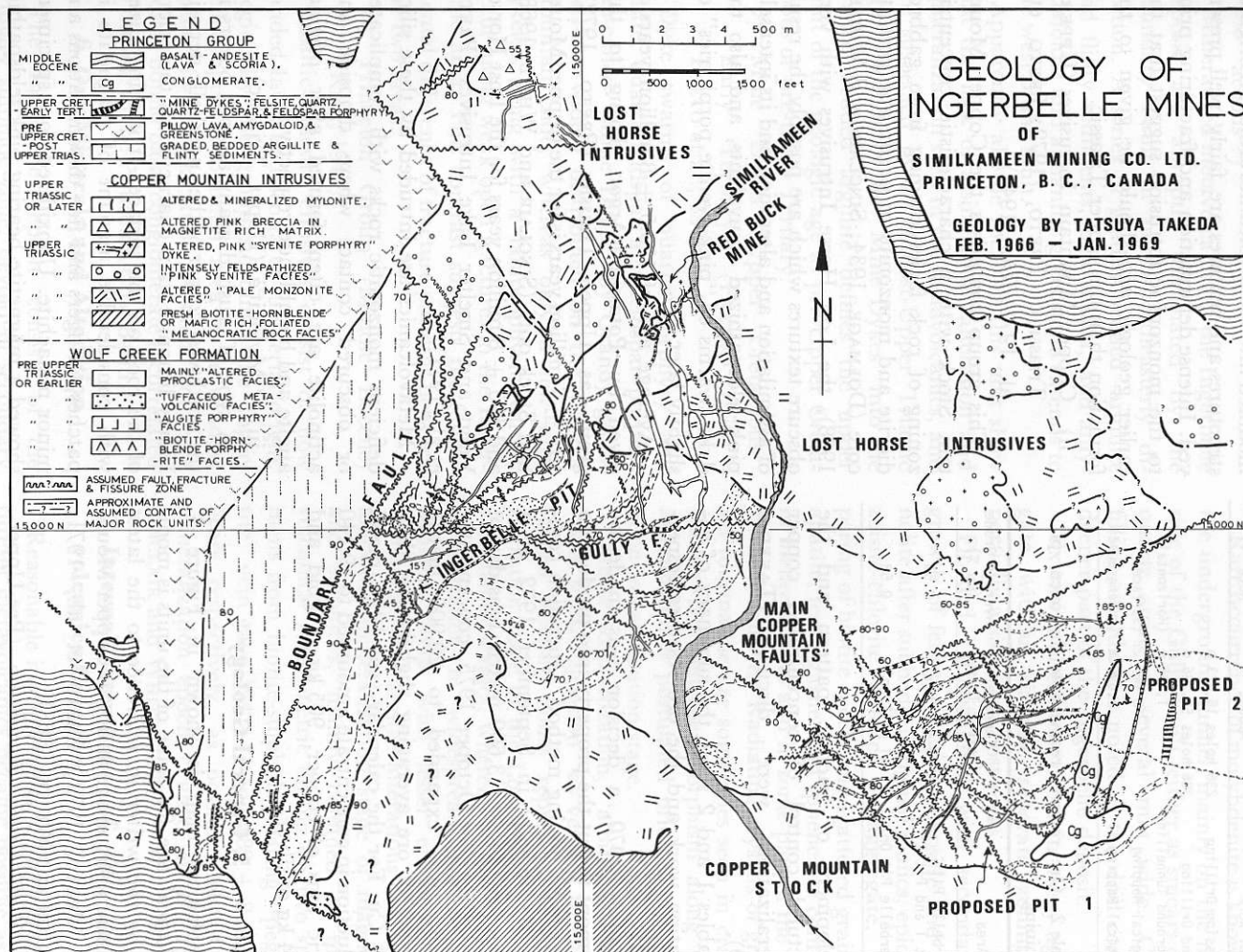


Fig. 3 Geology of Ingerbelle mines

Table 1 Summary of exploration work in the Ingerbelle area.
(Summer 1966–Fall 1968)

Type of Work	Amount	Note
Percussion Drilling	236 holes 18,823 m	
Diamond Drilling	306 holes 55,286 m	
Underground Tunnelling	1,696 m	(Horizontal)
Geological Mapping	8 km ²	(Surface)
Geological Mapping	1,696 m	(Underground)

Table 2 Ore reserve recoverable by open pit mining.

Pit Area	Tonnage (Metric Tons)	Average Grade (Cu %)
Ingerbelle Pit, Pit 1 and Pit 2	69 million	0.53
(Ingerbelle Pit Only)	(41 million)	0.53

development of fracture pattern and the structural control of concentrated copper mineralization were discussed (TAKEDA, 1969).

Tables 1 and 2 show the summary of exploration work and the ore reserves respectively.

In July 1970, a decision was made by Newmont to put the property into production by open pit mining method. Operation commenced officially in September 1972 at a production rate of 13,600 metric tons/day of ore and then in October 1975, concentrator capacity was expanded to 20,000 metric tons/day of ore averaging slightly less than 0.5% Cu. For the calendar year 1974, metal production in concentrate amounted to 19,140 metric tons of copper, 905 kg of gold and 3,664 kg of silver.

5. General Geology

Geological map is shown in Figure 3. Geological age for some of the units is modified by the writer in reference to the latest Potassium-Argon age dating at Copper Mountain (PRETO, 1972; PRETO et al., 1971; SINCLAIR and WHITE, 1968).

- i) Wolf Creek Formation (Pre-Upper Triassic) (DOLMAGE, 1934; RICE, 1947).

This non-fossiliferous, eugeosynclinal basaltic complex of submarine volcanic origin

is the oldest in the area and also is the most favourable host for copper mineralization. Due to the later assimilation and alterations, it was modified into meta volcanics although original structures and textures are fairly well preserved. Intense deformation and fracturing prior to the monzonitic intrusion suggest that the earlier geologic age should be given to the formation than the Upper Triassic.

- ii) Copper Mountain Intrusives (UPPER Triassic) (PRETO, 1972; PRETO et al., 1971; RICE, 1947)

This group comprises the Copper Mountain Stock with a characteristic concentric zoning of rock facies ranging from gabbro, diorite and monzonite to pegmatitic perthite core (DOLMAGE, 1934; SINCLAIR and WHITE, 1968), the Lost Horse Intrusives with very obscure textures which are possibly the result of assimilation and alteration and its intensely pink feldspathized equivalents, and also the dyke swarms of "pink syenite porphyries" of slightly later age.

Average age of 193.5 ± 8 million years is given by Potassium-Argon dating to this group as Upper Triassic (PRETO, 1972). 193 ± 7 million years is for the Copper Mountain Stock only (SINCLAIR and WHITE, 1968) and 195 ± 8 million years for the Lost Horse, Voigt and Smelter Lake Intrusives (PRETO et al., 1971).

Metavolcanics are intruded by these silica deficient monzonitic rocks with complicated or obscured contact where diopside and actinolite are often formed after original augite and hornblende respectively.

- iii) "Mylonitè (Upper Triassic)

A type of crushed granular rock occurs in the northwest corner of the Ingerbelle deposit. Heavy limonite stain characterizes the colour of the rock on the surface. It is mineralized with considerable amount of magnetite in patches, stringers and fine disseminations and minor malachite. Unoxidized core specimens showed a magnetite bearing pink feldspathic, granular rock, crushed and healed with heavy interstitial pyrite. Geologic mapping indicates that the Boundary and Gully Faults were in existence before the emplacement of this

mineralized, crushed rock.

- iv) Graded Bedded Sediments and Pillow Lava (Pre-Upper Cretaceous ?)

Mineralized metavolcanics of the Ingerbelle deposit are abruptly terminated by the Boundary Fault in north-northeasterly direction. A series of graded bedded argillite and flinty sediments, pillow lava, and amygdaloidal and aphanitic greenstone extends to the west of the fault.

Apparently all the rocks in this unit show that the lack of assimilation, alteration and mineralization seen in the metavolcanics, and are suspected to be of post-Upper Triassic age. Intrusion of the "Mine Dykes" into the graded bedded argillite defines the upper limit of the geologic age as pre-Upper Cretaceous or pre-Early Tertiary.

- v) Mine Dykes (Upper Cretaceous-Early Tertiary) (PRETO, 1972; PRETO et al., 1971)

Dyke swarms of quartz porphyry and felsite, quartz feldspar and feldspar porphyries-called "Mine Dykes" by Granby geologists-are widely distributed on the Copper Mountain side, whereas only a few grey dykelets along with a lamprophyric variety occur along weak open fractures in the Ingerbelle area. This contrast suggests the fundamental difference of fracture patterns between the two areas.

- vi) Princeton Group (Middle Eocene) (RICE, 1947)

Basaltic-andesite effusives consist of flow banded lavas and scoria of sub-aerial origin. Regionally the group surrounds the Ingerbelle-Copper Mountain area as a window opened by the glaciation. A small trough of loosely bound basal conglomerate is correlated to the one in the Princeton Coal Basin.

6. Ore Minerals and Alteration

The Ingerbelle deposit consists of the primary sulphide zone, devoid of secondary supergene enrichment in noticeable amounts. In the order of abundance, ore minerals are, magnetite, pyrite, chalcopyrite, pyrrhotite and minor occurrences of hematite, bornite,

molybdenite and microscopic sphalerite. Gold and silver are found in the concentrate in commercial quantity.

Rare occurrence of molybdenite is known in the underground tunnel, mainly on the north side of the Gully Fault, either as smears or in quartz stringers several mm wide. Crack filling anhydrite is noted in the drill core at deeper part of the Ingerbelle deposit.

Extensive alterations occur in messy aggregate without sizeable separate zoning in partially assimilated host rocks.

Flooded "albitization" with secondary growth of feldspar grains, diopside and actinolite after subhedral original mafics, epidote-zoisite-chlorite patches or aggregate, peppering of biotite specks and scattered grains of apatite, lesser garnet and sphene are common in metavolcanics and in some part of the Lost Horse Intrusives. Radiating crystals of greenish tourmaline are sometimes seen in cracks. Rather regional metamorphism along with assimilation is postulated prior to the alteration-mineralization stage.

Intense scapolitization, "albitization" and "pink feldspathization" as veinlets in closely spaced fracture zones represent the early alteration stage in the Lost Horse Intrusives and metavolcanics, whereas biotitization and chloritization in widespread hairlines and stringers occur with lesser epidote-zoisite, carbonates and argillic alterations during the following mineralization stage of magnetite and sulphides, mainly confined in metavolcanics. Radiometric dating on two specimens from biotite-sulphide bearing "pegmatite" vein gave 194 ± 7 and 189 ± 8 million years respectively, as possible age of the mineralization epoch (PRETO et al., 1971; SINCLAIR and WHITE, 1968).

7. Internal Structure of the Metavolcanics Complex

Reasonable interpretation of internal structure of metavolcanics became possible as the result of the detailed underground mapping of geology.

Thick pile of metavolcanics is composed of repetitive cycles of submarine eruptions and

are similar to other eugeosynclinal volcanic complexes with which the writer is familiar.

As a rule, each cycle consists of a sequence of four layers with transitional change at the contact:

i) Bottom layer of pyroclastics—Subangular, paler fragments enclosed in the darker matrix of similar composition, but of slightly granular texture. Dimension of fragments occasionally reaches up to several tens of cms in diameter and becomes larger near the bottom as if formed by auto-brecciated lava flow.

ii) Middle layer of “porphyrite”—Medium-grained or ophitic textured rock of possible slow cooling, basaltic lava flow origin. If one fails to recognize transitional contacts the layer would be, and often is, mistaken for a diorite sill because of uniformly distributed tiny specks of secondary biotite in apparent holocrystalline rock. Some layers show transitional change to “Augite porphyry” which contains gigantic augite phenocrysts up to 15 mm in diameter, partly or completely replaced by diopside.

iii) Upper layer of pyroclastics—Similar to the bottom layer except for smaller fragments and increasing tuffaceous fragments towards the top.

iv) Uppermost layer—Dark grey-brownish coloured fine-grained tuff, often revealing graded banding of light grey and pale green layers in alteration with occasional pinkish tint. Often, lapilli-like rounded pebbles of “Augite porphyry” are conformably enclosed in the graded banding of the tuff. Seemingly this layer represents the quiescent period between two eruption cycles. Underground, a series of intermittent lenses with crumpled graded banding indicates the possible disconformity and disturbance near the base of the succeeding eruption cycle.

Generally speaking, each eruption cycle may have a surprisingly extensive coverage in spite of the thickness of more or less 50 meters. However, lateral changes in facies and in thickness of each layer as well as multiple repetition of cycles vertically, make it difficult to find a definite marker horizon in the Copper Mountain—Ingerbelle area.

8. Deformation of the Metavolcanics

The Copper Mountain Stock and the Lost Horse Intrusives bound the north and south side of a narrow metavolcanics belt of 800 meters wide. Undulated deformation patterns are indicated by the subdivided layers across the belt as shown in Figure 3.

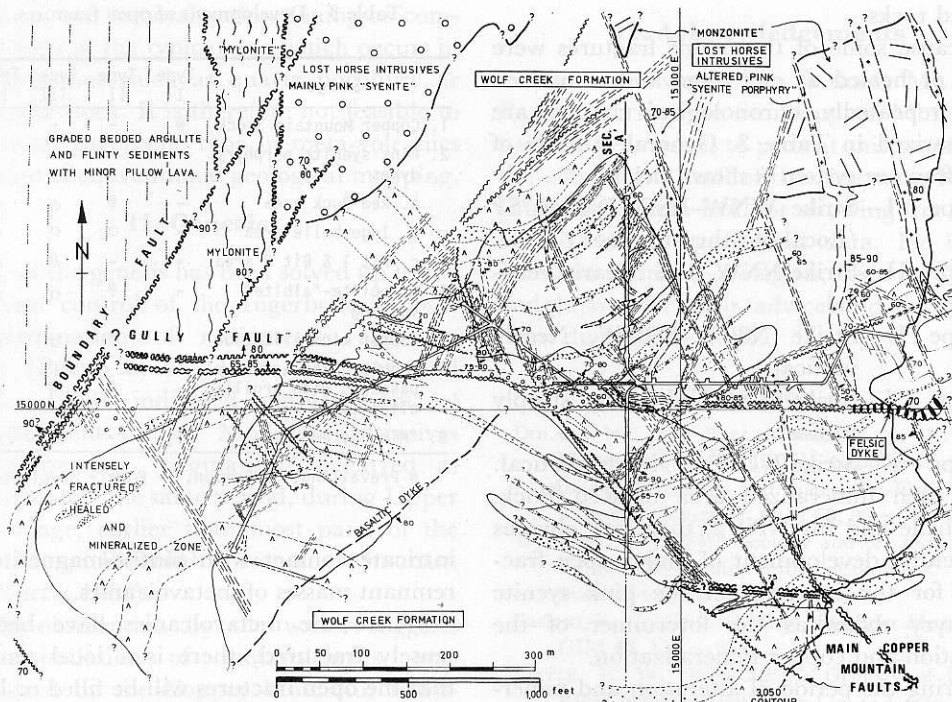
It is the most interesting feature that all the deposits of the Ingerbelle, Pit 1 and Pit 2 occupy the anomalously flexed portion of layers in WNW–ESE direction from the warped regional trend of NNE–SSW and NE–SW. The latter is similar to the attitude of sedimentary formations of Triassic or earlier age which are located 30–50 km to the east of deposits (LITTLE (1958, 1959).

The northern contact of the Copper Mountain Stock dips southerly so as to form overhang with vertical dipping near the surface and then becomes gentler to 40° with gradual decrease (FAHRNI, 1951). As far as interpreted from the internal structure of the metavolcanics, all the layers are flexed to west-northwesterly near the contact of the stock and discordantly dip away to the north, so as to emplace the Copper Mountain Stock in the local dome structure (Fig. 3).

9. Development and Healing of Fracture Patterns

Deformation of the alternate piles of competent lava flow and incompetent tuffaceous layers may be accounted for the development of major fractures in a regular pattern and subordinate dense, fine fracturing in all available directions.

Both lateral and vertical changes are seen in the manner of fracturing when a major fracture intersects different layers in the metavolcanics. As a rule, competent layers have wider fractures now healed with scapolite-“albite” veinlets, while incompetent tuff can only develop parallel hairlines with local messy shattering. In the Ingerbelle area, pyroclastic layers are prevailing and probably more favourable to develop dense fracturing which often forms intricate mixtures of the remnant volcanics and pale green



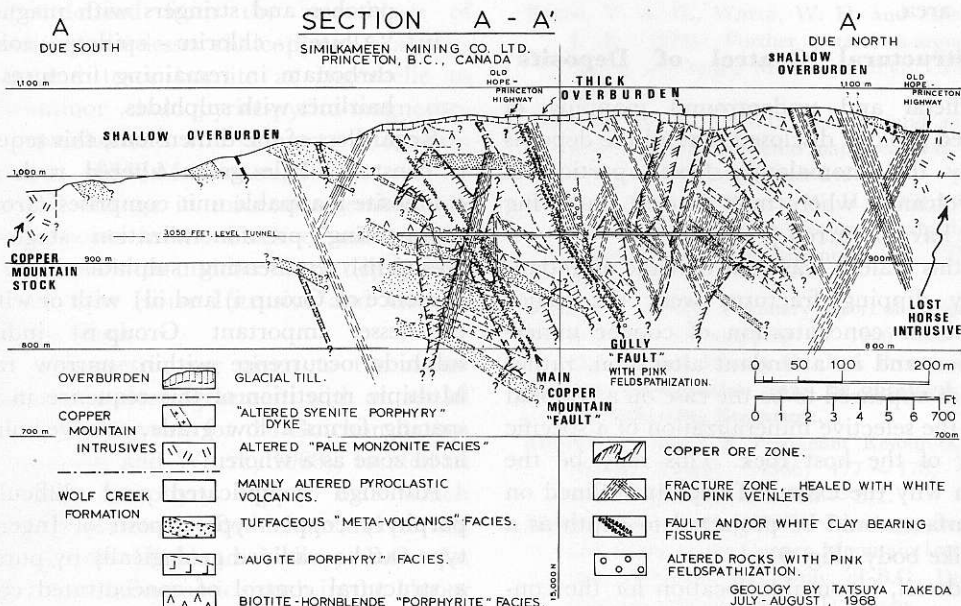
UNDERGROUND GEOLOGY OF
3050' LEVEL TUNNEL,
INGERBELLE MINES.

SIMILKAMEEN MINING CO. LTD.
PRINCETON, B.C., CANADA

GEOLOGY BY TATSUYA TAKEDA
JULY, 1966 - AUGUST, 1968

- ZONE OF CONCENTRATED COPPER MINERALIZATION.
- MAJOR FRACTURES, HEALED WITH SCAPOLITE BEARING WHITE VEINLETS AND BIOTITE BEARING PINK VEINLETS.

Fig. 4 Underground geology of 3,050' level tunnel, Ingerbelle mines.



SECTION A - A'

SIMILKAMEEN MINING CO. LTD.
PRINCETON, B.C., CANADA

DUE NORTH

DUE SOUTH

- | | |
|--|---|
| <p>OVERBURDEN GLACIAL TILL.</p> <p>COPPER MOUNTAIN INTRUSIVES "ALTERED SYENITE PORPHYRY" DYKE</p> <p>WOLF CREEK FORMATION MAINLY ALTERED PYROCLASTIC VOLCANICS.</p> <p> TUFFACEOUS "META-VOLCANICS" FACIES.</p> <p> "AUGITE PORPHYRY" FACIES.</p> <p> BIOTITE-HORNBLENDE "PORPHYRITE" FACIES.</p> | <p> COPPER ORE ZONE.</p> <p> FRACTURE ZONE, HEALED WITH WHITE AND PINK VEINLETS</p> <p> FAULT AND/OR WHITE CLAY BEARING FISSURE</p> <p> ALTERED ROCKS WITH PINK FELDSPATHIZATION.</p> |
|--|---|
- GEOLOGY BY TATSUYA TAKEDA
JULY - AUGUST, 1968

Fig. 5 Section A-A', Ingerbelle mines

altered rocks.

Because some of the major fractures were filled or healed at one stage and re-opened later, repeatedly, chronological changes are summarized in Table 3. General attitude of each fracture system is shown below:

Type I—Strike WNW–ESE. Dip 40°S?
(Local old thrust plane?)

Type II—Strike NNW–SSE. Nearly vertical.

Type III—Strike N80°E–S80°W, Nearly vertical.

Type IV—Strike NNE–SSW. Dip steeply to East.

Type V—Strike NE–SW. Nearly vertical.

In each mineralized area of Red Buck, Ingerbelle and Pit 1–Pit 2, there are obvious differential development of major open fractures for the intrusion of the pink syenite porphyry dykes as the forerunner of the alteration and copper mineralization.

During the period of alteration and mineralization (Stage 3, 4, 5), however, development of open fractures had almost identical patterns in the area a, b and c.

The "Mine Dykes" in the post-mineralization stage filled a few large fractures discriminantly re-opened in each mineralized area.

10. Structural Control of Deposits

Surficial and underground mapping of detailed geology disclosed that all the deposits occupy the anomalously flexed portion of metavolcanics where most intense fracturing might have occurred (Fig. 3 & 4).

At this scale it was seen that the abundant steeply dipping fractures were the major control for concentration of copper mineralization and its attendant alteration, rather than, as appeared to be the case on a regional scale, the selective mineralization of a specific layer of the host rock. This may be the reason why the extent of deposit outlined on the surface could be projected to depth as a pipe-like body (Fig. 5).

In detail, favourable location for the concentrated copper mineralization is usually found where the pale green altered rock is in

Table 3 Development of open fractures.

Stage	Type I	Type II	Type III	Type IV	Type V
1. Copper Mountain Stock	@	-	-	-	-
2. Pink syenite porphyry dykes					
a. Red Buck area	-	@	o	o	-
b. Ingerbelle area	-	o	o	o	o
c. Pit 1 & Pit 2 area	-	-	@	o	o
3. Scapolite-"albite" veining	-	@	o	o	o
4. Copper mineralization	-	@	o	o	-
5. Pebble dykes & mineral passages with argillic alteration	-	@	@	o	-
6. "Mine Dykes"	-	-	o	o	o

@ Prevailing, o Common, - Poorly developed

intricate contact with biotite-magnetite rich remnant masses of metavolcanics.

Where the metavolcanics have been intensely fractured, there is a local tendency that the open fractures will be filled or healed successively in the order of major to minor ones, by the following progressive alterations and mineralizations:

- i) Barren "albite"-scapolite veinlets to stringers.
- ii) "Pink feldspathization"-biotitization patches and stringers with magnetite.
- iii) "Albite" - chlorite - epidote - zoisite - carbonate in remaining fractures and hairlines with sulphides.

Regardless of the dimensions, this sequence is constant. Pale green altered rock as a composite mappable unit comprises Group i) representing pre-mineralization stage and Group iii) representing sulphide stage. Co-existence of Group i) and iii) with or without the lesser important Group ii) indicates sulphide occurrence within narrow range. Multiple repetition of this sequence in close spacing forms a low grade, massive mineralized zone as a whole.

Although complicated and difficult, a porphyry copper type deposit of Ingerbelle type can be outlined geologically by pursuing a structural control of concentrated copper mineralization of primary sulphides. However, there will be no regular pattern of

alteration and mineralization zoning as commonly seen in the typical one which occurs in a uniform host such as quartz porphyry or monzonite stock. It is therefore not feasible to explore an Ingerbelle type in meta-volcanics by means of conventional geological mapping.

11. Genesis

Part of the genesis has been solved up to the structural control of the Ingerbelle deposit.

Determination of radiometric ages on biotite (PRETO et al., 1971; SINCLAIR and WHITE, 1968) indicated emplacement of silica deficient Copper Mountain Intrusives and ore-bearing "pegmatites" occurred at approximately the same period, during Upper Triassic age, earlier than most parts of the Coast Range Batholithic complex (SINCLAIR and WHITE, 1968).

Field observation by the writer suggests that assimilation of metavolcanics was introduced by the Copper Mountain Intrusives and then alteration and mineralization spread through numerous zones of minor fractures which were developed after the intrusion of dyke swarms of "pink syenite porphyry".

Lateral mineral zoning on a large scale is roughly defined from the assemblage of magnetite-pyrite-lesser chalcopyrite-local pyrrhotite and trace bornite at Ingerbelle to bornite-minor chalcopyrite-pyrite-magnetite-local pyrrhotite at Copper Mountain (DOLMAGE, 1934; MACAULEY, 1973).

Vertical change in mineral assemblage is not yet known in the block of mineralized metavolcanics with undetermined depth, between the Lost Horse Intrusive and Copper Mountain Stock.

The radiometric age given to the meta-volcanics is in close agreement with an age of 200 ± 5 million years for the Guichon Batholith (SINCLAIR and WHITE, 1968), located in the eastern porphyry copper belt which includes the productive Bethlehem and Lornex Mines in the Highland Valley, B.C. An important metallogenetic epoch in the Upper Triassic age is suggested in the Western Cordillera region.

12. Acknowledgements

The writer would like to thank Mr. J. H. PARLIAMENT of the Similkameen Mining Co. Ltd. for permission to present this paper, and the officers and staff of the Newmont Mining Corp. of Canada Ltd. for allowing free access to the relevant geological data. He is also indebted to many geologists, both in Canada and Japan, for their advice and encouragement during this study.

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カナダ B. C. 州インガーベル鉱床の探査、 とくに鉱化帯の構造規制について

武田 達也

要 旨

インガーベル鉱床は珪酸分の不足したモンゾニ岩類により貫入され部分的に変成・同化作用をうけた変火山岩類を母岩とし、細裂か規制により生成された不規則分断塊状のポーフリークーパー型鉱床である。鉱化期は三疊紀上部とされ、黄銅鉱を含む初生硫化鉱物帯を採掘対象とする。輝水鉛鉱・石英微脈は稀で、スカポライト・“曹長石”細脈、磁鉄鉱および黒雲母・緑泥石微脈の多産が特長的である。

東西2列のB. C. 州内ポーフリークーパー帯のうち東列の最南端にあり、米国の大手産銅会社ニューモント社の子会社であるシミルカミン鉱山会社が1972年9月以来露天掘により稼行中で、開山時の公称可採鉱量6,900万t (Cu, 0.53%) そのうちインガーベル新鉱床が4,100万tを占める。13,600t/日より現在日産20,000t (Cu, 0.5%弱) に増強され、1974年産出精鉱中の金属量は銅19,140t、金905kgおよび銀3,664kgに達する。B. C. 州

で最初に低品位銅鉱を露天掘した実績をもつ、閉山中の銅マウンテン鉱山周辺における新鉱床賦存の可能性の再検討という探査経緯が成果を産んだ。筆者は1966年前半と1968年中にそれぞれ精密地表調査(4km²)ならびに坑内(1.7km)と地表(8km²)精密地質調査を担当実施した。1966年4-5月の調査でインガーベルとレッドバック両鉱床の輪かくを正確に把握し、さらに1968年には坑内精査と坑内外試錐資料から母岩の分帯による内部構造の推定、母岩の変形と裂か系の発達との相関関係から鉱床賦存の構造規制まで解明することができた。

本文は精密地質調査における観察事項に焦点を置いて構造規制の解析について説明する。母岩の変成・同化作用・変質作用・鉱化作用の関連性、とくにそれらの垂直変化等岩石・鉱床学的に興味ある現象が、なお十分解明されていない。今後各方面の諸氏の研究にまつ所が大きい。