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ABSTRACT

The Laidlaw Gold deposit is an open-space fissure cuartz vein containing arsenopyrite, pyrrhotite, chalcopyrite, marcasite, bismuth tellurides, and native gold. These minerals are characteristic of a mesothermal assemblage.

The vein shows crustiform textures and evidence of shearing. The textures of the ore minerals include brecciation, replacement and exsolution.

The tellurides are found to have a zonal distribution, with the sulfur-bearing tellurides located in the sulfide rich portion of the deposit. They are late forming minerals that were deposited at temperatures below 400°C. Microprobe analysis on some tellurides taken from the sulfide rich portion of the deposit proved to be an exsolution mixture of
telluride? telluride
tetradymite and joseite(II).

Depositional temperatures of the minerals from the deposit range from 600°C. to as low as 100°C. The earliest mineral to be deposited was arsenopyrite followed by pyrrhotite, chalcopyrite, marcasite, bismuth tellurides and native gold.

According to Bilibin's scheme of classification the deposit is a late stage post batholithic gold deposit.

INTRODUCTION

The Laidlaw Gold Property is located one mile south of Laidlaw, B.C. and one-half mile east of Waleach Creek. The veins on the property are found within a Tertiary hornblende-biotite quartz diorite which has intruded Pennsylvannian to Permian sedimentary rocks, of the Chilliwack Group.

The metallic minerals found within the vein system include native gold, arsenopyrite, marcasite, bismuth tellurides, chalcopyrite, pyrrhotite and pyrite. It is believed that the tellurides are sensitive to the bulk composition of the ore forming fluids and have an intimate relationship with late gold.

As an approach toward a better understanding of the metallogenesis of bismuth tellurides a general field and laboratory study was made of the Laidlaw Gold Property.

Acknowledgements:

The writer is indebted to the following people for their kindness and cooperation in aiding this study: E. Greensides for allowing the author to map the property and permitting the use of assay results; C. Westerman for assistance with the microprobe analyses; and L. Carleson for assistance with the X-Ray Spectroscope.

Method of Study

Forty-five samples collected mainly from the mineralized vein system and adjacent wall-rock (intrusive quartz diorite) were used in the study. The following table summarizes the methods used.

METHOD	DETAILS
Electron Microprobe	Analyses for Sulfur and Bismuth
Mineralographic Study	Polished sections observed with a reflecting microscope.
Thin-Sections	Sections of several rock types were observed under a polarizing microscope.
X-Ray Powder Diffraction	Used to distinguish types of tellurides and in determining temperatures of deposition.
X-Ray Spectroscopy	Arsenopyrite and pyrrhotite were analysed for elements with atomic numbers between 26 and 60.

I. REGIONAL GEOLOGICAL SETTING

The Laidlaw Gold deposit is found at the northern boundary of the Skagit range in the Cascade Mountains. The Cascade Mountains are composed of Palaeozoic and Mesozoic sedimentary and volcanic rocks, strongly folded and metamorphosed and intruded by granitic batholiths. The peaks of the range attain an approximately uniform elevation and represent monadnocks on an elevated Tertiary erosion surface of low relief.

The history of the Northern Cascades has been outlined by McTaggart (15). The geologic history includes:

(1) The formation of a pre-Devonian Basement complex
(2) Development of a eugeosyncline that lasted from Devonian to late Mesozoic times.
(3) Development of an axial zone of gneisses.
(4) A tectonic climax in mid-Cretaceous times and emplacement of granitic plutons.
(5) Emplacement of granitic plutons from earliest Jurassic to Miocene.

The Laidlaw Gold property veins are found to cut intrusive rocks of Tertiary age which are related to the Mount Barr Plutonic complex. The Mount Barr Plutonic complex was emplaced in the Middle Miocene (21 - 16 m.y.) (28) and belongs to a well-defined north trending belt of intrusions with related volcanic rocks lying along the Cascade Mountains of Oregon and central Washington (27). The Tertiary Cascade Plutons have been emplaced at relatively high levels in the crust. In the Northern Cascades the intrusive levels appear to be somewhat deeper, but probably not below 2 miles from the surface

(9). The intrusive plutons of Late Cretaceous through Tertiary age appear to be wholly magmatic. (9) This origin was suggested by McTaggart and Thompson (16) for the Tertiary Chilliwack Batholith. The manner of emplacement was by magmatic stoping with local forcing aside of the country rock or lifting of the roof with the level of emplacement in the epizone (2 to 4 miles).

The Miocene intrusions belong to a well defined north-trending belt of intrusions with related volcanic rocks both of which lie in the Cascade Mountains. Commencing probably in middle Pliocene times, the Cascades were subjected to an epeirogenic upwarping on a north-south axis, plunging gently south. Late Cenozoic block faulting may have helped to determine the locus of activity of the late Pliocene-Pleistocene andesitic volcanism (9). As noted by McTaggart, (15) the Fraser River fault zone is part of the Coast-Northern Cascade orogeny, which seems to have affinities with the north trending Cascade belt of Oregon and Washington. The zone which was apparently active intermittently for 50 million years reaches deep into the crust and quite possibly the ultramafic masses along it have been tectonically derived from the mantle. The Miocene Chilliwack plutons lie astride the Fraser River fault zone and they, along with the Snoqualmie batholith and the young volcanoes of the Cascade Mountains, may be related to this north trending fault zone (15).

The Laidlaw Gold Property lies 3 miles to the north of the Mount Barr Plutonic Complex which is composed of four plutons. The main pluton comprises 80% of the Mount Barr Plutonic Complex and is a concentrically zoned mass ranging in composition from quartz diorite to quartz monzonite. The three ages of 21, 18, and 16 million years have been obtained for the different phases of the Complex (28).

The intrusive rocks on the Laidlaw Gold Property are correlative with the Tertiary intrusive complex on the grounds that both are petrologically and structurally similar. The intrusive exposed on the property most probably represents an apophyses of cupola of the Mount Barr plutonic complex.

II. STRUCTURAL SETTING

The Laidlaw Gold Property is bounded on the west by a prominent north-south fault or fault zone that extends from Ruby Creek to the International boundary. Along this zone ultramafic rocks and basement slices have been emplaced. To the east the Chilliwack group of rocks is bounded by the southern portion of the Spuzzum Pluton which is part of what is termed by Monger, "The Axial Belt". (17a)

The structural pattern in the Hope map-area was established in Mid-Cretaceous to Early Tertiary time. The gneisses, schists and granitic rocks which compose the core of the Cascades were possibly formed earlier in the Mesozoic and were folded (?) and faulted during the Mid-Cretaceous orogeny. Sediments and volcanics were folded and thrust to the northwest and west; those on the east side were folded and reverse faulted. Normal and strike-slip faulting in Early Tertiary time and uplift in the Pliocene-Pleistocene time completed the structural evolution of the area. (17a)

The Coast Crystalline Belt and the northern Cascade mountains are coaxial and contemporaneous. The Northern Cascade geology exposes a higher level of the same orogen. McTaggart postulates that the anomalous north-east striking recumbent folds in the boundary region between the Northern Cascade Mountains and the Coast Crystalline Belt were probably produced by late orogenic gravity controlled sliding, activated by the subsequent rising of the Coast Crystalline Belt to the northwest of the area in the Paleocene. During the Eocene there was uplift and graben filling along the Fraser River fault zone.

The anomolous features transverse to the northwest trends are viewed by McTaggart as to represent the axis of relative uplift to the northwest, perhaps as a result of isostatic uplift of the predominately granitic terrain. (15). Monger suggests that these northeast trends may be due to response in basement deformation and that the orientation of these structures may be controlled by an old pre-Devonian, northeasterly trend in the basement rocks. (17b)

There is a striking alignment of mineral deposits along a northeasterly trend on which the Laidlaw Gold Property is located. This trend extends from Harrison Mills on the west to Treasure Mountain on the east. Thedeposits are found in close proximity to tertiary intrusives and the element assemblages for each of the deposits is similar. The existence of these transverse structural belts has been noted and commented upon by Grant. (9) He found that these transverse belts or "lineaments" passed through many of the important mining districts of the Cascade range. These belts are characterized by en echelon shear and/or fracture systems transversely traceable across the range for distances of up to 70 miles. These deformational belts are believed to be relatively deep-seated in origin and probably belong to the intra-regional class of breaks proposed by M. I. Itsikson. (10). The favourable combination of these transverse breaks with longitudinal breaks, control the localization of many important metallogenic zones. Grant has found that the most extensive sulfide mineralization in the Northern Cascades occurs in or adjacent to the intersection of northeast-trending shears and northwest trending faults.

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These transverse structures may have arisen from stresses resulting from movement within the Juan de Fuca Plate (East Pacific Rise). This idea has been stated by W. J. Morgan (18) who suggests that the independant motions of small blocks within the Juan de Fuca Plate have moved eastward into North America with the crust thickening beneath the Coast Range or Cascades. The extension of oblique faults within the Juan de Fuca Plate appear to have a strong affinity with the positions of volcanic activity along the Cascade Range.

The geological events that have been described in the preceding sections depict the end stages in the evolutionary cycle of a geosyncline. In particular, it is found that the Tertiary intrusive activity is typical of a *late geosynclinal* stage of development. The major characteristics of the late geosynclinal stage have been summarized by Precyshyn (20) and are outlined below.

(i) A dominatly andesitic volcanism, although there is some basaltic and rhyolitic eruptions.

(ii) A dominantly granodioritic plutonism(although some dioritic and granodioritic batholiths develop) that is more or less associated with the eruptions.

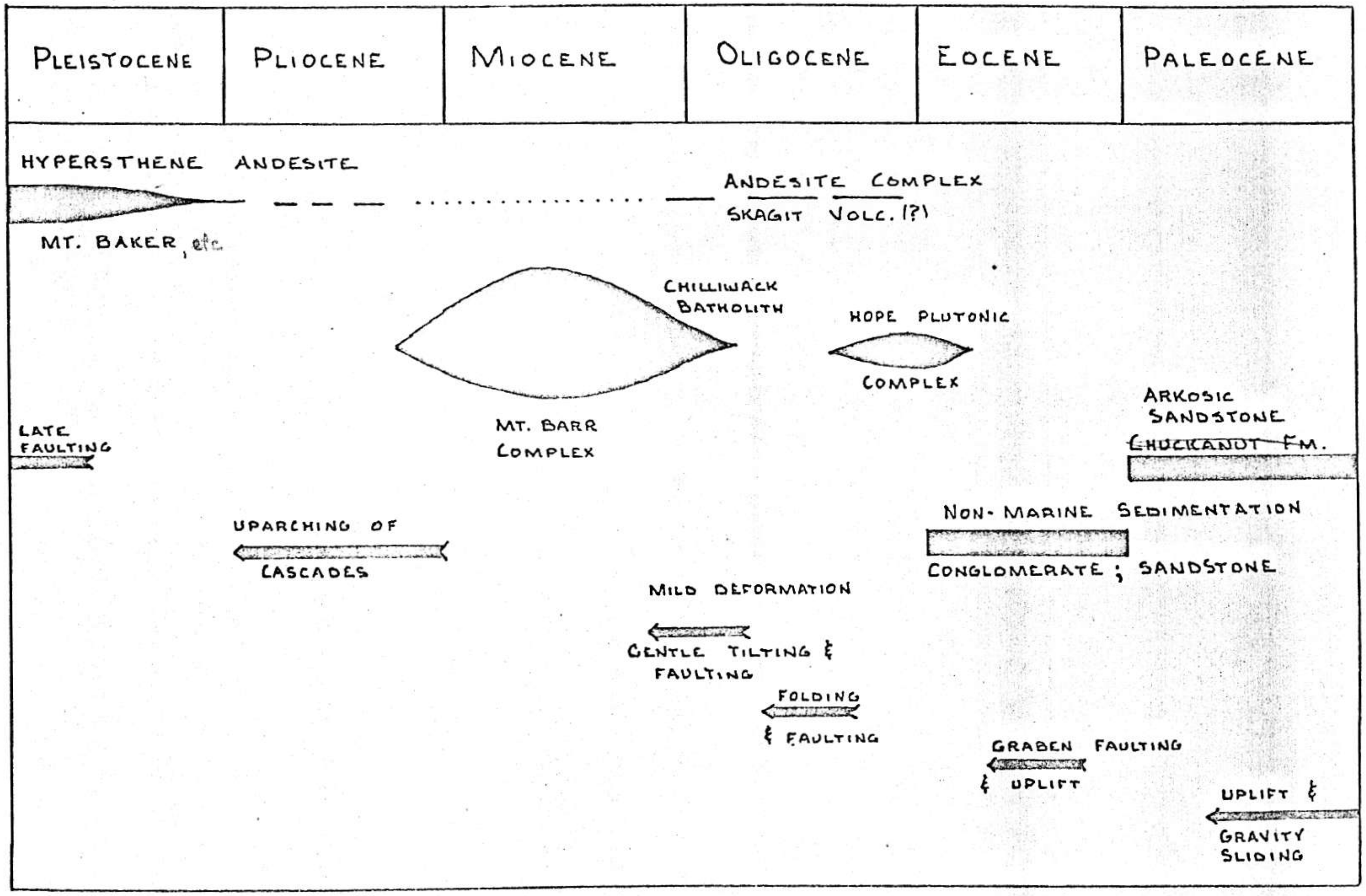
The intermediate composition of these rocks is usually attributed to palingenesis, that is, a wholesale mobilization of part of the sialic crust followed by hybridization with simatic magma.

(iii) Sedimentary sequences are discordant on the constituent rocks of the mountain chains.

(iv) The sediments are detrital and very thick. These sediments are termed mollasse.

(v) Gravity sliding of the sedimentary blanket off the sides of the cordilleras.

LATE STAGES OF EVOLUTION



DETAILS OF THE DEPOSIT STUDIED

Outcrops on the property are found as isolated cliffs with the majority of the area covered by forest and glacial till. The eastern portion of the property is traversed by Lorenzetta creek which occupies a steep northerly striking ravine.

The area covered by this report is contained within a 2,000 square foot section and is concentrated on the area of the main vein showings. Within the area studied there are three main rock types; an intrusive hornblende-biotite quartz diorite, a border migmatite and folded metasedimentary and metavolcanic rocks of the Chilliwack Group.

The intrusive hornblende-biotite quartz diorite is found in the northern portion of the map area and is probably a marginal facies or cupola of the larger Mount Barr plutonic complex. The intrusive rocks are fresh and show very little alteration except in the vicinity of the veins. There are a few xenoliths found in the intrusive rocks but these are no larger than one-half foot in diameter and are only seen exposed at the main vein showing.

A study of thin sections of the intrusive rocks showed these to be composed essentially of zoned plagioclase (oscillatory zoning) with an average content of Anorthite 47%; K-feldspar, and quartz. Some of the plagioclase show"moth-eaten" cores and slight sausseritization. Hornblende commonly encloses flecks of biotite. The biotite is partly altered to chlorite. Accessory minerals include magnetite, pyrite and apatite. The average grain size is 1.5mm, though near the contact the grain size decreases to .5mm. (See appendix for modal analysis). (See plates 12 a and b and plate 13)

The intrusive hornblende-biotite quartz diorite is well jointed and the joint sets are tight and widely spaced. These joint sets strike south of east and are low dipping either north or south at angles less than 20 degrees. It is along the south dipping joint set that the vein has been emplaced. The intrusive rocks have been sheared and faulted in a southerly and southwesterly direction and these surfaces dip steeply to the east and west. In the vicinity of the main vein workings these faults and shears are filled with quartz-carbonate veins which are only slightly mineralized.

The border zone migmatite is a transitional zone in which the intrusive rocks grade into quartzo-feldspathic mylonitic rocks. In this section these mylonitic rocks are extremely fine-grained with "eyes" of quartz and K-feldspar. The fine grained matrix is composed essentially of biotite, muscovite, quartz and accessory pseudotachylite. The quartzo-feldspathic medium is found to be folded as Z-folds and this is related to movement during the force of intrusion of the hornblende-biotite quartz diorite. These rocks may have been developed by plastic deformation during the last stages of crystallization of the intrusive rocks. (See plate 14)

The Chilliwack Group of rocks are widespread throughout the property and are essentially black phyllitic rocks and quartzitic slates that have undergone several periods of deformation. These rocks are Pennsylvanian to Permian in age. Lithologically similar rocks are found to outcrop as far south as Foley Creek where they are found to overlie amphibolitic rocks of an unknown age. (17b)

There are two vein sets found on the property. The main vein set strikes east-northesterly and dips at low angles to the south. The veins of this set pinch and swell from 3" to 1' and are found within the intrusive and near the contact. As this vein set is followed out towards the contact it becomes branching and lenticular. At L_1 the vein pinches and swells and has a sharp contact with the intrusive. (See Figure # 1 Appendix). There is evidence of shearing within this area as both the vein and the intrusive rocks show slickensiding. It is at this portion of the vein system that the major sulfide deposition took place. Here the vein shows a crustiform texture and the ore minerals are very coarsely crystalline. Their alteration is strongest at this position within the deposit and the vein is found to be enclosed by s thick envelope of sericitic alteration. The intrusive rocks are noticeably altered for a distance of 2' on either side of the vein. A study of thin sections from the altered intrusive rocks bordering the vein showed an albite-sericite-chlorite-calcite-zeolite assemblage which characterizes a propylitic alteration. This assemblage surrounds an inner zone of intense sericitic alteration.

At L_2 and L_3 the alteration is much weaker and does not show the effects of intense sericitization as that found at L_1. These locations are characterized by cryptocrystalline quartz veins that contain only minor amounts of sulphides which are typically fine grained and finely crystalline ? in nature. The most striking feature of the L_2 vein system is its branching and lenticular nature.

At L_3 the veins are constricted and are probably completely pinched out in the adjacent Chilliwack Group rocks. The veins show rhythmic layering of quartz. The appearance of these veins suggest a repeated shearing and deposition of quartz in a period of pulsating tectonic adjustment of the rocks. The second vein set occupy southerly trending shear and fault zones that dip steeply to the east and west. These veins are generally less than one inch in width and are found to be developed to the greatest extent at L_1. They are composed essentially of coarsely crystalline quartz, calcite and minor sulphides. These veins are probably late offshoots of the main vein set.

Description of Specimens

Hand Specimens:

Several samples taken from the area of the main vein workings will be described according to their megascopic features and contrasted with samples typifying other portions of the vein system.

L_1

T(a) Coarsely crystalline arsenopyrite forming crystals up to 1 cm. across and displaying a crude, short prismatic habit are developed in the interstices of quartz crystals. The sample is crustiform in appearance. Pyrrhotite is crystalline and also fills vugs and intersticies between quartz crystals. The arsenopyrite and pyrrhotite are covered by small druses of quartz and aragonite(?) crystals and botryoidal limonite. (See Plate 15 and 16)

T(b) Massive crystalline quartz that shows evidence of slickensides on both the walls and within the quartz vein material. Pyrrhotite crystals, as hexagonal plates, up to one-half a centimeter across occur in small vugs with drusy quartz crystals along shear surfaces. Tetradymite coats and fills the interstic~~i~~es of small quartz crystals along with an earthy limonitic druse. The telluride occurs as small crystalline plates up to .5mm across. Native gold is found on the periphery of the telluride cluster. (See Plate 17 and 18)

T(c) Massive milky white quartz contains sharp prismatic arsenopyrite crystals up to .5 cm in diameter that are surrounded by crystalline chalcopyrite. Pyrite occurs within the arsenopyrite masses as small (1 mm) euhedral crystals. The milky quartz is fractured in places and is healed by clear quartz. A crystalline pyrrhotite mass contains small arsenopyrite crystals and is tarnished black.

T(d) This sample is taken from a splay quartz vein offshoot. Milky white, finely crystalline quartz contains finely crystalline bismuth telluride plates. No other mineralogy except the occasional small arsenopyrite crystal was noted in these splays. The quartz showed several sericitic-chloritic surfaces developed within it, suggesting a repeated opening and quartz filling of these splays.

T(e) Coarsely crystalline quartz crystals contain green crystals of aragonite filling the interstices. The fillings are as large as 1.5 cm. across.

$\underline{L_2}$

T(f) Milky white finely crystalline quartz containing Wehrlite plates up to 1 cm. in length and finely disseminated hematite coating these plates. No other sulphides were noted.

$\underline{L_3}$

T(g) Massive cryptocrystalline quartz occuring as many parallel sheared surfaces. The surfaces are separated by earthy limonitic layers. The specimen shows fracture surfaces along which thin films of tellurbismuth are developed. There are also small quartz crystal vugs in which well formed hexagonal plates of tellurbismuth have formed. The tellurides are often coated with a yellow alteration(?) product and lenticular crystals of selenite. (See Plate 19).

Mineralographic Data

Forty polished sections from the various portions of the vein system were examined and those samples that best typify the mineral assemblages of the vein system will be described below.

$\underline{T_1}$ Coarsely crystalline arsenopyrite (1.5 to 2.5 cm.) is brecciated and healed by allotriomorphic granular pyrrhotite (.5 to 1.0 mm) of chalcopyrite which form an emulsion texture and partially replace the pyrrhotite. The pyrrhotite shows a weak tendency to replace the arsenopyrite. Found along grain boundaries and fractures within the pyrrhotite and lamellae of marcasite. The fracturing of the arsenopyrite is brittle and does not extend into the pyrrhotite. In many places quartz appears to be preferentially segregated along the borders of the arsenopyrite-pyrrhotite boundary.

$\underline{T_2}$ Intensive replacement of pyrrhotite by marcasite along parallel fracture zones and grain boundaries. Pyrrhotite and chalcopyrite replace fractured grains of pyrite (1 cm. in length). Chalcopyrite preferentially replaces pyrite.

$\underline{T_3}$ Fractured arsenopyrite is partially replaced by pyrrhotite and chalcopyrite. The pyrrhotite is replaced by marcasite and tetradymite. In places there is complete replacement of the pyrrhotite by marcasite leaving only relict chalcopyrite. The quartz gangue is brecciated and healed by fine crystalline quartz.

T_4 Coarsely crystalline quartz is brecciated and healed by fine grained quartz that contains masses of tetradymite (2mm) that enclose and are surrounded by crystalline native gold (1 - 2 mm) that display a dodecahedral (?) habit.

The percentages of the minerals that make up the assemblage is as follows:

Arsenopyrite	20%
Pyrrhotite	60%
Marcasite	15%
Chalcopyrite	1%
Bismuth Tellurides	less than 1%
Native Gold	less than 1%
Pyrite	less than 1%

The values obtained from assays for gold from the various portions of the vein system show erratic high gold values within the L_1 portion of the deposit ranging from .02 oz./ton to 32.44 oz./ton. The samples were taken from sulfide-rich portions of the vein; altered wall rock; and barren quartz. The results of these assays show that high grade values of gold are sometimes associated with sulfides (up to 10.18 oz./ton) though sulfides may return negligible gold values. The high values are attributed to late segregations of native gold in quartz while erratic values are due to an early deposition of gold in arsenopyrite. The wall-rock values ranged from 2.26 oz./ton to .005 oz./ton in gold. The values from L_2 gave lower values in gold (traces to .01 oz./ton).

PARAGENESIS

The General Vein Sequence

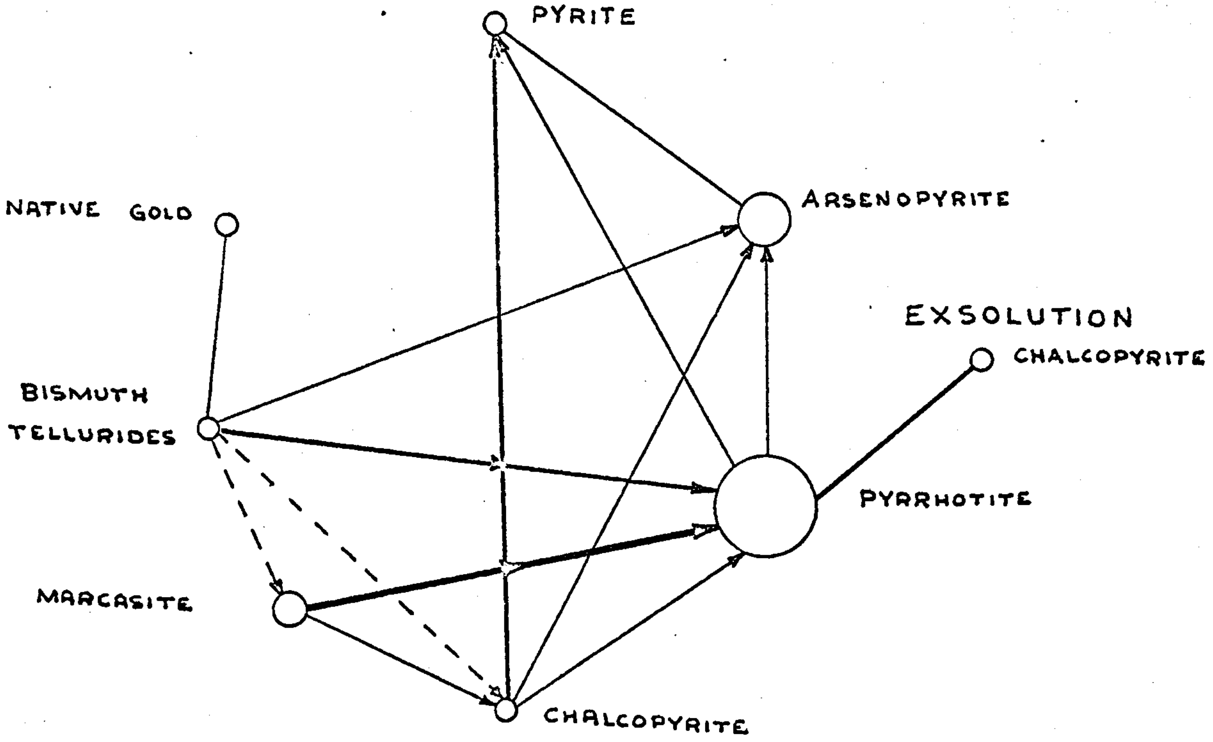
Viewed from the standpoint of age relations of chief gangue minerals and groups of metallic minerals the paragenetic sequence is clear-cut but the detailed age relations of the individual minerals is more difficult to determine.

The vein mineralization started with quartz whose deposition continued spasmodically throughout the ore-forming process. Aragonite, calcite and gypsum (variety selenite) formed in that order, with calcite and gypsum following the deposition of the tellurides and native gold. Several pulses or substages of sulfide deposition are indicated. The first being a pyrite - arsenopyrite assemblage; a later pyrrhotite - chalcopyrite assemblage; followed by a marcasite, telluride and native gold succession. The general sequence is that of a continuing process of mineralization which appears not to have been interrupted by significant lapses in deposition.

Structural movements during mineralization were confined largely to fracturing that persisted after initial opening of the veins. Brecciation and crushing of vein material locally affected early quartz and the arsenopyrite - pyrite - pyrrhotite assemblages. Fracturing of a lesser intensity appears to have continued into the earliest stages of telluride deposition however the tellurides are relatively undeformed. Minor fracturing followed the deposition of the tellurides as evidenced by the late quartz-carbonate veins that cross-cut the main vein system.

Generally the metallic sequence of mineralization at the Laidlaw Gold Deposit was early sulphides followed by a suite of bismuth telluride minerals and the last mineral to deposit was native gold. The following line diagrams and Van der Veen diagram illustrate the order of deposition of the minerals in the vein system.

VAN DER VEEN DIAGRAM



PARAGENESIS OF HYPOGENE ORE MINERALS

FIGURE 2

MINERAL PARAGENESES

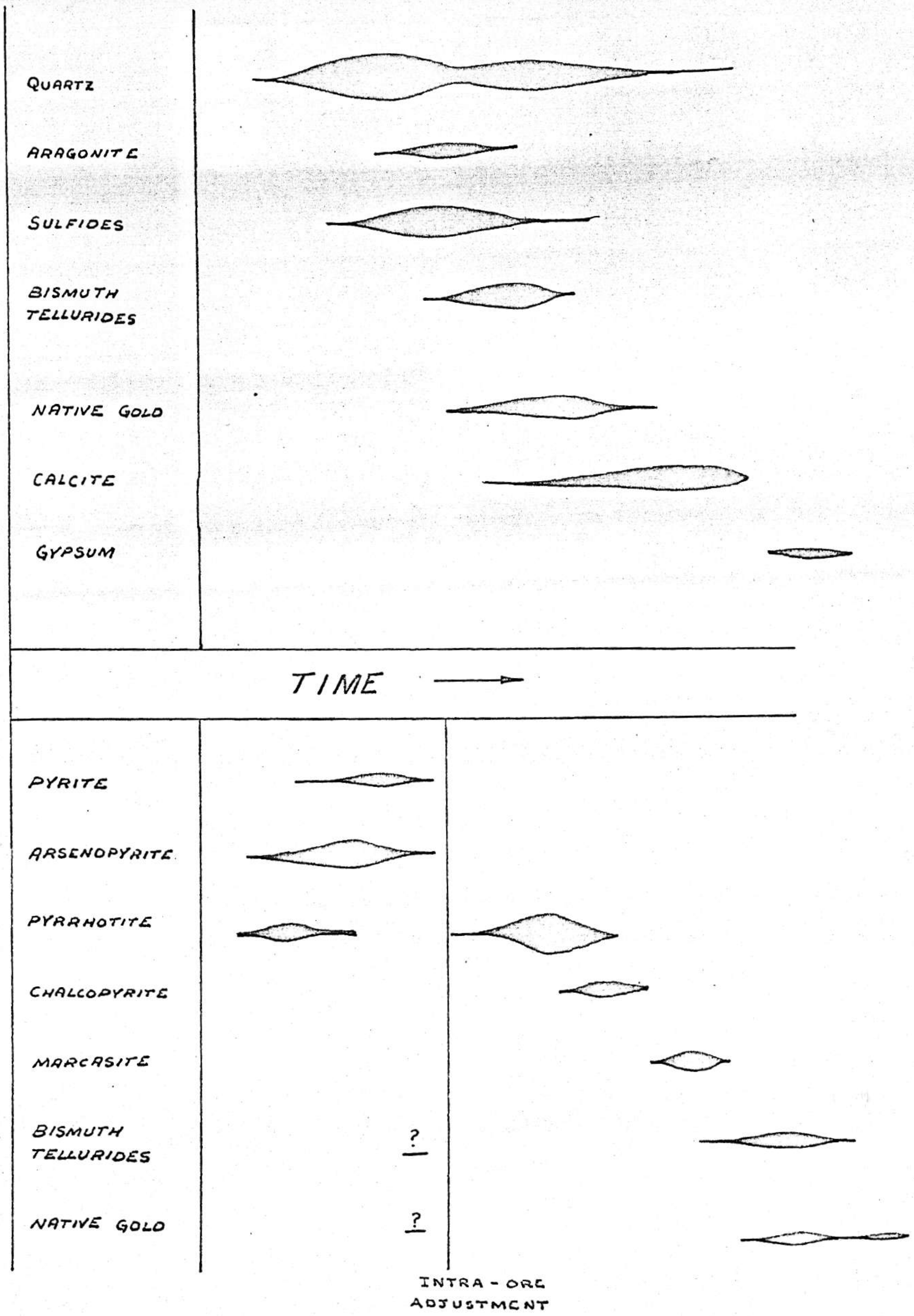


FIGURE 3

PARAGENESIS

Significant Textures

Plate 1

Fractured and brecciated arsenopyrite "healed" with pyrrhotite. Their is little replacement of the arsenopyrite by the pyrrhotite. Fracturing occurred due to brittle failure of arsenopyrite after deposition.

Plate 2

Pyrrhotite displays opening along the basal (0001) plane. Pyrrhotite behaves in a ductile fashion with movement in response to stresses by translation gliding on the basal (0001) plane.

Plate 3

Pyrrhotite shows effects of dissolution and reprecipitation of marcasite along preferred crystallographic boundaries.

Plate 4

Extensive transformation of pyrrhotite to marcasite leaves only relict cores of pyrrhotite surrounded by parallel lamellae of marcasite.

Plate 5

Marcasite displaying growth-zongin, perhaps due to slight differences in iron content. The concentric zones of the marcasite may be due to a series of interruptions in precipitation of marcasite.

Plate 6

Ex-solution texture of chalcopyrite in pyrrhotite. Some specimens show awell-developed "emulsion" texture formed by the distribution of rounded blebs of chalcopyrite throughout pyrrhotite. There is partial replacement of the chalcopyrite by marcasite.

Plate 7

Brecciation of early quartz and "healing" by late quartz. The late quartz contains euhedral crystals of native gold and plates of tetradymite.

Plate 8 and Plate 9

Oleander-leaf texture of tetradymite in joseite (Y). Crystallographic intergrowths of blades of tetradymite and massive joseite (Y). The tetradymite is rimmed by a mineral of highly variable composition (Table 3, Appendix, Microprobe Analysis). This texture is due to the unmixing of a solid solution of Bismuth, tellurium and sulphur.

Plate 10

Pseudo-eutectic intergrowth of pyrrhotite in tetradymite. This texture results when there is replacement of a homogeneous medium. The host mineral (pyrrhotite) must have been compact and uniform before the replacement by tetradymite.

Plate 11

"Pitted" tetradymite in contact with a telluride of unknown composition. The origin of the pits are from the breakdown of metastable phases.

GEOTHERMOMETRY

The results given by geothermometry studies are very speculative and must be treated with caution. There are many criticisms of the use of geothermometry in evaluation of the temperature of formation of different minerals in ore deposits. These criticisms have been shown to be valid (6) in the case of the pyrrhotite geothermometer as well as other geothermometer minerals. Admixtures of several mineral species and trace element content of the mineral as well as the fact that the mineralsmay have re-equiliberated are cited as the falling points of geothermometry.

Arsenopyrite Geothermometer - Geobarometer

The d(131) spacing was determined from six runs across the (131) peak of arsenopyrite. The d(131) spacing was found to be 1.631 Å which suggests a maximum temperature of formation of the arsenopyrite to be 460°C at a pressure of 2 Kbars. (7). A sample taken from massive arsenopyrite gave d(131) to be 1.633 Å. This would correspond to a maximum temperature of formation of 600°C at 2 Kbars.

These results suggest that there was either two stages of arsenopyrite deposition or that there was only one stage of deposition which spanned a large temperature range and was followed by a resurgence of ore solutions which brought about the deposition of the later pyrrhotite assemblage. The textures, mineral assemblages and abundance of pyrite suggest that the latter case would be more likely.

PYRRHOTITE GEOTHERMOMETER

Six determinations of the d(102) spacing of pyrrhotite from samples both in contact with pyrite and absent of any pyrite were made. The results of the scans showed a split peak with values of 2.053 Å and 2.062 Å. The split peak may correspond to the presence of two types of pyrrhotite or inclusions of undetected marcasite. Because of the uncertainties with the pyrrhotite geothermometer the corresponding values of 600° and 400° C. are viewed as very skeptical results.

DEPOSITIONAL TEMPERATURES

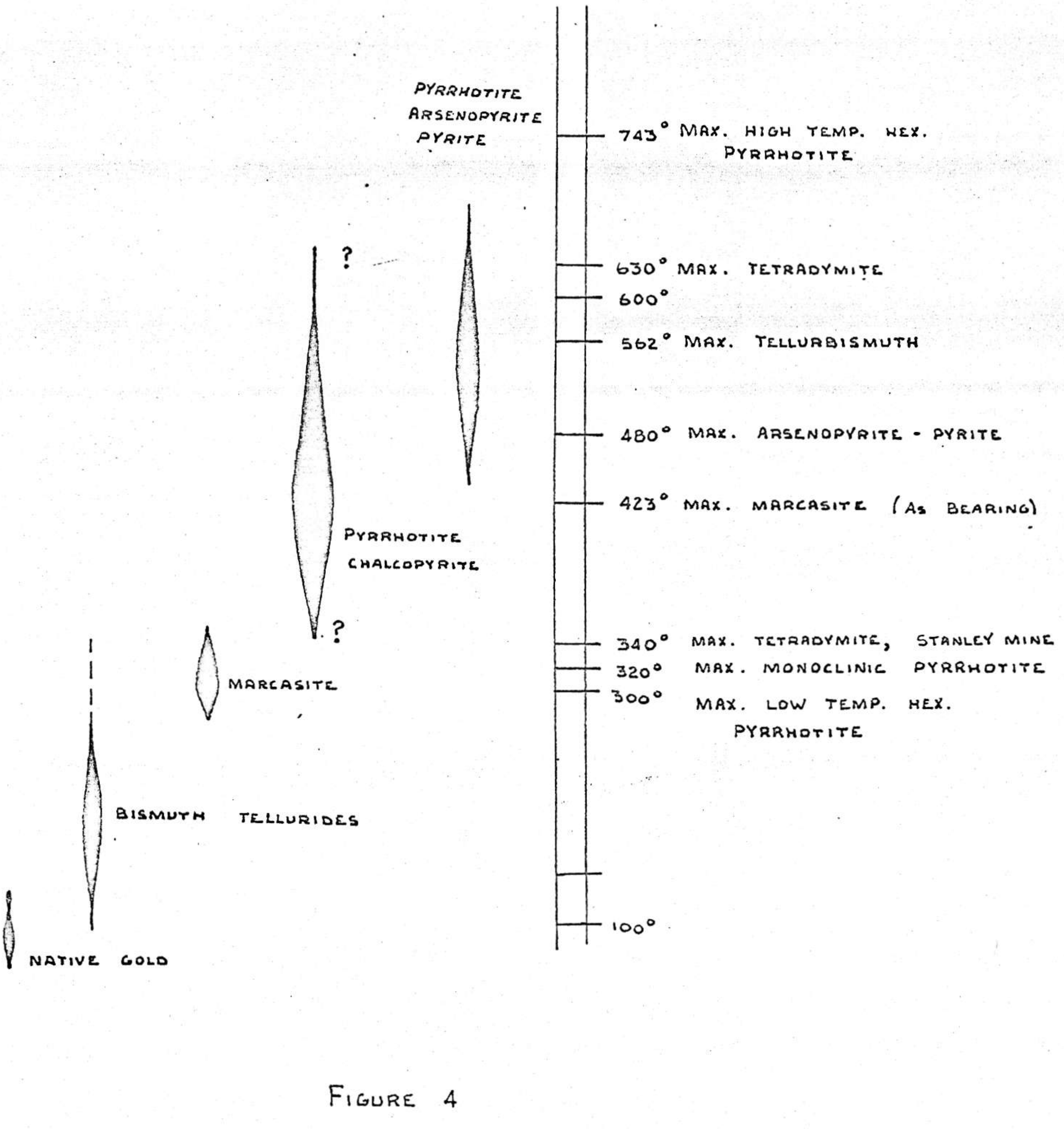


FIGURE 4

Zoning of the Deposit

The zoning within ore bodies is only slightly contrasting and is determined by the change of the type of minerals and the corresponding chemical composition of the minerals. The zoning of ore deposits was considered by Smirnov (23a) to be of two primary types, monascendant and polyascendant zoning.

(1) Monascendant Zoning - This type of zoning is characterized by a continuous change of mineral assemblages which do not show contrasting boundaries and differ in the main from each other by a gradual variation of mutual relations in the amount of ore-forming mineral.

(2) Polyascendant Zoning - A gradual separation of ore-bearing solutions varying in composition from the parent magmatic chamber and by a corresponding successive deposition of the mineral components of various composition within the contours of the ore body. This zoning may appear only in the deposits which are formed during several stages of mineralization in relation to the permanent re-opening or an ore cavity which results from subsequent tectonic deformations.

Monascendant zoning is very well displayed at the Laidlaw Gold Property and this type of zoning is distinguished by the variation of the types and chemical composition of the bismuth tellurides found within the various portions of the deposit.

In the central portion of the deposit the telluride assemblage is characterized by the sulfur bearing tellurides joseite(II) and tetradymite, while the telluride assemblage found towards the contact zone of the deposit is characterized by the non-sulfur bearing tellurides wherlite and tellurbismuth.

These minerals are considered to have deposited during one stage of mineralization and the variations in composition are due to decreases in the sulfur content and the increased tellurium content, of the later stages of mineralization. This suggests that there was a definite sequence of separation of volatiles (As, S and Te) on decrease in temperature and pressure conditions within the deposit, the appearance of these volatiles perhaps reflects the sequence in the separation of volatiles from the genetically associated magma chamber.

X-RAY DETERMINATIONS OF THE TELLURIDE MINERALS.

LOCALITY	I	d (meas)	MINERAL
L_1	10	3.12	TETRADYMITE
L_1	10	3.10	TETRADYMITE
L_1	10	3.11	TETRADYMITE
L_2	10	3.23	WEHRLITE
L_2	10	3.22	WEHRLITE
L_3	10 8 5	3.22 2.37 2.03	TELLURBISMUTH

FIGURE 5

Classification

The Laidlaw Gold Property is a plutonic hydrothermal deposit formed under conditions of low to intermediate depths with a wide range of mineral formational temperatures. The presence of open space fillings and vugs, the presence of replacement textures, and the close spatial relationship of genetically related igneous rocks support the classification of this deposit to the mesothermal group of deposits outlined by Park and MacDiarmid (19).

According to the scheme of classification given by Bilibin (3) this deposit has formed during the Late Stages of Evolution and is a postbatholithic gold deposit, associated with intrusive rocks of a hybrid nature. The "moth-eaten" cores of the plagioclase crystals, and presence of Xenoliths within the intrusive rocks also suggest this mode of origin.

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APPENDIX

MODAL ANALYSIS OF INTRUSIVE ROCKS

K-feldspar	6%
Plagioclase (An 47%)	65%
Quartz	18%
Hornblende	3%
Biotite	5%
Accessory Minerals:	3%
Magnetite	
Pyrite	
Apatite	

MICROPROBE ANALYSIS

Bismuth Analysis		At .% Bi
Standard Bi (100%)	Av. 13260 counts	
Mineral 1	Av. 5120 counts	39%
Mineral 2	Av. 7500 counts	57%
Mineral 3	Random counts 7240 to 9310	

Sulfur Analysis		
Standard S (66%)	Av. 15480 counts	At. % S
Mineral 1	Av. 5410 counts	23%
Mineral 2	Av. 1470 counts	7%
Mineral 3	Av. Random values 300 to 600 counts	

Mineral 1	$Bi_{39\%}S_{23\%}Te_{38\%}$ (?)	
	Tetradymite	Bi_2Te_2S
Mineral 2	$Bi_{57\%}S_{7\%}Te_{36\%}$ (?)	
	Joseite II	$Bi_{4+x}(Te, S, Se)_{3-x}$

QUALITATIVE ANALYSIS OF ARSENOPYRITE AND PYRRHOTITE

	Mo	Ni	Cu	Nb	As	Sn	Rb	Pd		RUNS
ARSENOPYRITE	6	5	4	1	/					6
PYRRHOTITE	8		8	8	8	5	6	5		8

QUANTITATIVE[*] ANALYSIS OF ORE FROM L_1 PORTION OF DEPOSIT

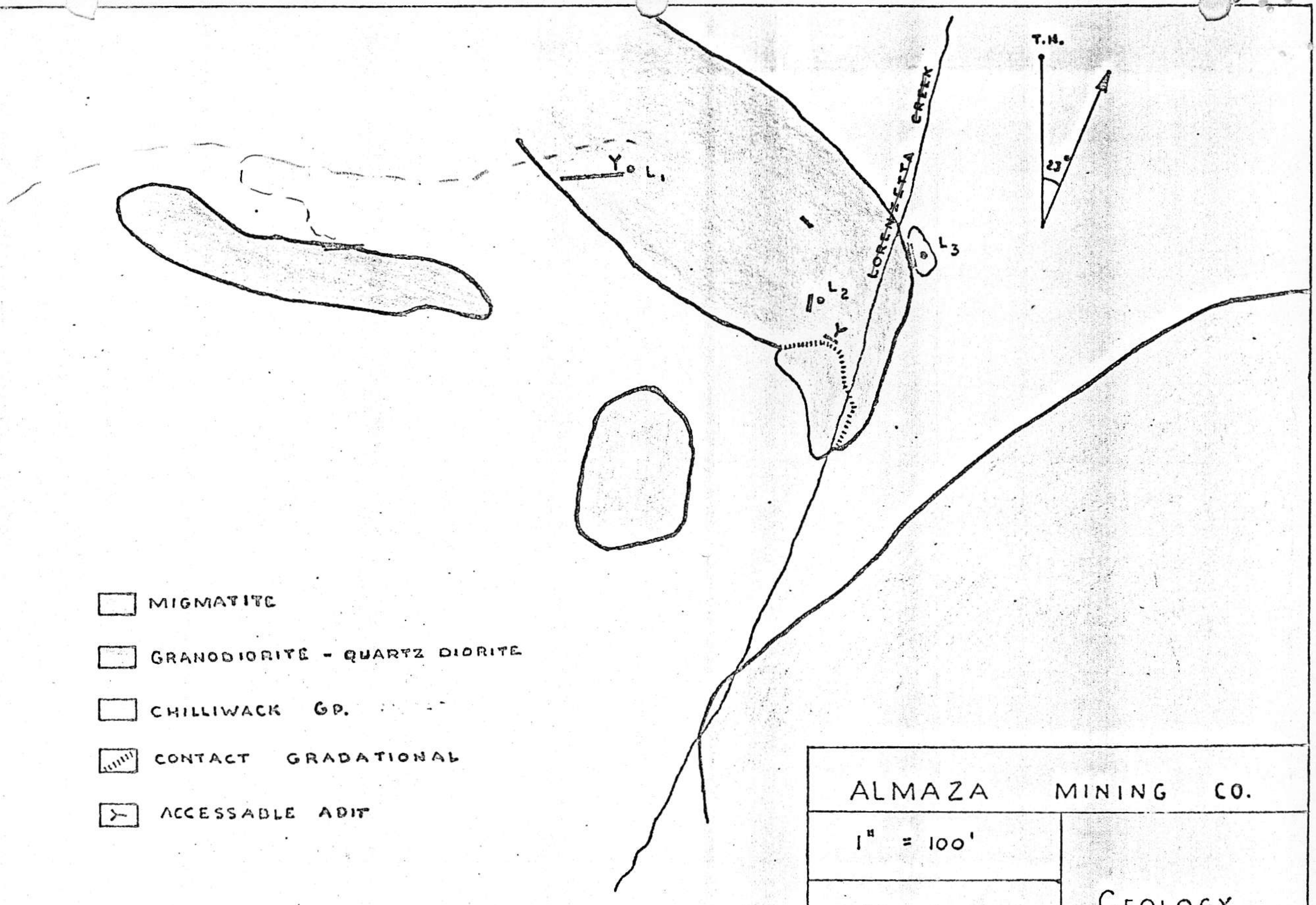
Ba	Cr	Co	Pb	Mg	Mn	Mo	Ni	Ti	V	Zn
.01	.001	.01	.01	1.0	.03	.001	.01	.3	.005	.05

RESULTS IN WEIGHT PERCENT.

[*] PERFORMED BY COAST ELDRIDGE

SPECTOGRAPHIC ANALYSES

TABLE 1



ALMAZA MINING CO.

1" = 100'

JMMc

GEOLOGY

JANUARY 23, 1971.

FIGURE 1

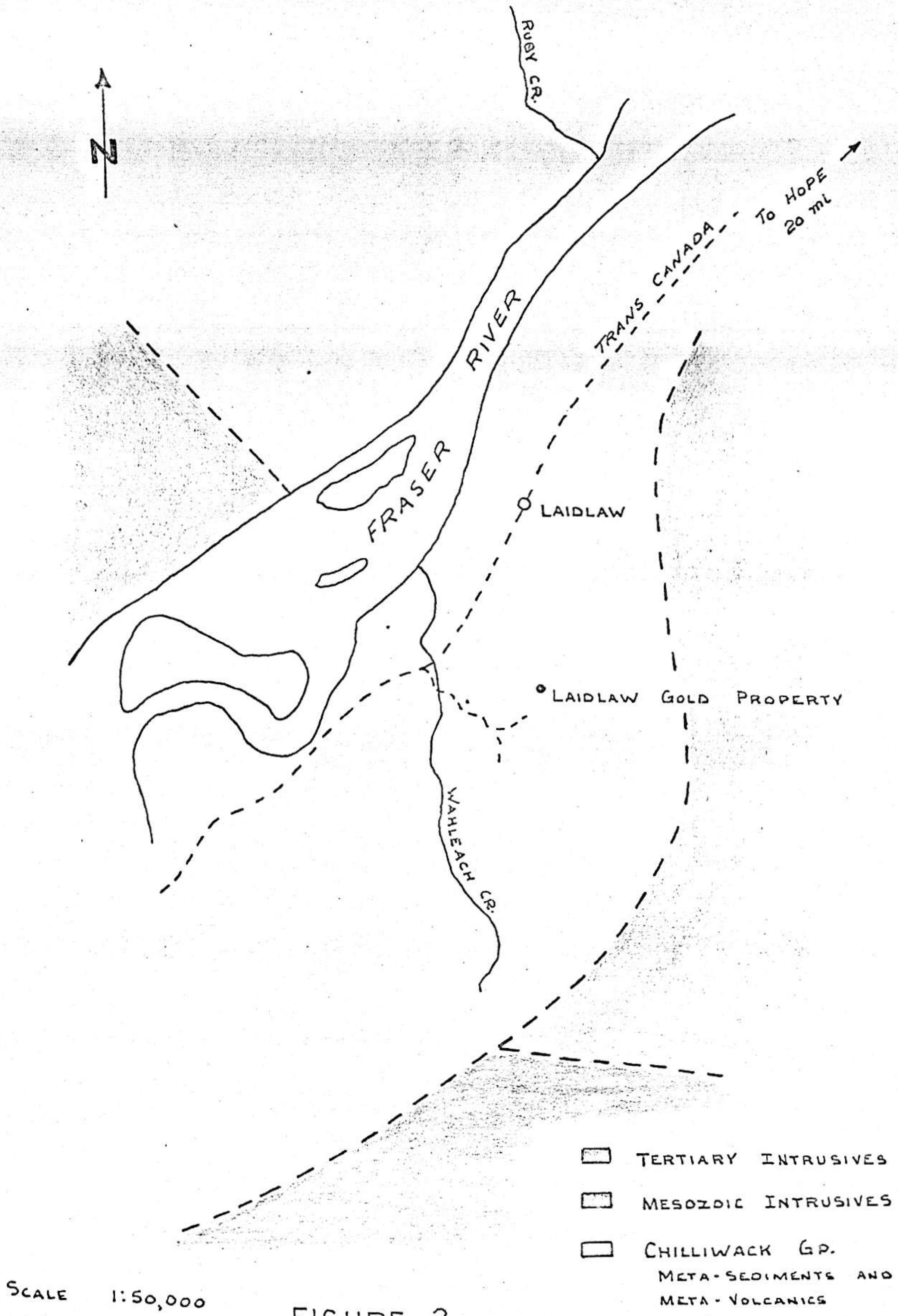
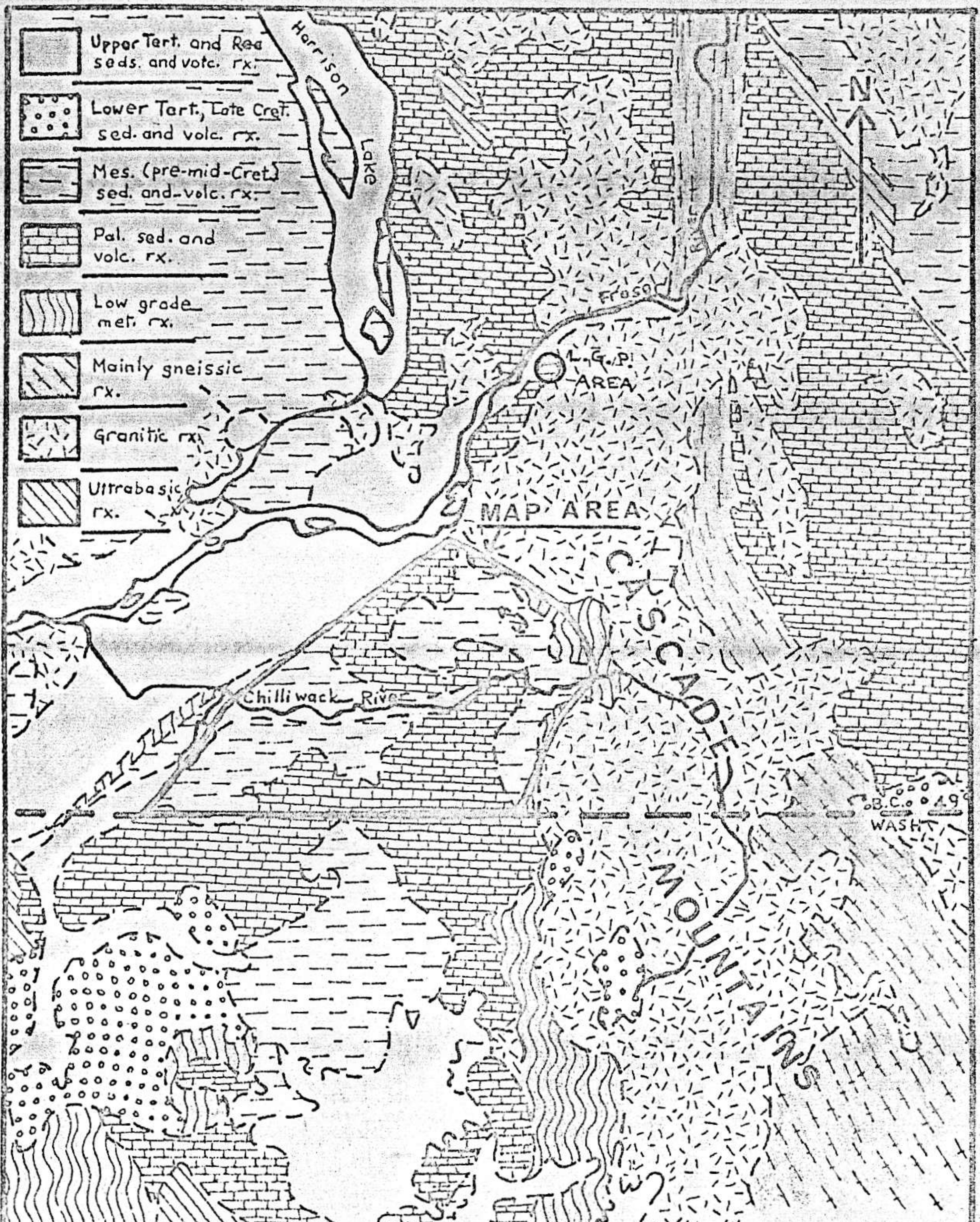

N
RUBY CR.
FRASER RIVER
TRANS CANADA
To HOPE 20 mi
LAIDLAW
LAIDLAW GOLD PROPERTY
WAHLEACH CR.
TERTIARY INTRUSIVES
MESOZOIC INTRUSIVES
CHILLIWACK GP.
META-SEDIMENTS AND
META-VOLCANICS
SCALE 1:50,000

FIGURE 2



(Map taken from Guidebook of Geol. Discussion Club, Vancouver, B.C., with modifications)

FIGURE 3 : Sketch map showing the geological setting of map area.

(Map taken from Guidebook of Geol. Discussion Club, Vancouver, B.C., with modifications)

FIGURE 3 : Sketch map showing the geological setting of map area.