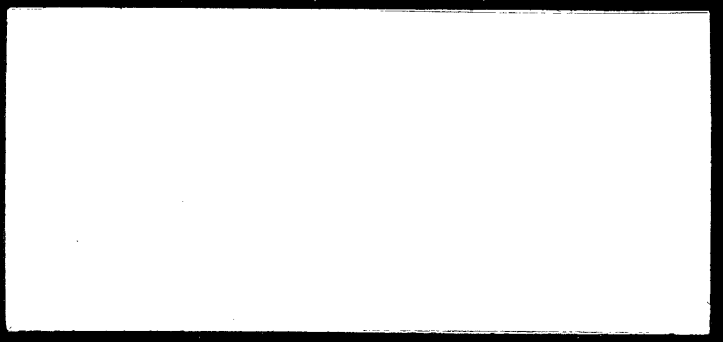

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BRALORNE MINE
JULY 1974

CONFIDENTIAL

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INTRODUCTION

Gold has been found in many parts of Bridge River district of British Columbia but is from a relatively small area in the valley of Cadwallader Creek that the bulk of production has come. This area, rectangular in shape, measures about one-half mile in width by three miles in length. In this area, here called for convenience the Cadwallader Gold Belt, are situated the Bralorne and Pioneer mines in addition to several prospects under development.

The gold of the Cadwallader Gold Belt occurs in quartz veins averaging about three feet in width. The ore contains about one-half ounce gold per ton. Except for a relatively small amount of silver, no other metals are produced from these veins. The productive veins occur in a variety of rocks. Vein-matter has filled reverse faults and modified tension structures. The fault structures are in some cases productive over lengths exceeding five thousand feet. 5 Km

The Bralorne Pioneer group of ore bodies produced approximately eight million tons of ore averaging 0.52 ounces of gold and 0.12 ounces of silver per ton before its closure in mid-year 1971.

Milling and Production

The Bralorne mill started in February 1932, gradually increased to 550 tons per day and the rate reduced in later years. Production from the Bralorne mine until November 1958 totalled $71,434,138 from 3,913,614 tons. The Pioneer mill commenced with an initial capacity of 100 tons per day in 1928 and increased to 400 tons per day in 1934. Operations were suspended in late 1960. Total Pioneer production to June 1958 was $41,666,596. The total production from the merged companies from 1959 to 1970 was 934,415 ounces of gold from 1,556,960 tons milled, valued at $33,325,913. Combined operations from 1932 to September 1971 produced over 4,100,000 ounces of gold with total metal revenue over $147,100,000. The gold price at the time of cessation of operations was $38.50 Canadian per ounce.

HISTORY

The earliest recorded reference to the occurrence of gold in the Bridge River area is to be found in the official reports of Government Agents to the Colonial Secretary dated over a period from May 18th to October 27th, 1863. These communications describe the reported discovery of rich gold placer deposits on the Bridge River by Chinese and the verification of these reports by John Cadwallader.

The lode showings that had given rise to these placers were not discovered until 1897 when, within the period of a few months, most of the veins of present importance in the Bridge River camp were found and staked.

Desultory development was carried on in the Cadwallader Gold Belt section from 1897 to 1928 when the Pioneer mine went into profitable production. The Bralorne mine went into profitable production in 1932 on a 100 ton a day basis, and continued until its shutdown in 1971.

GENERAL DESCRIPTION OF THE MAP AREA

Location: The Bridge River mining area, in the southeast corner of which the Cadwallader Gold Belt occurs, lies approximately 100 miles north of Vancouver on longitude 123 degrees and latitude 50 degrees 10 minutes.

Accessibility: Access to the area from Vancouver is via the Trans Canada Highway to Lytton, thence to Lillooet, continuing by improved gravel road to Goldbridge and the mine site, a total distance of approximately 285 miles. The mine can be reached by way of a route through Squamish and Pemberton, however the latter part of the route is over logging roads and is passable only in the summer months. Consideration has been given to the improvement of this section and, should this be undertaken, the accessibility of the Bralorne property will be improved. Freight is normally shipped by truck or train to Lillooet and thence to the mine. Communications are maintained by the British Columbia Telephone Company.

Topography: Topographically the Bridge River area is an area of marked relief ranging abruptly from 2500 to 8500 feet above sea level.

The Cadwallader Gold Belt section forms a narrow, rectangular strip, conforming quite closely with the east-west trend of Cadwallader Creek valley. The Gold Belt ranges from 3500 feet in elevation at its westerly end to 4500 feet in elevation at its easterly end.

Immediately north and south of the Cadwallader Gold Belt the Bendor Batholith Range and Cadwallader Batholith Range, respectively, tower in a series of peaks up to 8500 feet.

The Cadwallader Gold Belt is in part paralleled and in part crossed by Cadwallader Creek which is a typical mountain

river showing large and rapid fluctuations in volume. It follows, in places, a canyonous course and is fed by several tributaries, several of which enter the main stream from hanging valleys.

GEOLOGICAL TABLE

The rock types of the Cadwallader Gold Belt are tabulated for brevity, in sequence of origin, in the geological table.

STRUCTURAL GEOLOGY

A. Primary Structures

Fergusson Series: The basement complex of the Cadwallader Gold Belt, or the Fergusson Series, was formed as an extensively developed thin-bedded series of alternating argillite and chert, with, towards the top of the series, some lentils of limestone. The marked difference in the relative competency of the argillite and chert, and thinness of the beds, formed a rock series which was particularly susceptible to extensive small scale fracturing, mashing and crumpling under the stresses of regional deformation.

Pioneer Formation: The Pioneer greenstone of the Cadwallader Gold Belt appears in weathered outcrops as a homogeneous rock type of andesitic composition. Familiarity with freshly broken surfaces and in particular with diamond drill core of this rock makes it

Cenozoic	Recent		Stream deposits; volcanic ash; slide debris and soil.	± 300	Forming bars, low benches and a generally thin surface mantle.
	Pleistocene		Fluvioglacial, glacial and stream deposits.		Originally partly filling valleys, now forming high and low benches along valley sides.
Erosion—Nonconformity					
Mesozoic	Upper (?) Jurassic	Bralorne Intrusives	Lamprophyre dykes. Ore deposition. Albitite and quartz-albitite.		As dykes, lenses, irregular masses and "soaking material."
			Soda granite (albite feldspar).		As an elongated stock of somewhat sill-like habit.
			Quartz- and feldspar-"porphyries."		As isolated or swarms of sill-like masses; in part intrusive, in part "pseudo-porphyry" after tuffs or sediments.
			Quartz-diorite.		As small plug-like bosses.
			Diorite and greenstone-diorite. Gabbro and hornblendite. Peridotite ? (All in part serpentinized.)		As a lenticular, stock-like mass with gradational, sub-parallel zoning into more basic phases, along one flank where the hornblendite and gabbro phases in part "soaked" greenstones to form hybrid greenstone-diorite.
	Intrusive Contact				
	Upper (?) Triassic	Hurley (-Noel)	Argillaceous, tuffaceous and minor cherty sediments; conglomerate and agglomerate beds; locally limy and fossiliferous; minor intercalated andesitic ("greenstone") flows.	± 1200	Forming banded to laminated beds with little grain size variation. Conglomerate as lenses, at or near the base of the formation.
		Structurally Conformable			This contact, on basis of local basal conglomerate, may be disconformable.
		Pioneer	Green, massive, amygdaloidal or finely crystalline, regionally metamorphosed andesites ("greenstones") and some associated instrusive phases. Minor local rhyolitic flows and breccia at top of the series.	+ 1000	Mainly flows, tuffs and breccias with dyke-like and irregularly shaped generally fine-grained, intrusive phases. Top determinations of flows occasionally possible by amygdule size variations.
Structurally Conformable					This contact may be disconformable. Its original nature is now masked by basic sill-like intrusives, generally sheared and faulted, serpentinized and locally carbonated.
Paleozoic	Permian	Fergusson Series	Mainly green-colored andesitic to basaltic lavas and minor associated limestone with some local thin beds of oolitic jasper.		These lavas occur as amygdaloidal pyroclastics, pillows and flows with (probably) fine-grained intrusive phases. Stratigraphically they overlie, except where they intrude, the Fergusson sediments; structurally they are now commonly infolded in the latter. These lavas are probably the basal member of the Triassic Pioneer greenstones.
			Chert, quartzite and graphitic argillites.		Extensively developed as relatively thin, interbedded argillite, quartzite and chert.

possible to distinguish between four types of different internal structure and different physical characteristics. The types present are amygdaloidal flows rarely exceeding one foot in thickness and in which the amygdule size variation commonly indicates the flow top; tuffs in which grain size variation is only occasionally perceptible; minor flow top breccias and locally distributed, fine-grained crystalline textured phases which are intrusive into the flows and tuffs. The intrusive type of greenstone is difficult to distinguish from the megascopically similar, coarser-grained tuffs.

The amygdaloidal type occurs most commonly as a repeated succession of thin flows, followed by successions of thin tuff beds. Individual flow or tuff horizons cannot be correlated laterally with any reasonable degree of certainty.

The flow top breccias are of erratic occurrence, except towards the top of the greenstone series where they rapidly increase and gradually change into a type called for convenience "amygdaloidal pyroclastic". The latter is composed of subangular to rounded volcanic frament, of acidic composition and amygdaloidal structure, in a more basic fine-grained matrix. Locally the actual top of the greenstone series, where underlying the sediments and so spared from erosion, consists of one or more massive, acidic, (rhyolite or dacite), sometimes porphyritic, flows.

The flow and tuff types of greenstone, which probably comprise eighty percent of the volcanic series, react differently to stress. The flow type becomes somewhat schistose with soft chloritic films on the parting surfaces giving the rock a "greasy" feel, while the tuffs are more prone to fracture into angular fragments with abrasive-like surfaces.

All types of the greenstone series are relatively competent rocks which, under certain conditions, form a favorable host for much of the ore.

Greenstone-Diorite: This is a hybrid rock quite common in the Cadwallader Gold Belt. In places it presents a breccia-like appearance and may be composed of mixed sub-angular blocks of greenstone and dioritic material; or adjoining sub-angular blocks of dioritic material of different granularity and crystallinity; or simply fractured dioritic material. Commonly the divisions between blocks of different types are marked by narrow felspathic stringers. In places the breccia-like structure of the greenstone-diorite is absent and instead the complex consists of greenstone with small to large, irregularly shaped patches, which have been seemingly replaced or saturated with dioritic magma. In this type of the greenstone-diorite, contacts between the greenstone and intrusive material are gradational.

Distribution of the greenstone-diorite in the Cadwallader Gold Belt is confined to certain general zones and as these zones

are closely related to the regional folding and shearing, they will be further discussed under the heading of Secondary Structures.

Hurley-Noel Formation: These sediments, including argillaceous, tuffaceous and conglomeratic types, are generally thin-bedded. Grain size variation or other top determination criteria are poorly developed. No dependable horizon marker, other than a zone of congolmerate lenses, is known to the writer.

The conglomerate mentioned occurs in lens-like masses rarely more than twenty feet in thickness, and commonly much less. These lenses occur at, or close to, the contact of the sedimentary formation with the Pioneer greenstone. In places the conglomerate is formed of well-rounded pebbles of chert (of Fergusson Series origin?) of porphyritic, felsitic rock (of uppermost Pioneer formation acidic flow origin?) and other unidentifiable material. In other sections the conglomerate will include, in addition to the above, the conspicuous presence of rounded to angular pebbles and cobbles of limestone and granitic material.

Since the conglomerate observed is believed to occur in the basal zone of the sedimentary formation adjoining the Pioneer greenstone and includes in part pebbles of material resembling the uppermost volcanic flows of the Pioneer formation, the conglomerates are regarded in the main as basal conglomerates.

Rocks of this sedimentary formation are relatively incompetent but under special conditions have served as a host

for productive veins.

Bralorne Intrusives: These consist of a succession of intrusive types including, possibly, peridotite and pyroxenite, together with gabbro, hornblendite, diorite (hornblende and augite), quartz diorite, soda granite and related hypabyssal types. The peridotite and pyrozenite are doubtfully included in this group. Although evidence for the probable genetic and age relationship of the remainder of the group is obtainable, the ultrabasic rocks are commonly sheared, serpentinized and sometimes carbonated to a degree which masks their genetic and age relationship in the intrusive sequence. They are placed where they are in the Geological Table principally because of their very common spatial relationship with the gabbroic and dioritic rocks of the Cadwallader Gold Belt. There is some evidence in the Pioneer mine pointing to a post-soda-granite age for small amounts of ultrabasic rocks.

The gabbro, hornblendite and diorite (also greenstone-diorite) appear closely related genetically and spatially. They form sub-parallel bands with gradational contacts, across a zone which varies from twenty to fifteen hundred feet in width.

The diorite and greenstone-diorite of this series are competent rocks which form hosts for much of the ore. The more basic types are incompetent and are commonly schistose and serpentinized.

The primary structure and the origin of the "porphyries" is not yet clear. They are in general lens-shaped or tabular-shaped masses, from one to twenty feet wide, with commonly one well defined wall and the other wall showing replacement characteristics. They appear in part to be dyke or sill-like intrusions while microscopic thin section studies indicate that they are at least in part "pseudo-porphyries" after tuffs or sediments.

These "porphyries", common in the greenstone of the Pioneer mine, occur in sub-parallel swarms and are of some significance in connection with the vein structures. The "porphyries" are brittle rocks and fracture or shatter rather than fissure. They appear to be decreasing in number but increasing in size as depth is gained. The "porphyries" appear to be the siliceous forerunners of the soda granite.

The soda granite appears to be a late differentiate of the gabbro-diorite magma and it occurs in all cases within or adjoining these more basic phases. The contacts of the soda granite and diorite are commonly gradational across a patchwork-like zone of hybrid type; the contacts between the soda granite and greenstone are sharply defined with local shearing of the greenstone. In form, the soda granite is a lens-like mass. Its long axis conforms to the trend of regional folding. The westerly nose of the granite mass, occurring on the Bralorne property, is somewhat blunt and it plunges steeply to the northwest. The south-easterly "nose", occurring on the Pioneer property, consists of a rapid narrowing of the granite accompanied by a fingering-out of the mass until only one relatively narrow but persistent

dyke remains, to extend south-easterly along the Cadwallader Gold Belt towards the Pacific Eastern property. The south-easterly "nose" appears to plunge at about 45 degrees to the southeast.

Noteworthy features of the noses of these soda granite masses are that they are both seemingly soaked with sodic plagioclase, carbonate and conspicuous amounts of hydrothermally introduced quartz. The productive veins of the King mine on the Bralorne property and the Pioneer Main ("A") vein on the Pioneer property are situated on the west and east noses respectively of the soda granite.

In the Pioneer mine and west of the east nose of the intrusive mass and at deeper levels, the soda-rich phase is still present but rather than soaking or replacing the granitic mass, it forms a narrow, relatively well defined border or crust associated with spur and dyke-like masses quite often of porphyritic texture. Such small, commonly less than ten-foot-wide dykes, form the albitite or albitite porphyry which is often closely associated with the vein structures.

The albitites are competent rocks and they maintain remarkably persistent vein structures. The albite-soaked granite is also a competent rock, but more brittle than the albitite, it tends to shatter than than fissure.

At depth, where the surplus of albite has been segregated as dykes from the soda granite proper, the latter rock, which is quite coarsely crystalline, has a strong tendency to shatter rather than fissure. For this reason the soda granite proper, away from its albite-rich border, does not long maintain a single continuous fissure.

B. Secondary Structures

Introduction: In this section the folding and fracturing of the rock types of the area will be discussed. It has been pointed out that the structural problems of the Cadwallader Gold Belt are complex. The nature of the contacts between formations are commonly masked by the introduction of sill-like basic intrusions, now sheared and serpentinized and making the determination of attitudes and stratigraphic succession difficult.

To complicate the problem of stratigraphic succession further, there is close folding and duplication of the formations.

The linear sill-like injections of basic material and commonly associated shearing are, in general, parallel to the formational strike and so provide no offsetting criteria to aid in learning if such shear zones mark zones of faulting. To add to the difficulty of structural interpretation, rock outcrops are few since the Cadwallader Gold Belt occupies a topographic trough largely overburden-filled.

The Fergusson Series, which form the northeast boundary of the Cadwallader Gold Belt, dip in general from 45 to 65 degrees to the northeast. The Fergusson Series, which form the southwest boundary of the Cadwallader Gold Belt, dip (at the two isolated points observed) at about 60 degrees to the northeast. Between these two Paleozoic boundaries, the Mesozoic volcanics and sediments are believed to be symmetrically close-folded.

The most south-westerly band of Mesozoic sediments provides a relatively large number of outcrops, offering many dip and strike observations. The southwest limb of this structure is masked by a large, sill-like basic intrusive, now serpentinized, as is also in part at least, the northeast limb of the structure. Along the approximate position of the northeast limb and contact with the greenstone, on the south boundary of the Pioneer property, "float" of apparently Hurley-Noel basal conglomerate is strewn. Similar material was also found at one point on the southwest limb. No convincing top determination of individual beds could be made in this synclinal structure but a general and consistent transition of coarse to fine material, ranging through conglomerate, pebbly coarse sandstone, and sandstone to argillite members, is discernible from the limbs inward towards the axis. The synclinal structure appears to plunge to the northwest at a small angle which is exaggerated in plan by a flattening of dip on the north limb, as it continues north-westerly. The southwest limb of

this structure is steep-dipping, averaging between 70 and 80 degrees, while the northeast limb appears to be 20 degrees flatter.

Little is known, on the basis of direct evidence, concerning the structure of the Pioneer greenstone to the northeast of the syncline described, but its position between two indicated synclines, its stratigraphic position beneath the sediments, the dip of its contacts and the form of its massif (widening on depth), also some direct evidence that a similar band of greenstone to the north is an anticline, all suggest that this band, called locally the South Greenstone Band, forms an anti-clinal structure.

The sedimentary band between the two greenstone bands is poorly exposed at surface. A few outcrops are present near the west boundary of the Pioneer property, but unfortunately these occur in the greatly disturbed vicinity of the Cadwallader shear. Near the east boundary of the Pioneer property, in the bed of Extension Creek, outcrops are quite numerous and the attitude there suggests the steep-dipping, south flank of a synclinal structure.

The northerly greenstone band, called for convenience the North Greenstone, is the important member in which the Pioneer Mine is situated. Although only two outcrops of the North Greenstone are present on the Pioneer and Pacific (Eastern) properties,

the member is well outlined by the underground workings. The North Greenstone has been studied in detail in the Pioneer mine where it forms the host rock for much of the ore. Here, on the basis of many observations of amygdule size variation in flows, it appears folded into a tight, roughly symmetrical, anticlinal structure. The North Greenstone band appears to be narrower towards the southeast but it is not known whether this indicates a southeast plunging fold or is the result of "slicing" by the Cadwallader shear.

To the north of the North Greenstone is a narrow band of sheared and contorted sediments of the Hurley-Noel type. There are just two isolated out-crops of this member but it has been exposed in underground working and diamond drilling on both the Pioneer and Pacific (Eastern) properties. The south contact of this formation with the Pioneer Greenstone dips steeply (70 to 80 degrees) north and at several points along this contact a basal conglomerate is present. The bank exposed appears to be the south flank of a synclinal structure but the nature of the complete fold is unknown, since the northerly position of it has been sheared and sliced by the Fergusson Overthrust fault.

Shearing and Faulting: The Cadwallader shear is known to be at least three miles in length and it forms the present south-west boundary of the productive veins of the Cadwallader Gold Belt. Its average strike is about north 45 degrees west and it dips from 70 degrees south-west to vertical with local steep reverse

dips. Its course follows closely the southwest contact, or basic side, of the differentiated intrusive complex, even where this narrows down (as it does to the southwest of the Pioneer mine) to widths of 50 feet or less. The extension of the Cadwallader shear zone northwest of the King mine (Bralorne) appears to lose its identity in a zone of north-south faults which occur roughly parallel to, and mainly to the west of, the Hurley River canyons. The extension of the Cadwallader shear zone southeast of the Pioneer mine has been located only at widely spaced points. Pacific (Eastern) geologists believe that the Cadwallader shear zone can be correlated with a fault structure in their underground workings.

The Cadwallader shear is a zone of moderately to intensely schistose rock, averaging in the few places crossed about 200 feet in width. The schistose rock of the zone is characteristically a serpentinized basic intrusive whose identity is locally recognizable in occasional massive fragments. Locally bordering the shear zone, and across relatively narrow widths, the Pioneer greenstone may be intensely sheared with sometimes small to very large, relatively unbroken, hornblende crystals present.

The serpentine of the Cadwallader shear zone is very rarely talcose, carbonated, silicified or mineralized. It appears noteworthy that where the serpentine is so altered, such sections

are usually the intersection area of the Cadwallader shear zone with one of the northerly-striking faults related to the vein-fault pattern of the camp.

The Cadwallader shear zone has been described as a fault zone. The early evidence to support this was based on the assumption that there was a single greenstone band and the further assumption of displacive overlap to account for the local presence of two greenstone bands. The assumed overlap was taken to indicate the presence and direction of horizontal offset of a large fault. Subsequent work underground on the Pacific (Eastern) property and diamond drilling on the Pioneer property indicates two separate, parallel greenstone bands and not a single faulted and overlapping one as previously assumed.

No certain evidence of displacement along the Cadwallader shear zone is known to occur on the Pioneer property other than minor and local movement of the shear zone to adjust itself to the intersecting offsets of later corss-faults. As the Cadwallader shear zone conforms closely in position to formational and intrusive contacts, masked by injected sill-like masses of basic intrusive, it can be seen that fault displacements could be present yet not apparent. Some evidence that might bear on the question of possible displacement is shown by the unexplained presence of two or three very small outcrops of Fergusson-like rocks along the strike and within the Cadwallader shear zone. Additional evidence is reported to be accumulating on the Pacific

(Eastern) property to indicate that the Cadwallader shear may prove to be a major normal fault, with marked horizontal offset in a direction opposite to that assumed by earlier investigators.

Fergusson Overthrust: This structure was first described by Cairnes as one of "principal" northeasterly-dipping faults. The Fergusson Overthrust, now so named because all exploration to date points to a single major structure, is a reverse fault which has resulted in the late Paleozoic (Fergusson Series) rocks being thrust against and over the Mesozoic series. Forming as it does the fault contact between unlike rock types, it can be traced at intervals along the three or four miles of the Cadwallader Gold Belt and continues to the southeast for a probable eight miles more. To the northwest of the Bralorne mine the course of the Fergusson Overthrust becomes involved and obscure, as does the Cadwallader shear to the south, with probably later, northerly trending, westward dipping cross-faults, that parallel the general course of the Hurley River canyons.

The Fergusson Overthrust is roughly parallel to the Cadwallader shear zone, striking about north 45 degrees west, but it dips more flatly (averaging about 60 degrees) in the opposite direction or to the northeast. The course of the Fergusson Overthrust is sub-parallel to the formational trend in strike and dip and it slices along the contact of the north Greenstone Band and Hurley-Noel sediments, being in the main just within the latter.

The Fergusson Overthrust has been cut through or closely approached in the Taylor Bridge River workings of the Bralorne mine; the 51-cast drifts of the Empire mine, the 40 vein workings in the Pioneer mine, the vertical diamond drill hole on the Holland property (due north of the Pioneer mine), and the underground workings and surface drilling on the Pacific (Eastern) property. Where exposed, the Fergusson Overthrust consists of a zone of intensely sheared serptentinized rock, at least 100 feet in width. Where approached from the south as in the Bralorne 51-cast workings, the foot-wall greenstone of the Fergusson Overthrust becomes increasingly schistose and incompetent. The origin of the serpentine and talcose material in the Fergusson Overthrust poses an interesting problem. On the Pioneer property in the 40-vein hangingwall diamond drilling, it appears to have been derived, at least in part, from serpentinization of the basal conglomerate of the Hurley-Noel sediments.

The Fergusson Overthrust contains little vein-matter, that best known being the quartz lenses explored underground north of the Bralorne mine on the former Taylor Bridge River property. Although this vein-matter resembles that of the productive veins, it has to date produced no ore.

The time of formation of the Cadwallader shear and the Fergusson Overthrust is still uncertain but they appear to be of approximately the same age. The Fergusson Overthrust is known to be later than the quartz diorite intrusions. On the basis of

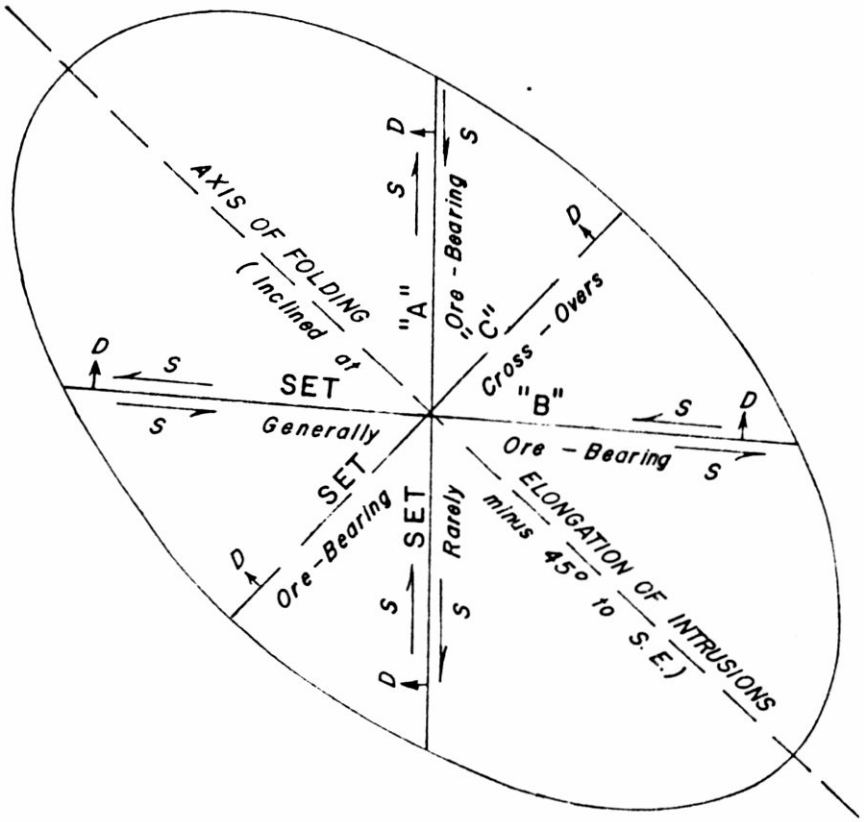
fragmentary but corroborative evidence these two structures appear to be not later and probably earlier than the vein-fault fracture pattern of the Cadwallader Gold Belt. Some evidence of this is the offsetting of the Cadwallader shear zone by the northerly striking faults of the Bralorne mine, the offsetting of the Cadwallader shear zone by footwall branches of the Pioneer Main vein and the presence of quartz veins in the Fergusson Overthrust. The presently available evidence points to a pre-fracture-pattern age for the Cadwallader shear and a possibly later but still pre-quartz age for the Fergusson Overthrust.

FRACTURE PATTERN

Diagramatic Presentation: The fracture pattern of the Cadwallader Gold Belt may be advantageously studied in the diagrammatic setting of the conventional strain ellipsoid as shown.

If the ellipsoid is oriented in plan on the basis of the probable directions of maximum regional compression as evidenced by the parallel close folding, the regional shear zone and regional overthrust fault, then it will be seen that the composite fracture pattern of the Gold Belt agrees closely with the theoretical pattern to be expected.

If, in vertical section, the southeast end of the axis of maximum elongation of the ellipsoid is depressed about 45 degrees, the close agreement between the actual fracture pattern and the theoretical pattern extends to all details such as agreement in dips of structures, directions of fault offsets, attitude



— LEGEND —

INDICATES DIRECTION OF DIP ..... D

INDICATES DIRECTION OF SLICKENSIDES AND HORIZONTAL FAULT OFFSETS ..... S

BRALORNE RESOURCES LIMITED

— STRAIN ELLIPSOID DIAGRAM —

Date : DEC./73 Drn.: LEONG .

of the widespread slicken-sidings and of other physical criteria characteristic of the individual shear or tension structures.

The individual fractures making up the pattern are discussed in great detail below.

Type A. Structures of the type indicated as "A" in the ellipsoid diagram are recognizable on the geological plan as the north-striking faults, which are, with one important exception (C-vein No. 2 fault), unmineralized. Three or more of these faults are clustered at the northwest extremity of the Cadwallader Gold Belt (King mine workings of the Bralorne), with two others at from 1500 to 2000 foot intervals to the southeast. None are known to occur on the northwest corner of the Pioneer property exposed by the Pioneer mine workings. A large fault of similar attitude that may belong to this same set has been inferred by Pacific Eastern geologists in the Plutus-Twinturn Creeks area on the Pacific Eastern property.

The faults of this set strike from due north to north 20 degrees west and dip from 45 to 70 degrees west, with one example, the Bralorne No. 1 fault, dipping 80 degrees to the east. The faults of this set are all thrust or reverse faults with both vertical and horizontal components of movement. The horizontal component of movement for each fault is roughly the same and between 200 and 300 feet, except for the Empire fault where the aggregate movement for three separate downward converging near-surface faults totals about 700 feet for the single fault structure resulting below the 3200 foot horizon. The horizontal displacement

along these faults is as shown in the diagrammatic ellipsoid or right-handed.

In detail there appears to have been hinged or rotational displacement along this north fault set. In the King mine, Bralorne property, vein dips increase in flatness for each successive fault block westwardly. Similar evidence of rotational movement is present in the Empire fault structure.

The individual faults of this set are known to be at least 1500 feet in length and in all probability they extend at least across the full width of the intrusive complex.

They follow in general a straight course except for the ore-bearing No. 2 fault (also called C vein) which is gently sigmoidal in plan.

The fault structures are filled with from one to fifty feet of schistose rock and gouge. In the case of the partly quartz-filled and ore-bearing No. 2 fault (C vein) the vein-matter consists of discontinuous, rudely lenticular bodies of more or less fractured quartz between heavy gouge walls with a re-cemented quartz breccia frequently evident. It is evident that this set of north-striking faults was active before (?), during and after the introduction of vein-matter.

Type B. Structures of the type indicated by "B" in the ellipsoid diagram are recognizable on the geological plan as the westerly-striking fault set, commonly quartz-filled and mineralized to form

the "Main" veins of the Cadwallader Gold Belt. The more important members of this set and their manner of distribution are shown on the geological plan.

These vein-filled faults, complementary to the type "A" faults of the ellipsoid diagram, strike between 15 degrees north and south of west and dip from 55 degrees north to vertical, with locally (in the Bralorne King vein and Pioneer Main vein), a steep reverse dip.

The vein structures of this set appear to be all thrust or reverse faults with both vertical and horizontal components of movement. The horizontal component of movement for these vein-faults is between 80 and 150 feet and in all cases the displacement is left-handed. The vertical component of movement is not accurately measurable but is is estimated to be as a rule slightly in excess of the horizontal component.

Extensive uniform development of slickensides and mullion structure show the hangingwall blocks to have thrust-ridden over the footwall blocks at an angle averaging 55 degrees from the horizontal. If the vein-filled faults of this general east-west set are regarded as fault segments of originally single east-west structures, now offset by the north-south fault system, then the original type "B" structures must have ranged from 2500 to over 5000 feet in length, or in other words extended across the full width of the igneous complex.

The vein-filled fault structures of this set, although they conform closely in general direction of dip and strike, have in detail individual characteristics. These individual characteristics appear to have been determined to a large degree by the relative competency of the rocks cut. Individual structures commonly split into diverging branches on approaching less competent types (such as serpentine, sediments or schistose greenstone) and commonly such branches curve to make the largest possible angle of intersection with the less competent rock.

In the Bralorne diorite the individual fault structures usually show minor irregularities in dip and strike with many branching "splits". This "splits" are often quartz-filled and occasionally ore-bearing. Less often, as in the Blackbird vein, the "splits" leave and re-join the main structure to form a closed or braided pattern which may be entirely quartz-filled with a resultant repetition of ore-shoots. In detail, this set of ore-bearing fault structures, where they occur in diorite, may be described as irregular in form.

In the soda granite these structures behave differently. Where the granite is coarse-grained, homogeneous, and contains a minimum of excess albite, it appears to have been over-competent or brittle. In this granite the fault structure loses its simple, single plane or narrow zone identity and is present as a wider, quartz-filled fracture zone, generally inhospitable to ore. Where the granite is finer grained with excess albite, a combination

usually found in its contact zone, the rock is sufficiently competent to fracture and maintain faults of this set as simple uniform structures suitable for ore disposition.

The conduct of these type "B" faults in Pioneer greenstones depends on several factors. Where the greenstone is massive, the members cut at a relatively large angle and where the assemblage has been given rigidity by swarms of "porphyry" dyke-like bodies, this rock is competent to a very favorable degree. An east-west ore-bearing fault of the set discussed (the Pioneer "A" vein) cuts rock of this type and the resulting quartz and ore-filled structure is probably the most uniform in dip, strike, width and simplicity of all examples in the Bralorne-Pioneer mines. Where the greenstone formation differs from the ideal above described the fault structure suffers and may be quite inhospitable to ore.

Faults of this "B" or ore-bearing set occur in the Mesozoic sediments but only under a certain general condition do they retain a simple structure and are quartz-filled and ore-bearing. This is where the fault zone has been cemented by an early dyke (commonly albitic) and subsequent movement been localized to the wall(s) of such a dyke as in the Bralorne North and (in part) the King veins.

Other general characteristics of this set of faults will be discussed under veins.

Type C. Structures indicated by type "C" in the ellipsoid diagram have their recognizable counterparts in the Cadwallader Gold Belt but only one such structure (Bralorne 59 vein) is shown on the geological plan because, with few exceptions, structures of this set are best developed only in the deeper levels or those below the 3000 foot horizon. Below this horizon several modified structures of this set (locally called "cross-over" veins) are productive, important examples being the Bralorne 59, 73, 75 and 79 veins and, probably, the Pioneer 27 vein.

The tension or cross-over structures illustrated diagrammatically as the "C" set strike north-easterly with moderate northwesterly dips. Some of the "C" set cross-over structures are steeper-dipping and some flatter-dipping than the "B" or main vein structures.

The tension or cross-over structures make an average angle of 45 degrees to the "B" or main vein set of faults and these two sets show a great variety of form at their points of junction. In general the tension structures curve tangentially as they approach the fault structures. In detail a tension structure may curve and join the fault structures to form a clean-cut junction; elsewhere the tension structure may curve, approach close to and parallel the fault structure with stringer connections between the two, while elsewhere the tension structure, on approaching the fault structure, may lose its identity in an intersection area of irregular fractures. Commonly the tension

structures terminate where they join a set "B" fault structure but in rare cases they form intersecting relationships.

Tension structures may be as little as 80 to 100 feet apart (Bralorne 73 and 75 veins) but again may be widely separated. Their length is largely determined by the distance separating the pair of limiting vein-faults.

The origin of the tension structures appears to have been contemporaneous with the set "B" fault structures.

Miscellaneous Structures. The three set system of structures above described form the basic structural pattern of the Cadwallader Gold Belt. There are in addition to the above, less well defined structures which are of some economic significance. These include a set of flat-dipping thrust-faults (active during and after mineralization) and a set of probably post-ore strike and transverse faults.

The flat (25 to 45 degree) dipping thrust faults are reported in the Bralorne mine (Blackbird section) and are present in the Pioneer mine. In strike, they vary from roughly east-west in the upper levels to north-easterly trends in the lower levels. The dips are to the north and northwest. These structures are observed as flatter-dipping strike faults along the east-west vein faults in the upper levels, curving in strike and steepening on dip to become strike faults along the north-easterly tension structures in the lower levels. These flat fault structures are believed to have contributed much to the structural development ("strength") of the tension structures where, at lower levels,

their planes have coincided. One of the best exposed of several such structures is the "Q" vein-fault of the Pioneer mine. The net vertical component of movement along these flat faults, where measurable, is between five and twenty feet.

Other minor structures are strike and cross faults apparently post-ore in age and of small displacement. The strike faults are present on both the Bralorne and Pioneer properties. They are characterized by short overlaps and discontinuities of the vein matter.

The cross-faults are of small horizontal offset, rarely exceeding drift width; with movement right-handed and dip to west. Such cross-faults appear more generally distributed in the Bralorne mines than in the Pioneer mine. In the Pioneer mine they appear localized to the near-contact zone with incompetent rocks such as the sediments or serpentine. In the Bralorne mines they show some localization by, and conformity to, the north-south fault system.

ORE DEPOSITS

Vein Matter. The vein matter of the Cadwallader Gold Belt consists of milky white quartz, commonly ribboned and of several ages, with very minor amounts of erratically distributed ferruginous carbonates, scheelite, mariposite and locally (in late tension fractures cutting the Pioneer 27 vein), appreciable quantities of black tourmaline.

The sulphides, comprising from 2 to 3 percent of the vein-matter, consist of pyrite and arsenopyrite, generally distributed and the most plentiful sulphides; sphalerite, galena and tetrahedrite, generally distributed but in very small amounts, important however as "high-grade indicators"; pyrrhotite and chalcopyrite, erratically distributed as local pockets, occasionally associated, together or separately, with high gold values; stibnite and marcasite, erratically distributed in the Pioneer mine along or close to post-ore faults or fractures; telluride and gold, the former apparently very rare, the latter generally and sparsely distributed with, also, occasional erratically deposited "pockets" up to nine hundred pounds in weight composed of 45 percent gold.

There is no recognizable zoning of sulphides in the Cadwallader Gold Belt but certain unusual features of sulphide and gangue occurrence in various of the modified tension ("cross-over") structures are noteworthy. These are the unique occurrence of stibnite in the Bralorne 59 vein, the observed occurrence of tetrahedrite in only one of the Pioneer veins (the "27") and that only below 19 level, and the first appearance of tourmaline in the same tension structure and at about the same horizon. Also in the "27" vein (a probable tension structure modified by minor thrust faulting) there is a unique condition present on the 25 level, about 3200 feet below the present surface. Here the characteristic ribboning in the quartz is widely spaced and

locally between the slickensided ribbon planes there are lenses of drusy to coxcomb-structured quartz. Sulphides here consist of a coarsely crystalline coxcomb filling, or forming small sphalerite, pyrite (and gold) rosette-like clusters.

Deep development in the Pioneer mine has shown that biotization is important as a form of wallrock alteration in the greenstone section of this mine. The biotite is considered to be of hydro-thermal origin. It is reported to have also been present in the upper, now inaccessible levels, in the east or greenstone section of the Pioneer mine.

Wallrock alteration of carbonatization and biotization appears entirely post-quartz in age. Locally the hydro-thermal solutions causing the rock alteration followed fractures other than the quartz-filled structures, but in general these channels coincided.

Ore Shoots - General. Ore shoots in the Cadwallader Gold Belt may individually exceed 1500 feet in length. Commonly the ore shoots are more persistent vertically than they are horizontally. They usually have a steep rake determined, in part at least, upon one or more of the structural controls described below.

Ore shoots may contain their gold erratically distributed, a not uncommon habit in ore shoots near serpentine, or very uniformly distributed. In other instances the gold may be so distributed in an ore shoot as to increase gradually from all

Take Zone

boundaries to form a "high-grade" nucleus. Some of these nuclei are large and rich; one in the Pioneer Main vein being 245 feet in length, 3.5 feet in average width and averaging 5 ounces gold per ton.

It is noteworthy that practically all of the productive vein structures in the Cadwallader Gold Belt, that have been developed through a vertical range exceeding 1500 feet from surface, have encountered, commonly at some point between the 8 and 14 level elevations, a non-commercial, roughly horizontal horizon, below which ore of excellent grade was again developed. It is note-worthy also that it is only at or below this critical horizon, that the several increasingly important ore-production tension ("cross-over") structures appear.

Probable Structural Controls. The form and size of ore shoots in the Cadwallader Gold Belt are determined by either physical or assay limits. Physical boundaries to the ore, such as vein structure termination, are definite and obvious. Less definite and obvious are the controls that have determined the concentrations of precious metal deposited (assay limits) in certain select sections of a large structure.

The environmental factors considered to have exerted some control on the presence, size and form of the ore shoots are as follows:

(a) The serpentine contact. The control here appears to have been a "damming" and, locally where the contact is suitably inclined,

as is most commonly the case, also a "capping" influence exerted by the incompetent and impervious serpentine. Not only are ore shoots of substantial size found in this locale but it is also the favored environment for small "bonanza pockets" of almost massive gold.

(b) Contacts between rocks of different competency. The control operating here appears to have been an impeding influence exerted where the vein structure passes, with physical variations in its nature (changing width, dip, strike, splitting, etc.), from a competent to less competent rock, as from diorite to schistose greenstone or massive greenstone to fissile argillite respectively. The distinction between this case and the first is that in this case the vein structure (and sometimes the vein filling of quartz) persists, but values are limited to the more competent side of the contact.

(c) Branching and intersecting structures. Apparently exerting some control on the presence, size, attitude and form of some ore shoots are the intra-mineralization-aged faults of the north-south set, either where these occur singly, as in the Bralorne Empire section, or where they occur as upward converging groups as in the Bralorne Lorne-King section. In addition to these faults, the presence and traces formed by the junction of branching structures has, apparently, exerted some control.

The effects produced by these fault structures have been several. The north-south faults probably determined the areas of

more intensive quartz fracturing prior to the deposition of metallics, and their commonly gougy, impervious nature later provided "dams", "caps" and, under certain conditions (as in the King vein, "A" Block) complete roof-like "traps" for the later auriferous hydro-thermal solutions. The subsidiary branching structures appear to have operated as active tensional components to the east-west vein faults, commonly resulting in abnormal widening of the quartz with an increase in grade, in the junction areas.

In summary, the presence and habit of ore shoots in the Cadwallader Gold Belt appears to depend upon such physical features as the relative competency of the host rock (in turn dependent on several variable factors even where the rocks are of the same composition) and the relationship of the fractures to each other.

BRALORNE RESOURCES LIMITED

DEPTH ORE POTENTIAL

77 VEIN

BRALORNE MINE, B. C.

Excerpts from Report by

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Consultant

Vancouver, Canada

May 29, 1973

SUMMARY & RECOMMENDATIONS

The largest and richest orebody in the Bralorne-Pioneer district is the 77 Vein. This orebody has a developed vertical continuity of about 5000 feet and is still strong on the bottom level of the mine, 4577 Decline. Two drill hole intersections indicate the continuity of the vein at mineable widths to a depth of 150 feet below this level.

The grade of the bottom level is 1.12 oz. Au/ton across 6.8 feet for a length of at least 530 feet. The gross, in situ, value of this ore at $100/oz for gold is $112/ton.

Geologically it can be reasonably assumed that the 77 Orebody continues to a depth of at least 300 feet below the present bottom level; in which case a probable reserve tonnage of about 89,000 tons is available. The grade of at least the upper half of this block is probably that of the bottom level. The grade of the remainder may possibly be the same.

RECOMMENDATIONS:

It is recommended that the existence of the 77 Orebody highgrade depth continuity be confirmed by three drill holes and that the ore block be used as a basis of reserve to explore for larger tonnages of possibly lower grade ore in the upper levels.

It is mandatory that all exploration in this mine be under experienced geological control because all of the known orebodies are situated in particular geologically structurally controlled environments.

77 VEIN DEPTH CONTINUATION

The 77 Vein in the Bralorne Mine exhibits all of the features of ore control described previously in this report. The 77 ore shoot on the vein is the largest known gold orebody in the entire Bralorne-Pioneer district by a very wide margin. It has been mined over a continuous vertical interval of nearly 5000 feet with horizontal lengths ranging from 500 to 1500 feet.

The location of the oreshoot on the vein is governed solely by structure in that it is richest and widest where the vein is steepest and also where the vein approaches the southwest contact of the main soda granite intrusive body. The vein strikes eastward from where it develops as a weak fracture zone near the Serpentine Fault side of the Cadwallader Fault Lense, but is deflected sharply southeastward at the soda granite with some narrow ore sections locally continuing along or into the body of the soda granite. For some 500 - 700 feet west of the soda granite contact the 77 Vein is consistently wider than elsewhere and is gold-bearing.

GRADE:

The grade of the 77 Vein orebody has varied with depth but generally is divided into two rich sections, one above the other, with the lean section coming between the 3600 and 4100 levels.

In Figure 1 of this report the relatively low grades on the 3900 and 4100 levels are shown. The higher grades above and below these levels can be verified from the plans at the mine. The grade of the 77 orebody at the bottom level, (4500), is 1.12 oz Au/t. across 6.8 feet for a length of 530 feet, a considerable improvement over the grade on the mined grade on the 3900 level, (850 ft. above), of 0.32 oz Au/t. across 6.9 feet for 500 feet.

Also shown on Figure 1 is the change in strike and width of the vein as the soda granite is approached, and also the "tailing out" of the vein structure westward from the soda granite.

DEPTH CONTINUITY OF 77 OREBODY

The geological conditions that have pertained downward through the Bralorne mine from the 15 Level for the 77 Vein remain the same at the 45 Level. The soda granite-greenstone contact plunges at the same angle and the relative rock competencies are essentially the same as in the upper levels. The vein widths and form are unchanged. Therefore, there is no obvious structural reason to expect an abrupt bottoming to the 77 Orebody just below the 4500 Level.

Some features existing on the 77 Vein below the 4300 Level actually suggest a possible improvement in the ore potential with increased depth.

1/ Below the 4300 Level the dip of the vein steepens and the grade increases correspondingly.

2/ Below the 4577 Decline level two holes drilled from the 4300 Level have intersected true widths of 6.2 and 7 feet, which, in this mine, have indicated ore material. Although the grades of these intersections are low, (0.11 and 0.12 oz Au/t. respectively), it should be appreciated that the grades of core intersections of ore throughout the mine have been historically lower on an average than the mined out grade. For example: hole 165 intersected 0.20 oz Au/t. across 7.2 feet at the 4577 Decline where it averaged on extraction about 0.83 oz/6.5 ft. This tendency for erratic grade returns from diamond drilling is also illustrated in the four holes drilled from the 4100 Level.

The drill results do indicate that the vein continues at least 150 feet below the bottom level at a true width of 6-7 feet and carries gold to that depth.

POSSIBLE 77 ORE BELOW THE 4577 DECLINE:

The grade of the bottom decline level on the 77 Orebody, still open at both ends, is:

1.12 oz Au/ton across 6.8 feet for 530 feet.

At a gold price of $100/oz. this ore will have a gross (in situ) value of $112 per ton. If it is assumed that the ore probably continues 150 feet down to hole 164 and then possibly down a further 150 feet there is a total tonnage of probable-possible ore of:

89,000 tons

It is appreciated that the vein could continue to depth but the gold in it may cease to be present, but by the same token the extension downward of a mere 300 feet for an orebody that has a vertical extent of nearly 5000 feet is a geologically modest projection.

Additional confirmation of the existence of the ore below the 4577 Decline may be obtained by further diamond drilling, but it must be emphasized that more credence be placed on the width and character of the quartz vein intersections than on grades. Also, although somewhat unconventional, serious consideration should be given for such drilling to be done directly down the vein. This type of exploration has been done before in precious metal vein deposits and produces results comparable to a small raise. It is used strictly for internal geological information but it can be far more productive and less costly than drilling a fan of holes from a crosscut.

CONCLUSIONS:

After consideration of all of the available geological evidence the writer concludes that the likelihood of the occurrence of a block of ore below the 4500 Level on the 77 Vein is practically a certainty.

The tonnage of the block has a reasonable likelihood of being approximately 89,000 tons and can be supplemented by some tonnage of lower grade ore left behind on the levels above on the same orebody.

The grade of the ore block could be as high as 1.12 oz Au/ton across 6-7 feet, probably the upper half of the suggested tonnage is at least close to that grade.

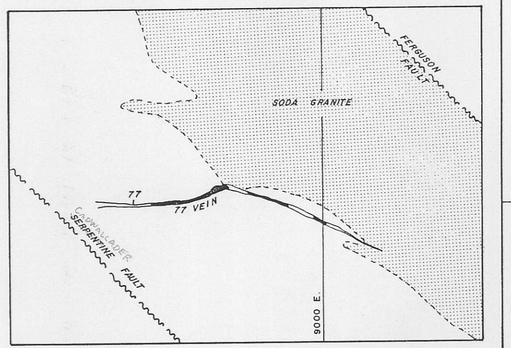
RECOMMENDATIONS:

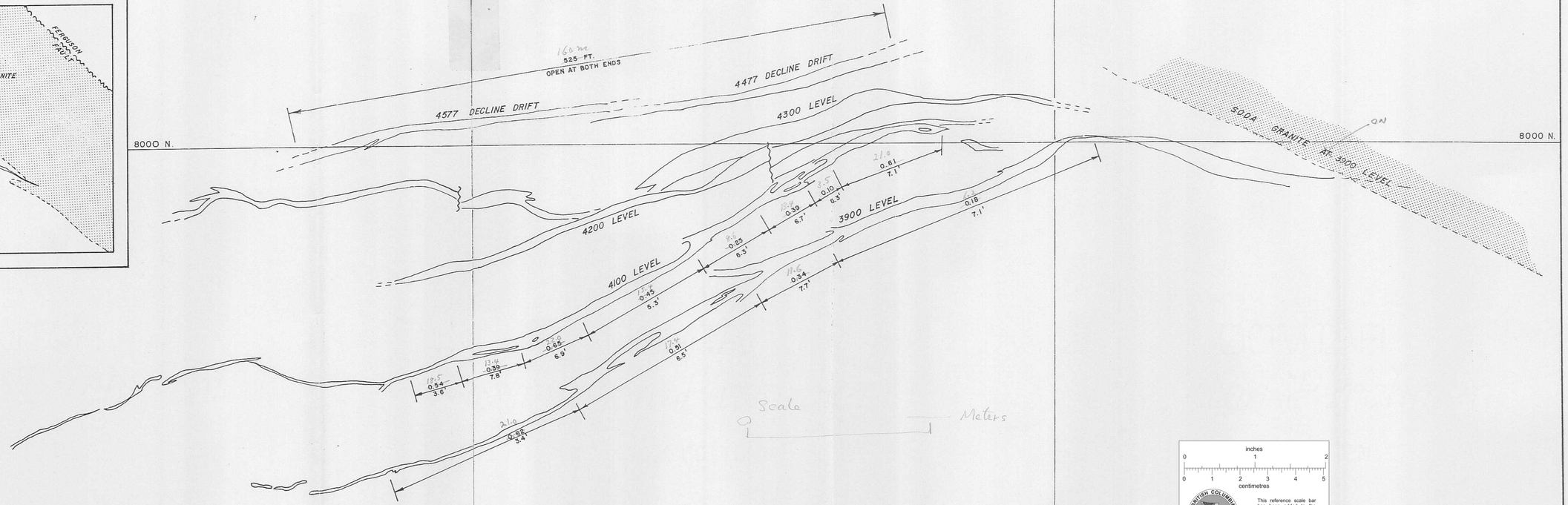
The writer recommends that the depth continuity of the 77 Vein be confirmed by at least 3 holes intersecting between 150 and 300 feet below the 4500 Decline, or preferably by 3 holes collared in the vein and drilled directly down and in it for 300 feet.

If the 77 ore is reasonably confirmed it should be kept as a high grade reserve pending exploration and development of additional lower grade ore in the upper levels in order to renew production at a relatively high mill rate in order to realize a higher profit from this deep level, high cost ore.

It is strongly recommended that in all exploration for new ore and for continuation of known ore in the Bralorne-Pioneer mines the direction of the exploration and interpretation of the results be entirely by a senior geological engineer experienced in precious metal vein deposits. All of the Bralorne-Pioneer orebodies are geologically structurally controlled and the controls are sometimes subtle and intricate; therefore, this is not the environment for capricious exploration.

— PLAN OF 300 LEVEL (77 vein)





7000 E.

7500 E.

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— BRALORNE RESOURCES LIMITED —

77 VEIN
COMPOSITE PLAN OF LOWER LEVELS ORE SHOOT

DATE : DECEMBER, 1973 — DRAWN : LEONG