ZEBALLOS ORES

Zeballos River Area.

Vancouver Island

by

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Geology 9. February 1939.

INDEX

ZEBALLOS ORE.

INTRODUCTION:

The following is a report based on publications on the area since 1930 by the following:-

(1) Stevenson J.S. : Annual Report of the British Columbia Minister of Mines, 1935, pages F 38 to F 40. inclusive.

(2) Stevenson J.S. : Lode Gold Deposits of the Zeballos Area, 1937, made for the B.C. Department of Mines.

(3) Gunning H.C. : Geological Survey of Canada, Summary Report, 1932, Part A-2, pages 29 to 50, Zeballos River Area, Vancouver Island, B.C.

(4) Bancroft M.F. : Geological Survey of Canada, Memoir 204, 1937, Gold-bearing Deposits ofthe West Coast of Vancouver Island between Esperanza Inlet and Alberni Canal.

(5) Clothier G.A. : Annual Report of the British Columbia Minister of Mines, 1929, page 376: 1930 page 441: 1932, page 205: 1933, page 252 to 254.

(6) Recent newspaper comments On the area with regard to mining and milling activities and gold output of some of the mines as told in "The Vancouver Province " and "The News Herald".

I should like to thank Dr. Warren of the Geological

Department of the University of British Columbia for his generous advice and assistance in obtaining the samples and helping me to co-relate the minerals examined in sections made from the group of properties studied.

LOCATION:

The Zeballos area is located on the Zeballos river which drains into Esperanza inlet on the west coast of Vancouver Island about 180 miles north of Victoria. The latitude is 50° north and longitude 126° 50' west. It includes the valley of the river and its watershed including Van Isle, Spud, Goldvalley, Bibb, Granite and Lime creeks with the two main tributaries Nomash creek and the drainage from Zeballos lake. The main development so far is on the watershed within five miles of the town of Zeballos situated at tide water on Esperanza inlet at the river mouth. The population is at present over one thousand persons; the town containing a post-office, deputy mining recorder's office, general store, and etc.

ACCESSABILITY:

Due to the coastal location, cheap transportation and communication is availabe through Canadian Pacific Steamships which maintain a trimonthly service, leaving Victoria on the first, eleventh, and twenty first of each month and arriving at Zeballos at noon of the third day. This along with Frank Waterhouse Steamers will be a useful outlet in the event that large quantities of concentrates for smelters need to be shipped out. The area is only two hours by plane from Vancouver by either Canadian Airways Limited or Ginger Coote Airways. Good unloading facilities are provided at the beach by a government dock for steamers and a floating dock for aeroplanes. In the immediate vicinity is a truck road, usable in practically all weather, up the main valley to Spud creek and up this creek to the Goldfields property, and by trail up the main valley as far as the North Star property.

TOPOGRAPHY:

Zeballos is very rugged, being a part of the west side of the Vancouver Island ~~small~~ range of the Insular Mountain system, and having a very irregular fjorded coast line trending N55° West. Just south of here, behind Nootka Sound, are the highest mountains on the Island, grading to those with less altitude in the north and south from a maximum of 7000 feet. Esperanza Inlet is no doubt, an old drowned river valley where the alpine glaciers moved out towards the Pacific. In the main Zeballos River valley there is a canyon half a mile long, two-thirds of a mile up from tidewater. Above this the river flows on a gravel bottom 2 to 400 feet wide and further upstream it often disappears underground in channels in limestone. The tributary creeks flow in narrow valleys and come into the main valley on steep gradients of 600 to 800 feet per mile. These might be used successfully to generate electric power. Mountains on either side rise to a hight of 4000 feet. These erosion mountains show geologically advanced youth as shown by their knifelike edges and deep "V" valleys cut by glacial drainage, and isolated ice, and clustered mountain peaks. The slopes of these are heavily wooded by a stand of good timber with no excessive undergrowth. The timber includes hemlock, cedar, fir and balsam. One of the best remaining stands of Douglas fir on the Island is in the upper Nimpkish valley. The worst underbrush is 1 to 2 miles from salt water. The trees serve as building for mills and houses, fuel, and for mine timbers. Zeballos Lake at an elevation of 1046 feet is half a mile above the fork of the river, slightly over 7 miles from the townsite. The woods, and a fairly heavy overburden make prospecting and overland travel difficult to impossible on the slopes, and as a result practically all vein discoveries have been made in creek beds.

CLIMATE:

Zeballos has one of the heaviest rainfalls on the west coast, and although no accurate records have been kept, it is estimated an average of 100 inches per annum falls. The major part of this falls between September and May, and two to three inches of snow near sea level are considered excessive, whereas, snow higher up is tremendous as it remains in quantity till on into June and July. Winter however is generally short and no extremely cold weather is experienced.

HISTORY:

1899 -- William J. Sutton and Carmichael, found quartz veins near the Albernie Canal with values of gold and silver and advised prospecting.

1902 -- Haycock and Webster worked along the west coast, being interested mainly in copper, gold and magnetite ores.

1920 -- V. Dolmage, did shoreline mapping and geology including Zeballos.

1932 -- H. C. Gunning reported on the Zeballos area off Esperanza Inlet.

1933 -- Gold was found in the grano-diorite which up to this time was believed unproductive and avoided. Here gold was found in float in the bed of Spud Creek.

At present 25 companies hold 258 claims and 8 fractions (Oct. 24/38.) most of them having been staked since 1932. Three mills, Privateer, Ray Oro and Spud Valley Ore are in operation at present, the first gold from these being shipped out in October 1938 when Ray Oro sent a brick of 260 ounces of gold to Vancouver. The first Privateer brick was sent out in mid-October valued at $49,000. In November the production increased to $117,911 from 2,288 tons of ore giving 3,332.86 ounces of gold and 1,111.89 ounces of silver.

GENERAL GEOLOGY:

The general trend of the outcropping formations is parallel to the mountain system, north-westerly, south-easterly.

The main belt is the Zeballos batholith which crosses the river about four miles from the mouth and is three quarters of a mile wide, diverging to more than twice this width on both sides of the river. Within the area it is composed mainly of granodiorite though varying in other localities from gabbro to quartz monzonite. This batholith has intruded the upper Triassic sedements or Vancouver group, and is assumed to be of Jurassic age. Northwest of this band, averaging about a mile wide is the Quatsino formation. It consists of several hundred feet of pure dark grey to white crystalline limestone with minor intercolations of green flows and fine grained grey-green or brown tuffs. This is the middle series of these upper Triassic beds and dips mainly towards the batholith at about 25° to 45° being folded and faulted on the Zeballos River a mile above the junction with Nomash Creek. Northeast of this and lying conformably beneath with a sharp contact is an older, wide, extensive band of Karmutsen volcanics comprising andesite to basalt with some tuff, and lenticular beds of limestone. The volcanic rocks are dark green to black, with breccia, amygdaloidal, and pillow lava structures. Southwest of the granite is the uppermost series, the Bonanza group definately upper Triassic, of andesite, dacite, rhyolite, some basalt, breccia, tuff, argellite and limestone. The volcanic flows and interbedded sediments rest conformably on the Quatsino limestone and contain many amygdaloid and pillow structures and containing mainly a more acidic, green and grey andesite. The Recent alluvium and glacial drift is found in the river bottom up to one half mile in width, and is quite continuous from Nomash Creek junction downstream.

The structures of the Vancouver group are mainly monoclinal folds, but the formations are badly broken up with folds overturned both west and east. This folding has been accompanied or followed by faulting. The most important fault trents slightly west of north along the north fork of the Zeballos River and dips steeply east where absorved. The east side is believed to have moved down and west in relation to the west side. The pre-mineral faults and fracturing cut the folded rocks and their included batholiths in such a way as to develop major shears along northwest-southeast lines and minor shears counter to the regional trend. The majority of known gold-bearing veins on Vancouver Island strike northeast and southwest, and such veins are particularly well defined in the granodiorite of the Zeballos mineral area. The veins show pronounced ribbon structure, due to fracture planes. The accompanying geological map indicates the geological contacts, faults and some topographical features. This map was adopted from the geological survey of Canada; Woss Lake, West Half.

ECONOMIC GEOLOGY:

In the Zeballos area the ore is mined mainly for the gold and silver values, though considerable zinc, copper and lead occur in some of the veins in association with the precious metals. Silver on the west coast is usually present in tetrahredrite but none was found in any of the ores examined. Gold deposits of the region are of different types, from high temperature, deep-seated deposits to low temperature deposits some distance removed from igneous contacts. In Zeballos there are various types represented in the Vancouver volcanics and the Zeballos granodiorite, the gold ores ranging from extremely complex ones to simple quartz veins carrying native gold and auriferous pyrite. In the main the veins occupy fractures and fracture zones, striking north 73° to north 30° east. It is apparent that these are almost at right angles to the general trend of the formations. There are four types of fractures containing gold deposits as laid down by J. S. Stevenson;

(1) Clean-cut, single fissures in the grandodiorite which are completely filled with quartz-sulphide veins; such veins may range from 1/4 to 6 inches in width.

(2) Clean-cut fissues in either greenstone or granodiorite, completely filled by quartz and abundant sulphides, but which tend to weave slightly and to have branch quartz-sulphidte stringers coming in from a side.

(3) Composite fracture-zones, in either greenstone ore granodiorite, that range from 4 inches to 4 feet in width; these consist mostly of crushed, leached rock, talcose gouge, and varying amounts of quartz-sulphide vein-matter. The vein-matter usually occurs as a single band that ranges from lenses

3 feet thick to bands of more constant widths, from 6 inches to a mere stringer; the vein material may even die out completely, but it may occur farther along in the same shear.

(4) Sheeted zones, up to 4 feet in width, that consist of joints spaced 2 to 8 inches apart and which contain either gouge-seams or 1/8 to 1/2 inch quartz-sulphide stringers.

There are, according to H. C. Gunning, four types of mineral deposits all of which are believed to be related to the coast range intrusive.

(1) Pyrometasomatic or contact metamorphic replacement in limestone and calcareous sediments and less commonly in flows and fragmental volcanics. Thes contain chalcopyrite sphalerite and some magnetite but not much gold.

(2) Replacements in volcanics or calcareous sediments but of a lower temperature.

(3) Veins of quartz , and quartz and calcite contain gold plus chalcopyrite, pyrite, pyrrhotite, galena, sphalerite and arsenopyrite found in flows and tuffaceous sediments, are a later low temperature phase.

(4) Some gravels of Zeballos contain gold, and five or six ounces were recovered in 1932.

The main number of properties, so far lie either in the granodiorite or the Bonanza volcanics near the southwesterly contact. At the Privateer mine the veins run in the sediments normal to the sediment-granodiorite contact. Underground the veins have pushed through a number of granodiorite tongues with no apparent change in value in the veins, however the pre-mineral faulting which caused the sheer zone has affected deposition since the veins finger out into the sheering.

MINERALOGY:

The various megoscopic and microscopic observations of each ore studied will be given and an attempt made to give a paragenesis of the mineral occurences of each deposit. For this determination the ideas of Bastin were used as laid down in Economic Geology, volume #26, september 1931, page 561. Lindgren does not put much faith in the microscopic mehtods used for determining ore relations an d explains several pseudo-eutectic types in Economic Geology, Vol #25, page 1 and page 658 to substantiate his beliefs; however there is no doubt that certain age relations may be postulated with a considerable degree of certainty from a microscopic study of polished sections.

The Minerals;

Gold: The most important of the economic minerals now mined in Zeballos, from which age relations could be detirmined, was found to occur only in the samples of the Trites ore. Here it is quite course and as a late mineral associated closely in contact with galena, though not included in it; secondly in fractures in pyrite and thirdly occuring with sphalerite, galena and sometimes quartz with mutual boundaries. The gold apparently shows a preference to replacing pyrite rather than quartz as it is never found unless it is in contact with sulphides, and seldomn without galena or sphalerite being in close viscinity. No source of the high silver production of Zeballos was found though tetrahedrite is said to be the source mineral .

<u>Pyrite:</u> This is the most abundent mineral in most sections constituting about 50% of sulphides observed. It is distinctly the earliest sulphide, filling the primary fissures and being later fractured permitting the later incoming of the quartz and sulphides at a possible lower temperature. For the pyrite it was decidedly difficult to obtain a good polish due to fractures and hard resistant properties of the mineral.

<u>Galena;</u> It is determined by its triangular pits showing the cubic cleavage. It is later than the pyrite and deformed only slitly as in the Trites sections. It occurs exclusively replacing pyrite in the fractures and along margins of grains.

<u>Sphalerite;</u> This in all cases contains small to large amounts of exsolved chalcopyrite which crystallised out along crystal boundaries when the solutions cooled, due to a reduced power of solubility of sphalerite at lower temperature as explained by Newhouse in Economic Geology 1930. The sphalerite is contemporaneous in most cases with the galena and seperate chalcopyrite occurences.

<u>Chalcopyrite;</u> This occurs as regular blebs or stringers in the sphalerate as explained, and also as a

distinctly seperate mineral approximately the same age as the sphalerite and galena. This appears to be the chalcopyrite which the sphalerite was unable to take into solution even at a high temperature, as it appears that the section with free chalcopyrite have the greater amount of chalcopyrite in the sphalerite.

Pyrrhotite; This mineral occurs in most of the ores and is thought to b e later than the pyrite, since in no cases is it fractured and skeleton structures indicate that the pyrite has been replaced by it. Though many writers believe pyrrhotite to be a high temperature mineral , it appears here to be distinctly mesothermal having mutual boundaries with sphalerite and with the chalcopyrite as seen in the Peerless section. (plate #4) In this latter section it is highly twinned and is very difficult to tell from cubanite as no microchemical tests could be made without including some chalcopyrite to give a positive copper test. All occurences appear to be well twinned and very highly anisotropic, the colors comparing with those of pyrrhotite in other sections. No gold is found in contact with it however, so its presence does not seem important here,

Quartz; This is in most cases later than the pyrite though it too is fractured in the Gold Peak ore, (plate #3) and was younger in some Privateer sections of Mr. Lanb, that were examined. There has evidently been a continual influx of quartz throughtout the formation of the mineral deposits since it appears to have mutual boundaries with all minerals in some section or other, unless it be the Pyrite in Gold Peak which still might have pushed the quartz aside to form crystals due to pyrite's strong crystallizing powers. It is found to be later than the gold in Trites #2.

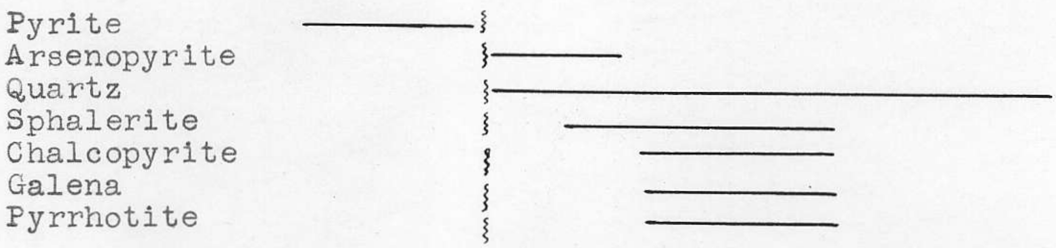
Arsenopyrite: This occurs quite frequently replacing pyrrhotite along the boundaries (plate #4) and also replacing pyrite and quartz. The mineral shows a tendency preferential replacement of quartz and is typically found as galena-white diamond shaped crystals in it. No large crystal occurences were found and its total percentage volume of the ore is very small.

ORES

PEERLESS:

Only one section of Peerless was made as this appeared to have all of the associations of the major part of the minerals gold being difficult to find in any section and depending considerably on luck, though through persistance, and an ample supply of ore in which it was certain gold existed study would no doubt reveal its association. It is however believed in this district that the gold has mainly the same type of occurence throughout and can thus be correlated from that of one property to another. Megoscopically the ore is in bands and shows a sucession of deposition as pyrite, then quartz and later sphalerite and quartz.

Parogenesis

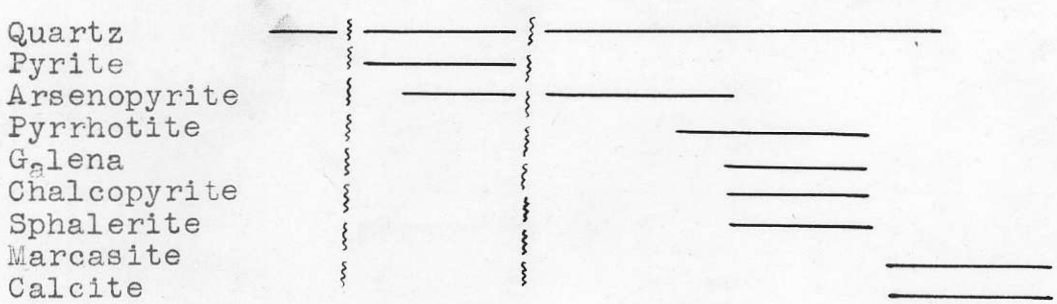


Pyrite was the first mineral deposited, possibly in a fracture zone as a fissure deposit. This was highly fractured and partly carried away, replaced and dissolved by later hydrothermal solutions. The fracturing was followed by incoming quartz which was later replaced by sphalerite with a small amount of exsolved chalcopyrite. The chalcopyrite disceminated in the sphalerite is extremely fine grained. Following these minerals was an influx of contemporaneous galena and chalcopyrite. In all cases a highly twinned pyrrhotite appears to be closely associated with this later galena and chalcopyrite, especially along the borders of the latter with streight line contacts. A small amount of arsenopyrite occurs that distinctly older than the galena, chalcopyrite and sphalerite since it has been replaced by them, but none was found in contact with the pyrite. It is however believed to be later than the pyrite as it is unfractured. Much of the quartz shows an indented sucession of convex curved surfaces to galena and shpalerite showing the method of replacement by the sulphides. Many euhedral crystals of quartz also stand out in chalcopyrite, galena and sphalerite indicating a loose crystalline structue permitting the influx of the sulphides; but these crystal faces show only slight replacement and miner cavities within, indicating how crystals are more resistant than noncrystalline or broken up minerals to replacement by solutions.

PRIVATEER:

Eight sections were studied including six belonging to Mr. J. Lamb, which he so kindly permitted me to examine. In the hand specimens the ore is a typical coarse banded vein type with a band of quartz then a band ½ inch wide of sphalerite, galena and quartz, then a ½ to 1 inch band of pyrite with some chalcopyrite in quartz, followed by very coarse transluscent quartz crystals 2 inches long. All minerals have comparatively coarse crystals, and the gold is also said to be mainly quite coarse. The ore veins vary in width from 4 inches to 24 inches but usually average about 10 to 11 inches.

Paragenesis;



Pyrite and arsenopyrite are contemporaneous and have both been slightly fractured. Next was a generation of quartz and then more arsenopyrite and later galena, chalcopyrite and sphalerite. These were slightly fractured and quartz has come in along the fractures. No gold was visible except in ore section made by Mr. Lamb, where the age of the mineral could not be determined, (plate #2a). Some very small occurences of marcasite are found filling the late fractures.

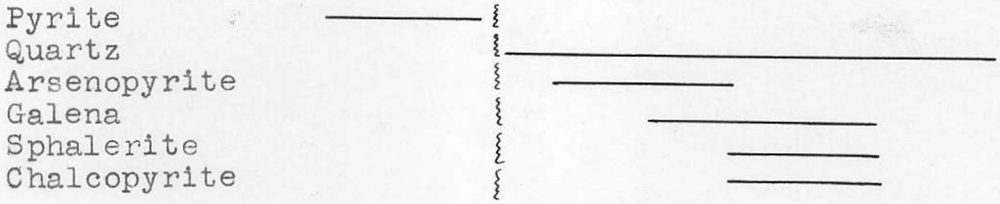
Some pieces of pyrite have been dissolved and carried away leaving only a rim of the former crystal. Some of these vacancies have been partly filled by pyrrhotite but the large number in the bakalite sections remain un-occupied except for possibly a slight covering of cacite, since the cavaties efforvesced vigorously on the application of 1:1 HNO_3. These outer rims are almost always in contact with quartz. One section made by Mr. Lamb is almost complet-ly pyrrhotite in quartz with a rim of pyrite around the pyrr-hotite in all cases. It appears that hydrothermal solutions have altered the pyrite to pyrrhotite except that small fring-es in contact with the quartz. Further study might reveal a reasom for this phenomena.

GOLD PEAK:

The ore is very friable and as a result sections were made by crushing the ore and mixing it with a percent-age of bakelite. Five sections were made in an attempt to find the association o f the gold but none was found.

Here the association is similar to the Privateer only no pyrrhotite was found

Paragenesis:

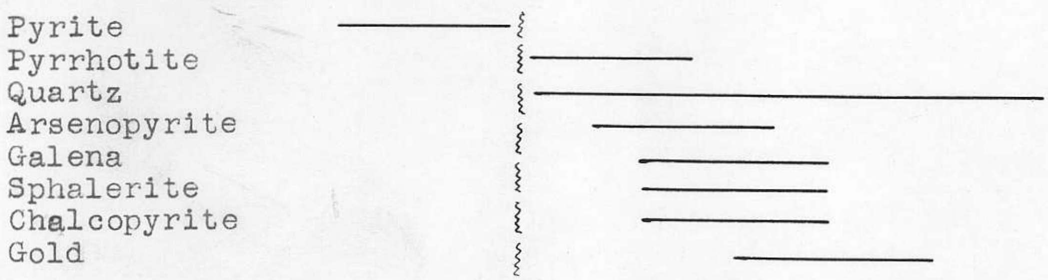


Pyrite is earliest as galena is found around it. Chalcopyrite and sphalerite are later than some of the galena because they have entered into fractures along shattered crystals of galena. Numerous arsenopyrite diamond shaped cryastals are found in the quartz replacing it. Quartz has come in after the pyrite but has been fractured and replaced by later sulphides. The blebs of chalcopyrite along the crystal boundaries in sphalerite are quite large and chalcopyrite is comparatively abundent.

<u>TRITES:</u>

Four sections were made from samples taken from various parts of the mine but all have about the same mineral content of pyrite, arsenopyrite, galena, chalcopyrite, sphalerite and gold.

<u>Paragenesis:</u>



First there was fissuring into which pyrite came, was refractured and recieved an influx of quartz which continued to come in later. The early quartz was fractured and followed by a small amount of pyrrhotite and then arsenopyrite. This latter mineral shows a preferential replacement of quartz and is most commonly found as diamond shaped crystals, the sulphides of lead, copper and zinc are found mostly replacing pyrite and are scarcely ever found isolated in quartz. Plate #4 is unusual in that it shows arsenopyrite replacing pyrrhotite. Along with later quartz comes sphalerite with exsolved chalcopyrite in a semblence of a pattern; galena and chalcopyrite are contemporaneous with this sphalerite. Gold is found in quite course crystals in these sections mainly associated with galena. It is however found in fractures in pyrite and also associated with sphalerite and chalcopyrite on the edges of these minerals, but never contained in them. Quartz has come in after the last deposition of gold since it is found seperating two pieces that were formerly together. In this section the coarse crystallisation of numerous hexagonal quartz crystals are visible showing the large interstices left for the later are bearing solutions. These crystal faces are only slightly relplaced by these later solutions showing them to be of only moderate temperature. From microscopic examinations it is evident that the gold increases with the increase of metallic sulphides of lead, zinc and copper.

CONCLUSIONS:

The Zeballos ore is apparently of hydrothermal, moderate temperature origin and should thus continue in depth. The gold is associated with the sulphides, mainly with those of lead and zinc and increases proportionally with them. It is comparatively coarse and should be mainly recoverable by a combination of cyanidation and amalalgamation with moderately fine grinding. The small percentage of very fine gold in the pyrite will require further treatment to be recovered. The sucession of deposition is in general pyrite and arsenopyrite; fracturing; arsenopyrite, pyrrhotite; sphalerite, chalcopyrite, galena; gold; marcasite and calcite. Quartz was first to deposit in the fractures caused by the batholithic intrusion and has continued throughout and after deposition of the main sulphides. This quartz is of the white transluscent variety with a closely filled comb texture of parallel prismatic crystals, normal to the vein walls. When the ore is broken the break comes between these crystals not across them indicating the open spaces which were filled by a loose aggregate of sulphides which makes for better gold deposition than replacement of gouge or wall rock. The area as a whole appears to have a bright future.

ADDENDA:

Two other sweets studied were the Engineer (one section) and the Delphine (three sections).

Engineer: This section also contains allamantite as does the Delphine, but two large circular spots appear on the polished surface. No difference in reaction of etch reagents could be determined but in reflected light the spots appeared blue and the main mass a silver-black. This may possibly be due to a variation in crystal orientation or a difference in age.

The allamantite is apparently contemporaneous with the only other mineral in the section, calcite, since the two show mutual boundaries. It was also noted that patches and bands of the mineral do not tarnish possibly due to a more compact crystal structure in these places.

Delphine; The ore was a sample of botryloidal brittle allamantite, an arsenic, antimony compound, which appears very much like native arsenic. The ore suppoedly contains high values in gold and silver; though no fire assey was run, no micrchemical test for gold and silver could be obtained. The specimens polished up beautifully and only showed there shelled or ringed deposition on being allowed to stand for several weeks, when the tarnish outlines the structure, No variation in composition could be determined throughout the sections. The gangue mineral is calcite, later or contemporaneous with allamantite, since it does not appear replaced by it and cannot replace this mineral (a metallic looking alloy). (See plate #6.)

Plate #1.

PEERLESS.

X 43.2 diam.

Legend:

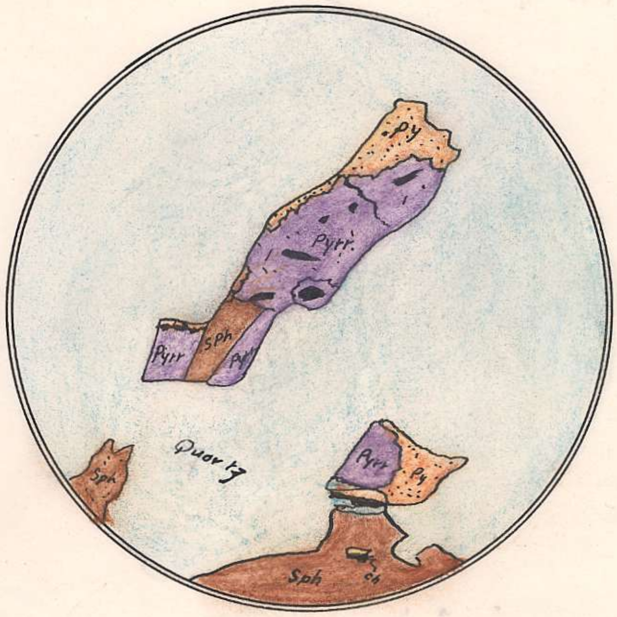
Galena:- Gal   Chalcopyrite:- ch   Pyrite:- Py

Remarks:

This portion of the polished section indicates the association of the fractured pyrite to the contemporaneous galena and chalcopyrite, which came in late and flowed around the pyrite grains. The surface of the pyrite was difficult to polish and the numerous holes in the section are due to this and the extreme fracturing of the early sulphide.

Plate #2.

PRIVATEER #1.



X 43.2 diam.

Legend:

Pyrrhotite:- Sphalerite:- Pyrite:-

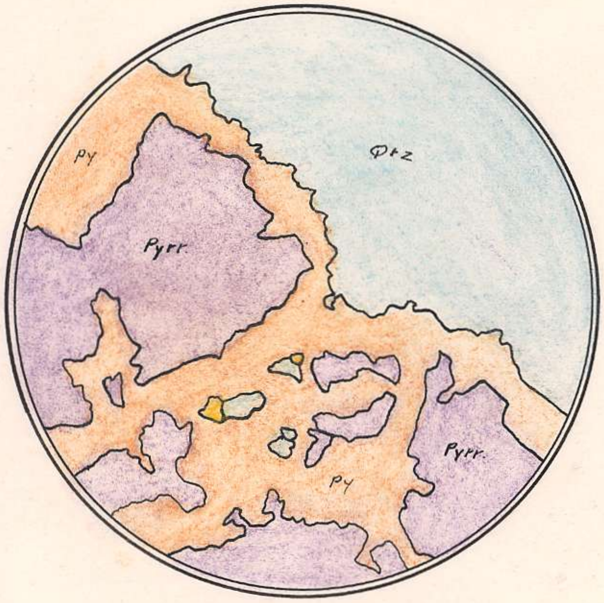
Quartz:- Chalcopyrite:-

Remarks:

The plate indicates that pyrite came in first and was replaced by pyrrhotite. The sphalerite here appears to be contemporaneous with the pyrrhotite as the boundaries are very straight at the contact with no spacing between the mineral grains. The sphalerite is of the general type with a slight amount of exsolved chalcopyrite. The age of the quartz here appears to be later than the sulphides as it surrounds them and there is no fractures leading to the quartz through which they might have reached their position.

Plate #2a.

PRIVATEER #2.



X 204. Diameters

Legend:

Pyrrhotite:- Quartz:- Gold;*

Pyrite:-

Remarks:

The section shows the association of gold in association with quartz. This quartz apparently came in quite early; was replaced by pyrite which in turn was replaced by pyrrhotite except for remnants along the borders of the former boundary. The gold is in the [redacted]pyrite with small spots of quartz but the age relations cannot be detirmined from this occurence.

Plate #3.

GOLD PEAK.

X 43.2 diam.

Legend:

Sphalerite:- Chalcopyrite:- Pyrite:-

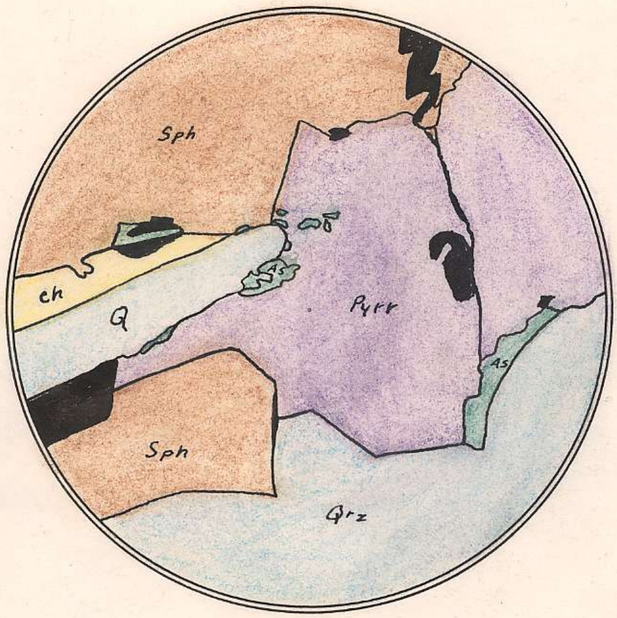
Quartz:- Bakelite:-

Remarks:

Quartz here is shown to be fractured severly. It is younger than the pyrite which it formerly enclosed. The late breakage cracks have been diverted around the more resistant pyrite and caused the quartz to break away from it rather than the fracture going through the pyrite. The sphalerite, containing some exsolved chalcopyrite, is late, probably replacing a former crystal of quartz.

Plate #4.

TRITES #1.



X 185 Diameters.

Legend:

Sphalerite:- Chalcopyrite:- Arsenopyrite:-

Pyrrhotite:- Quartz:-

Remarks:

The section shows the relation of the pyrrhotite to the other minerals. This patch and one which appears in the pyrite about 1/8 of an inch away were the only occurences found in this ore. Here the pyrrhotite is believed to be the earliest followed by quartz and then arsenopyrite replacing the pyrrhotite along the borders. Then followed the sphalerite with a small amount of exsolved chalcopyrite and chalcopyrite of about the same age as the sphalerite.

Plate #5.

PRITES #2A.

X 43.2 Diameters

Legend:

Gold:- Galena:- Sphalerite:-

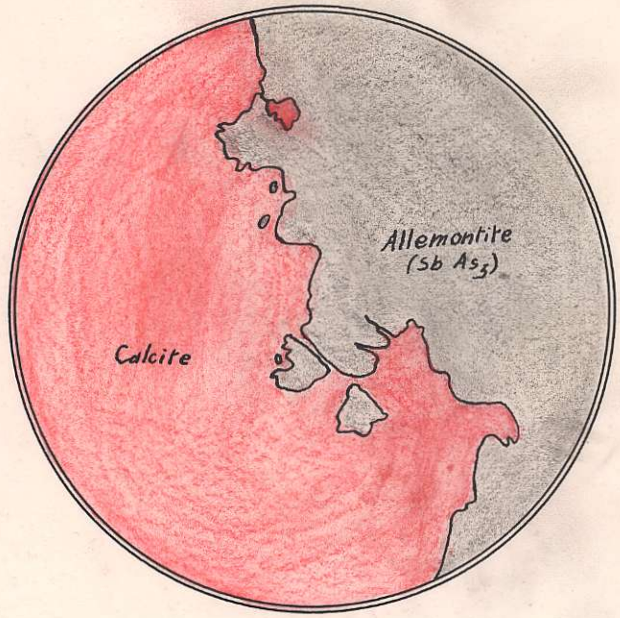
Pyrite:- Quartz:-

Remarks:

This section indicates the high degree of fracturing of the pyrite and the influx of quartz into the larger fractures. Here the quartz has been later replaced by the later galena and sphalerite along the borders in contact with the pyrite. The close association of the gold and galena is demonstrated, and even in the lower small bleb of gold there is some galena found in contact with it on examining the section under a higher magnification.

Plate #6.

DELPHINE #2.



X 185 Diameters.

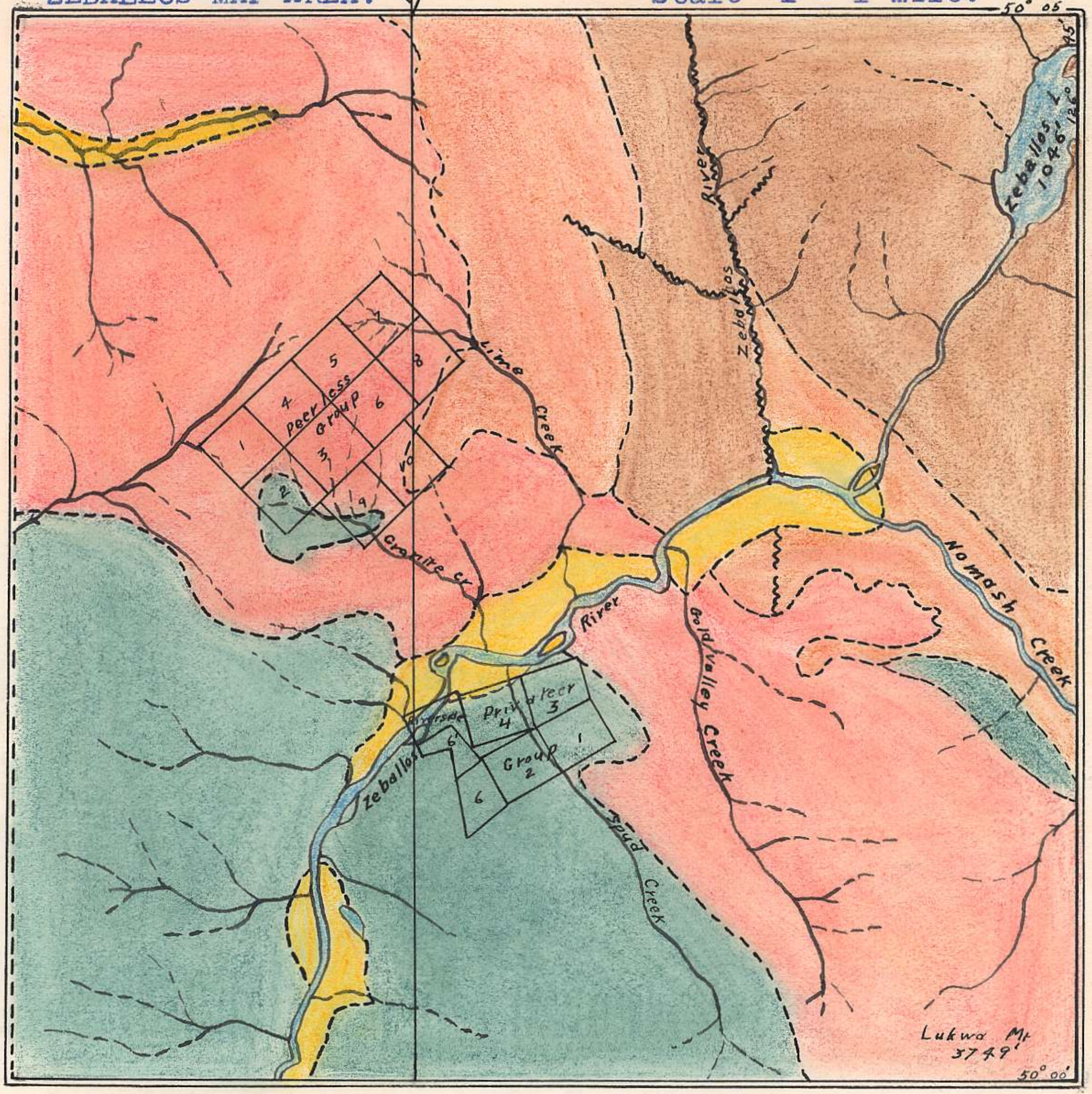
Legend:

Allemontite (Sb As_3) :- Calcite:-

Remarks:

It is exceedingly difficult to tell the age relations between the allamontite and the calcite in the samples studied. Both are late, low temperature minerals but since no calcite is found within the allamontite and crystals or blebs of allamontite are found surrounded by calcite, it is believed that the calcite is the later of the two minerals.

ZEBALLOS MAP AREA. Scale 1" = 1 mile.



Geological Time Table.

Recent, alluvium and glacial drift.

MESOZOIC:

Coast Range Intrusives: quartz monzonite, granodiorite, quartz diorite, gabbro.

Bonanza Group: Andesite, dacite, rhyolite; some basalt; breccia, tuff; argillite, limestone.

Quatsino Formation; Crystalline limestone; minor amounts of volcanic rocks.

Karmutsen Volcanics: Andesite, basalt; breccia, some tuff; minor beds of limestone.