A MINERALOGRAPHIC STUDY OF THE DOLLY VARDEN SILVER MINE

A mineralographic report submitted during the
Fourth Year of Arts at the
University of British Columbia

LEIF OLIVER OSTENSOE

April 26, 1956.

Very poorly presented. Fail

Fort Camp,
University of British Columbia,
Vancouver 8, B.C.
April 26, 1956.

Dr. R.M.Thompson,
Associate Professor of Geology,
University of British Columbia,
Vancouver 8, B.C.

Dear Sir:

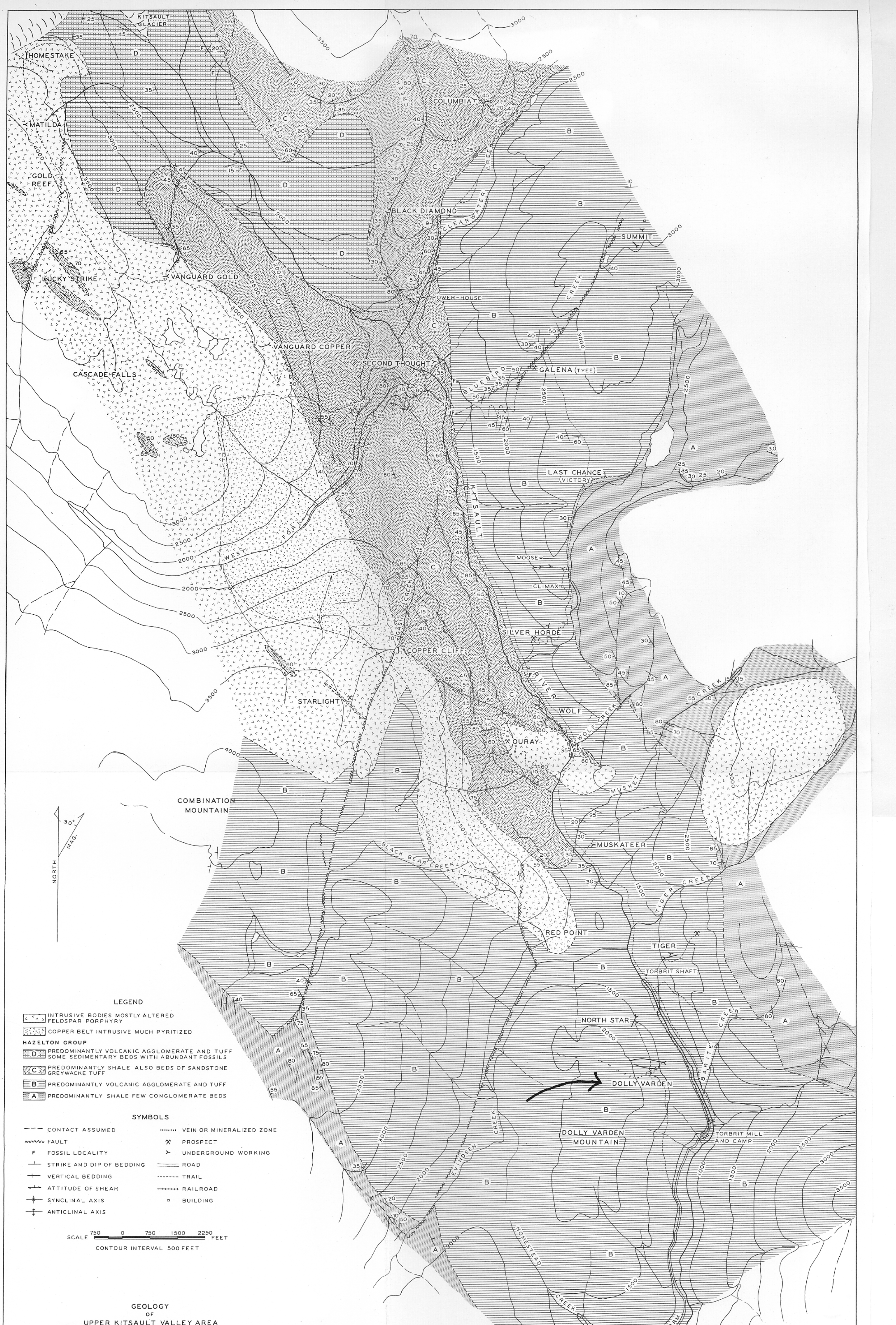
I am submitting this report entitled "Mineralogy of the Dolly Varden silver mine", in partial fulfilment of of the requirements for Geology 409, for the course in Fourth Year Arts.

Yours truly,

Leif Ostensoe

Leif Ostensoe

Geologic Map (over)



GEOLOGY OF UPPER KITSAULT VALLEY AREA

FIG. 1

from 1951 Dept. of Mines Annual Report
(private copy)

SILVER MINERALIZATION AT THE DOLLY VARDEN MINE

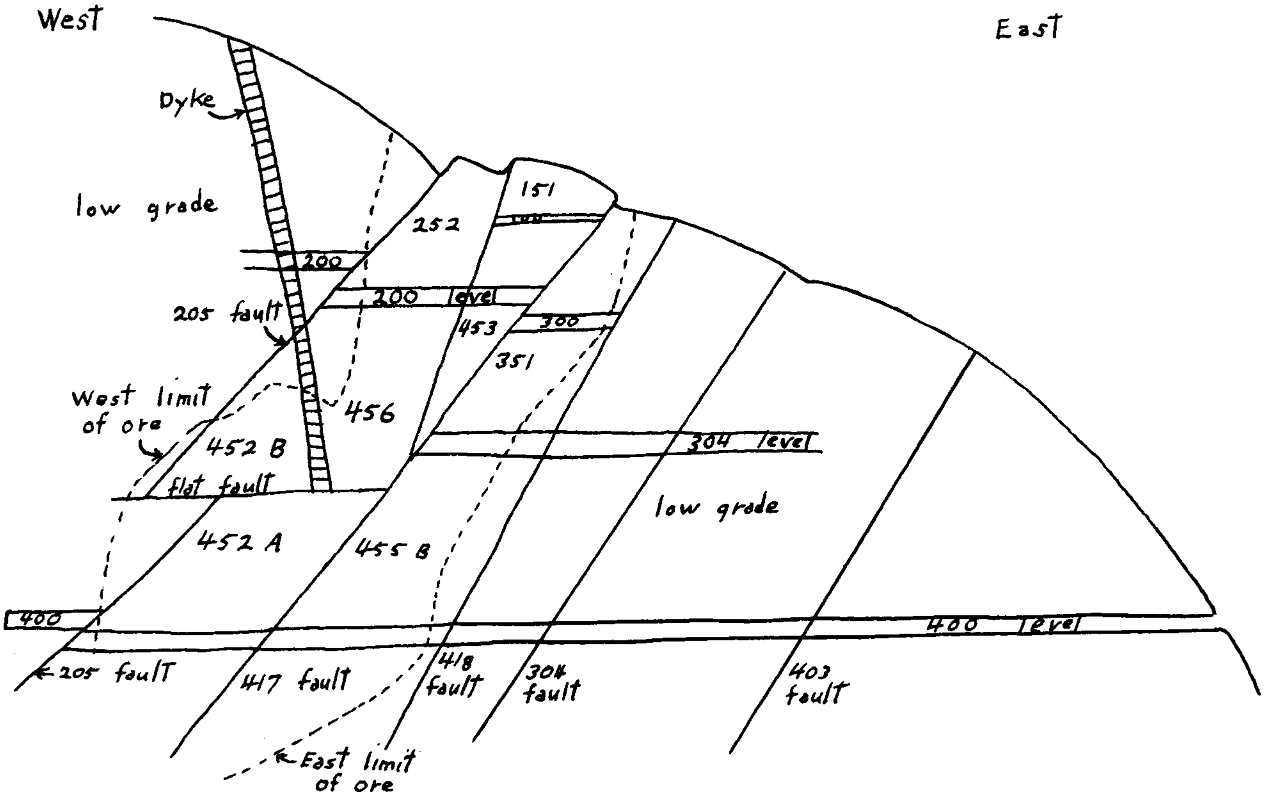
This introduction to my report is abstracted from an article by Dr. Warren and his student Mr. C.E.G.Brown that appeared in the October issue of The Miner in 1942(pp. 26-31) titled: The Dolly Varden Mineralization: Hypogene or Supergene?

The Dolly Varden Mine is situated in the Kitsault River valley, 18 miles from the head of Alice Arm, in the Portland Canal Mining Division of B.C.From 1919-1921, 1,300,000 ounces of silver from about 36,000 tons of ore was produced and smelted at Anyox.

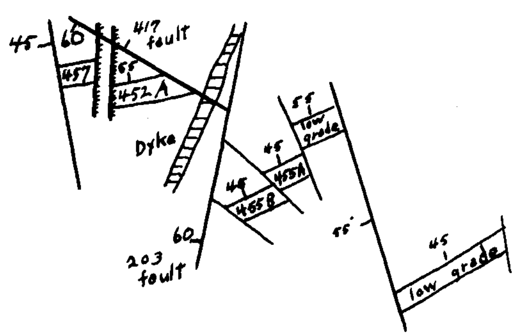
The rich surface workings became impoverished within 200 feet of the surface. Dolmage termed the deposit hypogene and Hanson termed it supergene. The correct interpretation of the type of deposit would enable a better assessment of the present worth of the Dolly Varden Mine.

The Dolly Varden Mine is in the central section of the northern half of the,'Kitsault igneous body,' which is a complex of intrusive, extrusive and fragmental igneous rocks of the Hazelton Group. The Hazelton Group is older than the Coast Batholith. No visible signs of a relationship with the Coast Batholith exist but dykes and small spurs etc., probably satellitic to the batholith, occur about 5 miles away.

The ore deposit is a vein which follows a fault fracture in the country rock, usually known by its color - purple or green - but here actually a complex of flows and fragmental rocks. The flows are in part andesitic. The fragmental components are coarse to fine breccias with a generally coarse textured, tuffaceous groundmass. The vein varies from an inch to 25 feet in width, has an average strike of N.55° E. and a dip to the N.W. of between 45° and 60°. mostly as a replacement of the footwall of the fault.



Projection of vein segments on a vertical plane.



Plan of vein segments on 1640' elevation.

from Warren and Brown

LABORATORY WORK ON SPECIMENS FROM DOLLY VARDEN MINE

SUMMARY

This report describes the mineralogy of the Dolly Varden Mine. Argentite and pyrargyrite are the main ore minerals. Pyrite, sphalerite, tetrahedrite, argyrodite, galena and native silver are other minerals of interest. Most of the native silver is probably supergene. The other minerals and a little of the native silver is hypogene.

A description of the four main types of ore.

(1) A specimen from near the surface of the 252 stope.

This is a hand specimen exhibiting comb structure. Argentite is in a vein well lined on both sides with clear quartz crstals. This may not be hypogene argentite.

(2) Specimen No. 3 from 252 stope.

The gangue here is black quartz. There is argentite and silver in vugs and fissures, with no wallrock replacement.

(3) Specimen No. 7 from the 452 stope.

Crudely banded pyrite is in a gangue of white quartz. There is sphalerite but no silver minerals present.

(4) Specimen NO. 1 from 151 stope.

Randomly oriented pyrite stringers traverse white quartz. There is pyrargyrite in small stringers and filling vugs. Diffusion of pyrargyrite into miarolitic spaces discolors nearby quartz red. Two ages of fracturing and mineralization are hence suggested.

MINERALIZATION

Quartz and pyrite are the earliest minerals in the deposit. Quartz both surrounds and brecciates pyrite while pyrite fills fractures in quartz and replaces it. The two minerals show overlapping deposition. There is black quartz and ordinary clear-white quartz present. Quartz is of more than one age and probably may be continuous. Quartz and pyrite are both replaced by later minerals. Marcasite was not noted.

Usually quite closely associated with the pyrite there is sphalerite. But it is a very light colored (iron poor) variety. Sphalerite is seen as grains in pyrite and also with grains of pyrite in it. This shows at least partial simultaneous deposition. But the sphalerite is iron poor. This is an anomalous situation. Some of the sphalerite shows chalcopyrite exsolution bodies under high power. The temperature of exsolution for sphalerite - chalcopyrite is given by Edwards as 350 - 400°C. Lamellar twinning is noted but etching brought out nothing. There is less than 1% zinc in the ore and it has never been recovered.

Argyrodite, tetrahedrite, galena and pyrargyrite probably are nearly contemporaneous. Only unreliable textures such as caries and poor veining structures were used to separate them in the paragenetic sequence.

Argyrodite ($4Ag_2S.GeS_2$) is a very rare germanium mineral, recognizedby its microchemical tests as given by Short. It has been noted by previous workers . Some of the microchemical tests indicated canfieldite, ($4Ag_2S.(Ge,Sn)S_2$). Only a few grains of either were noticed and the germanium is probably unrecoverable. It seems to be replaced by pyrargyrite.

Tetrahedrite $(Cu, Fe, etc.)_{12}(Sb,As)_4S_{13}$ occurs sparingly in the deposit. Microchemical tests indicate the presence of iron but not of silver. Hence, later silver minerals were not formed by its breakdown. It is placed before galean on the not too conclusive evidence of a small vein of galena leading from a larger mass of galena into a grain of tetrahedrite. In the period 1935-40, about 2 lbs. of copper per ton was recovered.

Galena and pyrargyrite (Ag_3SbS_3) are definetely contemporaneous, inclusions of one commonly being in the other. They both replace pyrite and sphalerite, but probably not quartz. Both occupy small fissures, vugs and at least for pyrargyrite, very small interstitial cavities, giving the quartz a red color. About one half of all the silver is from pyrargyrite. No textures suggest that it is supergene.

About 1% lead was recovered from the ores in the flotation circuit.

Argentite (Ag_2S) commonly replaces galena and pyrargyrite, especially along mineral boundaries and fractures. It also replaces sphalerite but apparently not pyrite. Argentite fills vugs and fissures too, giving masses up to a centimeter across. It is hypogene and all of one age even though it occurs both as replacements and open space fillings.

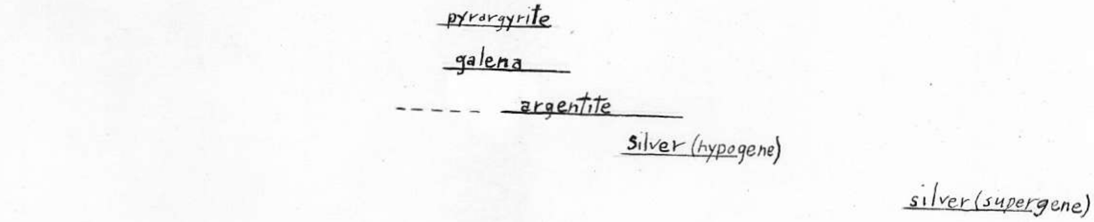
Native silver is probably of two ages. One age is contemporaneous with the argentite and is of very minor importance. It gives a segmented vein structure with argentite and in another place looked like it was invading argentite. It may be contemporaneous with argentite.

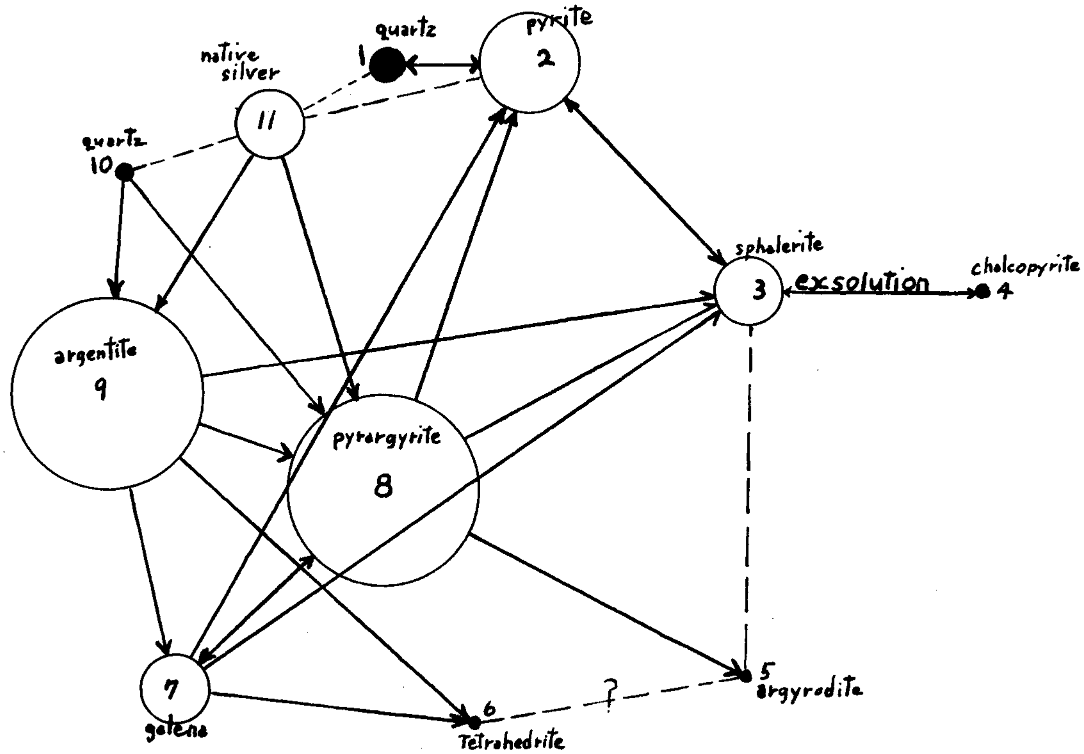
The other age was very important since it was in large masses near the surface. A specimen, probably from near the surface of the 151 stope, showed much native silver with small blebs (remnants) in it. Etching with HI for more than 1 minute brought out what looked like interference faces. They were only noted in one place and stronger reagents were ineffective in bringing out this very interesting structure. If these were interference faces, it would show that silver had been deposited in the colloidal form - possibly from the breakdown of pyrargyrite. Subsequent recrystallization has nearly obliterated the original textures. Edwards says this happens at fairly low temperatures - about 200°C.

Application to Ore Dressing

The ore is very hard and provision for this must be made in milling. Grinding to -68 mesh will free more than 98% of the precious minerals since the hard ore will result in the softer minerals being ground much finer. Though cyanidation seems at first glance to be the best recovery method, the native silver at the surface does not extend to depth. Flotation will recover the precious sulphides and sulphosalts as well as minor amounts of lead, copper and zinc. The ore averages about 30 ounces of silver to the ton.

Sequence





Van der Veen Diagram Showing Paragenesis

Quartz may be continuous
Relative positions of
argyrodite and tetrahedrite
not known.

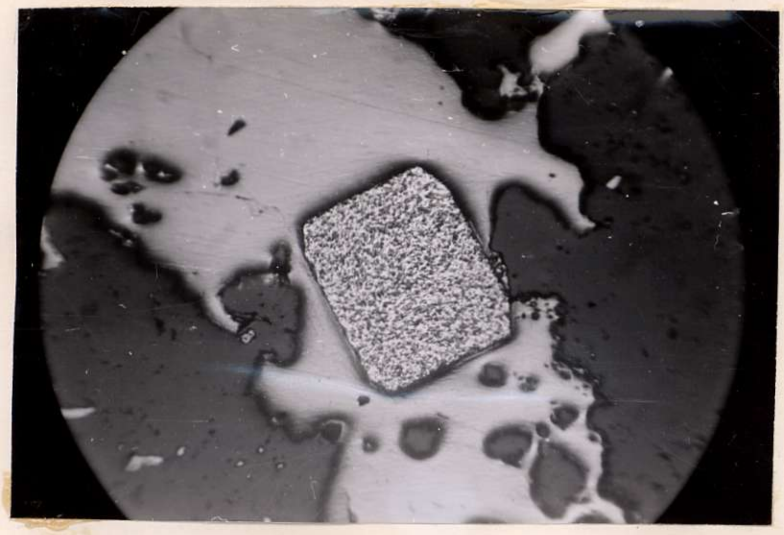
MICROPHOTOGRAPHS FROM THE DOLLY VARDEN MINE

These pictures were taken with a Contaflex, using Adox KB 14. The average exposure time was two to three seconds.

X80

Specimen from 252 stope.

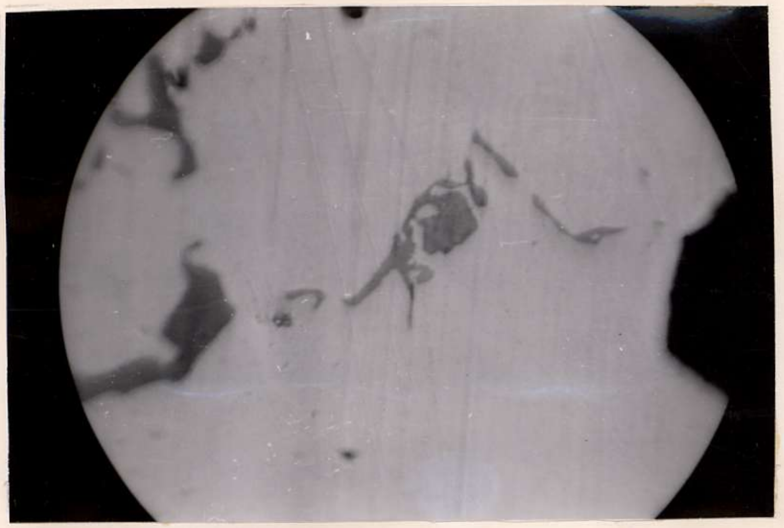
Galena, showing triangular pits, has argentite on mineral boundaries and as unsupported nuclei. Argentite apparently is later than galena.



X80

Specimen from 252 stope.

Pyrargyrite (light) here replaces pyrite slightly, but only enough to round the corners of the cube. Pyrargyrite was probably not too active a replacing solution so would prefer small fissures etc. rather than zones of prexisting sulfides.



X80

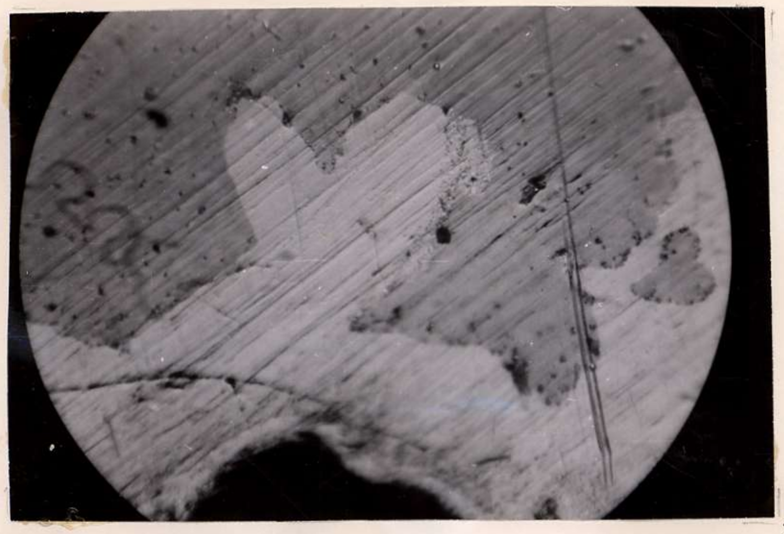
Specimen probably from near surface of 151 stope.

Native silver (light) nearly completely replaces pyrargyrite (small dark nuclei). Large masses of pressumably secondary native silver were found in the near surface workings at the Dolly Varden Mine.

X80

Specimen from 252 stope. Medium power.

Argentite (light) in a vug lined with very well developed quartz crystals. This is a common mode of occurence in the near surface workings. There is nothing to suggest that the argentite is supergene but rather suggests open space filling.



±X200

Specimen from 252 stope. Oil immersion.

Pyrargyrite (light) - Ag_3SbS_3-here replaces argyrodite (darker)- Ag_8GeS_6 or canfieldite - $Ag_8(Ge,Sn)S_6$. These last two minerals are very rare in North America. Textures involved are veining and caries.

X150

Specimen from 452-A stope. High power.

The spherical form is a 'ghost' in sphalerite. Notice the minute exsolution bodies of chalcopyrite (white). Temperature of deposition must have been at least 350°C. The ghost may be of pyrite which elsewhere is earlier, and two sides do form a rough right angle.

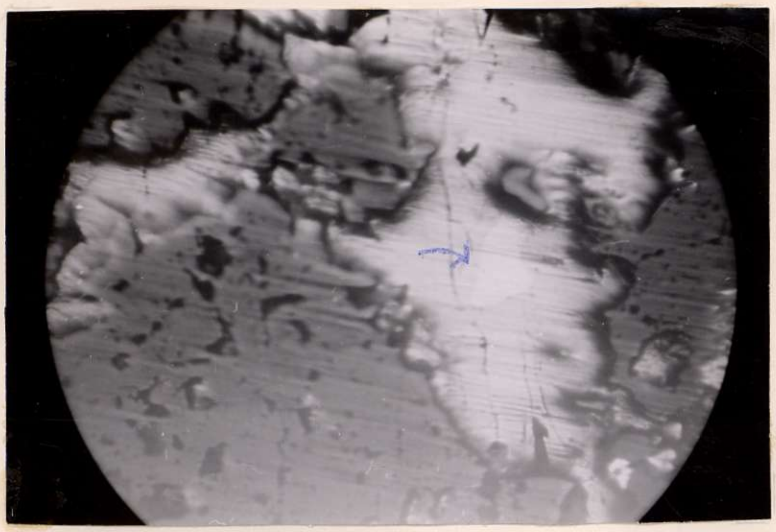
X80

Specimens from 252 stope

Silver (white) replaces argentite (dark). Argentite has been left as unsupported nuclei but the small white veinlets in the embayment (cente) show that the silver is later than the argentite.

BELOW The same picture , emphasizing the caries texture with silver replacing argentite.

X80



X80

Specimens from 151 stope

The darker of the white minerals is pyrargyrite and the lighter mineral is galena. Above, the galena is a small body in pyrargyrite and below, pyrargyrite is a small body in galena. This shows that galena and pyrargyrite were deposited simultaneously.

x 80

X30

Specimen from ?

Galena, showing fissure filling in quartz and also some replacement. Notice the quite good correspondence of the walls.