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MINERALOGRAPHY OF SPECIMENS
OF TORBRIT SILVER MINES

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fulfilment for the requirements
of Geology 409

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Location

Torbrit Silver Mine is located in the Kitsault River valley, about 18 miles from Alice Arm (see map). Alice Arm is visited weekly by a coastwise passenger boat from Vancouver. The property, which consists of twelve crown-granted claims and four recorded fractions, is connected by road to Alice Arm. A A narrow-guage railway about 1000 yards long connects the mine and the mill. The mine is east of Kitsault River and the mill and camp are west of the river. The mine is only a few hundred yards from the Dolly Varden Mine workings.

History

Silver occurrences were discovered in the bed of

Kitsault River and were explored by trenches in 1916. Two main zones of mineralization were indicated. The lower zone which was more attractive was explored in 1924 by an adit which exposed a deposit 100 feet wide. This exploration program was carried out on a group of Crown-granted claims called the Toric Group.

In 1927 a mill designed to treat 50 tons per day was completed. In 1929, the Britannia Mining and Smelting Company bought the property, but the property has remained idle until recently.

A road was constructed in the years 1946 to 1948 from Alice Arm along the Dolly Varden railway right-of-way. In 1948 a camp was built and a mill that would treat 350 to 400 tons of ore daily was constructed. Mining commenced in February of 1949. The company forming this most recent venture has been called Torbrit Silver Mines Limited and is a subsidiary of Mining Corporation of Canada.

General Geology

Kitsault River, at the mine location, is contained in a narrow gorge. Although the slopes on both sides of the river are steep, outcrops are few.

The country rocks are the intrusive and fragmental members of the Hazelton Group. The most common rock types are massive agglomerate and tuff, locally called greenstone. These red, purple, grey and green rocks are slightly schistose. The schistosity is approximately parallel to the ore contact and to the banding of the minerals in the deposit. The original textures of the country rock have been removed by shearing and crushing so that the attitude of the greenstone is not known. Masses of greenstone occur whithin the body of the main deposit.

The ore occurs as an irregular-shaped body. A. M. Cormie[1], mine superintendent, thinks that the ore replaces a series of folded volcanic breccias, tuffs and flow rocks. J. M. Black[2] thinks it probable that replacement has taken place along fractures and not in folded strata, as evidence of beds or closely folded beds susceptible to replacement is lacking.

The ore body is about 100 feet wide, strikes at approximately N 65° W and dips 35° to the west. A series of nearly vertical lamprophyre dykes that form a zone 140 feet wide cut across the body. The commercial grade is confined to lenses and shoots. Several faults have disrupted the ore body. The greatest horizontal displacement is about 30 feet.

The mill recovers silver, galena and sphalerite by flotation. Additional silver, mostly in the form of native silver, is recovered by cyanidation of the flotation tailings. Production in 1951 amounted to 119,711 tons of ore milled which produced 2,051,190 ounces of silver, 833,425 pounds of lead and 122,593 pounds of zinc.

Mineralography

Megascopic Examination

About 25 pounds of ore were examined that is supposed to be representative of the deposit. The overall appearance of

The specimens is that of a light-coloured, banded ore. In some specimens, crystals of barite several inches long were very obvious. The other gangue minerals are quartz and calcite. Jasper, a variety of quartz, is also fairly abundant in most specimens.

On closer examination, it can be seen that banding is formed by metallic minerals as well as by alternating layers of quartz, barite and jasper. The barite is present mainly as crystalline masses of oriented crystals with or without jasper between the crystals. However, in some specimens the barite crystals are oriented so that they are at right angles to the banding. Colloform banding of alternating layers of quartz, jasper and metallic minerals surround the barite crystals in some specimens. The calcite is present mainly in small fissures and as encrusting crystals.

Some specimens appear to have undergone differential movement and have become brecciated. Other specimens are composed of massive sulphides.

Metallic minerals that could be seen megascopically are galena, sphalerite, chalcopyrite, pyrite, marcasite and ruby silver. The galena is present as massive bodies and as disseminated particles in the bands. Sphalerite is present mainly in the bands of metallic minerals. Chalcopyrite appears as irregular blebs and the marcasite as a continuous coating one eighth of an inch think on one surface of a specimen. The ruby silver occurred with barite and jasper as disseminations. Under the binocular microscope, the ruby silver showed bright red internal reflection and appeared translucent.

Microscopic Examination

The minerals that were seen in the polished sections are probably representative of Torbrit Mine. However, it is probable that all the minerals of the deposit were not present in the specimens. For example, it is reported that native silver is one of the main silver minerals. But no native silver was seen either megascopically or microscopically.

The following minerals were revealed by a study of polished sections of the ore:

Pyrite
Tetrahedrite
Sphalerite
Galena
Proustite
Polybasite
Chalcopyrite
Hematite

Maps of the mine were not available, so that any attempt to correlate the specimens with their position in the orebody was impossible.

Pyrite $Fe S_2$

Pyrite occurs fairly abundantly, but not as abundantly as galena or sphalerite. Its subhedral to euhedral texture indicates that it was probably the first mineral to form. The pyrite occurred mainly as disseminated particles ranging in size from .01 to 1.2 mm. The disseminations are sometimes lineated so as to suggest formation along certain planes. Some grains of pyrite appear to have been fractured so that galena filled the fracture (see fig. 1) and possibly partly replaced the pyrite.

Most grains of pyrite appear to have been unreplaced. No silver values were found in the pyrite.

Tetrahedrite $5\ Cu_2\ S.2\ (Cu,\ Fe)\ S.2\ Sb_2\ S_3$

Tetrahedrite is very sparsely scattered in the sections. It was most abundant in a section of massive galena (N 6). One of the largest grains is shown in figure 2 and another grain is shown in figure 3. It seems evident from these figures that galena is probably replacing the tetrahedrite. The tetrahedrite, which exhibits subhedral shapes, has been partly replaced along its boundaries by galena. Blebs of galena occur within the tetrahedrite near its boundaries, which may indicate replacement also. What is thought to be proustite occurs in the main mass of the tetrahedrite, but its relation to the tetrahedrite is doubtful because of the smallness of the grains.

Tetrahedrite is also present in minor amounts in the sphalerite of section N 3. It occurred here as rounded blebs in the sphalerite. However one grain boundary between galena and tetrahedrite showed a small projection of galena into tetrahedrite, similar to the projections of galena into tetrahedrite in figure 2.

It is not known whether tetrahedrite carries silver values or not. It seems likely, but little could be done microchemically because of the small grain size.

Sphalerite ZnS

Sphalerite is present in all of the sections. In the sections containing high-grade silver (N2A and N2B) the sphalerite is iron-poor and exhibits a yellowish internal reflection. The outline of the sphalerite in these sections is very irregular and forms a lace-like pattern. The smallest grain size is about .05 mm.

In other sections, the sphalerite is massive and forms around barite crystals. The massive sphalerite shows little or no internal reflection. As the silver minerals are not associated with this iron-rich massive sphalerite, it would seem to indicate that the silver minerals were deposited at lower temperatures.

In other sections, such as N1, the sphalerite forms blebs in galena, with a grain size of .08 to .16 mm. (see fig.4). It appears to have been contemporaneously deposited with the galena, but galena also appears to vein the sphalerite. Probably the sphalerite is slightly earlier than the galena. Twinning in sphalerite is evident in section N1, but this is common to most sphalerite.

Galena PbS

Galena is also present in most sections. It forms masses of almost pure galena shown by section N6. It is also sparsely associated with the veinlets of silver minerals as small masses about .01 to .08 mm. in size (N2A, N2B, N4). However, galena seems to be most prevalent as irregular masses associated with sphalerite as in figure 4. As mentioned before, the galena appears to vein the sphalerite. Galena also occurs as blebs in sphalerite.

It is possible that the orebody was subjected to stress prior to deposition of galena, as galena appears to surround the sphalerite and in some instances replace the sphalerite.

Proustite $3Ag_2S\cdot As_2S3$

High-grade ore (20 oz per ton) from Torbrit Mine appears as disseminated ruby silver in massive barite. In polished section, the ruby silver appears as irregular veinlets (fig.5). Although the ruby silver looked very similar to pyrargyrite, etch tests and microchemical tests indicate one silver mineral to be proustite. The proustite gave a positive microchemical test for arsenic. Also, the proustite showed very bright red internal reflection. The grain size is at least as small as .004 mm. The greatest width of the veinlets is about .25 mm. The small disseminated grains of proustite impart to the barite a reddish colour similar to the colour of the jasper. It is therefore difficult sometimes to distinguish between ruby coloured barite and jasper in barite.

Proustite also occurs in massive galena, but the concentration of proustite is very small (fig. 6). The grain size of proustite in galena ranges from .08 to 1.5 mm. In section N6 (fig.7) proustite appears to have replaced part of a vein of galena. However, the true relationship between galena and proustite is not clear (fig. 6). The relation between proustite and tetrahedrite also is not clear (fig. 2).

Polybasite $8Ag_2S \cdot Sb_2S_3$

Polybasite is intimately associated with proustite in veinlets (fig.5). Little difference could be seen in plane light, between proustite and polybasite except for the slightly yellow colour of the polybasite. It is interesting to note that the polybasite showed very poor, if any, anisotropism, and that it also showed a weak anomalous internal reflection. Although etch tests placed the polybasite in the correct grouping, it was not until Dr. Thompson obtained an X-ray pattern of the powdered mineral that it was established as polybasite.

The polybasite occurs in grain sizes from .015 to .24 mm. The mutual straight boundaries between the polybasite and proustite would seem to indicate that they were deposited contemporaneously. However, the polybasite is seen to rim the proustite (fig.5) in some instances. Therefore, it is assumed that the polybasite is younger than the proustite.

Chalcopyrite $CuFeS_2$

Chalcopyrite is disseminated as blebs throughout most of the sections. Although the blebs are present in sphalerite and gangue, it is more commonly associated with the galena. Figure 8 illustrates a veinlet of galena in sphalerite, in which the galena has been partly replaced by chalcopyrite. Figure 4 shows chalcopyrite associated with galena, but only a caries texture is evident.

The grain size of the chalcopyrite varies from .008 mm blebs in sphalerite to grains of approximately .15 mm in galena.

Hematite $Fe_2 O_3$

Specular hematite occurs in some sections but mainly in section N 3. It is associated with pyrite, but no significant textures were seen. It seems reasonable that this ore, with so much jasper, would have a considerable amount of hematite present.

Native Silver Ag

Although native silver is common to the Torbrit ore, none was seen in the sections that were cut. Argentite also was not observed.

Paragenesis

The main features of the paragenetic sequence have already been stated. However, a short summary of the sequence would perhaps clarify the history of mineralization.

Successive layers of barite and quartz were probably the first minerals to form in the sequence. Colloform banding of quartz and jasper around barite crystals indicate that the large barite crystals were the first to form.

Deposition of metallic minerals came next in the succession. Bands of metallic minerals alternate with the quartz and barite, surrounding the barite crystals.

The relationship of the minerals to each other is not shown. However, pyrite was probably the first to form. Galena appears to vein sphalerite and probably has replaced some tetrahedrite. It is likely that stress was applied before galena was deposited as the pyrite grains have been broken, and galena surrounds sphalerite particles. Proustite appears to replace galena, and polybasite rims proustite. Chalcopyrite also appears to replace galena, but its relative position in the sequence is unknown. The position of hematite in the sequence is also unknown, but it was probably introduced with jasper.

Another period of fracturing took place after the metallic minerals had been deposited. Evidence for this is calcite which has a cutting relationship with the banded minerals. A specimen of calcite crystals from a fault show also also that calcite is post ore. Marcasite is also probably post ore.

At least two periods of mineralization are indicated. A specimen collected by the writer shows banded quartz, jasper, barite, and sulphides which have been cut almost at right angles by more banded sulphides. However, the relation of the periods of mineralization to the paragenetic sequence is not known.

Type of Deposit

Torbrit is considered a replacement deposit. Opinions differ slightly as to how the replacement occurred (see General Geology). However, the banding is parallel to the contact of the deposit, the ore shoots generally apex not far below the surface, and the deposit becomes wider at depth. Ore shoots in the hanging wall join the main ore body like branches to a main trunk, thus increasing the width with depth. It is thought by Black[2] that the ore shoots must have formed from ascending solutions and not by descending solutions.

The deposit is probably of the low temperature type and of hypogene origin as secondary minerals are absent. Proustite is thought of as being low temperature. However, if more than one period of mineralization is indicated, the deposit might not necessarily be of one temperature type. The presence of iron-rich and iron-poor sphalerite also indicate more than one period of mineralization or that there is a temperature gradient throughout the deposit.

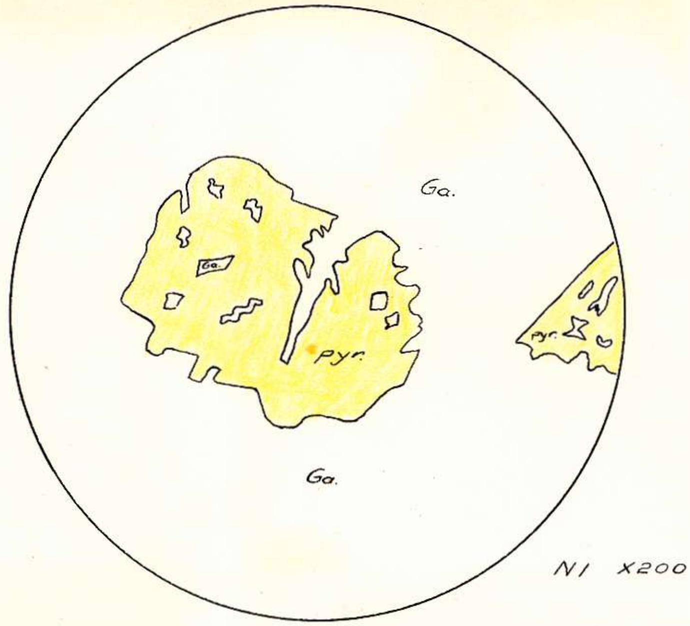


Figure 1. Pyrite (Pyr) replaced by galena (Ga) along a fracture

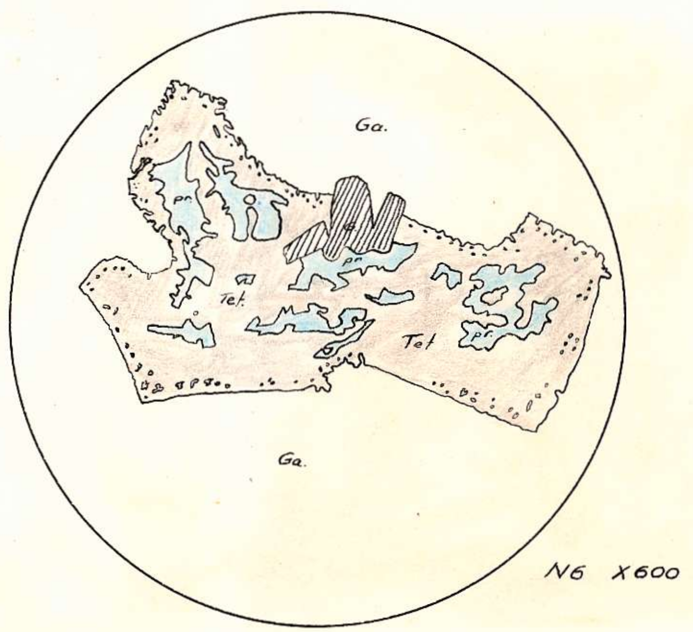
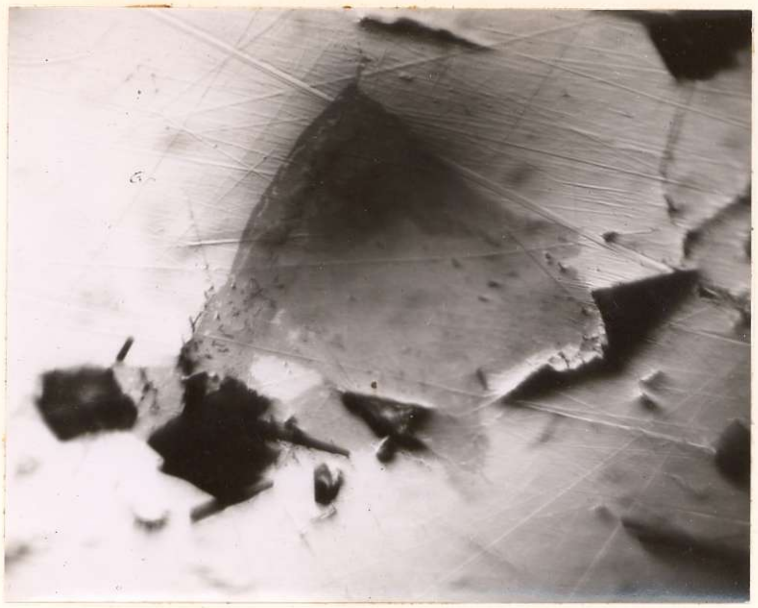
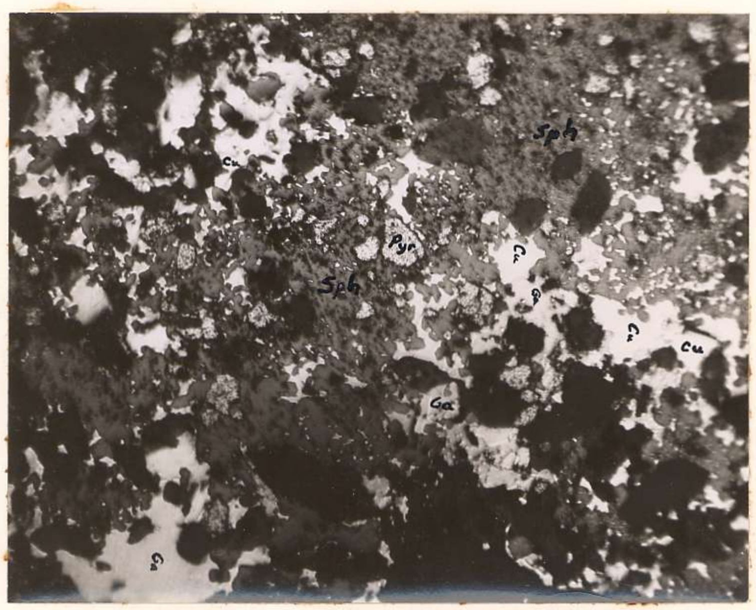


Figure 2. Tetrahedrite (Tet) replaced by galena (Ga) along boundaries. Proustite (pr) in tetrahedrite.



N6 X720

Figure 3. Tetrahedrite surrounded by galena. Proustite in tetrahedrite. Replacement by galena in tetrahedrite.

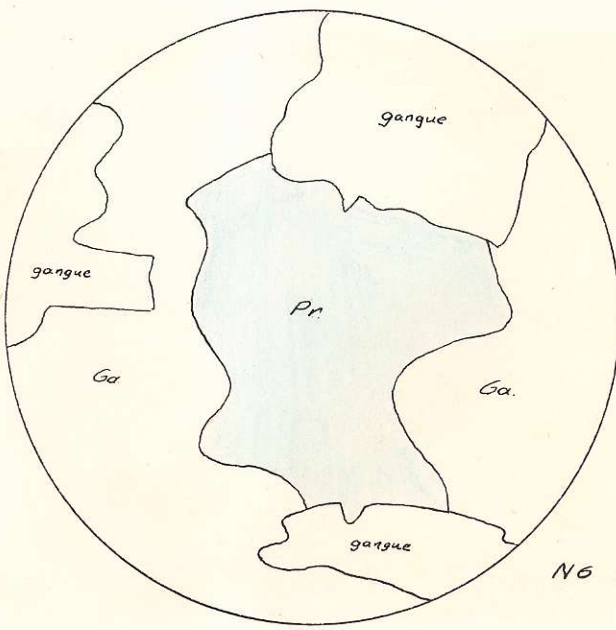


N1 X150

Figure 4. Massive sphalerite (Sph). Galena (Ga) replaced by chalcopyrite (Cu). Subhedral pyrite crystals (Pyr)

N2A X150

Figure 5. Veinlet of proustite (Pr) rimmed by polybasite (Poly).



N6 X 250

Figure 6. Proustite (Pr) in galena (Ga)

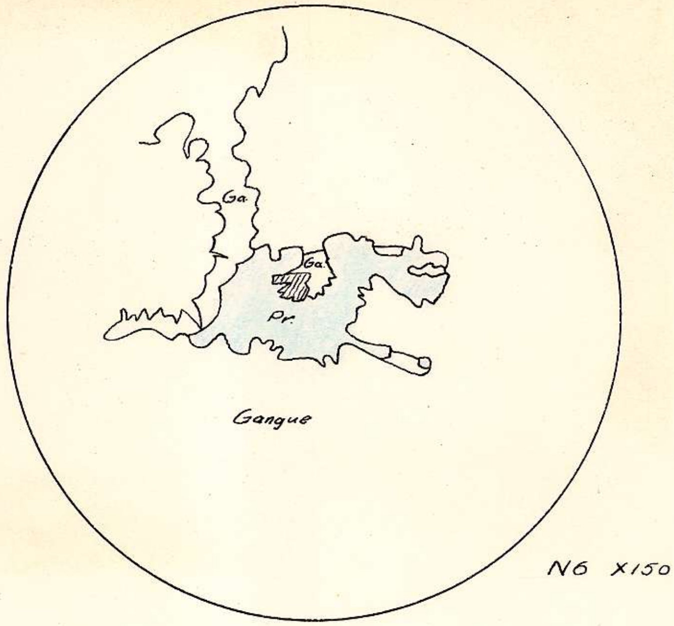


Figure 7. Vein of galena (Ga) replaced by proustite (Pr)

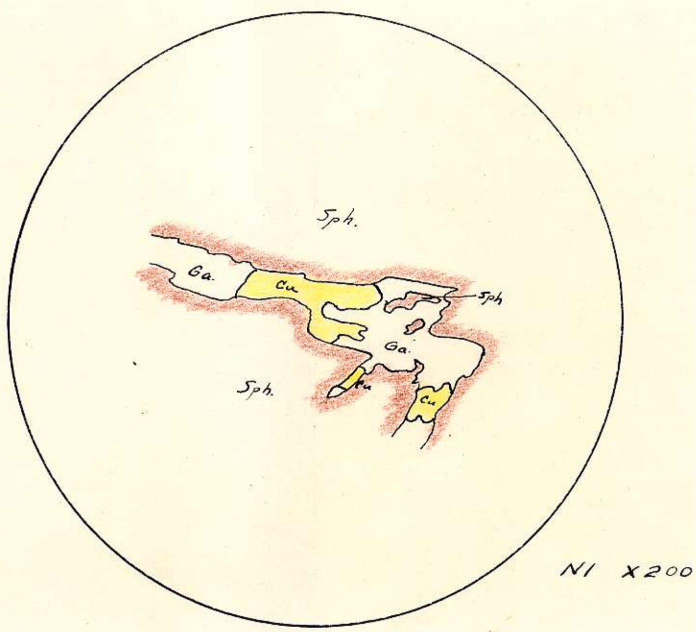
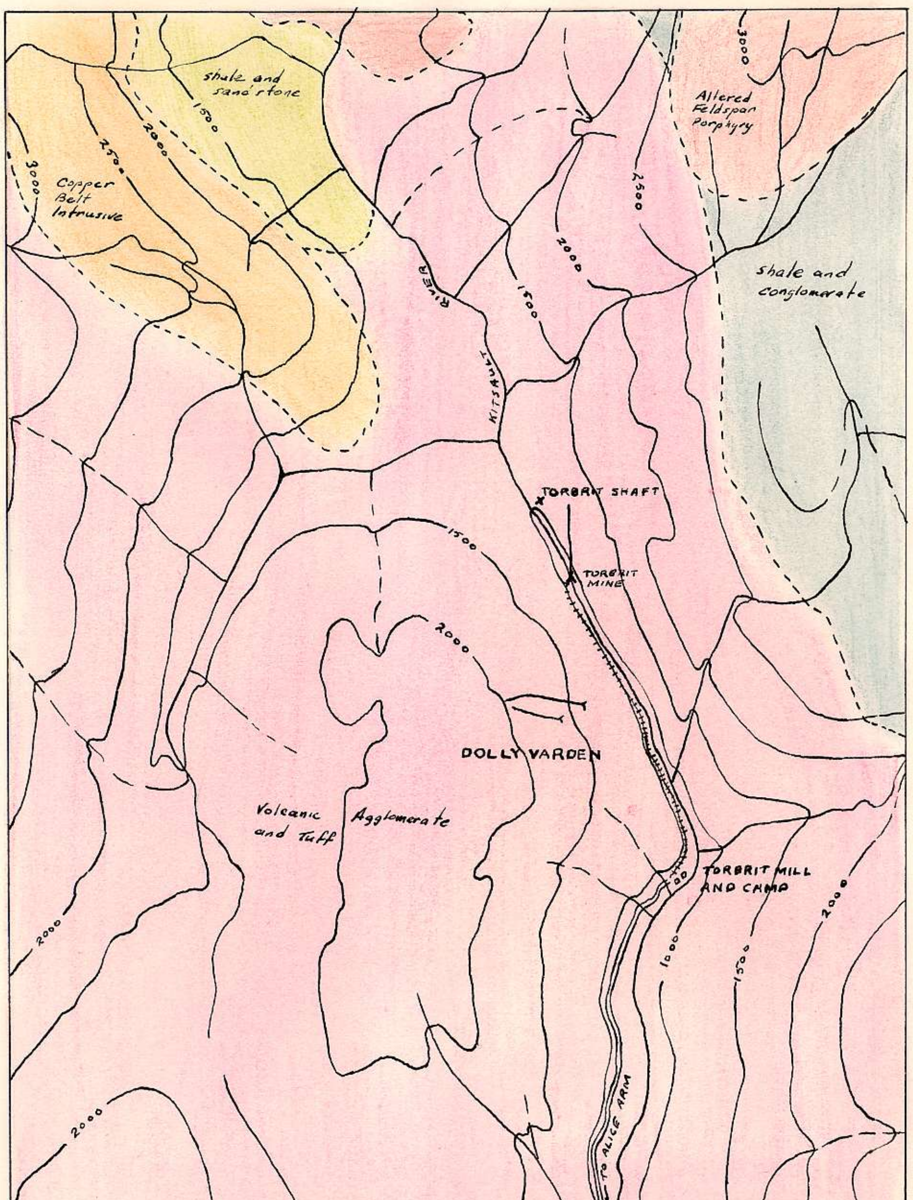


Figure 8. Vein of galena (Ga) replaced by chalcopyrite (Cu)

Plate 5

MAP OF KITSAULT AREA

Scale 1" = 2250'



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