600234

Mineralographic Report ✓

on

the Aberdeen Property, Merritt, B.C.

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Geology 409 :- Problem #2

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Introduction

This is a mineralographic study of the copper ores from the Aberdeen property near Merritt, B. C. The copper occurs as a vein of massive sulphides in a shear zone in granitic rocks. It is also found disseminated in the igneous rock adjacent to this vein. There was some interest in this property since the 2 to 3 foot vein was high grade containing such minerals as chalcocite, bornite and native copper. The main objective of this report is to determine the mineralogy and to distinguish the primary and secondary minerals thus giving an idea as to the origin of the deposit.

Megascopic Description

The specimens available for study are numerous thus for descriptive purposes have been divided into three main groups: the massive sulphides, the (lithified) gouge, and the mineralized granitic rock. The massive sulphides represent the actual vein; the lithified gouge represents material resulting from the pulverization of rocks along fault planes; and the mineralized granitic rock represents diffusion or secondary alteration

products deposited in the country rock adjacent to the main zone of emplacement.

The Massive Sulphides

These specimens vary in size and maybe up to four or five inches in diameter. They are generally a pinky-gray color and are highly fractured with varing degrees of alteration to green copper minerals most likely mainly malachite and to orange-brown hydrous iron oxides. On occasions native copper is visible as smears on the fracture surfaces. The pinky-gray sulphides which can constitute up to 80% of the rock have been shown in polished section to consist of an intergrowth of bornite and chalcocite. These minerals are imperfectly sectile, have a hardness about 3, and are often covered with a thin iridescent film of covellite. The hydrous iron oxide, presumably are derived from the bornite of specular hematite which occurs in small patches as a platy or micaceous gray mineral with a sub-metallic luster.

The Lithified Gouge

The lithified gouge varies greatly in character and composition and maybe

considered to grade into both the massive sulphides and the igneous country rock, inasmuch as often much of the ore specimens and igneous specimens have been brecciated and sheared with varing degrees of intensity. The most highly pulverized gouge specimens maybe deep red, light green, gray or a combination of these colors. Some of the specimens studied show good slickensided surfaces and others show good stratification presumably parallel to the shear direction. The minerals observed also vary greatly in composition and nature. The actual true highly pulverized gouge specimens mainly consist of very fine mylonitic material with probably some clay minerals developed. On the other specimens usually distinctive minerals can be recognized. The stratified deep red specimens contain blebs of brecciated calcite, veins and plates of native copper and some of the chalcocite and has an extensive fine grained matrix of gray, specular hematite which has a red coating that gives the rock its distinctive colors. There was some question (as) whether the coating is hematite or possibly fine disperse

To distinguish the two minerals HCl and HNO_3 tests were carried out. With application of 1:1 HCl to the specimen there was no reaction and no white precipitate, and with application of 1:1 HNO_3 there was a slight effervescence but no native Cu was precipitated, therefore, the conclusion was reached that the red material is finely ground hematite. The other gouge or shear zone specimens maybe considered intermediate between the original rock and the gouge described here.

The Mineralized Igneous Rock

These specimens again differ much in composition and nature. The majority of the specimens studied seem to be fine grained plutonic rocks with varing degrees of alteration but one set of specimens which contains a high percentage of mineralization seems to be a porphyritic amygduloidal volcanic rock. Generally the samples are high in quartz and have a moderate percentage of feldspar which is usually partly or completely sericitized. The studied samples are usually low in metallics (5-%) which are invariably native copper and fine grained chalcocite; there is some

bornite and rutile. Often the quartz and rutile are seen veining the rock thus indicating that at least some of the quartz is secondary in nature.

From the megascopic textures and characters of the whole suite of specimens it can be seen that the bornite and larger quantities of chalcocite are closely associated; that often native copper and some of the chalcocite are closely associated; that the native copper is found on fracture surfaces, in the kittified gouge, and as fine dispersed particles in the igneous country rock; that much of the ore has been altered to secondary oxides and carbonates; that the igneous rock has undergone certain types of hydrothermal alteration near the ore zone; and that there has been post ore movement along the fault.

Microscopic Description

Minerals

Bornite (Cu_5FeS_4) - Good polish; pinkish brown; hardness B; anomalous weak anisotropism; KCN stains brown; HNO_3 eff.; $FeCl_3$ slight yellowing; $HgCl_2$; KOH + HCl negative.

Chalcocite (Cu_2S) :- Good polish; blue-gray; hardness B; slight anisotropism in orthorhombic form; $HgCl_2$ very light brn.; KOH slight irid. to neg; KCN stains black & leaves corroded surface; also brings out grain boundaries; $FeCl_3$ blue; HNO_3 eff; drop deep blue; gray stain. Etch cleavage also brought out with $FeCl_3$; indicative of hypogene chalcocite-

Specular Hematite (Fe_2O_3) :- Good polish; galena white; hardness 6; in anistropic laths or plates; polarization colors grays & browns. Negative to all reagents.

Rutile (TiO_2) :- Poor polish; gray; hardness 6; anisotropic orange internal reflection; negative to all reagents

Could be Check

Covellite (CuS) :- Only very minor amts. & often occurs as tarnishs on polished surface; good polish; hardness B; strongly pleochroic blue to gray; anistropic blues reds & browns; $HgCl_2$, KOH, KCl, $FeCl_3$ neg.; KCN black.

Native Copper (Cu) :- Good polish; red-brown color; hardness B; sectile; in wires & flakes; $HgCl_2$ iridescent stain, $FeCl_3$ if left darkens

Copper (Continued):- & corrodes the surface.* Since no distinctive results were obtained when etching with the standard $(NH_4)_4SO_4$ solution to distinguish hypogene from supergene deposits a comparison with Michigan native copper ores was carried out. The results of this comparison displayed great differences, therefore it was concluded by this comparison & by the association & occurrence that the native copper on the Aberdeen property is supergene in origin.

The results of the comparison:
$(NH_4)_4SO_4$ reagent

Aberdeen:- After 10-15 seconds the complete surface is dark brown with numerous gray-black specks. It looses its polish completely.

Michigan:- After 25 seconds the original polish is untouched with only a slight tarnish and a few brown specks. After 120 seconds the surface was still hardly altered with only a few pits and a tarnish which could be wiped off.

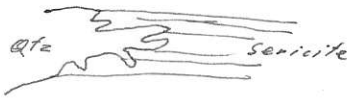
Thin-Sections of Igneous Rocks

The two thin-sections showed two different types of rock, both with high degrees of alteration. The composition of these rocks are as follows:

#1

- 10-15% Chlorite - light green pleochroism
- 20% Sericite - micaceous, small, platy aggregates; high birefringence colorless
- 50% Quartz - uniaxial (+)
- 15% Plagioclase (relics) - polysynthetic twinning; highly sericitized
- 4% Opagues
- small % Carbonates

Some of the quartz appears recrystallized & is seen cutting the sericite.



#2 (vimy sample)

- 5% Sericite
- 50% Quartz - uniaxial (+)
- 40% Feldspar - (most plag.) 2V≥60°; 2V⊥ at 90°; low relief; twinning
- 3% Carbonate
- 3% Opagues - found mostly adjacent to the qtz. veinlets; is likely rutile

The quartz constitutes part of the rock matrix and occurs also as veinlets cutting the rock. These veinlets display a micro-comb structure. These rocks are both fine grained igneous & originally were probably a quartz monzonite to quartz diorite.

Primary Minerals

Specularite :- (?) 30%
Chalcocite :- (?) 30%
Bornite :- (?) 25%
Rutile :- fractionate %
(Non-Metallics - Quartz, feldspar, sericite, chlorite, carbonate)

The percentages in actuality are probably incorrect, since they are only representative of the sections & specimens studied.

Secondary Minerals

Malachite :- 7-8%
Native Copper :- 4%
(Limonite etc.) Hydrous Fe Oxides :- 3-4%
Chalcocite :- 3%
Covellite :- fractionate %

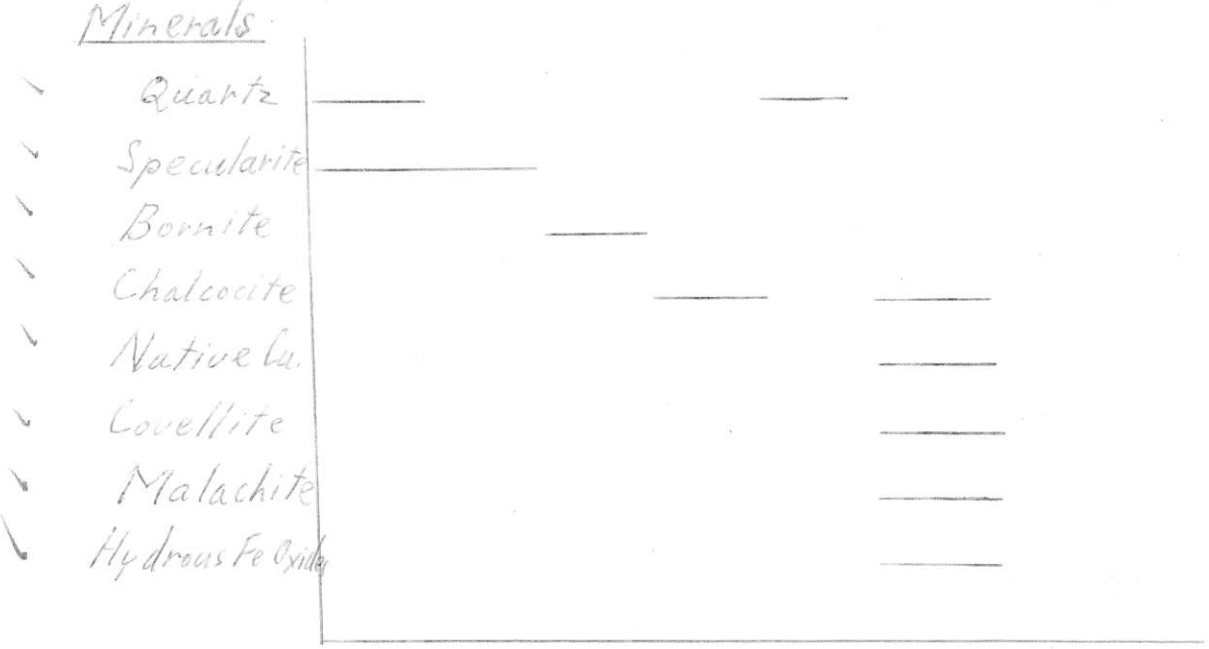
Textures & Paragenesis

The texture and paragenesis are relatively simple with the only difficulties being the origin of the chalcocite and native copper. Ore deposition mainly occured as fracture filling of a shear or shear zone and was accompanied by shearing and movement along the same zone. The earliest minerals are quartz and specularite which are closely intergrown with the specularite

as small laths included in the quartz (fig. #2+3). This most likely indicates contemporaneous deposition. After the quartz precipitation had ceased the specularite continued to be deposited. This is shown by the fact that the specularite also occupies a distinct zone of many laths which include breccia fragments of the prior (fig. #3). Presumably this period of specularite deposition was accompanied by movement along the shear zone. The criteria indicating this fact are the alignment and flow type of structure displayed by the specularite (fig. #3); the brecciated & highly fractured nature of the early quartz & specularite & the fact that the later replacing chalcocite seems to cross-cut & be independant of this structure. In the sections studied, chalcocite is usually in contact with the specularite and quartz, and is seen replacing both (fig #2 & #3) but presumably the bornite was emplaced before the chalcocite since the chalcocite is observed replacing the bornite (fig. #1 anatomose texture). In the massive bornite & chalcocite there is the odd breccia fragment of specularite. Following this, the last of the hypogene deposition is marked by a second generation of quartz. This is indicated by the fact that the quartz is seen veining the chalcocite.

Much supergene alteration of the deposits has taken place since the final deposition of the massive copper sulphides. This is probably due to the fact that the deposit has been highly fractured and sheared thus becoming very permeable for circulation of ground water. This is believed to be the origin of the native copper and some of the chalcocite. The reason that some of the chalcocite is believed to be supergene is that it is extremely fine grained + has similar occurrence and nature as the native copper.

Paragenetic Sequence



Temperature of Deposition

Deposition in this vein probably went on with a gradual fall in temperature. The specularite and ~~it~~ were probably deposited (very approximately) around 500°C, the bornite between 500° & 250°C and the chalcocite between 250° & 90°C with the supergene minerals being formed (just above) atmospheric temperature.

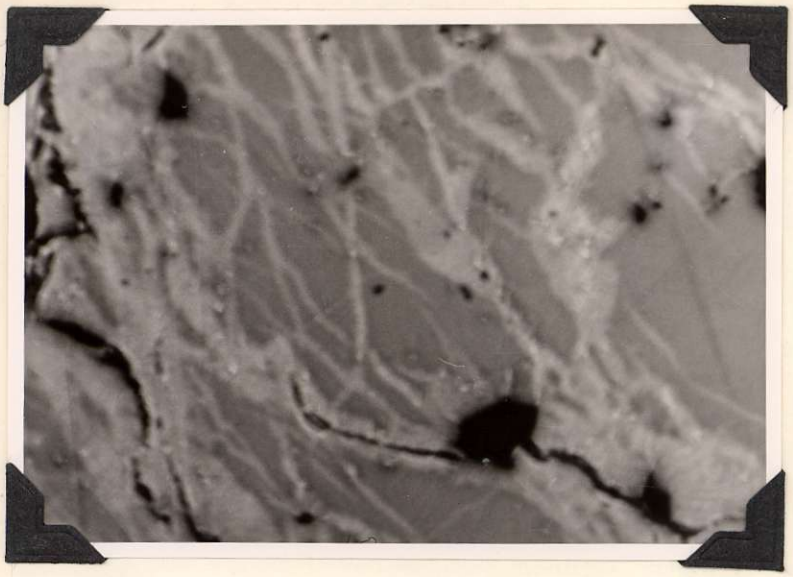


Figure #1 (~x150)

Shows the anastomose texture of chalcocite veinlets replacing the darker bornite.

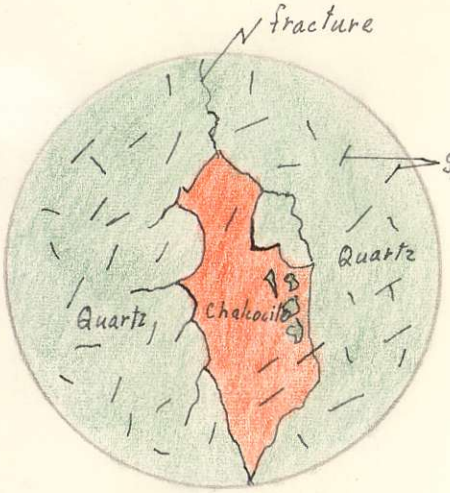
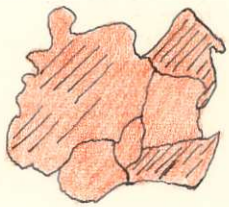


Figure #2 (Medium Power) ~150x

Shows hematite laths closely intergrown with quartz; chalcocite and quartz display Varie's texture with the chalcocite being younger; chalcocite seems to replace quartz in preference to specular hematite.

Figure #3 (X1)

Figure #4 (~x150)



Parallel etch(ed) cleavage in crystalline chalcocite brought out by $FeCl_3$ etch

Qtz. containing specularite laths is early. The mass of specularite laths are aligned due to shearing Qtz. fragments "dragged in" by brecciation/shearing. Chalcocite is later replacement.