Geology 402 - Report #4 - Apr 8. 64

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No references!
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Evidence for prelurgite?

Introduction: This report deals with a suite of specimens from the Mineral King Mine, situated in the southeast corner of British Columbia. Material studied included some 35 hand specimens and 20 polished sections, as well as several specimens of drill core from representative holes in the host rock.

General Geology of the Area:

The rocks in the Mineral King area are part of a thick sequence of late Precambrian sedimentary rocks in the upper part of the Purcell and lower part of the Windermere systems. The youngest sedimentary rocks are those of the Toby formation. These are mainly conglomeratic and unconformably overlie rocks of the Mount Nelson and Dutch Creek formation. The Mount Nelson formation consists of dolomite, argillaceous dolomite and argillite with a white quartzite at its base. Beneath this basal quartzite lie rocks of the Dutch Creek formation. They are chiefly black slate, argillite, dolomite, dolomitic argillite and quartzite. This formation is underlain by undifferentiated black slates and argillites.

Although the rocks have been complexly folded and faulted, regionally the structure consists of relatively open folds plunging gently to the northwest. Southwesterly dipping thrust faults and north to northwesterly trending normal faults are common. The pattern of folding and of thrust faulting has resulted from a relative movement of west over east. There appears to have been more than one period of deformation. There seem to be minor "N" shaped drag folds superimposed on the main anticlinal structure. Mineralization at the mine appears to have been partly controlled by "N" shaped drag folds.

The form of the ore bodies is extremely complex but they appear to plunge gently to the northwest, have a low dip, and to conform to fold structures within the dolomite. The orebodies in the upper part of the mine are replacements of dolomite by barite and sulphides. Towards the northwest, the plunge of the ore zones steepens

and they are now or less continuous with other orebodies in the lower part of the mine. These lower orebodies follow steeply dipping faults which strike to the north. Sulphides and quartz occur along them as replacements and fillings.

Mineralizing solutions may have passed upwards along the northerly trending steep faults in the lower part of the mine and spread out to produce the pipe-like replacement bodies at higher levels.

Megascopic Description: The ore specimens can be devided into two groups: those which consist mainly of fine grained massive sulphosalts, with minor sphalerite and abundant white granular barite; and those which contain mostly coarser grained sphalerite and galena, with lesser pyrite. This latter group are mostly either specimens of the host rock (dolomite) containing galena and sphalerite, or these minerals associated with white quartz. It would appear that the specimens falling into this second category come from the lower levels of the mine. The sulphosalts are soft and dull grey in colour. They are quite fine grained except for occasional small eyes of pale yellow sphalerite crystals which may be up to 1 cm. across. The galena and sphalerite associated with the dolomite is fairly consistantly coarse grained (up to ½ inch across). The host rock itself was examined from pieces of drill core and several thin sections. From the cores, the dolomite appeared to be considerably compacted, brecciated and contorted. The thin sections show interlocking crystals of dolomite which exhibit strain extinction. Minor sericite and quartz is scattered through this matrix. The sericite appears to be pseudomorphs after some pre-existing minerals in a number of cases.

Microscopic Description:

Sphalerite - (ZnS). The polish was fairly good - although ragged in parts; colour dark - medium grey. It is non pleochroic and isotropic, however, the yellow-white internal reflection was quite distinctive. All reagents had no effect on it

There are two colours

except that with $HNO_3$ occasional twin lamellae were brought out. The sphalerite generally occurs as large irregular masses — eaten into by later minerals or as small isolated blebs in masses of bournonite or freibergite.

Galena - ($PbS$) It takes a fine polish and the colour is the typical galena white colour. It is non pleochroic and generally isotropic although some grains with weak anisotropism were seen. The perfect cubic cleavage was often seen & triangular pits are common. At times the boundaries were quite cuspedal. All reagents are negative except HCl which stains irridescent and $HNO_3$ which stains black. When examined closely this black surface showed ~~a~~ tiny areas of enclosed material which were not affected. Edwards shows photomicrographs which resemble this phenomena and says that it is due to some included silver minerals. Galena occurs as large masses associated with sphalerite or as tiny stringers isolated in the host rock (incipient replacement ?) or as rounded blebs in bournonite or freibergite.

Freibergite - ($5(Cu,Ag)_2S \cdot 2(Cu,Fe)S \cdot 2Sb_2S_3$) The polish is good with a brownish grey tint - just slightly ~~darker~~ darker than bournonite. However, it is slightly ~~harder~~ harder than this mineral and can be distinguished by its high relief under the binocular. It is completely isotropic. It generally shows quite rounded outlines against galena or bournonite. All reagents are negative except $HNO_3$ which stains irridescent. It is generally found in small rounded grains but in one section, several large masses up to ½ cm across were found. A positive microchemical test for silver was obtained.

Bournonite - ($2PbS \cdot Cu_2S \cdot Sb_2S_3$) The mineral takes a smooth, fairly good polish and has a pale fawn colour against galena. It does not appear to be pleochroic but the anisotropism is distinctive, through deep blue - grey - yellow. This mineral very commonly shows multiple twinning and sometimes a cross-hatching effect is observed. All reagent negative except $HNO_3$ which produces a brownish irridescence. Under crossed nicols an area

of bornonite is seen to consist of a mosaic of interlocking crystals but not with automorphic outlines. It is generally found in rounded or blob-like intergrowths with galena & tetrahedrite.

Pyrite - ($FeS_2$) This mineral has a rough pitted surface and displays a yellow white colour. It is isotropic and generally developed as isolated subhedral grains which stand out sharply against the softer sulphides and sulphosalts. All reagents appeared to be negative against this mineral.

Barite - ($BaSO_4$) Generally this mineral occurs in rounded equigranular grains enclosing the sulphides. It is also found in veins through the ore minerals or in cleavage ~~cutting~~ pits in galena. It is white to colourless under reflected light.

Cerussite - ($PbCO_3$) The mineral is seen to have a medium grey colour (slightly darker than sphalerite) in reflected light. It shows a faint anisotropism in some instances ~~where~~ but for the most part, it appears to be isotropic. It occurs as fine grained secondary material which occurs in minute tiny veins and fractures which cut across most of the other minerals.

Covellite - ($CuS$) It occurs as tiny grains and plates within the veins of Cerussite. It has a blue-grey to a bright blue appearance. The anisotropism is very distinct going from a pink-white to a fiery orange-red which is characteristic of covellite. In some cases, the barite which is next these secondary minerals, has been stained a pale blue colour. This was at first thought to be a different mineral but the stains can be seen clearly with the binocular.

In addition ~~to~~ to these minerals there is considerable dolomite present since it is the material of the host rock. Quartz is present to a much lesser extent — $< 1\%$ of minerals.

Since there appear to be two separate assemblages of minerals — it is difficult to estimate amounts for the overall deposit. From an examination of the 2 types of ore, the following percentages were estimated:

1) For the upper — Barite — Bournonite - Freibergite assemblage:

| | |
|---|---|
| Barite | 35 % |
| Bournonite | 30 % |
| Freibergite | 17 % |
| Galena | 10 % |
| Sphalerite | 5 % |
| Cerussite + Covellite | 3 % |

2) For the lower — Sphalerite — Galena — Qtz - Pyrite assemblage:

| | |
|---|---|
| Sphalerite | 40 % |
| Galena | 20 % |
| Dolomite (host rock) | 20± % |
| Bournonite + Freibergite | 10 % |
| Quartz + Barite | 6 % |
| Pyrite | 3 % |
| Cerussite + Covellite | <1 % |

Textures: The most striking feature of the inter-relation of the different mineral types is that almost all borders are rounded. When one observes the frequency with which examples of mottled, pseudo-eutectic and vermicular textures are seen, the dominent process would appear to dissolution [illegible] of some of the minerals. However on a larger scale many pieces of evidence indicate that the dominent process was replacement. There is no regularity of certain minerals always being enclosed in others, although sphalerite blebs are occasionally found enclosed by all the later minerals. Galena is enclosed in bournonite + freibergite [illegible] but the reverse is occasionally found. A vein of galena was observed cutting across sphalerite in one section, in a rough manner, successive layers of the ore minerals were seen — sphalerite surrounded by galena, surrounded by freibergite which was

in turn surrounded by bournonite. Pyrite is the only mineral which displays outlines which tend to be automorphic. This is because it is an early formed mineral and is considerably harder than the rest of the ore minerals. Galena often occurs as vermicular or myrmekitic blebs in bournonite or freibergite. However, it can also be seen surrounded by these minerals and having scallop or cusp like embayments which are mostly convex towards the galena.

Where galena and sphalerite are in contact with the host rock, the dolomite is quite ragged and embayed. Small stringers of both these minerals are commonly found completely within the host rock, but only near the ore-host rock contact. This was interpreted as incipient replacement of the dolomite.

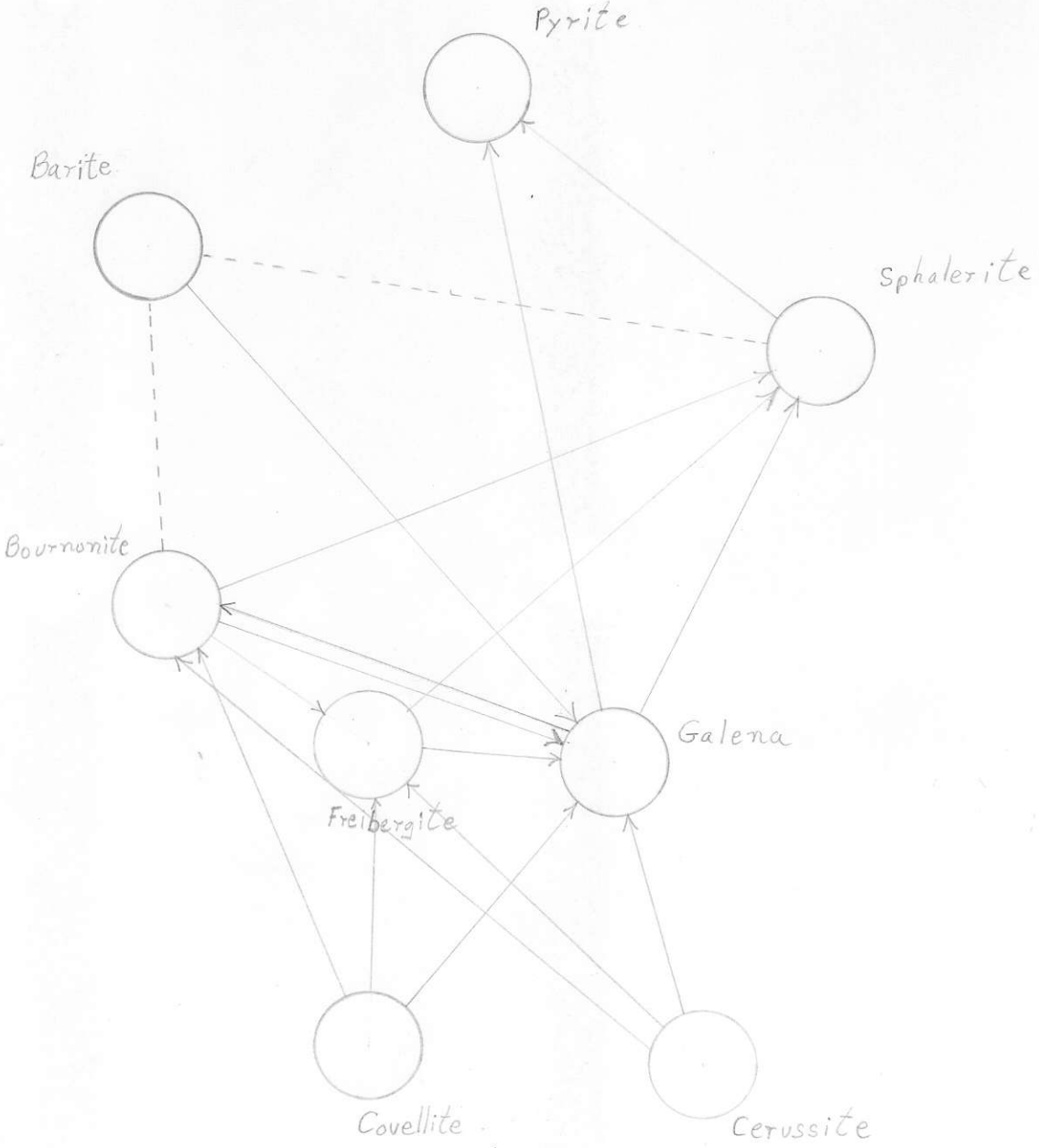
The only other texture of note is the partial replacement of galena and bournonite (and freibergite?) by cerussite and covellite. Many tiny fractures within these minerals are seen to be filled with these secondary minerals. Cerussite is by far the most important of these minerals with covellite only occurring as small grains and plates — usually on the outside of each cerussite "vein".

Paragenesis: The evidence points to successive replacement of the dolomite host rock by Sphalerite, Galena, freibergite, bournonite and barite. However these cannot be distinctly separated and there was probably overlapping in the time of deposition. There may even have been several periods of mineralization since there seem to have been at least two periods of deposition of galena. The formation of the cerussite and covellite is definately a supergene process which occurred at some later time.

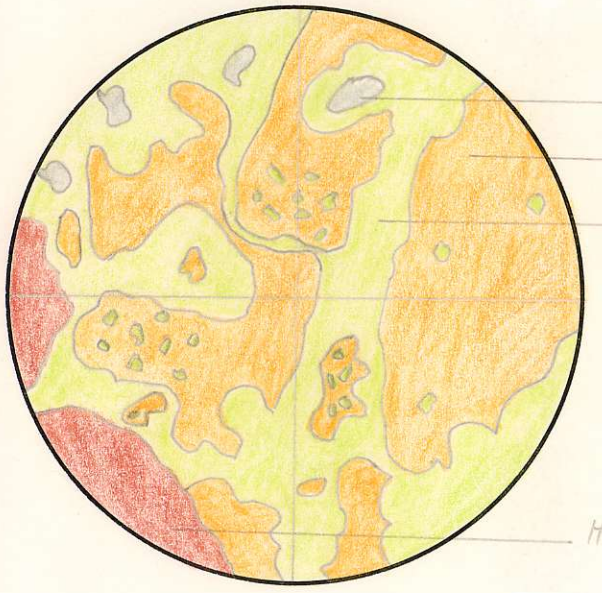
The deposit appears to be a hydrothermal replacement of dolomitic rocks by sulphide solutions. These solutions were probably directed upwards by steeply dipping faults. There appears to be an irregular zoning in this deposit with a concentration of Qtz - Galena - Sphalerite & Pyrite

pyrite ~~[illegible]~~ in the lower parts of the ore bodies and the lower temperature Bournonite - Jeffbergite - barite in the upper parts. From the assemblage of minerals present - the deposit would appear to be of the mesothermal type.

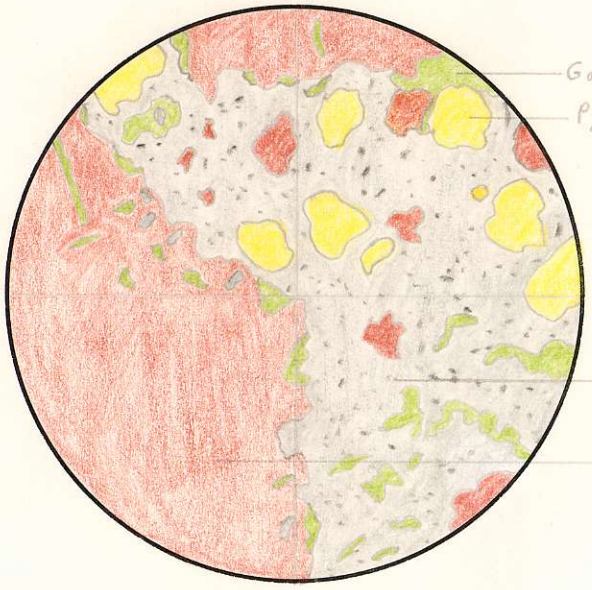
# Paragenesis



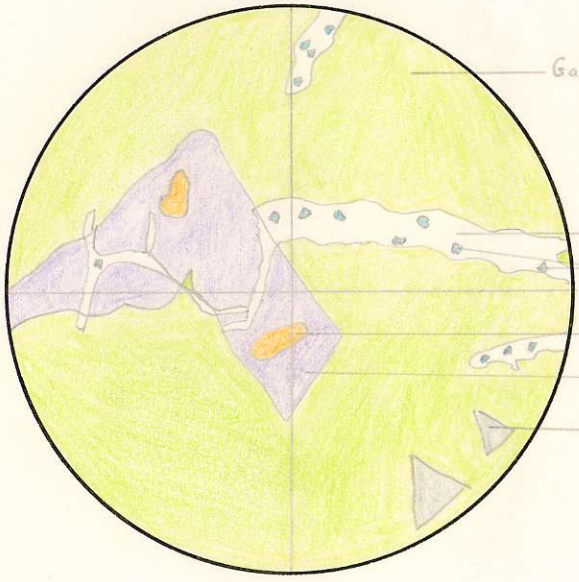
2·7 m.m.


Sphalerite
Freiburgite
Galena
Hostrock (limestone)

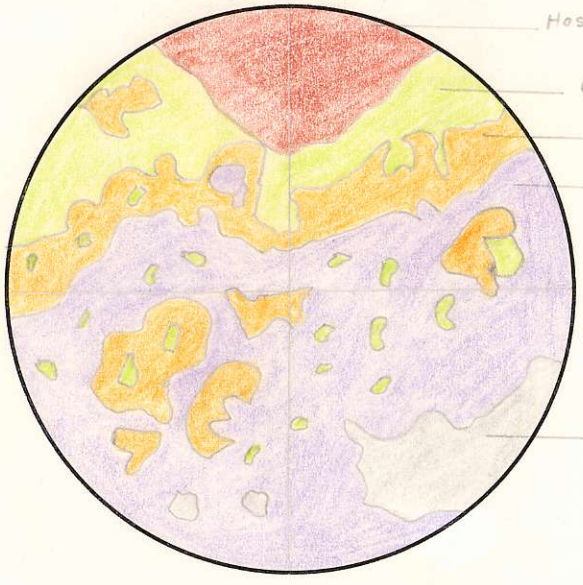
2·7 m.m.


Galena
Pyrite
Sphalerite
Limestone-Dolomite

960 μ


Galena
Cerussite
Covellite
Freibergite
Bournonite
Barite

960 μ


Host Rock (Lst- dolomite)
Galena
Freibergite
Bournonite
Sphalerite