ROSSLAND NEW MINES

ROSSLAND, B.C.

PROBLEM 4

A Geology 409 Report by:

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GENERAL GEOLOGY

During the Jurassic, batholithic invasions of Nelson granodiorite, diorite porphyry, and monzonite were accompanied by fracturing of the older rocks. In these fracture-zones, solutions from the cooling magma deposited rather low-grade sulphides. A second fracturing, which largely followed the earlier shear-zones, occurred when the Tertiary pulaskite batholith intruded. In these the highly alkaline solutions from this intrusive deposited sulphides much richer in precious metals the Mesozoic sulphide-deposition.

MINERALOGY

MEGASCOPIC FEATURES:

The hand specimens show fine-grained, disseminated or roughly banded, massive sulphides in a wall-rock gangue of sericitized rock. There is a little carbonate and quartz throughout.

MICROSCOPIC FEATURES:

1. PYRITE - FeS_2

POLISH - poor, pitted surface
COLOR - pale brass-yellow
HARDNESS - 6½
ISOTROPIC - sometimes weakly anisotropic
ASSOCIATION - all the other minerals; seem to have formed at every stage of mineralization
ETCH TESTS -
HCl, KCN, $FeCl_3$, KOH, $HgCl_2$: (-)
HNO_3, aqua regia : slight tarnish and effervescence
MICROCHEMICAL TESTS - (+) Fe

2. ARSENOPYRITE - FeAsS

POLISH - fairly good, for a hard mineral
COLOR - white to pale creamy

HARDNESS - 6½

ANISOTROPISM - strong (blue-green)

TWINNING - compound twins seen in some grains

ASSOCIATION - gold and stibnite especially

ETCH TESTS -

HCl, KCN, $FeCl_3$, KOH, $HgCl_2$: (-)

HNO_3 : stains irridescent

MICROCHEMICAL TESTS - (+) Fe, As

3. PYRRHOTITE - $Fe_{1-x}S$

POLISH - good

COLOR - pale pinkish brown

HARDNESS - 3½-4

STREAK - grey-black

PLEOCHROISM - very weak

ANISOTROPISM - strong (yellowish, greenish and reddish brown)

ASSOCIATION - chalcopyrite, pentlandite, niccolite, pyrite, gersdorffite

ETCH TESTS -

$HgCl_2$, KCN, HCl, $FeCl_3$: (-)

HNO_3, KOH : tarnishes brown

MICROCHEMICAL TESTS - (+) Fe

4. SPHALERITE - (Zn,Fe)S

POLISH - good

COLOR - grey-brown

HARDNESS - 3½

ISOTROPIC

INTERNAL REFLECTION - fairly good -- reddish brown

ASSOCIATION - stibnite, pyrite, gold

ETCH TESTS -

HCl, KCN, $FeCl_3$, KOH, $HgCl_2$: (-)

HNO_3 : (+) fumes tarnish, slowly stains brown

MICROCHEMICAL TESTS - (+) Zn, Fe

5. CHALCOPYRITE - $CuFeS_2$

POLISH - good

COLOR - bright yellow

HARDNESS - 3½ - 4

STREAK - greenish-black

ANISOTROPISM - weak (grayish blue and greenish yellow)

ASSOCIATION - pyrrhotite, pentlandite, niccolite, gersdorffite, pyrite

ETCH TESTS -

HCl, KCN, $FeCl_3$, KOH, $HgCl_2$: (-)

HNO_3 : fume tarnish

$AgNo_3$; turns black

MICROCHEMICAL TESTS - (+) Cu, Fe

6. GALENA - PbS

POLISH - good, usually triangular pits

COLOR - galena white

HARDNESS - B

PLEOCHROISM - neg.

ISOTROPIC

CLEAVAGE - perfect cubic

ETCH TESTS -

HNO_3 : stains black

HCl : tarnishes brown to irridescent

$FeCl_3$: tarnishes irridescent

KCN, KOH, $HgCl_2$: neg.

MICROCHEMICAL TESTS - (+) Pb

7. TETRAHEDRITE - ($5Cu_2S.2(Cu,Fe,Zn)S.2Sb_2S_3$)

POLISH - good

COLOR - greenish to brownish grey

HARDNESS - 3½ - 4

ISOTROPIC -

ASSOCIATION - with the other sulfo-salts and pyrite

ETCH TESTS -

HCl, KCN, $FeCl_3$, KOH, $HgCl_2$: (-)

HNO_3 : slow tarnish, irridescent

MICROCHEMICAL TESTS - (+) Cu, Fe, Zn, Sb

8. BOULANGERITE - $5PbS \cdot 2Sb_2S_3$

POLISH - fair

COLOR - white, with pale greyish-green tint

HARDNESS - B

PLEOCHROISM - weak; distinct

ANISOTROPISM - strong; distinct (tan brown to grey to blue)

ETCH TESTS--

HNO_3 : effervesces, with irridescent tarnish

KOH, KCN, $FeCl_3$, $HgCl_2$: neg.

MICROCHEMICAL TESTS - (+) Pb, Sb

9. PYRARGYRITE - $3Ag_2S \cdot Sb_2S_3$

POLISH - good, easy

COLOR - bluish-grey

HARDNESS - B^+

PLEOCHROISM - distinct, strong (bluish-grey to pale creamy-grey)

ANISOTROPISM - strong, partly masked by internal reflection

INTERNAL REFLECTION - strong, scarlet

ETCH TESTS -

HI : brings out texture

HNO_3 : slowly stains grey to brown, otherwise neg.

HCl : gives halo effect, does not wash off

KCN : quickly stains brown to dark grey

$FeCl_3$: deposits only ppt., no etching

KOH : stains dark grey to irridescent

Light Etching : rapid; to grey color

MICROCHEMICAL TESTS - (+) Ag, Sb

10. OWYHEEITE - $5PbS \cdot 4Ag_2S \cdot Sb_2S_3$

POLISH - fair

COLOR - grey-white with greenish tint

HARDNESS - B

PLEOCHROISM - distinct

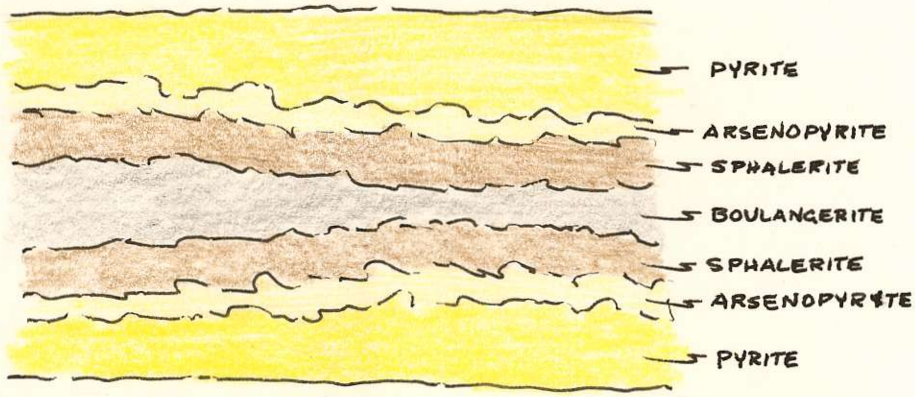
ANISOTROPISM - strong (yellowish white to grey)
TEXTURE - occasionally triangular pits
ETCH TESTS -
HNO_3 : stains differentially irridescent
HCl : fumes tarnish
KOH : slow, yields a vari-colored coating
KCN, $FeCl_3$, $HgCl_2$: neg.
MICROCHEMICAL TESTS - too small to test

11. MARCASITE -FeS_2
POLISH - fair
COLOR - pale creamy-yellow
HARDNESS - 6
PLEOCHROISM - weak
ANISOTROPISM - niccolite, chalcopyrite, pyrrhotite
ETCH TESTS -
$HgCl_2$, KOH, KCN, HCl, $FeCl_3$: (-)
HNO_3 : tarnishes brown
MICROCHEMICAL TESTS - (+) Fe

TEXTURES AND PARAGENESIS

The rough banding observed in hand-specimen and polished section possesses definite characteristics of fracture-filled ore mineralization. The shear-zone fractures are of many variable widths. This is evidenced by some banding which includes pyrite, arsenopyrite, sphalerite, boulangerite, sphalerite, arsenopyrite, pyrite, and other "banding" which has only pyrite and arsenopyrite as disseminated masses.

1½ x



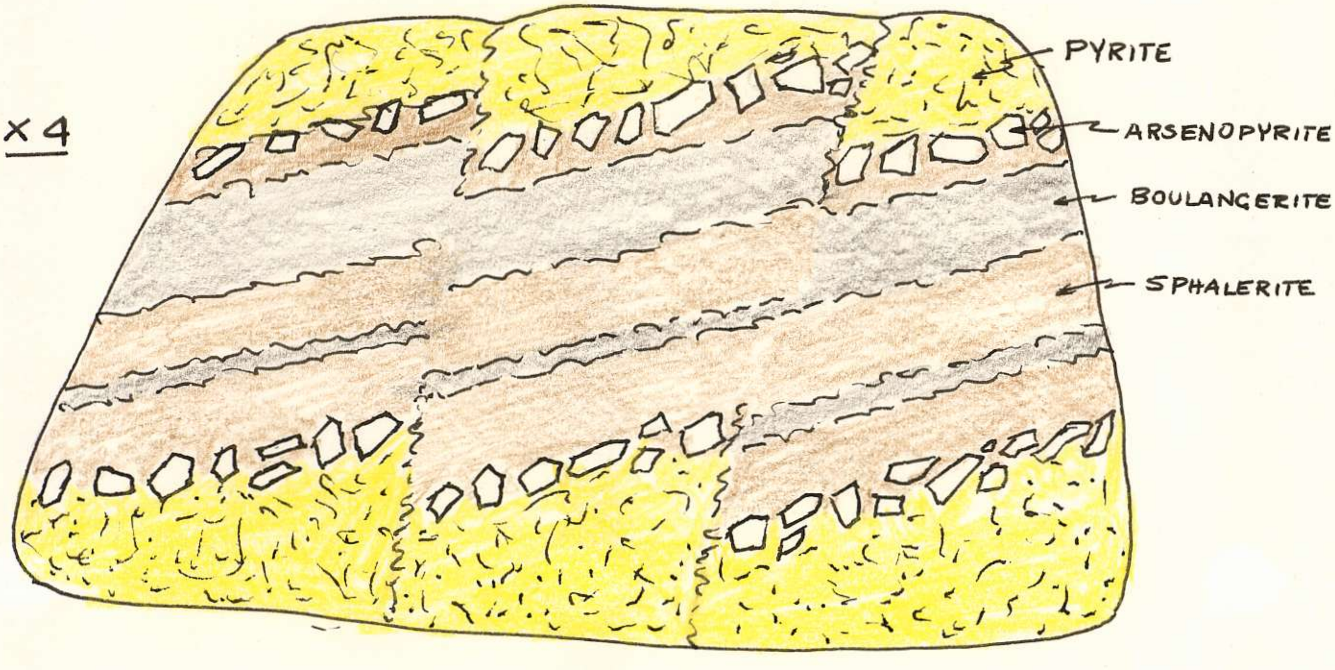
There appear to be two generations of mineralization. The first aqueous mineralizing solutions to ascend through the permeable portions of the fracture fissures deposited pyrite, arsenopyrite and pyrrhotite. They were relatively poor in precious metals.

Later, a second generation of precious metal-bearing solutions ascended the same channels and filled in the remaining, unfilled portions of the fracture fissures. According to the regular sequence of deposition, the mineralizing reacted with the wall rock, became supersaturated, and precipitated. The resultant sequence was more pyrrhotite, sphalerite, chalcopyrite, galena, tetrahedrite, boulangerite, pyrargyrite, and owyheeite.

A post-depositional event was supergene alteration of pyrite, pyrrhotite and sphalerite to marcasite. Acidic conditions must have gradually developed and likely still exists at the present time.

Another post-ore feature was minor faulting. It can be seen in one of the polished sections:

x 4



They appear to be small reverse faults and show brecciation of the pyrite and arsenopyrite. However, it seems that sufficient temperature and pressure were produced to alllow minor remobilization of the other minerals because they show occasional continuation across the fault line.

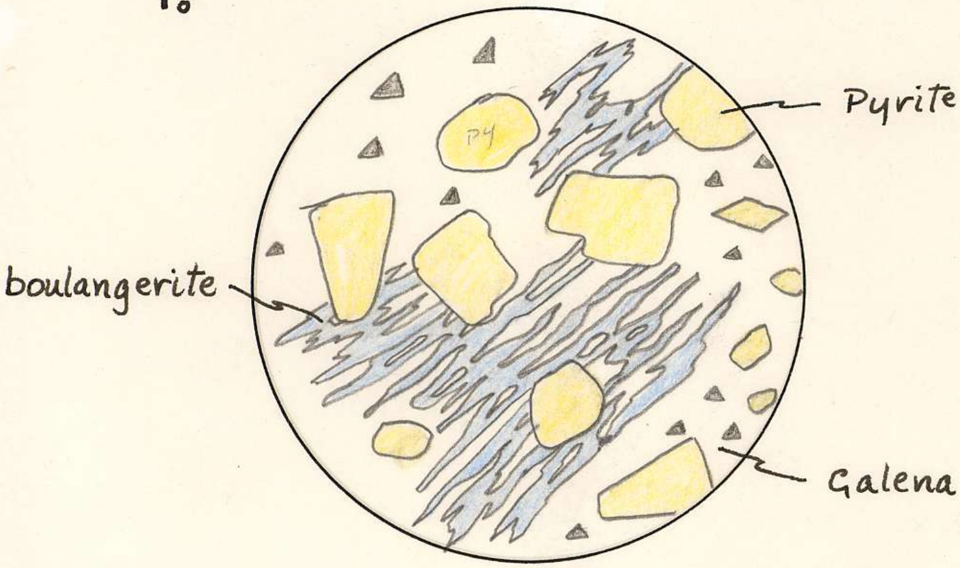
The minerals present and their coarse eutectic texture indicate a complete overlapping of all three temperature divisions of hydrothermal deposits. Early deposition of the pyrite, arsenopyrite and pyrrhotite denotes a high temperature (hypothermal) environment. Deposition of galena, tetrahedrite, sphalerite, chalcopyrite and boulangerite denote a mesothermal environment. Finally, the silver sulfo-salts--pyrargyrite and owyheeite-- indicate a definite cooling to below 250°C (epithermal).

The ore body can be classified as an epigenetic replacement deposit along shear or sheeted, fissure zones.

MODE:-

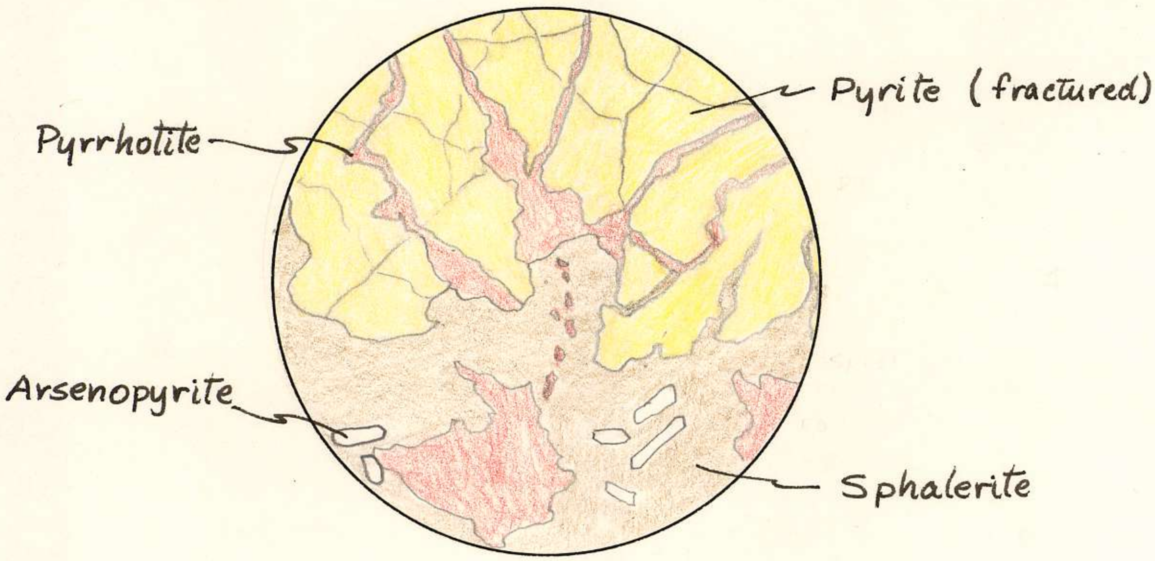
Pyrite	30	%
Arsenopyrite	8	%
Pyrrhotite	15	%
Sphalerite	15	%
Chalcopyrite	5	%
Galena	10	%
Tetrahedrite	5	%
Boulangerite	10	%
Pyrargyrite	0.09	%
Owyheeite	0.01	%
Marcasite	1.9	%
	100	%

1.


Pyrite
boulangerite
Galena

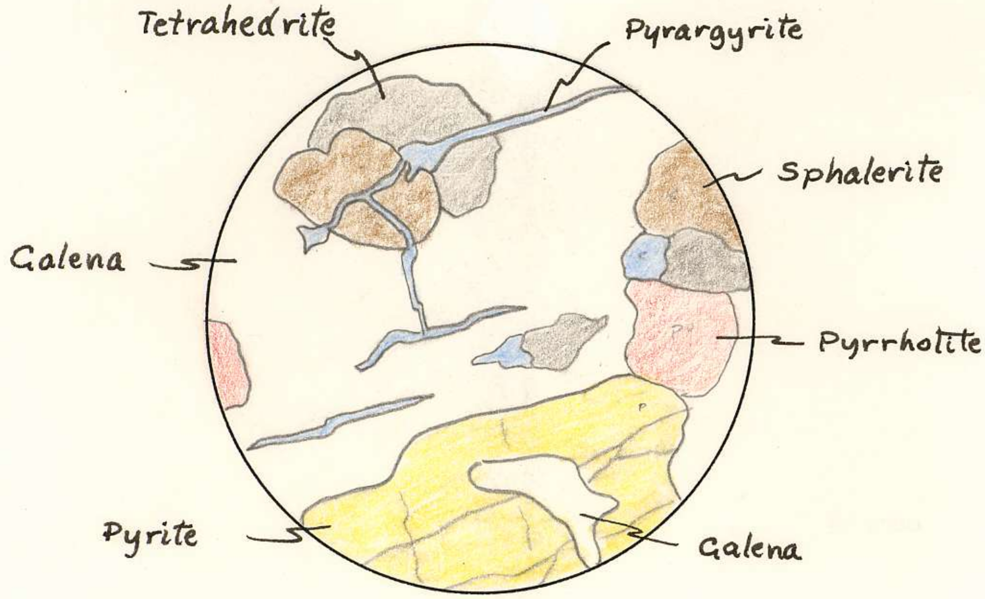
x 50

2.


Pyrite (fractured)
Pyrrhotite
Arsenopyrite
Sphalerite

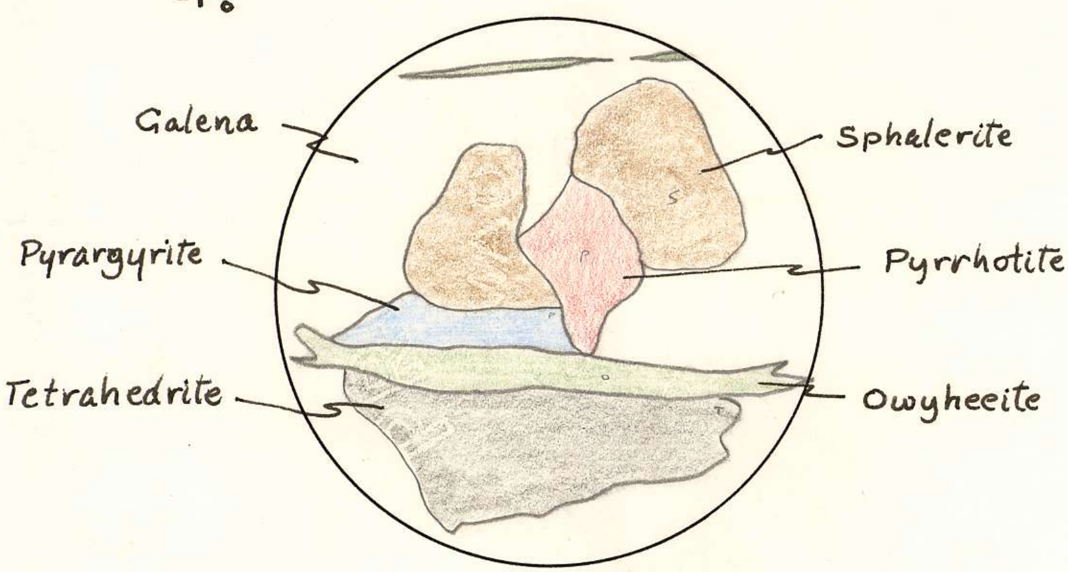
x 50

3.


Tetrahedrite
Pyrargyrite
Sphalerite
Galena
Pyrrhotite
Pyrite
Galena

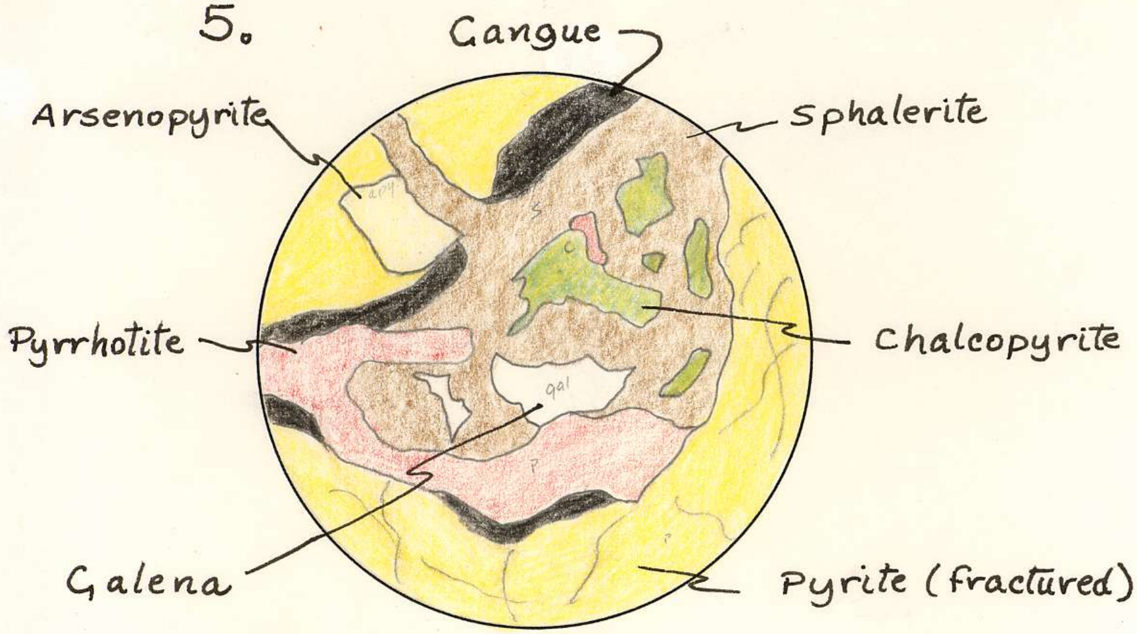
X 200

4.


Galena
Sphalerite
Pyrargyrite
Pyrrhotite
Tetrahedrite
Owyheeite

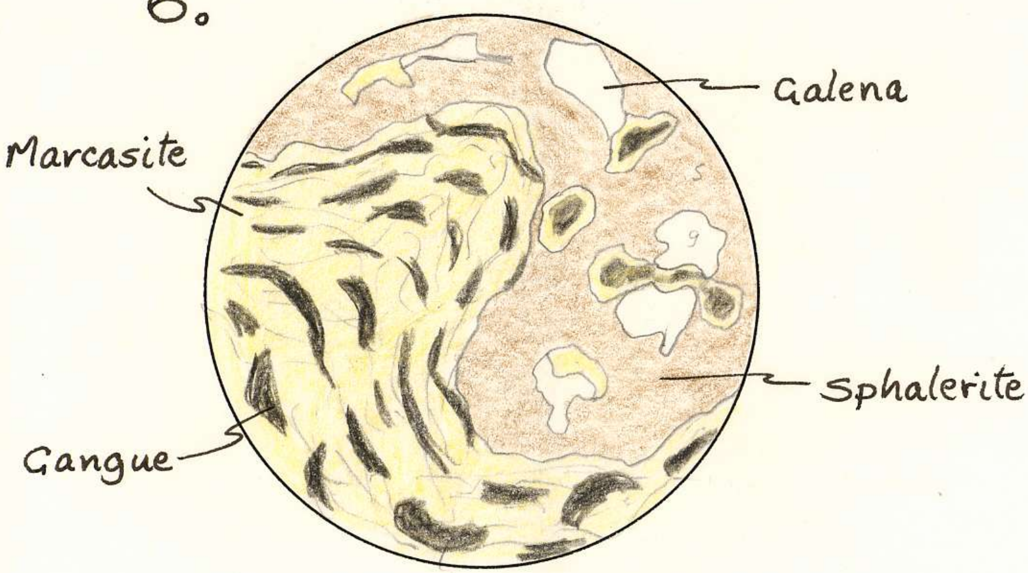
X 200

5.


Gangue
Arsenopyrite
Sphalerite
Pyrrhotite
Chalcopyrite
Galena
Pyrite (fractured)

X 200

6.


Galena
Marcasite
Sphalerite
Gangue

X 200

PARAGENETIC SEQUENCE