GEOL. 409 Problem.
March 1956

SILVER ORE FROM THE OLD BLUE BIRD - MAYFLOWER MINE, ROSSLAND

C. [illegible]

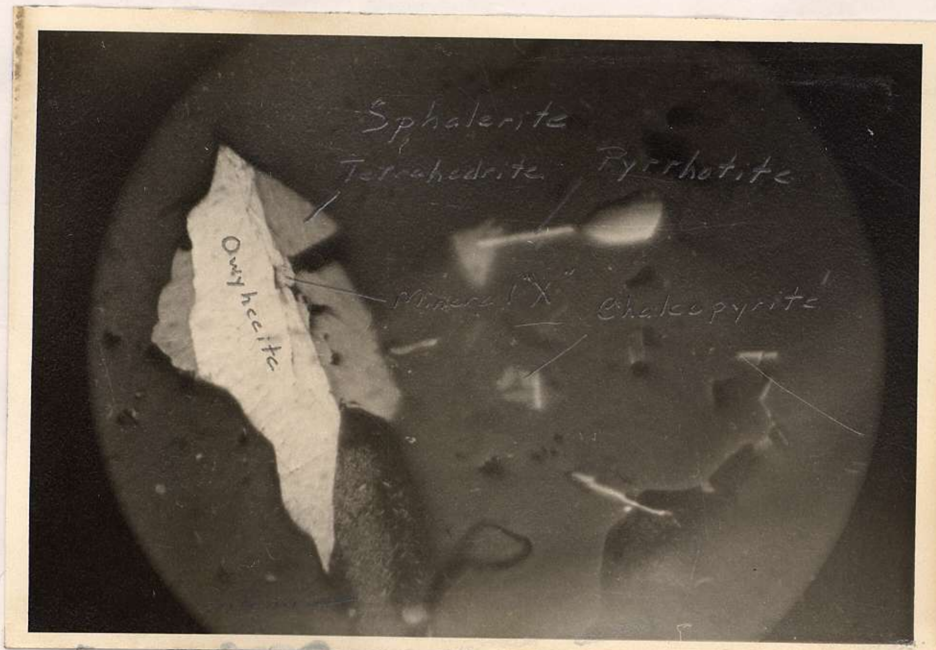
one of the poorest efforts in the past 5 years

Fail.

150 X

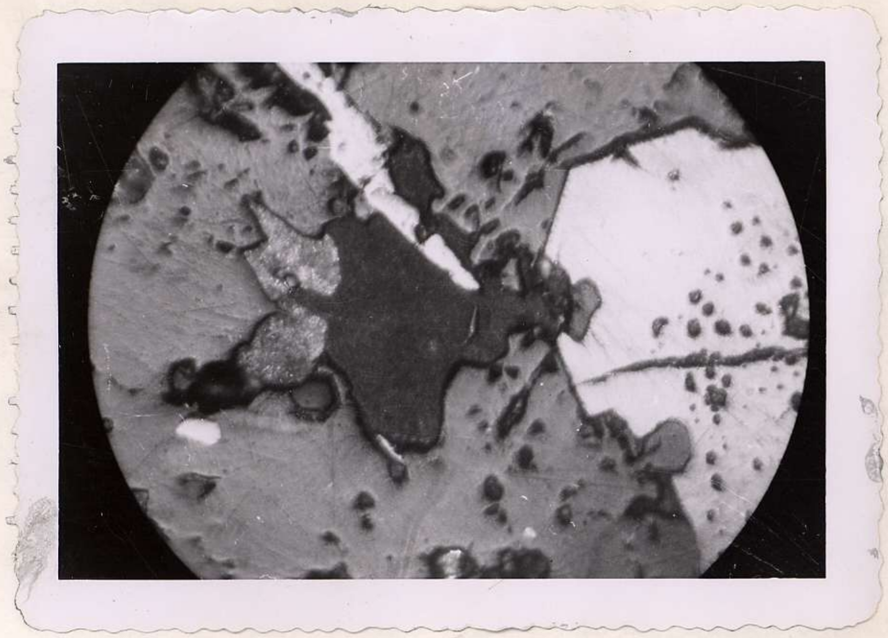
Cubic Pyrite, Rhomb of Arsinopyrite
Background of Boulangerite,
White Nebulous Owyheeite

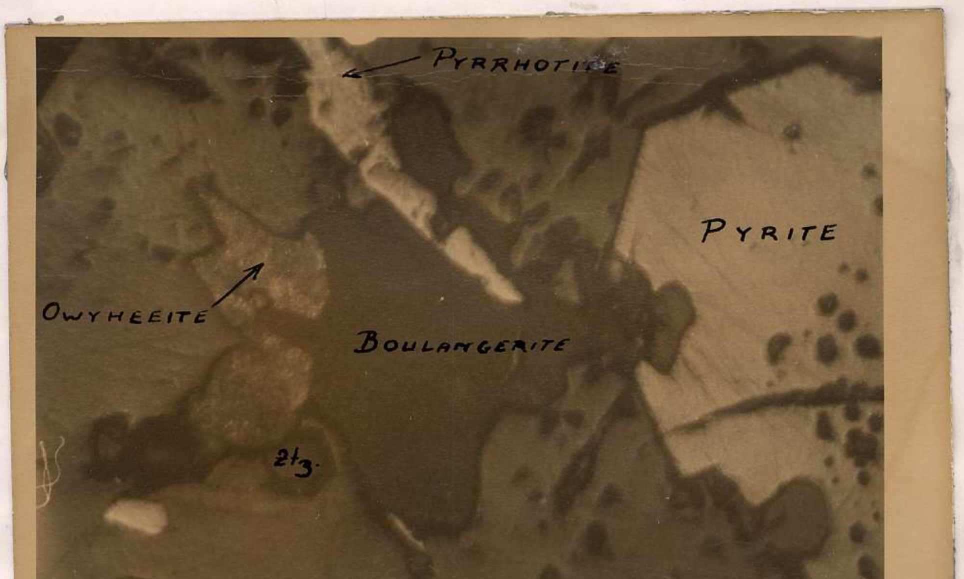
Etched 15 sec with HNO_3
Partly crossed Nicols



800 X Oil Immersion

Laths of Pyrrhotite, blebs of Chalcopyrite and exsolved unknown (unetched) in Galena (etched with HNO_3)





150 X Shows corrosion of euhedral Pyrite
Etched 15 sec with HNO_3, Nicols partly crossed.

ORE SAMPLE FROM THE OLD BLUEBIRD-MAYFLOWER MINE, ROSSLAND

INTRODUCTION

The object of this study is to determine the nature of the silver bearing minerals in the ore from the Old Bluebird-Mayflower Mine worked by the Rossland New Mining Company, and to determine the nature of the accompanying minerals and the conditions of their deposition.

MACROSCOPIC EXAMINATION

Minerals are predominantly base-metal sulphides in a fine grained disseminated replacement deposit, Brecciated euhedral pyrite and pyrrhotite in a groundmass of Boulangerite and Sphalerite. The gangue consists of sericitized rock and some quartz. A rough banding is apparent in the distribution of the pyrite crystals.

MICROSCOPIC EXAMINATION

Minerals Found	Approximate %
Pyrite	50 %
Pyrrhotite	3
Boulangerite	30
Sphalerite	15
Arsenopyrite	1
Galena Tetrahedrite Owyheeite Chalcopyrite Unknown	1

The Arsenopyrite is in small euhedral crystals replaced to some extent by later minerals. The pyrite is also euhedral and anomalously anisotropic and is brecciated and "healed" with Sphalerite showing exsolution and segregation textures with pyrrhotite. Boulangerite occurs in large quantities in needle-like crystal aggregates with Owyheeite in irregular laths. Galena is sparse and occurs with minute intergrowths of Owyheeite and Tetrahedrite.

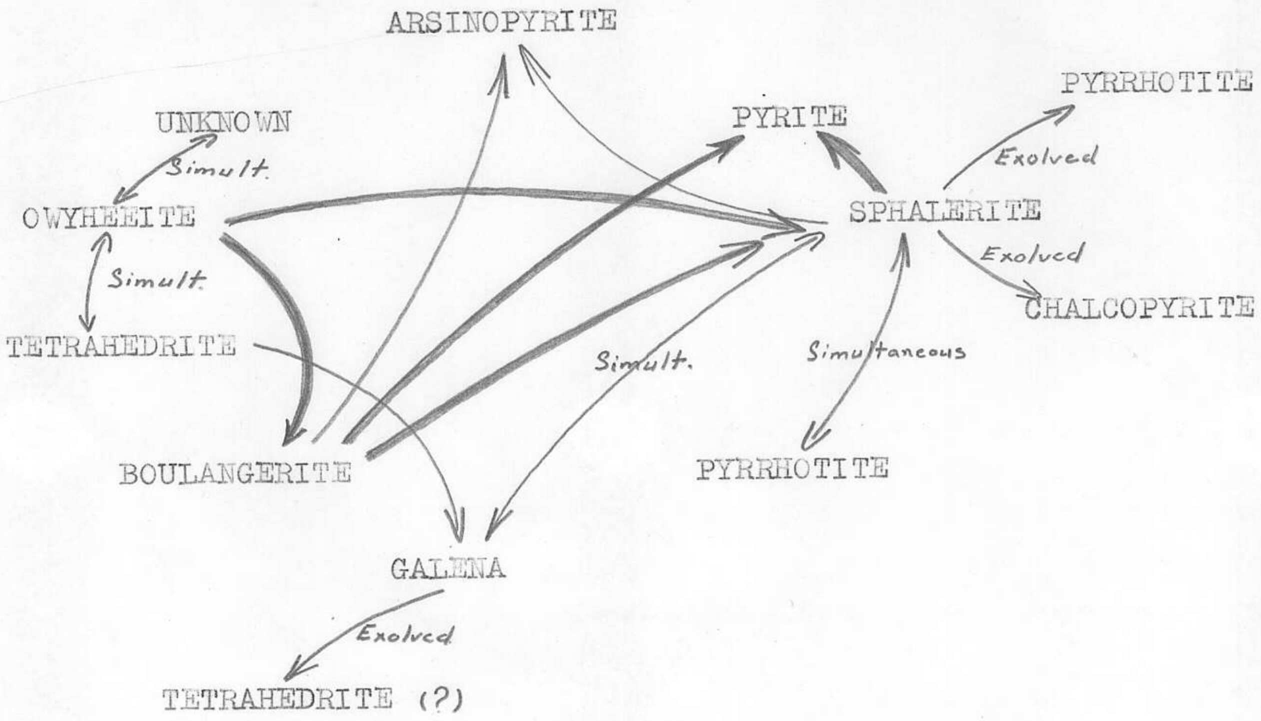
PROBLEMS AND ETCH CHARACTERISTICS OF OWYHEEITE

Owyheeite is difficult to determine from its etch-characteristics as it resembles many others in this respect and as its reaction to the reagents is variable. X-Ray spectrograph is required for positive identification.

Unetched Boulangerite and Owyheeite resemble each other closely and it is difficult to tell one from the other. They can be distinguished by etching with Nitric acid for 10 seconds. The Boulangerite becomes etched while the Owyheeite escapes in part, although not entirely, and there are still difficulties due to the inconsistant action of the acid and the lack of contrast for photographing. For rapid identification and good photographing it is best to etch with nitric for 15 seconds and adjust the polarizing nicols (10° from being crossed) until the etch product on the Owyheeite appears a brilliant mottled chartreuse against the duller Boulangerite giving a striking contrast. In photographing, care must be taken not to over-expose or the Owyheeite will appear as a white diffuse nebula.

HCl is almost negative although the fumes around the drop stain a light brown. HCl is negative when Owyheeite is in contact with Galena. KCN is definitely negative. $FeCl_3$ stains a strong brilliant blue and the etch product shows a strong blue to brown anisotropism. This reaction caused some difficulty. Short (p.132) and Uytenbogart (p.62) give the reaction as negative. The writer found it to be negative in contact with Galena (which reacted strongly) and strongly positive in contact with Boulangerite (itself negative)

PARAGENETIC RELATIONSHIPS OBSERVED IN ORE



KOH will stain a brown colour but rubs off. $HgCl_2$ only slightly affects the mineral. Aqua Regia is quick and in 10 seconds stains a dull brown, in contrast to Boulangerite (irridescent). While using an oil immersion lens the writer first found Owyheeite in minute intergrowths with Tetrahedrite, Galena and an unknown mineral. Although the Owyheeite was later found in the Boulangerite in much larger quantities, it seemed necessary at the time to identify it under the oil immersion in order to see enough of it to determine the effect of the etch reagents. However, Galena, being very sensitive to the reagents, it was necessary to do considerable buffing to remove the etch for a new reagent. This usually destroyed the minute grains also and new ones had to be found and identified before the etching could continue.

Among the grains to disappear was the "unknown" mentioned appearing in the immersion photograph.

SUMMARY OF CHARACTERISTICS

HNO_3	HCl	KCN	$FeCl_3$	KOH	$HgCl_2$	Aqua Regia
(+)	(−) Fumes Stain.	(−)	(−) or (+)	(−)	(−)	(+)

Colour - Galena white with an olive tint, particularly under oil

Hardness - B, same as Boulangerite

Anistropism - strong, yellowish white to grey

Internal Reflection - none

PARAGENETIC RELATIONSHIPS are complex. On the opposite page is a diagram of those relationships observed. Arsinopyrite and Pyrite occur together and their relationship in time is doubtful. Sphalerite replaces brecciated Pyrite strongly and Arsinopyrite weakly at the same time exolving Pyrrhotite along

along its structures, apparent as tiny laths with the oil immersion lens. Galena is rare but occurs as simultaneous deposition with sphalerite and exolves tetrahedrite along its cleavages (see oil immersion photo).

Boulangerite shows a preference for Sphalerite and leaves inclusions of Pyrrhotite partly replaced by later minerals and it partly replaces Pyrite. Owyheeite occurs chiefly in the Sphalerite and Boulangerite with a preference for the latter. Tetrahedrite and Owyheeite occur as intergrowths indicating simultaneous deposition and the Tetrahedrite shows textures of replacement of Galena.

In oil immersion (see photo) small orange blebs of Chalcopyrite appear in the Sphalerite, probably due to solid solution separation.

The ability of Owyheeite to replace Pyrite is doubtful because of the complex history. Textures suggesting replacement are observed between the Owyheeite and Pyrite could be due to indirect replacement, eg. Pyrite, Sphalerite, Boulangerite, Owyheeite.

TEMPERATURE OF FORMATION

The presence of the Pyrrhotite presents a problem. If some of it was deposited initially independent of the Sphalerite an initial temperature of 600° C. in indicated. If it was entirely derived from exsolution from the Sphalerite (and some of it unquestionably is) this would require a temperature somewhere between 138 - 394°C. (p. 92, Edwards) at some time during deposition at which exsolution could begin. Lack of replacement textures, however, suggests that the Pyrrhotite is all derived from a Pyrrhotite-Sphalerite solution before and after it was deposited.

The temperature of solidification must be relatively high in the range because of the high percentage of Pyrrhotite (20% of Sphalerite) which would speed separation. The Chalcopyrite would be exsolved from the Sphalerite at 350-400°C. or lower. These considerations fix the temperature of the Sphalerite phase at about 400°C. when deposited.

Due to the high proportion of Pyrrhotite and a rock temperature not too much lower than the solution segregation took place to some extent. Cooling was moderately rapid, however, and the remainder of the Pyrrhotite was exsolved along the crystal direction of the Sphalerite.

The Pyrite is a persistant mineral and tells us nothing of the temperature; however, the Arsinopyrite suggests a higher temperature in the initial stages. As colling progressed at a moderate rate, Tetrahedrite was exolved from the Galena and at a lower temperature still, the Tetrahedrite and Owyheeite were deposited.

The temperatures involved in this paragenetic sequence are, for the most part, in the Hypothermal range with moderate cooling rate to the Mesothermal range.

CONCLUSION

This ore is a high to medium temperature (200-500°C) disseminated deposit of Arsinopyrite, brecciated Pyrite with Sphalerite and Boulangerite and minor Pyrrhotite, Galena, Tetrahedrite and Owyheeite. The latter occurs in minute intergrowths with Tetrahedrite and an unknown and as moderate though common replacements in the Sphalerite and Boulangerite.