A MICROSCOPIC STUDY OF MINERALIZATION ON THE GRACEY GROUP, UNUK RIVER, B. C.

A report submitted in partial fulfilment of the requirements in the course of Geology 409 in the Department of Geology and Geography, University of British Columbia.

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W. HOLYK

April, 1949

ABSTRACT

This report describes a microscopic examination of mineral specimens from the quartz veins on the Gracey group of claims, Unuk River, B. C.

Galena, pyrite, chalcopyrite, sphalerite, native gold, and two unidentified minerals which may be tellurides have been recognized in the galena-pyrite type of mineralization. The specularite type contains only specular hematite and gold. Only pyrite, chalcopyrite, and magnetite were observed in the pyrite-chalcopyrite type of mineralization.

ACKNOWLEDGMENTS

The writer wishes to express his thanks to Dr. H. V. Warren and Dr. R. M. Thompson for their assistance and guidance in the laboratory work, and to Mr. J. A. Donnan for cutting the specimens and for his advice on the preparation of polished sections. The use of the polished sections prepared by Mr. R. H. Seraphim proved invaluable. The writer is also indebted to Mr. J. T. Fyles for his assistance in the laboratory and in microscopic photography.

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INTRODUCTION

The Gracey group of mineral claims occur on the south fork of the Unuk River about 30 miles northwest of Premier, B. C. The property is most easily reached via the Unuk River or by air to Boundary Lake and thence by trail. This group of claims was being explored by Leitch Gold Mines during the summer season of 1947.

Five of the eight quartz veins on the property are reported to give assays over one-half ounce in gold.[1] Polished sections of specimens representative of the mineralization on the property were prepared and studied. Ten polished sections prepared by the writer failed to show any minerals other than the common sulphides or specularite. Some twenty sections as prepared by Seraphim were repolished and subsequent examination revealed the presence of gold and two unidentified minerals.

1. Seraphim, R. H., Unpublished thesis, "A Gold Specularite Deposit, Unuk River, B. C." Dept. of Geology and Geography, University of B. C., 1948.

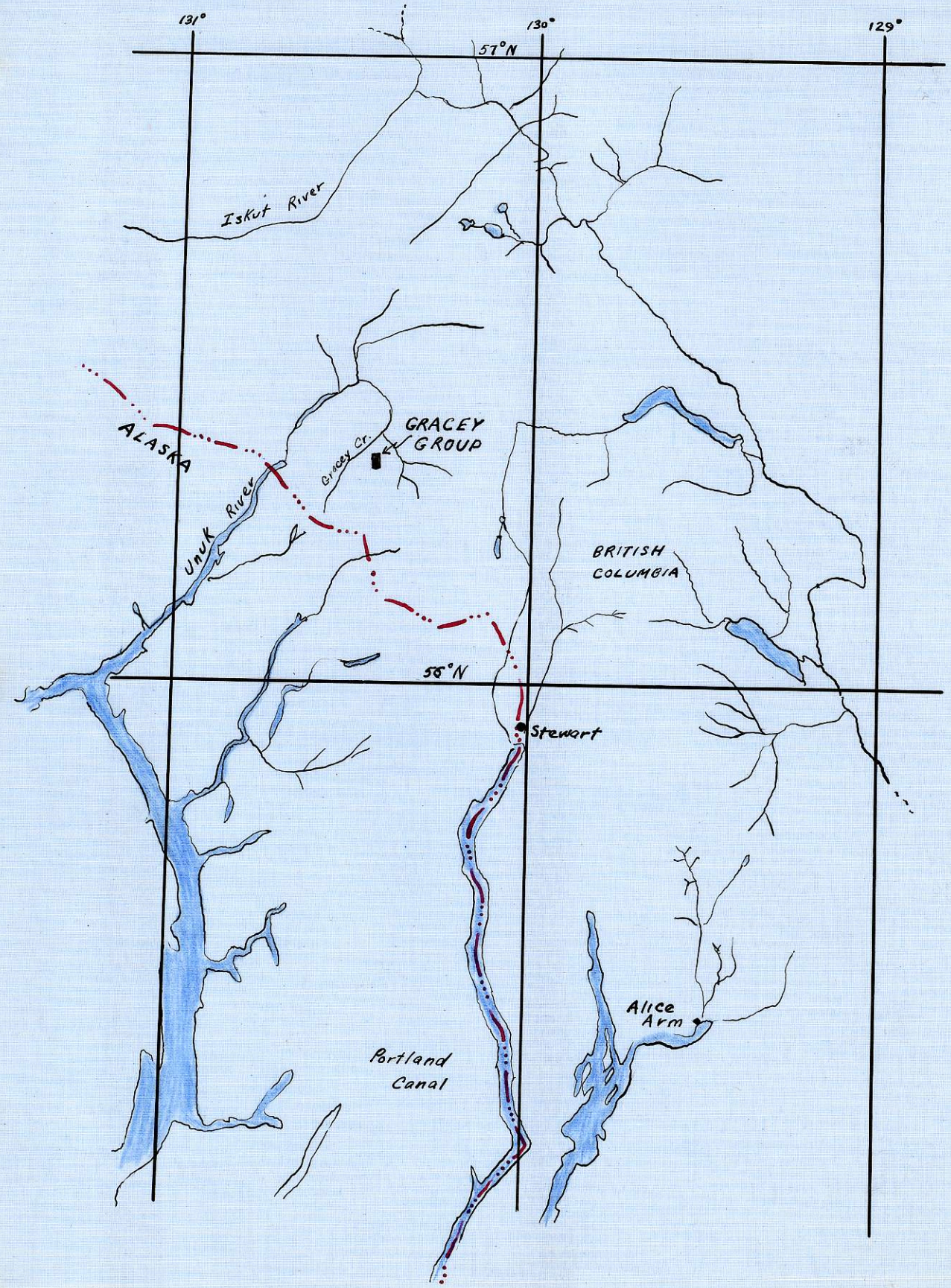


FIG. 1
Portion of Portland Canal
Map Area.

GENERAL GEOLOGY[1]

The Gracey group of claims lie on the eastern contact zone of the Coast Range batholith. The claims are underlain by sediments and volcanic rocks of Pre-Permian to Jurassic age. The rocks consist of limestone, argillite, tuff and siltstone. The local trend of the rocks is northwesterly dipping at moderate angles to the northeast. This group of rocks is intruded by stocks and sill like bodies of diorite gneiss and aplite, and syenite and lamprophyre dykes. The sediments have been closely folded in the claims area into several discontinuous northwest trending anticlines and synclines. The main body of the Coast Range batholith is exposed five miles to the southwest of the property.

The ore minerals are found in quartz veins up to 7 feet in width which have been formed along shear zones in massive dacite tuff. Some of the veins extend into the intrusive diorite where they diminish in width and also in values. The veins are all parallel, strike S 75° E , and dip steeply to the northeast. The veins lie between two sill like bodies of diorite gneiss which are about 1000 feet apart. Samples from five of the eight quartz veins sampled gave assays above one-half ounce in gold according to Seraphim.

1. op. cit., pp. 9-35.

Three types of mineralization have been recognized on the property by Seraphim. These consist of chalcopyrite-pyrite type, galena-pyrite type, and specularite type. The chalcopyrite-pyrite types of mineralization are represented by four quartz veins. Quartz carrying chalcopyrite is found on the footwall side of one vein whereas galena-pyrite occurs on the hanging wallside. The two types of mineralization are not separated by fractures. Galena-pyrite mineralization also occurs in three other veins.

Two veins are of special interest in that they lie along the same shear zone and are separated by a zone 30 feet long in which quartz is absent. This intervening shear zone is mineralized only with pyrite and some sphalerite. The western extension of the vein has galena and pyrite but no specularite. The eastern extension beyond the barren zone contains specularite but no sulphides.

MACROSCOPIC MINERALOGY

Specimens of the galena-pyrite type of mineralization are partly oxidized imparting a dark brown stain to the quartz. They show characteristics of both fracture filling and replacement. The galena is coarsely crystalline, massive, and fills irregular walled fractures in quartz. Pyrite occurs in the galena and quartz as irregular fragments which may retain an original cubic shape. The metallics form about 50% of the specimens examined.

The specularite specimens consist of approximately 50%

specular hematite in a gangue of quartz. The specularite is highly foliated, has a splendent metallic lustre, and yields a red streak upon being scratched. It is associated with fractures in the quartz. The irregularity of the fracture walls suggests some replacement. Several small vugs noticed in the specimens contained thin crystal plates of specularite. A brownish stain is imparted to the quartz. No other metallic minerals are associated.

Specimens of the chalcopyrite-pyrite type consist largely of crystalline pyrite cubes in a quartz gangue. The pyrite occurs in aggregates in which the individual crystals do not exceed several millimetres in width. Some of the pyrite has been oxidized leaving limonitic pits. The quartz is iron stained. Chalcopyrite cannot be observed in hand specimens.

MICROSCOPIC MINERALOGY

Galena-Pyrite Type

Galena

The galena is the most abundant sulphide. It is coarsely crystalline showing clearly the characteristic triangular pits. It has been formed by the filling of fractures in quartz and by replacement of the quartz and pyrite. Anglesite has partly replaced the galena along the cleavage faces of the more oxidized specimens (Fig. 5).

Pyrite

Most of the pyrite is associated with the galena, but may occur in cubic form within the quartz. It has been

been fractured and largely replaced by the galena. Residual pyrite fragments often suggest an original cubic form (Fig. 2). Some of the pyrite of Q 17 W vein appears free of fractures and its mutual boundaries with the galena is suggestive of contemporaneous deposition.

Chalcopyrite

The chalcopyrite is very sparsely distributed in the specimens. Where it is more abundant it is seen to vein and in part replace the quartz. These veinlets do not exceed 500 microns in length. It is also found as irregular elongated inclusions in the pyrite and generally as more rounded inclusions in galena. It has been introduced after the deposition of the quartz and probably after the pyrite but prior to the galena. The inclusions within the galena are thought to have resulted by the selective replacement of the quartz and pyrite by galena in preference to the chalcopyrite (Fig. 3).

Sphalerite

Sphalerite is not a common mineral. It occurs as small rounded inclusions in the galena or in the pyrite. It was also seen to occupy a fracture in quartz and was in turn veined by chalcopyrite. It has presumably been introduced prior to the chalcopyrite.

Gold

The gold is associated with the galena or quartz. Several small elongated veinlets up to 40 microns in length and several microns in width were observed to traverse the galena (Fig. 10), apparently filling a tiny fracture. The

gold is more often associated as an irregular intergrowth with two unidentified minerals in the galena. Elongated intergrowths of gold may be up to 50 microns in length but are very much narrower. More equidimensional grains rarely exceed 15 microns. The gold also occurs in irregular grains less than 15 microns in size in or near small fractures in the quartz.

Unidentified Minerals

Two unidentified white and grey minerals of metallic lustre occur as inclusions in the galena. They are generally found as aggregates but may occur alone. The aggregates consist of an intergrowth of the white and grey minerals with occasional anhedral fragments of gold suggesting contemporaneous deposition (Figs. 7 and 8). The aggregates are generally elongated and probably aligned along small fractures in the galena. Other occurrences of these minerals appear to be related to the cleavage traces of the galena (Figs. 6 and 9) The stringer like intergrowths may be as much as 100 microns in length but are considerably narrower. The largest inclusions of the minerals to be observed in polished sections (Fig. 6) was 75 microns in length and 35 microns in width. The white mineral may occur alone as rounded or elliptical grains usually less than 15 microns in size.

Microscopic examination revealed the following properties:

	Mineral No. 1	Mineral No. 2
Colour	white, whiter than galena	grey, slightly darker than galena
Internal Reflection	nil	nil
Anisotropism	nil	nil
Hardness	same as galena	same as galena
Cleavage	none observed	none observed
$HgCl_2$	negative	negative
KOH	some negative, others stain brown or black	negative
KCN	most negative, some stain grey	negative
$FeCl_3$	iridescent stain, same as on galena	negative
HCl	negative	negative
HNO_3	negative	negative

In all cases the etch reagents overlapped the galena. This may have interfered with the consistencies of etch reactions. The diagnostic values of these reactions are therefore limited.

The largest inclusion found in the galena (Fig. 6) was picked out and X-rayed by Dr. R. M. Thompsen. The X-ray pattern failed to reveal any mineral other than galena which was unavoidably present. All the polished sections containing these two minerals were re-ground and re-polished several times in an effort to bring up larger grains of these minerals. These attempts, however, proved disappointing in that no larger grains suitable for the X-ray were observed.

The following spectrographic analysis made on minute amounts of the minerals including some galena is reported by Seraphim[1]:

	" No. 1	No. 2
Ag	Medium	medium
Cu	weak	weak
Pb	present but known in galena included	
Te	trace	trace
As	strong	negative "

These minerals could not be identified by the properties and etch reactions of minerals listed by Short.[2] They are possibly tellurides. The white mineral may be altaite (PbTe) and the grey mineral petzite ($(Ag,Au)_2$ Te).

1. Op. cit., p. 44
2. Short, M. N., "Microscopic Determination of the Ore Minerals", U. S. G. S. Bull. 914, 1940.

Specularite Type

Specularite

The specular hematite observed in polished sections is highly lamellar and foliated. The cleavage laminae ~~are~~ are markedly twisted and bent. It is highly anisotropic and is negative to etch reagents. It occurs in fractures in quartz which it partly replaces. The specimens studied show a complete absence of metallic minerals other than gold.

Gold

The gold associated with the specularite occurs in more equidimensional grains than that associated with the galena. Grains of gold up to 50 microns in diameter occur in the minute 'folds' between cleavage laminae in the foliated specularite (Photomicrograph No. 1). The grains do not traverse the cleavage plates. Smaller irregular grains of gold may also occur in or near small fractures in the quartz.

Pyrite-Chalcopyrite Type

Pyrite

The pyrite occurs as euhedral crystals or as aggregates of subhedral grains in quartz. Later fractures affect both the quartz and pyrite grains. The crystals are generally less than 2 mm. in size. In one specimen containing chlorite in quartz the pyrite appears as irregular fragments in the chlorite and appears to be partly replaced by the chlorite. Several inclusions of pyrite occur in magnetite grains.

Chalcopyrite

The chalcopyrite occurs in irregular blebs along fractures in quartz. The longest particle seen was 350 microns in length. More equidimensional grains do not exceed 125 microns in diameter. The chalcopyrite was deposited after the pyrite. The fractures in which chalcopyrite is found also extend across the pyrite grains. A small speck of chalcopyrite was observed along a fracture in the pyrite.

Magnetite

Magnetite was observed only in one polished section which contained chlorite and quartz. The magnetite occurs as euhedral to subhedral grains in the chlorite. The grains are generally less than 500 microns in size. Several small stringer-like grains of magnetite appear to intersect quartz inclusions in the chlorite. Several crystals of magnetite have inclusions of pyrite (Fig. 4). The magnetite in other grains has been partly replaced by chlorite.

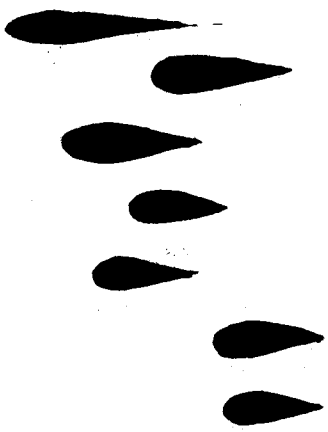
PARAGENESIS

The following diagrams will illustrate the sequence of the introduction of the various minerals as determined by the study of their relations. The width of the lines represent only the relative proportion of minerals deposited with respect to time and does not represent the abundance of the minerals present. The minerals are listed in an approximate order of abundance. The paragenesis is considered separately for the different mineral types which represent different

periods or composition of mineralization.

Galena-Pyrite Type

Quartz
Galena
Pyrite
Chalcopyrite
Sphalerite
Unidentified Minerals
Gold



Chalcopyrite-Pyrite Type

Quartz
Pyrite
Chalcopyrite
Magnetite — relation not determined except that it is later than the quartz.

Specularite Type

Quartz
Specularite
Gold

CONCLUSIONS

Microscopic examination of the polished sections substantiates the presence of three distinct types of mineralization consisting of:

(1) galena-pyrite type

(2) specularite type

(3) pyrite-chalcopyrite type.

Galena, pyrite, chalcopyrite, sphalerite, native gold, and two unidentified minerals which may be tellurides were observed in the galena-pyrite type of mineralization. The gold occurs alone or as an intergrowth with the unidentified minerals in the galena. It also occurs in the quartz. The gold grains average 15 microns in size.

Specularite and gold were the only metallics observed to be present in the specularite type of mineralization. Other sulphides are conspicuously absent. Specularite is also absent in other types of mineralization. Different conditions of deposition are indicated. Gold particles up to 50 microns in size occur in the specularite and smaller fragments occur in the enclosing quartz.

Gold appears to be absent in the pyrite-chalcopyrite type of mineralization. Pyrite, chalcopyrite, and magnetite were the only metallic minerals observed.

The white and grey minerals could not be identified in this investigation by etch reactions or the X-ray. The etch reactions as obtained may or may not be diagnostic because of

unavoidable overlap of the reagents unto the galena. Any subsequent identification will largely depend upon the discovery of particles of these minerals sufficiently large to respond to the X-ray. analysis

LIST OF MINERAL OCCURRENCES OF INDIVIDUAL SECTIONS

Gracey 1 to 5	: Galena, pyrite, chalcopyrite, sphalerite
Gracey 6 to 10	: Specularite

The following sections have been made by Mr. R. H. Seraphim and studied by the writer in this report.

Unuk Gracey Q 17	: Specularite, one piece of Au in quartz.
Unuk Q 17 A	: Specularite, several fragments of Au in specularite.
Q 17 B	: Specularite, several fragments of Au in specularite.
Unuk Q 17	: Specularite
Unuk Q 17 C	: Specularite, one piece of Au in specularite.
Unuk Q 17 D	: Specularite.
Unuk Gracey Q 17 #4	: Specularite.
Unuk Q 17 W	: Galena, pyrite, chalcopyrite.
Unuk Q 17 W #1	: Galena, pyrite, chalcopyrite, Au, white and grey minerals.
Unuk Q 17 W #2	: Galena, pyrite, chalcopyrite, Au, white and grey minerals.
Unuk Q 17 W #10	: Galena, pyrite, chalcopyrite, Au, white and grey minerals.
Unuk Gracey Q 17 W	: Galena, pyrite, chalcopyrite, Au, white and grey minerals.
Unuk Gracey Q 19	: Pyrite crystals, chalcopyrite and sphalerite inclusions.
McQ 22 A	: Galena, pyrite, chalcopyrite, sphalerite.
McQ 22 B	: Galena, pyrite, chalcopyrite, sphalerite.
Unuk Gracey Q 23	: Quartz, chlorite, pyrite, magnetite, chalcopyrite.
McQ 24 A	: Pyrite, chalcopyrite.
McQ 24 B	: Pyrite, chalcopyrite.
Unuk Q 25 #3	: Galena, pyrite, chalcopyrite, Au, white and grey minerals.
Unuk Gracey Q 25 #31	: Galena, pyrite, chalcopyrite, sphalerite, Au.
Unuk Gracey Q 25 #32	: Sphalerite, chalcopyrite in fracture.

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1. Seraphim, R. H., Unpublished thesis,"A Gold Specularite Deposit, Unuk River, B. C.", Dept. of Geology and Geography, Univ. of B. C., 1948.

2. Short, M. N., 'Microscopic Determination of the Ore Minerals', U. S. G. S., Bull. 914, 1940.

3. Edwards, A. B., 'Textures of the Ore Minerals', Australasian Institute of Mining and Metallurgy, 1947.

4. Bastin, E. S., Graton, L. C., et al., 'Criteria of Age Relations of Minerals,' Econ. Geol., Vol. XXVl, 1931 pp. 561-610.

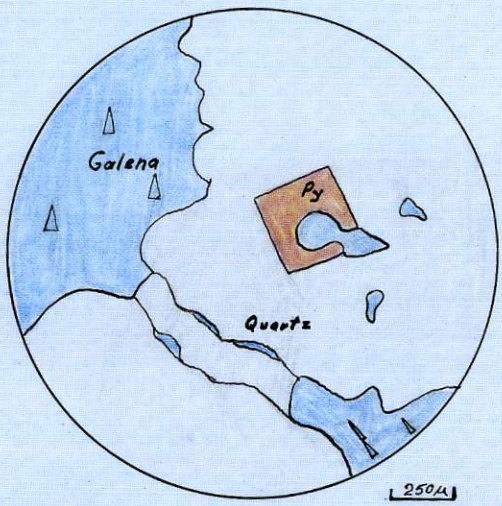


FIG. 2

Figure showing a pyrite cube in quartz being replaced by galena. The galena is also seen to occur along fractures in quartz. (Sect. # UnuK 1)

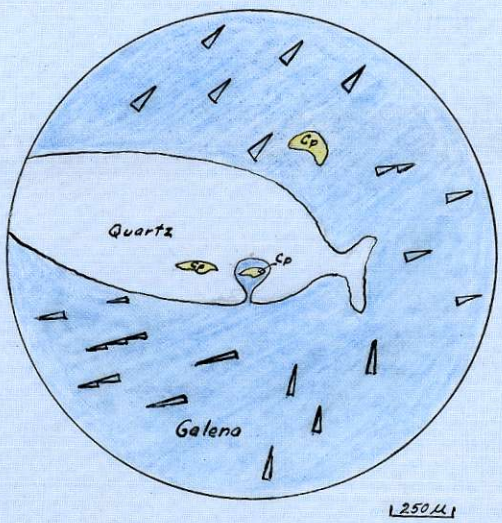


FIG. 3

Inclusions of chalcopyrite in quartz and galena. The inclusions in the galena appear to have resulted by the selective replacement of quartz by galena. (section # Gracey 2)

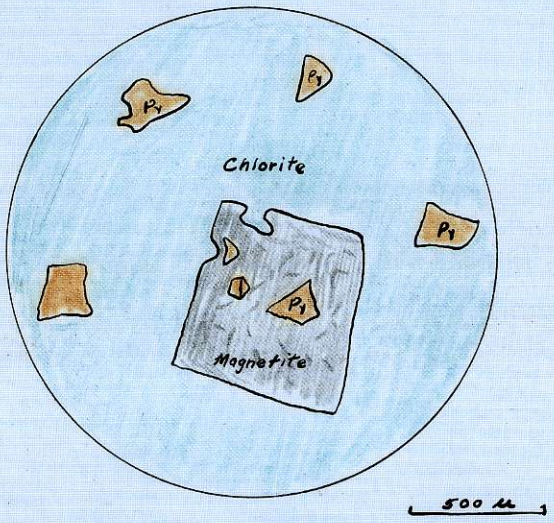


FIG. 4

Inclusions of pyrite fragments in a crystal of magnetite. The chlorite appears to be replacing the magnetite. (Sect. No. Unuk Gracey Q 23)

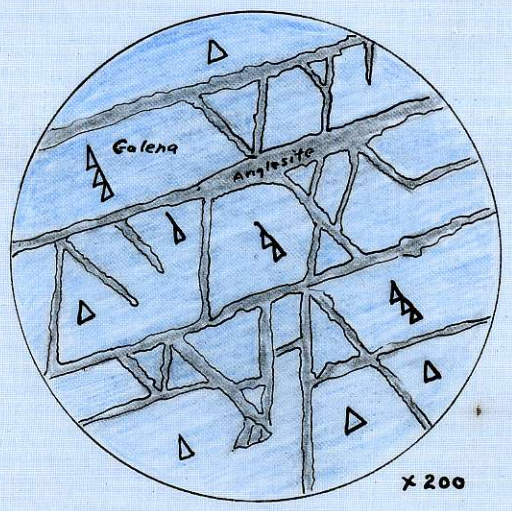


FIG. 5

Development of secondary anglesite (grey) by replacement along cleavage planes of galena (blue) (Sect. # Gracey 3)

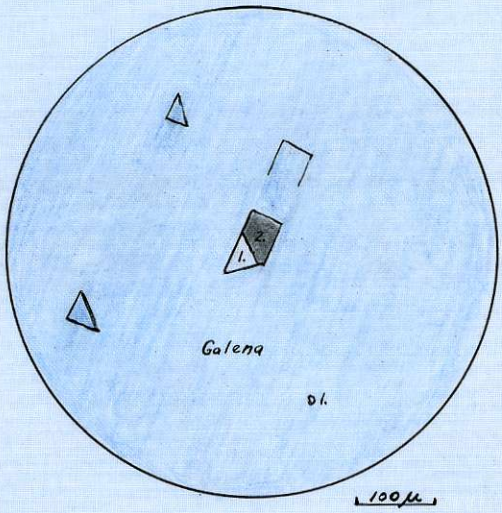


FIG. 6

Figure showing white (1.) and grey (2.) minerals in galena. They appear to be related to the cleavage pits in galena. The white mineral also appears as a small bleb in the galena. (Sect. # Unuk Q 17-10)

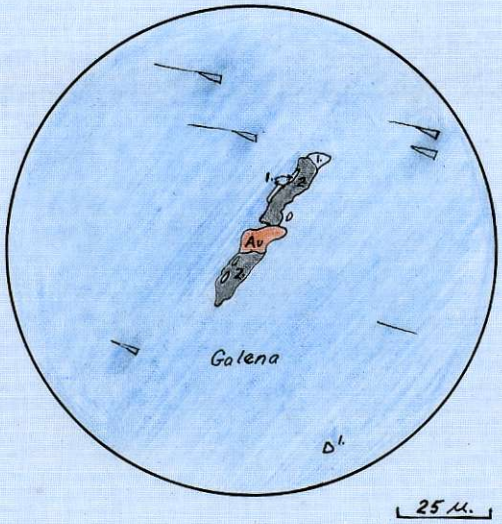


FIG. 7

Figure showing aggregate of gold (orange), white (1.) and grey (2.) minerals in galena. No relation to the galena cleavage is exhibited. The intergrowth of the minerals suggests contemporaneous deposition. (Sect. Unuk Gracey Q17W)

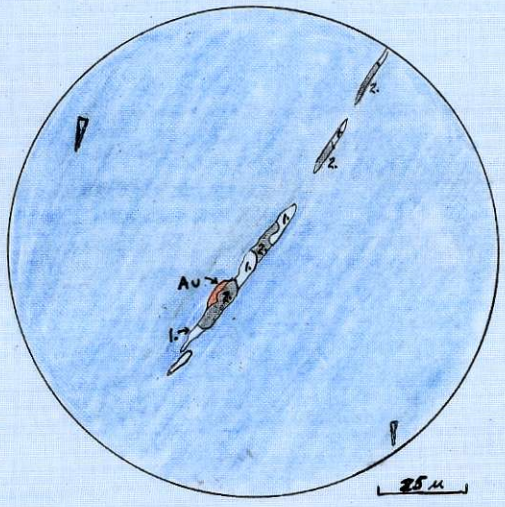


FIG. 8

Vein like intergrowth of gold, white (1.) and grey (2) minerals in galena. The veinlet does not show any relation to the cleavage directions and probably is aligned along a small fracture. (Unuk Q17W-1)

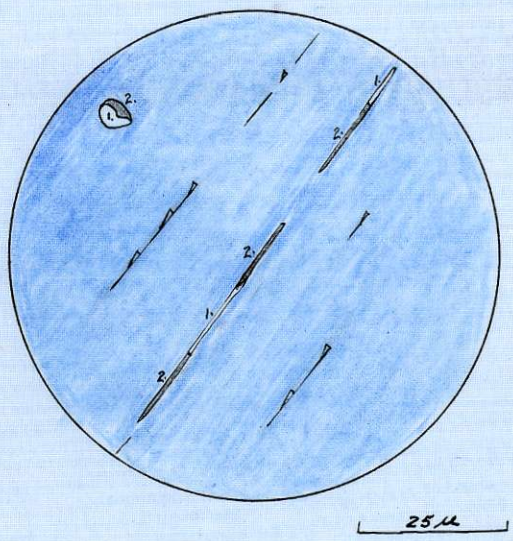


FIG. 9

Grey and white minerals are parallel to the cleavage trace of the galena. A small rounded bleb of the two minerals is also shown. (Sect. Unuk Gracey Q17W)

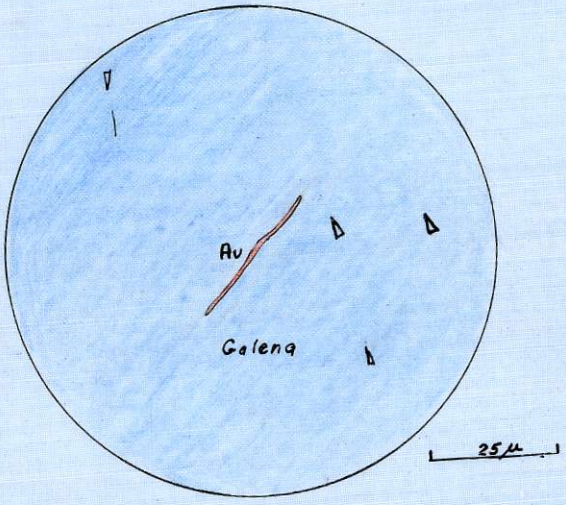


FIG. 10

A small veinlet of gold filling fracture in galena. (Sect. UnuK Q17W-2)

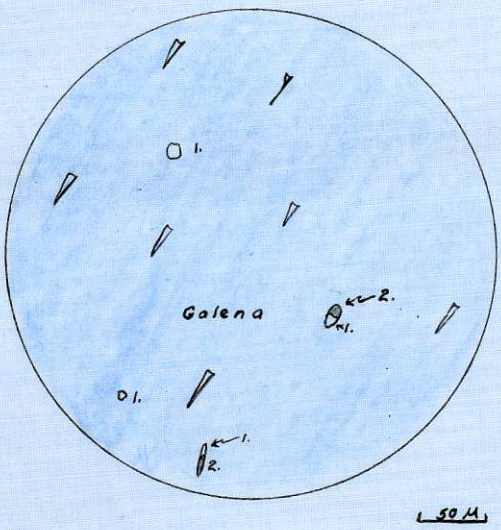
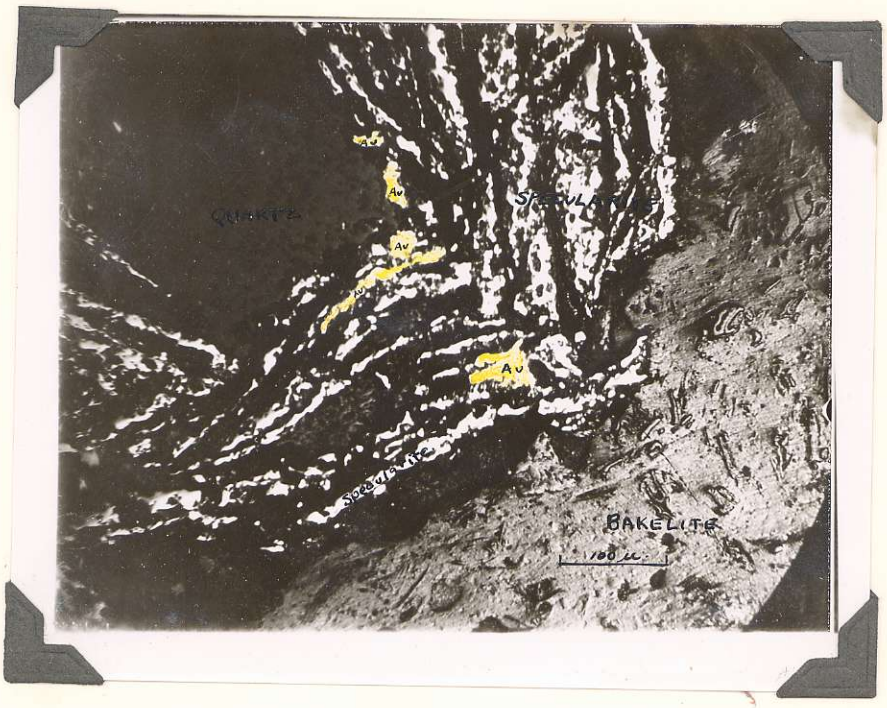


FIG 11

Small blebs of white (1) and grey (2) minerals occuring alone or together in galena. (UnuK Q17W-10)



X 125

Photomicrograph No.1

Native gold occurring between the cleavage flakes of specularite.(Sect# Unuk Q 17 A)