Excellent job 85
No ideas on exsolution?

A REPORT ON THE MINERALOGY

OF THE

CONTACT GROUP

LIARD MINING DIVISION, BRITISH COLUMBIA

A report submitted
in partial fulfillment of
the requirements for the course
in Mineralography (Geology 409),
University of British Columbia.

PHILIP ROY WILSON

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The University of British Columbia,
Vancouver, B.C.

CONTENTS

ILLUSTRATIONS

ACKNOWLEDGEMENTS

The author wishes to thank Dr. R.M. Thompson, Assistant Professor of Mineralogy, University of British Columbia, for valuable assistance rendered in the preparation of this report, both in the microscopic work, and with X-ray determinations.

The writer is also indebted to Mr. J. McDougall, post-graduate student, University of British Columbia, for information on the Contact Group of claims and assistance in the laboratory work, and to Mr. J. Donnan, laboratory technician, for his excellent work in the preparation of polished sections.

SUMMARY

This report contains a brief account of a mineralographic study of specimens from the Contact Group of mineral claims, McDame area, Liard Mining Division, British Columbia.

The specimens contain very little gangue and consist of magnetite, sphalerite, pyrite, galena, pyrrhotite and alabandite, with minor amounts of other minerals, in relative order of abundance. Selected specimens of vein material assay 60 oz silver per ton, and at least two silver bearing minerals were found. Spectrographic analyses show a tin content of about 0.2%, but no tin-bearing mineral was found.

Should the deposit be brought into production, no problems in mineral dressing should be encountered, since most of the silver is probably contained in the galena.

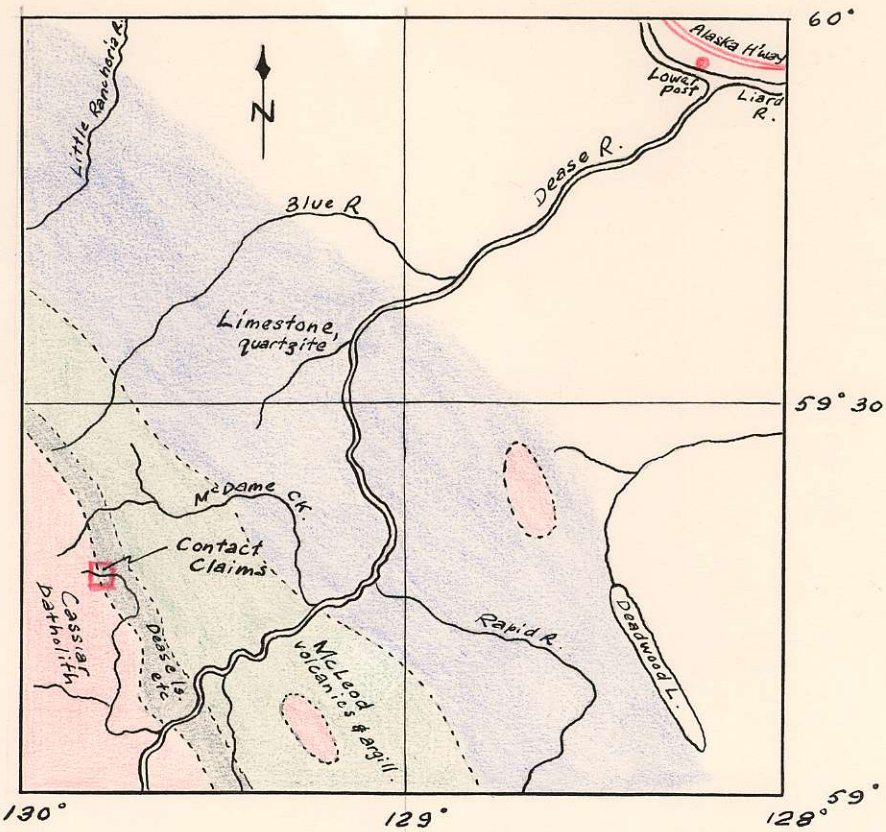
In view of the undeveloped nature of the property and its remoteness, much more work will be necessary to determine whether mining operations are warranted. However, the tenor of the vein material is good, and should it continue with the present mineralisation laterally and to depth, a profitable operation may be established.

Purpose and Scope of this Report

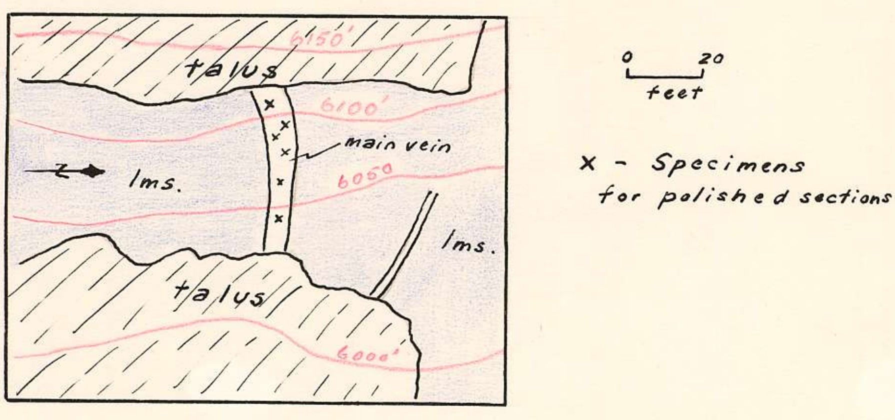
The purpose of this report is to present a brief account of the mineralogy of the Contact Group of mineral claims, Liard Mining Division, British Columbia. Polished surfaces of selected specimens of mineral were studied with the reflecting microscope, and X-ray determinations were also made. It is hoped that this report may be of some future use if the deposit is ever brought into production. To the knowledge of the writer, surface work only has been carried out to the present date.

Introduction

The Contact Group of mineral claims is situated in the McDame area of Northern British Columbia, and lies between latitudes 59 and 60 degrees North, and longitudes 129 and 130 degrees West. (See Map) The main showing consists of a vein cutting dolomitised limestone and composed chiefly of galena and sphalerite. It is exposed for a length of about 100 feet, the average width being about eight feet. During the Summers of 1950 and 1951, Mr. J. McDougall, post-graduate student, University of British Columbia, spent the field season in the McDame area, and obtained the mineral specimens the study of which is the subject of this report. The specimens studied were obtained from the main vein as shown on the sketch map, and were obtained from the surface outcrops.



Sketch map showing location of Contact claims



Main showing on "Contact" M.C.

Mineralogy

A. Megascopic

The hand specimens are somewhat unusual in that they show little or no gangue minerals; in addition a black, oxidised coating is present on most of the weathered surfaces which is probably composed of oxides of manganese. The minerals noted were magnetite, in scintillating grains irregularly disseminated throughout the mass, together with smaller amounts of pyrrhotite, galena, and sphalerite. Most of the galena shows excellent cleavage, while the sphalerite and pyrrhotite appear to be massive, the sphalerite being of a dark brown colour. On weathered surfaces the specimens are coated with yellowish-brown iron oxides, together with the black manganese oxides as noted above.

B. Microscopic

1. Magnetite

This mineral occurs as subhedral to anhedral grains disseminated irregularly throughout the specimens. The grains appear to be neither altered or replaced by other minerals, and are fairly uniform in size, ranging from about 0.1 m.m. to 0.4 m.m. in diameter.

2. Pyrite

In some of the polished sections, pyrite is almost completely absent, whereas in others it is very abundant. It occurs both in the massive and crystal forms. One mass in section M21E is about 4 c.m. in diameter, this being the largest seen. The crystals average about 0.2 m.m. in diameter with a maximum size of about 1 m.m. and are disseminated irregularly throughout the matrix of galena and sphalerite in much the same manner as the magnetite. Many of the crystals are fractured, and replacement has evident-ly taken place, in some to a considerable extent. Figure 8 shows a crystal of pyrite being replaced by galena.

3. Pyrrhotite

This mineral occurs as small, irregular grains scattered throughout the matrix of galena and sphalerite. It also occurs as minute exsolution bodies in the alabandite and in some of the sphalerite.

The pyrrhotite grains vary in size from about 0.1 m.m. up to about 0.5 m.m. The grain boundaries are very irregularly rounded, and many show poorly developed caries texture. It is possible that some replacement by galena has taken place, but conclusive proof of this was not observed. However, in Section C7EK, excellent examples of replacement of pyrrhotite by marcasite were found. Numerous relics of pyrrhotite grains embedded in a matrix of marcasite were seen in this section; a typical example has been reproduced in Fig. 11.

The exsolution bodies in the alabandite occur as small irregularly-shaped blebs about 50 microns in diameter and as elongated lath-like bodies about 10 microns in thickness. In addition, a few larger bodies occur at the grain boundaries in most grains. (See Fig. 10).

The lath-like bodies show preferred orientations in two directions approximately at right angles, supporting the contention that they have been exsolved from the alabandite on cooling.

Some of the sphalerite shows small rounded blebs of pyrrhotite. It was noted that this sphalerite was always closely associated with alabandite, either showing exsolved alabandite or in contact with grains of it. On the other hand, other sphalerite grains show no inclusions of pyrrhotite, but do contain blebs of chalcopyrite. As will be explained later, the writer suspects that there are two types of sphalerite in the specimens, one associated with alabandite and the other with chalcopyrite.

4. Marcasite

This mineral occurs in irregular masses, being particularly well developed in Section M21E. Here it shows marked colloform structure, with development of peculiar oval-shaped bodies about 0.5 m.m. in diameter. (See Fig. 14). It was found to replace pyrrhotite as already explained above. Some of the chalcopyrite associated with the sphalerite shows minute inclusions of a mineral which resembles marcasite, but these inclusions are so small, being of the order of a micron or less in size, that it proved to be impossible to determine them with certainty.

It is problematical whether the marcasite is of supergene or hypogene origin, but in view of the fact the specimens are from surface outcrops, the former would appear to be the more likely.

5. Chalcopyrite

The only occurrence of chalcopyrite found was that already referred to, namely, as very small blebs in sphalerite. Most of these are situated near or at the grain boundaries of the sphalerite, and average about 30 microns in size. It is possible that the chalcopyrite has been exsolved from the sphalerite, and owing to slow cooling has had time to coalesce and migrate to the grain boundaries.

6. Sphalerite

A considerable part of the specimens is composed of sphalerite, in the writer's estimation, to the extent of about 30 - 50%. It appears to be present in two varieties.

The first is associated with chalcopyrite and occurs as irregular to subhedral grains ranging from 0.1 m.m. to 1 c.m. in size. It shows a characteristic pitted surface, and has probably been replaced by galena to some extent. (See Fig. 7). At any rate, it is obviously earlier than the galena. It shows a deep brown-red internal reflection.

The second variety appears to be intimately associated with alabandite and pyrrhotite. It nearly all shows inclusions of alabandite, and in addition often includes pyrrhotite. It seems to be slightly lighter in colour (under the microscope) than the other variety and seems to take a slightly better polish. Fig. 9 shows replacement of galena by this type of sphalerite. In Section M21E, numerous examples of this type of replacement may be seen, the caries texture being particularly well developed in the galena. Some striking ex-solution textures of alabandite in sphalerite were observed in this section.

The writer therefore believes that there may be two generations of sphalerite, separated by the deposition of galena, but this is by no means definitely proven.

7. Alabandite (MnS)

The presence of a primary manganese mineral in significant amounts was suspected when the black coating on the weathered specimens was observed. The mineral proved to be alabandite. It was recognized by its excellent polish and lighter colour as compared with sphalerite, and also by its violent reaction with ~~with~~ HCl, with the emission of copious amounts of H_2S. It is isotropic and does not show internal reflection, at least the writer was not able to observe any. It occurs as exsolution bodies in sphalerite and as irregular grains, seemingly closely associated with sphalerite and pyrrhotite, up to 4 m.m. in size. Positive identification was made by dissolving a little of the powdered mineral in HCl and then adding a little sodium bismuthate. The characteristic colour of $KMnO_4$ instantly appeared.

8. Arsenopyrite

Euhedral to subhedral crystals of arsenopyrite, often fractured, are scattered very sparingly throughout the matrix of galena and sphalerite, being found in both. The crystals are fairly uniform in size, averaging about 0.1 m.m. in length. A number of crystals were found which were partly replaced by pyrargyrite. (See Figs. 3 and 4). The crystals stand out in relief against the galena, and take a good polish. Since both galena and sphalerite were found filling fractures in the crystal, the areenopyrite is probably earlier than these minerals. It was identified by its great hardness, crystal form, and strong anistropism - blue to yellow under crossed nicols.

9. Galena

Galena was found as irregular veinlets ramifying through the sphalerite and forming a matrix enclosing sphalerite, alabandite, magnetite, and pyrrhotite. It is rather unusual in character in that it also contains small inclusions of a number of other minerals in addition to the above. As previously noted, the galena replaces and is replaced by sphalerite and possibly replaces pyrrhotite. A description of the included minerals in the galena follows.

10. Native Antimony

Two or three widely scattered grains of a very white mineral were found in the polished sections. The largest of these measured about 1 m.m. in length. The mineral takes a very good polish, has a hardness about the same as galena and is isotropic. X-ray tests by Dr. R.M. Thompson showed that the mineral is probably native antimony. Etch tests tended to confirm this determination, the results of which are as follows: $HgCl_2$ - neg; KOH - pos.; KCN - pos.; $FeCl_3$ - pos. (slow); HCl - pos.; HNO_3 - pos.; no eff. The antimony was found only in galena.

11. Dyscrasite (Ag_3Sb)

Also occurring as inclusions in galena were found four or five grains of a pale yellow mineral, ranging in size from about 0.05 m.m. in diameter up to 0.25 m.m. for the grain shown in Fig. 13 . This mineral has about the same hardness as galena, and is fairly strongly anisotropic, the colours changing from yellow-brown to blue-grey under crossed nicols. The mineral was found to tarnish very rapidly, and Fig. 13 shows strongly tarnished dyscrasite in contact with native antimony. This photograph was taken after the section had been exposed to the air for about a week. Fig. 6 shows two subhedral crystals of dyscrasite from a freshly polished section. The results of etch tests were as follows: $HgCl_2$ - pos. (strongly); KOH - neg.; KCN - pos. (strongly); $FeCl_3$ - pos.; HCl - pos.; HNO_3 - pos. These placed the mineral in the antimonial silver group, and X-ray tests by Dr. R.M. Thompson showed it to be dyscrasite.

12. Pyrargyrite

This mineral was easily identified by its beautiful blue-grey colour and deep red internal reflection. Confirmation was obtained by etch tests. It shows a marked preference for arsenopyrite, replacing this mineral. (Figs. 3 and 4). It was also found filling fractures in galena (Fig. 2) and one crystal was found enclosed in sphalerite (Fig. 1) The remaining occurrence is illustrated in Fig. 5, where a small grain was found in Unknown Mineral II.

13. Unknown I

Much of the galena contains peculiar worm-like inclusions of pale pinkish-grey mineral that could not be positively identified. It has a hardness of C, is isotropic, and etch tests gave results as follows: $HgCl_2$ - neg.; KOH - neg.; KCN - pos. (etches slowly - brings out scratches) $FeCl_3$ - neg.; HCl - neg.; HNO_3 - neg.; aqua regia - neg. These results do not place the mineral in any definite classification as given by Short. An attempt at X-ray determination gave inconclusive results, due no doubt, to the fact that the mineral occurs in such small grains that it is very difficult or impossible to obtain amounts sufficiently pure to give a good X-ray pattern. The inclusions do not appear to have any particular preferred orientation within the galena, but often show a peculiar positioning with the greatly elongated grains arranged one behind the other extending in arcs across the microscopic field. Their average size is about 0.1 m.m. in length with a width of about 0.01 m.m.

14. Unknown II

Fig. 5 shows pyrargyrite embedded in a pale grey mineral which could not be positively identified. It has a hardness of C, is isotropic, and shows no internal reflection. It is negative to all reagents and may possibly be tetrahedrite.

15. Unknown III

The galena also contains very minute inclusions of a very white mineral which again could not be positively identified. It has about the same hardness as galena, and under high power, using the oil immersion lens, was seen to consist of euhedral crystals in the form of rhombs, cubes, and prisms, showing distinct anisotropism. The crystals range in size from a few microns up to about 20 microns. Etch tests gave results as follows: $HgCl_2$ - neg.; KOH - pos.; KCN - pos.; $FeCl_3$ - neg.; HCl - pos.; HNO_3 - pos. Following Short's classification this places the mineral in the Kermesite - stibnite class, but the mineral is obviously neither of these because it is very white in colour and stands out sharply in contrast with the galena. It is probable that the etch tests are not very reliable as the grains are so small, also the galena may cause spurious reactions.

16. Limonite

A mineral showing pronounced colloform banding and deep red internal reflection was found filling fractures in galena. This is probably limonite with possibly some carbonate also, as HCl produced marked effervescence.

17. Gangue

Very little gangue is present in the specimens examined. What is present appears to consist of almost colourless subhedral to anhedral grains of carbonate, probably dolomite, irregularly disseminated through the sphalerite and galena.

PARAGENESIS

The deposit is unusual in that it shows both hypothermal and epithermal mineralisation. There is a possibility that there has been more than one period of mineralisation. At first, magnetite, pyrrhotite and pyrite may have been deposited with later deposition of lower temperature minerals such as galena, sphalerite, and alabandits. The small inclusions in the galena were probably deposited with it, and unknown Mineral I has probably been exsolved. The pyrargyrite and marcasite may both be supergene.

A suggested paragenesis is as follows:

Magnetite)
Pyrrhotite) Simultaneous or
Pyrite) nearly so?
Arsenopyrite)

Sphalerite associated with Chalcopyrite
Galena
Sphalerite " " Alabandite

Pyrargyrite) Supergene?
Marcasite)
Limonite - - - Supergene

The writer is aware that this is not a very satisfactory interpretation of the paragenesis, but with such an unusual suite of minerals with a rather complex relationship it is difficult to arrive at very definite conclusions on the basis of a somewhat limited study. It is probable that with further work a clearer picture of the paragenesis could be obtained.

CONCLUSIONS

Assays of selected specimens show a silver content of 60 oz per ton. Two silver bearing minerals were found, namely pyrargyrite and dyscrasite, with the possibility that some of the unknown minerals may also contain silver. Since, with the exception of some of the pyrargyrite, all the silver-bearing minerals are probably in the galena, no problems should be encountered in mineral dressing and a good recovery of silver should be obtained. It should be possible to produce a good lead concentrate which would probably carry most of the silver; similarly, it should be possible to produce a good zinc concentrate containing a small amount of silver. The sphalerite no doubt contains a small amount of iron since it has a brownish-red colour. To the knowledge of the writer, there is no gold present in the deposit, and no gold was seen in the specimens.

A spectrographic analysis showed a small quantity of tin to be present to the extent of about 0.2%. No tin-bearing mineral was identified, but it is possible that the tin is contained in one or more of the unidentified minerals in the galena.

As previously stated, no underground work has yet been carried out on the property, but it appears to be a prospect of some merit, and should further work show the vein to continue laterally and to depth with the present mineralisation, the property would appear to have some value. However, with the prices of lead and zinc at their present low levels, and taking the remoteness of the property into consideration, a fairly large tonnage of ore would be required to warrant initiation of mining operations.

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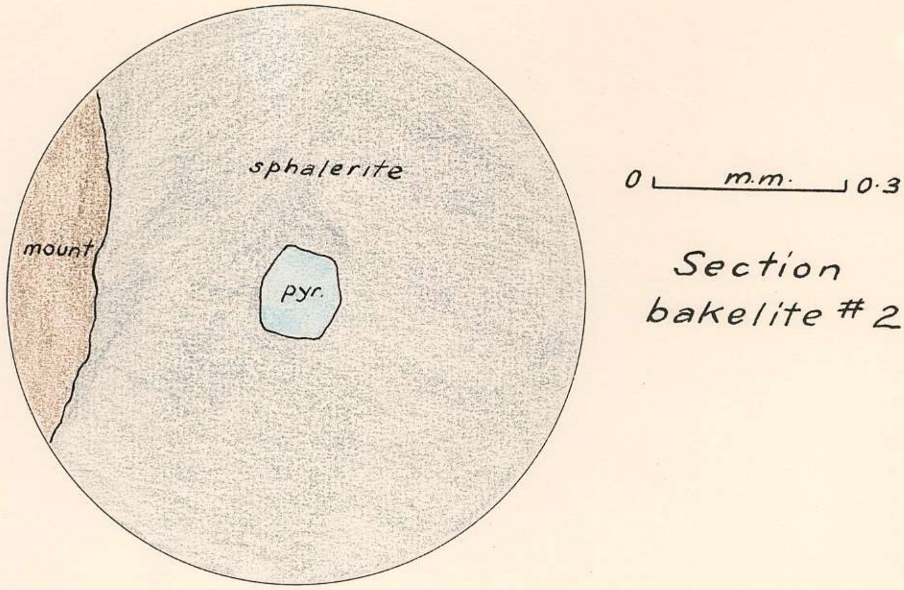


Fig. 1. Euhedral crystal of pyrargyrite in sphalerite

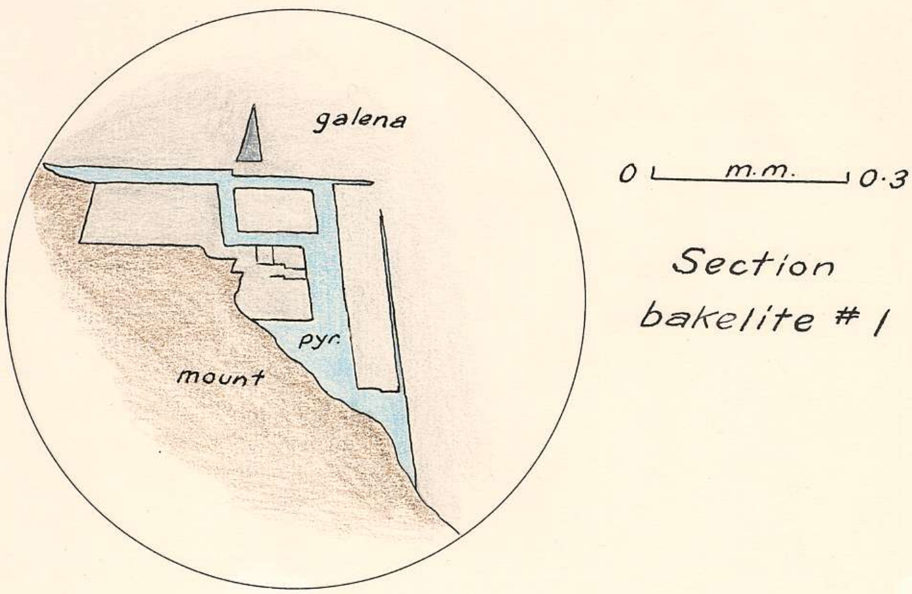
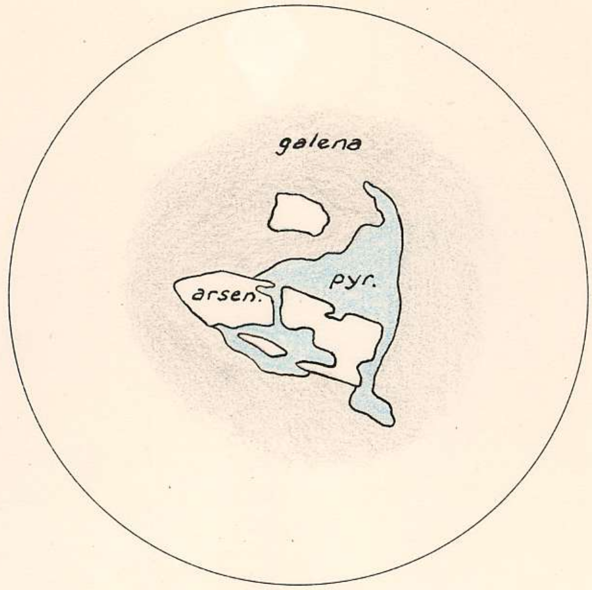


Fig. 2. Pyrargyrite filling cleavage fractures in galena



0 m.m. 0.3

Section bakelite #2

Fig. 3. Replacement of arsenopyrite by pyrargyrite

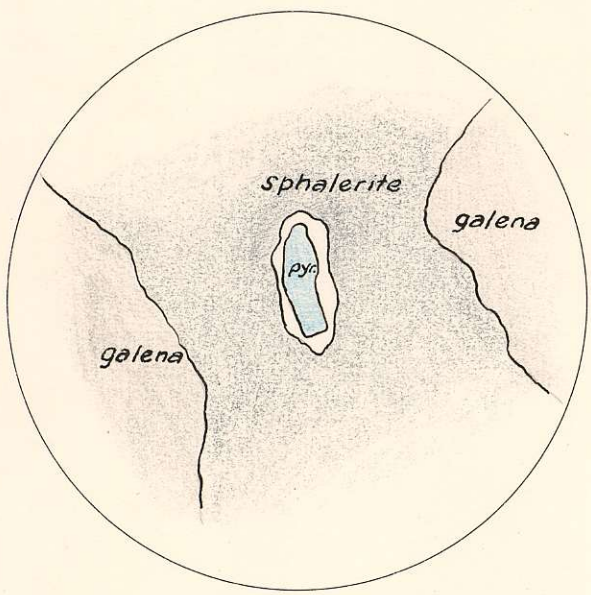


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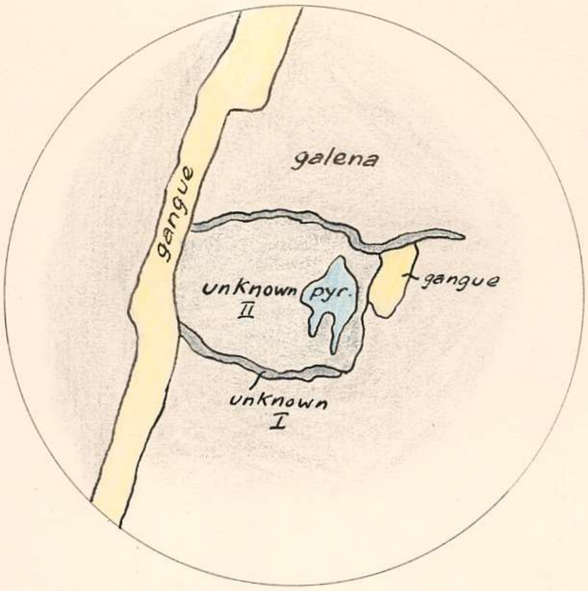
Fig. 4. Arsenopyrite being replaced by pyrargyrite in sphalerite



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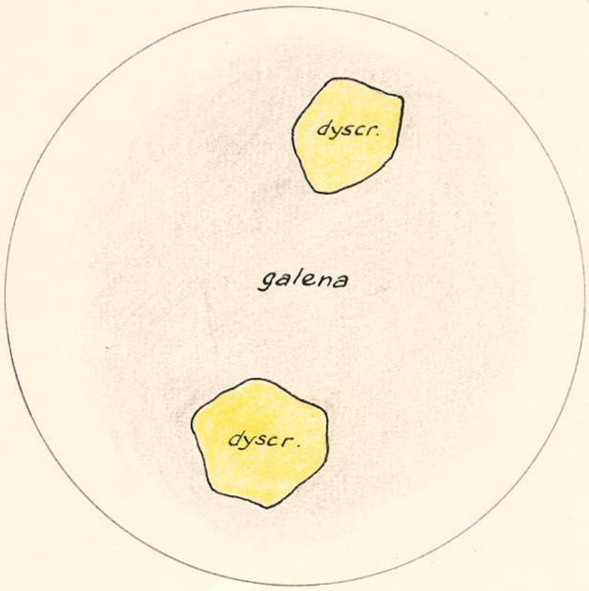
Section
M47 B₁

Fig. 5. Showing pyrargyrite in unknown mineral II rimmed by unknown I



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Section
bakelite #1

Fig 6. Showing subhedral grains of dyscrasite in galena

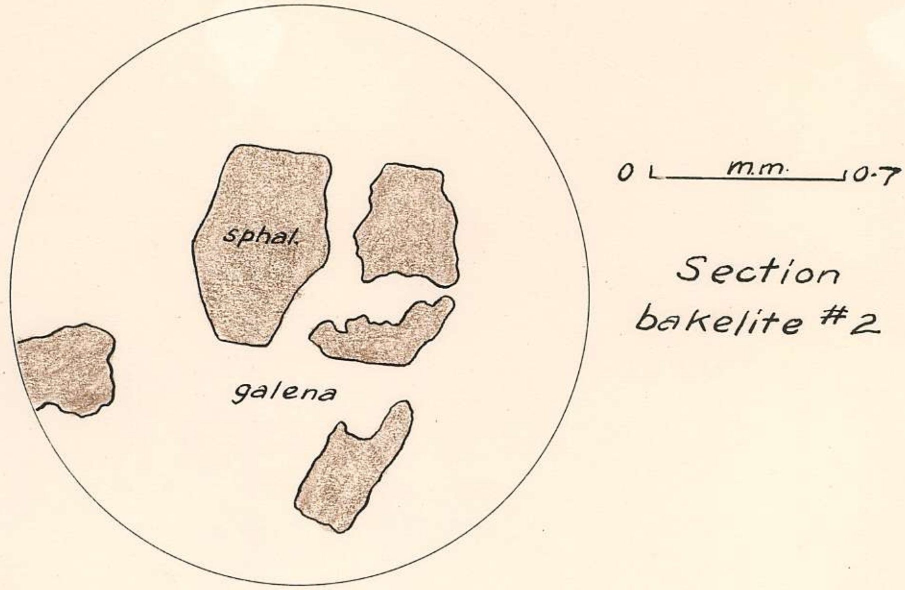


Fig. 7. Fractured euhedral crystal of sphalerite with some possible replacement by galena

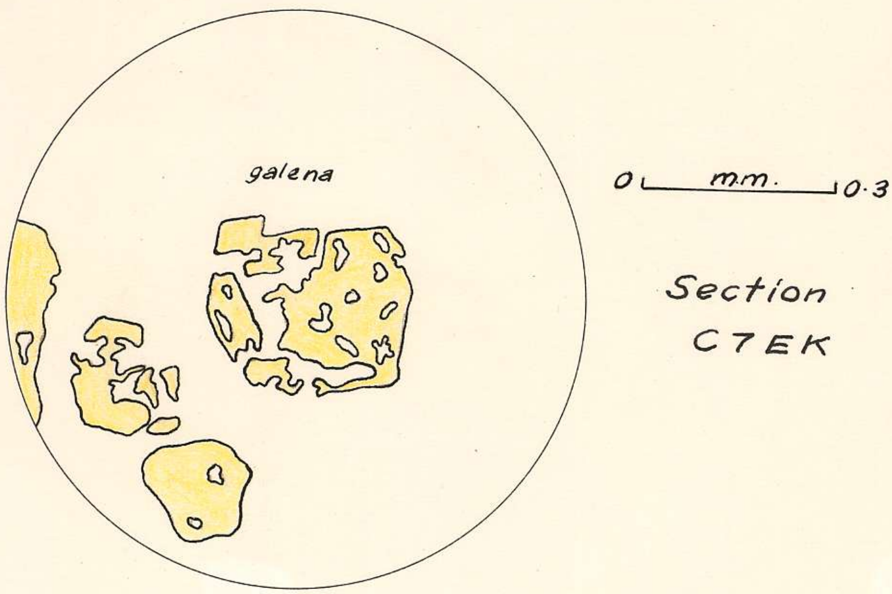


Fig. 8. Fractured and corroded crystals of pyrite in galena

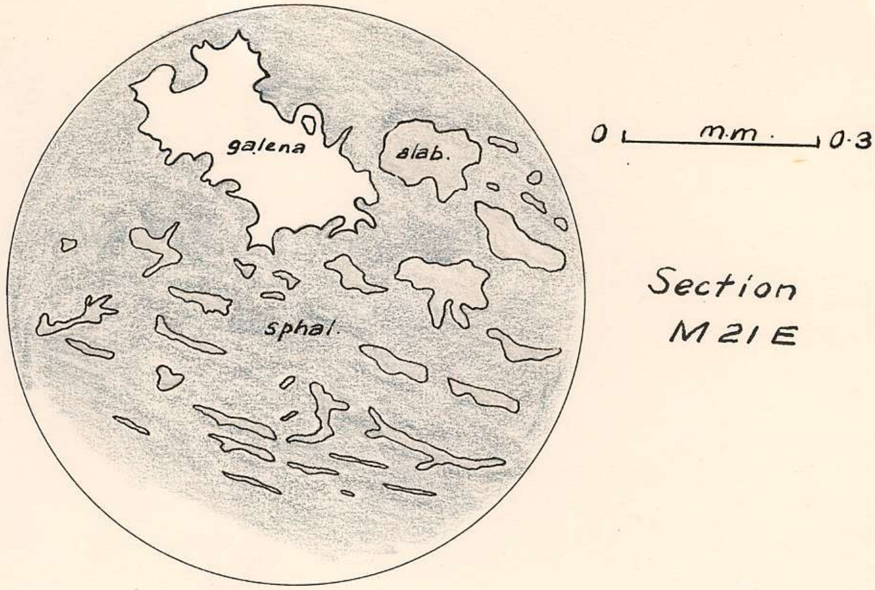


Fig. 9. Replacement of galena by sphalerite with exsolved alabandite

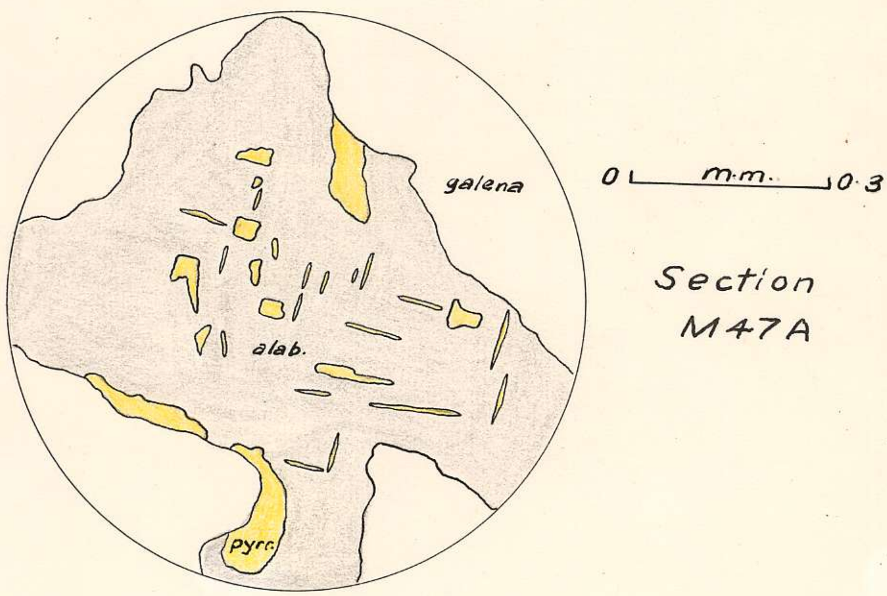


Fig. 10. Alabandite showing exsolved pyrrhotite

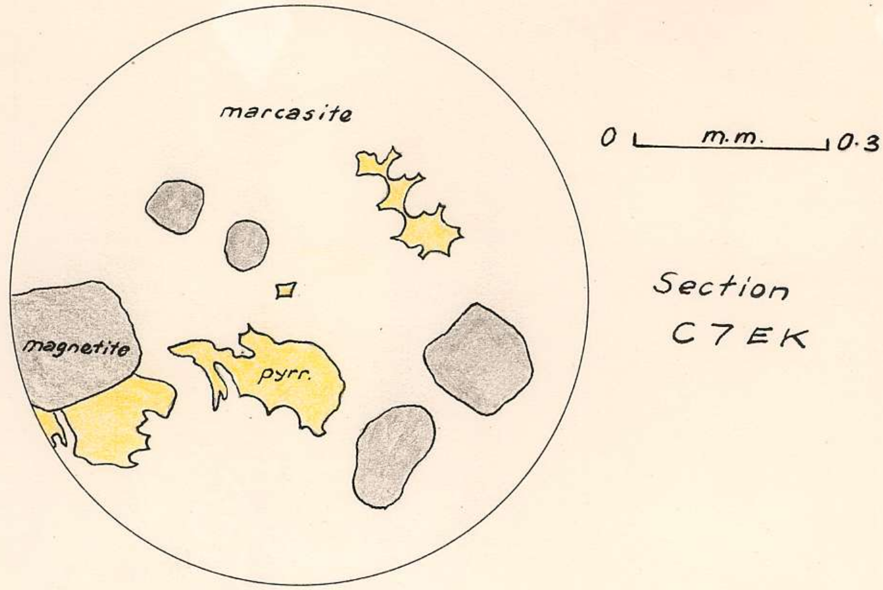


Fig. 11. Replacement of pyrrhotite by marcasite

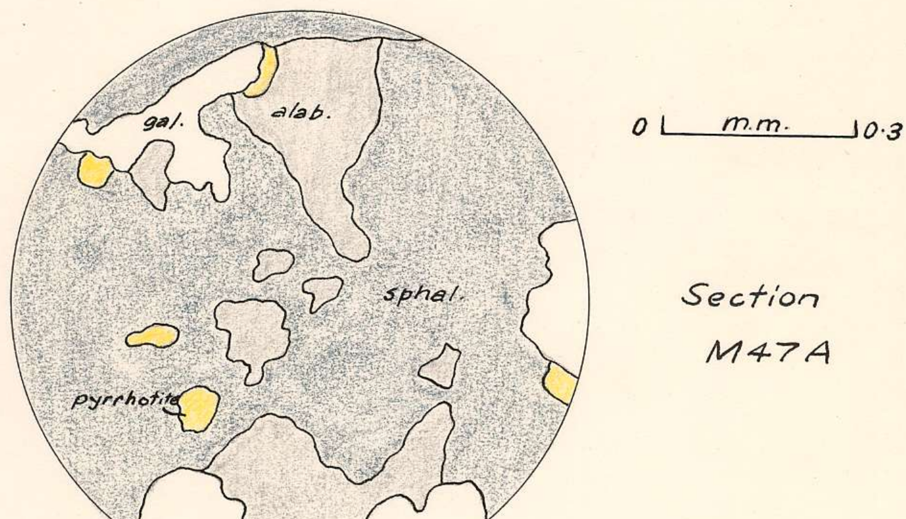
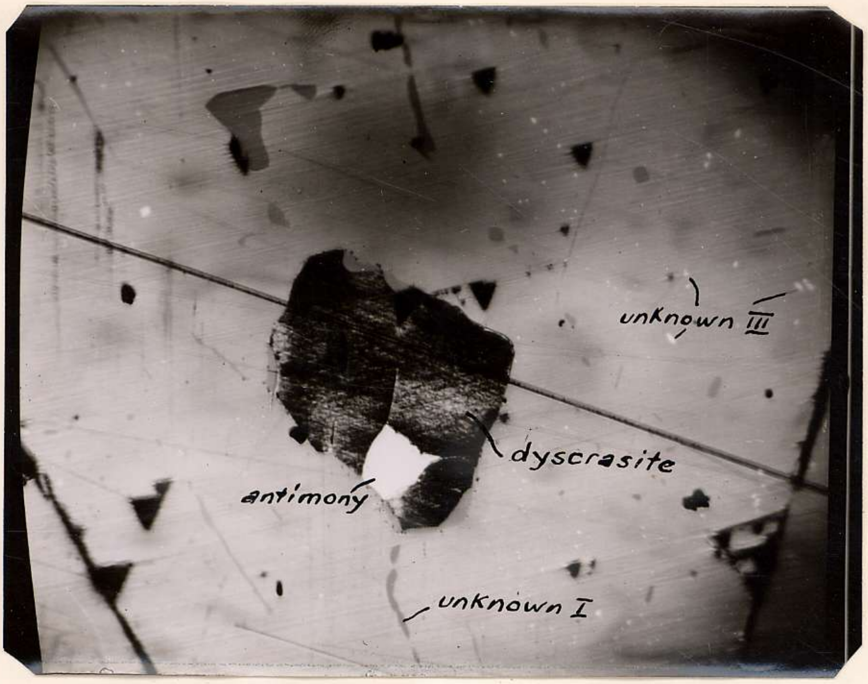


Fig. 12. Sphalerite, alabandite and galena showing mutual boundaries



0 m.m. 0.25

Section bakelite #2

Fig. 13. Tarnished grain of dyscrasite with antimony in galena

0 m.m. 0.5

Section M21E

Fig 14. Marcasite showing colloform texture