MINERALOGY OF THE REEVES-McDONALD MINE

by

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The ore suite was kindly supplied by Mr. Henry Hill, Manager of the Reeves-McDonald mine.

MINERALOGY OF THE REEVES-McDONALD MINE

Location

The Reeves-McDonald mine is located in the Salmo area on the north side of the Pend D'Oreille River about two miles from the international boundary. The mine is about four miles west of Nelway or about eight miles east from Waneta.

Geology

The ore occurs in the limestone of the Reeves-McDonald formation. The Reeves-McDonald formation is now considered as the lower part of the Metaline limestone. The Metaline limestone is part of the Palaeozoic Pend D'Oreille series. The property covers a low hill rising from 1700 feet to 3000 feet above sea level between the Pend D'Oreille and Salmo River.

The Reeves-McDonald formation, in the mine area, consists of four well defined bands of limestone separated by schists and quartzites. The strike of the formation here is about N 70°E and the dip is about 50°SE. The following simplified section of the formation has been measured:

Top	Feet
Black and grey thinly bedded limestone..............	300
Micaceous schists and phyllites.....................	75
Thin bedded grey to buff limestone and dolomite.....................................	500
Limy phyllite and slate.............................	500
Grey, massive and banded limestone and dolomite.....................................	850

2. White and buff platy quartzite and phyllite	1000
1. Thinly laminated grey limestone	300
bottom	?
	3525

The ore occurs in limestone members 2 and 4, and follows the strike of the limestone. The mineralization fades away laterally and the limits are defined by assay values. J.F. Walker describes the mineralization as "low-grade, disseminated replacements of limestone by pyrite, pyrrhotite(?), sphalerite, and galena".

In the polished sections studied, the writer could not find any pyrrhotite.

The average content of the ore body as was given to Walker was: 6.2% Zinc, 1.6% Lead, and half an ounce of Silver to the ton.

The writer could find no silver in the sections. It probably occurs in solid solution with galena.

Two suites of ore were supplied by Mr. Henry Hill, Manager of the Reeves-McDonald mine. Sample No. 1 was from the Reeves Tunnel-elevation 2510 feet. Sample No. 2 was from the River Tunnel-elevation 1750 feet.

Mineralogy

The following minerals were identified in polished sections of the ore:

Sphalerite
Pyrite
Galena
Quartz
Calcite

The rock in which the ore occurs is a very thin bedded limestone. Black and white bands, in general about 1/8 inch to

1 inch wide, are characteristic of the limestone.

Mineralization consists of low grade replacements of this limestone by the above five minerals. In most cases the above minerals are very finely disseminated. A thin section was made to see if the minerals were deposited between the grains of limestone. The section revealed that the minerals were strictly replacements.

In the unfractured portions of the limestone(in which most of the ore occurs) all available evidence seems to point to a contemporaneous deposition of the first four minerals. Not very much is known of the occurence of calcite because the bedrock is crystalline limestone and it is impossible in most cases to tell if there has been introduced calcite.

No veining or replacement criteria could be found in these massive portions. One interesting example of colloform structure was found of galena and pyrite. This will be more fully discussed under paragenesis(page 11).

In the unfractured portions, the minerals tend to replace in general parallel or sub-parallel to the bedding of the limestone and resulting lenticular streaks of pyrite, sphalerite, galena, quartz and probably calcite occur.

Some minor fracturing and movement has occured in the ore specimens obtained from the mine. This fracturing occured after the replacement had taken place. In these fractures some quantitatively minor amounts of sphalerite, galena, quartz and calcite were deposited.

Sphalerite

Sphalerite occurs as anhedral grains, quite variable in size,replacing the limestone. In none of the sections observed, both from No. 1 and No. 2 tunnels, could sphalerite be observed cutting any other minerals in the unfractured portions of the rock. Although the contacts with other minerals are extremely irregular, there are no feathery boundaries with these minerals or with the limestone which it definitely does replace.

There is a pronounced tendency for sphalerite and galena to occur together. Where they do, there is relatively little pyrite. Pyrite, on the other hand, has a tendency to segragate into bands containing little sphalerite or galena.

A few minor fractures, mentioned previously, occur cutting across the bedding of the limestone. Sphalerite was deposited,in places along these cracks, in relatively large masses(1 cm. long by 3 mm. wide). Some minor amounts of galena, as well as quartz and calcite occured with the sphalerite in these cracks. The sphalerite deposited in these cracks is quite small in comparison with the amount of replacement sphalerite occuring in the massive portions of the rock. The minerals deposited in these fractures were deposited later than the main replacements and probably as a last stage of deposition.

The sphalerite in all the polished sections appears to be quite pure. Under inclined light the colour is a light clear yellow colour. Deeper grains are amber in colour.

The most common grains of sphalerite vary in size from

250 to 500 microns(see page 15).

Pyrite

Pyrite commonly occurs as anhedral to subhedral grains. A few grains are nearly euhedral. In general the size of the grains is somewhat more constant than with the other sulphides. The typical grain of pyrite is almost circular or oval. These circular and oval grains, where they are segragated into bands, give the rock a pock-marked appearance. Less commonly these rounded grains occur within or at the boundaries of sphalerite and galena grains. It is not believed, however, due to replacement of these two sulphides by the pyrite.

No pyrite could be seem veining or replacing other minerals. It is therefore assumed that the pyrite is contemporaneous with the rest of the sulphides.

In the ore specimens, pyrite has a tendency to segragate into bands about ½ inch wide parallel to the bedding. These bands are about 1 to 2 inches apart. Not enough ore specimens were available to see if this was common in the rest of the mine. Relatively small amounts of galena and sphalerite occur within these bands (see page 15).

The average size of pyrite grains seems to about 160± microns(see page 15).

Galena

Galena, as observed in the sections, is the least abundant of the sulphide minerals. In a few cases there are relatively large replacements of galena in limestone(about 3 mm. wide), but in most cases the galena forms small disseminations and a few tiny irregular vein-like replacements of limestone.

As with both sphalerite and pyrite, no positive replacement of the other minerals could be seen. In one place, however, a suggestion of veining by galena of sphalerite was seen(see page 16).

A very slight tendency was noticed for the galena to form tiny rounded grains within the sphalerite, much the same shape and manner in which some of the pyrite occurs within sphalerite and galena. In none of the sections could sphalerite be observed occurring as a similar type of grain within other minerals.

Galena occurs with the sphalerite in the displaced fractures cutting the limestone. In these fractures, both the galena and sphalerite form large grains with quite regular, curved or straight boundaries.

Quartz

A thin section was prepared of the Reeves-McDonald ore. In this section, irregular bands composed of anhedral quartz grains were observed replacing the limestone. The grains in this section were about the same size as the primary calcite. That the quartz was not primary was shown by the fact that some of the quartz bands cut across the bedding of the limestone. In this thin section, in the unfractured portions, the quartz was observed not to replace or cut the sphalerite. Sphalerite because of its slight transparency was the only sulphide that could be positively identified. Where sphalerite and quartz occured together, the boundaries between the two were smooth and rounded.

In the thin section, a fragmentary remnant of one of the fractures remained after grinding. One grain of sphalerite was observed in this fracture that was shattered. Some of the cracks produced by this shattering were partially filled with quartz. It is assumed that the displacement of the fracture shattered the sphalerite grain and that the quartz deposited itself within the cracks as probably a very late stage of deposition.

Since in the massive parts of the slide, the quartz appeared contemporaneous with the other minerals, it is assumed that quartz was deposited during the whole period of ore formation and continued probably as one of the last minerals.

The black carbonaceous bands of the limestone, as seen in the section, did not seem very susceptable to replacement.

Calcite

The relationship of calcite to the other minerals is not very well understood. Only one thing is certain; that some calcite was deposited as a late stage in some of the fractures.

In the massive portions of the polished sections, large elliptical($1\frac{1}{2}$ cm. length) globules of white crystalline calcite commonly occur. The origin of these globules is obscure.

The inner and most of the outer part of the calcite globules are barren. There are some very small rounded grains of sphalerite and galena occuring just within the boundaries of these globules.

Three possible explanations for the origin of these calcite globules can be given:

1. The calcite is merely part of the original limestone which by reason of some inherent chemical characteristic was

was not susceptable to replacement.

We might expect, if this were the reason, to find some remnant of bedding within the grain. We do not. The calcite is very pure. There is just a slight suggestion, however, that the long axis of the globules are parallel to the bedding. Mineralization tends to obscure this relationship between the globules and the bedding.

2. Pieces of the wall rock spalled off when the ore solutions were rising. These pieces were subsequently re-crystallized to the white calcite which we see as the globules.

This theory is not very probable. In the first case there is no fracturing of the wall rock around where these grains were observed. If it had spalled off, it would be impossible to be carried in one piece through solid limestone to where it is now. We should also expect, if it had spalled off, that it would be replaced fully as much as the more massive limestone.

3. The calcite is introduced. For this third theory, not much proof, either positive or negative, can be found.

If the calcite has been introduced before the main mineralization, we should expect to see it replaced by the sulphides.

If it had occured contemporaneously, it would probably have been deposited much like the quartz, ie., in scattered irregular grains and not as large blebs the way these grains of calcite are.

To this last paragraph, a qualifying statement should be made; the quartz could be easily be recognized because being harder than the limestone, it stood out above it after polishing. If the calcite were contemporaneous, however, smaller grain should naturally be hard to recognize in polished sections because it would probably be at the same level as the limestone. We should also expect a few large globules of calcite to be deposited with this finer calcite.

In the massive portions of the thin section, no calcite could be recognized as being definitely secondary.

This third theory has the support of Dr. H.C.Gunning. It would appear to be more probable than the first two.

The calcite then should have been deposited probably during the whole period of ore formation, much the same way as quartz.

Paragenesis

		Fracturing	Fracture Filling	Movement Along Fracture
Zn (sphalerite)	————		————	
Fe (pyrite)	————			
Pb (galena)	————		————	
Si (quartz)	————		————	- - - -
Ca (calcite)	- - - - -		————	

Order of Deposition

1. Contemporaneous deposition of sphalerite, galena, pyrite, quartz and probably calcite.

2. Very minor fracturing of the limestone.

3. Deposition of sphalerite, galena, quartz and calcite in these fractures.

4. Very slight movement along the fracture. This is assumed because one grain of sphalerite was observed shattered and the cracks partially filled with late quartz. It is possible that the movement might have occured at the same time as the deposition in No. 3.

5. Continued deposition of quartz as a very late stage. This is assumed because quartz fills the cracks produced by shattering of the sphalerite grain mentioned on page 8.

Discussion

Sphalerite, pyrite, galena, quartz and probably calcite are assumed contemporaneous in the massive portions of the limestone because no good evidence for veining or replacement of one another could be found.

One good example of what is believed a colloform structure of pyrite and galena was found. Dr. K.DeP. Watson examined this structure and was unable to draw any definite conclusion as to the relationship of these two minerals (see page 7). He believed that it could possibly be:

1. Rimming of pyrite by galena. In this case the pyrite would have been deposited before the galena.

2. Crustification. In this case the pyrite should have been deposited on top of the galena. This conclusion is thought unlikely because in the larger of the two colloforms we have the relationship of pyrite in the center zone, galena in the intermediate zone and more pyrite in the outer zones. If this structure were crustification, we would have the relationship of pyrite being deposited first, then galena, then more pyrite. This, compared to observations made elsewhere, is most improbable.

3. Colloidal deposition. In this case, the solutions were brought in at the same time in the form of colloids. They then deposited to form these colloids.

Dr. Watson thought that this was most probably the answer. This would agree with observations made on all the other massive portions of the sections in which the introduced minerals appear to be contemporaneous.

Grain Size of Sulphides

The table on page 15 attempts to give an indication of the grain sizes of the sulphides.

Since the grain sizes of these minerals are so variable, it was thought that a statistical method would be very inaccurate. The writer accordingly has examined each section and has judged what he believes to be a fairly representative grain size for each mineral. It must not be assumed that this is accurate because it is subject to personal error. It is merely an indication of the size.

A second measurement was taken of the largest grain size of each mineral. This is more accurate than the first measurement.

Measurement of the smallest grain size of each mineral was not attempted because there is no lower limit. The smallest size in all the sections is submicroscopic.

With sphalerite, in some sections, neither the average, nor the largest grain size could be measured because of its anastomizing character.

It is felt that the measurement of the pyrite grains are the more accurate than the measurements of the other minerals because pyrite has a more noticeable tendency to remain a given size. It will be seen, however, that there are noticeable exceptions to this.

Polished Section No:	Pyrite	Galena	Sphalerite
1(a)	Average 170 microns Largest 800 microns	Average 80 microns Largest 250 microns	Anastomozing ?
1(b)	Average 125 microns Largest 400 microns	Average 80 microns Largest 200 microns	Average 250 microns Largest 700 microns
1(c)	Average 200 microns Largest 400 microns	Average 50 microns Largest 100 microns	Anastomozing
2(a)	Average 80 microns Largest 500 microns	Average 80 microns Largest 650 microns	Average 350 microns Largest 650 microns
2(b)	Average 160 microns Largest 1200 microns	Average 130 microns Largest 500 microns	Average 500 microns Largest 1000 microns
2(c)	Average 160 microns Largest 2500 microns	Average 160 microns Largest 1000 microns	Average 650 microns Largest 1000 microns
2(d)	Average 160 microns Largest 1500 microns	Average 80 microns Largest 1500 microns	Average 350 microns Largest 400 microns

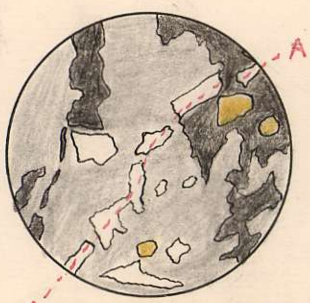
Pyrite Replacement of Limestone

X100

The drawing shows the typical form of pyrite replacement that takes place when pyrite is in bands about ½ inch wide. Minor amounts of sphalerite and galena occur with the pyrite. From Specimen 2(b).

- calcite(limestone)
- sphalerite
- pyrite
- galena

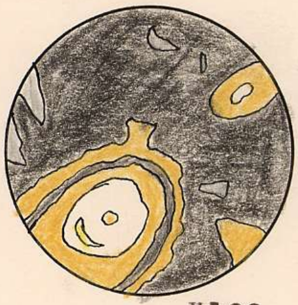
Galena Veining Sphalerite(?)



X100

There is a suggestion that the galena might be in a form of a vein replacing sphalerite along the line A-A. If this were so, then the galena, in this part of the section at least, would be later than the sphalerite.

Colloform Structure in Limestone



X100

This is believed to result from colloidal deposition of pyrite and galena. In this case these two minerals would be contemporaneous.

- calcite(limestone)
- sphalerite
- pyrite
- galena