

006503

MINERALOGICAL EXAMINATION
OF SAMPLE NO. V-90-PC08

submitted on behalf of

CURRAGH RESOURCES

Progress Report No. 1

Project No. L.R. 4074

NOTE:

This report refers to the samples as received.

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LAKEFIELD RESEARCH
A DIVISION OF FALCONBRIDGE LIMITED
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S U M M A R Y

The sample consisted of minus 10 mesh material comprised of pyrite, sphalerite, galena, non-opaque minerals, minor pyrrothite, marcasite, magnetite, goethite, silver as well as some chalcocite, digenite and covellite.

Copper minerals were associated in many grains with sphalerite, galena and pyrite as inclusions and as attached particles - even as middlings. This will have a serious adverse effect on the flotation of acceptable zinc and lead concentrates. A further complication is that the secondary copper minerals present tend to slime in milling and these slimes may result in undesirable activation of the minerals resulting in Pb reporting in Zn concentrates and vice versa as well as Cu reporting in both products.

The silver appears to be associated with galena, probably as inclusions of acanthite.

INTRODUCTION

A sample identified as Sample No. V-90-PC08 was received in the Mineralogy laboratory for examination. The purpose of the examination was to determine:

1. the mineralogical composition of the ore
2. the degree of oxidation
3. the degree of liberation
4. the presence of secondary copper minerals or sources of zinc (sphalerite)

activation.

A portion of the sample was briquetted and polished for microscopic examination and for photomicrographs of pertinent features or observations.

RESULTS

Composition: The sample contained the following minerals. The volume percent for each was estimated.

Mineral	Wt. %
Pyrite	35
Sphalerite	7
Galena	6
Chalcopyrite	1
Chalcoite	<1
Digenite	<1
Covellite	<1
Tennantite	Trace
Pyrrhotite	1
Marcasite	2
Cu (native)	Trace
Ag	Trace
Magnetite	2
Non-opaque	43
Other (goethite)	2
TOTAL	100

Results - Continued

Silver appears to be present in galena, possibly as acanthite. We deduce this from the tarnish present on the galena which is characteristic of silver in the lead sulphide. Native copper was identified as 3 possibly 4 minute inclusions in sphalerite.

Oxidation: Goethite after pyrite, pyrrhotite and marcasite was identified with some goethite containing pyrite as subhedral to almost euhedral crystals as well as anhedral pyrite. It is unusual to find subhedral much less euhedral pyrite in goethite. Alteration of chalcopyrite was evident on some copper grains as tarnish as well as the presence of the minerals chalcocite, digenite, covellite and the four minute grains of metallic copper. Not all of the chalcopyrite exhibited pronounced alteration or tarnishing but of those grains that did not an estimated 40 percent showed a greener yellow colour than that of fresh chalcopyrite and experience indicates that such "off colour" chalcopyrite will not respond to beneficiation quite as readily as fresh chalcopyrite. The ratio of fresh chalcopyrite to the off-colour mineral to that exhibiting tarnishing and alteration was estimated to be 11:7:2.

The secondary copper minerals represented perhaps 50 percent to 60 percent of the total copper in the sample. Three grains of galena showed evidence of corrosion/erosion of the surface but the remainder of the galena appeared to be fresh.

Oxidation is present in the sample therefore we may expect adverse reaction to flotation by the minerals. Zinc, lead and copper concentrates may be most affected.

Degree of Liberation: The sample consisted of minus 10 mesh material, therefore little liberation is to be expected. However, the following generalizations apply:

- A. The secondary copper minerals, particularly covellite and digenite can be expected to form slimes in milling and this may affect the amenability to float of some minerals, particularly of the sphalerite or may result in dilution of zinc concentrates by other minerals.
- B. Secondary copper minerals have replaced some of the chalcopyrite inclusions in sphalerite and have formed as coatings on sphalerite grains. They may remain as attached particles or become smears on the zinc mineral surfaces perhaps causing the mineral to respond as a copper mineral. The smearing of secondary copper minerals or their slimes on other minerals - pyrite, galena, etc. may cause these minerals to respond in like manner as the sphalerite. The alteration to secondary copper minerals of chalcopyrite associated with pyrite and galena will have similar effects as that in sphalerite.
- C. Some free grains of sulphide and non-opaque minerals were observed but many of these contained inclusions of other sulphide and the manner of this response to flotation would be questionable. We did not consider liberation determination to be valid on minus 10 mesh material.

Results - Continued

Secondary Copper Minerals: Covellite, digenite and chalcocite were identified. Also, some grains of chalcopyrite showed surfacing affects such as tarnishing and dullness of colour on freshly polished surfaces. These minerals and their associations are described more fully below.

Separation of Sphalerite and Galena: Both minerals are described more fully below. Copper minerals were associated with some grains of both sphalerite and galena and may be expected to have some effect on the flotation characteristics of each.

MINERALS

SPHALERITE:

The zinc sulphide was present as occasional free grains measuring 400 micrometers and smaller, but more commonly associated with other minerals as middlings grains. It also was present as host for fine to medium sized inclusions of galena, chalcopyrite, secondary copper minerals and occasional other minerals. Illustration 1, 2 and 3 show the range of inclusions present in sphalerite. Illustration 2 also shows inclusions of product of alteration of chalcopyrite. One fracture contains digenite and a few grains of metallic copper are present.

Sphalerite was present as grains without inclusions as shown in Illustrations 4 and 5. However, fractures in such sphalerite grains may and usually were filled with secondary copper minerals. Illustration 5 shows one such fracture filled with digenite and covellite. These fractures may be filled with galena and/or secondary copper minerals as is shown by the fracture in Illustration 4.

Illustration 4, 5, 6 and 7 show another bad feature associated with some sphalerite, that of coatings and attachments of galena and secondary copper minerals. Illustration 7 is an extreme example of this surface coating. Sphalerite so affected will be adversely activated with poor to null separation into separate concentrates of Zn and Pb - also of Cu if attempted. The ore appears to be fairly well zoned with a zinc zone of no inclusions in sphalerite to one where chalcopyrite was the dominant inclusion to one where galena was the major inclusion. The features shown in Illustrations 4-7 inclusive, can guarantee the improbability of an acceptable Zn concentrate without sacrificing recovery and possibly grade.

GALENA:

The lead sulphide was present in various associations with sphalerite, pyrite, copper minerals and non-opaque minerals. These associations included:

1. Cementing together and sometimes replacing pyrite and sphalerite.
2. As inclusions in sphalerite and pyrite and very rarely in chalcopyrite or gangue.
3. As fracture fillings in the zinc and iron sulphides.
4. As occasional free grains measuring 200 micromillimeters and smaller.
5. Most importantly, alone or with the secondary copper minerals as coatings or surface attachments on grains of sphalerite as shown in Illustrations 4 to 7.

Minerals - Continued

The association in item 5 above when the secondary copper minerals are present results in zinc concentrate contamination by lead and copper and in contamination of lead concentrates by zinc and copper. Three grains of galena showed alteration leaving behind a 'boxwork' of galena and secondary lead mineral. One such grain is shown in illustration 8. Some galena exhibited a tarnished iridescent surface which is characteristic of galena containing silver in one form or other. Galena also was present as a 'crummy looking' coating on some grains of pyrite. This galena invariably was associated with the secondary copper minerals.

It was not possible using the microscope to determine the ratio of galena to copper mineral in the coatings on sphalerite.

CHALCOPYRITE:

This mineral was present cementing grains of pyrite; as inclusions of different sizes in sphalerite, occasionally pyrite or galena and in gangue. Some chalcopyrite had been more exposed to the processes of weathering than other grains of the mineral and the effects ranged from tarnishing of chalcopyrite surfaces through partial to complete alteration to secondary copper minerals described below.

Illustrations 9 and 10 illustrate the cementing feature plus the tarnishing and alteration to digenite while illustrations 1 to 3 show examples of chalcopyrite as inclusions in sphalerite. The tarnishing of the chalcopyrite presents a cautionary sign for beneficiation. Experience has shown such chalcopyrite to be refractory during beneficiation. The grain size ranged from 60 to smaller than 5 micrometers. The ratio of chalcopyrite present as fine grained inclusions in sphalerite to all other chalcopyrite was estimated to be 1:3.

Minerals - Continued

SECONDARY COPPER MINERALS:

In decreasing order of abundance these minerals were chalcopyrite, digenite, covellite and metallic copper. A trace of bornite may have been present but was too fine-grained for positive identification. These minerals were the products of alteration of chalcopyrite. They were present as occasional free particles and in other associations of chalcopyrite. Illustrations 9 and 10 show minor digenite and a trace of chalcocite all after pyrite. The one noteworthy association has been referred to under the headings of sphalerite and galena. It is shown in illustrations 4 to 7 inclusive and is that of chalcocite, digenite and covellite present as a coating or attached fine grained particles on sphalerite grains. In this association there also may be fine grained galena. The net effect of this feature or association would be to make exceedingly difficult the separation of sphalerite from galena or chalcopyrite. Sphalerite could respond as galena or chalcopyrite and the same could be said for galena and chalcopyrite.

Secondary copper minerals such as chalcocite, digenite and covellite have a tendency to form slime particles in milling/grinding and the presence of such slimes in a mixed ore has been known to result in unwanted activation of non-copper minerals in a sample. They could contribute to the refractory problems of copper and lead minerals in and on sphalerite.

PYRITE:

This was the major sulphide mineral in the sample and was present as anhedral to rare nearly-euhedral pyrite, with it were associated the sulphide minerals as cementing material, attached particles and occasional inclusions. Individual grains measured as much as 500 micrometers but the grain size for 80 percent of the pyrite was smaller than 150 micrometers. Some grains exhibited embayment and replacement - particularly by galena. A few pyrite grains were affected by galena with secondary copper minerals present as a crummy or grainy coating on the surface of the pyrite. Most of the pyrite was homogenous but isolated grains departed from such pyrite. Examples of this consisted of isolated grains of pyrite shot through or peppered with 2 micrometer and smaller particles of sphalerite and of a few grains of pyrite which contained inclusions of galena measuring 1 to 14 micrometers.

Some pyrite can be expected to report in any concentrate prepared from this sample because of the presence of coating or inclusion of the mineral and perhaps because of activation by slimed secondary copper minerals.

Minerals - Continued

OTHER OPAQUE MINERALS:

This group includes among others, the minerals pyrrhotite and marcasite (after pyrrhotite). Together, these minerals represent 3 percent or less of the sample. While most of these two minerals occurred together, isolated fine-grained inclusions of pyrrhotite were identified in sphalerite and pyrite. Goethite also was present in small amount and probably represented alteration of pyrite. However, one occurrence of goethite had inclusions of pyrite some of which was almost euhedral and exhibiting no sign of attack or alteration. An unexpected occurrence. Magnetite made up approximately 2 percent of the sample. It was associated with the non-opaque minerals and occasionally with pyrite. Neither magnetite nor goethite are expected to cause problems.

NON-OPAQUE MINERALS:

Not all of the non-opaques were identified in this investigation. This may be done as an appendix to this report - if it should be required. The major minerals present in this group were quartz and feldspar.