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POLISHED SECTION REPORT

YUKON DEPOSITS

Summary data on pages 10 & 11-12

INTRODUCTION

Eleven sulphide specimens were submitted to the writer by Mr. Wm. Sirola for the preparation of polished sections and a written report on their mineralography. Purpose of this report is to outline mineralogical and textural data which might be important in evaluating milling procedure for these ores. An initial group of 7 specimens was arbitrarily numbered KA-1 to KA-7 respectively by the author. A second suite of 4 specimens from the Vangorda deposit was arbitrarily numbered V-1 to V-4 inclusive. A report on the mineralography of the specimens follows.

KA-1--Drill core, Swim deposit, magnetic. Abundant fine-grained sulphides (about 50% by volume) disseminated through gangue. Sphalerite is by far the most abundant sulphide, with much smaller amounts of pyrite and galena.

Polished Section:

The only opaque minerals present in the polished section are magnetite, pyrite, sphalerite and galena in that order of deposition, and very small amounts of pyrrhotite and chalcopyrite. Gangue minerals (mainly carbonate) were not studied in detail but constitute slightly less than half the surface area of the section

Pyrite: Grains are mostly anhedral although a few show a crude outline of cubic form and have 1 or more crystal faces poorly developed. Pyrite is generally equidimensional or nearly equidimensional grains about 0.4 to 0.5 mm. in diameter. A few grains are slightly more than 1 mm. in diameter and a few are as small as 0.05 mm. diameter. Grains are more-or-less rounded with only a few

protrusions extending into surrounding material. A few grains contain inclusions of gangue and sphalerite but these are negligible quantitatively.

Sphalerite: Grains are completely anhedral and grain contacts are commonly interpenetrating with adjacent gangue and galena grains. Most commonly sphalerite grains have smooth cusp-like segments to their contacts. Thin projections of galena into sphalerite are common. Nearly all sphalerite grains contain a few minute inclusions of chalcopyrite. Most grains are equidimensional or nearly so and have diameters in the range 0.2 to 0.5 mm. A few are 3 to 4 times this size. An appreciable but small proportion of sphalerite occurs as thin seams and penetrations between grains of other minerals. These seams are commonly 0.1 mm. wide or less. The larger grains of sphalerite commonly contain a small but important amount of galena as very small(less than 1 mm. dimaeter) irregular inclusions.

Galena: Galena has the most variable habit of all sulphides present. Grains are extremely irregular with many penetrations into surrounding grains and between grains of adjacent minerals. Much of the galena forms a series of irregular, contiguous masses filling in between grains of other minerals. Widths of these masses are highly variable but are commonly 0.2 to 0.4 mm. wide and range down to 0.01 mm. wide. Much galena is present as thin projections extending from large masses between grains of adjoining minerals (sphalerite and gangue especially). A large number of minute, irregular isolated grains occur surrounded by gangue and to a lesser degree in sphalerite.

Pyrrhotite: Only a couple of extremely small (less than 0.1 mm. diameter) grains of pyrrhotite were observed. These are anhedral with irregular, rounded contacts. They form an insignificant proportion of total sulphides present.

Chalcopyrite: Quantitatively this is not an important mineral. It

appears to be restricted entirely to inclusions in sphalerite. Most inclusions are about 0.01 mm. in diameter and are rounded in outline. A few irregular inclusions were observed as much as 0.2 mm. in diameter, completely enclosed in sphalerite. A single minute grain was seen in galena.

Magnetite: Subhedral to anhedral form. Individual grains are 0.2 to 0.5 mm. in diameter but in places they occur in aggregates several times this size. A few grains show fairly good crystal form. Magnetite has been replaced by galena and sphalerite but its place in the paragenetic sequence relative to pyrite is uncertain. Negligible amounts of sulphides are contained in magnetite grains as inclusions or protrusions.

KA-2: Swim deposit, drill core, magnetic. Consists of massive, fine-grained opaque minerals, mainly pyrite with smaller amounts of sphalerite and magnetite. Galena is not apparent in hand specimen. A very faint layering can be seen in the hand specimen.

Polished Section:

Minerals observed are pyrite, sphalerite, galena, pyrrhotite, magnetite and gangue. Order of deposition appears to be pyrite, magnetite, sphalerite and galena with the position of pyrrhotite being uncertain but earlier than sphalerite.

Pyrite: Grains are anhedral to euhedral, equidimensional with diameters commonly in the range 0.1 to 0.5 mm. Some grains are considerably larger (up to 1 mm. diameter). Grain contacts are fairly smooth with negligible interpenetration with surrounding minerals. Rare inclusions are present, mainly sphalerite grains less than 0.1 mm. diameter.

Sphalerite: In the polished section sphalerite is somewhat more abundant

than pyrite and forms a "matrix" in which isolated grains of other minerals occur. Masses of sphalerite range from 0.1 mm. to more than 1 mm. in diameter and these are mostly interconnected. Sphalerite contains numerous small inclusions (about 0.1 mm. diameter or less) of galena and gangue. These inclusions have irregular outlines. Rare inclusions of magnetite are present.

Magnetite: Grains are irregular and elongate with maximum dimension up to 1 mm. or slightly more. Some grains have intergrown pyrrhotite present and numerous seam-like inclusions of gangue. Either pyrrhotite or magnetite may predominate in a single grain.

Pyrrhotite: Occurs as extremely irregular grains distributed irregularly throughout the section, commonly intergrown with magnetite. In places pyrrhotite encloses small euhedral pyrite crystals. Grains range mostly from 0.2 to 1.0 mm. in diameter.

Galena: Very irregular grains with thin protrusions into and between neighbouring grains. Most blebs are much less than 0.1 mm. in diameter. Some are elongate with lengths up to 0.5 mm. Galena is much less abundant in this specimen than in KA-1. A small but important percentage of galena occurs as minute inclusions in non-opaque gangue and to a lesser degree in sphalerite.

KA-3: Swim deposit, drill core, massive sulphides, moderately coarse-grained in places but mainly fine-grained. Pyrite, galena and sphalerite are apparent.

Polished Section:

Sphalerite: Occurs mainly as rounded grains from 0.1 to 0.5 mm. diameter. Borders of grains are slightly interwoven with galena and magnetite. Many grains are free of inclusions but many contain numerous minute inclusions of galena and

to a lesser degree chalcopyrite.

Pyrite: Euhedral to subhedral, equidimensional grains. Majority of grains are 0.1 to 0.3 mm. diameter; a few rare grains are twice this size. Many euhedral grains are skeletal crystals containing numerous inclusions of gangue.

Magnetite: A fairly abundant constituent of the specimen as masses of anhedral grains containing numerous minute inclusions of gangue. Fairly closely intergrown with gangue and to a lesser degree sphalerite and galena such that the effective grain size of magnetite is 0.1 mm. or less.

Pyrrhotite: Small amount present as highly irregular blebs rarely up to 0.1 mm. in diameter.

Galena: Occurs mainly as minute grains about 0.01 to 0.05 mm. diameter. Rarely blebs are up to 0.2 mm. diameter. Grains are highly irregular with thin penetrations into and between surrounding grains.

Chalcopyrite: Not very abundant but much more so than in specimens KA-1 and KA-2. Occurs as discrete grains up to 0.1 mm. in diameter but generally much smaller. Grains are enclosed in gangue, galena, sphalerite and magnetite. Mutual boundaries with galena suggest contemporaneous deposition of the two. Larger grains are highly irregular much like galena.

KA-4: Swim deposit, drill core, massive sulphides, mostly fine-grained, with well defined layering shown by pyrite concentrations. Specimen is cut by a thin, fine-grained gangue seam of unidentified material. Obvious minerals are pyrite and sphalerite. Specimen is magnetic.

Polished Section:

Pyrite: Euhedral to anhedral crystals from 0.05 to 0.3 mm. diameter. Most grains are less than 0.1 mm. diameter. Pyrite contains practically no in-

clusions. In places where pyrite is most highly concentrated the only other material present in significant amounts is nonopaque gangue occupying spaces between pyrite grains.

Sphalerite: Grains are more-or-less equidimensional with diameters generally about 0.2 mm. Some grains are rounded, others have irregular contacts with surrounding minerals. Sphalerite contains very few inclusions but locally chalcopyrite and/or galena are present as very minute rounded grains.

Galena: Occurs in two ways: (1) as relatively large irregular grains 0.1 to 0.5 mm. in diameter, commonly with associated chalcopyrite, and (2) as extremely small blebs about 0.01 mm. diameter as inclusions in magnetite and between grains of gangue.

Magnetite: Completely anhedral grains up to 0.4 mm. diameter containing numerous small gangue inclusions and locally extensively intergrown with galena.

Chalcopyrite: Forms about 1% of the specimen. Much of it occurs as anhedral grains 0,05 to 0.1 mm. in diameter in contact with or enclosed by galena. A few grains are enclsoed in gangue. A small amount of chalcopyrite occurs as very small inclusions in sphalerite. Textures suggest that chalcopyrite and galena are contemporaneous in large part.

Chalcocite: Two minute grains observed, both in contact with the same pyrite grain.

Nonopaque Gangue: Occurs mostly as grains 0.3 to 0.5 mm. in diameter. Some also present as thin seams between sulphide grains. Much galena is disseminated through gangue as blebs 0.01 to 0.05 mm. in diameter.

KA-5: Vangorda deposit, drill core, 140 feet. Massive, fine-grained sulphides, mainly sphalerite and pyrite. No sign of layering present. Some carbonate present.

Polished Section:

Pyrite: Anhedral to subhedral, rounded, equidimensional grains 0.1 to 0.5 mm. diameter. Very little interpenetration with surrounding grains. More-or-less evenly distributed throughout the section. A few grains are euhedral, especially those surrounded by galena.

Sphalerite: Completely anhedral grains mostly in the range 0.1 to 0.3 mm. in diameter. Many thin protrusions of galena extend into sphalerite grains. Borders of grains are mostly smooth, curved surfaces.

Galena: Very irregular grains, many up to 0.3 mm. in diameter but much galena occurs as thin protrusions extending from larger masses into and between grains of surrounding minerals. Also occurs as thin inclusions less than 0.1 mm. in diameter in gangue and in very minor amounts in sphalerite.

KA-6: Anvil deposit, small angular specimen consisting mainly of massive, coarse-grained pyrite.

Polished Section:

Pyrite: Anhedral, equidimensional grains mostly about 1.0 mm. in diameter. Grains have irregular contacts but pronounced protrusions of other sulphides into pyrite grains are rare. Some grains are fractured and in a few of these galena and sphalerite occur along the fracture.

Sphalerite: Highly irregular grains occupying spaces between pyrite grains. Commonly about 0.5 mm. diameter. Contains numerous inclusions of chalcopyrite, galena and gangue. Chalcopyrite occurs as small blebs scattered throughout sphalerite and in strings of such blebs, probably representing a specific crystallographic orientation.

Galena: Present as completely anhedral masses interstitial to pyrite and commonly intergrown with sphalerite. Some grains are up to 0.5 mm. in diameter

or even larger but most are of the order of 0.1 mm. diameter or less and occur as inclusions in sphalerite.

Chalcopyrite: Entirely restricted to inclusionsin sphalerite. All sphalerite contains these inclusions more-or-less evenly distributed throughout the grains. In some cases the chalcopyrite inclusions are arranged in linear trends which probably represent a crystallographic direction which has controlled exsolution. Locally a few blebs in sphalerite are up to 0.1 mm. in diameter.

Nonopaque Gangue: Not very abundant. Restricted to interstitial spaces with spahlerite where it occurs in grains up to 0.5 mm. in diameter.

KA-7: Anvil deposit. Small hand specimen of coarse-grained massive sulphides, mostly pyrite.

Polished Section:

The specimen is very similar to KA-6 and does not warrant a separate detailed description. The specimen differs slightly from KA-6 in the following respects:

(1) Nonopaque gangue is more abundant in KA-7.

(2) Chalcopyrite is less abundant and occurs as a few isolated blebs here and there in sphalerite rather than as evenly distributed small inclusions as is the case in KA-6.

(3) Galena is more consistently present as large (0.4 mm. diameter) irregular blebs in KA-7 rather than the many minute blebs present in KA-6.

Vangorda Specimens V-1, V-2, V-3 and V-4:

The four chips supplied were arbitrarily numbered V-1, V-2, V-3 and V-4. All consist essentially of layered sulphides, predominantly pyrite.

Polished sections were made for each of the chips but they are described together because of their similarity.

Polished Sections:

Pyrite: This is by far the most abundant sulphide present, accounting for about 70 percent of each of the specimens. Grains are mostly equidimensional in the size range 0.1 to 0.3 mm. diameter. Crystals are anhedral although a few are subhedral and rare euhedral crystals do occur. Grain boundaries are very irregular with numerous embayments of gangue and more rarely other sulphides. Pyrite is almost completely free of inclusions although a few small inclusions of sphalerite were observed.

Sphalerite: This is the second most abundant sulphide but is much rarer than is pyrite. Grains are most commonly about 0.1 mm. in diameter or slightly less. Outlines are highly irregular with thin projections of sphalerite commonly extending between neighbouring grains. Sphalerite is generally free of inclusions except for rare minute blebs of galena.

Chalcopyrite: Only trace amounts are present. In one section two small rounded grains about 0.05 mm. diameter were seen, one in contact with sphalerite, the other surrounded by gangue. In a second section a few small (0.05 mm. diameter) anhedral inclusions in sphalerite were observed.

Galena: Occurs mainly as minute anhedral grains 0.05 mm. in diameter. Locally a few larger blebs occur with diameters of 0.1 to 0.4 mm. Galena occurs between grains of gangue for the most part and to a lesser degree associated with sphalerite.

Magnetite: Observed in only one polished section where it formed completely anhedral grains about 0.2 to 1.0 mm. in diameter, and accounted for about 1 to 2 percent of the section. There appears to be an increased concentration of chalcopyrite near magnetite grains.

SUMMARY

MAIN PARTICLE SIZE RANGE

Deposit	Pyrite	Magnetite	Pyrrhotite	Galena	Sphalerite	Chalcopyrite
Swim	0.05 - 0.5	0.2 - 0.5	0.05 - 0.1	0.01 - 0.4	0.1 - 1.0	0.01 - 0.2
Vangorda	0.1 - 0.5	0.2 - 1.0		0.05	0.05 - 0.3	0.05
Anvil	1.0			0.1 - 0.5	0.5	0.1

All values quoted are in millimeters.

CONCLUSIONS:

The main purpose of this work has been to compare the Swim, Vangords and Anvil deposits from the point of view of texture and mineralogy, and to outline the effects these properties will have on beneficiation methods. A list of significant conclusions follows:

(1) The deposits all have similar mineralogies although the limited number of specimens examined is not entirely representative of total mineralogies of any of the deposits.

(2) Mean grain sizes of individual minerals in Anvil deposit is 2 to 10 times the size of the same minerals in Vangorda and Swim deposits (see table on page 10).

(3) Pyrite and magnetite from Swim and Vangorda ores should be separable with ease by mechanical means because of their relatively large grain size and occurrence as equidimensional grains with relatively smooth contacts. Furthermore, no significant loss of values should be experienced because economically sulphides do not occur as inclusions in pyrite or magnetite in appreciable amounts.

(4) Sphalerite separation should not be too difficult because of the rounded nature, equidimensional shape and large grain size of most grains. A significant proportion of galena occurs as minute inclusions in sphalerite and separation will be extremely difficult. Much of the chalcopyrite present exists as extremely minute inclusions in sphalerite and will be separated mechanically only with great difficulty.

(5) Galena separation with high recovery may be extremely difficult because more than half the galena in sections examined is present in very fine irregular grains (especially in Vangorda specimens). Some galena exists as inclusions in sphalerite. This is particularly serious because of the probable

association of high silver values with galena. The problem is compounded because much of the very fine-grained galena is intermixed with gangue and may be lost in tailings.

(6) Chalcopyrite occurs as minute inclusions in sphalerite in both Swim and Vangorda deposits and will be separable from sphalerite only with extreme difficulty. Some chalcopyrite in specimens from the Swim deposit occurs as rounded inclusions in galena and as irregular blebs in contact with galena. In this latter form chalcopyrite may be more easily separated into a copper concentrate than would the very fine inclusions in sphalerite.

(7) Pyrrhotite is not an important constituent of any of the specimens examined and should offer no serious separation problems and no significant loss of values.

(8) Most nonopaque gangue occurs in fairly large grains that should be easily separable from sulphides. A small but significant proportion occurs as very thin seams between grains of valuable sulphides.

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