66001723

Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	See title page
AUTHOR	Clark, J.G.; Allen K.D.; Dean, D.
DATE OF DOC(S)	1999
MULTI_DIST Y / (N?) Additional Dist_Nos:	
QUAD_NAME	Sulphur 7.5
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Rosebud Mining Co. LLC; Applied Petrographics
COMMODITY If not obvious	gold; silver
NOTES	Petrographic report; photographs; geology; mineral list 11 p.

Keep docs at about 250 pages if no oversized maps attached (for every 1 oversized page (>11x17) with text reduce the amount of pages by ~25)

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Revised: 1/22/08

66001723 4010

DISTRIBUTION OF GOLD-BEARING MINERAL PHASES IN TAILINGS SAMPLES FROM THE ROSEBUD MINE, NEVADA

By

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APPLIED PETROGRAPHICS
Tucson, Arizona

12 August 1999

Prepared for
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INTRODUCTION

Systematic assays of tailings from processed ore at the Rosebud mine showed unacceptably high residual gold values. A petrographic study of mine tailings samples from the Rosebud deposit was undertaken in order to determine the distribution and mode of occurrence the major gold-bearing minerals, and to point the way toward possible solutions that might result in increased gold recoveries.

METHODOLOGY

Three samples of fragmental tailings material were selected by Kurt Allen and Dale Dean, geologist and metallurgist, respectively, for the Rosebud Mining Company. Samples were drawn from two size fractions. The coarser size fraction consists of fragmental material up to approximately 3.5mm in length/diameter. Material from the finer size fraction ranges to about 0.4mm in length/diameter. Standard size (1" X 2") grain mount polished thin sections were prepared from the samples. For each sample three polished thin sections were made of the coarse fraction material and one polished thin section was made from the fine fraction material. Sample numbers are:

B 515 (3 sections; coarse fraction)
B 515 +100 (I section; fine fraction)
A 516 (3 sections; coarse fraction)
A516 +100 (I section; fine fraction)
B 516 (3 sections; coarse fraction)
B 516 +100 (1 section; fine fraction)

A total of twelve polished grain mount thin sections was investigated during the course of this study. The thin sections were observed using reflected light microscopy on an Olympus BX60 polarizing microscope. Each thin section was examined systematically in grid-like fashion in an effort to identify all gold-bearing phases and their modes of occurrence. Owing to the fine grain size of the mineralization, most of the work was performed using magnifications of 100X and 200 X. All samples were also examined under cathodoluminescence (CL) in an effort to quickly identify carbonaceous material as a possible host for the gold. Carbonaceous matter sometimes gives a disctinct, but decaying luminescence. CL observations were made using a Reliotron cathodoluminescence instrument mounted on an Olympus SZ60 stereo microscope. Results from the study are documented in photomicrographs in Figures 1 - 12. Photomicrographs were taken using an Olympus OM-2 photo system.

RESULTS

Figures 1 and 2 show the size and shape characteristics of the two size fractions examined for this study. Samples B 515, A 516, and B 516, both coarse and fine fractions, are similar with respect to ore and gangue mineralogy and texture. Host material for the ore minerals is a fine-grained matrix of quartz, clay, and carbonate. Disseminated pyrite and marcasite are relatively abundant. Average gangue matrix grain size is probably less than 0.01 mm diameter.

Ore mineral phases and modes of occurrence are similar in all samples examined for this study, as well as for both size fractions. Ore mineral phases identified during examination of the samples are listed below. Abundance estimates were not made:

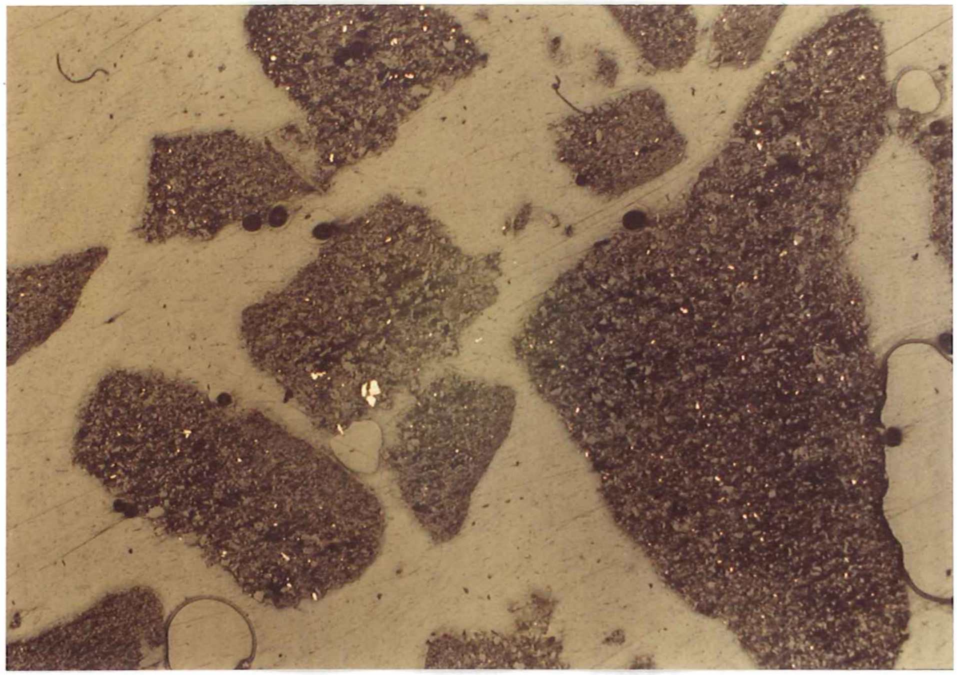

Figure 1. Sample A 516 - Coarse fraction fragmental tailings material. Note very fine-grained, disseminated pyrite (yellowish white grains with moderately high reflectance). Reflected light (RL) photomicrograph; 1 cm on the photo = 0.532mm.

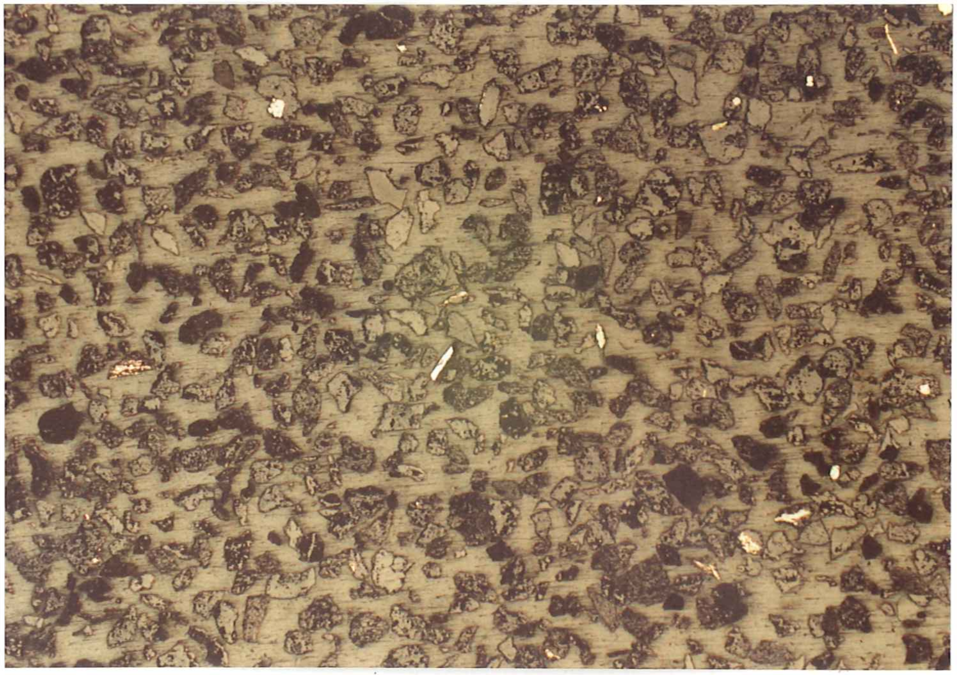

Figure 2. Sample A 516 +100 - Fine fraction tailings fragments. Disseminated and free grains of pyrite (yellowish white grains with moderately high reflectance). At photo center are a grain of free electrum (bright white; high reflectance) and a grain of very fine, partly encapsulated native gold (high reflectance; bright yellow). These grains of electrum and gold are shown at higher magnification in Figures 8, a and b. RL photomicrograph; 1 cm on the photo = 0.532mm.

pyrite
marcasite
native gold
electrum
Ag sulphosalt minerals
- antimonpearceite
- stephanite
- pyrargyrite

acanthite
pyrrhotite
chalcopyrite

All samples contain significant pyrite and marcasite disseminated in the fragmental matrix host and as discrete crystals dispersed with the fragmental matrix material. The pyrite and marcasite are generally subhedral to anhedral crystals that range from <0.01mm - >0.10mm diam. The silver-bearing minerals occur primarily as disseminations in host matrix, but were found also as discrete grains with or without bits of adherent matrix. They tend to be anhedral to subhedral and very fine-grained, generally less than 0.01 mm in length/diameter. Sample B 516 appears to contain a lower abundance of silver minerals than do samples B 515 and A 516. Pyrargyrite appears to be the most abundant silver mineral in all samples (Figures 3 and 4).

The primary gold-bearing mineral phases in all three samples are native gold and electrum. Modes of occurrence for the gold-bearing phases are illustrated in the photomicrographs in Figures 5 - 12. Both phases can occur as disseminations in the quartz-clay-carbonate matrix and as discrete grains. Electrum is present as fine-grained, elongate to anhedral crystals that range from <0.005 - 0.2 mm in length/diameter (Figures 4, 5, 8, and 12). Native gold forms very fine, anhedral grains that tend generally to be smaller than the electrum grains. The largest grain of native gold was approximately 0.24mm in length (Figure 10), but the majority of the gold is much finer grained. Some gold grains were observed to be < 0.007mm in diameter. Sample B 516 appears to contain a lower abundance of both gold and silver minerals than do the other samples.

The gold and electrum commonly show partial to complete encapsulation by quartz (Figures 5, 6, 7, 8, and 9), although both can be present also as free grains accompanying the larger tailings fragments (Figures 10 and 11). The gold usually shows irregular grain margins and minor to extensive surface pitting or corrosion (Figures 6 - 11). This "motheaten" surface texture common to the gold grains is interpreted to result from incomplete reaction with a corrosive fluid, the sodium cyanide solution added to the crushed ore during processing. In contrast to the gold, the electrum shows little surface pitting, but commonly a great deal of edge corrosion (Figure 8).

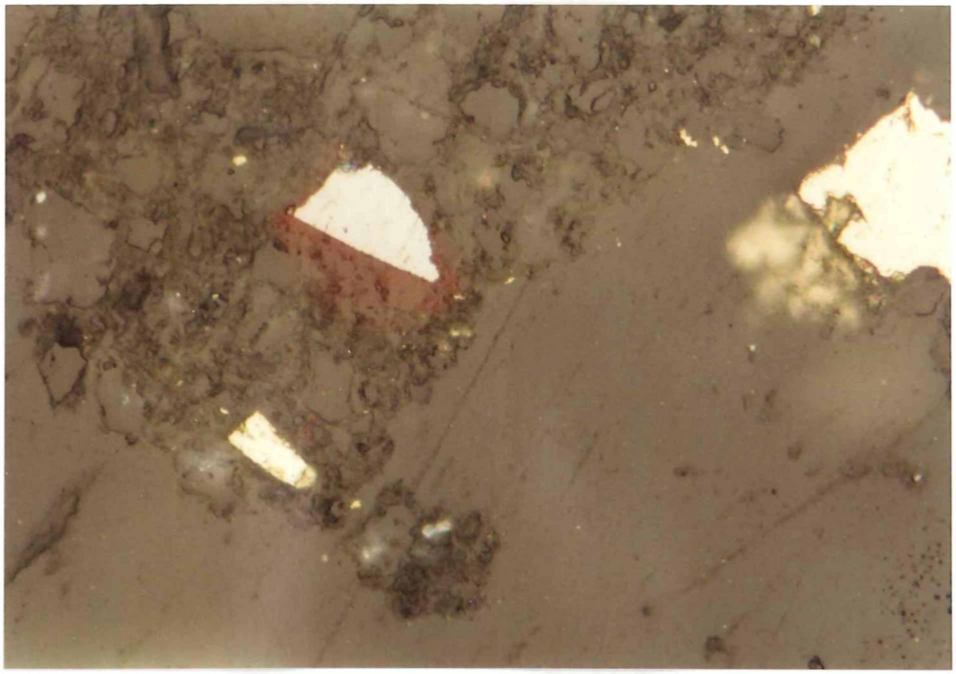

Figure 3. Sample B 515 - Grayish white grain with reddish halo is pyrargyrite, disseminated in tailings fragment. The bright, yellowish white grains are pyrite. RL photomicrograph; 1 cm on the photo = 0.022mm.

Figure 4. Sample A 516 - Grains of pyrargyrite (larger grain with gray color and moderate reflectance), electrum (elongate; white; very high reflectance), and pyrite (yellowish white; high reflectance) grains distributed within a tailings fragment.). RL photomicrograph; 1 cm on the photo = 0.022mm.

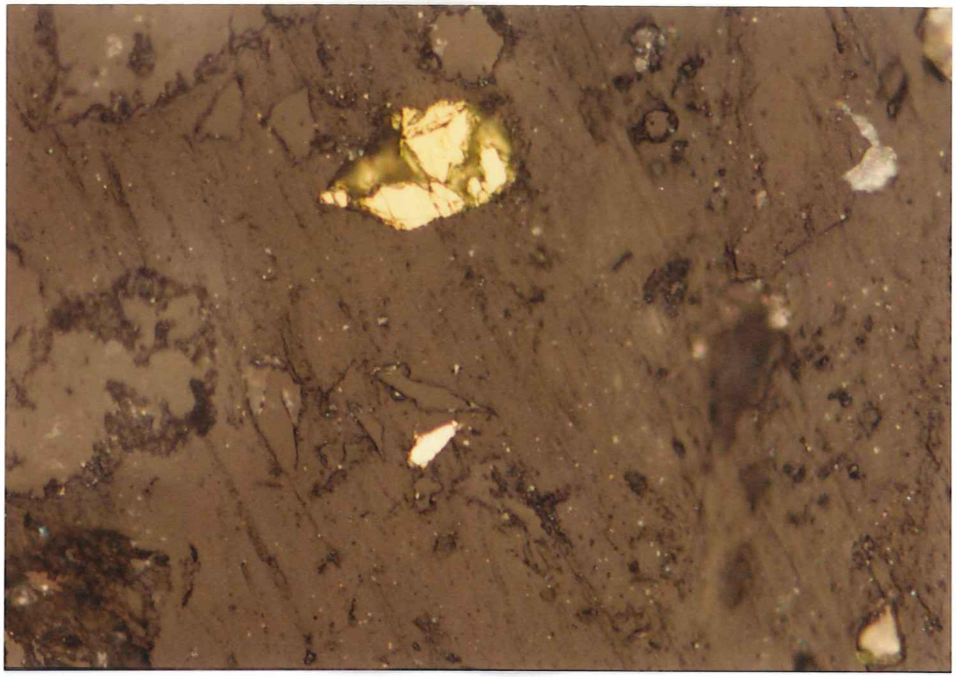

Figure 5a. Sample B 515 - Very fine grains of native gold (yellow; high reflectance) and electrum (white; high reflectance) partly encapsulated in quartz within a fragment of tailings material. RL photomicrograph; 1 cm on the photo = 0.022mm.

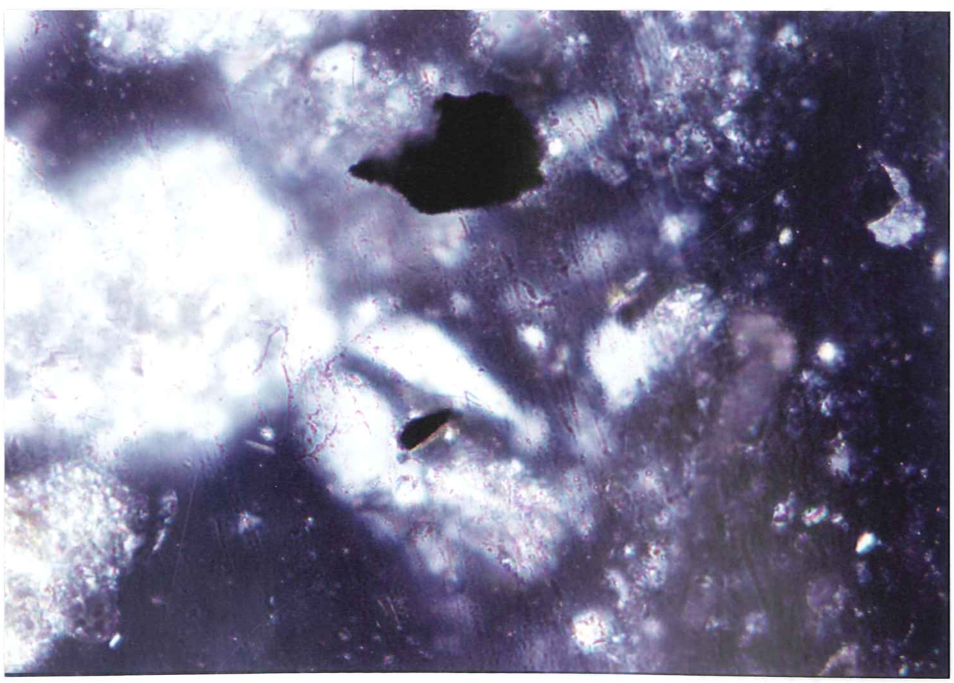

Figure 5b. Sample B 515 - Same view and scale as Figure 3a. The gold and electrum are opaque under transmitted light with nicols crossed (TLX), while the fine-grained quartz is white. TLX photomicrograph; 1 cm on the photo = 0.022mm.

Figure 6a. Sample B 515 - Angular grain of native gold (yellow; high reflectance) partly encapsulated in fine-grained quartzose matrix of a tailings fragment. RL photomicrograph; 1 cm on the photo = 0.022mm.

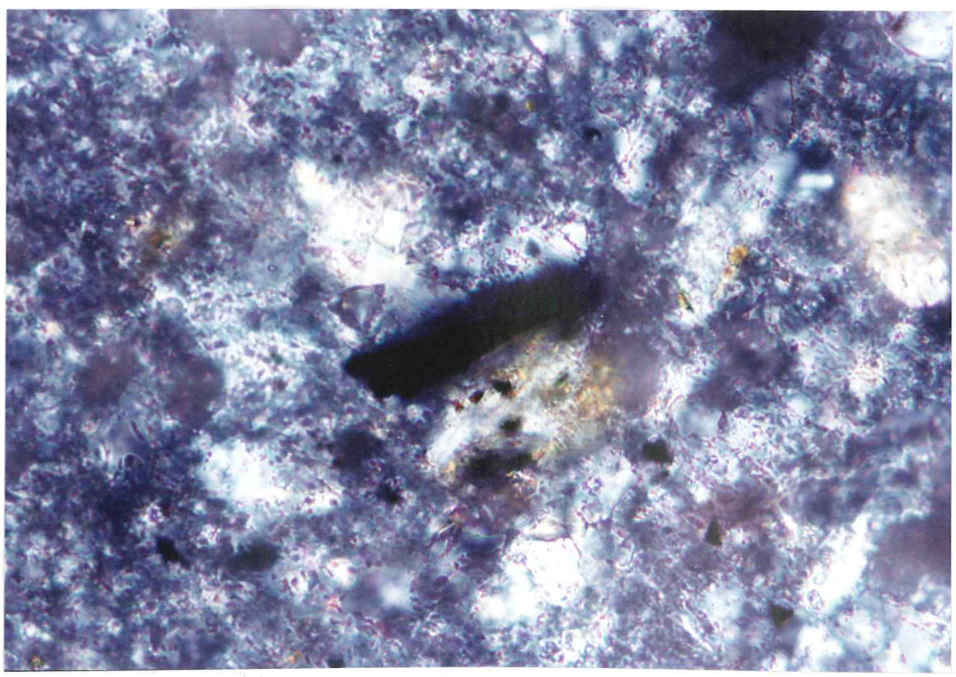

Figure 6b. Sample B 515 - Same view and scale as Figure 4a. The TLX photomicrograph shows the textural relationship between the gold (opaque grain) and the very fine-grained quartzose matrix to better advantage. TLX photomicrograph; 1 cm on the photo = 0.022mm.

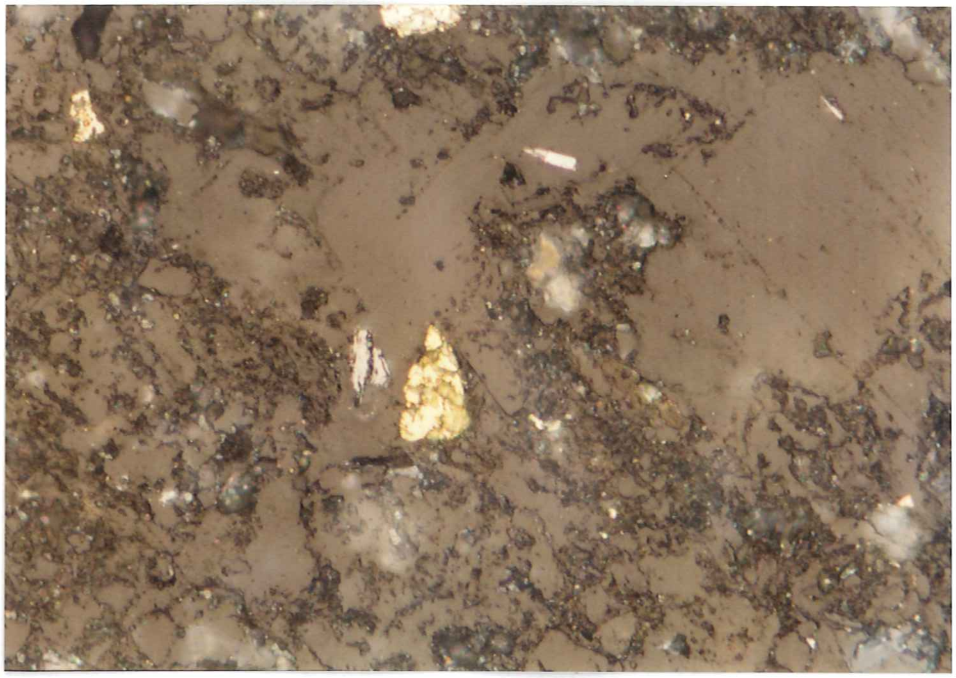

Figure 7a. Sample B 515 - Grain of native gold at photo center is partly encapsulated by fine-grained quartz in the quartz-clay matrix of a tailings fragment. Surface roughness may be due to interaction with corrosive cyanide solution. RL photomicrograph; 1 cm on the photo = 0.022mm.

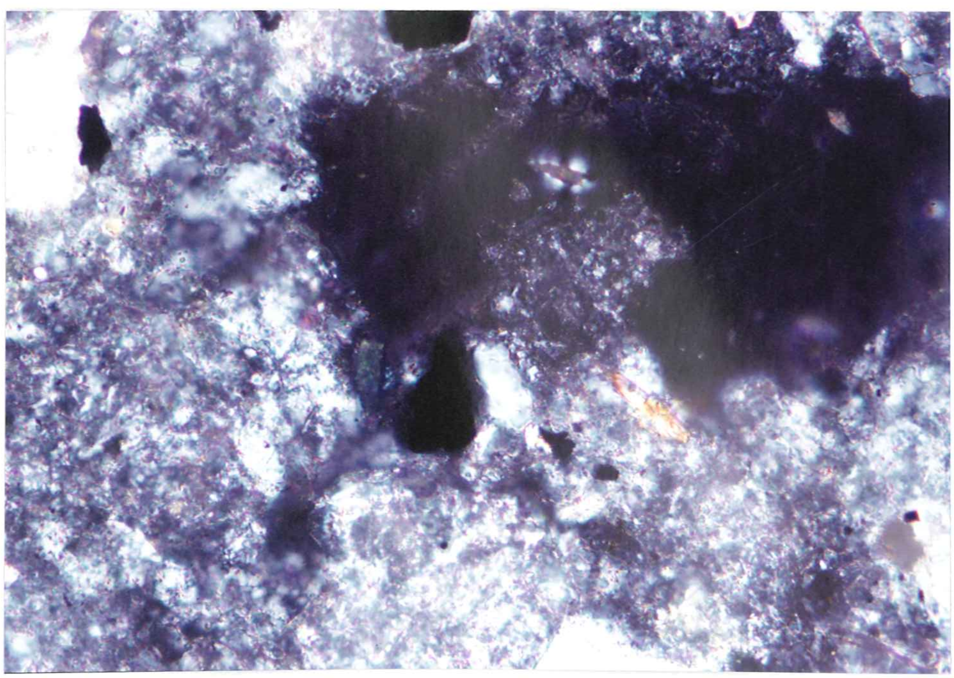

Figure 7b. Sample B 515 - Same view and scale as Figure 5a. Larger white grains are quartz, while the extremely fine, polycrystalline material is a mixture of quartz and clay. TLX photomicrograph; 1 cm on the photo = 0.022mm.

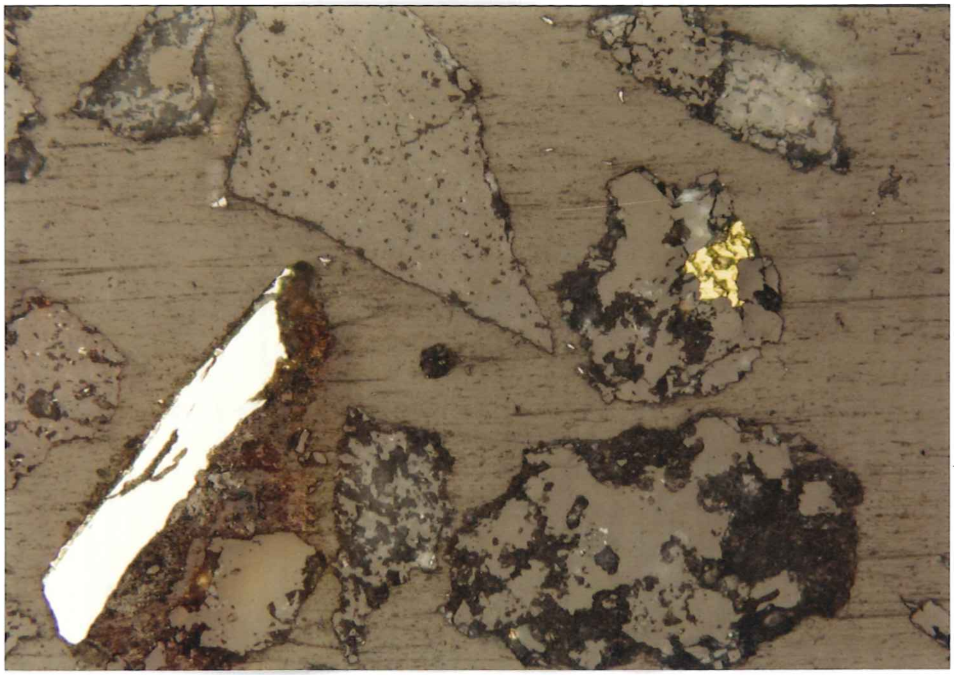

Figure 8a. Sample A 516 +100 - Large white grain with high reflectance is electrum anchored to a tailings fragment. A fine, corroded grain of native gold is almost completely encapsulated by quartz in the upper right quadrant of the photo. RL photomicrograph; 1 cm on the photo = 0.053mm.

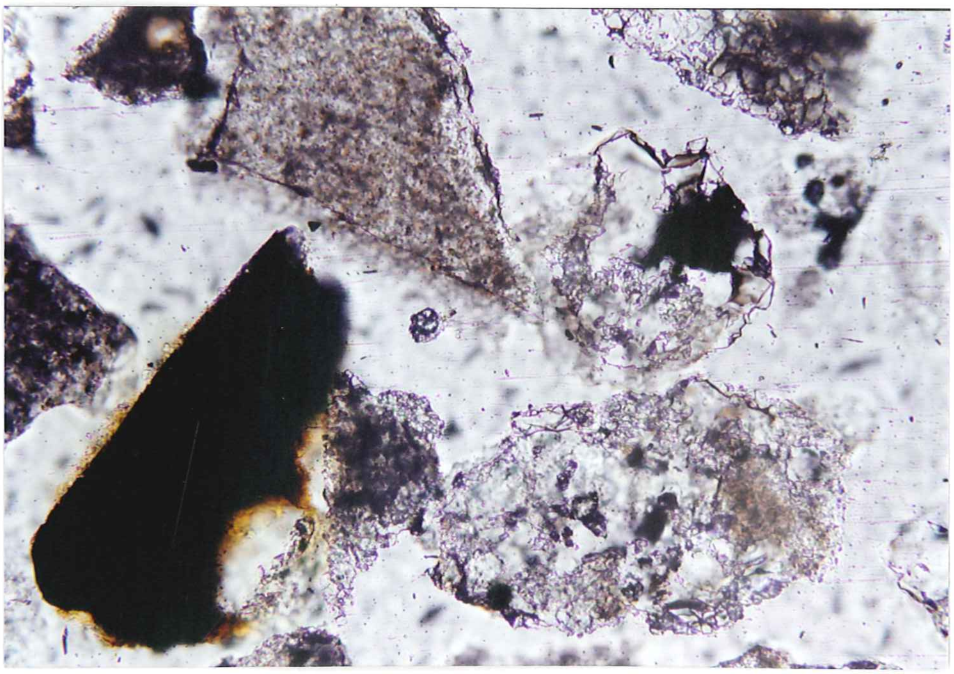

Figure 8b. Sample A 516 +100 - Same view and scale as Figure 8a, but under plane polarized transmitted light (TLP). The encapsulation of the native gold by quartz is readily apparent in this mode. TLP photomicrograph; 1 cm on the photo = 0.053mm.

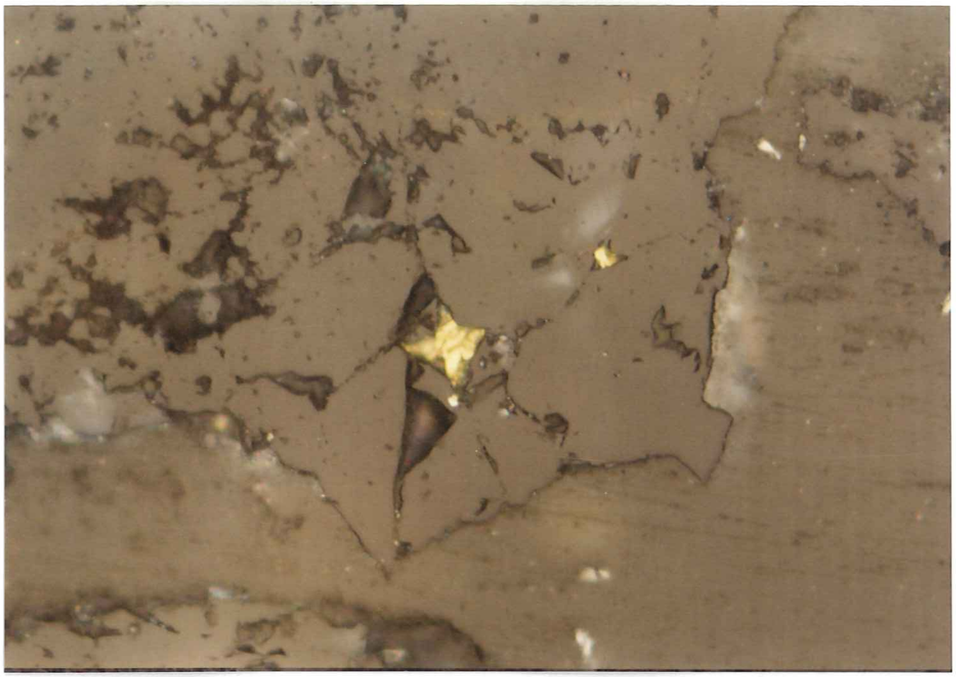

Figure 9. Sample A 516 +100 - Partial encapsulation of very fine native gold by quartz. The gold grain is ±0.01mm diameter. RL photomicrograph; 1 cm on the photo = 0.022mm.

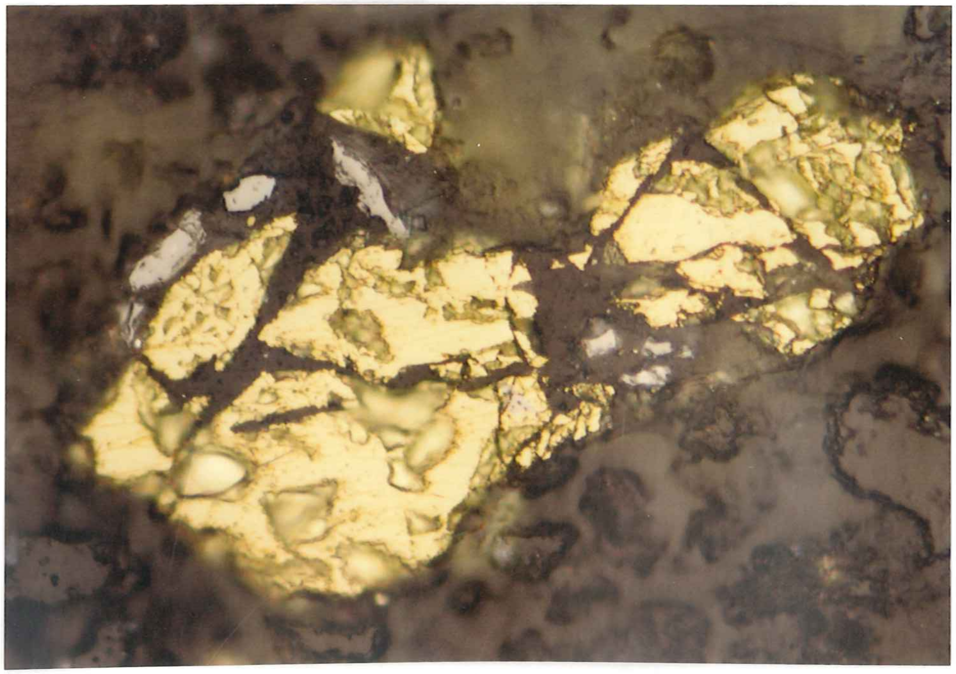

Figure 10. Sample A 516 - Highly corroded grain of free native gold. This was the largest grain of native gold identified during this study (appx 0.24mm length). There is a tiny inclusion of a probable silver mineral phase in the central part of the gold grain (gray color, much lower reflectance). RL photomicrograph; 1 cm on the photo = 0.022mm.

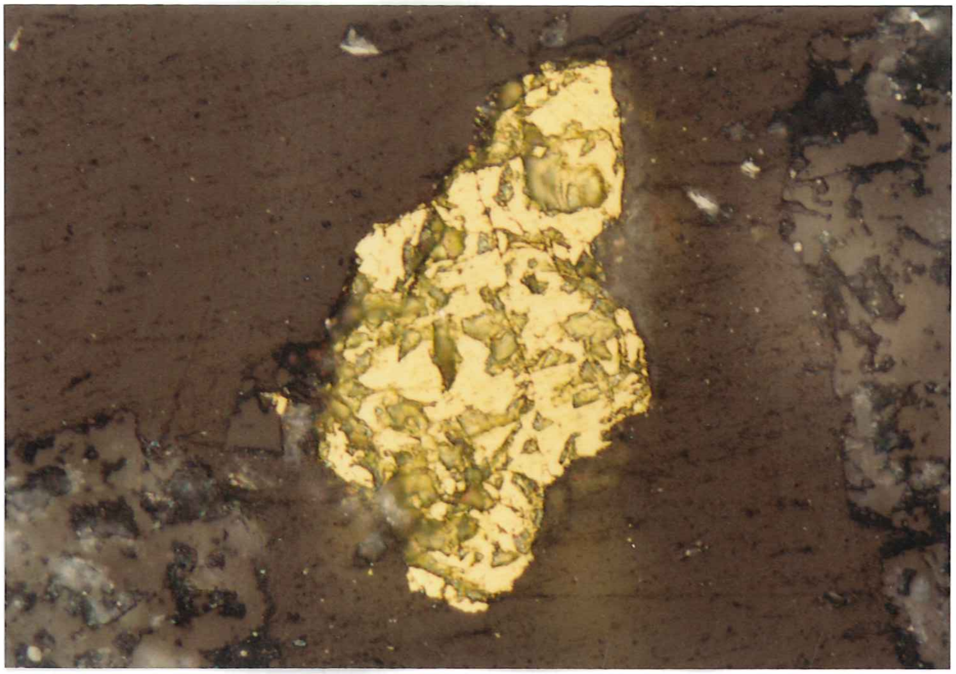

Figure 11. Sample B 516 +100 - Free grain of native gold in fine fraction tailings showing extensive surface corrosion, probably from reaction with cyanide solution. RL photomicrograph; 1 cm on the photo = 0.022mm.

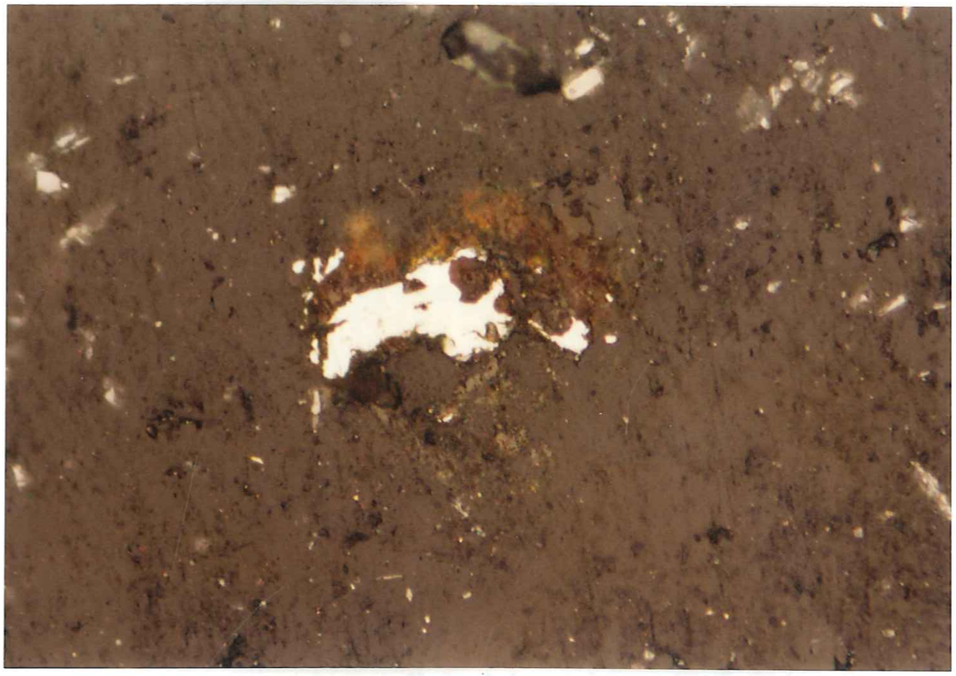

Figure 12. Sample B 515 - Free electrum grain (white; high reflectance) has an irregular margin, perhaps due to interaction with corrosive cyanide solution. RL photomicrograph; 1 cm on the photo = 0.022mm.

SUMMARY AND CONCLUSIONS

The textural and mineralogical characteristics that appear to be primarily responsible for loss of gold to the tailings at the Rosebud mine are:

- The mineralization in the ore type represented by samples B 515, A 516, and B 516 is generally extremely fine-grained, with size ranges for both gold and electrum from <0.01 - 0.24mm length or diameter.

- The fine grain size of the mineralization appears to have facilitated partial to complete encapsulation of the gold and electrum by quartz during ore deposition. The quartz itself is also very fine-grained.

All samples examined also contain free grains of gold and electrum apart from the tailings rock fragments.

Most of the gold and electrum grains, even though encapsulated to varying degrees, appear to show at least limited reaction with sodium cyanide solutions during processing of the crushed ore.