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MINERALOGY OF A FRANCKEITE CONCENTRATE OF A TIN ORE FROM BOLIVIA FOR PROSPECTION LIMITED

by

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MINERAL SCIENCES DIVISION

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SUMMARY OF RESULTS

The franckeite concentrate from Bolivia is complex mineralogically, as a number of the metallic minerals in it have similar physical properties. The most abundant metallic minerals are galena and boulangerite. Most of the tin is present as franckeite and stannite, but some is also contained in cassiterite. The silver in this concentrate is contained in galena and freibergite.

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INTRODUCTION

A sample of a franckeite concentrate from Bolivia was received from R.C. McAdam of the Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch. Mr. McAdam stated that the sample was submitted to the Mineral Sciences Division by L.E. Djingheuzian, Chief of the Mineral Processing Division. Mr. Djingheuzian reported that the sample was submitted to the Mines Branch by Prospection Limited, 80 Richmond Street West, Toronto, Ontario, and requested chemical and mineralogical investigations of it. The chemical composition is being determined by Mr. McAdam.

SAMPLE

The sample received was crushed to about -48 mesh. A partial chemical analysis, supplied by Prospection Limited, is given in Table 1.

TABLE 1

Partial Chemical Analysis of Franckeite Concentrate from Bolivia*

Element	Weight, Per cent
Pb	45.92
Sb	15.40
Sn	3.32
Zn	1.90
Cu	0.57
Ag	0.555 = 178 oz/ton
In	0.033
Ga	0.04
Ge	0.004
Tl	0.004
Au	tr

*Analysis supplied by Prospection Limited, 80 Richmond St. W., Toronto, Ontario.

METHOD OF INVESTIGATION

The sample was analysed spectrochemically to determine the elements present. It was also sized, and the -65 +200 mesh fraction was separated into sub-fractions by means of heavy liquids. Polished sections were prepared from the resulting fractions and sub-fractions and the minerals were identified by means of microscopical and X-ray diffraction studies.

RESULTS OF INVESTIGATION

Spectrochemical Analysis

The elements present in the sample, as determined by a semi-quantitative spectrochemical analysis, are given in Table 2.

TABLE 2

Elements Present in Franckeite Concentrate from Bolivia*

Element	Weight, Per cent (see Legend)
Pb	A
Sb	A
Fe	B
Zn	B
Sn	C
Al	C
Si	C
Au	C
As	C
Ag	C
Mg	D
Bi	D
Ca	D
Mn	D
In	D
Cr	D
Ti	D
B	D
Mo	E
Ga	tr
Zr	tr
V	tr
Tl	tr
Ge	nd
Au	nd

Legend

A = +5%
B = 1 to 5%
C = 0.1 to 1%
D = 0.01 to 0.1%
E = 0.001 to 0.01%
tr = trace
nd = not detected

*Semi-quantitative spectrochemical analysis by E.M. Kranck, Report SL-63-078, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

Mineralogy

General Mineralogy

The metallic minerals in the concentrate are galena (PbS), freibergite ($(Cu, Fe, Ag)_{12}Sb_4S_{13}$), boulangerite ($Pb_5Sb_4S_{11}$), cosalite ($Pb_2Bi_2S_5$), franckeite ($Pb_5Sn_3Sb_2S_{14}$), stannite ($Cu_2FeSnS_4$), cassiterite ($SnO_2$), sphalerite (ZnS), pyrite (FeS_2), arsenopyrite (FeAsS), magnetite (Fe_3O_4) and goethite ($Fe_2O_3.H_2O$). The non-metallic minerals are amphibole, quartz, mica and calcite.

Detailed Mineralogy

Galena

Galena is the principal constituent in the concentrate. It occurs as small grains that frequently show intergrowths with boulangerite, stannite and freibergite. In the coarse fractions these grains are present as small angular inclusions in gangue and goethite (see Figure 1), but in the fine fractions they are largely liberated.

The cell edge of galena, as determined by accounting for film shrinkage, is 5.915A. When this value is applied to a graph reported by Ontoev et al. (1), about 3 to 5 per cent $AgBiS_2$ in solid solution is indicated. This is equivalent to about 0.8 to 1.4 per cent Ag or 256 to 448 ounces per ton Ag. Thus, it is likely that the galena is the principal silver-bearing mineral in this ore.

Freibergite

A few grains of freibergite were observed in the -65 mesh fractions of the concentrate. They are present as freed grains and as inclusions in boulangerite (see Figure 2) and in galena.

Boulangerite

A significant amount of boulangerite is present in the concentrate. That in the coarser fractions is present as small grains in gangue and goethite (see Figure 1), whereas that in the finer fractions is present as freed grains and as minute inclusions in galena and gangue (see Figure 3). Many of the freed grains contain inclusions of freibergite and franckeite (see Figures 2 and 4).

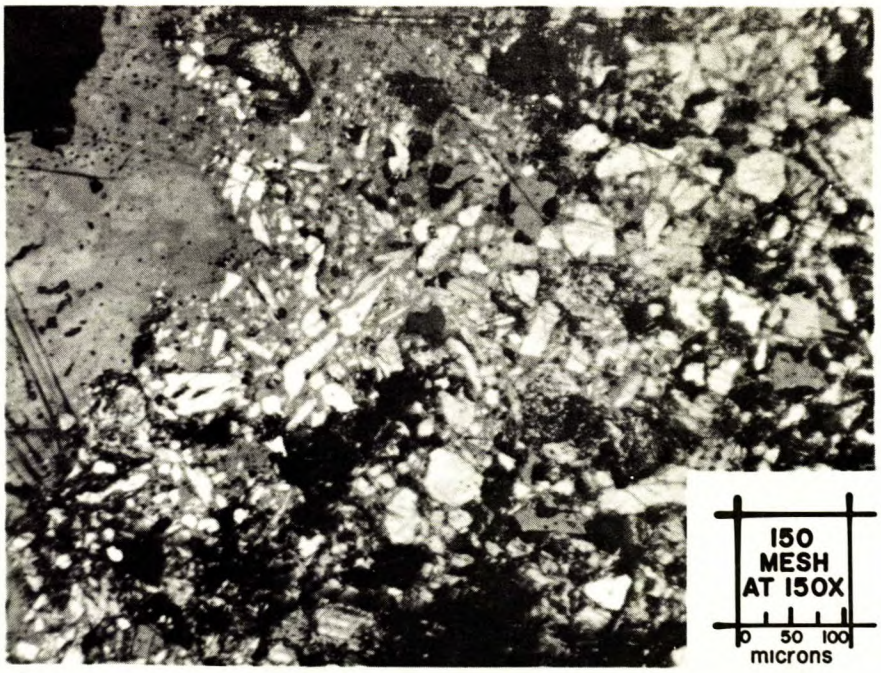

Figure 1. Photomicrograph of a polished section of a coarse fraction of the concentrate. It shows inclusions of galena, boulangerite and franckeite (white) in goethite (grey).

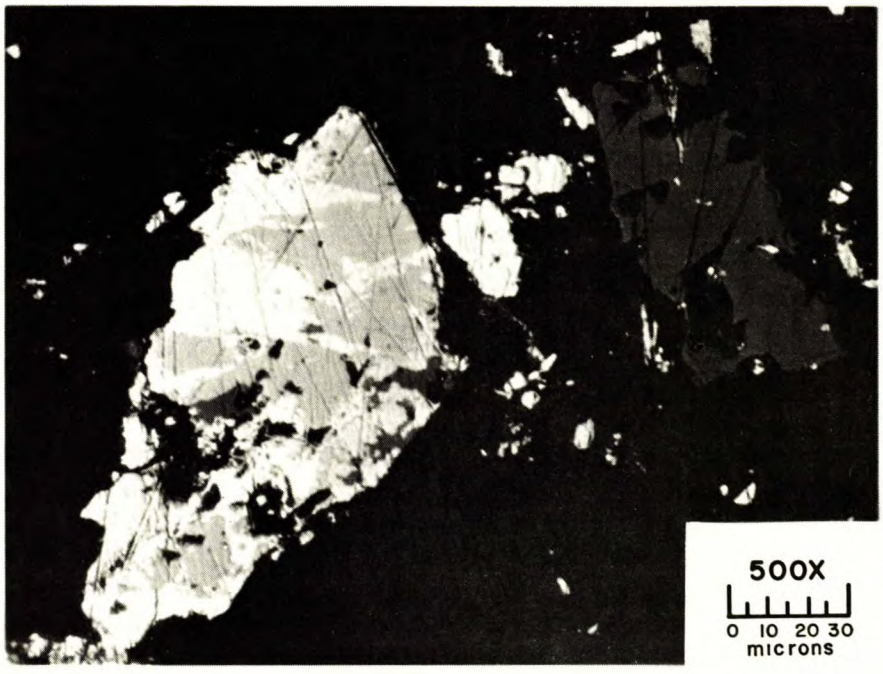

Figure 2. Photomicrograph of a polished section of a -65 +200 mesh fraction. It shows freibergite inclusions (grey) in boulangerite (white).

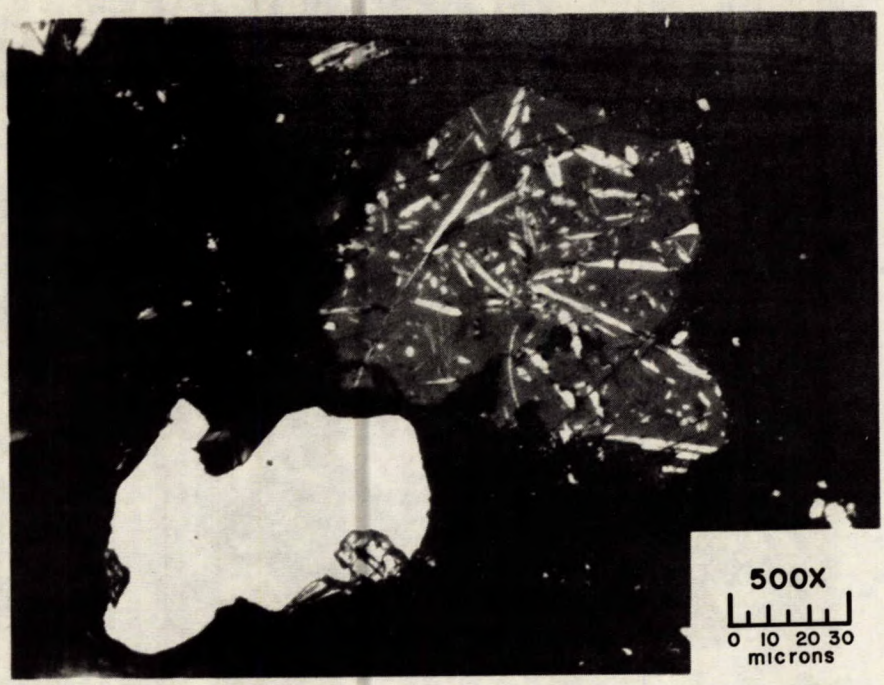

Figure 3. Photomicrograph of a polished section of a -65 +200 mesh fraction. It shows a grain of gangue (grey) and a grain of pyrite (white). The gangue contains small inclusions of boulangerite (white).

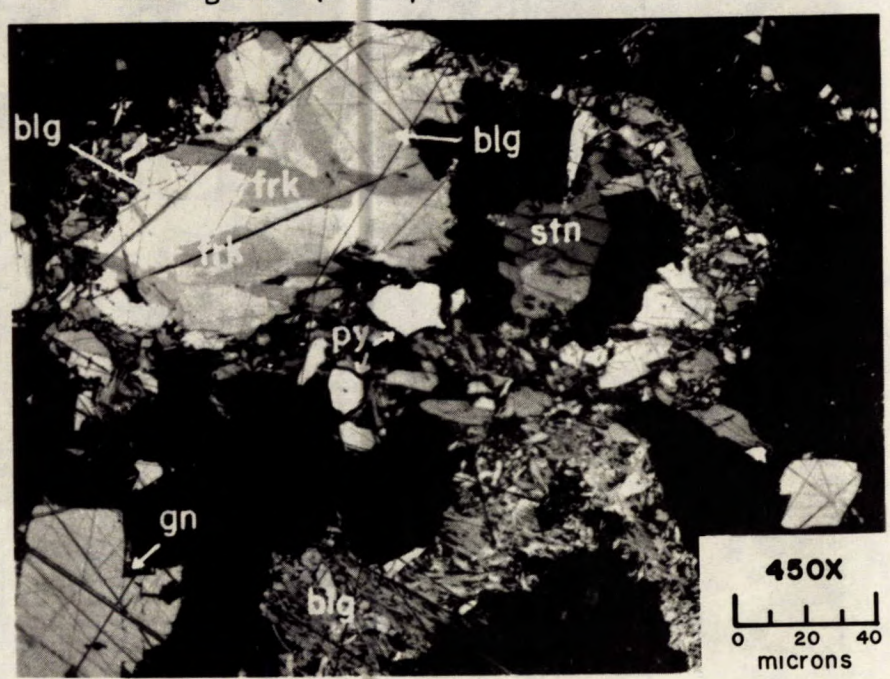

Figure 4. Photomicrograph of a polished section of a -65 +200 mesh fraction. It shows a boulangerite grain (blg) that contains franckeite inclusions (frk) (nicols partially crossed), as well as a few grains of pyrite (py), galena (gn), and stannite (stn).

Cosalite

Cosalite was not identified in polished sections, but X-ray diffraction studies of the various fractions indicate that it is present in the concentrate.

Franckeite

A small amount of franckeite was found in the concentrate. It occurs as freed grains and as inclusions in boulangerite (see Figure 4), gangue and goethite.

Stannite

A small amount of stannite was found in the finer fractions of the concentrate (see Figure 4). It occurs as freed grains and as inclusions in galena, boulangerite, pyrite and sphalerite.

Cassiterite

A minute amount of cassiterite is also present in the concentrate. It was found only as inclusions in gangue (see Figure 5).

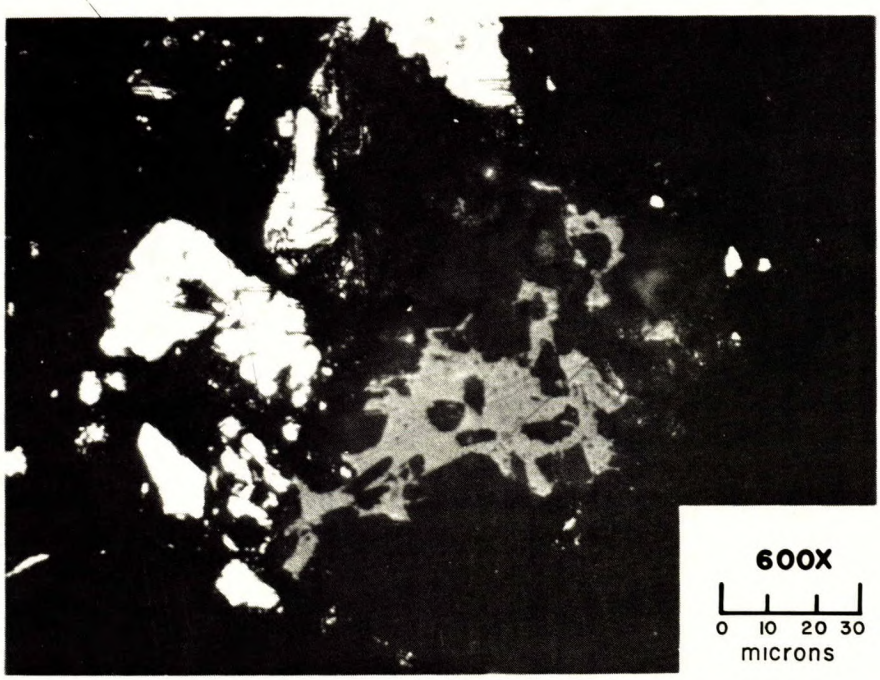

Figure 5. Photomicrograph of a polished section that shows a cassiterite inclusion (grey) in gangue (diffuse area surrounding the cassiterite). The white area represents boulangerite.

Sphalerite

A few isolated grains of sphalerite were also found in the concentrate. Most of them are freed (see Figure 6), but some of these freed grains contain inclusions of stannite.

Pyrite and Arsenopyrite

Individual grains of pyrite and arsenopyrite, as well as inclusions of these minerals in galena, are present in the concentrate (see Figure 7). Pyrite is more abundant than arsenopyrite.

Magnetite and Goethite

Magnetite was found only as relatively large grains and most of it is partially altered to goethite (see Figure 8).

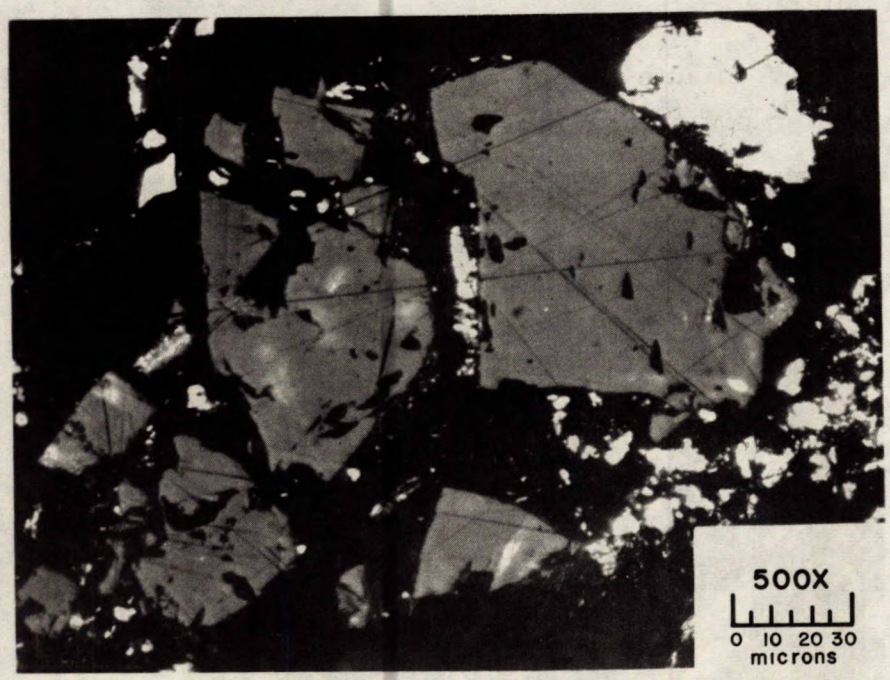

Figure 6. Photomicrograph of a polished section that shows grains of sphalerite (grey) and galena (white).

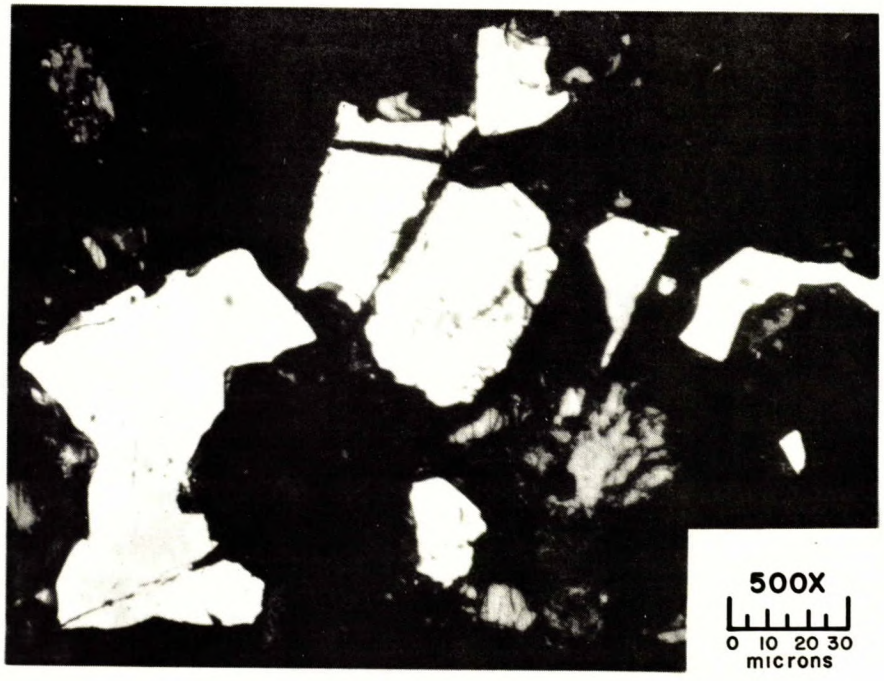

Figure 7. Photomicrograph of a polished section that shows grains of pyrite (white) and galena (light grey).

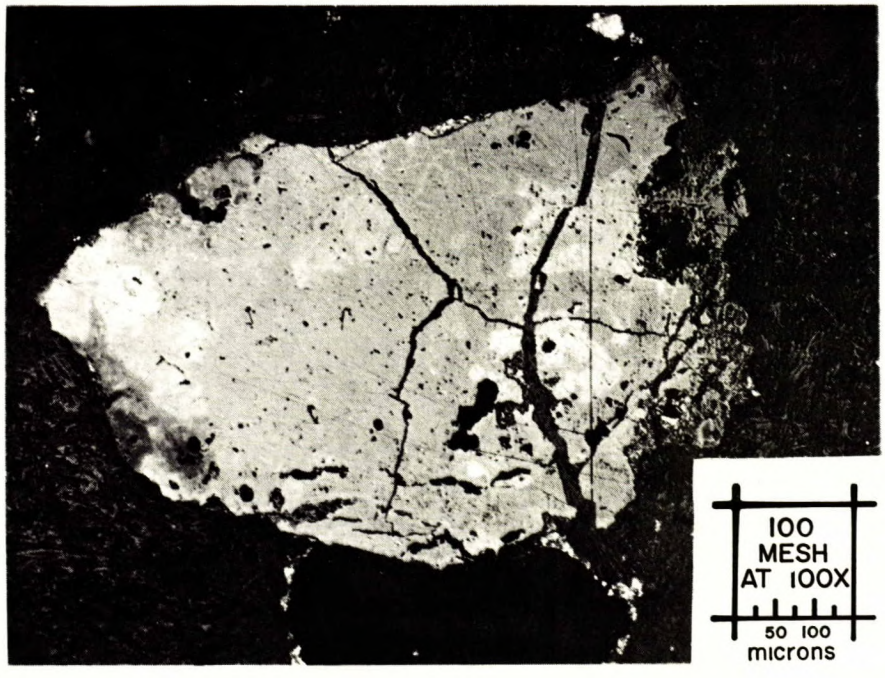

Figure 8. Photomicrograph of a polished section showing a magnetite grain (grey) that is partially altered to goethite (light grey).

REFERENCE

1. D.O. Ontoev et al., "The Nature of High Bismuth and Silver Contents in Galena of the Bukukinsk Deposit and Some Problems of the Isomorphism in the System, PbS-Ag_2S-Bi_2S_3", Geochemistry, No. 5, 494-510 (1960).

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