Dr. J. Convey

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 64-14

MINERALOGY OF THE POLLACO TIN ORE FROM EMPRESSA MINERA UNIFROIDA DE POTOSI, BOLIVIA, FOR PROSPECTION LIMITED

by

W. PETRUK

MINERAL SCIENCES DIVISION

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COPY NO. 1

JANUARY 30, 1964

Industrial Confidential

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SUMMARY OF RESULTS

The Pollaco tin ore from Empressa Unifroida de Potosi, Bolivia, is comprised of both unweathered and weathered material, and contains an unusually wide variety of minerals. The tin-bearing minerals are cassiterite and franckeite. The silver-bearing minerals are pyrite, jarosite, native silver and freibergite. Most of the silver in the unweathered rock is in pyrite; in the weathered rock it occurs mostly in jarosite.

Other minerals present in the ore are hematite, magnetite, ilmenite, goethite, bournonite, sphalerite, boulangerite, native iron, sulphur, topaz, fluorite, tourmaline, pyrochlore, siderite, barite, quartz, feldspar, a clay mineral, chlorite, and svanbergite.

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* Scientific Officer, Mineralogy Section, Mineral Sciences Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

INTRODUCTION

Samples of Pollaco tin ore from Empressa Minera Unifroida de Potosi, Bolivia were received from G.O. Hayslip of the Mineral Processing Division in September, 1963. Mr. Hayslip stated that the ore was sent to the Mines Branch by Prospection Limited, 80 Richmond Street West, Toronto, Ontario.

SAMPLES

The samples received consisted of the following:

(1) Hand specimens.
(2) Head sample of the ore crushed to about -10 mesh.
(3) Silver concentrate.
(4) Silver cleaner tails.
(5) Silver flotation tails.

METHOD OF INVESTIGATION

Polished and thin sections were prepared from the hand specimens and these were examined microscopically. The head sample was screened and the -65+200 mesh fraction was separated into sub-fractions by means of heavy liquids and the Frantz isodynamic separator. The minerals in the sub-fractions were identified by means of microscopy and X-ray diffraction. The silver in some of the sub-fractions was determined chemically. The elements present in the crushed head sample were determined spectrographically.

Polished sections of the silver concentrate, cleaner tails and flotation tails were examined under the ore microscope.

RESULTS OF INVESTIGATION

Semi-Quantitative Spectrographic Analysis

The results of the spectrographic analysis are given in Table 1.

TABLE 1

Spectrographic Analysis of the Crushed Head Sample of Pollaco Tin Ore from Bolivia

Element	Weight per cent*
Si	A
Al	B
Fe	B
Pb	C
Sb	C
Ti	C
Na	C
Sr	C
Sn	C
Mg	C
Ba	D
Ca	D
Mo	D
Cu	D
Zr	D
Mn	D
Ag	E
Ni	E
B	E
Cr	E
V	E
In	E
Bi	E
Ga	E
Be	tr.

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

*Internal Report SL-63-210 by E. M. Kranck, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

The Hand Specimens

In hand specimens the fresh rock is light grey, fine-grained and contains a significant amount of pyrite. The weathered rock is yellow to grey, porous, has an earthy texture, and contains significant amounts of hematite and goethite.

Mineralogy

General Mineralogy

The minerals found by means of microscopy and X-ray diffraction are hematite, magnetite, ilmenite, cassiterite, pyrite, bournonite, sphalerite, boulangerite, franckeite, freibergite, native silver, native iron, sulphur, quartz, feldspar, tourmaline, topaz, fluorite, pyrochlore, a clay mineral, chlorite, siderite, barite, goethite, jarosite and svanbergite.

Detailed Mineralogy

Cassiterite (SnO_2)

Cassiterite is the principal tin-bearing mineral. It is buff coloured in hand specimens and occurs as irregular grains up to 150 microns in size. Microscopical examinations show that the grains have a pitted surface and are frequently intergrown with other minerals.

Franckeite ($Pb_5Sn_2Sb_2S_{14}$)

A few small grains of franckeite were found in sub-fractions prepared from the head sample.

Pyrite (FeS_2)

Pyrite was found mainly in the fresh rock. It is present as irregular and cubic grains up to 1 millimeter in size and contains inclusions of sphalerite and a silver-bearing mineral. The silver-bearing mineral, however, was not found in polished sections but a chemical analysis of a pyrite sub-fraction reported 163 ounces silver per ton*.

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*Analyses by L. Lutes and D. Cumming, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch, Internal Report MS-AC-64-12.

Jarosite ($K_2Fe_6(OH)_{12}(SO_4)_4$)

Jarosite was found only in the weathered rock. It is fine grained and occurs as masses, veinlets and encrustations on other minerals. A chemical analysis of a jarosite-svanbergite concentrate, prepared by the writer, reported 17 ounces silver per ton*, and that of a hematite concentrate containing some jarosite reported 2 ounces silver per ton*. This indicates that the jarosite is silver-bearing.

Native Silver (Ag) and Freibergite ($(Cu, Fe, Ag)_{12}Sb_4S_{13}$)

Individual grains of native silver and freibergite were found in sub-fractions of the crushed head sample and in the silver concentrate and tails submitted by Mr. Hayslip.

Sphalerite (ZnS)

Sphalerite was found as minute inclusions in pyrite and as small grains in fractions of the crushed head sample.

Boulangerite ($Pb_5Sb_4S_{11}$) and Bournonite ($Pb_2Cu_2Sb_2S_6$)

Boulangerite and bournonite were found only as small individual grains in fractions of the head sample.

Hematite (Fe_2O_3) and Goethite ($Fe_2O_3 \cdot H_2O$)

Abundant amounts of hematite and goethite are present in the weathered rock. They occur as veinlets, as irregular grains, up to 1 millimeter in size, and as cubic forms that are regarded as pseudomorphs after pyrite. The veinlets are generally zoned, with goethite occurring along the walls and hematite in the middle.

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*Analyses by L. Lutes and D. Cumming, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch, Internal Report MS-AC-64-12.

Magnetite (Fe_3O_4) and Ilmenite ($TiFeO_3$) and Native Iron (Fe)

Only small amounts of magnetite and ilmenite are present in the ore. They occur as irregular grains up to 1 millimeter in size and occasionally the ilmenite grains contain hematite lamellae.

Some metallic iron bordered by goethite is present in sub-fractions prepared from the crushed head sample. It is not known whether the metallic iron is a constituent of the ore, or has been picked up in the grinding circuit.

Sulphur (S)

A few grains of sulphur were found in a sub-fraction prepared from the crushed head sample.

Svanbergite ($Sr_2Al_6O_{11}P_2O_5(SO_3)_2 \cdot 6H_2O$)

A significant amount of svanbergite is present in the weathered rock. It is colourless and occurs in the form of rhombohedral crystals.

Siderite ($FeCO_3$), Barite ($BaSO_4$) and Pyrochlore ($(Na, Ca)_2(Nb, Ti)_2(O, F)_7$)

Small individual grains of siderite, barite and pyrochlore were found in the sub-fractions of the crushed head sample. Some of the barite grains are white, some are red.

Fluorite (CaF_2)

A significant amount of fluorite was found in the ore. It occurs as irregular grains and as a component of reaction rims around large quartz crystals. The irregular grains are frequently intergrown with prismatic crystals of topaz.

Topaz ($(Al, F)_2SiO_4$)

Topaz was found only as prismatic crystals in fluorite and quartz.

Tourmaline ($H_9Al_3(B, OH)_2Si_4O_{19}$)

No tourmaline was recognized in thin and polished sections but X-ray diffraction studies show that it is present in the ore.

Quartz, Feldspar, Clay Mineral and Chlorite

Quartz, feldspar, a clay mineral and chlorite are the principal rock forming minerals and will not be discussed in this report.

CONCLUSIONS

The cassiterite in the Pollaco tin ore is very fine grained and the grains have a pitted surface. This indicates that it may be difficult to liberate, and hence recover, the cassiterite from this ore by conventional methods.

Most of the silver in the Pollaco ore is contained in pyrite and jarosite. The pyrite occurs primarily in fresh rock and the jarosite occurs in weathered rock. The weathered rock, however, also contains hematite and goethite pseudomorphs after pyrite. This shows that in the weathered zone, the pyrite was replaced by hematite and goethite and that the silver contained in it was released and redeposited in jarosite.

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