



Secretaría de Industria y Comercio
Dirección de Minas y Geología

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POSSIBILITIES OF SUCCESSFUL TIN EXPLORATION IN THE PIRQUITAS
REGION, JUJUY

The possibility of discovering new, important sources of tin ore in the Pirquitas region of Jujuy can be judged only on the basis of what is known of the geology and mining history of the region and its ore deposits. This knowledge is, at present, small, and hence the conclusions presented herein are necessarily tentative and preliminary. They are based largely on a private visit by the writer to the Pirquitas mines in March 1947.

Pirquitas mines

The Pirquitas tin mines are situated 90 kilometers due west of Abra Pampa, on Quebrada Pircas, a tributary of the Rio Orosmapayo. They include both tin alluvials and tin-silver veins. The alluvials were discovered by Picchetti and were first worked in 1933. The veins were discovered a year or so later. Until 1947, when operations were suspended, the deposits were successfully mined by the Sociedad Minera Pirquitas, Picchetti y Cía. S. A.

Silver-tin veins:- The silver-tin veins crop out on both sides of the steep canyon of the upper Pircas river. They cut beds of Paleozoic slate and sandstone, folded on north-south axes. Early veins of barren quartz trend parallel to the bedding. The productive veins dip steeply and strike nearly east-west, making angles of about 80 degrees with the fold axes. There are about 6 large veins and many small ones. Only the Potosí and Chocaya veins have produced large quantities of ore.

Geologically, the productive veins are characterized by the existence of three depth zones: (1) a superficial zone of oxidation and enrichment, containing much native silver; (2) a zone of primary ore lying beneath the superficial zone; and (3) a barren zone in depth. This zone is marked by a narrow seam of gouge with scattered pyrite. The top of the barren, lower zone seems to coincide approximately with

a pronounced flattening of the dip of the vein, possibly indicating that structural, rather than temperature, control was operative in the localization of the ore shoots.

At the time of my visit, the Potosi vein, which had been the main producer, had only a few tons of ore left. Only the Chocaya vein was producing regularly. Smaller veins and branches of the main ones were being worked by pirquineros because their exploitation by the company was no longer feasible economically. All of the ore shoots except that in the Chocaya vein had been bottomed, and the barren zone in each case had been explored to depths of 2 or 3 levels below the bottom of the ore. Indications were strong that the veins were approaching exhaustion. Careful geological studies, aimed at prolonging the life of the mines were, however, not made by the company. Consequently there must remain a certain doubt as to whether or not undiscovered ore shoots exist.

Operating costs during the year 1944-45 were as follows:

Exploration and development	\$5.27 m/n per metric ton ore
Mining	18.12
General	10.54
Crushing	2.78
Concentration	27.99
Total	<u>64.70</u> m/n per metric ton ore

Expenses of shipment and smelting of concentrate, taxes, general administrative expenses, amortization, selling, etc., brought the total cost of production to about \$120.- m/n per metric ton of ore. This cost lies in the general range of present costs of mining tin ore veins in Bolivia. It is a high figure, undoubtedly influenced by many factors not least of which was the inefficiency and hostility of labor.

Tin alluvial in the Pircas valley:- For 6 or 7 kilometers below the lode mines the Pircas valley is narrow and steep, and there has been little opportunity for the accumulation of valuable placer deposits. At the Pirquitas camp, the Pircas canyon opens on to a wide pampa underlain by soft Tertiary shale, and the stream bed widens notably. From the canyon mouth to a point some 4 kilometers downstream, rich tin placers have been mined in the Pircas river channel and flood plain.

The best ground was found at the mouth of the Pircas canyon, near the camp. ~~Here~~ ^{Here} the flood plain deposit was 400 meters wide, with 5 meters of overburden and from 1 to 1.5 meters thickness of pay gravel

("llampo") resting on red shale bedrock. The llampo at this place carried 15 kilograms of concentrate per cubic meter, ~~at~~ the concentrate being a mixture of cassiterite, quartz and hematite carrying 50 to 60 percent metallic tin. As the deposit was worked downstream, the tin content as well as the thickness of the llampo were found to decrease very gradually. In March 1947, the workings had been carried 4 kilometers downstream from the canyon mouth and the alluvial had diminished in width from 400 to 200 meters, with 3 to 3.5 meters of overburden and only 50 centimeters of pay gravel carrying 3.8 kilos of concentrate per cubic meter. At that time the economic limit of the deposit appeared nearly to have been reached. With a price of \$3.50 m/n per kilo of concentrate the gross value of the pay gravel was \$13.30 m/n per cubic meter. Total placer mining costs were about \$10.00 m/n per cubic meter beneficiated. This left a margin of only \$3.30 m/n per cubic meter, or \$0.87 per kilo of concentrate, to pay for shipment, smelting, and other charges. Under the conditions of high cost then prevailing, and in view of the fact that farther downstream the llampo was thinner and carried only 2 kilos of concentrate per cubic meter, it was clear that placer mining could not long continue.

In the latter years of the mining operation, dragline excavators were used. The deposit was mined in strips 14 meters wide and extending from bank to bank across the course of the stream. The draglines first stripped the overburden and dumped it on top of the worked-out ground immediately upstream; then the pay gravel was excavated to bedrock and dumped on a long conveyor belt leading to the washing plant. The latter was mounted on rails and was moved downstream as the working face advanced. Water for washing was pumped from a small dam across the Pircas river. It was not abundant but there appeared to have been no critical shortage.

The high cost of power was an important factor in the cost of ~~mining~~ mining. Diesel-electric power cost \$0.18 m/n per kilowatt-hour. Hand methods of concentration were tried in order to save power, but the cost was said to be about the same as that for the mechanical methods previously used.

On the south side of quebrada Pircas, near the camp, are alluvial terraces at three levels. During the early years of operation a small part of the upper terrace was mined by the company and a good yield was obtained. The two lower terraces reportedly were tested but the llampo proved too thin and the overburden too thick to give profitable results by mechanical methods of mining.

The top layer of these bench deposits consists of mixed sand, silt and flat pebbles of slate, sandstone, and red or brown conglomerate composed, in turn, of sandstone fragments cemented by iron oxide and much sandy material. Ledges of this conglomerate were seen upstream, below the lode mines. It is an old valley filling that has been largely removed by stream downcutting. A piece of conglomerate that I has analyzed contained 0.7 percent tin.

On the lowest terrace, near the main camp, the pay gravel lies 5 1/2 meters below the surface, being covered by the more or less sterile material described in the preceding paragraph. It is mined by the pirquineros in vertical pits from which short tunnels are driven to excavate the tin-bearing material. After hoisting to the surface the llampo is screened, the fine and coarse sizes being rejected. The intermediate material, from 1/2 to 2 1/2 cm. in diameter, is concentrated in hand jigs. A crew of two men and a woman in one of the workings was said to produce 80 to 90 kilos of 60 percent tin concentrate per week. On the middle terrace, similar operations are carried on. The pits there are from 7 to 10 meters deep to pay gravel. Two men are said to produce as much as 150 kilos of concentrate a week at one of the working places.

On both the lower and middle terraces the pay gravel appears to be thin and irregularly distributed, as indicated by the fact that some pits give a good production while others do not. The average grade of the llampo is said to be about 2 kilos concentrate per cubic meter. The terraces continue downstream but the proportion of tin farther down is believed to be low.

On the north side of the Pircas river, opposite the camp, is a single terrace which was worked in small part by a dragline but with disappointing results.

Exploration

Exploration of Pirquitas veins:- Until thorough geologic studies of the Pirquitas veins and the immediately surrounding territory have been made, it is not possible to eliminate the old mines as possible sources of more tin and silver. Moreover, a more extensive search into the outlying areas should be based upon geological knowledge to be gained only through study of the formerly productive mines.

A complete study of the veins should properly include the following:

- (a) geologic and topographic map of the surface in the vicinity of the mines
- (b) maps of all accessible underground workings
- (c) geologic cross-sections
- (d) petrographic and mineralogic studies of the ore and rocks
- (e) statistical and historical studies of production and cost records and reports of the Soc. Minera Pirquitas.

The making of such a study is complicated by the fact that the mines are closed and that, in all probability, many of the underground workings are no longer accessible. On the other hand, these difficulties would be partially offset, and the work greatly facilitated, if the numerous mine maps and topographic maps, as well as survey records, in the possession of the Soc. Minera Pirquitas were made available to the persons making the study.

The practical results of such a program might be nil, or, contrarily, might lead to renewed exploration by tunneling and diamond drilling, with the conceivable result of finding more ore. There are, however, no present positive indications that more ore exists. That possibility can be judged only after the study has been made.

Exploration of Pirquitas placers:- The only tin placers that I examined were those being worked by the company and others in the immediate vicinity. These have been described in foregoing pages. Sgrosso ^{1/} states that cassiterite

^{1/} Sgrosso, P., Contribuciones al conocimiento de la minería y geología del noroeste argentino, D.M.G. Bol. No. 53, 1943, pp. 112-119.

is found also in the lower reaches of the Pircas river and in the Oroswayo river, into which the Pircas flows. He estimates (pp.117-118) that there are 42,000 metric tons of metallic tin in the alluvials lying between the mouth of Pircas canyon and Cerro Galan, and downstream, and an additional

2,000 tons of metallic tin in the alluvials of the Rio Orosmayo between the Rio Porvenir and the quebrada de Ajedrez. Part of this reserve, perhaps 9,000 tons, has already been mined from the richest part of the alluvials by the Soc. Minera Pirquitas.

Efforts by the Government to promote renewed tin production in the Pirquitas zone might well include an exploration of the Pircas-Orosmayo alluvials with a view to accurately determining the areal extent and geology of the deposits; thickness, depth, and average tin content of the pay gravel; and general economic feasibility of resuming mining operations.

In carrying out preliminary investigations, it may be worthwhile to solicit from the company whatever testing data and surveys they may have available. Other valuable information probably may be had through consultation with Mr. J. C. Tonkin (C. Parera 178, Bs. Aires) who, as general manager of the company during its period of growth and maximum production, was largely responsible for the success of the Pirquitas enterprise.

In considering the feasibility of exploration in the areas formerly exploited by the Soc. Minera Pirquitas, it should be realized that, although additional tin placers probably exist, they might prove to be uneconomic to mine by large-scale methods under present conditions of metal price, wages, etc. Indeed, because the principal mining company in the zone has suspended operations, it is to be presumed that economic mining is no longer possible.

Exploration of area surrounding Pirquitas mines:- Sgrosso 2/ describes
2/ Sgrosso, P., Idem., pp. 108-112, 120-122.

numerous tin veins and alluvials in the areas north, west, and south of Pirquitas. These include deposits at Cerro Pululus, Cerro Pairique and the Sierra de Zapaleri, Yungara, Rio Granada, and the region of Cerro Caucani and quebrada de Tugli. None of these seems to have commercial importance judging from Sgrosso's accounts.

Shortly after the discovery of the valuable deposits at Pirquitas, engineers of the Hochschild interests of Bolivia made an exploration for tin throughout a wide area around Pirquitas and extending south into the Territory of Los Andes. According to reports that I have heard of this expedition, small quantities of cassiterite were found in many streams, but none contained commercially valuable concentrations.

It appears that most of the known tin veins of the area surrounding

Pirquitas are genetically related to dacite and liparite flows, which cover large parts of the region. Deposits of this genetic type have never achieved commercial importance at any place, so far as I am aware.

Although it is unlikely that important tin deposits will be found in the areas covered by volcanic rocks, yet it may be advisable to revisit the known tin-bearing localities at some future time.

Conclusions

On the basis of scanty and imperfect knowledge of the tin zone of southwest Jujuy, the following practical conclusions may be drawn:

- (1) The most likely place to find more tin is the immediate area of the Pirquitas mines, both veins and placers.
- (2) The remaining tin alluvials of the Rio Pircas and Rio Oros mayo will probably be found uneconomical to work with large-scale methods under present conditions.
- (3) The Pirquitas tin-silver veins are probably exhausted, but the possibilities of finding new orebodies cannot be judged until a geologic study has been made.
- (4) The known tin deposits in the area surrounding Pirquitas are of no commercial importance.
- (5) The area surrounding Pirquitas appears to have been fairly well prospected. If so, the chances of finding new, important tin deposits are small.
- (6) If exploration is undertaken, most of the work should be concentrated in the immediate area of the Pirquitas mines.

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Al señor Director de Minas y Geología:
S / D

Tengo el agrado de someter al señor Director, en conformidad con sus indicaciones de la fecha 21 de enero del presente, un memorandum escrito en inglés sobre las posibilidades de encontrar nuevos depósitos de estaño en la zona de Pirquitas, Provincia de Jujuy.

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Buenos Aires
27 enero de 1948

