

THE MINERAL INDUSTRY OF

BOLIVIA

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According to the National Statistical Institute of Bolivia, the gross domestic product (GDP) grew by 2.0% to about \$8.6 billion¹ in 1999 compared with 4.7% in 1998. The slower growth of the economy in 1999 was due, in part, to depressed commodity prices, reduced sales of natural gas, and the devaluation of the Brazilian real. The economy was, however, expected to grow by about 4% in 2000; this was predicted on a probable recovery in commodity prices and an anticipated boost in overseas investment in public infrastructure, mining, and energy projects. The inflation rate, which was under control; fell to an average of about 3.4% in 1999 compared with 4.4% in 1998. Mining of nonfuel minerals remained important in 1999 and provided 4.5% of GDP; crude oil and natural gas provided 4.6%. Together with agriculture, forestry, and fishing, these primary activities accounted for one-fourth of the country's legitimate economy. Investment was expected to decrease owing to the completion of the Bolivian portion of the Bolivia-to-Brazil natural gas pipeline.

Export revenues increased by about 1.13% to about \$1.29 billion owing to increases in the exports of crude oil, natural gas, gold, silver, tin, and zinc. These revenues represented about 54% of Bolivia's total export earnings. The contribution of mining to Bolivian exports trade was more significant than that of natural gas and crude oil. In 1999, gold, silver, tin, and zinc outputs were the mineral production that sustained Bolivia's mineral industry (U.S. Energy Information Administration, July 1999, Bolivia—Background—Country analysis briefs, accessed on November 18, 1999, at URL <http://www.eia.doe.gov/emeu/cabs/bolivia.html>).

Government Policies and Programs

Government economic policies are directed to stimulating the private sector and attracting overseas investment capital. For the past 15 years, the International Monetary Fund (IMF) has helped steer Government policy in Bolivia. Every 6 months or so, it reviews achievements and agrees on macro economic targets with the Government. This guidance is reinforced by continued credits (until September 2001) through the IMF's poverty reduction and growth facility. This has helped Bolivia manage a foreign debt of \$5.5 billion and to damp down otherwise possible violent swings in economic performance.

The hydrocarbon sector, in particular, had a growing economy whose potential and demand for energy seemed unlimited. Its was considered to have a very solid future owing to the completion of a gas pipeline to Brazil. "Companies from the United States, Brazil and Argentina are actively exploring for hydrocarbons throughout the country. Petroleum companies already operating in Bolivia have announced investments

¹Where necessary, values have been converted from bolivianos (\$b) to U.S. dollars at the rate of \$b5.89=US\$1.00.

totaling \$2 billion through 2002. There will also be new investments made in new concessions to be awarded by the government in 11 new areas.

"An on-going project to define mining claims using Global Positioning System coordinates will also help encourage new investment in the sector" (U.S. Embassy, La Paz, July 1998, FY 1999 country commercial guides—Bolivia—Executive summary, accessed December 9, 1999, at URL http://www.state.gov/www/about_state/business/com_guides/1999/wha/bolivia99.html).

All future oil exploration activity will be carried out via joint venture contracts that Yacimientos Petrolíferos Fiscales Bolivianos (YPFB) will administer. Several mines owned by Corporación Minera de Bolivia (COMIBOL) were available as a joint venture or leasing contract with COMIBOL (U.S. Embassy, La Paz, July 1998, FY 1999 country commercial guides—Bolivia—Investment climate—Openness to foreign investment, accessed December 9, 1999, at URL http://www.state.gov/www/about_state/business/com_guides/1999/wha/bolivia99.html).

"Overseas Private Investment Corporation (OPIC) provided for a full range of OPIC programs, including insurance, financing assistance through direct loans and through guarantees of loans by private U.S. financial institutions for investments by U.S.-based firms in Bolivia. OPIC has worked with a growing number of new investors—particularly in providing insurance against inconvertibility expropriation and political risk—and is eager to do more business in Bolivia" (U.S. Embassy, La Paz, July 1998, FY 1999 country commercial guides—Bolivia—Investment climate—OPIC and other investment insurance plans, accessed December 9, 1999, at URL http://www.state.gov/www/about_state/business/com_guides/1999/wha/bolivia99.html).

Environmental Issues

Environmental standards are monitored nationally by the Ministry of Sustainable Development and by its Departmental Secretary of Sustainable Development and Environment at the regional or departmental levels. All projects require an environmental license, which can be obtained by a certificate of dispensation, a declaration of environmental impact, or the approval of an environmental manifesto. The license expires after a fixed period of time or may be revoked if its conditions are violated.

Production

According to the Viceministerio de Minería y Metalurgia, (1999), 1999 was a disappointing year with overall output down by some 15%. The depressed gold price rallied slightly in the second half but remained below \$300 per ounce for most of the

year. The impact on production was reflected in a contraction among the smaller producers and in delays in anticipated investments and of startup dates for new ventures. Production of precious metals decreased by 18.4% for gold and increased by 4.6% for silver in volume and decreased 22.6% for gold and 1.3% for silver in value, respectively, as well as for nonferrous metals. These trends reflected the fall in world prices for most of Bolivia's minerals during the year.

Mining prospects were clouded by the downturn in metal prices that delayed or deterred some anticipated investments.

The generally depressed conditions of 1999 showed few signs of alleviating a growing crisis within the industry. In contrast, the petroleum industry will, no doubt, benefit from the opening of the 557-kilometer (km)-long natural gas pipeline to the Brazilian border in 1999 (Mining Journal, 1999).

The medium sized mining sector (the privately owned commercial mines) continued to be the dominant producer and was responsible for about 56.9% of the value of mine production in 1999 followed by the small sized mining sector with 35%, COMIBOL had 8.1%.

In 1999, Bolivia produced about 13.5 million barrels per year of crude oil and 6.8 billion cubic meters per year of natural gas (table 1).

Large and small mining companies were involved in an increasing level of exploration in each of the four principal regions of the country—the Altiplano, the Brazilian Shield, the Cordillera, and the Northeast. Inti Raymi's pilot plant was to use bio-oxidation heap leaching on additional oxide ore reserves at Llallagua, which adjoins Kori Kollo on the Altiplano north of Oruro. Inti Raymi was about to reach a decision whether this would help extend the limited economic life of the mine, which was of central importance to the region's economy. Corporación Minera del Sur S.A.'s. (COMSUR) El Puquio Norte gold-copper open pit mine in the Precambrian east remained in production in spite of the unfavorable price of gold.

Andean Silver Corp., which was a fully owned subsidiary of Apex Silver Mines proposed the development of a large zinc-silver deposit at San Cristobal in the far south of the Altiplano. This deposit had great potential for many years of economic life.

Other large mining companies, such as Barrick Gold Corp., Rio Tinto Zinc Corp. plc., Battle Mountain Gold Co. (BMG), and Broken Hill Proprietary Co. Ltd. (BHP), shared the expectation that the mining policy set by the Government would continue to attract potential capital investors to the country.

Trade

The United States remained Bolivia's largest provider of foreign aid, its principal trading partner, and the largest source of foreign investment. Both countries shared a strong commitment to foster and strengthen democracy and to maintain sustainable economic growth. The true importance of minerals in the national economy lay in their contribution to Bolivia's export earnings—41% in 1999 and 43% in 1998; the fall was a consequence of lower commodity prices, which was part of a wider deterioration in Bolivia's terms of trade. The Bolivia-to-Brazil natural gas pipeline, has just begun to export 2.2 million cubic meters per day (Mm³/d) of natural gas from Bolivia to Brazil's southeastern province of Porto Alegre and Sao Paulo. The 3,050 km pipeline was completed at a cost of \$2.5 billion which was finance in part by the World Bank and Petrobras,

which is the Brazilian national oil company. This pipeline was the spearhead of the regional energy integration process that will be essential for Bolivia's future economic development. The first stage of the project was completed in February 1999 and was operational in July 1999 with deliveries to Sao Paulo, Brazil. A hub of pipelines with Bolivia at the center seems likely to develop as regional energy integration proceeds. The pipelines will connect natural gas producers (Argentina, Bolivia, and Peru) and the giant consumer market of Brazil (U.S. Energy Information Administration, July 15, 1999, Bolivia—Country analysis briefs, accessed November 18, 1999, at URL <http://www.eia.doe.gov/emeu/cabs/bolivia.html>). Bolivia exported natural gas to Argentina and Brazil and had major plans to expand exports of natural gas to Peru and Paraguay in the near future. Minerals and hydrocarbons contributed more than 50% of Government revenues. Zinc produced an income of about \$158 million, which was an increase of 1.5% compared with that of 1998. It was followed by gold with \$106 million, which was a decrease of 22.6% compared with that of 1998; silver with about \$71 million, which was a decrease of 1.3%; and tin with about \$67 million, which was an increase of 7.5%. Exports of metallic tin by Vinto Smelter decreased in volume to 11,799 metric tons (t) and decreased in value by 19% to \$65 million from \$81 million in 1998 (Instituto Nacional de Estadísticas de Bolivia, 1998, Resumen estadístico—Indicadores económicos, accessed February 3, 2000, at URL <http://www.ine.gov.bo/iwd0201.htm>).

Structure of the Mineral Industry

The Vice Ministry of Mining and Metallurgy, which is a branch of the Ministry of Economic Development, is legally responsible for formulating mining policy for the sector's development. It also provides investors with the necessary information regarding the rights and guarantees of mining concession holders, current tax and mining laws, and environmental regulations for mining. It controls and participates in the mineral industry through Servicio Geológico y Minero de Bolivia, the Instituto de Investigaciones Minero-Metalúrgicas de Oruro, and the Sistema Nacional de Información Minera. The Servicio Nacional de Catastro Minero and COMIBOL are autonomous entities.

In accordance with the provisions established in Supreme Decree 23230-A of July 30, 1992, the Government of Bolivia sought to transfer several mining, metallurgical, and infrastructural assets held by COMIBOL, which included joint ventures, leases, and optional arrangements, to private sector interests to promote private investment in the mining sector.

Private sector mining, which comprised medium and small-scale mining entities and cooperatives, maintained its position as the leading producer of antimony, gold, lead, tin, tungsten, and zinc in the country. In 1999, the private Medium-Size Miners Association comprised the following affiliated mining companies; Andean Silver Resources, Arisur BAREMSA, Borrosquira Ltda. Empresa Minera Bernal, Cia. Minera Concepción, COMSUR, Empresa Minera Unificada S.A. (EMUSA), Empresa Minera Inti Raymi S.A., Cia. Minera "La Rosa," L & M Mining Co., Cia. Minera "La Solución," Empresa Minera Paititi, Empresa Santa Lucia, and Vista Gold Corp.

The Small-Size Miners Association, which was grouped under the Camara Nacional de Minera, included 600 small mines operating in the country. Mining cooperatives were

organized under the Federation Nacional de Cooperativas Minera and included most of the gold mining cooperatives of Gonzata, Guanay, Mapiri, and Tipuani. More than 320 mining cooperatives in the country were grouped under the Federation Regional de Cooperativas, of which about 40% were mining gold in 1999 mainly in the Tipuani area in the Province of Larecaja, La Paz Department.

Commodity Review

Metals

Antimony.—Bolivia's antimony output, which decreased by 41.1% in 1999 compared with that of 1998, amounted to about 2,790 t for a total value of \$2.3 million. Its production was entirely in the hands of the private sector. Approximately 63% was produced by the medium-sized group of mines, and 37%, by the small-sized group and cooperatives. Their entire output was sold to Laurel Industries of the United States, which produced trioxide, under a toll contract. EMUSA produced 8 t of antimony metal in 1999. Of the country's total output, 80% was antimony trioxide; 19%, antimony concentrate, and 1%, metallic and antimony alloy.

During 1999, the Vinto tin and antimony smelter produced 2,741 t of antimony metal, which included 1,697 t of antimony trioxide produced by toll contract.

The Chilcobija antimony mine, which was Bolivia's biggest antimony producer, formally issued notice to more than over 200 of its core workforce in 1999. The mine had been on care and maintenance since the beginning of the year and ore stockpiles were being used to meet its continuing contractual commitments. A toll contract with the Vinto smelter to supply Laurel Industries will be completed in September 2000 after which further antimony trioxide fuming will likely cease. The company refused to comment about the future prospects for Chilcobija. "This marks the end of the road for the Bolivian antimony industry," said a local trader (Metals & Minerals Latin America, 1999a).

Bismuth.—Canada's Corriente Resources Inc., which was a joint venture partner with COMIBOL at the Tasna bismuth mine in southern Bolivia, was changing its strategy to develop the mine. Under the terms of its contract, Corriente Resources was to have had the mine in production by the end of 1999, but the low bismuth price prevented this.

The mine reserves also contain quantities of gold, copper and tungsten, and the company is now studying alternative ways of developing the mine that does not prioritize bismuth. The mine's mineral credits other than bismuth have previously been estimated to be worth about 40% of the value of any eventual output. Also, recent production of tungsten and gold has been used for metallurgical testing purposes (Metals & Minerals Latin America, 1998c).

The results of the latest study will give the company a better understanding of Tasna's structure and provide a route that will put the mine back into production faster than waiting for a stable bismuth price above \$4 per pound.

Gold.—In 1999, official gold production in Bolivia, which decreased by 18.4% from that of 1998, amounted to 11.8 t. The Kori Kollo gold and silver mine, which is in the Altiplano north of Oruro and was operated by Empresa Minera Inti Raymi S.A.,

continued to be Bolivia's most productive operation. BMG's share of Kori Kollo production in 1998 was 9,176 kilograms (kg) (295,000 ounces) at an average cash cost of \$175 per ounce sold (\$51.6 million) despite falling prices, grade, a drop in mill recovery, and a higher stripping ratio that adversely affected production. This mine, however, stimulated much of the recent foreign interest in the Bolivian mining sector. At the nearby Llallagua deposit, Empresa Minera Inti Raymi S.A. had good success with the testing of a heap-leach bio-oxidation process; recovery rates from early tests averaged more than 65%. A year-long 200,000-t pilot plant test of the bio-oxidation heap leach project was initiated in the first quarter of 1999. If proven successful, this technology could be adapted to other refractory deposits now under evaluation by BMG. In 1999, Llallagua was estimated to contain more than 30 t (1 million ounces) of gold mineralization (Battle Mountain Gold Co., 1998-1999).

Vista Gold Corp. of Canada found closure of its twin gold exploration projects in Bolivia, Amayapampa and Capa Circa, to be a headache. The long troubled relationship with the local community over the company's plans to develop a 15.6 t (500,000 ounces) gold mine should have ended when the company announced plans to abandon the project and to lay off its 125-strong workforce in August 1999. The viability of the low-grade project was dependent on a gold price that was close to \$300 per ounce and in the face of continuing price weakness, Vista was forced to issue lay off notices to its workforce, taking effect in 2000. Opposition to the company's plans to close its exploration activities, and prevent local miners from exploiting the resources on their own behalf, became the subject of intense negotiation. The company agreed that limited access to the site by excompany employees to hand-mine surface gold occurrences will be permitted (Metals & Minerals Latin America, 1999c).

Orvana Minerals Corp. of Vancouver, Canada, and its joint-venture partner EMUSA received notice from BHP World Exploration that it is terminating its exploration agreement for the nine properties held by Orvana/EMUSA in the Bolivia's Altiplano. Orvana believed that the BHP decisions to pull out of the earn-in option agreement and to close its La Paz offices were related to the major reduction and reorganization of BHP's Exploration Division worldwide and a switch in emphasis away from gold exploration. BHP had completed a 15-hole drilling program at the Pederson prospect, a disseminated gold target with 49.8 t (1.6 million ounces) of proven reserves and an additional 22.7 t (730,000 ounces) of inferred reserves. The low grade of 1.4 grams per metric ton (g/t) gold had prevented the economic development of the prospect. BHP had been hoping mineralized extensions to the deposit were capable of boosting total reserves to between 155.5 and 311 t. Orvana and EMUSA were forced to put on hold well-advanced plans for the development of a gold-copper mine at the companies' Don Mario prospect in Bolivia's Precambrian region. Despite the completion of a bankable feasibility study in May that showed the deposit contained at least 14.5 t (466,000 ounces) of recoverable gold at a cash cost of around \$100 per ounce, the plummeting gold price made the company revise its plans. The mainly underground mining operation needed for Don Mario and its distance from any kind of infrastructure made development of the mine and mill expensive. Feasibility study estimates of between \$47 million and \$54 million for a 750-metric-ton-per-day treatment capacity proved prohibitive at the 1999 gold price (Metals & Minerals Latin America, 1999d).

The richest and most productive alluvial gold deposits in Bolivia are located in Challana, the Kaka, the Mapiri and the Tipuani River valleys which are in the northern area of the Department of La Paz. Golden Eagle International, Inc., held mining rights to concessions in the Cangalli gold deposit. In 1998, Golden Eagle International announced a major gold discovery at Cangalli, south of La Paz, with reserves of 199 t (6.4 million ounces). The second most important alluvial mining was in the Araras area, which is in the northeastern part of the country on the border with Brazil, where gold has been recovered from the Madeira and the Madre de Dios Rivers.

Lead, Silver, and Zinc.—Production of lead concentrates decreased by 27% from the already depressed levels of 1998; metallic lead, however, increased by 30.8%. Output of metallic silver decreased to about 72,000 kg. The medium-sized mining sector was the dominant lead and zinc producer with 81.1% of total lead and 65% of total zinc. In this sector, the major producer of lead, silver, and zinc was COMSUR.

A final attempt was made by COMIBOL to tender the lease of the Porco zinc-lead-silver mine in Bolivia. At the closure of bidding on June 10, COMSUR, which has operated the mine for the last 30 years, was the sole contender. Apex Silver Mines Ltd. and Breakwater Resources, as well as several other companies, had been directly approached by the government to make an offer but remained uninterested. In 1998, annual production from Porco was 32,700 t of zinc, 2,400 t of lead and 31 t (1 million ounces) of silver, and output levels were expected to be maintained by COMSUR for 1999 (Metals & Minerals Latin America, 1999e).

In 1998, a bankable feasibility study was finalized at the San Crisobal silver-zinc-lead prospect in southern Bolivia as a result of the Apex Silver Mines Ltd. of Canada drilling program. Despite this, the company decided on another round of widely spaced exploratory drill holes to try to prove a further 100 million metric tons (Mt) of probable ore reserves. The original feasibility study had already shown proven reserves of 314 Mt that grade 62 g/t silver, 1.6% zinc, and 0.6% lead on results from 169,500 meters (m) of diamond and reverse circulation drilling (Metals & Minerals Latin America, 1998a).

Tin.—To attract investors to the Vinto smelter, COMIBOL must boost local tin mine production. Vinto took about 45% of its feed from its own mines and cooperatives working COMIBOL properties. Some 2,000 cooperatives miners worked in Huanuni and produced from around 50 to 100 metric tons per month (t/mo) of tin. As part of the privatization and investment process, the cooperatives were asked to organize themselves into a limited partnership company to work the Pozoconi zone, which is the upper part of the deposit. With some technical investment, production could reach from 200 to 500 t/mo. Overall, COMIBOL projected that tin output in the short term could recover to 14,000 metric tons per year (t/yr) and rise to 20,000 t/yr within 3 years, as a result of investment and efficiency improvements. The smelter had a capacity of 30,000 t of tin (Metals & Minerals Latin America, 1998b).

Tin production in 1999 increased by about 9.8% to 12,417 t compared with that of 1998, and the tin output value increased by 7.4% of the country's total mineral-export value. The largest production increase in the private sector was by the small-sized mines and cooperatives. For the 13th consecutive year, they replaced COMIBOL as the leading tin producer with an output

of about 60% of Bolivia's tin production in 1999. The COMIBOL mines produced about 37% of the country's total tin mining output (Viceministerio de Minera y Metalúrgia, 1999).

COMIBOL signed 13 new joint-venture exploration contracts with local and foreign mining companies to explore its own mines and ore bodies in Northern Lipez and Southern Lipez in Potosí Department. COMIBOL's Huanuni Mine has been the largest tin mine in the country since its reopening in September 1988. The Vinto tin smelter, which was formerly operated by Empresa Nacional de Fundiciones, exported 11,127 t of metallic tin and 1,417 t of tin concentrate in 1999. About 83% of Bolivia's metallic tin was exported to the United States, and the rest, to Latin American countries, Holland, and Spain (Viceministerio de Minera y Metalúrgia, 1999).

Tungsten.—Bolivia's production of tungsten concentrate in 1999, which was heavily dependent on international prices, decreased by about 32.9% to 334 t from 497 t in 1998. Production came from the small miners and cooperatives that had small deposits with high ore grades and low labor costs.

Industrial Minerals

Traditionally, Bolivia's cement industry has been able to match its cement production to the requirements of the market. In 1999, its production capacities increased for the first time in the last few years; heretofore, the country had been importing significant amounts of cement, according to Sociedad Boliviana de Cemento, S.A. (SOBOCE). Bolivia produced 1.2 Mt of cement and 904,940 t of clinker representing 78.5% and 71.2% of their respective annual capacities. According to recent national output figures, cement production grew by 3% in 1999 compared with that of 1998, and the domestic sales went up by 15%. Trade was based mainly on clinker. Bolivia exported 1,832 t of clinker to Peru in 1999. For local producers that were unable to match clinker output levels with such market gains, imports of clinker were a necessity. Clinker imports came mostly from Brazil with a smaller tonnages from Argentina. Clinker imports trebled to 9,000 t. In the past 3 years, Bolivia's cement market has grown, albeit with varying success. Cement consumption has grown to 1.3 million metric tons year (Mt/yr) in 1999 (International Cement Review, 1999).

According to the geographical spread of cement sales in 1998 across Bolivia's nine Departments, the Santa Cruz region in the east clearly dominated by accounting for a 37% share in national sales. Centrally located Cochabamba and La Paz in the west accounted for an additional 23% each. Five cement producers had a joint clinker production capacity of 905,000 t/yr and a combined cement production capacity of 1.456 Mt/yr installed in seven cement works (five full production facilities and two additional grinding plants).

The United Kingdom-based Commonwealth Development Corporation (CDC) Group) invested about \$20 million in a loan package to SOBOCE as part of this upgrade program in 1999. CDC intended to build up a number of cement clients in the developing world (International Cement Review, 1999).

In May, Cemento EMISA began expanding its facilities to 133,000 t/yr from 66,000 t/yr of clinker and to 190,000 t/yr from 110,000 t/yr of cement. In July, Cemento Viacha increased its clinker capacity in La Paz to 210,000 t/yr, thus making its total capacity 505,000 t. Projection for 2000 has the demand for cement increasing by 10% (International Cement

Review, 1999).

Mineral Fuels

At yearend 1999, Bolivia's total oil reserves amounted to an estimated 132 million barrels (Mbbbl) of proven resources and an estimated 60 Mbbbl of probable resources. Bolivia which was self-sufficient in oil, consumed an estimated 38,000 barrels per day (bbl/d) in 1999, which was slightly more than it produced (around 35,000 bbl/d) in 1998. Almost all crude oil produced in Bolivia was for domestic consumption, except for a small amount that was exported to Chile.

Energy integration will continue to be promoted vigorously with the aim of attracting more investment in the hydrocarbon sector. Apart from the \$435 million already invested in the construction of the gas pipeline, the growth and diversification of investment in such other areas as hydrocarbon exploration, production, and transport, will be encouraged. This growth in investment has already achieved specific and quantifiable results. Certified and potential reserves of natural gas have increased dramatically. In 1999, Totalfina Elf SA made a number of major natural gas discoveries in Bolivia. In the Tarija region of Bolivia, which stretched from the southeast of the country down to the Argentine border, Totalfina was involved in four permits along the geological extension of major gas deposits already in production in Argentina. Through Total Exploration Production Bolivia, which was the group's local subsidiary, Totalfina was operator on two of the four permits—block XX west and Bereti. The Group had a 41% stake in block XX west alongside the American companies Mobil Oil Corp. and Tesoro, and had a 75% interest together with Tesoro in the Bereti block. Totalfina had a 15% stake in each of the other two permits—San Alberto and San Antonio—alongside the Brazilian company Petrobras (operator with a 35% interest) and the Andina Consortium (50%). The exploration campaign operated by Totalfina posted its first success in June 1999, 280 days after the first bit went down, when the Itau X-1(A) well tested positive at a depth of 5,500 m. The test well yielded nearly 800,000 cubic meters per day of gas under conditions similar to those on the San Alberto permit (Energies, 1999). Nearly 15 trillion cubic feet have already been certified for Itau, San Alberto, and San Antonio. On the San Antonio permit, Petrobras also found gas with its very first well, with production test on Sabalo X-1 yielding close to 1 Mm³/d. The areas of Itau, San Alberto, and San Antonio are part of a single huge gas deposit that stretches over some 60 km. Working together to develop an integrated production system, the two project partnerships will be able to optimize production of the reserves. A rational production arrangement would benefit Bolivia as well, and the Government was drawing up the general principles applicable to this kind of situation according to common practice within the oil industry. The geological formation currently (1999) being explored in the Andean foothills extends over about a dozen permits, all of which have real potential to produce gas. Between the privatization of the upstream activities of the Bolivian state company YPFB in 1997 and the end of 1999, the country's certified gas reserves will have increased fourfold. By 2001, these gas reserves could double again, practically reaching the level of reserves (30 trillion metric feet) found in neighboring Argentina.

The Bolivia-to-Brazil natural gas pipeline, which was inaugurated in July 1999, is being used to transport gas

purchased by Petrobras to supply the Brazilian Industry. The 20-year sales contract between the Governments of Bolivia and Brazil provided for a gradual increase in Bolivian gas exports from 2 to 30 Mm³/d in volume between the end of 1999 and 2005; the total would remain at the 30-Mm³/d level until 2019 (Energies, 1999).

Companies that carried out exploration campaigns in Bolivia were understandably keen to market any gas they find without undue delay because as few as two exploratory wells can involve investment of up to \$100 million. The Bolivian Government was aware of the risk that exploration efforts may be discontinued if the short-term (2003-2005) market outlook can not clearly defined. Discussions were under way with a view to doubling gas exports to Brazil by 2010, and studies on building gas-fired power-generation capacity in Bolivia were being carried out. This would allow Bolivia to export electricity rather than just gas. During the next 3 years, exports to Brazil will be increased from 18 to 30 Mm³/d. To meet the terms of the contract, Bolivia would have to develop reserves of 205 billion cubic meters (Gm³). Because Bolivia also expected a rise in domestic gas demand for some 6 Mm³/d, the amount of gas reserves that will need to be produced during the next 20 years would need to total 206 Gm³. These requirements will necessitate an increase of some 30% in Bolivia's 1999 certified reserves of 200 Gm³.

There is little interest in extending earlier export contracts with Argentina, which now has its own supplies coming up from the south.

As of January 1, 1998, Bolivia confirmed that natural gas reserves were proven/probable 6.62 trillion cubic meters; possible, 3.17 trillion cubic meters; and potential 29.0 trillion cubic meters.

The two upstream companies that will have to make these increases were Chaco S.A. and Andina S.A. These two semipublic companies each inherited 50% of the upstream assets of YPFB when it was privatized in 1998. Chaco was in partnership with Amoco Oil Co., and Andina, with the Argentinian consortium of YPF/ Perez Companac and Pluspetrol (Energies, 1998).

Infrastructure

The transportation network of Bolivia comprised 42,815 km of highways. The Pan-American Highway, which links Argentina and Peru, crosses the country from south to northwest. The national railroad system was capitalized in two sections in 1995. Cruz Blanca of Chile, which bid \$39 million to capitalize the Andean and the Eastern lowland railway networks that were owned by the state Empresa Nacional de Ferrocarriles (ENFE) cut back its 50% participation in ENFE to 13.5% by transferring 36.5% to Antofagasta Holdings, which operated the Chilean end of the Antofagasta Bolivia railway. The Chilean rail operators have so far spent \$8 million on track and rolling stock repairs on the Andean network. The Eastern Lowland Network wanted to invest \$32.5 million during the next 5 years (\$4.6 million per year) on track improvements and rolling stock. Between them, the two networks transport 250,000 t/yr of lead and zinc mineral concentrates and 900,000 t/yr of soya to Chilean ports. An additional 150,000 t of wheat comes into the country over the same lines (American Chamber of Commerce of Bolivia, [1998], In transit—Investment opportunities in Bolivia, accessed February 12, 2001, at URL

<http://www.bolivianet.com/amcham/invest.htm>).

The rail system consists of two independent lines that are separated by the eastern Andes. The western line connects the cities of La Paz, Cochabamba, and Oruro with northern Argentina and the Chilean ports of Antofagasta and Arica. The eastern line connects Santa Cruz with northern Argentina and western Brazil. Rolling stock (55 locomotives and 2000 railway cars) can be transferred between systems only through northern Argentina. The lack of adequate rail transport capacity is of special concern to the booming agricultural export industry around Santa Cruz (U.S. Embassy, La Paz, Bolivia, July 1998, FY 1999 country commercial guides—Bolivia—Investment climate—Openness to foreign investment, accessed December 9, 1999, at http://www.state.gov/www/about_state/business/com_guides/1999/wha/bolivia99.html).

As a landlocked country, Bolivia has no ocean ports, but does have access to international markets through ports in Antofagasta and Arica Provinces, Chile, and Matarani, Peru.

About 13.5 Mbbl of crude oil and condensates, 5.6 Mbbl of refined oil products, and 1,251 million cubic meters of natural gas were transported between major distribution centers in Bolivia through 5,980 km of pipelines owned and operated by Andina and Chaco. All the pipelines were reversible, with the exception of the export pipeline to Arica. The generation, transmission, and distribution of electrical power in Bolivia was carried out by state and private companies. The Government sold its electric company to three United States firms. Bolivia had an installed electrical generating capacity of 804.5 megawatts (MW), of which 308 MW, or about 38.3%, was generated by hydroelectric plants; the remainder was generated by thermoelectric plants that were operated by Empresa Nacional de Electricidad S.A., the installed generating capacity was 496.5 MW, or 61.7% of Bolivia's total.

Outlook

The Bolivian economy will continue to rely heavily on the hydrocarbon sector. Taxes and royalties to be paid on internal sales of finished petroleum products will remain essential revenues for the national treasury. Natural gas exports to neighboring countries will be a significant component of Bolivia's foreign exchange earnings. The Bolivia-to-Brazil natural gas pipeline project is expected to become a major driving force for the Bolivian economy, in addition to transporting natural gas to Brazil, which was the largest South American market. At the same time, the project will help attract private investments for the hydrocarbon sector because the volumes of natural gas to be provided to Brazil will activate exploration and production activities. The value of these exports will range from \$125 million for the first year to \$500 million per year after 5 years of operation. If thermoelectric powerplants are included and the pipeline system is expanded, then exports can be doubled. Other benefits for Bolivia included attraction of private investment needed for natural gas exploration and development, infrastructure development along the pipeline (compression facilities, liquids extraction plants), creation of new employment opportunities, economic integration with Brazil, expansion of the internal natural-gas-gathering transportation system, production and exports of liquids byproducts, improved access of natural gas to Southern

Cone markets, and incentive for other private companies to construct more gas pipelines and to invest in gas-transportation activities (ViceMinisterio do Energía e Hidrocarburos, March 20, 1998, Bolivia-Brazil pipeline, accessed July 29, 1998, at URL <http://www.energiagov.bo/ingles/GAsDuct.html>).

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Major Sources of Information

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Major Publications

- Ministerio de Desarrollo Economico
Viceministerio de Minería y Metalurgia
Boletín Estadístico 1997
Publicación Oficial No. 182
La Paz-Bolivia
- Asociación Nacional de Mineros Medianos
Memoria e Informe Anual-1997
Noticias Minera Mensuales-1997

TABLE 1
BOLIVIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/ METALS 4/	1995	1996	1997	1998	1999 e/
Antimony:					
Mine output, Sb content	6,426	6,488	5,999	4,735	2,790
Metal including Sb content of trioxide	4,840	4,909	4,136	3,836	2,241 5/
Arsenic, mine output, arsenic trioxide, arsenic sulfide					
	362	255	282	284	437 5/
Bismuth:					
Mine output, Bi content	121	348	684	550	236
Metal, smelter	19	28	55	44	19
Copper, mine output, Cu content					
	127	92	182	48	252
Gold, mine output, Au content 6/ kilograms					
	14,405	12,634	13,292	14,444	11,788 5/
Lead :					
Mine output, Pb content	20,387	16,538	18,608	13,848 r/	10,153 5/
Metal, smelter	195	102	77	65	45
Silver:					
Mine output, Ag content kilograms	425,053	384,384	387,200	403,961	422,492 5/
Refined 7/ do.	81,322	70,852	1,112,411	1,157,954	72,195 5/
Tantalum, tantalite do.	565	646 e/	727	15,624	8,808 5/
Tin:					
Mine output, Sn content	14,419	14,802	12,898	11,308	12,417 5/
Metal, smelter	17,709	16,733	16,853	11,102	11,166 5/
Alloys	248	226	123	160	75
Tungsten, mine output, W content					
	655	582	513	497	334
Zinc, mine output, Zn content					
	146,131	145,092	154,491	152,110	146,316 5/
INDUSTRIAL MINERALS					
Arsenic trioxide					
	362	255	282	284	437
Barite					
	10,845	4,745	4,402	2,500	6,005 5/
Bentonite					
	252	69	50	50 e/	50
Calcite e/					
	20	20	20	20 e/	20
Cement, hydraulic					
	891,776	934,303	1,034,800	1,166,512 5/	1,202,000 5/
Gemstone, amethyst:					
Polished kilograms	47 e/	36	18	21	20
Rough do.	310	238	122	140	130
Gypsum, crude					
	1,800	192	20	--	--
Marble					
	170	242	274	250	260
Onyx kilograms					
	250	--	--	--	--
Quartz do.					
	--	--	39	32	35
Salt					
	4,924	273	869	4,562	4,500
Slate (pizarra)					
	280	393	458	484	490
Ulexite					
	6,891	9,231	12,309	15,951 r/	15,362 5/
MINERAL FUELS AND RELATED MATERIALS					
Gas, natural:					
Gross million cubic meters	5,349	5,281	5,349	6,756	6,800
Marketed do.	3,361	3,259	3,341	3,426	3,396 5/
Natural gas liquids:					
Natural gasoline thousand 42-gallon barrels	2,300	2,456	3,000 e/	3,000 e/	3,000
Other (consumption) do.	2,447	2,450	2,600 e/	2,600 e/	2,600
Petroleum:					
Crude including condensate do.	10,220	10,950 r/	10,585 r/	12,775 r/	13,505 5/
Refinery products: do.					
Liquefied petroleum gas do.	1,650	602	730 r/	610 e/	700
Gasoline do.	3,095	3,665	3,650 r/	3,680 e/	3,700
Jet fuel do.	701	964	1,095 r/	960 e/	1,000
Kerosene do.	299	245	365 r/	250 e/	400
Distillate fuel oil do.	2,694	2,978	2,920 r/	2,990 e/	3,000
Residual fuel oil do.	296	183	365 r/	180 e/	200
Unspecified do.	3,446	4,993	4,015 r/	5,000 e/	4,200
Total do.	12,181	13,630	13,140 r/	13,700 e/	13,200

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through December 2000.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ In addition to the commodities listed, a variety of industrial minerals (clays, crushed and broken stone, dimension stone, and sand and gravel) are produced, but available information is inadequate to make reliable estimates of output levels.

4/ Unless otherwise specified, data represent actual production by Corporación Minera de Bolivia and small- and medium-sized mines.

5/ Reported figure.

6/ Includes production of metallic gold.

7/ Includes production of metallic silver.