

# BOLIVIA

By Pablo Velasco

Bolivia, which has been one of the poorest and least developed Latin American countries for many years, has made considerable progress toward the development of a market-oriented economy. Successes under the previous Government included signing a free trade agreement with Mexico and the entry into the Mercado Común del Cono Sur (Mercosur), as well as the partial privatization of the state airline, the telephone company, the railroad, the electric power company, and the petroleum company. The current [2000] administration favors free market economics and social conservatism.

Bolivia, which is located southwest of Brazil in central South America, has an area of about 1,098,580 square kilometers. In July 2000, the population was 8 million with a gross domestic product (GDP) per capita of \$3,000<sup>1</sup> and a GDP of \$24.2 billion based on 1999 purchasing power parity.

The slower growth of the economy in 1999 was due, in part, to tight Government budget policies and the fallout from the Asian financial crisis. Growth should rebound to 4% in 2000 given reasonably favorable world commodity prices. The inflation rate fell to an average of about 2.1% in 2000 (U.S. Central Intelligence Agency, 2000, *Bolivia—Economy*, World Factbook 2000, accessed May 21, 2001, at URL <http://www.odci.gov/cia/publications/factbook/geos/bl.html>).

Mining of nonfuel minerals remained important in 2000 and provided 5% of the GDP; crude oil and natural gas provided an additional 5%. Together with agriculture, forestry, and fishing, these primary activities accounted for one-fourth of the country's legitimate economy (Fox, 2000).

Bolivia has traditionally been a mining country that produced antimony, bismuth, copper, gold, lead, silver, tin, tungsten, and zinc. It has large reserves of gold, lithium, iron ore, natural gas, and petroleum. In 2000, Bolivia exported \$429 million worth of minerals; this was an increase of 7.1% compared with 1999 (Vice Ministerio de Minería y Metalurgia, 2000, p. 8).

Starting in 1999, companies that were looking to invest in the minerals sector were granted a deferral on value-added tax and customs duty payments that represented a savings of up to 20% on investment project costs. The large number of available prospects and a new mining code have encouraged mineral exploration in the country. "The new mining code guarantees the rights of private firms to operate in the mining sector independent of the State Mining Corporation (COMIBOL). In addition, the new law expressly authorizes the state-owned mining sector to subcontract, lease, and operate joint ventures with private firms (including foreign companies). Further changes are pending parliamentary approval providing better rights to holders of concessions.

"As is the case with the new hydrocarbons law, the new mining code provides a special taxation code for the industry. The newly modified code attempts to reduce the overall tax burden on foreign mining firms by making Bolivian taxes fully

deductible under U.S. corporate income tax regulations. Three taxes apply: a. An advance payment on profits, consisting of 2.5% of net sales, payable at the time of export; b. A profits tax of 30% on net profits. Net profits are defined as gross income minus all expenses and costs. Net losses can be carried forward for up to 5 years. If the advance payment is greater than the tax owed, the enterprise receives a nonnegotiable fiscal credit; c. Mineral production is also subject to a value added tax (IVA), which is levied at a flat rate 13% of value added in all normal economic activity, and transaction taxes; however, the transaction tax is waived for domestic mineral sales" (American Chamber of Commerce of Bolivia, [undated], *Investment opportunities in Bolivia—Bolivia's investment climate*, accessed February 2, 2001, at URL <http://www.bolivianet.com/amcham/invest.htm>).

Mining in the traditional western highland region will face competition from new mining projects in the Precambrian Shield in the eastern lowlands near the border with Brazil where rich gold and copper deposits have been discovered.

Bolivia's novel capitalization program (50% partial privatization) has had a better than expected effect on foreign investment inflows. Since 1995, nine international companies and consortia have 50% partially privatized state-owned companies for electricity, telecommunications, the national airline, the railways, and the oil and gas sector's production and transport divisions. The companies that manage Bolivia's strategic industries were given between 3 and 7 years to make good their investment commitments in the former state enterprises. The need to generate the earliest possible return on their capital investment, however, caused companies to accelerate their spending plans. Investment commitments for the partially privatized enterprises and the rise in hydrocarbon exploration have resulted in foreign investment inflows taking off. These have risen to \$1.4 billion in 1998 from \$372 million per year in 1995 and \$120 million in 1992. According to the Government, total investment, which has included private (domestic and foreign) and public, will climb to \$2.8 billion per year by 2002. The current [2000] Government of Bolivia forecasted that it would be able to draw in more than \$11.0 billion worth of investment during the next 5 years, of which \$7.2 billion will come from private sources and \$4.7 billion will be covered by foreign investment. The largest project to attract foreign investment was the natural gas pipeline to Brazil. International oil companies are expected to invest more than \$2.5 billion in exploration during the next 5 years to prove natural gas reserves (American Chamber of Commerce of Bolivia, 2001).

Brazil accelerated its commitment to purchase 30 million cubic meters per day of natural gas from 2003 to 2006. This rise in demand has prompted speculation that a second pipeline may have to be built sooner rather than later (American Chamber of Commerce of Bolivia, 2001).

Export revenues increased by about 3.65% to about \$1.46 billion owing to increases in the exports of crude oil, natural

<sup>1</sup>Where necessary, values have been converted from Bolivian bolivianos (\$b) to U.S. dollars at the rate of \$b6.00=US\$1.00.

gas, gold, silver, tin, and zinc (Instituto Nacional de Estadística, 2001, Resumen estadístico—Indicadores económicos, accessed May 31, 2001, at URL <http://www.ine.gov.bo/iwd0201.htm>).

### Government Policies and Programs

The development of potentially rich material deposits that straddle the common border between Argentina and Bolivia has been the subject of bilateral talks since 1998. Negotiations on an accord to clarify how mining investors will be treated by both countries should attempts be made to develop cross-border projects have never reached a conclusion. During a 2-day visit to La Paz, Bolivia, in early November, the Argentine delegation said, “We are extremely interested in signing a mineral exploitation agreement with Bolivia.” The Argentine ambassador to La Paz expected the form of the accord to be similar to the one signed between Argentina and Chile in March (Metals & Minerals Latin America, 2000e).

Bolivia was the first country in Latin America to be declared eligible for debt relief under the enhanced heavily indebted poor countries (HIP) initiative. During the past decade, Bolivia has experienced a dramatic improvement in its macroeconomic performance. Inflation fell from hyperinflationary rates in 1985 to just 3.4% in 2000; official international reserves and foreign direct investment have increased significantly; and the external debt burden, while still high, has eased significantly. Annual growth increased to an average of about 4% in real terms during the 1990s from virtual stagnation in the previous decade (World Bank Group, 2001).

### Environmental Issues

Environmental standards were monitored nationally by the Ministry of Sustainable Development and by its Departmental Secretary of Sustainable Development and Environment at the regional and 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 (Mining Journal, 1998).

During the past 4 years, construction was begun on two major gas pipelines that will connect east-central Bolivia and Brazil. The first pipeline, which was completed in 1998, connects gasfields around Santa Cruz, Bolivia, to markets in and around Sao Paulo and Porto Alegre, Brazil. The second pipeline will connect gasfields around San Miguel, Bolivia, to a gas-powered electric powerplant in Cuiababa, Brazil. Both pipelines include collection and distribution pipelines that collect the gas and distribute it to intermediate markets along the pipeline. Additional pipelines have been proposed that would connect Bolivia to other markets in Brazil and to ports in Chile and Peru. The San Miguel-to-Cuiababa pipeline passes through wetlands and dry tropical forest. A number of international environmental organizations, which included Friends of the Earth, the World Wildlife Fund, and Amazon Watch, and local civic and governmental organizations have opposed the route of this pipeline (U.S. Department of Energy, [2001], An energy overview of Bolivia natural gas, accessed January 15, 2002, at URL <http://www.fe.doe.gov/international/bolvoer.html>).

In Beni Department in northeastern Bolivia, Government land sales and subsequent clearing of forest for timber sales and

agricultural purposes have raised the concerns of indigenous people, and recent oil exploration in the region has heightened their concerns. The Sécure block area, which was granted to Repsol-YPF-Maxus, is in communal lands that belong to the Chimanis, the Ignaciones, the Mojeno, the Movinas, and the Yuracires indigenous peoples. Previous spills of oil into the Desaguadero, the Pirque, and the Parapetí Rivers have raised concerns about the possibility of similar events happening in the Apere River, which is used as a source of water by indigenous peoples (World Rainforest Movement, October 2000, Bolivia—Indigenous peoples concerned by oil prospection, accessed January 15, 2002, at URL <http://www.wrm.org.uy/bulletin/39.html>).

### Production

After 2 consecutive years of low commodity prices, the value of mining production in Bolivia increased by 2.5% to more than \$431 million in 2000 compared with that of 1999. The medium-sized mining sector continued to be the dominant producer and was responsible for about 59% of the value of mine production in 2000 followed by the small-sized mining sector with 36%; COMIBOL, 2%; and others, 3% (Vice Ministerio de Minería y Metalúrgia, 2000, p. 1).

In 2000, Bolivia produced about 11.5 million barrels (Mbbbl) of crude oil and 15.6 billion cubic meters of natural gas (table 1).

Mining prospects were clouded by the downturn in metal prices that delayed or deterred some anticipated investments. The generally depressed conditions of 1999 continued in 2000 and showed few signs of alleviating a growing crisis within the industry. In contrast, the reform and development of the hydrocarbon sector continued to be of great importance to the Bolivian Government. This sector represented more than 30% of the Government’s annual revenues and 20% of the country’s exports. The success of the sector made direct and indirect contributions to alleviating poverty in Bolivia because the Government uses hydrocarbon revenues for health care and education.

In 2000, Empresa Minera Inty Raymi S.A.’s Kori Kollo gold and silver mine, which is north of Oruro in the Altiplano performed relatively well with the mill operating at a throughput of about 21,000 metric tons per day (t/d) of ore to give total gold production of about 8,646 kilograms (kg) and 21,567 kg of silver and alloys.

Cía. Minera del Sur S.A. (Comsur) (of which Rio Tinto plc held 30%) was another major player in the medium mining sector. In recent years, Comsur has become the largest zinc producer in the country with the Porco zinc-silver-lead mine in Potosi being the major source. In 2000, Comsur acquired the Vinto Antimony Smelter (Asociación Nacional de Mineros Medianos, 2000, p. 11).

### Trade

The United States remained Bolivia’s largest trading partner. In 2000, the U.S. exported \$413 million of merchandise to Bolivia and imported \$190.7 million in merchandise from Bolivia. Bolivia’s major exports to the United States were gold, jewelry, tin, and wood products, and its major imports from the United States were computers, machinery, vehicles, and wheat. A bilateral investment treaty was signed in 2000, but had not

been ratified by the United States by yearend.

Bolivia's trade with neighboring countries was growing in part because of several regional preferential trade agreements the Government had negotiated. Bolivia is a member of the Andean Community and has free trade with other member countries—Colombia, Ecuador, Peru, and Venezuela. Bolivia began to implement an association agreement with Mercosur in March 1997. The agreement provides for the gradual creation of a free-trade area that covers at least 80% of the trade between the parties during a 10-year period. The U.S.-Andean Trade Preference Act (ATPA) allows numerous Bolivian products to enter the United States free of duty on a unilateral basis.

The Government of Bolivia remained heavily dependent on foreign assistance to finance development projects. 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 drop was a consequence of lower commodity prices, which was an indication of a wider deterioration in Bolivia's terms of trade. The Bolivia-to-Brazil natural gas pipeline had started to export 2.2 million cubic meters per day of natural gas from Bolivia to Brazil's southeastern province of Porto Alegre and Sao Paulo. The 3,050-kilometer (km) pipeline was completed at a cost of \$2.0 billion, which was financed in part by the World Bank and the Brazilian national oil company Petroleo Brasileiro S.A. (Petrobras). This pipeline increased regional energy integration. The first stage of the project was completed in February 1999 and was operational in July 1999 (U.S. Energy Information Administration, July 15, 1999, Bolivia—Natural gas, Country Analysis Brief, accessed November 18, 1999, at URL <http://www.eia.doe.gov/emeu/cabs/bolivia.html>).

### Structure of the Mineral Industry

The 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 the 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.

COMIBOL's continuing attempts to dispose of the three main assets it still controls (the Cerro Rico silver deposit, the Mutún iron deposit, and the shuttered Karachipampa lead-silver smelter) made only slow progress in 2000. Poor infrastructure and a high manganese content has long hampered the sale of Mutún's estimated 4 billion metric tons of iron ore reserves. The Karachipampa Kivcet technology smelter has been dormant since its completion in 1984 owing to a lack of appropriate feed for the single-belly furnace. A study into the feasibility of using Karachipampa's facilities to treat zinc may be a last hope for the

plant. A joint venture between Germany's Lurgi GmbH and the Russian-based Gas Energy Finance was engaged in a \$400,000 study to build a completely new zinc smelter.

According to COMIBOL, "If the project proves viable, slag from the smelter could be treated in the existing lead-silver plant." COMIBOL estimated that the total cost of modifying the smelter to process zinc and to bring the Kivcet furnace up to modern environmental standards would be around \$160 million. The plan was dependent on the development of the Apex Silver Mines Ltd. San Cristobal zinc-silver-lead mine, which was expected to produce around 500,000 metric tons per year (t/yr) in 2003 or later (Metals & Minerals Latin America, 2001).

Mutún's fortunes could also change, but the project still looked marginal to many. If Bolivia's recently discovered reserves of natural gas can be harnessed to develop a direct reduced iron plant at Mutún, then the cost and difficulty of shipping large volumes of concentrates could be avoided. COMIBOL claimed that Rio Tinto Zinc Corp. plc. and Phelps Dodge Corp. were seriously interested in the Mutún deposit. Although companies were taking a fresh look at the iron reserves, the suggested interest of informed industry sources was muted because Mutún's complex metallurgy made it less attractive than COMIBOL believed. Transport costs still make the project susceptible to fluctuations and high risk, at least for a single investor (Metals & Minerals Latin America, 2001).

Cerro Rico was protected as a United Nations Educational, Scientific, and Cultural Organization site, thus making the use of expensive backfill mining techniques necessary to maintain the mountain's shape. A scheme to exploit sedimentary silver deposits ("pallacos") at the base of the mountain, however, was being seriously pursued by U.S.-based Coeur d'Alene Mines Corp. Coeur bought the San Bartolomé property from ASARCO Incorporated in 1999. Provisional studies estimated 3.3 million kilograms (105 million ounces) of silver are contained in the gravel bed channel deposits on the sides of Cerro Rico. The company intended to complete an in-house bankable feasibility study on the \$70 million project by August 2001, according to one of the venture's partners, who indicated that a decision still needed to be made on the best extraction technique to be used and on whether to employ a conventional mill or opt for a heap-leach treatment plant (Metals & Minerals Latin America, 2001).

The private mining sector, which was made up of 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 2000, the number of affiliated mining companies in the private Medium- Size Miners Association increased to 15. The new list comprised the following affiliated mining companies: Andean Silver Corp. (lead, silver, and zinc), Empresa Minera Arisur S.A. (lead, silver, and zinc), Empresa Minera Bajaderia S.A. (tin), Empresa Minera Barrosquira Ltda (tin), Cia. Minera Calcarea S.A. (tin and zinc), Cia. Minera Concepción S.A. (silver), Cia. Minera del Sur S.A. (lead, silver, and zinc), Empresa Minera Unificada S.A. (Emusa) (antimony), Empresa Minera Himalaya S.A. (tungsten), Empresa Minera Inti Raymi S.A. (gold and silver), L&M Mining Co. (gold), Cia. Minera La Rosa S.A. (copper, gold, and silver), Cia. Minera San Cristobal S.A. (lead, silver, and zinc), Empresa Minera Santa Lucía S.A. (lead, silver, and zinc), and Cia. Minera La Solución S.A. (lead, silver, and zinc) (Asociación Nacional de Mineros Medianos, 2000, p. 8).

The Small-Size Miners Association, which was grouped

under the Cámara Nacional de Minería, included 600 small mines operating in the country. Mining cooperatives were organized under the Federación Nacional de Cooperativas Mineras and included most of the gold mining cooperatives of Gonzata, Guanay, Mapiri, and Tipuani. According to the National Institute of Cooperatives, more than 300 mining cooperatives in the country were grouped under the Federación Regional de Cooperativas, of which about 40% in 2000 were mining gold mainly in the Tipuani area in the Province of Larecaja, La Paz Department.

## Commodity Review

### Metals

**Antimony.**—The sale of Comibol's shuttered Vinto antimony smelting plant was concluded on November 20 with a \$1.1 million offer from Colquiri S.A. The only other contender was Allied Deals Corp. of the United Kingdom, which had acquired the Vinto tin smelting plant in 1999. Allied's antimony plant tender was disqualified, and Allied was evaluating whether or not to challenge the disqualification decision. The Colquiri bid of \$1.1 million exceeded the \$100,000 base price set by the Government's advisors by 11 times. The purchase of the plant, however, did not represent a renewed interest in the Bolivian antimony industry. Despite improved price conditions that have once again made antimony mining economically viable in Bolivia, securing sufficient feed to reactivate the plant will prove difficult because of mine closures owing to low antimony prices in the past. According to industry sources, conversion of the existing smelting facility to treat other metals, such as zinc or tin, lay behind the recent interest from Allied and Comsur to acquire the assets. Having failed to purchase Vinto's tin smelter, CDC may well seek to add value to its earlier purchase of the Colquiri Mine by converting the antimony plant to treat tin. If conversion proves feasible, then Allied's hopes of securing additional feeding for the existing tin smelter from Colquiri Mine's 200-metric-ton-per-month (t/mo) production of tin-in-concentrates will not be realized (Metals & Minerals Latin America, 2000a, d).

Depressed world prices for antimony resulted in a sharp decline in Bolivian antimony output to 1,800 t/yr in 2000 from 2,790 t/yr in 1999 and an average 6,000 t/yr in recent years. This decline was due to the closure of Emusa's antimony operation at Chilcobija in mid-1999. Empresa Minera Poroma and other potential bidders for the smelter began producing 100 t/yr of antimony. In 2000, Poroma was selling its concentrate production to Oxy Chemie and Brazilian buyers, but it hoped to increase output to produce 200 t/mo of antimony regulus once the Vinto smelter was recommissioned (Metals & Minerals Latin America, 2000b).

**Gold.**—In 2000, official gold production in Bolivia, which increased by 1.8% compared with that of 1999, amounted to 12,000 kg. Inti Raymi S.A.'s pilot plant, which used bio-oxidation heap leaching on additional oxide ore reserves at Llallagua, was about to reach a decision whether to begin production this year; the plant adjoins Kori Kollo. If proven successful, then this technology could be adapted to other refractory deposits now under evaluation by Battle Mountain Gold Co. (BMG) that would then help extend the limited economic life of the mining region, which was almost entirely

dependent upon mining for its livelihood. The low price of gold in 1999 and 2000 delayed progress on a number of small gold-base projects that might otherwise have reached production. For example, feasibility work at the Don Mario project (Vancouver-based Orvana Minerals Corp.) was virtually halted as was the Amayapampa-Capacirca project (Denver-based Vista Gold Corp.). Eaglecrest Explorations Ltd. of Vancouver continued to drill the area in the vicinity of the Paititi pit in its San Simon property. The Kori Kollo gold and silver mine continued to be Bolivia's most productive operation. In 2000, BMG's share of Kori Kollo production was 9,741 kg (313,180 ounces) at an average cash cost of \$279 per ounce (\$87 million) despite falling prices, grade, a drop in mill recovery, and a higher stripping ratio that adversely affected production. In 2000, Llallagua was estimated to contain more than 30,000 kg (1 million ounces) of gold (Battle Mountain Gold Co., 2000, p. 13).

Orvana announced that Comsur had decided not to pursue its agreement to take a lease from Orvana on the Don Mario gold-copper project in eastern Bolivia. Orvana and its Bolivian subsidiary Minera Paititi agreed to lease the Don Mario deposit in September. Terms of the deal were still to be finalized. Comsur elected not to extend the terms and time period of the agreement to receive the necessary approvals as required under the contract. Completion of a financial feasibility study on the project by Australia's Minproc Ltd. took place in April, but Orvana failed to find a suitable financing package to develop the \$28 million mine owing to low gold prices. Orvana had indicated that an estimated production of more than 395 kilograms per year (kg/yr) (127,000 ounces per year) of gold at a total operating cost of \$5.16 per gram (\$166 per ounce) would stimulate interest from a joint-venture partner. Comsur's interest arose because it was already operating a cyanide heap-leach gold project in the area at Puquio Norte. Using feed from Don Mario to increase grades through its existing mine and mill would have saved the company much of the capital cost needed to exploit Don Mario's part underground/part open pit reserves (Metals & Minerals Latin America, 2000c).

The richest and most productive alluvial gold deposits in Bolivia are located in Challana and the Kaka, the Mapiri, and the Tipuani River valleys, which are in the northern area of La Paz Department. Golden Eagle International, Inc., of the United States held mining rights to concessions in the Cangalli gold deposit. In 1998, Golden Eagle announced a major gold discovery at Cangalli, south of La Paz, that had reserves of 199,000 metric tons (t) (6.4 million ounces) (Mining Journal, 1999). 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.**—Barex Empresa Minera (Baremsa) (a joint-venture partnership between Barex World Trade and U.S. metallurgical consultants Kappes, Cassidy & Associates) halted treatment of silver tailings at its Itos plant outside Oruro. Operations were suspended until a financial reorganization. Baremsa held a lease agreement with COMIBOL to exploit the tailings from the adjacent San José Mine where underground mining operations had ceased in 1992. The Itos mill's unusual hot acid-ferric chloride leaching plant began operations in 1996 and was designed to produce 31.1 kg/yr (1 million ounces per year) of silver billion (7% of Bolivia's total silver production)

from the treatment of 180,000 t/yr of metallurgically complex silver-lead mine tailings at a grade of 220 grams per metric ton (g/t) silver. The plant has achieved recoveries of around 75% of the contained silver and still has about 1.2 million metric tons (Mt) of tailings to process. Removal of the tailings from the outskirts of Oruro for reprocessing helped COMIBOL to resolve a potentially costly environmental liability. The suspension of operations at Itos was the result of the continued weakness in the price of silver and a lack of capital investment to commission additional byproduct circuits. Baremsa estimated that sales from byproduct lead and sodium sulfate could be worth an extra 25% in revenues to Baremsa. If a financial rescue package can be negotiated that will inject fresh capital into the plant and the additional byproduct circuits are built, then Baremsa's mill may yet have a future (Metals & Minerals Latin America, 2001).

Production of zinc concentrates represented Bolivia's largest mineral export with an output equivalent to 149,134 t of zinc concentrates in 2000. Production of lead concentrates was 9,523 t. Output of metallic silver decreased to about 55,720 kg. The medium-sized mining sector was the dominant lead and zinc producer with 69.4% of total lead and 69% of total zinc. In this sector, the major producer of lead, silver, and zinc was Comsur (Vice Ministerio de Minería y Metalurgia, 2000, p. 1).

A long-term commitment to Bolivian mining and a relatively successful history has given Comsur easier access than most to external sources of concessional and commercial finance. The Porco (lead, silver, and zinc) mine reportedly has 4 Mt in probable reserves at a grade of 11.2% zinc, 0.7% lead, and 107 g/t silver. The plant has a capacity of 1,500 t/d. The initial 30-year Porco leasing agreement with COMIBOL was renewed for a further 15 years in mid-1999 after bids were requested and after considerable delays that critics claimed were due to political antipathies. The most interesting potential mine is the proposed development by Andean Silver Corp. (a fully owned subsidiary of Apex Silver Mines Ltd.) of a large zinc-silver deposit at San Cristobal in the far south of the Altiplano. Minera San Cristobal S.A. (a wholly owned subsidiary of Apex Silver) selected the Anglo-Norwegian engineering and construction group Kvaerner ASA to perform detailed engineering, procurement, and construction services for the San Cristobal open pit silver-zinc mining project. Kvaerner had previously conducted a feasibility study for the project. Using projections developed in Kvaerner's feasibility study, the project would operate and process 40,000 t/d (rising later to 60,000 t/d) from which a production of 746 t/yr (24 million ounces per year) of contained silver and 250,000 t/yr (560 million pounds per year) of zinc-in-concentrate could be anticipated during the first 5 years of the mine's life. This would make San Cristobal the largest open pit silver and the third largest zinc mine in the world and the lowest cost producer of silver and zinc. Total capital costs calculated in the feasibility study were \$413 million. Expected mine life of a minimum 17 years was based on proven and probable reserves of 240 Mt of ore that contains 0.06 g/t (2.0 ounces per metric ton) silver, 1.67% zinc, and 0.58% lead. The intention was for concentrate to be transported in sealed containers by road to ports in Chile and then shipped to refineries in Asia, Europe, or the United States (Fox, 2000).

**Tin.**—The privatization of COMIBOL's Vinto tin smelter and Huanuni and Colquiri mines in 1999 has caused tin

production to languish. The new owners Allied (Vinto/Huanuni) and Comsur (Colquiri) formulated development plans and carried out modernization of the rundown infrastructure inherited from the state. The hiatus in production caused by the changes has been exacerbated by the total closure since April 1999 of the Colquiri Mine for refitting. Despite the difficulties, refined tin output from Vinto in 2000 was expected to be close to the 11,166 t produced by COMIBOL in 1999 largely owing to Allied contracting to process about 500 t/mo of tin-in-concentrate from Brazil. Allied and Comsur, however, have completed their plans for development of two mines, thus opening up the prospect of significantly increased feed for Vinto in the near future. A source close to negotiations between Allied and Comsur indicated the reopening of Colquiri was "imminent" and that a deal had been struck between the two companies to ensure that of the mine's estimated 200 t/mo of tin production will be refined at Vinto and not shipped abroad as concentrates. Production from Huanuni was steadily picking up in recent months to 350 t/mo tin-in-concentrate in August 2000 from a postprivatization production level of 250 t/mo with a target of 400 t/mo by yearend. With supplies from small cooperative producers and Bolivia's only other tin mining operation Barrosquira-Bajadera selling increasing quantities of concentrates to Vinto, informal estimates indicate that production from the smelter could jump to as high as 15,000 t of refined metal in 2001. In the medium term, Allied committed to spend \$10 million on new investment in Huanuni within the first 2 years of its privatization contract and was studying the possibility of driving a ramp from the surface into the mine's interior in order to provide open access to its deeper underground levels and to allow bulk mining techniques to be used. Introduction of bulk mining at Huanuni will take at least 18 months to implement, but increasing feed to Vinto in the long term was a company priority (Metals & Minerals Latin America, 2000a).

In 2000, tin production increased by about 0.4% to 12,464 t compared with that of 1999, and the tin output value increased by 0.5% to \$67,657,000 of the country's total minerals export value. The largest production increase in the private sector was by the small-sized mines and cooperatives. For the 14th consecutive year, they replaced COMIBOL as the leading tin producer with an output of about 60% of Bolivia's tin production. COMIBOL's mines produced about 7.7% of the country's total tin mining output (Vice Ministerio de Minería y Metalurgia, 2000, p. 1).

**Tungsten.**—In 2000, Bolivia's production of tungsten concentrate, which was heavily dependent on international prices, increased by about 14% to 382 t compared with 334 t in 1999. Production came from the small miners and cooperatives that had small deposits with high ore grades and low labor costs (Vice Ministerio de Minería y Metalurgia, 2000, p. 1).

## Industrial Minerals

Traditionally, Bolivia's cement industry has been able to match its cement production to the requirements of the market. According to information received from Sociedad Boliviana de Cemento, S.A. (Soboce), Bolivia produced 1.30 Mt of cement and more than 1.16 Mt of clinker. According to recent national output figures, cement production grew by 7.08% in 2000

compared with that of 1999. In 1998, Bolivia had five cement producers that had a joint clinker production capacity of almost 1.36 million metric tons per year (Mt/yr) and a combined cement production capacity of more than 1.16 Mt installed in five cement works and two grinding plants. Soboce was the main player with three works—its own units at Viacha and Warnes and the former Tarija works of Cemento El Puente; these totaled about 267,000 t/yr of clinker production capacity and 557,000 t/yr of cement capacity. A new line was opened at the Viacha works in early 2000. This was a 1,000-t/d unit provided by F.L. Smith and Larsen & Toubro Ltd. and represented a capital investment of \$60 million, which will effectively push nationwide, clinker production to the 1.2 Mt/yr level. Soboce was owned by Inversiones Industriales S.A. (International Cement Review, 2000).

Fábrica Nacional de Cemento S.A. (Fancesa) was the second largest cement producer with a 334,000-t/yr unit at Cal Oro that was based on a clinker line rated at 276,000 t/yr. This plant was owned by the Government, the local municipality, and the local university. In 2000, Soboce bought out the Government's 33% stake. Additionally, Soboce was given management control of the Fancesa works, which effectively made Soboce-Fancesa the major producer in Bolivia. Cooperativa Boliviana de Cemento (Coboce) ran a 300,000-t/yr clinker and 315,000-t/yr cement integrated work at Cochabamba. Another company that produced cement was Empresa Mineral Industrial S.A. (Emisa) (owned by New Zealand's Fletcher Challenge Building Ltd. and Itacamba S.A.). By early 2000, clinker production cement capacity remained unchanged at more than 1.16 Mt. Cement capacity may increase in to keep pace with local demand. Soboce had a national market share of 37.4%; Fancesa, 28.9%; Coboce, 18.7%; Itacamba, 8.8%; and Emisa, 6.2% (International Cement Review, 2000).

Bolivia exported some minimal amounts of clinker in recent years; Soboce sold clinker product from its Viacha plant to Arequipa, Peru. No cement was exported. Minimal clinker imports were required to service the small grinding plant of Itacamba. Imports came from neighboring Brazil, and until the new line was completed at Viacha, some clinker was purchased from Juan Minetti in Argentina and delivered to the Warnes clinker grinding unit (International Cement Review, 2000). CDC invested about \$20 million in a loan package to Soboce as part of this upgrade program in 1999 and intended to build up a number of cement clients in the developing world (International Cement Review, 1999).

### Mineral Fuels

At yearend 2000, Bolivia's total oil reserves amounted to an estimated 441 Mbbbl of proven resources and an estimated 452 Mbbbl of probable resources (Cámara Boliviana de Hidrocarburos, 2001). Data of petroleum and natural gas reserves correspond to data certified by the international petroleum consultancy firm DeGolyer & McNaughton on January 1, 2001, for 98.4% of the reserves. The remaining percentage corresponds to certifications made by the same firm on January 1, 2000, for Yacimientos Petrolíferos Fiscales Bolivianos (YPFB). National natural gas reserves amounted to 675.1 billion cubic meters of proven resources and 651.0 billion cubic meters of probable resources (Cámara Boliviana de Hidrocarburos, 2001). The data of hydrocarbons reserves of Bolivia were realized by the Vicepresidencia de Negociaciones

Internacionales y Contratos in La Paz on March 23, 2001.

Bolivia, which was self-sufficient in oil, consumed an estimated 39,000 barrels per day in 2000, which was slightly more than it produced in 1999. Almost all crude oil produced in Bolivia was for domestic consumption except for a small amount that was exported to Chile. "In midyear 1999, Bolivia began shipping natural gas to Brazil through the \$2 billion pipeline that extends from Santa Cruz to Campiñas, which is about 100 km from Brazil's eastern coast...Deliveries through the 1,971-km (1,225-mile) system were to reach 4,955 billion cubic meters per day by yearend and continue rising to 17,698 billion cubic meters per day. Deliveries were to exceed 198 billion cubic meters for 20 years" (International Petroleum Encyclopedia, 2000).

In the past 4 years, Bolivia has increased its proven and probable natural gas reserves to about 1,325 billion cubic meters (46.8 trillion cubic feet) in 2000 from about 142 billion cubic meters (5 trillion cubic feet) in 1997 with the possibility of an increase to 1,608 billion cubic meters (56.8 trillion cubic feet) by 2002. The finds gave Bolivia the second largest reserves in the southern part of the area following Venezuela. Of the current reserves, 85% is located in Tarija Department in southern Bolivia. Major operators in the Bolivian gasfields were Petrobras, YPF-Repsol, the Bolivian consortium Andina S.A., Chaco S.A., and British Gas plc. Although these reserves are impressive by world standards, Bolivia will face the challenge of finding a way of getting gas to markets. Including the domestic market and Bolivia's 20-year sales agreements (principally with Brazil), only about 300 billion cubic meters (10.6 trillion cubic feet) of the reserves have been obligated; this has left more than 1,019 billion cubic meters (36 trillion cubic feet) with no apparent market (U.S. Embassy, La Paz, Bolivia, 2001).

### Infrastructure

The transportation network of Bolivia comprised 52,216 km of highways. The Pan-American Highway, which links Argentina and Peru, crosses the country from south to northwest.

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. Puerto Suarez, which is situated along the border with Brazil, may become Bolivia's latest boomtown. Border trade has steadily grown in recent years. In February 1999, construction of the Bolivia-to-Brazil gas pipeline, which runs just a few kilometers from the town, was completed. Local developers were expecting the arrival of a new type of business—large-scale electricity plants. At least four companies have applied to Bolivia's Vice Ministry of Energy and Hydrocarbons with official requests to study the feasibility of exporting electricity to Brazil. The idea was to establish powerplants in border areas, such as Puerto Suarez or Beni Department, and to use natural gas produced in these areas. Brazil's demand for electricity was growing at a rate of 6% per year. This means that an additional 3,750 megawatts (MW) of installed capacity would be required each year, and the hydroelectric potential upon which Brazil relies to meet this demand may not be able to keep pace. "Brazil has a great

deficit of electricity in the works and is thus a very attractive source of demand” (Washington Times, 1999).

This situation presents clear opportunities for exports of electricity to neighbors. Bolivia, for example, has cheap and readily available fuels, such as natural gas (Washington Times, 1999). About 13.5 Mbbbl of crude oil and condensates, 5.6 Mbbbl of refined oil products, and 1.3 billion 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 but the export pipeline to Arica were reversible. Bolivia had an installed electrical generating capacity of 804.5 MW, of which 308 MW (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 (Velasco, 2001).

## 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 investment for the hydrocarbon sector because the volume 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 will include attracting private investment needed for natural gas exploration and development and development of such attendant infrastructure as compression facilities and liquids extraction plants along the pipeline.

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## Major Sources of Information

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## Major Publications

Vice Ministerio de Minería y Metalúrgia: Bulletin Estadístico 2000, Publicación Oficial No. 194.

Asociación Nacional de Mineros Medianos: Memoria e Informe Annual—2000.





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

(Metric tons unless otherwise specified)

Commodity 3/ METALS 4/	1996	1997	1998	1999	2000
<b>Antimony:</b>					
Mine output, Sb content	6,488	5,999	4,735	2,790	1,907
Metal including Sb content of trioxide	4,909	4,136	3,836	2,241	1,285
Arsenic, mine output, arsenic trioxide, arsenic sulfide	255	282	284	437	318
<b>Bismuth:</b>					
Mine output, Bi content	348	684	1,032 r/	708 r/	75 e/
Metal, smelter	28	55	83 r/	57 r/	6
Copper, mine output, Cu content	92	182	48	252	110
Gold, mine output, Au content 5/ kilograms	12,634	13,292	14,444	11,788 r/	12,001
<b>Lead :</b>					
Mine output, Pb content	16,538	18,608	13,848	10,153	9,523
Metal, smelter, primary	102	77	65	45	251
<b>Silver:</b>					
Mine output, Ag content kilograms	384,384	387,200	404,000 r/	422,492	433,592
Refined 6/ do.	70,852	1,112,411	1,157,954	72,195	55,720
Tantalum, tantalite do.	646 e/	727	15,624	8,808	9,443
<b>Tin:</b>					
Mine output, Sn content	14,802	12,898	11,308	12,417	12,464
Metal, smelter	16,733	16,853	11,102	11,166	9,353
Alloys	226	123	160	75	217
Tungsten, mine output, W content	582	513	497	334	382
Zinc, mine output, Zn content	145,092	154,491	152,110	146,316	149,134
<b>INDUSTRIAL MINERALS</b>					
Arsenic trioxide	255	282	284	437	318
Barite	4,745	4,402	2,500	6,005	3,050
Bentonite	69	50	50 e/	50 e/	--
Calcite e/	20	-- r/	-- r/	-- r/	--
Cement, hydraulic	934,303	1,034,800	1,169,000 r/	1,214,000 r/	1,300,000
<b>Gemstone, amethyst:</b>					
Polished kilograms	36	18	21	20 e/	20 e/
Rough do.	238	122	140	314 r/	320
Gypsum, crude	192	20	--	--	--
Marble	242	274	250	468 r/	673
Quartz kilograms	--	39	31 r/	36 r/	--
Salt	273	869	562 r/	688 r/	327
Slate (pizarra)	393	458	484	198 r/	269
Ulexite	9,231	12,309	7,026 r/	6,746 r/	33,951
<b>MINERAL FUELS AND RELATED MATERIALS</b>					
<b>Gas, natural:</b>					
Gross million cubic meters	5,281	5,349	6,756	6,800 e/	15,581 5/
Marketed do.	3,259	3,341	3,426	3,396	3,500 e/
<b>Natural gas liquids: e/</b>					
Natural gasoline thousand 42-gallon barrels	2,456 7/	3,000	3,000	3,000	3,000
Other (consumption) do.	2,450 7/	2,600	2,600	2,600	2,600
<b>Petroleum:</b>					
Crude including condensate do.	10,950	10,585	12,960 r/	11,848 r/	11,466 5/
<b>Refinery products:</b>					
Liquefied petroleum gas do.	602	730	730 r/	730 e/	730 e/
Gasoline do.	3,665	3,650	4,015 r/	4,000 e/	4,020 e/
Jet fuel do.	964	1,095	1,095 r/	1,090 e/	1,100 e/
Kerosene do.	245	365	365 r/	360 e/	365 e/
Distillate fuel oil do.	2,978	2,920	2,920 r/	2,900 e/	2,920 e/
Residual fuel oil do.	183	365	365 r/	360 e/	365 e/
Unspecified do.	4,993	4,015	5,110 r/	5,100 e/	5,110 e/
Total do.	13,630	13,140	14,600 r/	14,540 e/	14,600 e/

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

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

2/ Table includes data available through June 5, 2001.

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/ Includes production of metallic gold.

6/ Includes production of metallic silver.

7/ Reported figure.