

THE MINERAL INDUSTRY OF

CHILE

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The Republic of Chile, which is located in southern South America, bordering the South Atlantic and South Pacific Oceans between Argentina, Bolivia, and Peru, has an area of about 756,950 square kilometers. The country's land boundaries total 6,171 kilometers (km), and its borders are with Argentina (5,150 km), Bolivia (861 km), and Peru (160 km). In 2001, the population was 15,498,930 with a gross domestic product (GDP) of \$153 billion based on 2001 purchasing power parity and per capita GDP of \$10,000 (2001 estimates). Copper remained the country's most important export product and accounted for about 37.2% of export earnings in 2001 (U.S. Central Intelligence Agency, 2002^{§1}).

Chile has a market-oriented economy characterized by a high level of foreign trade. Chile's economy grew by 2.8% in 2001 and was projected to grow by about 3.3% in 2002. Moreover, total public and private investment in the Chilean economy has remained high despite current economic difficulties. The Government recognized the necessity of private investment to boost worker productivity and was encouraging diversification, including such nontraditional exports as fruit, wine, and fish, to reduce the relative importance of traditional exports, such as copper, timber, and other natural resources (U.S. Embassy, Santiago, Chile, 2002). Total foreign direct investment flows into Chile in 2001 grew to \$4.6 billion, up from \$3.6 billion in 2000 but down from \$9.2 billion in 1999.

Chile's economy, which is highly dependent on international trade, recovered with 5.4% growth in 2000, with Asian markets rebounding and copper prices edging up. Unemployment remained in the 8% to 10% range well into the economic recovery. Foreign private investment, however, has developed many new mines, and the private sector now produces more copper than the state-owned Coproración Nacional del Cobre de Chile (CODELCO).

Government Policies and Programs

In February 2001, the Mining Integration and Complementation Treaty between Argentina and Chile was approved by the Chilean Congress. It was the final step towards creating the basic legal framework for mineral exploration and operations that straddle the long border region. The treaty is an important step in improving cooperation between the two countries; it creates the legal framework that permits protocol zones to be defined for each particular project, thus providing freedom of movement within the area defined. Both countries are actively working on the regulations needed to make this treaty operable (Tarbutt, 2002).

¹References that include a section twist (§) are found in the Internet References Cited section.

Environmental Issues

Air pollution in Santiago results in damaging respiratory diseases and a large number of premature deaths. The city sits in the middle of a valley and is surrounded by two mountain ranges—the Andes and the Cordillera de la Costa—so ventilation and dispersion of air pollutants within the valley are restricted. As a result, Santiago, which has emission levels similar to those of other cities, suffers from high levels of atmospheric pollution.

Chile is the world's largest producer of copper, and industrial emissions in Santiago primarily arise from the mining sector and smelter operations. The process of mining contributes a considerable amount of pollutants to both air and water. The smelting process of copper ore alone emits large amounts of arsenic and carbon monoxide into the air and water around the mines. Smelter emissions are also a problem in northern Chile, which is where Chiquicamata, the largest copper mine in the world, is located. CODELCO, which oversees the country's copper mining sector, had to shut down Chuquicamata for an entire month in 1994 as a result of environmental violations caused by excessive fumes from the mine's smelter (U.S. Energy Information Administration, 2002).

Proyecto Alumysa Ltda. (an affiliate of Noranda Inc. of Toronto, Ontario, Canada) announced on August 29 that it had filed an environmental impact study (EIS) with the Environmental National Commission of region XI in southern Chile for the construction of an aluminum reduction plant and its related hydroelectric facilities. The plant will have a capacity of approximately 440,000 metric tons per year (t/yr) of aluminum. The project's EIS must first obtain approval from the Chilean environmental authorities. Then, the participation of one or more investment partners must be secured, and finally, Noranda's board of directors will need to approve a revised feasibility study that incorporates the latest economic and operational data. It is expected to take between 6 and 9 months for the Chilean environmental agency to make a decision on the EIS (Noranda Inc., 2001).

In March, the Government announced the Atmospheric Decontamination and Prevention Plan, which restricted bus travel on Santiago's city streets and the use of leaded gas. Negotiations continued on a United States-Chilean bilateral trade agreement. The environmental component of the agreement, which is required by law, had not been discussed between the two countries at the time of this report. The Office of the U.S. Trade Representative released a report that suggested that environmental degradation associated with forestry and mining was unlikely to increase as a result of a trade agreement. Chile's economy has grown rapidly, and total energy demand was expected to continue to grow by 7% per

year. Air pollution in Santiago was reaching “critical” levels. Chile’s fuel mix was expected to evolve away from petroleum and coal towards natural gas and hydroelectric generation. The challenge in the years ahead will be to find a balance between meeting Chile’s growing energy needs and limiting environmental pollution (U.S. Energy Information Administration, 2002).

Production

In 2001, the Comisión Chilena del Cobre (COCHILCO) reported that Chilean copper production was 4.7 million metric tons (Mt), which was an increase of about 3% compared with that of 2000; about 33.6% of the total, or 1.6 Mt, was produced by CODELCO, and about 66%, by the private sector; Servicio Nacional de Geología y Minería de Chile (SERNAGEOMIN), which was an agency of the Ministry of Mines, reported that gold production in 2001 had decreased by 21% to 42,673 kilograms (kg) and that silver production had increased by 8.9% to 1,349 metric tons (t). Large-scale mining companies contributed 93% of the total copper, followed by the medium- and small-sized mines with 6% and 1%, respectively. Gold production was 47% by the large mines, 47% by the medium-size mines, and 6% by the small mines; silver production was 78% for the large, 21% for the medium, and 1% for the small mines (Servicio Nacional de Geología y Minería, 2001b).

All metal production except gold increased in Chile during 2001; the shortfall in gold production was owing to the continued suspension or closure of processes at the Guanaco and Refugio mines by Kinross Gold Corporation and at the Tambo and El Indio mines by Barrick Gold Corp. Copper mine production increased, in spite of falling head grades and heavy maintenance programs. The increase was owing mainly to Antofagasta Minerals’ El Tesoro Mine coming onstream in April and circuit improvements being completed at Los Pelambres; similar modifications by other companies also contributed to the increase (Tarbutt, 2002).

In 2001, CODELCO’s production of copper was 1.7 Mt (this figure includes the 49% of El Abra’s production that corresponds to CODELCO’s share of that company); the increase in production was 5.4% higher than that in 2000. The higher production came mostly from the Radomiro Tomic expansion. The average ore grade in 2001 was 0.97%, compared with 1.02% in 2000. From 1997 to 2001, the ore grade fell by approximately 15%. In recent years, CODELCO has become a world leader in production and sales of copper byproducts, particularly molybdenum. In 2001, CODELCO produced 24,238 t of molybdenum, which represented 18% of world molybdenum production (Corporación Nacional del Cobre de Chile, 2001).

CODELCO’s total income from copper and byproducts totaled \$3.422 billion in 2001, down \$188 million from 2000. Copper sales totaled \$2.585 billion, down from \$2.742 billion in 2000. Byproduct sales totaled \$283 million, down \$16 million from 2000; molybdenum generated income worth \$122 million, down \$9 million from 2000 because of lower prices. About 90% of copper sales were refined copper, cathodes, and fire refined, with the remainder being nonrefined products (Corporación Nacional del Cobre, 2001).

During 2001, CODELCO’s production was 1.7 Mt of fine copper; this amount was almost equal to that generated in 2000. Total CODELCO production was divided between its five divisions as follows: Chuquicamata produced 641,931 t; El Teniente, 355,600 t; Andina, 253,341 t; Radomiro Tomic, 260,336 t; and Salvador, 81,166 t. El Abra produced 106,604 t. Chuquicamata output was 288 t higher than that of 2000. Of the total refined copper, 1.54 Mt was in the form of cathode from concentrate (Corporación Nacional del Cobre de Chile, 2001c). The five CODELCO divisions accounted for about 35.8% of the 2001 Chilean copper production. In 2001, Radomiro Tomic’s production capacity was boosted to 272,000 t. CODELCO was also a producer of gold (metal doré), molybdenum (trioxide and concentrate), silver, and sulfuric acid (Corporación Nacional del Cobre de Chile, 2001d).

Trade

Chile’s economy is highly dependent on international trade. In 2001, exports decreased to \$17.4 billion from \$18.2 billion in 2000, and imports decreased to \$15.9 billion from \$16.7 billion the previous year. Exports accounted for about 25% of GDP. Traditionally, copper has accounted for a large part of Chile’s economy; CODELCO is the world’s largest copper-producing company (U.S. Embassy, Santiago, Chile, 2002).

Structure of the Mineral Industry

The Chilean Government, through the Ministry of Mines, exercised control of the mineral industry through three large state-owned mining companies and four regulatory agencies. The mining companies were CODELCO, Empresa Nacional de Minería (ENAMI), and Corporación de Fomento de la Producción (CORFO). The subsidiaries of CORFO included Cía. de Acero del Pacífico S.A. Empresa Nacional del Petróleo S.A., Empresa Nacional del Carbón S.A., Cía. Chilena de Electricidad, S.A., and Sociedad Química y Minera de Chile, S.A. (SQM). The four regulatory agencies were SERNAGEOMIN, COCHILCO, the Foreign Investment Committee, and Comisión Nacional del Medio Ambiente (CONAMA).

Chile’s state mining company ENAMI was trying to sell its 10% stake in the Quebrada Blanca copper mine, which it owned in conjunction with local group Minera Pudahuel (13.5%) and Canada’s Aur Resources (76.5%). Quebrada Blanca was designed to produce 75,000 t/yr of copper cathode. Pudahuel (controlled by Chile’s Cruzat group) had an option to acquire an additional 9.5% from Aur by the end of 2001. Pudahuel obtained its share in Quebrada Blanca, which was previously operated by Vancouver, British Columbia, Canada-based Teck Cominco, by providing the leaching technology for the high altitude mine. ENAMI had its 10% share by virtue of the fact that it originally held the property, which is in the far north of Chile.

ENAMI also wanted to sell its 10% interest in the Carmen de Andacollo copper mine in north-central Chile, which was 63% owned and operated by Aur. Compañía Acero del Pacífico (CAP) held the other 27% of Andacollo, which produced about 22,000 t/yr of copper cathode. CAP was also looking to sell its

stake in Andacollo. In addition, ENAMI wanted to sell its 10% stake in the Altamira Mine, which was 90% owned by Pudahuel. Altamira was not in operation in 2001. ENAMI also operated the Ventanas copper smelter and refinery (Metals & Minerals Latin America, 2001e).

In 2001, the mineral industry employed 47,518 people, which included staff and office personnel who worked directly for the minerals sector. The metal sector employed about 39,909 workers; the industrial minerals sector, 5,042 miners; and the mineral fuel sector, 2,567 workers, which included 1,005 coal miners and 1,562 oil workers. Copper mining employed 34,277 workers, or about 72% of the mineral industry. The large-scale copper mining industry employed 28,812 miners; the medium-scale mining industry, 3,345; and the small-scale mining industry, 2,120 (Servicio Nacional de Geología y Minería, 2001a).

Commodity Review

Metals

Aluminum.—Approval of the EIS for Noranda's \$2.75 billion, 440,000-t/yr Alumysa aluminum project in southern Chile was not expected until 2002. Environmental groups have joined forces with salmon farmers and tourism companies, among others, in objecting to Alumysa, which would be along one of Chile's fjords. November 22, 2001, was the last day for the public and nongovernmental organizations to comment on the study. More than 400 comments were received. Alumysa would need 758 MW of power, which would be supplied by three hydroelectric dams, requiring \$930 million of the total investment. The project would produce aluminum ingots from 846,000 t/yr of imported alumina, that could be imported from Australia, Brazil, or Jamaica (Metals & Minerals Latin America, 2001h).

Copper.—According to CODELCO's annual report, world copper consumption in 2001 fell by 3.4%; it declined by 10.5% in the United States and 13.8% in Japan. Prices fell below \$0.60 per pound. The average annual price of \$0.72 per pound was one of the lowest in the past 100 years. CODELCO posted \$410 million in pretax profits; despite the declining prices, production of copper in Chile increased by 3.0% in 2001 compared with that of 2000. Copper mine production increased by 136,600 t to 4.74 Mt.

Registration of exploration claims, which are maintained by SERNAGEOMIN and have to be renewed every 2 years, showed that the number of valid claims in 2001 dropped to 18,220 from 21,944. Larger companies continued their search for new opportunities. The highlight of the year was at El Morro in region III, where Noranda closed the year by exercising its option with the owner, Metallic Resources of Denver, Colorado, by purchasing \$1 million of Metallic's common stock. This was after establishing an inferred mineral resource of about 410 Mt at 0.61% copper (principally sulphide copper) and 0.56 grams per ton (g/t) gold at a cutoff grade of 0.4% equivalent copper. Noranda can earn a 70% interest in the property by spending \$10 million on exploration and development during 6 years, completing a feasibility study by 2007, and paying an additional \$10 million to Metallic.

Antofagasta Minerals (a subsidiary of London, United Kingdom-listed Antofagasta plc, which is 60% controlled by the Luksic family) has approved a \$24 million expansion at its 60% owned Los Pelambres copper mine in central Chile. The investment would install a new pebble crusher to process intermediate-size ore, thus increasing the processing rate to 114,000 metric tons per day (t/d) from 98,400 t/d in the first 4 months of 2002 and an expected average of 105,000 t/d for 2002 as a whole. The expansion is expected to come onstream in August 2002. The \$1.36 billion open pit mine is expected to produce around 350,000 t of copper in 2002, up from almost 300,000 t/yr in 2001, its first year of commercial operations. Additional expansions under study by Luksic Group could increase the processing rate to 165,000 t/d. All output is in concentrates. Cash costs were reportedly 38.5 cents per pound in the first 4 months of 2001. A consortium of Japanese smelter companies held the other 40% of Los Pelambres.

Antofagasta owns 61% of the El Tesoro Mine in northern Chile. The mine was expected to produce 41,300 t of copper cathodes in 2001, after starting production in April. El Tesoro was planned to produce at full production capacity (6,250 metric tons per month or 75,000 t/yr) by August. Average cash costs were estimated to be 40 cents per pound in the first 5 years of operations. Australia's Ecuatorial Mining held the other 39% of El Tesoro as well as all solvent extraction electrowinning (SX-EW) operations (Metals & Minerals Latin America, 2001a).

Alliance Copper Ltd. (jointly owned by CODELCO and BHP Billiton) was developing technology for bioleaching concentrates, which will facilitate the mining of ore bodies that have a high arsenic content. In 2001, Alliance Copper completed a feasibility study for a prototype plant with a capacity of 20,000 t/yr, using concentrates with 1.8%, 2.5%, and 4% arsenic content. Getting approval to build the plant and testing the technology will require an investment of \$56 million. The plant was expected to start up in the second half of 2003 at the Chuquicamata Mine. CODELCO, CORFO, and the National Science and Technology Research Commission (Conicyt) signed a biomining development agreement (Corporación Nacional del Cobre, 2001).

Exxon Mobil Corp. was seeking a buyer for its Chilean subsidiary Cia. Disputada de Las Condes. Disputada owned the Los Bronces and El Soldado mines and the Chagres smelter, all located in central Chile. Los Bronces is an open pit mine that produced 170,000 t of copper, 3,000 t of molybdenum concentrate, and 12,000 t of electrowon copper cathode in 2000. El Soldado is a combined open pit and underground mine. It produced 66,000 t of copper concentrate and 6,000 t of electrowon copper cathode in 2000. The Chagres smelter produced 108,000 t of blister copper and 31,000 t of copper anode in 2000. A modernization program was expected to increase production to 150,000 t of copper in 2001; 135,000 t would be copper anode. The program was expected to be completed in late 2001 or early 2002. Exxon Mobil said it would continue to own and operate Disputada if an appropriate buyer could not be found (Engineering & Mining Journal, 2001\$).

CODELCO began engineering work at its Gaby and Mansa Mina projects in northern Chile. Gaby had a resource of 400

Mt of copper oxide grading 0.54% copper and was expected to produce between 70,000 t/yr and 120,000 t/yr of cathodes; Mansa Mina contained 500 Mt of sulfides grading more than 1% copper. Both are in Chile's Antofagasta region, where CODELCO operated the 630,000 t/yr Chuquicamata Mine and smelter and the 250,000 t/yr Radomiro Tomic Mine and SX-EW plant (Metals & Minerals Latin America, 2001d).

In 2001, Escondida produced about 800,000 t of copper which was 120,000 t less than in 2000. One of the world's largest copper mines, Escondida's production was more than 6% of the world copper market. Production decreased because of lower grades. Escondida was owned by BHP Billiton (57.5%), Rio Tinto (30%), a Japanese consortium (10%), and the International Finance Corporation (2.5%). Despite low copper prices, Escondida was undertaking a \$1.045 billion Phase-IV expansion, which would increase production to a rate of 1.2 million metric tons per year (Mt/yr) in April 2003. Most of the mine's production was in concentrates, but it also produced about 150,000 t/yr of copper cathode (Metals and Minerals Latin America, 2001f).

Escondida was expected to reach its Phase IV production level by the second quarter of 2004. The project included a new concentrator to increase treatment capacity by 85% to 237,500 t/d. This will compensate for falling grades. The Escondida Norte open pit, 5 kilometers (km) to the north, was completed; the objective was to feed the existing plant via conveyor belt. A prefeasibility study for the low-grade sulfide dump leaching project, valued at \$435 million, was also completed (Tarbutt, 2002).

In early 2002, the new reactor at the Altonorte Smelter was activated. The reactor was part of Altonorte's \$170 million Phase 3 expansion project. The Altonorte copper smelter, which was owned by Noranda and was near Antofagasta in northern Chile, was expected to be completed in early 2003. The expansion would increase concentrate treatment capacity to 820,000 t/yr from 400,000 t/yr, copper production to 290,000 t/yr from 160,000 t/yr, and sulfuric acid production to 700,000 t/yr from 250,000 t/yr. The installation of state-of-the-art equipment will allow the smelter to continue operating in full compliance with Chilean environmental regulations and Noranda's environmental policy. After the expansion is completed, Altonorte will rank as the eighth largest copper smelter in the world (Noranda Inc., 2002).

According to Falconbridge Ltd. officials, the Lomas Bayas copper mine in northern Chile was expected to produce 55,000 t of copper cathodes in 2001, representing an increase of 8% compared with that of 2000 but still below the design capacity of 60,000 t/yr. Falconbridge purchased Lomas Bayas and the adjacent Fortuna de Cobre copper deposit for \$175 million, less debt, from Boliden Mineral AB of Sweden. Falconbridge will invest \$50 million in the Lomas Bayas property to maintain production at 60,000 t/yr. The investment would raise ore production by 15% to 10,000 t/d by mid-2003 (Metals & Minerals Latin America, 2001g).

The Collahuasi Mine had its highest annual production ever at 438,900 t of copper in 2001 and operating cash costs of \$0.38 per pound. In line with the original plan, the Collahuasi officials approved the transition of mining from the Ujina to the Rosario orebody in 2004; however, the related mill expansion

was delayed until market conditions improved. Engineering work continued on the expansion project (Falconbridge Ltd., 2001, p. 4-5).

Gold and Silver.—Production of gold in 2001 reached 42,673 kg, which was 21.2% lower than that of 2000. The silver production derived from the gold and copper mining reached 1.35 million kilograms, which was an 8.6% increase compared with that of 2000 (Commission Chilena del Cobre, 2002).

Barrick announced that its El Indio Mine in northern Chile would finally close in mid-2002, after a 3-year stay of execution. The mine had been expected to close in 1999, but the company has kept it running because new reserves were found through ongoing exploration, and cost-cutting measures allowed cash flows to continue. A Barrick spokesperson indicated that no new exploration would be conducted, and the mine was no longer profitable. Other operations that Barrick planned to conduct included very limited work at its Pascua Lama gold-silver project on the Chilean-Argentine border. Upon completion of the takeover of California-based Homestake, which owned nearly 60% of the Veladero project, Barrick planned to combine Pascua Lama and Veladero into one mining district. Pascua Lama's EIS had already been approved by Chilean regulators, and Argentine approval had been expected in the third quarter of 2001. Barrick suspended construction of Pascua Lama at the end of 2000 because of low precious-metals prices. It had been expected to produce 24,883 to 31,104 kilograms per year (kg/yr) of gold for 20 years for an initial investment of \$1.2 billion, but the mine plan was being revised. The most recent Homestake engineering study for Veladero envisaged gold output of 19,316 kg/yr at an average cash cost of \$117 per ounce for 11.5 years and capital costs of \$608 million (Metals & Minerals Latin America, 2001b).

Iron Ore, Manganese, and Steel.—Chile produced iron ore from the El Algarrobo, Los Colorados, and El Romeral mines, which were owned by Minera del Pacifico S.A. and Mitsubishi Corporation of Japan. In 2001, Chilean iron ore production increased by 1.2% to 8.8 Mt. Cia. Minera del Pacifico owned mining and maritime concessions and industrial and port installations. The main property that had been exploited in 2001 was the Los Colorados east open pit mine, which had been opened in 2000 in the Huasco Valley in region III. It produced 5.4 Mt/yr and replaced the old El Algarrobo pit mine, which was closed in 1998 due to mineral exhaustion.

The Los Colorados iron ore deposit has reserves of 245 Mt with an average grade of 48% iron. The nearby Los Colorados east pit, which is also in region III and supplies iron pre-concentrates to the Huasco Pellets Plant, produced about 1.2 Mt/yr of pellets. Its known reserves amounted to 3.6 Mt with an average iron content of 47.5% and a cutoff grade of 26% iron. Finally, the El Romeral mine in the region IV supplied fines, lumps, and pellets feed to the domestic and foreign markets. Its proven reserves amount to 44.5 Mt with an average iron content of 49.1% and a cutoff grade of 30% iron (Corp. Acero del Pacifico, 2002a§).

Of the total manganese produced in 2001, 62% was by the small companies, and the balance, by the medium-size

companies. The production of steel in Chile decreased to 1.25 Mt, which was 25% lower than that of 2000 (Corp. Acero del Pacifico, 2002b§). During 2001, Manganesos Atacama S.A. produced 31,320 t of manganese, which was a 25% decrease compared with that of 2000. The domestic market bought 23,748 t, and the remainder was bought by the Huachipato smelter in Coquimbo in region IV. In 2001, Huachipato produced 1,975 t of ferromanganese, 153 t of silicon manganese, and 23 t of manganese dioxide.

Zinc and Lead.—During 2001, Chile produced 32,762 t of zinc in concentrate, 4.3% higher than that of the previous year. Lead production likewise reached 1,193 t in 2001, an increase of 52% compared with 2000. Sociedad Minera El Toqui (a subsidiary of the Canadian zinc producer Breakwater Resources Ltd.) operated the El Toqui mine, the largest zinc and lead mine in Chile. The underground mine produced 23,679 t of zinc in the first 9 months of 2001 compared with 23,162 t in the same period in 2000. As a result, total cash costs fell to 36 cents per pound of payable zinc from 45 cents per pound. A new ramp has provided access to reserves in two new zones at El Toqui, and work has started on developing these areas, which will be the main source of feed for the next 3 to 4 years (Metals & Minerals Latin America, 2001c).

Industrial Minerals

Nitrates and Iodine.—SQM was engaged in producing and marketing natural nitrates, iodine, lithium, and sulfates for agricultural and industrial use. The company was producing more than 1.6 Mt/yr at its mining and production facilities in the middle of the arid Atacama Desert (SQM Oceania Pty Ltd., 2002§). Company products are obtained from processing caliche ore in regions I and II and from the brines of the Salar de Atacama in region II. Caliche is extracted from mines in Pedro de Valdivia, Maria Elena, and Pampa Blanca. Sodium nitrate, potassium nitrate, sodium sulfate, and iodine are obtained from the caliche process. The brines of the Salar de Atacama deposit contain high concentrations of lithium, potassium, sulfate, boron, and magnesium. SQM produces potassium chloride, lithium carbonate, potassium sulfate, and boric acid (Sociedad Química y Minera, 2002§).

Atacama Minerals Chile (a subsidiary of the Canadian company Atacama Minerals Corp.) reported that the iodine and sodium-sulfate expansion program at the Aguas Blancas project was underway. Twelve 240,000-t piles of ore were under heap leach and provided feed solution to the iodine plant. Materials were sourced and ordered for a third set of blowout towers, which would provide 50% additional iodine production capacity. The first pair of evaporation ponds to facilitate sodium sulfate production were completed and were operating. Construction of a larger evaporation pond system had started. These ponds were expected to be in operation in 2002. Commercial-scale production of sodium sulfate was scheduled to begin at an initial rate of 50,000 t/yr. Ultimately sodium sulfate production was expected to be expanded in stages to 300,000 t/yr.

During 2001, mining operations at Aguas Blancas focused primarily on the Repasos ore reserves. Plans were being

finalized for the construction of a pilot agitated (mechanical) leach system to establish the optimum parameters for production of the high-grade Virgin ore reserves. In addition to iodine recovery (which would contribute up to a 15% increase in existing iodine revenues), the agitated leach pilot plant will include a sodium sulfate processing circuit. Aguas Blancas was expected to be the largest sodium-sulfate producer in South America (Atacama Minerals Corp., 2002).

Mineral Fuels

Coal.—Bituminous coal output in 2001 was reported by the SERNAGEOMIN to be 0.6 Mt or about 13% more than that in 2000. Chile had a small coal market in which the most important consumers were electric utilities. Domestic coal mines were mainly in regions VIII, X, and XII. The largest coal producers in Chile were the state-owned Empresa Nacional del Carbón S.A. (ENACAR), which was privatized in 1985, and Carbonifera Victoria de Lebu S.A. Coal reserves in Chile were estimated to be 1.3 billion metric tons (Gt) in 1999; the coal was of low quality. Coal production has been decreasing since 1992; the country's largest coal producer was Cia. De Carbones de Chile S.A., which mined subbituminous coal in Pecket near Punta Arenas, which was shut down in 1997. In 2001, coal was produced only in the Lota/Coronel area and in Tierra del Fuego in the extreme southern part of the country. There were only two small coal mines in operation in the country, and much of the coal that was consumed in Chile was imported, mostly from Australia. Coal in Chile was primarily consumed by electric utilities (72%) concentrated mainly in the central part of the country, where 93% of the population lived, and in the northern area associated with mining and mineral refineries; by the steel sector as input to coke ovens (14%); and by other industries (Fossil Energy International, 2002§).

Natural Gas.—The principal natural gas reserves of the country were in the Magallanes Basin in the far south of Chile. Production of natural gas in Chile in 2001 decreased slightly by 0.7% to about 2,700 million cubic meters compared with that of 2000, continuing the declining trend since 1990 (Servicio Nacional de Geología y Minería, 2001c). Chile produced a relatively small amount of natural gas. Following power shortages in the late 1990s when Chile's dependency on hydropower was severely tested by a drought, instead of producing their normal 80% of Chile's energy consumption, its hydroelectric powerplants only produced 20%. Chile's National Energy Commission (CNE) called for increasing the use of natural gas in Chile's energy mix to approximately 43% by 2020. Almost all natural gas consumed in Chile was supplied by Argentine gasfields via four pipelines—the GasAndes pipeline in central Chile; the Gasoducto del Pacifico, which opened in November 1999 and transported 4 billion cubic meters per day over 530 km to southern Chile; and the GasAtacama and Nor Andino pipelines, which connected northern Chile to Argentine sources. Chile's domestic production supplied only a fraction of the natural gas consumed in its cities of Punta Arenas and Puerto Natales. New electricity-generating capacity was beginning to come online that used natural gas as fuel. An increasing number of

industries in Chile had access to natural gas, and there was a program to connect residential users in the cities to the gas transmission system as well. All this resulted in Chile becoming a natural gas importer. Natural gas production and imports in Chile was handled by Chile's state-owned oil producing and refining company Empresa Nacional de Petróleo (ENAP). The country also planned to import natural gas from neighboring countries to the north (Argentina and Bolivia) to supply natural gas for the large mining activities in the north of Chile and, in February 2000, opened discussions with the Government of Bolivia for that purpose (Fossil Energy International, 2002§).

Petroleum.—Chilean production of crude oil sustained a further decrease of 4.93% in 2001 to 1.9 million barrels (Mbbbl). Imports of crude oil were 75 Mbbbl compared with 67.4 Mbbbl in 2000. ENAP planned to focus more on international exploration and production in 2001, in an effort to increase its production to satisfy 30% of the Chilean demand. ENAP's international involvement increased in 2001 through agreements with Latin American neighbors. In November 2000, ENAP's subsidiary Sipetrol and Ecuador's Petroecuador signed an agreement to cooperate in joint ventures in production, exploration, and refining in Ecuador for 2 years. Chilean oil and gas reserves were primarily in the southern part of country and the Magallanes Basin, which was the most hydrocarbon-rich area. There was additional exploration activity underway in Chile, mostly on the island of Tierra del Fuego. About 50% of Chilean crude oil supplies was transported via the 260-mile (418-km) Estenssoro-Pedral (formerly the Transandino) pipeline, which connected Chile's Petrox S.A.'s refinery to the Neuquen Basin in Argentina. There was one additional international oil pipeline into Chile, which connected northern Chile to Bolivian oil sources. Demand nearly doubled during the past decade, while crude oil production had declined by one-half, leading Chile to increase its imports of oil. In 2001, Chile's main sources of imported oil were Gabon, Nigeria, and Venezuela (Fossil Energy International, 2002§).

Infrastructure

Chile had a 6,702-km railway system. Empresa de Ferrocarriles del Estado was the largest Government-owned railway. In the past 11 years, almost no investment has been made in the railways. The railway system served all the important industrial, mining, and agricultural areas from region I (Iquique) to region X (Puerto Montt). The pattern of highways was similar to that of the railways. The road system totaled 79,800 km, of which 11,012 km was paved, and 68,788 km was unpaved. The country had 70 airports with paved runways more than 3,047 km long.

International trade of mineral commodities, chiefly copper and its byproducts, was handled through the ports of Antofagasta, Arica, Chañaral, Coquimbo, Iquique, Puerto Montt, Punta Arenas, San Antonio, San Vicente, Talcahuano, and Valparaíso; they handled almost 60% of the total tonnage.

Chile had 755 km of pipelines for crude petroleum; 785 km, refined products; and 320 km, natural gas. In addition, a 450-km, 41-centimeter-diameter oil pipeline was expected to

transport crude oil from Argentina's Puesto Hernandez oilfields to Chile's Talcahuano terminal in the near future, and a 1,200-km natural gas pipeline between gasfields in Neuquén and Santiago was planned (U.S. Central Intelligence Agency, 2002§).

Outlook

Chile's copper production is set to continue increasing during the next 3 to 4 years as several high-profile mining operations become operational. The development of the El Tesoro and Los Pelambres Mines will see United Kingdom-listed Antofagasta plc become one of the world's leading copper producers.

Falconbridge added to its copper business by purchasing the Lomas Bayas copper mine in northern Chile, increasing its total copper mine output by almost 20% to more than 300,000 t/yr. The acquisition of this property was done in conjunction with Noranda Inc. Global economic activity is expected to remain subdued until the middle of 2002. Markets have improved, especially for copper, following a number of production cuts. The U.S. economy has gained some strength; however, until there is a pickup in industrial production, metal consumption is not expected to increase significantly (Falconbridge Ltd., 2001, p. 11).

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TABLE 1
CHILE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1997	1998	1999	2000	2001	
METALS						
Arsenic trioxide e/	8,350 3/	8,400	8,000	8,000	8,000	
Copper:						
Mine output, Cu content 4/	thousand tons	3,392	3,687	4,391	4,602	4,739
Metal:						
Smelter, primary 5/	do.	1,390	1,403	1,474	1,460	1,503
Refined: 6/						
Fire-refined, primary	do.	881	1,108	1,362	1,373	1,538
Electrolytic	do.	1,236	1,227	1,304	1,296	1,344
Total	do.	2,117	2,335	2,666	2,669	2,882
Gold, mine output, Au content	kilograms	49,459	44,980	48,069 r/	53,983 r/	42,673
Iron and steel:						
Ore and concentrate:						
Gross weight	thousand tons	8,738	9,112	8,345	8,729	8,834
Fe content	do.	5,461	5,694	5,215	5,455	5,520 e/
Metal:						
Pig iron	do.	941	993	1,030	1,024 r/	927
Ferroalloys:						
Ferrochromium e/		2,000 3/	2,000	2,000	2,000	2,000
Ferromanganese		5,517	3,652	2,833	4,011 r/	4,000 e/
Ferromolybdenum		3,157	1,978	2,079	1,454 r/	1,400 e/
Ferrosilicomanganese		3,175	3,921	2,048	1,800 r/	1,800 e/
Ferrosilicon		1,294	1,159	1,000	1,100 e/	1,100 e/
Total		15,143	12,710	9,960	10,365 r/	10,300 e/
Steel, crude 7/	thousand tons	1,167	1,171	1,291	1,352	1,247
Semimanufactures	do.	1,062	1,060	1,303	1,300 e/	1,300 e/
Lead, mine output, Pb content		1,264	337	606	785 r/	1,193
Manganese ore and concentrate:						
Gross weight		63,673	48,931	40,505	41,716	31,320
Fe content		18,147	14,345	11,915	12,474	9,129 e/
Molybdenum:						
Mine output, Mo content		21,339	25,298	27,270 r/	33,639 r/	33,492
Oxides		11,537	13,678	10,000	12,000	8,813
Rhenium, mine output, Re content e/ 8/	kilograms	2,500	2,500	2,400	2,200	2,200
Selenium e/ 8/	do.	49,500	49,000	49,000	40,000	40,000
Silver		1,091	1,340	1,380 r/	1,239 r/	1,347
Zinc, mine output, Zn content		33,934	15,943	32,263	31,402	32,762
INDUSTRIAL MINERALS						
Barite		2,654	1,430	823	1,026	584
Borates, crude, natural (ulexite)		170,605	280,140	324,691	337,966	327,743
Cement, hydraulic	thousand tons	3,735	3,888	3,036	3,491	3,500 e/
Clays:						
Bentonite		717	721	1,104	1,314	1,695
Kaolin		14,238	11,530	4,361	6,445	5,300
Other (unspecified)		14,537	5,040	53,721	23,387	28,330
Diatomite		11,825	14,868	14,477	13,384	22,705
Dolomite		11,840	16,473	20,016	12,506	29,940
Feldspar		3,808	1,460	1,346	2,311	2,867
Gypsum:						
Crude	thousand tons	398	781	886	376	517
Calcined	do.	251	246	188 r/	176 r/	175
Iodine, elemental		7,154	9,722	9,317	10,474	11,355
Lapis lazuli e/	kilograms	118	58 3/	100	100	100
Lime, hydraulic e/	thousand tons	1,000	1,000	1,000	1,000	1,000
Lithium carbonate		24,246	28,377	30,231	35,869	31,320
Nitrogen, natural, crude nitrates:						
Sodium (NaNO ₃)	thousand tons	693	722	751	800	868 e/
Potassium (KNO ₃)	do.	154	160	165	188	204 e/
Total	do.	847	882	916	988	1,072
Phosphate rock (apatite)		12,605	15,065	12,074	12,474	11,511
Pigments, mineral, natural, iron oxide		10,678	10,449	9,992	10,000 e/	10,000 e/
Potash (K ₂ O equivalent)		235,000 r/	280,000 r/	312,000 r/	330,000 r/ e/	390,000 e/

See footnotes at end of table.

TABLE 1--Continued
CHILE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1997	1998	1999	2000	2001
INDUSTRIAL MINERALS--Continued					
Potassium chloride (KCl) e/	80,000	80,000	60,000	55,000	50,000 e/
Pumice, including pozzolan thousand tons	491	912	958	830	785
Quartz, common do.	555	641	491	576	538
Salt, all types do.	5,488	6,207	6,074	5,083	5,989
Sodium compounds, n.e.s., sulfate 9/	64,335	51,928	58,026	56,501	67,760
Sand and gravel, silica e/ thousand tons	300	300	300	300	300
Stone:					
Limestone, calcium carbonate do.	5,618	5,999	5,618	5,395	5,563
Marble	1,248	1,427	828	812	782
Sulfur, byproduct, from smelters and oil refining	768,000	899,000	1,040,000	1,100,000	1,160,000
Talc	3,986	3,772	2,231	2,421	4,177
MINERAL FUELS AND RELATED MATERIALS					
Coal, bituminous and lignite thousand tons	1,415	231 r/	508	504 r/	578
Coke, coke oven do.	350 e/	476 r/	511 r/	500 r/ e/	500
Gas, natural:					
Gross million cubic meters	3,211	3,218	2,957	2,702	2,684
Marketed e/ do.	1,900	1,900	1,900	1,900	1,900
Natural gas liquids: e/					
Natural gasoline thousand 42-gallon barrels	1,100	1,100	1,000	1,000	1,000
Liquefied petroleum gas do.	2,900	2,880	2,000	2,500	2,500
Total do.	4,000	3,980	3,000	3,500	3,500
Petroleum:					
Crude do.	3,076	2,948	2,314	2,050	1,949
Refinery products: e/					
Liquefied petroleum gas do.	5,475 3/	5,350	5,200	5,200	6,265 3/
Gasoline:					
Aviation do.	74 3/	75	80	80	5,384 3/
Motor do.	16,716 3/	16,700	16,700	16,700	17,530 3/
Jet fuel do.	4,380 3/	4,350	4,390	4,390	5,384 3/
Kerosene do.	2,190 3/	2,150	2,250	2,250	1,283 3/
Distillate fuel oil do.	21,900 3/	21,500	21,800	21,800	22,096 3/
Residual fuel oil do.	12,045 3/	12,100	12,200	12,200	12,857 3/
Unspecified do.	4,745 3/	4,650	4,750	4,750	4,221 3/
Total do.	67,525 3/	66,900	67,400	67,400	75,020 3/

e/ Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. r/ Revised.

1/ Table includes data available through August 2002.

2/ In addition to the commodities listed, pyrite is also produced, but available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

4/ Figures are the nonduplicate copper content of ore concentrates, cement copper, slags and minerals, and copper as a byproduct measured at the last stage of processing as reported by Commission Chilena del Cobre. Mine production reported by Servicio Nacional de Geología y Minería was as follows, in thousand metric tons: 1997--3,438; 1998--3,764; 1999--4,422; 2000--4,646 (revised); and 2001--4,766.

5/ Detailed statistics on electrowinning are now available and reported by the International Copper Study Group, Copper Bulletin (May 2002) as follows, in thousand metric tons: 1997--881; 1998--1,108; 1999--1,362; 2000--1,373; and 2001--1,538.

6/ Figures are total refined copper distributed into two classes according to method of refining, fire-refined and electrolytic, which includes electrowon copper refined in Chile, as reported by the Chilean Copper Commission.

7/ Excludes castings.

8/ Rhenium and selenium are produced in Chile, but available information is inadequate to continue making reliable estimates of output levels.

9/ Includes production of natural sodium sulfate and anhydrous sodium sulfate, coproducts of the nitrate industry (salitre).

TABLE 2
CHILE: STRUCTURE OF THE MINERAL INDUSTRY IN 2001

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Coal, bituminous	Empresa Nacional del Carbón S.A. (ENCAR) [Government (100%)]	Three mines (Colico, La Chulita, and Trongol) and a Planta Lota in Lota, Curanilahue in region VIII	82,000.
Do.	Carbonifera Schwagner S.A. [Agencias Universales S.A. (61%); private shareholders (39%)]	Regions X and XII (closed since 1994)	85,000.
Coal, sub-bituminous	Cía. de Carbones de Chile (COCAR) S.A. [Cía. de Petroleos de Chile S.A. (45.05%); International Finance Corp. (IFC) (9.9%); and Inversiones Ultraterra S.A. (45.05%)]	Pecket Coal mine, region XII; open pit mine	340000
Copper	Corporación Nacional del Cobre de Chile (CODELCO) [Government (100%)]	Mines: Of which: Andina Chuquicamata El Teniente Rodomino Tomic Salvador	1,516,000. (258,000). (630,000). (356,000). (191,000). (81,000).
Do.	do.	Smelters: Of which: Chuquicamata El Teniente Salvador	960,000. (460,000). (360,000). (140,000).
Do.	do.	Refineries: Of which: Chuquicamata (oxide) Chuquicamata (sulfide) Salvador	815,000. (600,000). (85,000). (130,000).
Do.	do.	SX-EW plants: 1/ Of which: Chuquicamata (oxide) El Teniente Salvador (oxide 41 and sulfide 24)	197,000. (130,000). (2,000). (65,000).
Do.	do.	Sulfuric acid plants: Of which: Chuquicamata (3 plants) El Teniente	860,000. (830,000). (30,000).
Do.	Cyprus Amax Minerals Co. (51%), CODELCO (49%)	El Abra mine	97,000.
Do.	Empresa Minera de Mantos Blancos S.A. [Anglo-American Corp. (88%); IFC (12%)]	Open pit, flotation/SX-EW plant, Mantos Blancos 1/	80,000.
Do.	do.	Open pit, SX-EW plant, Mantoverde 1/	42,000.
Copper, gold, and silver kilograms	Empresa Minera Escondida Ltda. [BHP Minerals (57.5%), RTZ Corp. plc (30%), Japan Escondida Corp. (10%), IFC (2.5%)]	Escondida open pit, copper mine, and plant Antofagasta, region II	800,000 copper.
Do.	do.	do.	3,300 gold.
Do.	Empresa Nacional de Minería (ENAMI) [Government (100%)]	Taltal, Salado, Matta, Vallenor, Chancado plants	270,000.
Do.	do.	Smelters: Of which: Las Ventanas Paipote	225,000. (145,000). (80,000).
Do.	do.	Las Ventanas refinery	200,000.
Do.	do.	Chancado, Vallenar SX-EW plants 1/	20,000.
Do.	Cía. Contractual Minera Candelaria-Phelps Dodge (80%), Sumitomo Metal Mining Co. Ltd. (15%), Sumitomo Corp. (5%)	Copiapó open pit mine, and concentration plant, region III	137,000 copper.
Do.	kilograms do.	do.	2,500 gold.
Do.	do. do.	do.	30,000 silver.
Do.	do. do.	Mine, 22 kilometers southeast of Copiapó and 9 kilometers south of Tierra Amrilla	2,488 gold.

See footnotes at end of table.

TABLE 2--Continued
CHILE: STRUCTURE OF THE MINERAL INDUSTRY IN 2001

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper, gold, silver--Continued		ExxonMobil Corp.'s Cia. Minera Disputada de Las Condes S.A. [Exxon Minerals Chile (United States) (87%), ENAMI (13%)]	Mines: Of which: El Cobre El Soldado Las Bronces	148,000. (18,000). (60,000). (70,000).
Do.		do.	Chagres smelter	75,000.
Do.		do.	Chagres sulfuric acid plant	100,000.
Do.		do.	Tortolas SX-EW plant 1/	300,000.
Do.	kilograms	Cia. Minera El Indio, Barrick Chile Ltda. (Canada) (82.9%)	El Indio mine and concentration plant, Tambo, Pascua (Nevada), region IV	5,400 gold.
Do.	do.	CODELCO [Government (100%)]	Andina, Chuquicamata, El Salvador, and El Teniente	1,227 copper.
Do. 2/	do.	do.	do.	1,300 gold.
Do. 2/	do.	do.	do.	248 silver.
Do.	do.	Cia. Minera El Bronce de Petorca [private (100%)]	Carmencita 240, Providencia, Santiago	2,700 gold.
Do.	do.	Cia. Minera Mantos de Oro [Placer Dome (50%), TVX (50%)]	Ladera Farellon, Farellon Bajo	18,600 gold.
Do.	do.	do.	do.	358,000 silver.
Iodine		Sociedad Química y Minera de Chile S.A. (subsidiary of CORFO) [private (65%), Government (35%)]	Miraflores 222, Santiago' Santa Elena, Pedro de Valdivia	7,150.
Iron ore		Cia. Minera del Pacifico S.A., El Algarrobo, Los Colorados, region III, and El Romeral, region IV	Pedro Pablo Muñoz 675, La Serena Province	8,400.
Iron ore pellets		do.	El Romeral, El Algarrobo, Los Colorados Mines, region III; and El Romeral Mine, La Serena Province, region IV	5,200,000.
Lead and zinc	kilograms	Soc. Contractual Minera El toqui Ltda. (Breakwater Resources Ltd. of Canada)	Baquedeno 238, Coyahaique, region XI; Doña Rosa	470 gold.
Do.		do.	do.	500,000 zinc.
Lithium carbonte		Soc. Chilena de Litio Ltda. (subsidiary of Cyprus/Amex Minerals Co. of the United States) [private (100%)]	Salar de Atacama, region II	20,000.
Do.		Soc. Minera Salar de Atacama (Minsal S.A.)	Toconao, Atacama	4,200.
Molybdenum 2/		CODELCO [Government (100%)]	Huérfanos 1270, Santiago	25,000.
Natural gas	million cubic feet	ENAP (subsidiary of CORFO) [Government (100%)]	Ahmuda 341, Santiago	4.
Petroleum	thousand barrels	do.	do.	6,500.
Potassium nitrate		do.	Planta María Elena, Iquique Province	250,000.
Silver 2/	kilograms	CODELCO [Government (100%)]	Huérfanos 1270, Santiago, Chile	604,100.
Do.	do.	Cia. Minera San José Ltda., El Indio mine, Barrick Gold Ltd. of Canada (83%)	Barrio Industrial, Alto Pa, Coquimbo	48,000.
Sodium nitrate		do.	Planta Pedro de Valdivia, Pedro de Valdivia Province	600,000.
Steel		Cia. Siderúrgica de Huachipato S.A. (subsidiary of CAP) [private (100%)]	Huérfanos 669, Santiago, Chile	800,000.

1/ SX-EW Solvent extraction-electrowinning.

2/ Byproduct from copper.

TABLE 3
CHILE: MAJOR MINERAL INVESTMENTS FROM 1994 TO 2001 e/

(Million dollars)

Region	Project	Commodity	Owner(s)	Investment	Startup date
I	Cerro Colorado	Copper	Rio Algom Ltd. (Canada)	200	1998
I	Quebrada Blanca (expansion)	Copper cathodes	Cominco Ltd., 47.25%; Teck Corp. Ltd., 29.25%; Soc. Minera Pudahuel Ltda., 13.50%; ENAMI, 10%	373	1998
I	Collahuasi	do.	Falconbridge Ltd. 44%; Minorco Ltd., 44%; Mitsui Consortium, 12%	2,185	1998
II	El Abra	Copper	Cyprus Amax Minerals Co., 51%; Corporación Nacional del Cobre de Chile S.A., 49%	1,800	1997
II	Zaldivar	do.	Placer Dome Inc., 50%; Outokumpu Copper Resources, 50%	600	1995
II	Santa Barbara (expansion)	do.	Mantos Blancos S.A., 51%; Anglo American Corp., 49%	160	1996
II	Lomas Bayas	Copper cathodes	Westmin Resources Ltd.	244	1998
II	Escondida (expansion)	Copper oxides	BHP Minerals (Australia) 57.5%; RTZ, Corp. (United Kingdom), 30%; Mitsubishi Consortium, 10%; International Finance Corp., 2.5%	2,342	1998
II	Spence	Copper	Rio Algom Ltd., 99%; Rio Algom Expl. Inc. (Canada), 1%	500	2003-4
II	Yolanda	Iodine, nitrates	Kap Resources Ltd., Canada	140	1998
II	Minsal	Lithium	Sociedad Química y Minera de Chile S.A.	290	1994
II	Ivan-Zar	do.	Rayrock Yellowknife Resources Inc.	36	1996
II	Fundicion La Negra	Copper	American Barrick, Noranda Inc.	48	1997
II	Fundicion Refimet S.A.	do.	Inver. Mineras del Pacifico, 50%; Barrick, 25.1%; Noranda, 24.8%	100	1999
II	Fundicion Altonorte (expansion)	Blister copper	Noranda Inc. (Canada) (feasibility study)	170	2003
II	La Negra	do.	Noranda Inc. (Canada)	158	2000
II	Tuina	do.	Minera Mahogeny Ltd. Minera Northern	7	TBD
II	La Candelaria	Copper/gold/silver	Phelps Dodge Corp., 80%; Sumitomo Metal Mining, 15%	1,500	1994
II	Sierra Gorda	Copper	Yuma Gold Mines Ltd.	85	TBD
II	Prucobre	do.	Punta del Cobre S.A.	50	2000
II	Aguas Blancas	Copper cathodes	Atacama Minerals/Canada	27	TBD
II	Santa Catalina	do.	Minera Santa Catalina S.A (Chile); Outokumpu of Finland	100	TBD
III	La Candelaria	Copper/gold/silver	Phelps Dodge Corp., 80%; Sumitomo Metal Mining, 15%; Sumitomo Corp., 5%	1,500	1994
III	Manto Verde	do.	Anglo American Corp.; Minorco Ltd.	180	1995
III	El Refugio	do.	Amax Gold Refugio Inc.; Bema Gold Ltd.	130	1996
III	La Coipa	Gold/silver	Placer Dome Inc. Ltd.; TVX Gold Inc.; Cia. Minera Mantos de Oro	400	1994
III	Nevada.	Gold	Cia. Minera San José Inc. (American Barrick)	168	1997
III	Aldebarán	do.	Placer Dome Inc.	800	1997
III	Chimberos	Silver	Placer Dome Inc.; TVX Gold Inc. (Canada)	30	1998
III	Pascua	Gold/silver	Barrick Gold Corp. (Canada)	950	TBD
III	Cerro Casale	Copper/gold	Placer Dome Ltd. Arizona Star Resources Bema Gold, Canada	1,330	TBD
III	Lobo Marte	do.	do.	300	TBD
III	Los Colorados	Iron ore	Mitsubishi Consortium (Japan)	100	1998
III	Radomiro Tomic	Copper	Division Radomiro Tomic-CODELCO., 100%	171	2000
III	Atacama Kozan	do.	Grupo Errazuris/Chile, Nittetsu/Japan	130	2002-3
IV	Los Pelambres (expansion)	do.	Luksic Group; Mitsubishi Corp.; Mitsubishi Materials; Nippon Mining and Metals Co.Ltd.; Marubeni; and Mitsui Consortium	1,307	1999
IV	Tesoro	do.	Luksic Group of Chile, 69%; Equatorial Mining, 31%	300	2001
IV	Andacollo Oro	Gold	Andacollo Gold Inc., La Serena Inc.	50	1996
IV	Tambo (expansion)	do.	Cia. Minera San José Inc. (American Barrick)	105	1995
IV	Quebrada de Pascua	do.	Quebrada de Pascua	300	TBD
IV	Andacollo Cobre	Copper	ENAMI (Chile); Tungsten Intenational, Inc. (Canada); Cia. Minera del Pacifico S.A. (Chile)	55	1997
XI	Fachinal	Gold/silver	Coeur d'Alene Mines Corp.	85	1996

e/ Estimated. TBD To be determined.

1/ Potassium and sodium nitrates.