

# THE MINERAL INDUSTRY OF

# CHILE

By Pablo Velasco

In 1999, Chile, which continued to be the top producer and exporter of copper, in terms of volume and value, produced about 35% of the world's mined copper. Copper remained the country's most important export product and accounted for about 37.7% of export earnings in 1999. Chile was also one of the world's significant producers and exporters of potassium nitrate and sodium nitrate and ranked second after Japan in world production of iodine. Chile ranked first in lithium, first in rhenium, and third in molybdenum.

The Chilean economy suffered a sharp recession from November 1998 to late 1999. On average, the profits of companies traded on the Santiago Stock Exchange were down by 40%, and with the economic slowdown, inflation for the year was 2.3% compared with 4.7% in 1998. Unemployment dropped from 11% in midyear 1999 to 9.7% at the end of the fourth quarter. Such products as copper remained strong; copper exports rose an average of 20% in value compared with those of 1998 despite lower prices that prevailed for much of 1999 (U.S. Department of State, 2000).

In 1999, low copper prices severely affected Corporación Nacional del Cobre de Chile (CODELCO) projects. CODELCO was committed to an ambitious corporate modernization plan. Its 1994-99 plan called for a total investment of about \$3.3 billion, which made it possible to implement some very profitable projects. In 1999, this effort required \$356 million, which was down from \$670 million the year before (Corporación Nacional del Cobre de Chile, 1999a).

Chile had a world-renowned, solid, and highly developed mining sector that accounted for 44% of the country's exports during 1999. In fact, this sector's dynamism and 16.2% growth during 1999 kept the economic recession from causing greater consequences. Its principal exporting minerals were copper, which composed 37.7% of the total exports value; gold, 1.9%; iodine, 0.9%; molybdenum, 1.0%; iron, 0.8%; silver, 0.8%; and others, 1.1% (Comisión Chilena del Cobre, 1999b).

## Government Policies and Programs

Chile joined the Asia-Pacific Economic Cooperation Organization in an effort to boost commercial ties to Asian markets. Also, Chile and the European Union (EU) planned to negotiate a trade agreement in the medium term. Chile shared the U.S. interest in negotiating a comprehensive trade agreement between the two countries. This was because the United States was Chile's most important single trading partner and source of foreign investment. In 1995, Chile began negotiations to join the North American Free Trade Agreement (NAFTA). Those talks have been stalled because of political factors in the United States. The U.S. administration planned to introduce legislation in Congress, which, if approved, would

allow negotiations related to Chilean accession to NAFTA or to a bilateral trade agreement with the United States.

A key feature of the Government of Chile's development strategy was a welcoming attitude towards foreign investors, which was embodied in the country's foreign investment law known as Decree Law (DL) 600. DL 600 was promulgated in 1974 and has been made more liberal through frequent revisions. Under this law, foreign investment must be approved by the Government's foreign investment committee. The Law serves as the most significant guideline for foreign investment. Investors choosing not to use DL 600 may invest via the provisions of Chapter XIV of the Central Bank's foreign exchange regulations. Under DL 600, investors sign standardized contracts that give them the right to receive nondiscriminatory treatment, to participate in any form of investment, to hold assets indefinitely, to remit or reinvest earnings immediately and remit capital after 1 year, to opt for either national tax treatment or a guaranteed rate [currently (1999) set at 42%] for the first 10 years of an investment, and to acquire foreign currency at the interbank rate of exchange. Investments of more than \$50 million may qualify for tax concessions. This encouragement to foreign investment, as well as with the country's wealth of natural resources, has led to about \$21.6 billion of foreign investment, which included portfolio investments, in the 5 years ending in 1998 (\$8 billion in 1997 alone). Foreign direct investment has totaled more than \$31.7 billion since 1974, and the flow in 1998 almost surpassed \$6 billion. Foreign investors have purchased many of the assets privatized by the Chilean Government within the last decade. Foreign firms compete on an equal basis in privatization processes. Despite Chile's generally positive attitude toward foreign capital, some restrictions persist. Foreign investors may choose to have their profits taxed at a guaranteed 42% rate for the first 10 years of their investment or at whatever rate applies to local firms, which was 35% on fully distributed earnings in 1999; U.S. and Chilean officials began negotiation of a bilateral tax treaty in June 1999. In the absence of such a treaty, U.S. and Chilean investors can be taxed in both countries, although, in practice, the U.S. Internal Revenue Service usually grants credits for taxes paid in Chile (U.S. Embassy, Santiago, Chile, 1999).

## Environmental Issues

Comisión Nacional del Medio Ambiente (CONAMA) defines Chile's environmental policy, proposes environmental legislation, and develops and maintains the resources necessary for the administration and enforcement of environmental regulations. Comisión Regional del Medio Ambiente, which are regional subsidiaries, authorize pollution prevention and

abatement plans, advise the Ministry of Mining on designing environmental policies and the regulations that implement these policies, diagnose environmental impacts, and develop general environmental objectives and policy responses.

Regulations that implement the Basic Law established equal rights and responsibilities for public and private enterprises. The Government planned to phase in the regulations gradually to minimize disruptions to the economy and to allow time to develop monitoring and enforcement capabilities. The Government promulgated two decrees intended to reduce fixed-source air pollution (including Decree Law 185 of 1991, which regulated sulfur dioxide emissions) and implemented regulations pertaining to the disposal of waste water from mine tailings in coastal zones. It also took some initial steps to contain and eventually to reduce air pollution around Santiago.

In 1999, the low copper prices had an impact on CODELCO. This situation required extraordinary efforts to adjust operations to make them more efficient and to cut costs dramatically so that CODELCO could continue maximum profitability and thus fulfill its mission. From 1994 through 1999, \$727 million was invested in projects related to environmental issues. The amounts allocated to air-decontamination plans and to the control and management of solid and liquid wastes remained in line with the established plan, and CODELCO expect that this would continue unchanged until completion (Corporación Nacional del Cobre de Chile, 1999b).

## Production

In 1999, the Comisión Chilena de Cobre (COCHILCO) reported that Chilean copper production was 4.38 million metric tons (Mt), which was an increase of 18.9% compared with that of 1998; 1.62 Mt, or about 36.9% of the total, was contributed by CODELCO, and the remainder (63.1%), 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 for Chile in 1999 had increased by 6.9% to 48,069 kilograms (kg) and that silver production had increased by about 3% to more than 1.38 million kilograms (Mkg). The medium- and small-sized mines produced 73% of the gold and 53% of the silver in the country followed by the large-sized mines of CODELCO with 27% of the gold and 47% of the silver produced primarily as byproducts of copper operations.

CODELCO also accounted for all the output of molybdenum in the forms of concentrate, molybdenum oxide, ferromolybdenum, and molybdenum trioxide and was a major sulfuric acid producer. In 1999, its molybdenum production reached 27,270 metric tons (t), which made Chile the world's second most important producer after the United States.

The increase in production of copper by the private sector in 1999 established a new benchmark in Chile's historical copper output chiefly because of the startup of five new copper mine projects—El Abra, La Candelaria, Cerro Colorado, La Escondida expansion, and Quebrada Blanca—and the increase in output of the second phase of the copper cathode production from the Minera Michilla project. Production of industrial minerals increased significantly compared with that of 1998 (table 1).

## Trade

Chile remained highly dependent on international trade. The economy has grown for more than a decade, but the previous rapid rate of economic expansion has slowed as the country absorbs the double impact of lower commodity prices and shrinking Asian markets. Foreign investment, which is oriented towards relatively long-term periods, was still substantial. In 1999, total exports reached \$15.3 billion, and imports, \$16.3 billion. Nontraditional exports have grown faster than those of copper and other minerals. In 1999, nontraditional exports accounted for about 59% of export earnings. Chile's export markets were geographically diverse. Asia (\$2.24 billion) and the EU (\$2.27 billion) were the largest regional markets. The United States, which was the largest single market (\$60 million) took in about 17% of Chile's exports (Central Bank of Chile, October 2000, The Central Bank of Chile and the economy, accessed October 24, 2000, via URL <http://www.bcentral.cl>).

Chile signed free trade agreements with Colombia, Ecuador, Mexico, and Venezuela. An association agreement with Mercado Común del Cono Sur [Southern Cone Common Market (Mercosur)] (Argentina, Brazil, Paraguay, and Uruguay) had become effective in October 1996. Chile's 1996 free trade agreement with Canada was modeled largely on NAFTA in anticipation of an eventual trade pact with the United States (U.S. Department of State, written commun., October 1998).

Besides copper, Chile's other minerals exports were ferromolybdenum, gold, iodine, iron ore, iron pellets, lithium carbonate, molybdenum oxide, nitrate, potash, silver, sodium nitrate, and zinc. In 1999, CODELCO shipped 1.7 Mt of fine copper, which was 9% more than was shipped in 1998. Revenues from copper sales by CODELCO were about \$2.3 billion, or \$175 million lower than those of 1998, and the revenues from the sale of byproducts (molybdenum, metal doré, sulfuric acid, and others) reached \$270 million. In the case of molybdenum, which was the main byproduct, sales income reached \$130 million, which was \$8 million less than that of 1998 owing to an 18% drop in prices and a resulting \$28 million less in profit that was partially compensated for by increased shipments. From the total sales of copper, 90% was copper refined (cathodes and fire-refined) products; the remainder was unrefined products (Corporación Nacional del Cobre de Chile, 1999a).

## Structure of the Mineral Industry

The Chilean Government, through the Ministry of Mines, exercised dominant control over 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). Subsidiaries of CORFO included Cía. de Acero del Pacífico S.A. de Inversiones; 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 CONAMA.

CODELCO comprised five divisions—Andina,

Chuquicamata, Rodomiro Tomic, El Salvador, and El Teniente. Sociedad Contractual Minera El Abra was formed in 1994 by CODELCO (49%) and Cyprus El Abra Corporation (51%) with Cyprus Amax Minerals Co. as its guarantor for the development and exploitation of El Abra deposit. Exploitation operations began at the end of 1996. The five CODELCO divisions accounted for about 36.9% of all the 1999 Chilean copper production, which included the 49% output of copper from El Abra. The Rodomiro Tomic operation generated 190,100 t of fine copper. CODELCO was also a producer of gold, metal doré, molybdenum (trioxide, and concentrate), and silver, as well as ammonium perrhenate (rhenium) and sulfuric acid.

ENAMI purchased concentrates of copper, gold, and silver; precipitates and minerals for direct smelting; and copper anodes and blister copper for its smelters and refineries. It served as a market-regulating force by determining rates for minerals and mining products bought from producers in potentially attractive mining zones, provided credit to miners who lacked access to standard sources of financing, facilitated miners' access to banking sources, and provided training and support programs to small-sized miners. ENAMI also produced, sold, and distributed sulfuric acid; participated with private investors in the development of small- and medium-sized mining projects; guarded against potential environmental harm from mining production; and bought ores for flotation and leaching at its own plants.

In 1999, the total labor force in Chile was about 5.4 million—42%, industry and commerce; 40%, agriculture, forestry, and fishing; 17%, construction; and 1%, mining. The mineral industry employed 46,150 which included staff and office personnel working directly for the minerals sector. The metal sector employed about 38,034 workers; the industrial minerals sector, 5,313 miners; and the mineral fuel sector, 2,803, which included 1,181 coal miners and 1,622 oil workers. Copper mining employed about 31,849 workers, or about 82% of the mineral industry this total included its own copper workers and contractors' personnel. The large-scale copper mining industry employed 26,653; miners; the medium-scale mining industry, 3,357; and the small-scale mining industry, 1,839 (Comisión Chilena del Cobre, 1999a).

## Commodity Review

### Metals

**Aluminum.**—Canadian miner Noranda Inc. was to initiate a new round of negotiations with a number of companies potentially interested in its Alumysa aluminum smelter project in the region of Aisen, southern Chile. Noranda's executive vice president said that the current environmental impact study for the project appeared to indicate that difficulties will not be major, although the company is still waiting for a third permit for water rights at Rio Blanco to ensure ample energy supplies.

Noranda's official said that the next phase of the project's development was to establish a consortium of companies to build the \$1 billion 777-megawatt hydroelectric plant at the same time as the smelter. The Alumysa project envisaged a 440-million-metric-ton-per-year (Mt/yr) aluminum smelter that cost \$1.6 billion, as well as the hydroelectric plant, with start-

up not earlier than 2005 (Metals & Minerals Latin America, 1999e).

**Copper.**—Production of copper in Chile increased 18.9% in 1999 as the expansion of CODELCO's Andina Division and the Collahuasi Mine gear up to full production. Additionally, the expanded Los Pelambres Mine placed additional copper into the supply chain. According to Sociedad Nacional de Minería (SONAMI), the private mining sector in Chile increased its output by 25.9% to about 2.9 Mt, following on from a 5.7% rise in 1998 that brought production in the sector up to 2.3 Mt. SONAMI also indicated that CODELCO's production rose by 7.7% to 1.62 Mt of fine copper in 1999. CODELCO officials said the increase was primarily due to the Andina expansion starting up and the Rodomiro Tomic Division reaching full production levels. These figures included 49% of El Abra production, which reflected CODELCO's share in that company. Of the total CODELCO production, the Chuquicamata Division produced 630,000 t; El Teniente, 346,300 t; Andina, 249,300 t; Salvador, 91,700 t; and Rodomiro Tomic, 190,100 t. Chuquicamata was struggling to keep its output levels up; the 1999 figure was 20,000 t lower than that of 1998. Of the total refined copper, 1.4 Mt was in the form of cathode from concentrate, 1.1 Mt was electrowon cathode, and 200,000 t was in the form of fire refined copper (Metals & Minerals Latin America, 1999c).

CODELCO's officials indicated that no new investment projects in 1999 will be approved following the Finance Ministry's decision to cut CODELCO's budget for the year to \$450 million from the \$700 million the company had requested. The two main projects hit by the budget cut were the expansion of the Rodomiro Tomic operation, which would have raised capacity by 70,000 metric tons per year (t/yr) in a \$2 million investment, and the El Teniente development project, which would have boosted output at that division to 500,000 t/yr of contained copper by 2001. An expansion at Chuquicamata and a further expansion at Andina have also been delayed. Expenditures related to environmental improvements took up one-third of the 1999 budget; most were allocated to completing the acid plant access Salvador Division's Potrerillos smelter some 2 years ahead of the original completion date of 2001. Construction was also expected to start on a second acid plant at El Teniente for which a tender will be issued in the near future (Metals & Minerals Latin America, 1999b).

In 1999, optimization began at Rodomiro Tomic Mine, which was scheduled for completion during the first half of 2001, for a production increase of 256,000 t/yr of copper cathode. The \$450 million expansion at the Andina Mine, which was opened in 1999, virtually doubled ore-processing capacity to 64,500 metric tons per day (t/d) from 34,000 t/d and increased concentrate production to 250,000 t/yr. One of the great strengths of this project is the presence of confirmed resources and reserves of 1.5 billion metric tons of ore with an average grade of 0.8%. A third, recently inaugurated project was El Teniente's Esmeralda Mine, which promised benefits similar to Andina's; the investment was \$177 million. Finally, in 1999, CODELCO completed El Salvador Division's \$78 million heap-leaching project, which provided modern infrastructure to process 65 Mt of ore, of which 41 Mt was oxides ores and 24

Mt, sulfide ores (Corporación Nacional del Cobre de Chile, 1999a).

Chile's Minera Escondida's fine copper production rose to 958,520 t in 1999 compared with 867,570 t in 1998. It produced 11,520 t of copper cathodes compared with 5,440 t the previous year. In 1999, gold concentrate production fell to 4,633 kg from 4,652 kg in 1998 (Metals & Minerals Latin America, 2000b).

Noranda Minerals Inc. of Canada planned to resume the expansion of its Altonorte copper smelter and refinery in Chile; this included rebuilding or replacing most of the operation's systems and equipment. The project should include an expanded sulfuric acid plant that will capture more than 90% of the sulfur content of the ore compared with about 85%. A new acid plant will be built, the existing No. 2 plant will be upgraded, and the smaller No. 1 acid plant will be shut down. This will effectively increase sulfuric acid production to 700,000 t/yr from 250,000 t/yr. The 7-year-old smelter at La Negra was about 25 km southeast of the port of Antofagasta. The plant had a workforce of approximately 500 people (Metals & Minerals Latin America, 2000e).

Los Pelambres copper mine was officially opened in April 1999. The giant \$1.36 billion mine operation had been operational since December 1998 and at about 10% above the target for 1999. Los Pelambres shipped 240,000 t of copper concentrates at a grade of about 44% copper in 1998 and expected to produce 300,000 t of contained copper in 1999. The company was also ahead of its total cash costs, which were around \$0.79 per kilogram against a target of just more than \$0.88 per kilogram (Metals & Minerals Latin America, 2000c).

Los Pelambres' construction began in November 1997 to develop the mine and to build the concentrator, the 120-kilometer (km) slurry pipeline to the port, and related facilities. It was completed on October 29, 1998, when the second crushing mill was installed. The ore grades were 0.78% copper and 0.21% molybdenum; the mine ratio was superior to other Chilean copper mines. The company was mining higher ore grades that would have a greater impact on cash flow during the first 10 to 15 years of operation. As mining extends at the pit, the gold and silver content in the ore will rise, as will molybdenum grades. The mine can continue operating even if the snowfall is 2 to 2.5 meters (m) deep (Metals & Minerals Latin America, 2000c).

In 1999, ENAMI refined 309,520 t of copper concentrates, which was an increase of 4.4% compared with 296,603 t of copper in 1998. Last year, ENAMI's activities were largely refining and smelting the output of small and medium miners. Its gold production rose to 5,321 kg, and silver production was 98,364 kg. It had losses of \$23.4 million in 1999 compared with \$17.6 million in 1998. ENAMI's officials indicated, "Our poor results were nonoperational and were due to the high interest of \$24 million we had to pay on our \$441 million debt" (Metals & Minerals Latin America, 2000f).

ENAMI subsidized processing costs for small- and medium-sized mining companies. It was the only state-owned mining company in Chile to have a loss in 1998 (Metals & Minerals Latin America, 2000f).

CODELCO's Andina Division was producing at its expanded

rate some 6 months later than was originally planned. Late last year when the new equipment was switched on at 97.5% completion, the mill had to be halted owing to a fault, which was soon rectified. This did, however, set the expansion back by some months. The new mill at Andina had a throughput capacity of 60,000 t/d and has boosted overall milling capacity at the Division to 65,000 t/d from 34,000 t/d. Fine copper production at the mine, which is located 90 km northeast of Santiago, is set to rise to 260,000 t/yr from 150,000 t/yr, with direct costs a further 8 cents per pound from current levels of 65 cents (Metals & Minerals Latin America, 1999c).

Cia. Minera Doña Inés de Collahuasi was on course to produce about 500,000 t of copper in 1999 after achieving a production level of 244,000 t of fine copper in the first half of 1998. This included 219,000 t of copper in concentrate and 25,318 t of electrowon cathode. The company projected an output of 490,000 t in 1999; this was 6.5% higher than the original target of 460,000 t because of better-than-anticipated ore grades. This has also enabled the company to reduce the production costs forecast in the bankable feasibility study. In the first 6 months of 1999, Collahuasi saw profits of \$30.2 million. Collahuasi, which is 180 km southeast of Iquique in northern Chile, was 44% owned by Anglo American Chile, 44% by Falconbridge Ltd., and 12% by Japanese Mitsui consortium. It came on-stream in 1998 and reached design capacity at the start of 1999 (Metals & Minerals Latin America, 1999d).

**Gold and Silver.**—Production of gold in 1999 reached about 48,069 kg, which was 6.9% higher than that of 1998; the silver production derived from the gold and copper mining reached 1.38 Mkg, which was a 3% increase compared with that of 1998 (Servicio Nacional de Geología y Minería de Chile, 1999).

In 1999, Cia Minera Maricunga, which was a 50-50 joint venture between Kinross Gold Corp. and Bema Gold Corp., produced more than 5,600 kg (180,000 ounces) of fine gold at its Refugio Mine, which is located 120 km east of Copiapo in the Salar de Maricunga zone, Atacama region. Although the figure is higher than that of 1998, it is still less than the earlier 1999 estimate of about 7,200 kg (230,000 ounces). The company did, however, achieve a significant cash cost reduction to \$9 per gram in 1999 from \$12 per gram in 1998 owing to improvements at the operation (Metals & Minerals Latin America, 2000d).

Homestake Mining was awaiting the results of biooxidation tests on the Jerónimo ore at the Agua de la Falda gold mining operation in Chile, which it operated as a 50-50 joint venture with CODELCO. If these prove positive, it was planning to invest some \$50 million between now and 2001 to develop the ore body and to modify the processing plant. Production from Jerónimo was forecast to be 2,900 kilograms per year (Metals & Minerals Latin America, 1999f).

**Iron Ore, Manganese, and Steel.**—In 1999, Chilean iron ore production decreased by 8.4% to 8.3 Mt. In 1997, Cia. Minera del Pacifico S.A. (CMP) began developing the Colorado East open pit at its Los Colorados iron ore deposit. The Colorado East pit produced about 5.4 Mt/yr. The new beneficiation plant began operations in 1998. The nearby Los Colorados pit produced about 1.2 Mt/yr of pellets. The new pit was intended

to be a replacement for the Algarrobo pit, which was closed in 1998. The Huasco pellet plant of Cia. Minera Huasco (CMH) project was a 50-50 joint venture between CMP and Mitsubishi Corp. The 4-Mt/yr Huasco pellet plant, which remained CMP's property, will be leased to CMH. The plant was expected to produce 3.2 Mt/yr of blast furnace pellets and 800,000 t/yr of pellets for direct reduction. Exports of Chilean iron ore in 1999 totaled 2.6 Mt, and iron ore pellets exports were 3.3 Mt compared with those of 1998.

Manganesos Atacama, S.A. (MASA), which was a Swiss-Chilean industrial group and subsidiary of Compañía Aceros del Pacífico, owned iron mines and Chile's largest steel plant, which produced ferromanganese and ferrosilicon alloys, manganese, and steel cones for mills in the Coquimbo plant for the domestic market. The company produced manganese ore at El Corral Quemado and Los Loros Mines in Region IV. During 1999, production of manganese decreased by 17% to 40,505 t compared with that of 1998. Most of the manganese produced by MASA was bought by the Huachipato smelter. The production of steel ingots at Huachipato amounted to 1.18 Mt, which was 0.8% higher than that of 1998.

**Zinc and Lead.**—The largest zinc and lead mine in Chile was El Toqui Mine, which was owned and operated by Breakwater Resources Ltd. of Canada and is near Coihaique in southern Chile. Breakwater bought El Toqui from Barrick Gold Ltd. in 1997. Breakwater closed the mill temporarily in September 1998 to make modifications at an estimated cost of \$2.6 million; mine development continued during this period. Subject resulted in the stockpiling of 103,000 t of broken ore, equivalent to about 3 months of production. Zinc production costs have been lowered owing to the modifications in the processing facilities and mining combined with the new ship-loading facilities at the port of Chacabuco. Breakwater said that such modifications would reduce cash operating costs to about \$0.99 per kilogram compared with an average of \$1.21 per kilogram in the first half of 1998 and would cut the workforce by about 13% (Metals & Minerals Latin America, 1999a).

Breakwater won a public tender for an exploration concession with a purchase option in the southern Chilean region of Aisén. CORFO tendered properties that covered 7,271 hectares in the Lago General Carrera and the Puerto Sanchez-Cristal areas, some 250 km south of Breakwater's El Toqui. An estimated 2 Mt of high-grade zinc, related base metals, and silver ore has been extracted since the 1930's. The mineralization was mainly skarn and replacement deposits of volcanic origin. Sociedad Minera El Toqui will pay \$25,000 for exploration rights and would have 33 months in which to exercise the purchase option at a price of \$200,000 plus a 2% net smelter royalty up to a total of \$2 million. Minera El Toqui also owned the Doña Rosa Mine, which had an annual zinc ore production of 500,000 t (Metals & Minerals Latin America, 2000a).

### **Industrial Minerals**

Chilean nitrate producer Minera Yolanda S.C.M. applied to the civil courts in Santiago to be taken into receivership in an effort to resolve the financial problems that caused the company to halt operations in December 1998. Refinancing of the

company or any orderly sale of assets would prevent total liquidation. Yolanda, which was a subsidiary of Canada's Kap Resources and Yukon Ltd., laid off 150 of its 180 workers and retrained just enough staff to keep the mine and plant on care and maintenance. Kap held talks with its principal creditor group led by Interinvestment Corp. of the United States, which was also shareholder in Yolanda. Negotiations should be complete by the end of 1999 officials said. Yolanda's targeted production in 1999 was 160,000 t of potassium nitrate, 75,000 t of sodium nitrate, and 290 t of iodine, thus making it the world's third-largest producer of potassium nitrate. Some \$60 million was invested in the mine and plant construction (Metals & Minerals Latin America, 1999g).

### **Mineral Fuels**

**Coal.**—In 1999, bituminous coal output was reported by SERNAGEOMIN to be 508,000 t, or 120% more than that of the previous year. The Chilean Government has encouraged greater domestic coal production as a means of reducing the dependence on petroleum. Chile, with a population of more than 15.1 million, has a small coal market in which the most important consumers were electric utilities. Demand for electricity was concentrated in the central part of the country where 93% of the population lived and in the northern area associated with mining and minerals refineries. The largest coal producer in Chile was Cia. de Carbones de Chile S.A. (COCAR), which strip-mined subbituminous coal in Pecket, near Punta Arenas, and was also developing the Isla Riesco coal project. In 1999, production from the Pecket Mine was about 67% of the total. Although COCAR had a long-term contract with CODELCO to supply CODELCO's Tocopilla powerplant with 850,000 t/yr, Tocopilla was taking all Pecket's output.

Empresa Nacional del Carbon S.A. (ENACAR), which was the second largest coal producer in Chile, operated three mines and a plant in the Lota/Curanilahue area of Region VIII. It received financing not only through stocks, but also directly from the Government. The continued capital flow from the state was, however, conditional. ENACAR proved the existence of 2.5 Mt of coal at the end of 1996.

**Natural Gas.**—The principal natural gas reserves of the country are in the Magallanes Basin in the far south of Chile. In 1999, natural gas production decreased by 8.1% to 2.96 billion cubic meters, which continued the declining trend that began in 1990.

The country's energy matrix will shift in the near future—natural gas will largely replace coal. To that end, three pipelines will be added to the existing Methanex and Gas Andes lines. When completed, the Gas Atacama, the Nor Andino, and the Pacifico pipelines will import gas from neighboring Argentina. The Gas Atacama line, which was owned by CMS Energy (40%), Empresa Nacional de Electricidad S.A. (40%), and Pluspetrol (20%) began operation in July 1999, thereby beating the rival Nor Andino pipeline in a well-publicized race (World Oil, 1998).

In exploration, Evergreen Resources Inc. of Denver had a 75% stake (the Government had the remainder) in two 1.2-million-acre blocks in northern Chile. Evergreen will begin

seismic operations in 1999 and exploratory drilling in 2001. The Canadian firm Cordex Petroleum Inc. sold its interest in the Austral Basin of the Magallanes region to Gener S.A., which was a Chilean-based power conglomerate. No exploration was performed on the block (World Oil, 1999).

State firm Empresa Nacional del Petróleo (ENAP's) exploration director indicated that the company was concentrating on exploration of oil between the fields of Magallanes region.

Cardinal Resources Inc. of the United States was seeking partners to join it and ENAP in a planned 300-km seismic program on the 1.2-million-acre block in the northern Tamarugal Basin near Peru. Chile awarded Evergreen Resources two 5,000-square-kilometer blocks in the central and southern part of the Tamarugal Basin. ENAP held 25% interest in the Cardinal and the Evergreen contracts. Cardinal signed a letter of intent and in early 1998 expected to be awarded a 500,000-acre onshore block along the Pacific coast in the Arauco Basin between Valdivia and Concepción. Cardinal planned to pursue coal bed methane there.

ENAP and Cordex Petroleum Inc. of Denver planned to explore a 950,000-acre Austral Basin block. The 35-year contract called for initial 4- and 6-year exploration stages.

The 51-centimeter (cm) Gas Atacama pipeline project was under construction, thus beating two possible competing projects. Numerous supply contacts were signed in recent months that should ensure success when the line opens in spring 1999.

Tierra del Fuego continued to provide Chile's only hydrocarbons production. Work requirement was one well on each concession by 2000 (International Petroleum Encyclopedia, 1999).

**Petroleum.**—Chile must import increasing quantities of oil and gas to satisfy its robust growth. In the past 10 years, oil demand has doubled, and production has declined by two-thirds. As a result, the nation must import most of its oil, 60% of which came from Argentina. The dramatic two decade decline in oil production continued unabated. The waning production trend may accelerate as the Chilean state oil company ENAP cuts spending further. With production running about 7,500 barrels per day (bbl/d) and demand at roughly 200,000 bbl/d, Chile's oil and gas supply will increasingly come from Argentina, as well as the efforts of Sipetrol, which was ENAP's international arm. ENAP planned to privatize this year via a public offering of Sipetrol's shares (World Oil, 1999)

Chilean production of crude oil decreased by 21.5% in 1999 to 2.3 million barrels.

## Infrastructure

Chile had a 6,782-km railway system. The Empresa de Ferrocarriles del Estado was the largest Government-owned railway. In the past 10 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) (U.S. Embassy, Santiago, Chile, 2000).

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; most of the remainder was of secondary quality. The country had 370 airports with paved runways that were more than 3,047 m long.

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

Crude oil, refined products, and natural gas were transported to consumption centers by 785-, 755-, and 320-km pipelines. In addition, a 450-km, 41-cm-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.

NOVA Corp. of Calgary, Canada, and its partners won approval to begin moving Argentine gas to Chile via the \$325 million Gas Andes pipeline. The 463-km-long, 61-cm-diameter line from near Mendoza in north-central Argentina ended in the Santiago outskirts. Early deliveries totaled 1.7 million cubic meters per day (Mm<sup>3</sup>/d) with target volumes of 5.5 Mm<sup>3</sup>/d by yearend and 6.0 Mm<sup>3</sup>/d by 2000 (World Oil, 1998).

## Outlook

The Bilateral Free Trade Agreement between Chile and Canada will eliminate tariffs on most of the \$500 million in goods traded between the two nations. The Canada-Chile Free Trade Agreement included no safeguards against predatory pricing and paved the way for possible expansion of NAFTA; this was a solid stepping stone for getting Chile into NAFTA. On October 1, 1998, Chile became an associated member of Mercosur. Chile still maintains its common external tariff of 11%; Mercosur has an average external tariff of 13%. A mining treaty between Chile and Argentina has been in process since 1997. The presidents of both countries signed in 1997, and the Argentine Chamber of Deputies approved the treaty after it was ratified by the Senate last year. Only one step remains, which is the approval of the Chilean Congress. The agreement, which was approved by Chile's Chamber of Deputies in November 1999, allows companies to explore and exploit mineral deposits along most of the border between the two countries.

Investments in the mining industry were estimated by Chilean Officials to be \$1,100 million in 1999 but were expected to be between \$600 million and \$700 million in 2000; this will be down about 35%, with few projects due to come on-stream.

Chilean mining activities were concentrated in the following mineral groups: coal, copper and its byproducts, industrial minerals, iron and steel, and precious metals. Chile's copper production was expected to grow from 4.4 Mt/yr in 1999 to about 4.6 Mt/yr in 2000; this would be an increase of more than 2.6% and represent more than 38% of world supply. Gold production was projected to increase from about 44,980 kg in 1998 to 55,460 kg in 2000, and silver was projected to increase from 1.34 Mkg in 1998 to about 1.44 Mkg in 2000.

SQM emerged as a large integrated producer of natural nitrates and distributor of industrial chemicals, iodine and

iodine derivatives, lithium carbonate, and specialty fertilizers. The production of bentonite, boric acid, diatomite, nitrates, potassium chloride, potassium sulfate, and sulfuric acid were also expected to increase by significant amounts in 2000.

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## Major Sources of Information

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## Major Publications

- COCHILCO: 1999, Estadísticas del Cobre y otros Minerales.  
CODELCO: 1999, Annual Report.  
SERNAGEOMIN: 1999, Anuario de la Minería de Chile.

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

(Metric tons unless otherwise specified)

Commodity 3/	1995	1996	1997	1998	1999 e/
<b>METALS</b>					
Arsenic trioxide	4,076	8,000 e/	8,350	8,400 e/	8,000
Copper:					
Mine output, Cu content 4/	2,489	3,116	3,392	3,687 r/	4,383 5/
Metal:					
Smelter, primary 6/	1,294	1,356	1,390	1,403	1,474 5/
Refined: 7/					
Fire-refined, primary	373	648 r/	881	1,108	1,361 5/
Electrolytic	1,119	1,113	1,236	1,227	1,304 5/
Total	1,492	1,761 r/	2,117	2,335	2,665 5/
Gold, mine output, Au content	44,585	53,174	49,459	44,980	48,069 5/
Iron and steel:					
Ore and concentrate:					
Gross weight	8,432	9,082	8,738	9,112	8,345 5/
Fe content	5,233	5,275	5,437	5,540 e/	5,215 5/
Metal:					
Pig iron	855	996	941	993	996
Ferroalloys:					
Ferrochromium	2,730	2,079	2,000	2,000 e/	2,000
Ferromanganese	7,987	8,498	5,517	3,652 r/	3,700
Ferromolybdenum	3,241	4,222	3,157	1,978 r/	2,000
Ferrosilicomanganese	1,617	1,599	3,175	3,921 r/	3,950
Ferrosilicon	4,279	4,650	1,294	1,159 r/	1,160
Total	19,854	21,048	15,143	12,710 r/	12,800
Steel, crude 8/	1,014	1,178 r/	1,167	1,171	1,180
Semimanufactures	886	1,095	1,062	1,060 r/	1,080
Lead, mine output, Pb content	944	1,374	1,264	337	170
Manganese ore and concentrate:					
Gross weight	70,449	62,887	63,673	48,931	40,505 5/
Fe content	20,188	18,277 r/	18,147 r/	14,345 r/	11,915 5/
Molybdenum:					
Mine output, Mo content	17,889	17,415	21,339	25,298	27,270 5/
Oxides	9,672	9,416 r/	11,537 r/	13,678 r/	14,057 5/
Rhenium, mine output, Re content e/	2,628 5/	2,600	2,500	2,500	2,400
Selenium e/	51,000	50,000	49,500	49,000	4,900
Silver	1,041	1,147	1,091	1,340	1,381 5/
Zinc, mine output, Zn content	35,403	36,004	33,934	15,943	32,263 5/
<b>INDUSTRIAL MINERALS</b>					
Barite	3,080	2,559	2,654	1,430 r/	1,520
Borates, crude, natural (ulexite)	211,312	149,008	170,605	280,140	200,000
Cement, hydraulic	3,275	3,634	3,735	3,888 r/	3,100
Calcite (chalk) e/	6,300	6,300	6,200	6,250	6,000
Clays:					
Bentonite	684	1,191	717	721 e/	725
Kaolin	10,845	13,452	14,238	11,530 r/	11,600
Other ( unspecified)	28,725	18,462	14,537	5,040 r/	5,500
Diatomite	11,451	11,592	11,825	14,868	12,000
Dolomite	4,631	2,569	11,840	16,473	16,500
Feldspar	7,293	3,702	3,808	1,460	1,500
Gypsum:					
Crude	464	520	398	781	785
Calcined	203	243 r/	251 r/	246 r/	250
Iodine, elemental	5,103	5,514	7,154	9,722 r/	9,800
Lapis lazuli	190	150	118 e/	58	100
Lime, hydraulic	1,006	1,050	1,000 e/	1,000 e/	1,000
Lithium carbonate	12,943	14,180	24,246	28,377 r/	28,000
Nitrogen, natural, crude nitrates:					
Sodium (NaNO <sub>3</sub> )	732 e/	662	693 e/	722	737
Potassium (KNO <sub>3</sub> )	163 e/	147	154 e/	160	163
Total	895 e/	809	847 e/	882	900
Phosphate rock (apatite)	12,164	17,356	12,605	15,065	15,000
Pigments, mineral, natural, iron oxide	16,451	18,821	10,778 r/	10,449	10,500

See footnotes at end of table.



TABLE 1--Continued  
CHILE: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/	1995	1996	1997	1998	1999 e/	
<b>INDUSTRIAL MINERALS--Continued</b>						
Potash (K <sub>2</sub> O) equivalent) e/	52,100	180,000	150,000	100,000	50,000	
Potassium chloride (KCl) e/	84,290 5/	80,000	80,000	80,000	60,000	
Pumice, including pozzolan	thousand tons	460 r/	500	491	912	600
Quartz, common	do.	598	583	555	641	600
Salt, all types	do.	3,494	4,043	5,488	6,207	6,400
Sodium compounds, n.e.s., sulfate 9/		50,718	44,345	64,335	51,928	55,000
Sand and gravel (silica) e/	thousand tons	300	300	300	300	300
<b>Stone:</b>						
Limestone (calcium carbonate)	do.	5,912	6,009	5,618	5,999	4,325 5/
Marble		5,908	401	1,248	1,427	1,400
Sulfur, byproduct, from smelters and oil refining		588,000 r/	587,000 r/	768,000 r/	899,000 r/	700,000
Talc		4,107	4,276	3,986	3,772	3,800
<b>MINERAL FUELS AND RELATED MATERIALS</b>						
Coal, bituminous and lignite	thousand tons	1,485	1,444	1,413	231	508
Coke, coke oven e/	do.	350	350	350	350	350
<b>Gas, natural:</b>						
Gross	million cubic meters	3,783	3,632	3,211	3,218 r/	2,957 5/
Marketed	do.	1,860	1,911	1,900 e/	1,900 e/	1,900
<b>Natural gas liquids: e/</b>						
Natural gasoline	thousand 42-gallon barrels	970 5/	1,000	1,100	1,100	1,000
Liquefied petroleum gas	do.	2,810 5/	2,800	2,900	2,880	2,000
Total	do.	3,780 5/	3,800	4,000	3,980	3,000
<b>Petroleum:</b>						
Crude	do.	4,015 r/	3,285 r/	2,555 r/	2,948	2,314 5/
<b>Refinery products:</b>						
Liquefied petroleum gas	do.	5,351	3,585	5,475 r/	5,350 r/ e/	5,200
<b>Gasoline:</b>						
Aviation	do.	50 e/	83	74	75 e/	80
Motor	do.	14,875	15,744	16,716 r/	16,700 r/ e/	16,700
Jet fuel	do.	2,900	2,744	4,380 r/	4,350 r/ e/	4,390
Kerosene	do.	2,240	2,443	2,190 r/	2,150 r/ e/	2,250
Distillate fuel oil	do.	21,203	20,132	21,900 r/	21,500 r/ e/	21,800
Residual fuel oil	do.	14,753	9,812	12,045 r/	12,100 r/ e/	12,200
Unspecified	do.	1,524	4,715	4,745 r/	4,650 e/	4,750
Total	do.	62,896	59,258	67,525 r/	66,900 r/ e/	67,400

e/ Estimated. r/ Revised.

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

2/ Table includes data available through November 2000.

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

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 Comision Chilena del Cobre. Mine production, in thousand metric tons, reported by Servicio Nacional de Geologia y Minería was as follows: 1995--2,510; 1996--3,144; 1997--3,438; 1998--3,764; and 1999--4,422.

5/ Reported figure.

6/ Detailed statistics on electrowinning are now available and reported by the International Copper Study Group, Copper Bulletin (January 1999), as follows, in thousand metric tons: 1995--372.5; 1996--635.7; 1997--881.0; 1998--1,108.0; and 1999--1,361.0.

7/ 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.

8/ Excludes castings.

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 1999

(Thousand 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. (ENACAR), subsidiary of Corporación de Fomento de la Producción (CORFO) [Government, 40%; private, 60%]	Three mines: Colico, La Chulita, Trongol, and Planta Lota in Lota/Curanihue in region VIII	82.
Do.	Carbonifera Schwagner, S.A. (Agencias Universales S.A., 61%; private shareholders, 39%)	Regions X and XII (closed since 1994)	85.
Do. (subbituminous coal)	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 in region XII (open pit mine)	340.
Copper	Corporación Nacional del Cobre de Chile (CODELCO) (Government, 100%)	Mines:	
		Chuquicamata	630.
		El Teniente	346.
		Andina	249.
		Salvador	92.
		Rodomirol Tomic	190.
Do.	Cyprus Amax Minerals Co. (51%); CODELCO (49%)	El Abra (49% CODELCO)	108.
		Total	1,615.
Do.	CODELCO	Smelters:	
		Chuquicamata	460.
		El Teniente	360.
		El Salvador	140.
		Total	940.
Do.	do.	Refineries	
		Chuquicamata (sulfide)	600.
		Chuquicamata (oxide)	85.
		El Salvador	130.
Do.	do.	SX-EW plants: 1/	
		Chuquicamata (oxide)	130.
		El Salvador (oxide 41 and sulfide 24)	65.
		El Teniente	2.
Do.	do.	Sulfuric acid plants:	
		Chuquicamata (3 plants)	830.
		El Teniente	30.
Do.	Empresa Minera de Mantos Blancos S.A. (Anglo-American Corp., 88%; IFC, 12%)	Plant, Mantos Blancos	90.
Do.	do.	Smelter, Antofagasta	30.
Do.	do.	SX-EW plant, Mantos Blancos 1/	20.
Do.	do.	Sulfuric acid plant:	
		Mantos Blancos (shutdown)	200 Cu.
Do.	Empresa Minera Escondida Ltda. (BHP, 57.5%; RTZ Corp. PLC, 30%; JECO, 10%; IFC, 2.5%)	Escondida, kilometer 135 camino a Socompa, Antofagasta	800 Cu, 3,300 (kg Au).
Copper and gold	Cía. Minera El Indio, El Indio Mine, Barrick Chile Ltda. Barrick Chile Ltda. (82.9%) Canada	Barrio Industrial, Alto Pañuelos, Coquimbo, Region IV	4,400 (kg Au). 45,000 t Cu.
Copper, gold, silver	Empresa Nacional de Minería (ENAMI) (Government, 100%)	Plants:	270.
		Taltal, Salado, Matta, Vallenor Chancado	
Do.	do.	Smelters:	
		Las Ventanas	145.
		Paipote	80.
Do.	do.	Refinery:	
		Las Ventanas	200.
Do.	do.	SX-EW plants: 1/	
		Vallenor, Chancado	20.
Do.	do.	Ventanas sulfuric acid plant:	225.
Do	Cía. Contractual Minera Candelaria-Phelps Dodge (80%) Sumitomo Metal Mining (15%) Sumitomo Corp.(5%)	(Cu, Au, Ag)-Mine región III, Copiapó open pit, concentration plant	137 Cu, 2,500 kg Au. 30,000 kg Ag.
Do.	Exxon's Cía. Minera Disputada de Las Condes, S.A. [Exxon (US), 87%; ENAMI, 13%]	Mines:	
		Las Bronces	70.
		El Soldado	60.
		El Cobre	18.

See footnote at end of table

TABLE 2--Continued  
CHILE: STRUCTURE OF THE MINERAL INDUSTRY IN 1999

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper, gold, silver		Exxon's Cía. Minera Disputada de Las Condes, S.A. [Exxon (US), 87%; ENAMI, 13%]	Smelter, Chagres	75.
Do.		do.	Sulfuric acid plant, Chagres	100.
Do.		do.	SX-EW plant, Tortolas 1/	300.
Do.		Cía. Contractual Minera Candelaria (Phelps Dodge, 80%; Sumitomo Metal Mining, 15%, Sumitomo Corp, 5% )	Mine 22 kilometers SE of Copiapo and 9 kilometers south of Tierra Amarilla	2,488 kg Au.
Gold, copper, silver	kilograms	Cía. Minera El Indio, Barrick Chile Ltda. (82.9%) Canada	El Indio mine, concentration plant, region IV, Tambo and Pascua (Nevada) region IV	5,900 Au, 5,400 Au.
Do.	do.	CODELCO (byproduct from copper) (Government, 100%)	Chuquicamata, El Teniente, El Salvador, and Andina	1,300 Au, 248 Ag, 1,227 Cu.
Gold and silver	do.	Cía. Minera El Bronce de Petorca (private, 100%)	Carmencita 240, Las Condes Santiago	52,700 Au.
Do.	do.	Cia. Minera Mantos de Oro (Placer Dome 50%, TVX Gold 50%)	Ladera Farellon, and Farellon Bajo, region III	8,600 Au, 358,000 Ag.
Iodine	metric tons	Sociedad Química y Minera de Chile, S.A.subsidiary of CORFO (private, 65%; Government, 35%)	Miraflores No. 222, Santiago, Maria Elena, Pedro de Valdivia	7,150 iodine.
Iron ore		Cía 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.	Minas El Romeral, El Algarrobo, Los Colorados, Region III, and El Romeral Region V, La Serena Province	5,200.
Lead and zinc		Soc. Contractual Minera El Toqui Ltda.. (Breakwater Resources Ltd. of Canada)	Baquedeno 238, Coyhaique, XI region Doña Rosa (Zn, Au)	500 Zn, 470 (kg Au).
Lithium carbonate		Soc. Chilena de Litio Ltda. (subsidiary of Cyprus/Amx Minerals Co. of the United States) (private, 100%)	Salar de Atacama, Production of lithium carbonate and potash, region II	20.0.
Do.		Soc. Minera Salar de Atacama (Minsal S.A.)	Toconao Atacama, Chile.	4.2.
Molybdenum (byproduct from copper)		CODELCO (Government, 100%)	Huérfanos 1,270, Santiago	14.4.
Natural gas	million cubic feet	ENAP subsidiary of CORFO (Government, 100%)	Ahumada 341, Santiago	4.0.
Petroleum	million barrels	do.	do.	6.5.
Potassium nitrate		do.	Planta María Elena, Iquique Province	250.
Silver	kilograms	CODELCO-Chile (byproduct from copper)	Huérfanos 1,270, Santiago	604,100 (kg Ag).
Sodium nitrate		do.	Planta Pedro de Valdivia, Pedro de Valdivia Province	600.
Sodium sulfate		do.	Oficina Antofagasta, Anibal Pinto 3,228	70,000.
Steel		Cía. Siderúrgica de Huachipato S.A., CAP subsidiary (private, 100%)	Huérfanos 669, Santiago	800.

1/ Solvent-extraction-electrowinning.

TABLE 3  
CHILE: MAJOR MINERAL INVESTMENTS, 1994-2001 e/

(Million dollars)

Region	Project	Commodity	Owner/s	Investment	Startup date
I	Andina (expansion)	Copper	CODELCO	450	1999
I	Cerro Colorado	do.	Rio Algom Inc. (Canada)	200	1998
I	Quebrada Blanca (expansion)	do.	Cominco Ltd., Teck Corp. Ltd, Soc. Minera Pudahuel Ltda, Empresa Nacional de Minería de Chile (ENAMI)	373	1998
I	Sta. Ines de Collahuasi	Copper cathodes	Falconbridge Ltd. (Canada) and Minorco Plc. (Luxembourg)	1,760	1998
I	Rodomiro Tomic	do.	CODELCO	642	1999
II	El Abra	do.	Cyprus Amax Minerals Co. (51%); Corporación Nacional del Cobre de Chile S.A. (49%)	1,800	1997
II	Zaldivar	do.	Placer Dome Ltd., Outokumpu Copper Resources Chile B.V.	600	1995
II	Santa Barbara (expansion)	do.	Mantos Blancos S.A. and Anglo American Corp.	160	1996
II	Lomas Bayas	do.	Gibraltar Mines Ltd.	300	1998
II	La Escondida (expansion)	Copper oxides	Broken Hill Proprietary Company Ltd., Rio Tinto Zinc Corp., Japan Escondida Corp., and International Finance Corp.	1,393	1999
II	Yolanda	Nitrates/iodine	Cap Resources Ltd. and Yukon Ltd.	89	1997
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	Refimet (smelter)	do.	Inversiones Mineras del Pacifico, Minera Barrick and Noranda Inc.	100	1999
II	Leonor/El Tesoro	do.	Luksic Group of Chile and Equatorial of Australia	230	2000
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	Atacama Kosan	do.	Cía. Minera Cominor S.A.	130	1998
II	Prucobre	do.	Punta del Cobre S.A.	50	2000
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 Ltd., TVX Gold Inc., Cia. Minera Mantos de Oro	400	1994
III	Nevada	Gold	Cía. Minera San José Inc. (American Barrick)	168	1997
III	Aldebarán	do.	Placer Dome Ltd.	800	1997
III	Chimberos	Silver	do.	20	1999
III	Pascua	Gold	Barrick Gold Corp. (Canada)	400	TBD
III	Cerro Casale	do.	Placer Dome Ltd. (Canada)	792	TBD
III	Lobo Marte	do.	do.	300	TBD
III	Los Colorados	Iron ore	Mitsubishi (Japan)	100	1998
IV	Los Pelambres (expansion)	Copper	Luksic Group of Chile and Japanese consortium led by Mitsubishi Corp, Mitsubishi Materials, Nippon Mining Marubeni and Mitsui Corp.	1,307	1999
IV	Andacollo Oro	Gold	Andacollo Gold Inc., La Serena Inc.	50	1996
IV	Tambo (expansion)	do.	Cía. 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 Int. Inc. (Canada), Cia. Minera del Pacifico (Chile)	55	1997
XI	Fachinal	Gold/silver	Coeur d'Alene Mines Corp.	85	1996

e/ Estimated. TBD To be determined.