THE MINERAL INDUSTRY OF

MEXICO

By David B. Doan

In the midst of a gradual recovery from the financial crisis and peso devaluation of late 1994 and in spite of minor political unrest in rural areas of one or two southern States, Mexico's mineral industry marked 1995 as a year in which production of metal ores forged ahead while output of industrial minerals was slowed by the effects of recession. Notwithstanding a fall of nearly 7% in gross domestic product and a plunge of about 50% in the value of the peso against the dollar, Mexico maintained its position of prominence in mineral production, once again leading the world in output of silver among the metals and strontium (celestite) and sodium sulfate among the industrial minerals. Mexico was among the world's top five producers of antimony, (white) arsenic, barite, bismuth, fluorspar, and graphite; beyond these, it was one of the top ten producers of cadmium, copper, gypsum, lead, manganese, molybdenum, salt, sulfur, and zinc. Throughout the Western Hemisphere, only Mexico and Brazil produced manganese in significant quantities.[2] Mexico remained in sixth place in terms of world output of petroleum crude.

Mexico's economic problems began in December, 1994, about a year after ratification of the North American Free Trade Agreement (NAFTA), with a serious financial crisis involving collapse of the peso and, briefly, an almost total loss of international confidence in the country's financial structure. Although recovery of the banking system and the rebuilding of confidence are a separate story, the mining industry performed well in supporting domestic demand, export earnings, and cash- flow into mining's labor sector amidst the sharp drop nationwide in purchasing power.

The notable gains in Mexico's metal mining sector versus the bleak picture in the overall economy arose from several factors, starting with the general improvement in metals prices in world markets. This alone furnished impetus to plans for new mines and expansion of existing production but, simultaneously, the peso devaluation abruptly lowered relative operating costs, including payroll obligations, of all Mexican mines. Valuation of output continued at dollar-denominated prices set by world markets, thus enhancing peso revenues to levels much higher than normal and fostering increased contributions to revenues by exports. Less obviously, but nonetheless significantly, the long program of privatization of mining properties inherited from two previous (1982-88 and 1988-94) administrations bore fruit as former State-owned mines, newly privatized, increased efficiency and realized expanded production at virtually the same operating costs. Furthermore, Mexico's mineral sector received infusions of hard currencies. According to the Mexican Mining Chamber, $1.17 billion[3] was invested in the mining industry during the 1992-94 period. Moreover, the Chamber forecast that at least $5 billion more will be invested during the 1995-2000 period.

Several new projects and specific properties were prominent as invested capital continued to be applied in 1995. In Baja California, Grupo Frisco put $20 million into the opening of a gold project at San Felipe. The company also invested $30 million in a high-grade copper project, called “Mariquita,” in Sonora, and were reviewing a gold-silver project, named “Santa Fe”, in Chiapas. Industrias Penoles S.A. put $70 million into a gold-silver mine in Durango, called “La Cienega,” that began operations during 1995. Grupo Sanluis, after investing $45 million to reopen the old, flooded El Oro gold and silver mine in the State of Mexico, put another $5 million into exploration of the Metates project in Durango, a low-grade gold project with 500 million tons (Mt) of ore reserves. The same company invested $3 million in two gold projects, one at San Martin in Queretaro and the other at Promontorio, in Durango. With operations starting at yearend 1994, San Martin was responsible for the 30% gold production increase of Grupo Sanluis. Other prospects, particularly gold and copper, were being explored by Mexican and foreign mining enterprises.

Government Policies and Programs

Priority continued to be given to Government privatization efforts that began in the last part of the 1980's and that, by 1995, have placed almost all former State-owned mines in private hands.

Under the 1917 Mexican Constitution, minerals were considered to be part of the national patrimony. The Government awarded concessions for exploration and exploitation of nonfuel minerals. In most cases, foreign participation in the nonfuel mineral sector was limited to no more than 49% ownership. The 1961 Mining Law imposed a requirement for a majority Mexican participation, both in equity and management of mining companies. The 1961 law granted a 25-year grace period for “Mexicanization” of the industry, but most companies in the mining industry were Mexican-controlled within 10 years. The 1975 Mining Law

gave the Government even more control over mining activities. The law limited foreign participation to 34% in concessions on national reserves and all projects exploiting certain minerals, such as iron ore and coal. Exploitation of oil and gas, phosphate rock, potassium, sulfur, and uranium was reserved for the Government. In 1990, a regulation issued by the Secretaria de Energia, Minas e Industria Paraestatal (SEMIP), allowed more flexibility in foreign ownership through exploration and production trusts undertaken in keeping with the 1975 Mining Law.

Regulations of the most recent mining law, which became effective in September 1992, as well as the Manual de Servicios al Publico en Materia Minera, (referred to hereafter as "The Mining Law") were published on March 25, 1993, in the official gazette. This law allowed the private sector to play a much larger role in the mining industry as the Government of Mexico privatized State-owned companies, decontrolled its mining reserves, and encouraged domestic investment and foreign participation in the mining industry. The law permitted direct investment, with up to 100% ownership of the capital stock, in exploration works and activities. It also allowed, through a 30-year trust mechanism, up to 100% foreign participation in mine production. The Mining Law provided greater legal security for holders of exploration and exploitation concessions, and allowed private-sector participation in the exploitation of mineral deposits previously considered as priority and strategic within the domain of Government ownership, such as coal, iron, phosphorus, potassium, and sulfur. The Mining Law extended the term of exploitation concessions from 25 to 50 years, renewable for a similar period, while exploration concessions were to be for a nonrenewable 6-year period. It allowed exploration and mining, through competitive bidding, for minerals on the continental shelf and underwater shelves of islands, as well as the seabed and subsoil of the exclusive economic zone extending 200 miles offshore as defined by the Law of the Sea and the United Nations. The only limiting factor of these concessions was that they were nontransferable.

Exploitable substances not covered by The Mining Law included the following:

- Petroleum and solid, liquid, or gaseous hydrocarbons.
- Radioactive minerals.
- Substances contained in suspension or dissolution in subterranean waters, as long as they did not originate from a mineral deposit different from the components [sic] of the land.
- Rocks or the products of their decomposition that could only be utilized for the fabrication of materials for construction or ore destined for such purposes.
- Products derived from the decomposition of the rocks, whose exploitation was performed principally by open pit work.
- Salt that came from salt pits formed by evaporation of brines in river basins.

The Mining Law eliminated the need for concessions for ore preparation plants. Individuals engaged in processing minerals subject to this law would be obligated to inform the Government when their operations began, submit the relevant reports, and comply with the general regulations and specific technical standards in the area of environmental control.

In practical terms The Mining Law brought greater flexibility to the management of mining affairs; eliminated excessive red tape; stimulated small- and medium-scale mining production; and promoted private-sector investment in exploration and mining activities. The beneficial aspects of this law, combined with the 1989 reduction of corporate income tax to 35% and the 1991 elimination of the mineral production tax, have led to an increase in new mining projects. The number of mining claims issued has doubled from 2,000 annually to more than 4,200. The land area covered by mining concessions has increased from 2.8 million to 7.1 million hectares.

Environmental Issues

Although various environmental laws and regulations had been promulgated since 1946, protection of the environment became a priority for the Government of Mexico as population, technology, and mining grew in size or importance. Accordingly, a key element of environmental legislation was passed in 1992 named "The General Law of Ecological Balance and Environmental Protection" or LGEEPA. Environmental responsibilities residing in various Government agencies were transferred to a new Ministry of Environment, Natural Resources, and Fisheries (SEMARNAP), having broad powers. Enforcement of environmental regulations was to be buttressed by the newly formed Environmental Attorney's Office.

Under the new SEMARNAP, mineral exploration and mining required a number of environmental permits and authorizations to conform to the statutes of LGEEPA, starting with a preliminary environmental impact statement for all major activities or projects. Besides an operating license, necessary permits for any mine or plant included water well usage, water discharge, land use, explosives, and hazardous materials handling.

There were also regulations concerning noise, gas and dust emissions, dumps and tailings, storage of oil and fuel, and electrical transformers.

Water discharge regulations were specified in the "National Water Law" of December, 1992, and the preceding "Federal Law Concerning Water Rights" (LFDMA) of January 1992. According to LFDMA, water pumped from mining works was not subject to discharge fees, so long as it was not used in the "exploitation and/or metallurgical treatment of ore" or for other industrial or domestic use. In any case, however, discharge fees were required for water containing more than 2,500 milligrams per liter of total dissolved solids, unless the discharged water was able to

meet the minimum quality standards set by the Consejo Nacional de Agua (CONAGUA). Although water discharged to runoffs or water basins was also exempted from payments of discharge fee if it met CONAGUA water quality standards, all other types of water discharge required payment of a fee according to schedules set by LFDMA.

Production

Overall, the production of antimony, barite, celestite, coal, coke, copper, gold, graphite, fluorspar, iron, manganese, molybdenum, and silver increased in 1995, compared with that of 1994, while production of arsenic, bismuth, cadmium, gypsum, lead, and zinc declined. Output of selenium and tungsten, produced as byproducts, had been suspended in 1993 for lack of profitability.

The total value of Mexican mining production in 1995, excluding cement and petroleum, was $3.94 billion, or slightly less than the $4.19 billion of the previous year. The overall loss was attributable solely to the nonmetallic or industrial minerals, whose value of production in 1995 fell from that of 1994 to about $1.4 billion, a drop of $722 million.

The $3.94 billion total for 1995 comprised the following subtotals: nonferrous metals, $1,685 million; nonmetallic (industrial) minerals, $1,380 million; precious metals, $679 million; and manganese plus iron, $192 million. Individually, copper was the most important metal in terms of value ($1,041 million), trailed by zinc ($419 million), with silver following closely ($418 million). Value of produced gold was approximately $251 million.

Gray portland cement was the most valuable nonfuel mineral product in Mexico, but the total value of 1995 output was $2.6 billion, down $1.14 billion from 1994. This reflected the effect of the economic recession on domestic consumption as well as the devaluation, even though domestic cement prices increased approximately 87% in terms of pesos during the year.

In the industrial mineral sector (excluding cement), sand was the most important in terms of value, at $253 million, followed by gravel ($219 million); limestone, excluding that for cement ($113 million); gypsum ($95 million); and marble ($63 million). Petroleos Mexicanos (PEMEX) saw its 1995 production of petroleum crude drop about 2.5% below that of 1994 as the result of hurricane effects on operations offshore. Production of natural gas was less affected, however, and climbed almost 4% compared with the previous year. Output of coal in 1995 rose about 3% over that of 1994. *(See table 1.)*

Trade

Total Mexican exports of goods and services in 1995 amounted to an estimated $79.5 billion, up about one-third from $60.9 billion in 1994, and testifying to the trade advantages of devaluation. Imports totalled $72.2 billion, down from $79.4 billion in 1994 and reflecting diminished business activity during the recession. Approximately 67% of Mexico's mineral exports went to the United States, while more than 60% of its mineral imports were from the United States. Mexico was a major exporter of such metals as copper, lead, manganese, silver, and zinc and such industrial minerals as cement, fluorspar, graphite, gypsum, salt, sodium sulfate, and sulfur.

PEMEX International (PMI), the trading arm of PEMEX, exported approximately 1.3 million barrels per day (Mbbl/d) of crude oil, of which 1.094 Mbbl/d went to the Americas (chiefly the United States), 134,000 barrels per day (bbl/d) went to Europe, and 77,000 bbl/d went to Asia. PMI's trade operations brought in about $7.5 billion to Mexico during 1995.

Mexico has expanded trade with its Latin American neighbors through other free trade agreements, including an agreement with Colombia and Venezuela in 1994. Seeking to expand its economic and trade ties beyond the Americas, Mexico joined the Asia Pacific Economic Cooperation forum in November 1993 and the Organization of Economic Cooperation and Development in April 1994.

After its implementation on January 1, 1994, one impact of NAFTA on the financial sector became apparent in the second half of 1994 when the Mexican Government authorized 51 subsidiaries of U.S. and Canadian financial institutions to operate in Mexico.

Structure of the Mineral Industry

The Government's participation in the mining sector continued to change as more State-owned entities were privatized. In late 1994, a reorganization of SEMIP moved the Direccion de Minas, Comision de Fomento Minero (CFM), the Consejo de Recursos Minerales (CRM), the Fideicomiso de Fomento Minero (FMNM), and the Mining Directorate to the Secretaria de Comercio y Fomento Industrial, known as SECOFI. PEMEX and the Comision Federal de Electricidad remained part of SEMIP, which was renamed The Secretaria de Energia, known simply as SE.

Of these entities transferred, CFM was formed in 1934 to promote mining activity through financial support, technical advice, and assistance to the medium and small mines. It was also responsible for constructing and operating regional mineral processing plants and research facilities. CRM, formed in 1975, was responsible for mineral exploration and statistics. Under The Mining Law, CRM was also given the ability to provide technical assistance, such as reserve verification, to promote further the small- and medium-sized mines. FMNM's function had been to promote the development, mining, and processing of industrial minerals. In 1990, the managements of CFM and FMNMwere merged with research laboratories and assigned to CRM.

The Mining Directorate gained control over mineral

concessions and the national mineral register, plus responsibility for updating and revising mining laws and regulations.

Other organizations within the the Mexican mining community included Cámara Minera de México, widely known as CAMIMEX, which promoted the interests of the mining industry as well as dialogue between the Government and the private industry. The trade union, Sindicato Nacional de Trabajadores Mineros, Metalurgicos y Similares de la Republica Mexicana, represented nearly all the mine workers in Mexico. The cement industry union was controlled by the Confederacion de Trabajadores de Mexico, or CTM, the largest Mexican labor union. In 1995, direct employment in the mining sector was 210,000 workers, compared to 175,000 in 1994.

Five large and diversified private-sector companies dominated the production of nonfuel minerals, as shown in table 2. These were Corporacion Industrial Sanluis S.A. de C.V. (Sanluis); Empresas Frisco S.A. de C.V. (Frisco); Industrias Penoles S.A. de C.V. (Penoles); Grupo Mexico S.A. de C.V., formed in August 1994 as a result of reorganization of Grupo Industrial Minera Mexico S.A. de C.V. (IMMSA) and its subsidiary Mexico Desarollo Industrial Minero S.A. de C.V.; and the Grupo Acerero del Norte, S.A. de C.V. (GAN). GAN owned Real del Monte y Pachuca, Minera el Baztan, Magistral del Oro, Barita de Sonora, Minera del Norte, Cerro del Mercado, Minera Carbonifera Rio Escondido (MICARE), Minerales Monclova, and two other corporations related to energy and chemicals. The cement industry was dominated by Cementos Mexicanos (CEMEX), Cementos Apasco S.A. (Apasco), and Cementos Cruz Azul S.C.L. (Azul).

Under Article 27 of the Mexican Constitution, the production of crude oil, natural gas, and basic petrochemicals was reserved for the Government through PEMEX, the Government-owned monopoly, through its four subsidiaries:

- Exploracion y Produccion— charged with the exploration and exploitation of oil and natural gas.
- Refinacion— controlled the industrial refining processes, the manufacture of petroleum products, and basic petroleum derivatives and the distribution systems.
- Gas y Petroquimica Basica— managed processing of natural gas, natural-gas liquids, and the production of basic petrochemicals.
- Petroquimica—controlled production of secondary and tertiary petrochemicals.

Each PEMEX subsidiary managed its own budget, planning, operations, and the transport, storage, and sales of its products. Private investment was not allowed in exploration, exploitation, and refining, but was allowed in secondary and tertiary petrochemical operations. In 1995, the implementing regulation of Article 27 was changed to allow private-sector participation in natural gas transmission, distribution, and storage.

At yearend 1995, PEMEX had approximately 135,524 employees in its work force, most of whom were represented by the Petroleum Workers Union. This figure was down from 215,000 in 1989, a peak year, and reflected the various measures undertaken by PEMEX to reduce its costs and improve its efficiency.

A gradual but predictably long-term change in the mining industry of Mexico has been the influx of more than 100 U.S. and Canadian exploration companies, many of which have set up field offices in the Hermosillo area of Sonora.

Commodity Review

Metals

Copper.—In 1995, mine production of copper increased about 9% from that of the year before. Mexicana de Cobre S.A. was the leading producer with 51% of national output, all from its La Caridad mine and its new plant, which started up in midyear, that utilizes solvent extraction and electrolytic deposition (SX-EW). With a capacity of 1.08 million cubic meters (Mm^3), this operation was expected to produce about 21,000 metric tons (t) of cathodes per year.

Mexicana de Cananea S.A.'s Cananea mine was the second greatest producer, followed by the Maria mine, owned by Minera Maria S.A. de C.V., a joint venture between Empresas Frisco S.A. de C.V. (51%) and Cominco Resources International (49%). The newest copper producer in Mexico, the high-grade underground Maria mine started up in late 1990 and achieved full production in 1991. It produced a total of 210,000 t of ore with an average grade of 9% copper during 1992. The 1,000-ton-per-day (t/d) concentrator came on-stream in November 1991. Total copper production amounted to 16,600 t in 1993, 8,600 t in 1994, and 1,730 t in 1995. The Maria mine closed in 1995, to be replaced by a new operation named La Mariquita that was expected to begin production in 1997. These three mines, La Caridad, Cananea, and Maria, all in the State of Sonora, accounted for 87% of Mexico's total production of copper in 1995.

Other significant copper-producing States were, in descending order of output, Zacatecas, Chihuahua, San Luis Potosi, Durango, and Michoacan.

Mexico's 1995 production of refined copper was 2.5% more than that of 1994. The Cobre de Mexico refinery accounted for more than 60% of refined copper production, followed by the Cobre de Pasteje refinery and the one at Mexicana de Cananea. Much of the anode and blister copper produced by Cananea and La Caridad was transported to Mexico City, where it was refined in Cobre de Mexico's electrolytic refinery. In response to the environmental problems of Mexico City, some of this work was transferred to the company's new facility in Celaya, Guanajuato.

Copper reserves in Mexico were as follows: La Caridad had 469 Mt of ore grading 0.53% copper and 0.03% molybdenum for the flotation plant, and 203 Mt of

semioxidized or low-grade ore averaging 0.24% copper for solvent extraction and electrowinning, or SX-EW. Cananea had 1,605 Mt of ore grading 0.61% copper, plus 823 Mt of semioxidized or low-grade ore averaging 0.25% copper. The El Arco project, in Baja California Norte, had 600 Mt grading 0.60% copper.

Gold.—Interest in exploration for gold by both domestic and foreign mining companies increased steadily in Sonora, Baja California, Chihuahua, Durango, Guanajuato, and Sinaloa. After successes in the western region of the United States, some companies found great attraction in the southward extension of the prolific Cordillera and Basin and Range geologic provinces into Mexico. Many of the foreign companies seeking gold established investment trusts that allowed 100% foreign ownership of their exploration efforts in Mexico.

Mine production of gold surged to 20.3 t in 1995, an increase of 43% over 1994 production that was notable in the annals of Mexican gold production. Although world gold prices had more or less stabilized, these prices were high enough above typical efficient mining costs that gross profits of $3,200 to $4,800 per kilogram (kg) were possible. In the more common language of mining companies this translated as $100 to $150 per troy ounce. Most, if not all, gold mines produced silver as their primary product. Sonora was the leading gold producing State, contributing about 33% of the national output. Durango was second with 20%, Guanajuato with 14%, and Baja California with about 14%. Sonora's Cucurpe municipality, which included the Santa Gertrudis mine, owned 49% by U.S.-based Phelps Dodge, increased its gold output in 1995 to more than 2,693 kg.

Newly opened mines accounted for most of the overall expansion of production. At yearend 1993, Minera Hecla's La Choya operation in northwestern Sonora began production at its open pit operation. Eldorado Corp. Ltd.'s La Colorada operation began recovering gold the previous year and, in 1995, produced 1,247 kg. Sanluis began operation at the San Martin project in Queretaro in the last quarter of 1993, and in 1995, was able to produce 488 kg. During 1994, Penoles started the Cienega, a polymetallic underground mine that yielded gold associated with other metals. Other promising projects included the Empresa Minera Can Mex's property at Mulatos, Sonora (owned by Placer Dome of Canada), and Cambior's "Metates" project in Durango. The Promontorio project of Sanluis, in the San Dimas District of Durango, involved the development of richly mineralized veins in the southeast part of the district near the Tayoltita area.

Iron and Steel.—The 1995 production of pig iron jumped 22% compared to the preceding year. Direct-reduced iron (sponge iron) production increased 15%, and crude steel production was up 18%. During 1995, 62.5% of crude steel was produced by electric furnace, while 37.5% was produced by basic oxygen converter. The open hearth process was no longer used in Mexico, which was the second largest steelmaker in Latin America after Brazil, producing about 25% of the Latin American output. Mexico's steel exporters enjoyed the benefit of the abrupt peso devaluation in the financial crisis of December 1994. They prospered throughout 1995 as the result of very competitive lower dollar-denominated prices for their export goods, whose production costs were paid for in pesos. These 1995 exports soared to about 6.3 Mt of semifinished and finished steel products worth $2.7 billion, while Mexico imported 1.1 Mt of semifinished and finished products worth $1 billion. Exports of semifinished and finished products in 1994 had been 2.4 Mt valued at $1.1 billion, while imports of semifinished and finished products in 1994 totalled 3.1 Mt valued at $2.7 billion.

Technological improvements, as in the United States, were resulting in less rather than more semiskilled and unskilled labor in the industry, but enhanced the net return for companies making the changes.

The largest steel producer in 1995 was Altos Hornos de Mexico S.A. (AHMSA), with 3.10 Mt; followed by Hylsa de Mexico S.A. (HYLSA) in Monterrey, 2.47 Mt; IMEXA, previously known as SICARTSA II, 2.26 Mt; and Siderurgica Lazaro Cardenas-Las Truchas S.A. (SICARTSA I), 1.44 Mt; Tubos de Acero de México S.A. (TAMSA), with facilities in Veracruz and headquarters in Mexico City, was the fifth largest producer of crude steel at 0.551 Mt. TAMSA's most important domestic client was PEMEX, for tubular steel. Finally, small-mill production amounted to 2.31 Mt.

Steel industry plans were to invest at least $1.7 billion in the next few years as follows: AHMSA, $400 million; Villacero, $250 million; Ispat, $250 million; HYLSA, $200 million; IMMSA (now Grupo Mexico), $110 million; and the other companies, $490 million.

Lead and Zinc.—Mexico continued as the sixth largest producer in the world of lead and zinc. In 1995, Mexico produced about 5.8% of the world's output of lead and 5.2% of world's output of zinc. Most of this output was associated with the production of silver. The leading producers of lead and zinc were Grupo México (formerly IMMSA), Frisco, and Penoles. The six leading lead and zinc producing States were Chihuahua, Zacatecas, San Luis Potosi, Hidalgo, Durango, and Guerrero.

Not only did firmer 1995 world lead prices reflect increased demand for lead-acid vehicle batteries in many industrialized nations, but Mexico's devaluation made its lead offerings very competitive. All of this resulted in enhanced financial results for the year for Mexico's principal lead producers: Grupo Mexico, Frisco, and Penoles.

The largest lead producer in 1995 was Frisco's Minera Real de Angeles S.A. de C.V. mine in Zacatecas, which turned out 34,800 t of lead, followed by the Cia. Fresnillo

S.A. de C.V. mine in Naica, Chihuahua, which produced 34,000 t of lead. Frisco's other major producer, the San Francisco del Oro mine, near Hidalgo del Parral in Chihuahua, produced 15,800 t of lead.

The Tizapa project in the State of Mexico, a joint venture between Penoles and Dowa Mining Co., aimed to exploit a zinc-silver-lead deposit that initiated production in 1994 at a start-up rate of 700 t/d of ore lifted. A massive sulfide deposit, Tizapa had an estimated 4 Mt of ore grading approximately 8% zinc, 2% lead, and 250 grams per ton (g/t) of silver. The presence of graphite and iron minerals in the ore has led to metallurgical problems causing low recovery rates in processing.

The leading zinc producer was Sombrerete in Zacatecas, owned by Grupo Mexico, which turned out 46,031 t, followed by Frisco's Noria de Angeles in the same State, 40,483 t; Bismark, 34,249 t; Frisco's San Francisco del Oro in Chihuahua, 30,308 t; and Grupo Mexico's Santa Barbara operation in Chihuahua, which produced 24,657 t.

Mexico's largest new mining project, the Bismark zinc mine, started up in mid-1992 near the U.S. border in Ascension, Chihuahua, but its flotation plant did not reach capacity level of 2,500 t/d in 1994. Bismark reported reserves of approximately 8.8 Mt of ore grading 8.5% zinc and 69 g/t silver. Minera Bismark S.A. de C.V. was originally a joint venture between Penoles (40%), Cyprus Minerals (40%), and Promociones Industriales Banamex (20%); but Penoles bought out Cyprus and controlled 80% of the shares.

Silver.—Continuing as the leading producer of silver with 17% of world production, Mexico lifted ore containing 2,496 t of silver from its mines in 1995, representing an increase of 5% over the output of the previous year.

About 85% of Mexico's silver production came from six States: Durango, Chihuahua, Durango, Guanajuato, Hidalgo, Sonora, and Zacatecas. The leading producers in 1995 were Penoles, 937,700 kg; San Luis, 155,000 kg; Frisco, 331,673 kg, of which 262,725 kg came from Real de Angeles Mine; and Grupo Mexico, 666,514 kg. In addition, byproduct silver from Mexicana de Cobre amounted to 77,381 kg, and byproduct silver from Mexicana de Cananea was 17,038 kg. The Fresnillo Mine in Fresnillo, Zacatecas, a joint venture between Penoles (60%) and AMAX (40%), yielded about 631,200 kg of silver in 1995, sustaining its leadership as the largest single producer of silver in the world.

Most Mexican refined silver came from facilities that also refined lead and zinc. The Penoles facility at Torreon, Coahuila, and the Grupo Mexico plant in Chihuahua refined lead concentrates and produced large quantities of silver in the process. Silver was also produced from zinc concentrates at both of these facilities. The Cobre de Mexico refineries in Mexico City and Celaya, Guanajuato, extracted silver electrolytically from copper anodes. Real del Monte in Pachuca has a precious metal refinery that processed silver and gold from the mine's own concentrates as well as concentrates of other mines.

Mexico dramatized the country's silver production by issuing new 10-peso, 20-peso, and 50-peso silver coins in 1993 in a move to monetize and thus support the "new" peso, adopted during the Salinas Administration.

Industrial Minerals

Cement.—Mexican cement production dropped 18% in 1995 to 24 Mt, a decrease due in no small part to the effect of the financial crisis on the construction industry throughout Mexico, but also owing to the effects of U.S. tariffs on exports to the United States. Sales of cement, both domestic and export, were valued at $2.5 billion in 1995. The average consumer cement price in the country was about $126 per ton in 1994 and $106 in 1995. Owing to the devaluation of the peso, the production cost dropped from $41 per ton in 1994 to $29 per ton in 1995. In real terms, gross profit dropped from $85 to $77, or a net decrease of about $8. Even this was a cut of almost 10%, enough to force improvements in efficiency or, possibly, suspension of output.

Traditionally, Mexico has been a large exporter of cement to the United States; however, in 1990 the U.S. Government placed a countervailing duty of about 50% on Mexican cement exports into the United States. In 1992, a dispute settlement panel formed under the auspices of the General Agreement on Tariffs and Trade (GATT) declared that the compensatory duties levied by the United States on cement imported from Mexico were illegal according to the terms of the antidumping code of the GATT and recommended the rebate of deposits paid to that date. Since late 1992, the U.S. and Mexican Governments have negotiated to seek settlement of the dispute.

CEMEX was the leading producer of cement with about 75% of the national installed capacity of about 32 Mt, or 61% of the domestic market. CEMEX was the world's fourth largest cement producer in 1995 and operated 38 cement plants, 387 concrete plants, 27 maritime distribution terminals, and 76 distribution terminals in 22 nations.

In 1992, CEMEX acquired the two most important cement companies in Spain, Valenciana de Cementos and La Auxiliar de la Construccion, which could facilitate the replacement of Mexican exports by Spanish cement exports to the United States.

In 1994, CEMEX acquired two cement plants in the United States, one from Lafarge Coppee of France and the other from Holderbank Financiere Ltd. of Switzerland.

Other Mexican cement producers included Azul, Apasco, and nine other independent producers. Apasco, which was partially owned by Holderbank, was Mexico's second largest cement producer, with six plants, and undertook an expansion program in Ramos Arizpe, Coahuila.

A workers cooperative with two plants, Azul was Mexico's

third largest cement producer. The Chihuahua group built a new plant in Zamlayuca, Chihuahua, and Cementos Moctezuma was expanding its Cuernavaca plant in Morelos. Market share for Mexico's leading cement companies in 1995 were approximately as follows: CEMEX, 61%; Apasco, 21%; Azul, 14%; Cementos Chihuahua, 3%; and others, 1%. Industry analysts expected Mexican cement capacity to increase from 45 Mt in 1995 to 48.6 Mt in 1996, based on expansion plans by CEMEX, Azul, and Apasco, as well as several small producers.

Fluorspar.—Mexican production of fluorspar increased an impressive 60% from 328,000 t in 1994 to 522,000 t in 1995. Of the 1995 total, 252,268 t was metallurgical-grade material and 270,390 t was acid-grade material. Mexico exports 60% to 75% of its fluorspar production, with the United States being the principal customer. Significant quantities of Mexican fluorspar were converted into hydrofluoric acid, most of which was imported also by the United States.

Mexico's most important fluorspar deposits were in the northern State of Coahuila; in Zaragoza municipality of San Luis Potosi; and in the Rio Verde area of Guanajuato. Many lead-zinc-silver veins in Mexico also contain fluorspar, to be recovered as a byproduct of polymetallic deposits in the Hidalgo del Parral, Santa Barbara, and the San Francisco del Oro region of Chihuahua. Mexico's largest fluorspar producer was Minera Las Cuevas near Zaragoza, which produced 13% of the world's fluorspar. Installed capacity was 320,000 tons per year (t/yr) of acid-grade concentrates and 200,000 t/yr of metallurgical grade. Las Cuevas fluorspar has a relatively high arsenic content that limited the use of the material in hydrofluoric acid plants and, thus, export sales. The firm was undergoing a 4-year expansion program to achieve total capacity of 750,000 t/yr of production. Minera Las Cuevas was 51% owned by Mexican nationals and 49% owned by Noranda Inc. of Canada.

Graphite.—Ranking as the largest graphite producer in the world after China, the Republic of Korea, and India, Mexico's production climbed from 30,900 t in 1994 to 34,400 t in 1995, about 98% of which was amorphous graphite.

The center of graphite production in Mexico was southeast of Hermosillo, Sonora, where amorphous graphite was mined from altered coal seams by the largest producers, Grafitera de Sonora and related companies. This group, Grafitos Mexicanos S.A., an affiliate of Cummings Moore Graphite Co. of the United States, accounted for about 78% of the graphite production of Sonora. Other companies producing amorphous graphite were Grafito Superior and Exploradora Sonorense de Grafito.

Grafito de Mexico produced flake (crystalline) graphite at Telixtlahuaca, Oaxaca. This company was privatized in 1989 by having been sold by the Government to Minerales No Metalicos Mexicanos, a mining company specializing in barite, bentonite, kaolin, and phosphate rock. Their plant had an annual capacity of about 2,000 t of flake graphite produced from 50,000 t of ore. Mexico exported one-half of its graphite production to the United States and has supplied about 30% of the U.S. demand for imported graphite in recent years.

Gypsum.—Mexican production of gypsum was about 4.92 Mt in 1995, down 11% from that of 1994. As with other so-called "construction" mineral commodities such as cement, the Mexican financial crisis and devaluation impacted the market for gypsum within the country by discouraging new construction. However, the Mexican gypsum industry retained its export markets as the third largest producer of gypsum in the Western Hemisphere, after the United States and Canada, and as the seventh largest producer in the world.

Most of the gypsum mined was used in the production of wallboard. Other uses were the manufacture of plaster, cement additives to adjust setting time, soil enhancers, glass additives, and as fillers in pharmaceuticals.

The largest gypsum producer in Mexico was Cia. Occidental Mexicana, S.A., a 49%-owned affiliate of Domtar Ltd. of Canada. This operation produced about 2.5 million tons per year (Mt/yr) of crude gypsum at facilities on San Marcos Island, about 40 kilometers (km) southeast of Santa Rosalia, Baja California Sur, in the Gulf of California. Most of this production was shipped to wallboard plants in the Western United States and Canada.

Other important producers included Yeso Mexicano, Yeso Panamericano, and Ciksa, affiliates of USG Inc. of the United States; Yeso Monterrey; and Yeso El Tigre. Yeso Mexicano's capacity was 280,000 t/yr of processed gypsum from its mine and plant at La Borreguita, San Luis Potosi. Yeso Monterrey had a processing capacity of 150,000 t/yr at its mine and plant in Mina, Nuevo Leon. Yeso El Tigre's capacity was 80,000 t/yr from its facilities at Lagunillas de Rayon, Puebla. Another company, Yesera Nazas S.A., had a production capacity of 60,000 t/yr from its plants in Matamoros, Coahuila, and Gómez Palacio, Durango. In 1990, Minera Caopas started production of gypsum at Santa Rosalia, Baja California Sur.

In addition to these producers, Mexican cement companies operated dedicated mines to meet their gypsum requirements, which amounted to approximately 1.44 Mt in 1994, the most recent data point. Gypsum was produced in 16 of Mexico's 31 States.

Sulfur.—PEMEX produced 867,000 t of sulfur as a byproduct of petroleum and natural gas operations in 1995. Sulfuric acid plants at Mexican base metal smelters produced 2.01 Mt of sulfuric acid in 1995, with an estimated sulfur content of 656,000 t.

Two companies with large Government equity participation, Azufrera Panamericana S.A. (APSA) and Compania Exploradora del Istmo S.A. (CEDI), produced 102,000 t of Frasch sulfur in 1993 until October of that year when their plants were closed, a conspicuous decrease of 86% from 1992 production of 710,000 t. The Frasch operations were closed as the result, and it was not clear when or if they would reopen. The Government of Mexico was expected to sell APSA as well as its two-thirds share of CEDI.

Mineral Fuels

Coal.—Production (run-of-mine) of steam and metallurgical coal increased about 3% from that of 1994 to 11.2 Mt, plus 1.85 Mt of washed metallurgical coal; this was much smaller than the 12% increase from 1993 to 1994.

The principal coal mining area of Mexico was the northern part of Coahuila, where MICARE operated. MICARE, the principal coal producer in Mexico, was sold to a joint venture between Grupo Acero del Norte (51%) and Mission Energy (49%) for $30 million plus the assumption of $100 million of debt. MICARE was undertaking an expansion program to increase its annual production to 9 Mt to supply new coal-fired plants being installed at Rio Escondido.

Other coal deposits were in Sonora and in Oaxaca. About 4 Mt/yr of steam coal has been mined by MICARE in Coahuila from the company's two open pit and two underground mines. Approximately 3 Mt of metallurgical coal was mined by Minerales Monclova S.A., and the remaining production was from about 10 small producers.

Natural Gas.—Mexico produced 38,879 Mm^3 of natural gas in 1995, up a little less than 4% from the 37,492 Mm^3 produced in the previous year. The Government of Mexico, in the form of PEMEX, owned all production. Most, but not all, of Mexico's output was associated gas, produced from oil reservoirs having either a gas cap or high saturation by lighter hydrocarbons that split off as gas at surface temperatures and pressures.

Gas production was consumed primarily within the country, but Mexico both exported and imported natural gas, with imports exceeding exports by about 4.3 Mm^3 per day. This difference was expected to shift in favor of net exports in 1996. Domestic production went partly into the petrochemical industry and otherwise into a growing system of domestic distribution pipelines. During 1995, the Government approved legislative changes to permit both domestic and foreign private-sector participation in natural gas storage, transport and distribution. Six consortia were competing for the right to distribute natual gas in Mexicali. Whichever wins will become the first licensed distributor under the new legal arrangements. Plans were for the next distribution license to be for the city of Chihuahua. PEMEX had 12,763 km of transmission pipelines, not counting gas distribution lines that it plans to divest as distribution areas are awarded.

Petroleum Crude.—The year 1995 saw Mexican crude production drop to 955.2 million barrels (Mbbl) from 980.0 Mbbl in 1994, representing a decrease of about 2.5%. Hurricanes Opal and Roxanne interfered with operations at PEMEX's maritime fields in the autumn of 1995, resulting in production losses of about 36 Mbbl of crude and 669 Mm^3 of natural gas. Prior to the incidence of these storms, PEMEX had been on-line to exceed production levels of 1994.

Overall, Mexico produced three grades of crude oil; namely, “Isthmus,” “Maya,” and “Olmeca.” Olmeca was a very light crude running 39.3^0 API gravity with 0.8% sulfur by weight. Isthmus was a light crude at 33.6^0 API gravity with 1.3% sulfur, and Maya was a heavy crude running 22^0 API gravity with 3.3% sulfur. During 1995 the approximate mix of total production was Maya, 47%; Isthmus, 33%; and Olmeca, 20%. PEMEX calculated its average production costs at $2.52 per barrel (bbl), with maritime production at about $1.86 per bbl, which was in the range of much of the production of the Arabian Gulf. Highest costs were in the northern part of the country where, in line with south Texas economics, crude production cost $8.29 per bbl. Export prices of Mexican crude during 1995 varied from a minimum of $14.47per bbl (July) to a maximum of $17.35per bbl (April), averaging $15.70 per bbl.

As of 1995, Mexico ranked in sixth place in the world as a producer of crude oil and eighth in terms of reserves. In the Western Hemisphere, only the United States produced more oil than Mexico. Venezuela, the second leading producer of crude in Latin America, generated slightly less than 90% of Mexico's production. During the year, Mexico exported 1.306 million bbl per day of crude to about 23 countries, of which 84% went to the United States. Exports of crude in 1995 earned $7.48 billion for Mexico, an improvement of 13% over the value for 1994. In recent years PEMEX, via domestic and export sales, tax payments, and gas taxes, has provided about 30% of Mexico's total export earnings and has brought in about one-third of all public-sector income.

Reserves

The term “reserves” refers generally to mineral materials (ore) that can be mined, processed, and marketed to economic advantage.[4] Yearly changes in estimation of reserves are, in simplest terms, the arithmetic result of additions to reserves, deletions of reserves, and production. Additions result from new discoveries, new technical information, and commodity price increases. Deletions are caused by increases in mining costs, decreases in market prices, and unforeseen requirements for additional capital for exploitation of otherwise favorable sites. Production is driven by the favorable balance between mining cost and return on

investment, both of which may change continuously. Most mining operations aim at extracting the lowest grade that is profitable at prevailing prices for the product, thus not infrequently causing redefinition of the ore reserves. Some of the reserves in Mexican mines and deposits are contained in polymetallic deposits, necessitating close attention to market price and processing costs for two, or several, mineral commodities simultaneously to enable production as coproducts. *(See table 3).* Mexican gold output has roughly doubled between 1993 and 1995, and exploration has turned conspicuously toward gold, but reserve estimates have been in a state of flux and are not shown in table 3. No total value has yet been reported.

Infrastructure

Mexico had 26,445 km of railroads in 1993 and 245,433 km of roads. As part of the Toll Highway Program that began in 1989, more than 5,000 km of new highways were being constructed. In addition, private companies were constructing 33 toll highways, 1,600 km of roadways, and four bridges across the U.S. border with Mexico. The Government, while financing the expansion of 2,100 km of highways to four lanes, allowed the private sector to participate in such projects, including toll roads. The concession holder was allowed to charge tolls on projects developed until construction costs had been recovered and a reasonable profit made, at which time ownership of the highway would revert to the Government.

To streamline transportation of freight within Mexico, the Government, in 1990, modified regulations governing the trucking industry. After elimination of route control by private companies, Mexican carriers could move freight anywhere in the country. In addition, under NAFTA, U.S. and Canadian trucking lines, after a 3-year waiting period, would be able to avoid transshipment delays at the border by transporting freight directly across national boundaries to destinations in Sonora, Chihuahua, Nuevo Leon, and Coahuila. Mexican carriers had reciprocal rights to operate in Arizona, California, New Mexico, and Texas.

The country had 21 ports and 2,900 km of navigable rivers and coastal canals. Of the country's 64 ships in the merchant marine, at least 44 were available for the transportation of mineral products. Most ore and metallurgical products within Mexico were transported by truck. Railways declined in importance during the 1980's, as the volume of freight and passenger transport dropped by more than 25% owing to increasingly poor and unreliable service. Railroads accounted for only 9% of Mexico's total freight traffic in 1991, and were used mainly for bulk items such as coal, coke and iron ore. Gray portland cement, for example, was transported by roads (61%), by railroads (26%), and by ship (13%). About 65% of the cement sold in bulk.

U.S. railroads, such as Burlington Northern, Santa Fe, Southern Pacific, Tex-Mex Railroad, and Union Pacific, were working with the Mexican railroad, Ferrocarriles Nacionales de Mexico (FNM), to transport freight inside Mexico. Union Pacific was investing in the Huehuetoca rail distribution center and in the Port Laredo facility. Union Pacific Technologies has sold its Transportation Control System, designed to manage yard operations and train scheduling, to FNM. Southern Pacific and FNM offered double-stack container service to Mexico City. Southern Pacific also was investing in Ferropuertos, a series of intermodal distribution centers in Celaya, Monterrey, Torreon, and north of Los Mochis. The facilities would handle such shipments as consumer goods, grains, and minerals in bulk. Finally, FNM also was cooperating with Southern Pacific, Tex-Mex, and Union Pacific on the integration of shipping rates and training of Mexico's railroad employees.

Hydrocarbon output continued to dominate Mexico's energy sector. Crude oil and natural gas generally represented about 90% of all energy produced. The remaining 10% of primary energy production typically was from wood and sugar cane (4.3%), hydroelectric sources (3.1%), coal (1.5%), geothermal wells (0.7%), and nuclear energy (0.5%) according to an analysis (rounded) of 1992.

Crude oil and natural gas were transported mainly through pipelines within Mexico. Of the country's nine refineries, eight received crude oil by pipeline.

Outlook

After a generally strong showing in 1995, Mexico's production of all major minerals was expected to expand further. Some sectors of the industry, particularly iron and steel, demonstrated flexibility amidst the sharp decline in domestic consumption by shifting to higher output and boosting of exports in the space of the single year 1995. Other sectors, such as copper, lead-zinc, and silver, increased their production in the knowledge that the markets were ready and able to accommodate their offerings. PEMEX was able to sell all of the petroleum crude and natural gas it could produce. Market pricing in hard currencies, not only the dollar but the yen, the pound, and the deutsche mark, presented attractive export targets for mineral commodities whose production costs were denominated in the recently devalued pesos.

Certain dislocations in metallic mineral commodity markets of the late 1980's and early 1990's, resulting in world price weaknesses, seem to have been overcome to the extent that prices have firmed and climbed, providing an incentive for production and expansion. World petroleum prices have risen also through the past year or so; with no warrant of permanence, they have nonetheless brought enhanced income to PEMEX and hence Mexico itself.

The future holds great promise for the virtually explosive expansion of interest in exploration, development, and mining in the gold sector, where production increased by one-third in 1995 alone. More than 200 companies, many

from the United States and Canada, have been involved in mineral exploration for gold in Sonora, Durango, and Baja California. Foreseeably, many of these companies will succeed and become permanently involved in Mexico, bringing new capital and technology.

The downside of Mexico's mineral industry has been the recent sharp contraction through 1995 in demand for construction materials such as cement, gypsum, and steel for domestic use. The outlook here, critical to a large proportion of Mexican wage-earners, will fluctuate as a function of the recovery of the peso. Some direct international financial support has been extended that will help stabilize the currency. The prospect of continued investment of foreign capital in Mexico's mineral industry, and other sectors, will help to restore confidence and solvency within the economy.

Mexico has been viewed by many companies as not only presenting fewer obstacles to mining but also as being less of a political risk for mining investments than Canada, the United States, and some other Latin American countries. Consequently, Mexico was expected to attract more foreign capital, and its mining industry should continue to increase in significance. Total mining investment in the next 5 years had been estimated by the Mexican Mining Chamber to be on the order of $5 billion.

Toward the end of the century, NAFTA may well benefit the overall economy; even so, The Mining Law (1992) and new foreign investment law were expected to play significant roles in attracting foreign capital, not only from North American companies but, increasingly, from those in Europe and Asia.

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[1]Much of the general and commodity information in this report was provided by Mr. Steve Ordal, Regional Resources Officer, and Ing. Javier Moya R., Minerals Specialist with the Economic Section of the Embassy of the United States in Mexico City. Mr. Moya's efforts have been invaluable in providing a comprehensive, detailed, and timely report. Ing. Moya not only compiles the annual Minerals Questionnaire, but he also is the author of the comprehensive annual Mexico's Minerals Outlook Report used extensively as source material for this report. Any datum or statistic in the text not referenced elsewhere may be assumed to be from either the Minerals Outlook Report or the related series of separate, preliminary, topical reports prepared by Ing. Moya.

[2]Where necessary, values have been converted from Mexican pesos (Mex$) to U.S. dollars at the rate of Mex$6.4=US$1.00, the average rate of exchange for 1995.

[3]U.S.Geological Survey. Circular 831—Principles of a Resource/ Reserve Classification for Minerals.

Major Sources of Information

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

(Metric tons unless otherwise specified)

Commodity 3/		1991	1992	1993	1994	1995
METALS						
Aluminum, metal:						
Primary		50,800	24,800	25,800	--	10,413
Secondary		54,200	59,500	69,900	145,216 r/	128,618
Antimony:						
Mine output, Sb content		1,470	1,200 e/	1,470	1,800 e/	1,820 e/
Metal 4/		1,280	1,060	1,490	1,760	1,783
Arsenic 5/		4,920	4,290	4,450	4,440	3,620
Bismuth:						
Mine output, Bi content 6/		651	807	908	1,050	995
Metal, refined e/		500	550	650	836 7/	924 7/
Cadmium:						
Mine output, Cd content		3,100 e/	3,250 e/	3,320	2,580	1,385
Metal, refined		688	602	797	646	689
Copper:						
Mine output, Cu content 8/						
By concentration		260,400	251,100 r/	277,000	279,700 r/	304,300
Leaching (electrowon)		32,100	27,900	24,100 r/	25,800 r/	27,600
Total		292,500	279,000 r/	301,100	305,500 r/	331,900
Metal:						
Anode and blister		183,000	227,000 r/	94,000 r/	277,000 r/	298,000
Refined:						
Primary 9/		106,000	111,000	93,800 r/	104,300 r/	103,100
Secondary		53,000	80,500	77,200	92,700 r/	98,800
Total		159,000	191,500 r/	171,000 r/	197,000 r/	201,900
Gold:						
Mine output, Au content	kilograms	10,100	9,890	9,770	14,642 r/	20,292
Metal, refined	do.	5,020	5,740	6,090	6,450	8,355
Iron and steel:						
Iron ore, mine output:						
Gross weight	thousand tons	9,994 r/	10,964 r/	11,435 r/	8,538 r/	8,523 e/
Fe content	do.	6,596 r/	7,236	7,547	5,516 r/	5,625
Metal:						
Pig iron	do.	2,960	3,400	3,420	3,401 r/	4,142
Sponge iron	do.	2,460	2,390	2,740	3,220	3,691
Total	do.	5,420	5,790	6,160	6,621 r/	7,833
Ferroalloys:						
Ferromanganese	do.	98	79	70 e/	117	109
Silicomanganese	do.	51	51	55 e/	72	77
Ferrosilicon	do.	6	5	(10/)	--	--
Ferrochromium	do.	(10/)	(10/)	--	--	--
Other	do.	(10/)	(10/)	(10/)	--	--
Total	do.	155	135	126	189	186
Crude steel	do.	7,960	8,460	9,190	10,260 r/	12,128
Rolled products 11/	do.	6,250	6,240	6,660	7,583 r/	8,478
Lead:						
Mine output, Pb content		168,000	170,000	149,000	170,322	164,348
Metal:						
Smelter:						
Primary		163,000	163,000	172,000	152,502 r/	160,322
Secondary (refined) e/		10,000	10,000	10,000	10,000	10,000
Total e/		173,000	173,000	182,000	164,000	170,322
Refined:						
Primary 12/		152,000	167,000	178,000	162,000	164,348
Secondary e/		10,000	10,000	10,000	10,000	10,000
Total e/		162,000	177,000	188,000	172,000	174,348 7/
Manganese ore: 13/						
Gross weight		254,000	407,000	363,000	307,000	472,200
Mn content e/		92,800	153,000	135,000	112,000	174,200
Mercury, mine output, Hg content		340	21	12	12	15 e/
Molybdenum, mine output, Mo content		1,720	1,460	1,710	2,610	3,810
Selenium, mine output, Se content	kilograms	2,800	400	--	--	--

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity 3/		1991	1992	1993	1994	1995
METALS--Continued						
Silver:						
Mine output, Ag content	do.	2,300,000	2,100,000	2,110,000	2,214,638 r/	2,496,000
Metallurgical products, Ag content:						
In copper bars	do.	210,000	286,000	409,000	470,000	435,906
Mixed gold and silver bars	do.	72,600	103,000	109,000	124,000	169,744
Metal, refined, primary	do.	1,780,000	1,770,000	1,770,000	1,700,000	1,781,111
Other	do.	73,200	111,000	78,100	123,000	106,489
Tin:						
Mine output, Sn content		12	1	3	3	1
Metal, smelter, primary		2,260	2,590	1,640	1,640	770
Tungsten, mine output, W content		194	162	--	--	--
Zinc:						
Mine output, Zn content		317,000	294,000	369,000	361,689 r/	363,658
Metal, refined, primary		189,000	152,000	210,000	209,200	222,748
INDUSTRIAL MINERALS						
Abrasives, natural e/ 14/		25,000	25,000	25,000	25,000	25,000
Barite		192,000	188,000	136,000	86,605	248,367
Cement, hydraulic	thousand tons	25,100	26,880	27,120	29,700	23,971
Clays:						
Bentonite		145,000	136,000	94,600	92,476 r/	92,432
Common		3,920,000	4,170,000	4,420,000	4,553,635 r/	4,894,689
Fuller's earth		41,100	41,100	36,100	21,377 r/	21,377
Kaolin		167,000	144,000	216,000	193,034 r/	188,640
Diatomite		46,000	46,400	46,100	52,100 r/	55,226
Feldspar		152,000	160,000	124,000	133,441	121,779
Fluorspar:						
Acid-grade	thousand tons	277	189	187	129 r/	270
Metallurgical-grade	do.	90	95	93	103	252
Submetallurgical-grade e/	do.	3	3	3	3	--
Total	do.	370	287	283	235 r/	522
Graphite, natural:						
Amorphous		35,300	30,500	42,600	29,903	32,938
Crystalline		1,940	985	960	960 e/	1,450
Gypsum and anhydrite, crude (yeso)		4,770,000	5,160,000	5,340,000	5,530,000	4,917,840
Lime, hydrated and quicklime e/	thousand tons	6,500	6,500	6,500	6,500	6,500
Magnesium compounds:						
Magnesite		600 e/	--	1,530	1,120	1,200 e/
Magnesia 15/		112,000	125,000	125,000 e/	125,000 e/	125,000 e/
Mica, all grades		5,590	5,870	6,440	5,753 r/	5,142
Nitrogen: N content of ammonia		2,220,000	2,200,000	1,760,000	2,030,000	1,992,000
Perlite		48,900	42,600	34,600	31,918 r/	29,471
Phosphate rock 16/		596,000	515,000	237,000	546,857 r/	622,354
Salt, all types	thousand tons	7,530	7,400	7,490	7,460	7,670
Sodium compounds, n.e.s.:						
Carbonate (soda ash): e/ 17/						
Natural		190,000	160,000	160,000	160,000	160,000
Synthetic		259,000	280,000	280,000	280,000	270,000
Sulfate, natural (bloedite) 18/		518,000	534,000	500,000 e/	527,228	500,000 e/
Stone, sand and gravel:						
Calcite, common		458,000	476,000	423,000	389,749 r/	359,221
Dolomite		471,000	466,000	545,000	588,000	550,000 e/
Limestone 19/	thousand tons	29,500	31,800	34,000	12,260 r/	18,976
Marble		750,000	860,000	987,000	1,130,000	898,990
Quartz, quartzite, glass sand (silica)		1,200,000	1,130,000	1,310,000	1,359,987	1,292,265
Sand	thousand cubic meters	44,000	46,300	47,600	50,982 r/	54,592
Gravel	do.	39,700	42,600	43,700	44,899	50,536
Strontium minerals, celestite		62,200	61,100	71,900	111,000	100,000 e/
Sulfur, elemental:						
Frasch process	thousand tons	1,040	710	102	--	--

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity 3/		1991	1992	1993	1994	1995
INDUSTRIAL MINERALS--Continued						
Sulfur, elemental--Continued:						
Byproduct:						
Of metallurgy e/	do.	280	817	730	2,014 7/	2,010 7/
Of petroleum and natural gas	do.	754	775	804	877	867
Other e/	do.	20 7/	--	30	30	25
Total e/	do.	2,094	2,302	1,666	2,921	2,902
Talc		11,900	19,600	14,400	14,900 r/	15,443
Vermiculite		117	125	134	300	300
Wollastonite		13,900	27,400	35,800	29,000 r/	29,000
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Run-of-mine:						
Metallurgical	thousand tons	4,540	3,640	4,500	4,632	4,036
Steam	do.	4,870	5,060	5,720	6,311 r/	7,197
Total	do.	9,410	8,700	10,220	10,943 r/	11,233
Washed metallurgical coal	do.	2,210	1,610	1,710 e/	1,800 e/	1,850 e/
Coke: 20/						
Metallurgical	do.	2,010	1,890	1,890	1,933	2,097
Imperial	do.	3	2	3	3	--
Breeze	do.	98	144	49	49	51
Total	do.	2,111	2,036 r/	1,942	1,985 r/	2,148
Gas, natural:						
Gross	million cubic meters	37,600	37,100	37,000	37,492	38,879
Marketed	do.	33,700	32,700	35,700	36,000 e/	36,000 e/
Petroleum:						
Crude	thousand 42-gallon barrels	977,000	974,000	976,000	980,025	955,205
Condensate	do.	1,440	1,640	1,500 e/	1,500 e/	1,500 e/
Total	do.	978,440	975,640	977,500	981,525	956,705
Refinery products:						
Liquefied petroleum gas	do.	25,200	20,100	21,500	24,100	22,265
Motor gasoline	do.	153,000	148,000	152,000	157,000	154,395
Jet fuel	do.	22,600	23,700	26,300	27,000	25,550
Kerosene	do.	3,650	4,020	3,650	3,290	1,825
Distillate fuel oil (diesel)	do.	101,000	101,000	97,500	104,000	92,710
Lubricants	do.	2,920	2,920	2,560	2,560	2,555
Residual fuel oil	do.	152,000	157,000	162,000	156,000	151,840
Asphalt	do.	7,670	8,400	8,760	11,700	10,950
Unspecified and refinery fuel and losses	do.	19,000	19,900	20,700	24,400	24,090
Total	do.	487,040	485,040	494,970	510,050	486,180

e/ Estimated. r/ Revised.

1/ Data published for 1990 through 1994 in the preceding year were rounded by the U.S. Bureau of Mines to three significant digits. Where possible, data in the present table have been unrounded to their original state.

2/ Table includes data available through Aug. 31, 1996.

3/ In addition to the commodities listed, additional types of crude construction materials are produced, but output is not reported; available information is inadequate to make estimates of output levels.

4/ Sb content of antimonial lead and impure bars plus refined metals.

5/ Arsenic content of white and black (impure) arsenic trioxide.

6/ Refined metal plus Bi content of impure smelter products.

7/ Reported figure.

8/ Series reported by Camara Minera de Mexico (CAMIMEX). Tonnages reflect a 2.5% metal loss in smelter.

9/ Includes cathode copper from the Cía. Mexicana de Cananea S.A. de C.V. electrowinning plant, in metric tons, as follows: 1991--32,000; 1992--27,900; 1993--24,100 (revised); 1994--25,800 (revised); and 1995--27,600.

10/ Less than 1/2 unit.

11/ Includes flat, nonflat, and seamless pipe steel products.

12/ Pb content of antimonial lead and impure bars plus primary refined metals.

13/ Mostly oxide nodules; includes smaller quantities of direct-shipping carbonates and oxide ores for metallurgical and battery applications.

14/ Based on exports comprising mostly pumice stone and emery (a granular, impure variety of corundum).

15/ Reported by Industrias Penoles S.A. de C.V. as the only major producer.

16/ Includes only output used to manufacture fertilizers.

17/ Total sodium carbonate reported by Asociación Nacional de la Industria Química.

18/ Series reflects output reported by Industrias Peñoles plus an additional 22,000 tons estimated production by Sulfato de Viesca.

19/ Excludes that for cement production.

20/ Includes coke made from imported metallurgical coal.

TABLE 2
MEXICO: STRUCTURE OF THE MINERAL INDUSTRY FOR 1995

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities 1/	Annual capacity
Aluminum		Aluminio S.A. (Nacobre, 77.8%; Carso Group, 20%)	Smelter at Veracruz, Ver.	94.
Antimony		Cia. Minera y Refinadora Mexicana S.A. (private Mexican, 51%; Cookson Ltd., 49%)	San Jose Mine, Catorce, S.L.P.	365.
Barite		Barita de Sonora S.A. (Grupo Acerero del Norte S.A. de C.V., 100%)	Mazatan, Son.	264
Do.		Minera Capela S.A. (Penoles, 100%)	La Minita Mine, Coalcoman, Mich.	150. 2/
Do.		Minerales y Arcillas S.A. de C.V. (private Mexican, 100%)	Galeana, N.L.	108.
Do.		do.	Apodaca, N.L.	60.
Do.		Barita de Santa Rosa S.A. de C.V. (private Mexican, 100%)	Muzquiz, Coah.	256.
Cement		Cementos Mexicanos S.A. de C.V. (private Mexican, 100%	Monterrey, N.L.; Torreon, Coah.; Huichiapan, Hgo.; Valles, S.L.P.	8,970 (Monterrey group).
Do.		Cementos Anahuac S.A. (Cementos Mexicanos, 100%)	Leon, Gto.; Merida, Yuc.; Tlanepantla, Mex.; Tamuin, S.L.P.	6,970 (Maya group).
Do.		Cementos Tolteca S.A. (Cementos Mexicanos, 100%)	Atotonilco, Hgo.; Zapotiltic, Jal.; Tula, Hgo.; Hornillos, Sin.; Hermosillo, Son	7,150 (Tolteca group).
Do.		Cementos Guadalajara S.A. (Cementos Mexicanos, 100%)	Ensenada, B.C.N.; Guadalajara, Jal.; Hermosillo, Son.; Hidalgo, N.L.	4,445 (Cegusa group).
Do.		Cementos Apasco S.A. de C.V. (Holderbank, 49%)	Apasco, Hgo.; Ramos Arizpe, Coah.; Macuspana, Tab.; Caleras, Col.; Orizaba, Ver.; Acapulco, Gro.	9,500.
Do.		Sociedad Cooperativa La Cruz Azul (private Mexican, 100%)	Jasso, Hgo.; La Cruz Azul, Oax.	4,600.
Do.		Cementos Chihuahua S.A. de C.V. (private Mexicanos, 100%)	Chihuahua, Chih.; Cuidad Juarez, Chih.	1,160.
Coal		Minerales de Monclova S.A. (Altos Hornos de Mexico, S.A., 100%)	Mimosa, Palau mines, Muzquiz washing plant at Palau, Coah., and Coking plant at Monclova, Coah.	3,000.
Do.		Carbonifera de San Patricio S.A. de C.V. (private Mexicanos, 100%)	Progresso, Coah.	1,314.
Do.		Industrial Minera Mexico S.A. de C.V. C.V. 3/ (Grupo Mexico, 74%; Asarco Inc. of U.S. and others, 26%)	Nueva Rosita, Coah.	1,500.
Do.		Minera Carbonifera Rio Escondido S.A. (MICARE) (Grupo Acerero del Norte, 51%; Mission Energy, 49%)	MinaI, Mina II, and Tajo I at Nava and Piedras Negras, Coah.	4,000.
Copper		Mexicana de Cobre S.A. (Mexico Desarollo Industrial Minero, 96.4%) 3/	La Caridad Mine and smelter at Nacozari de Garcia, Son.	180 smelter, 16 leaching.
Do.		Mexicana de Cananea S.A. (Mexicana de Cobre, S.A., 76.1%; ACEC Union Miniere, S.A. of Belgium, 21.2%; Workers Union, 2.7%)	Mine and smelter at Cananea, Son.	170 smelter, 20 leaching.
Do.		Minera Maria S.A. de C.V. (Empresas Frisco, 51%; Cominco Resources International, 49%)	Cananea District, Son.	18.
Ferroalloys		Cia. Minera Autlan S.A. (Grupo Ferrominero, 54%; Minas de Basis S.A. de C.V., 32%; Broken Hill Property Co. Ltd. of Australia, 14%)	Plant in Tamos, Ver. Plant in Teziutlan, Pue.	140. 38.
Fluorspar		Cia. Minera Las Cuevas S.A. (Grupo Industrial Camesa S.A. de C.V.) 4/	Salitera (Zaragoza), S.L.P.	520.
Do.		Fluorita de Mexico S.A. de C.V. (private Mexican, 51%; AIMCOR, 49%)	Mines at La Encantada range and plant at Muzquiz, Coah.	500.
Gold	kilograms	Cia. Fresnillo S.A. (Industrias Penoles, S.A. de C.V., 60%; AMAX, 40%)	Fresnillo Mine, Zac.	1,866.
Do.	do.	Minas de San Luis S.A. (Industriales Luismin, 100%)	Tayoltita, Dgo.	1,400.
Do.	do.	Cia. Minera de Santa Gertrudis (Grupo Ariztegui, 51%; Phelps Dodge, 49%)	Santa Gertrudis Mine, Son.	1,600.

See footnotes at end of table.

TABLE 2--Continued
MEXICO: STRUCTURE OF THE MINERAL INDUSTRY FOR 1995

(Thousand metrictons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities 1/	Annual capacity
Gold--Continue kilograms	Exploraciones El Dorado S.A. de C.V. (70%), Minerales Sotula (70%)	La Colorada Mine, Son.	800.
Do. do.	Minera Hecla (Hecla Mining Co. of U.S., 100%)	La Choya Mine, Son.	2,000.
Do. do.	Walhalla Mining Co. NL (private foreign, 100%)	Amelia Mine, Son.	1,300.
Do. do.	Cia. Minera las Torres S.A. de C.V. (100% Industrias Penoles)	Guanajuato, Gto.	730.
Do. do.	Cia. Minera El Cubo S.A. de C.V. (private Mexican, 100%)	do.	128.
Do. do.	Sociedad Cooperativa Minero Metalurgica Santa Fe de Guanajuato (private Mexican, 100%)	do.	438.
Graphite	Grafitos Mexicanos S.A. (Cummings Moore Graphite Co. of the U.S., 25%; private Mexican, 75%)	Lourdes and San Francisco Mines, Son.	60.
Gypsum	Cia. Occidental Mexciana S.A. (private Mexican, 51%; Domtar, Ltd. of Canada, 49%)	Santa Rosalia on San Marcos Island, B.C.S.	2,500.
Iron ore	(Grupo Acerero del Norte, 29%; Caribbean ISPAT, 29%; Hylsa de Mexico S.A., 42%)	Pena Colorada Mine and pellet plant near Manzanillo, Col.	3,000.
Do.	Siderurgica Lazaro Cardenas-Las Truchas, S.A. (SICARTSA) (Grupo Villacero, 80%; Government, 20%)	Ferrotepec, Volcan, and Mango deposits in Las Truchas project area and pellet plant, Mich.	1,900.
Lead and zinc	Mexico Desarollo Industrial Minero S.A. (Grupo Mexico, 74%; Asarco Inc. of U.S. and others, 26%)	Charcas, S.L.P.; San Martin, Zac.; Santa Eulalia, Chih.; Taxco, Gro.; Rosario, Sin.; lead smelter at Chih.; lead refinery at Monterrey, N.L.; zinc refinery at S.L.P.	70 (lead), 150 (zinc).
Do.	Industrias Penoles S.A. de C.V. (private Mexican, 97%; U.S. private, 3%)	Mines at La Encantada, Coah.; Fresnillo, Zac.; Naica, Chih.; Bismark, Son. Rey de Plata, Gro. (Penoles, 60%; Outokump, 40%); Metallurgical complex at Torreon, Coah., with silver, lead, and zinc smelter and/or refineries operated by Met-MexPenoles (Penoles, 100%)	50 (lead), 60 (zinc).
Do.	Minera San Francisco del ro S.A. de C.V. (Frisco, S.A. de C.V., 100%)	San Francisco del Oro, Chih.	15 (lead). 21 (zinc).
Do.	Minera Real de Angeles S.A. de C.V. (Frisco, S.A. de C.V., 100%)	Noria de Angeles, Zac.	45 (lead). 47 (zinc).
Manganese	Cia. Minera Autllan S.A. (Grupo Ferrominero, 54%; Minas de Basis, S.A. de C.V., 32%; Broken Hill Property Co. Ltd. of Australia, 14%)	Molango Mine, Hgo. Nonoalco Mine, Hgo. Gomez Palacio, Hgo.	460. 26. 35.
Molybdenum	Mexicana de Cobre S.A. (Mexico Desarollo Industrial Minero, 96.4%)	La Caridad Mine, Molybdenum plant, Son.	6.
Petroleum thousand 42-gallon barrels per day	Petroleos Mexicanos (PEMEX) (Government, 100%)	Comalcalco, Poza Rica, Ver., and Gulf of Campeche, Cam. districts	3,500. 5/
Salt	Exportadora de Sal S.A. (ESSA) (Fideicomiso de Fomento Minero, 51%; Mitsubishi Corp., 49%)	Solar salt complex at Guerrero Negro, B.C.S.	6,000.
Silver kilograms	Industrias Penoles S.A. de C.V. (private Mexican, 97%; U.S. private, 3%) 6/	Naica, Chih.; Fresnillo, Zac.; Las Torres, Gto.; Cuale, Jal.; La Negra, Qro.; La Encantada, Coah.; La Minita, Mich.	654,000.
Do. do.	Mexico Desarollo Industrial Minero S.A. (Grupo Mexico, 74%; Asarco Inc. of U.S. and others, 26%)	San Martin Mine, Sombrerete, Zac.; Taxco, Gro.; Charcas, S.L.P.; Santa Eulalia, Chih.; Refiney at Monterrey, N.L.	467,000.
Do. do.	Minera Real de Angeles S.A. de C.V. (Frisco S.A. de C.V., 100%)	Open pit mine and concentrator at Noria de Angeles, Zac.	924,000.
Sodium carbonate	Sosa Texcoco S.A. (private Mexican, 100%)	Lake Texcoco, Mex., from subsurface brines	200.
Sodium sulfate	Quimica Magna, S.A. de C.V. (Industria Penoles S.A. de C.V., 100%)	Subsurface brines at Laguna del Rey, Coah.	350.

See footnotes at end of table.

TABLE 2--Continued
MEXICO: STRUCTURE OF THE MINERAL INDUSTRY FOR 1995

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities 1/	Annual capacity
Steel	Altos Hornos de Mexico S.A. (AHMSA), Grupo Acereros de Norte (GAN)	Steelworks at Monclova, Coah. (Iron ore from Pena Colorada Mine in Col.)	3,900.
Do.	Hylsa de Mexico S.A. (Grupo Industrial ALFA, 100%)	Direct-reduction units at Monterrey, N.L., and Puebla, Pue., (Iron ore from Cerro Nahuatl Mine in Col.)	1,800.
Do.	Siderurgica Lazaro Cardenas-Las Truchas S.A. S.A. (SICARTSA) (Grupo Villacero, 80%; Government, 20%)	Port of Lazaro Cardenas, Mich.	1,300.
Do.	Siderurgica del Balsas S.A. (SIBALSA) (Caribbean ISPAT, 100%)	SICARTSA II Plant Facilities at Lazaro Cardenas, Mich.. plus 29% share in the Pena Colorada Mine, Col.	2,000 (steel), 1,500 (steel plate).
Strontium (celestite)	Cia. Minera La Valenciana (private Mexican, 100%)	San Agustin Mine in Coah	50.
Sulfur	Petroleos Mexicanos (PEMEX)	Nationwide petroleum operations	890,000.
	Azufrera Panamericana S.A. (APSA) (Fideicomiso de Fomento Minero, 96%; private, 4%)	Coachapa, Patapa, Jaltipan, Ver.	1,230. 7/
Do.	Cia. Exploradora del Istmo S.A. (Government, 64%; Texasgulf, Inc., 34%; private, 2%)	Texistepec, Ver.	750. 7/
Tin 8/	Metales Potosi S.A. (private Mexican, 100%)	San Luis Potosi, S.L.P.	6.4.
Do.	Estano Electro S.A. (private Mexican, 100%)	Tlalnepantla, Mexico, D.F.	1.3.
Do.	Fundidora de Estano S.A. (private Mexican, 100%)	San Luis Potosi, S.L.P.	1.2.

1/ State abbreviations: Baja California Norte (B.C.N.), Baja California Sur (B.C.S.), Campeche (Cam.), Chiapas (Chia.), Chihuahua (Chih.), Coahuila (Coah.), Colima (Col.), Distrito Federal (D.F.), Durango (Dgo.), Guanajuato (Gto.), Guerrero (Gro.), Hidalgo (Hgo.), Jalisco (Jal.), Mexico (Mex.), Michoacan Mich.), Nuevo Leon (N.L.) Oaxaca (Oax.), Puelba (Pue.), Queretaro (Qro.), San Luis Potosi (S.L.P.), Sinaloa (Sin.), Sonora (Son.), Tabasco (Tab.), Veracruz (Ver.), Yucatan (Yuc.), and Zacatecas (Zac.)

2/ Operation was shut down in 1989.

3/ In Aug. 1994, Mexico Desarrollo Industrial Minero and Grupo Industrial Minera Mexico were reorganized to form Grupo Mexico.

4/ Grupo Industrial Camesa S.A. de C.V. is owned by private Mexican (51%) and Noranda, Inc. of Canada (49%).

5/ PEMEX operates nine refineries with an installed capacity of 1.68 million barrels per day.

6/ Includes capacity from Cia. Fresnillo S.A. de C.V.

7/ Operation was shut down in 1993.

8/ Smelter output from mostly imported concentrates.

TABLE 3
MEXICO: RESERVES OF SELECTED MINERAL COMMODITIES FOR 1995

(Thousand metric tons unless otherwise specified)

Commodity 1/		Reserves
Antimony		180
Barite		7,000
Bismuth	metric tons	10,000
Cadium	do.	35,000
Copper		14,000
Fluorspar 2/		19,000
Gas, natural 3/	billion cubic meters	1,840
Graphite, natural		3,100
Lead		1,000
Manganese		4,000
Mercury	metric tons	5,000
Molybdeum	do.	90
Petroleum, crude 3/	million 42-gallon barrels	42,146
Selenium	metric tons	4,000
Silver	do.	37,000
Sodium carbonate, natural		200,000
Sodium sulfate, natural		170,000
Sulfur 4/		75,000
Zinc		6,000

1/ All metals expressed in metal content.

2/ Measured as 100% calcium fluoride.

3/ Yearend 1995. Source: Petroleos Mexicanos Statistical Yearbook 1995.

4/ Sulfur in all forms.