THE MINERAL INDUSTRY OF

MEXICO

By Ivette E. Torres and David B. Doan[1]

In 1997, Mexico's gross domestic product increased by 7% from that of 1996 (Dirección General de Promoción Minera, SECOFI, October 13, 1998, Development of the domestic economy and mining-metallurgical sector, Mexican Mining Industry Report, 1997, accessed November 24, 1998, at URL http://www.mexmin.com/mingov97.htm). Mexico's export sector increased by 15% to $110.4 billion, contributing significantly to the economic growth. Imports, however, increased by 22.7%, to $109.8 billion. For 1997, Mexico's trade surplus was about $600 million. Inflation declined significantly to 15.7% from 27.7% in 1996. Total investment increased by almost 21%, and total consumption increased by 5.7%. Mexico's industrial sector increased by 9.3%, with mining increasing by 4.3% (Cámara Minera de México, 1998, p. 5). These improvements were achieved despite the negative impact of the Asian economic crisis and lower prices for petroleum and other important mineral commodities had on the Mexican economy.

Total investment in the mining-metallurgical sector by companies associated with the Mexican Chamber of Mines increased by 60%, to $1.2 billion (Cámara Minera de México, 1998, p. 26). About 84% of the investment was by the largest mining-metallurgical Mexican companies. Because of the importance of copper to the Mexican economy, about 30% of the investment was for the expansion and modernization of copper operations.

Investment by the Government petroleum company, Petróleos Mexicanos S.A. de C.V. (PEMEX), increased by 37%, to $4.6 billion (Petróleos Mexicanos S.A. de C.V., 1998, p. 11). Almost 75% of PEMEX's investment was by the exploration and production division; of the total, 17% was in the refining area.

Government Policies and Programs

Government privatization efforts that began in the late part of the 1980's and had placed almost all former State-owned mines in private hands by 1997, continued to be emphasized. Because minerals were considered to be a part of the national patrimony under the 1917 Mexican Constitution, the Government awarded all 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, and granted a 25-year grace period for "Mexicanization" of the industry, although 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 by limiting foreign participation to 34% in concessions on national reserves and all projects exploiting certain minerals, such as iron ore and coal; production of oil and gas, phosphate rock, potassium, sulfur, and uranium was reserved exclusively for the Government. In 1990, a regulation issued by the Secretaría de Energía, Minas e Industria Paraestatal (SEMIP) allowed more flexibility in foreign ownership through exploration and production trusts undertaken according to the 1975 Mining Law.

The most recent mining law, the Mining Law of 1992, became effective in September 1992. The Regulations of the mining law, as well as the Manual de Servicios al Público en Materia Minera were published on March 25, 1993, in the daily official register. This mining 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 Mining Law permitted direct investment, with up to 100% ownership of equity, in exploration works and activities and allowed, through a 30-year trust mechanism, up to 100% foreign participation in mineral production. It also provided greater legal security for holders of exploration and exploitation concessions and allowed private sector participation in the exploitation of mineral deposits, such as coal, iron, phosphorus, potassium, and sulfur, previously considered to be priority and strategic within the domain of Government ownership. The term of exploitation concessions was extended from 25 to 50 years, renewable for a similar period, and exploration concessions were to be for a nonrenewable 6-year period. The Mining Law 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, which extends 200 miles offshore as defined by the Law of the Sea and the United Nations. Concessions in these areas 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.

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- Rocks or the products of their fragmentation that could only be used for the fabrication of materials for construction, or ore destined for such purposes.
- Products derived from the fragmentation of the rocks, whose exploitation was performed principally by open pit.
- Salt formed by evaporation of brines from salt pits.

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, to submit the relevant reports, and to 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 (Ordal and Moya, 1995, p. 6-8). 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 increased from 2,000 per year to more than 4,200. The land area covered by mining concessions has increased from 2.8 million hectares to 7.1 million.

In 1994, Government responsibility for the mining sector was transferred from SEMIP to the Secretaría de Comercio y Fomento Industrial (SECOFI). Since the functions were transferred, the responsibility of revising the Mining Law and regulations have been held by the Dirección de Minas.

Environmental Issues

Although various environmental laws and regulations have been promulgated since 1946, protection of the environment became a priority for the Government of Mexico as the population increased and mining grew in size and importance. Accordingly, a key element of environmental legislation, The General Law of Ecological Balance and Environmental Protection (LGEEPA) was passed in 1992 (Ordal and Moya, 1996, p. 5). Environmental responsibilities residing in various Government agencies were transferred to the new Ministry of Environment, Natural Resources, and Fisheries (SEMARNAP). 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, the necessary permits for any mine or plant included water well usage, water discharge, land use, explosives, and hazardous materials handling. Other regulations were concerned with noise, gas and dust emissions, dumps and tailings, storage of oil and fuel, and electrical transformers.

Water discharge regulations were specified in the Federal Law Concerning Water Rights (LFDMA) of January 1992 and the National Water Law of December 1992. According to LFDMA, water pumped from mining works was not subject to discharge fees as 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 in LFDMA.

Production

Mexico is a country with a rich mining tradition. It is a significant producer of almost 20 nonfuel minerals and mineral products and is the world's leading producer of silver, celestite, and bismuth. (*See table 1.*) According to U.S. Geological Survey world production data, in 1997, it ranked 2nd in world production of fluorspar (after China); 3rd in the production of graphite; 4th in arsenic; 6th in barite, cadmium, lead (mine), molybdenum, and zinc (mine); 7th in gypsum and salt; 8th in manganese ore, and sulfur; and 10th in copper (mine); 12th in cement; 13th in gold; and 15th in crude steel.

The total value of Mexico's mining production in 1997, excluding cement and petroleum but including coal, was $4.1 billion,[2] with metals contributing to about 64% of the total or $2.6 million (Consejo de Recursos Minerales, 1998, p. 25). The total value represented 3.4% increase at 1993 prices despite a general decrease in metal prices (Dirección General de Promoción Minera, SECOFI, October 13, 1998, Domestic mining-metallurgical production—Production value, Mexican Mining Industry Report, 1997, accessed November 24, 1998, at URL http:// www.mexmin.com/mingov97.htm). Individually, in terms of value, copper was the most important mineral produced, representing 19% of the total production value and 31% of the metal value; it was followed by zinc and silver. The most important industrial mineral was sand, which ranked fourth, with a value of almost $334 million (8% of total value and 22% of industrial mineral value).

In terms of value, 4 of the 31 States and the Federal District produced slightly more than 50% of Mexico's mineral production in 1997. Sonora was the leading producer of minerals with 21.6% of total production. The other most important mineral producers were Zacatecas (11%), Chihuahua (10%), and Coahuila (8.8%) (Consejo de Recursos Minerales, 1998, p. 24).

Although not included in the mining total, cement was the most valuable nonfuel mineral product in Mexico. Domestic and foreign sales totaled $3 billion, an 11% increase from those of 1996.

Overall, petroleum continued to dominate Mexico's mineral sector. It brought the country sizable earnings through foreign exchange even though prices remained low in 1997. Mexico ranked as the world's eighth leading world producer of crude. It was the third largest producer in the Western Hemisphere after the United States and Venezuela.

[2]Where necessary, values have been converted from Mexican pesos (Mex$) to U.S. dollars at the rate of Mex$7.92=US$1.00.

Trade

In 1997, Mexico's total exports were $110.4 billion (Consejo de Recursos Minerales, 1998, p 26). Of that total, mining exports (including coke) accounted for $1.4 billion or 1.3% of the total. Of these, metal exports were $1 billion. Total imports were $109.8 billion (Consejo de Recursos Minerales, 1998, p. 27). Of that total, mining (including coke) accounted for $929.7 million, less than 1% of the total. Of these imports, metals were only about 42%. Exports from the iron and steel sector totaled $3.2 billion, and imports, $1.5 billion; iron metal and ferroalloys combined were less than 2% of the exports and about 3.3% of the imports in that sector.

The major destinations of Mexican minerals were the United States (64.4%), Belgium (9%), the United Kingdom (5.2%), and Japan (5.0%). The major sources of Mexican mineral imports were the United States (68%), Chile (6.1%), Canada (4.1%), and China (3.2%).

Copper was the most important mineral commodity in terms of foreign trade representing 24.9% of total of metal and industrial minerals exports (including coal and coke), by value. Gold (11.3%), silver (11.1%), and zinc (10.4%) followed. The most important industrial mineral was salt, representing 6.1% of exports, and was followed by marble with 4.4% of exports. Iron (19%) led total imports of metal and industrial minerals and was followed by coke (10.2%), gold (9.7%), coal (9.2%), and copper (6.1%).

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 Dirección de Minas, Comisión de Fomento Minero (CFM), the Consejo de Recursos Minerales (CRM), the Fideicomiso de Fomento Minero (FMNM), and the Dirección de Minas to SECOFI. PEMEX and the Comisión Federal de Electricidad remained part of SEMIP, which was renamed the Secretaría de Energía.

CFM had been formed in 1934 to promote mining activity through financial support, technical advice, and assistance to the medium- and small-sized 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 authority 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 FMNM were merged with research laboratories and assigned to CRM. The Dirección de Minas gained control over mineral concessions and the national mineral register, plus the responsibility for updating and revising mining laws and regulations.

Other organizations within the Mexican mining community included Cámara Minera de México, which promoted the interests of the mining industry, as well as dialogue between the Government and private industry. The trade union, Sindicato Nacional de Trabajadores Mineros, Metalúrgicos y Similares de la República Mexicana, represented nearly all the mine workers in Mexico. In 1997, 150,000 workers were employed in the mining sector compared with 180,000 in 1996 and 210,000 in 1995. The cement industry union was controlled by the Confederación de Trabajadores de México, or CTM, the largest Mexican labor union.

Five large and diversified private sector companies dominated the production of nonfuel minerals. (*See table 2.*) These were Corporación Industrial San Luis S.A. de C.V. (San Luis); Empress Frisco S.A. de C.V. (Frisco); Industrial Peñoles S.A. de C.V. (Peñoles); Grupo México S.A. de C.V. (Grupo México), formed in August 1994 as a result of the reorganization of Grupo Industrial Minera México S.A. de C.V. (IMMSA) and its subsidiary México Desarollo Industrial Minero S.A. de C.V.; and the Grupo Acerero del Norte (GAN). About 230 metal mining units were distributed in about 20 States (Dirección General de Promoción Minera, SECOFI, October 13, 1998, Production structure—mining-metallurgical production, Mexican Mining Industry Report, 1997, accessed November 24, 1998, at URL http://www.mexmin.com/ mingov97.htm). Of this total, 40 units were part of the 5 large-sized mining companies, 20 were part of the medium-sized mining companies, and 170 were part of the small-sized mining companies. The large companies produced 100% of manganese and molybdenum and more than 90% of cadmium, copper, lead, silver, and zinc. The medium-sized mining sector, however, dominated the output of many of the industrial minerals by producing 100% of the celestite, feldspar, fluorspar, gypsum, silica sand, and almost 90% of the graphite. The small-sized mining sector was important in the production of kaolin, producing almost 75% of the total.

The cement industry was dominated by Cementos Mexicanos S.A. de C.V. (CEMEX), Cementos Apasco S.A. de C.V. (Cementos Apasco), and Cooperativa Manufacturera de Cemento Portland La Cruz Azul S.C.L. (Cementos Cruz Azul).

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

- Exploración y Producción was charged with the exploration and exploitation of oil and natural gas.
- Refinación controlled the industrial refining processes, the manufacture of petroleum products and basic petroleum derivatives, and the distribution systems.
- Gas y Petroquímica Básica managed the processing of natural gas and natural-gas liquids and the production of basic petrochemicals.
- Petroquímica controlled production of secondary and tertiary petrochemicals.

Each subsidiary managed its own budget, planning, and 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, Article 27 was changed to allow private sector participation in natural gas transmission, distribution, and storage.

At yearend 1997, PEMEX employed about 131,600 people up from 128,600 in 1996, most of whom were represented by the

Petroleum Workers Union. Although this was an increase from the 128,600 employed in 1996, it was a significant decrease from the 215,000 employed in 1989, a peak year.

Inevitably, a gradual and probably long-term change in the mining industry of Mexico has been the influx of direct-foreign investment. At yearend 1997, 415 foreign exploration and mining enterprises were operating in Mexico, according to the Public Mining Registry, an increase of 10% from 1996 when 372 foreign companies were operating in Mexico (Dirección General de Promoción Minera, SECOFI, October 13, 1998, Mexican Mining Industry Report, 1997, accessed November 24, 1998, at URL http://www.mexmin.com/mingov97.htm). Of these, 42% were Canadian and 36% were U.S. companies. Originally, many foreign companies set up field offices in the Hermosillo area of Sonora, but more recently, bases have been established in the States of Chihuahua, Coahuila, Durango, and Sinaloa in the north; the States of Guerrero, Jalisco, México, Queretaro, San Luis Potosí, and Zacatecas in the center and south; and the State of Baja California in the west.

Commodity Review

Metals

Copper.—Copper mine production in Mexico was 390,536 metric tons, a 14.6% increase from that of 1996. Production of refined copper also increased significantly to 297,000. After a severe reduction in the level of consumption of refined copper in 1995, consumption in 1996 and 1997 increased, reaching 230,000 tons in 1997. Most of the copper mined in Mexico was produced by two mines in the State of Sonora, La Caridad and Cananea. These two mines produced about 79% of the total copper mined in Mexico in 1997. Cananea and La Caridad were owned by the same company, Grupo México, through its subsidiaries Mexicana de Cobre S.A. de C.V. and Mexicana de Cananea S.A. de C.V., respectively. At yearend 1997, copper reserves at La Caridad were estimated to be 451.4 million metric tons at a grade of 0.53% copper and 241.8 million tons of leach material at a grade of 0.23% copper and reserves at Cananea were estimated to be 1,737.5 million tons with a grade of 0.62% copper and 1,341.6 million tons of leach material with a grade of 0.27% copper. (Grupo México, 1998, p. 7). Grupo México invested $120 million in La Caridad mining complex in Nacozari de García mining district—smelter capacity was increased from 180,000 metric tons per year to 300,000 tons per year, and a second sulfuric plant with a 700,000-ton-per-year capacity was built. When completed, the expansion of this smelter should replace the smelting capacity at Mexicana de Cananea, which under the North America Free Trade agreement had to reduce its emissions.

Mexicana de Cobre constructed built a new copper refinery in Nacozari de García at a cost of $170 million. Built in two stages, the refinery had an initial capacity of 180,000 tons per year with an ultimate capacity of 300,000 tons per year by 1998. In 1997, production from the new refinery was about 70,000 tons, or 24%, of Mexico's total copper refinery production.

Mexicana de Cananea was also expanding its facilities at Canananea. In August, the company finished the expansion of its crusher area to achieve a capacity of 24 million tons per year. Further expansions were planned for Cananea including solvent extraction-electrowining (SX-EW) circuit expansion by adding a plant that will produce 23,000 tons per year, scheduled for completion in 1999 and another that will produce 30,000 tons per year scheduled for completion in 2000. In 1997, SX-EW production from Cananea was about 27,000 tons.

Development drilling by International Curator Resources of Canada on the Boleo property in Santa Rosalía, Baja California, showed an estimated 395 million tons of ore averaging 0.88% copper and 0.075% cobalt (Metal Bulletin Monthly, 1997). A bankable feasibility study being conducted at yearend was expected to be completed in April 1998. Curator Resources had a 30% working interest in the property. Terratech Environmental Corp. held the remaining 70%. Curator Resources had the option to purchase Terratech Environmental's share for $7.46 million. The company planned an open-pit mine with a minimum life of 15 years and processing facilites including a copper-zinc-cobalt flotation circuit, a power plant, an acid plant, solvent extraction, and electrowinning facilities for copper and cobalt.

Gold.—Mine production of gold reached 26,001 kilograms compared with 24,477 kilograms in 1996. The increase was slower than those of 1996 and 1995 when output increased by 21% and 46%, respectively. Mexico was the 13th leading producer of gold in the world, accounting for 1% of the total output. A large portion of that gold Mexico was from mines producing silver as their primary product.

Sonora continued to be the leading producing State with 34% of the output, followed by Durango (20%) and Guanajuato (11%). The large increases of recent years were due mainly to new mines that began operating after the changes in the mining and investment laws in 1992.

During the year, Peñoles continued with the construction of the Herradura gold mine in the State of Sonora. The project is a joint venture between Peñoles (56%) and Newmont Mining (44%). The project is scheduled for completion in 1998, and will have an estimated average annual production of 4,665 kilograms (150,000 ounces) per year of gold (Industrial Peñoles C.A. de C.V., 1998).

Iron and Steel.—In 1997, Mexico was the second leading producer of steel in Latin America, after Brazil, with about 27% of the region's output. Production increased by 8.2%, to 14.3 million tons and consumption increased by almost 15%, to 8.7 million tons. By process, 65% of Mexico's steel was produced by electrical furnace, and 35%, by basic oxygen converter. Increased steel consumption was largely attributed to the recovery of the Mexican economy and an increased level of foreign investment.

The largest producer of steel was Altos Hornos de México S.A. de C.V. (AHMSA) in Monclova, Coahuila, a subsidiary of GAN, with an output of 3.5 million tons. Hylsa de México S.A. de C.V. with facilities in Monterrey and Apodaca in the State of Nuevo León and Puebla, the State of Puebla was the second largest producer with 3.06 million tons. It was followed by ISPAT Mexicana S.A. de C.V. in Lázaro Cárdenas, Michoacán, with a production of 2.87 million tons. The other producers were Siderúrgica Lázaro Cárdenas-Las Truchas also in Michoacán

(1.46 million tons), Tubos de Acero de México S.A. in Veracruz (0.77 million tons), and minimills (2.54 million tons).

In 1997, AHMSA invested $10 million to rehabilitate a blast furnace in its Monclova, Coahuila, plant. The rehabilitation and modernization of the furnace increased the pig iron capacity from 2,100 tons per day to 2,500 tons per day and extended its life for another 5 years. The company planned to invest $150 million in 1998 and to increase crude steel capacity to 3.85 million tons (Altos Hornos de México S.A. de C.V., press release, December 4, 1997, accessed on December 5, 1997, on URL http://biz.yahoo.com/prnews/971204/altos_hornos_de_mexico_1.html).

At yearend, GAN announced that it was contemplating a $2 billion investment in a new iron ore project in Tahuantepec, State of Oaxaca (Simonds and Moya, 1998).

Lead and Zinc.—Mexico's mine production of lead was about 174,700 tons, or about 6% of the world total. The country was the sixth leading producer of mined lead in the world and, after Peru, the second most important producer in Latin America. Chihuahua (43%) and Zacatecas (34%) were the two most important lead-producing States in Mexico (Consejo de Recursos Minerales, 1998, p.). Naica, of Cía Fresnillo S.A. de C.V. (a Peñoles subsidiary, in the state of Chihuahua, was the largest lead producer in the country with an output of 37,785 tons.

Total zinc mine production was almost 379,300 tons, a slight increase from that of 1996. As the sixth leading producer of mined zinc, Mexico produced about 5% of the world total. Like lead, the leading zinc-producing States were Chihuahua and Zacatecas. Most of the production in those two States comes from the same mines Naica, Santa Bárbara, and San Francisco del Oro in Chihuahua and Real de Angeles and San Martín in Zacatecas. The largest producing zinc mine in Mexico, however, was Charcas in San Luis Potosí with 48,527 tons.

The milling capacity of Minera Tizapa S.A. de C.V., the joint venture between Peñoles (51%) and Dowa Mining Co. Ltd. of Japan (49%), in the State of México was being expanded to 450,000 tons per year of ore during 1997. The expansion was scheduled for completion in 1998.

Silver.—Mexico continued to be the leading producer of silver, accounting for 17.5% of total world output. During the year, it produced 2.7 million kilograms, an increase of 6% from that of 1996. Four States, in decreasing order of output, Zacatecas, Chihuahua, Durango, and Guanajuato, produced about 74% of the total production (Consejo de Recursos Minerales, 1998, chapter 7 [unpaginated]). Peñoles was the largest producer of silver in Mexico. Its Fresnillo mine, the largest silver mine in the world produced 641,037 kilograms of silver, more than 50% of the silver produced in Zacatecas. IMMSA produced 454,500 kilograms. Frisco produced 281,900 kilograms, and Sanluis 183,900.

Most of the silver in Mexico is produced from polymetallic mines. A small portion of the production comes from gold-silver or silver mines. The largest silver refinery in Mexico, Tex-Mex-Peñoles S.A., located in Torreón, Coahuila, refined silver from lead concentrates. In 1997, refined metal production from Tex-Mex totaled 1.95 million kilograms, about 72% of the country's total. Refined silver was also produced in IMMSA's metallurgical complex in Monterrey, Nuevo León. The Chihuahua refinery was closed in 1997. Cobre de México S.A. de C.V. with refineries in Mexico City and in Celaya, Guanajuato, refined silver from copper anodes. Cía Real del Monte y Pachuca in Pachuca, Hidalgo, refined silver from concentrates produced at its own mines, as well as silver from other companies in its precious metal refinery.

In 1996, Consolidated Nevada Goldfields Corp. of Denver, Colorado, purchased the historic Real del Monte y Pachuca mine in Pachuca, State of Hidalgo from GAN (Metals & Minerals Latin America, 1997). The company restructured the mines debt and were initially focusing on achieving the mill's 2,400-ton-per-day capacity, but long-term plans included expansion of the capacity and modernization of the mine equipment. The company also planned a 5-year exploration program for the property and surrounding areas. In 1997, production from the mine in 1997 was 58,069 kilograms of silver (Consolidated Nevada Goldfields, [no date], company annual report 1997, operations overview, p. 1, accessed 1/11/99 at URL http://www.nvgold.com/97ar/97aror.html). Most of the production was from new mine ore, but some production was from treating 4,000 tons of tailings during the first quarter of the year and purchasing 13,000 tons of ore.

Industrial Minerals

Cement.—In 1997, Mexico produced 27.6 million tons, or about 63% of the country's installed capacity of 44 million tons. After Brazil, it was the second largest producer of cement in Latin America. Production came from 30 plants owned by 5 companies. The largest producer was CEMEX with an installed capacity of 27 million tons. The second largest company, Cementos Apasco, a subsidiary of Holderbank Financière Glaris Ltd., has six plants with a capacity of about 9 million tons. These two companies, with about 80% of Mexico's cement capacity, also have recently expanded their production capacities outside Mexico. CEMEX owned or was part owner of cement companies in Colombia, the Dominican Republic, the Pacific Rim, Panama, Spain, and Venezuela. In 1997, Cementos Apasco bought a minority interest in the Honduran company Cementos del Norte. The other three producers were Cementos Cruz Azul (5.6-million-ton capacity), Cementos de Chihuahua (1.9-million-ton-per-year capacity), and Cementos Portland Monctezuma (about 500-ton-per year capacity).

In 1997, Mexico consumed about 85% of its production and exported the remainder mainly to the United States, the Caribbean, and Central America.

Feldspar.—Unimin Corp. of the United States purchased the Mexican feldspar and silica sand producer Materias Primas y Minería for $131 million cash. The sale was subject to Mexican regulatory approval (Industrial Minerals, 1997).

Fluorspar.—Production of fluorspar was about 553,000 tons in 1997. Of the total, 291,000 tons was acid grade and 262,000 tons, metallurgical grade. Of the production, 74% was from San Luis Potosí. The largest company was Cía. Minera Las Cuevas S.A. de C.V., which produced 70% of the country's total (Cámara Minera de México, 1998, p. 105). In 1997, Las Cuevas' proven and probable reserves in were 35 million and 20 million tons, respectively (Gaytan, 1997, p. 10). Since 1995, research has been

conducted on a process to reduce arsenic and other impurities from the acid-grade fluorspar from Las Cuevas. The construction of a $30 million refinery was approved for October 1997, and the new product, premium-grade acidspar was expected to reach the market in 1998. In 1997, improvements were also made to the flotation and grinding facilities, which resulted in increased capacities.

Graphite.—Production of natural graphite in Mexico increased slightly to about 48,000 tons, 97% of which was amorphous. Two States, Sonora and Oaxaca, produced 100% of the Mexican graphite; most of the production was from Sonora. All crystalline (flake) production was in Oaxaca where Grafito de México S.A., the only producer of crystalline graphite in Mexico, operated. In 1997, Grafito de México expanded one of its production lines in the Telixtlahuaca flotation plant (Industrial Minerals, 1997). Production at the plant at yearend was about 140 metric tons per month, most of which was being exported to Superior Graphite Co. of the United States. During the year, about 30% of natural graphite production was exported, mostly to the United States.

Gypsum.—Yesera S.A., a producer of gypsum and wallboard, announced plans to open a new gypsum mine and build a gypsum board in State of San Luis Potosí. The plant, scheduled for completion in 1998, will produced wallboard and ceramic plaster for the domestic market and for export to Central America (Industrial Minerals, 1998) under the company name "Yesera Potosina S.A." The new 500-million-ton mine will have an initial output of 500 tons per day for the first year. The plant was designed to receive 1,000 tons per day of gypsum. In addition to supplying gypsum to the wallboard and ceramic plaster plant, Yesera Potosina will supply gypsum to cement plants in Central Mexico.

Wollastonite.—Nyco Minerals Inc., a Canadian company, was developing a wollastonite mine in Hermosillo in the State of Sonora. The Pilares mine, scheduled to begin operating in 1998, will have an original production capacity of 150,000 tons per year, with a plan to increase production to 400,000 tons per year in the second phase of the project. During the first phase, the project will employ about 100 people.

Mineral Fuels

Coal.—AHMSA opened a new coal mine, No. 5, in Coahuila in late 1997. The mine design capacity is 2.2 million tons, which was expected to be reached in early 1998 (North American Mining, 1997). The capacity from No. 5 mine was designed to replace that from No. 1 mine, which will be closed owing to reserve depletion.

Petroleum, Crude and Natural Gas.—In 1997, production of crude petroleum increased by an estimated 5.7%, to 1.1 billion barrels. About 76% of the production was from offshore oilfields. Mexico exported about 628 million barrels (about 57% of total production), an increase of 11.5% of the 1996 total. The value of exports, however, decreased by 3.4% to $10.3 billion (Petróleos Mexicanos S.A. de C.V., 1998, p. 133), because of lower petroleum prices. The average export price of Mexican crude was $16.46 per barrel, $2.48 lower than in 1996. Exports went mainly to the United States (77.6%), Europe (9.8%), and Japan (3.7%). About 2.4% of the crude was exported to Latin America under the San José Accord. Mexico's net export value for petroleum also decreased to $8.5 billion. Mexico was a net importer of refinery products.

Gross production of natural gas increased by 6.5% from that of 1996. Of the internal sales, about 61% was used by the industrial sector, and 33% was used by the electricity sector.

Reserves

The term "reserves" is defined as mineral materials (ore) that can be mined, processed, and marketed to economic advantage (U.S. Bureau of Mines and U.S. Geological Survey, 1980, p. 2). 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, extensions to known reserves, new technical information, and commodity price increases. Deletions are caused, among other things, by increases in mining costs, decreases in market prices, and unforeseen requirements for additional capital for exploitation of otherwise favorable sites. Commonly, production is driven by a 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 even several, mineral commodities simultaneously to enable production as coproducts. *(See Table 3.)* Between 1993 and 1995, Mexican gold output more than doubled, and exploration turned conspicuously toward gold, but consolidated reserve estimates have not yet been promulgated so that no total value has been reported. Although a nominal estimate is listed, significant amounts of gold are associated with reserves of silver and other polymetallic deposits.

Infrastructure

In 1997, Mexico had 26,725 kilometers of railroads and 306,119 kilometers of roads. As part of the Toll Highway Program that began in 1989, more than 5,680 kilometers of new highways were being constructed. In addition, private companies were constructing 33 toll highways, 1,600 kilometers of roadways, and 4 bridges across the U.S. border with Mexico. While financing the expansion of 2,100 kilometers of highways to four lanes, the Government 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 modified regulations governing the trucking industry in 1990. 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, would be able to avoid transshipment delays at the border by transporting freight directly across national boundaries to

destinations in Chihuahua, Coahuila, Nuevo León, and Sonora. Mexican carriers had reciprocal rights to operate in Arizona, California, New Mexico, and Texas.

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

In 1997, Ferrocarriles Nacionales de México sold 25-year concessions on two of the three railroad lines auctioned as part of Mexico's privatization program (Wall Street Journal, 1997). The 711-kilometer (442-mile) Coahuila-to-Durango line concession was sold to a consortium between Peñoles and GAN for $23 million. The second 25-year concession, the 71-kilometer (44-mile) line from Tijuana to Tecate was awarded to the construction company Comunicación y Transporte de Tijuana for $10 million. This became possible in 1995 when the Mexican Congress approved the Constitutional ammendments permitting concessions of up to 50-year.

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%), coal (1.5%), geothermal wells (0.7%), and nuclear energy (0.5%).

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

References Cited

Cámara Minera de México, 1998, LXI Asamblea general ordinaria 1998 [LXI General ordinary assembly 1998]: Cámara Minera de México, June, 132 p.

Consejo de Recursos Minerales, 1998, Anuario estadístico de la minería mexicana 1997: Consejo de Recursos Minerales, August, 439 p.

Gaytan, J., 1997, Las Cuevas—A vision to the future: Industrial Minerals Fluorspar 1997, Shanghai, China, October 7-9, 26 p.

Grupo México, 1998, 1997 Annual company report: Grupo México, Mexico City, Mexico, 32 p.

Industrial Minerals,1997, Grafito de México update: Industrial Minerals, issue 362, November, p. 90.

———1998, Gypsum mine development by Yesera: Industrial Minerals, issue 364, January, p. 12.

Industrial Peñoles S.A. de C.V., 1998, 1997Annual company report: Mexico City, Mexico, 80 p.

Metal Bulletin Monthly, 1997, Boleo reveals large copper reserves: Metal Bulletin Monthly, No. 322, October, p. 84.

Metals & Minerals Latin America, 1997, Real de Monte—all set for a sixth century?: [London] Metal Bulletin September Supplement, June, p. 26-27.

North American Mining, 1997, Ahmsa coal output: North American Mining, August, p. 21.

Ordal, Steve, and Moya, Javier, 1995, The mineral industry in Mexico in 1994: U.S. Embassy Mexico City, Mexico, yearly report to U.S. Secretary of State, (undated), 24 p.

———1996, The mineral industry in Mexico in 1995: U.S. Embassy, Mexico City, Mexico, yearly report to U.S. Secretary of State, (undated), 25 p.

Petróleos Mexicanos S.A. de C.V., 1998, Memoria de labores 1997: Petróleos Mexicanos S.A. de C.V., March, 315 p.

Simonds, Katherine, and Moya, Javier, 1998, The mineral industry in Mexico in 1997: U.S. Embassy Mexico City, Mexico, yearly report to U.S. Secretary of State, (undated), 36 p.

U.S. Bureau of Mines and U.S. Geological Survey, 1980, Principles of a resource/reserve classification for minerals: U.S. Geological Survey Circular 831, 5 p.

Wall Street Journal, 1997, Mexico sells rails concessions: Wall Street Journal, October 16, p. A15.

Major Sources of Information

Asociación de Ingenieros de Minas, Metalurgistas y Geólogos de México, A.C.
Jaime Torres Bodet No. 176
Colonia Santa María La Rivera
06400 México, D.F., Mexico
Telephone: (52) 5 547-1094, 547-1473
Fax: (52) 5 547-0707

Asociación Mexicana del Cobre, A.C.
Sonora No. 166, Piso 1, Colonia Roma
06100 México, D.F., Mexico
Telephone: (52) 5 553-4191, 533-4441
Fax: (52) 5 286-7723

Cámara Minera de México
Sierra Vertientes 369
Lomas de Chapultepec
11000 México, D.F., Mexico
Telephone: (52) 5 540-6788, 540-6789
Fax: (52) 5 540-6061

Cámara Nacional del Cemento, A.C.
Leibnitz No. 77
Colonia Anzures
11590 México, D.F., Mexico
Telephone: (52) 5 533-2400, 533-0132

Cámara Nacional de la Industria del Hierro y del Acero, A.C.
Amores No. 338
Colonia del Valle
03199 México, D.F., Mexico
Telephone: (52) 5 543-9113, 543-4443

Consejo de Recursos Minerales
Blvd. Felipe Angeles
Carretera México-Pachuca, Km. 93.5
42080 Pachuca, Hidalgo, Mexico
Telephone: (52) 771 14266, 14244
Fax: (52) 771 13938, 13252

Fideicomiso de Fomento Minero
Puente de Tecamachalco No. 26
Colonia Lomas de Chapultepec
11000 México, D.F., Mexico
Telephone: (52) 5 540-2588, 540-3400
Fax: (52) 5 520-7730

Instituto Mexicano del Aluminio A.C.
Bosques de Ciruelos No. 130, Piso 4
Colonia Bosques de las Lomas
11700 México, D.F., Mexico
Telephone: (52) 5 531-2614, 531-7892
Fax: (52) 5 531-3176

Instituto Nacional de Estadística, Geografía e Informática
Francisco Sosa No. 383
Esq. Salvador Novo
Colonia del Carmen
04000 México, D.F., México
Telephone: (52) 5 554-1495, 554-1905

Secretaría de Comercio y Fomento Industrial
Dirección General de Minas
Morena No. 811
Colonia Narvarte
03020 México, D.F., Mexico
Telephone: (52) 5 639-5076, 639-4575
Fax: (52) 5 639-7555, 639-3327

Secretaria de Energía
Ave. Insurgentes Sur 552
Colonia Roma Sur
06769, México, D.F., Mexico
Telephone: (52) 5 564-9640, 564-9759

Sindicato Nacional de Trabajadores Mineros, Metalúrgicos y Similares de la República Mexicana
Dr. Vertiz No. 668
Colonia Narvarte
A.P. 12-872
03020 México, D.F., Mexico
Telephone: (52) 5 519-2992, 519-5690

Sociedad Geológica MexicanaJaime Torres Bodet No. 176
Colonia Santa María La Rivera
06400 México, D.F., Mexico
Telephone: (52) 5 567-8261, 368-4565

U.S. Embassy—Mexico City
Ing. Javier Moya
Economic Section
Paseo de la Reforma, 305
México 5, D.F., Mexico
Telephone: (52) 5 211-0042, ext. 3142
Fax: (52) 5 514-1187

Major Publications

Asociación de Ingenieros de Minas, Metalurgistas y Geólogos de México, A.C., Mexico City: GEOMIMET, bimonthly magazine.

Banco de México, Mexico City: Informe Anual, Annual Report.

Cámara Minera de México (CAMIMEX), Mexico City: Asamblea General Ordinaria, Annual Report.

Cámara Nacional de la Industria del Hierro y del Acero (CANACERO), Mexico City: Annual Report.

Consejo de Recursos Minerales, Mexico City: Anuario Estadístico de la Minería Mexicana, Annual Report.

Consejo de Recursos Minerales, Mexico City: Directorio de la Minería Mexicana 1997.

National Autonomous University of Mexico, Geological Institute Geological Map of the Mexican Republic, 1:2,000,000 scale, 5th edition.

Petróleos Mexicanos S.A. de C.V. (PEMEX), Mexico City: Indicadores Petroleros (Production and trade), monthly.

PEMEX, Memoria de Labores, annual report.

PEMEX, Statistical Yearbook, annual report.

Randol International Ltd., Mexican Mining Directory 1998, 248 p.

U.S. Bureau of Mines, Washington, DC: The Mineral Economy of Mexico, 1992, 150 p.

U.S. Embassy, Economic Section, Mexico City:
Minerals Questionnaire, annual.
Minerals Outlook Report, annual

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

(Metric tons unless otherwise specified)

Commodity 3/		1993	1994	1995	1996	1997
METALS						
Aluminum, metal:						
Primary		-- r/	--	10,413	61,458	66,358
Secondary		40,654 r/	145,216	128,618	84,982	123,179
Antimony:						
Mine output, Sb content		1,470	1,800 e/	266	--	849
Metal 4/		1,494 r/	1,758 r/	1,783 r/	983	1,909
Arsenic 5/		4,447 r/	4,440	3,620	2,942	2,999
Bismuth:						
Mine output, Bi content 6/		948 r/	1,047 r/	995 r/	1,070 r/	1,642
Metal, refined		690 r/	836	924	957	990
Cadmium:						
Mine output, Cd content		3,323 r/	2,579 r/	1,385	1,455	1,327
Metal, refined		797	646	689	784	1,223
Copper:						
Mine output, Cu content						
By concentration		277,069 r/	268,889 r/	294,647 r/	295,303 r/	342,319
Leaching (electrowon)		24,082 r/	25,799 r/	38,918 r/	45,407 r/	48,217
Total		301,151 r/	294,688 r/	333,565 r/	340,710	390,536
Metal:						
Anode and blister		281,627 r/	271,741 r/	274,356 r/	280,462 r/	348,290
Refined:						
Primary		156,300 r/	170,600 r/	179,400 r/	225,500 r/	282,000
Secondary		14,800 r/	26,500 r/	32,800 r/	16,500 r/	15,000
Total		171,100 r/	197,100 r/	212,200 r/	242,000 r/	297,000
Gold:						
Mine output, Au content	kilograms	9,792 r/	13,888 r/	20,292	24,477	26,001
Metal, refined	do.	6,093 r/	6,449 r/	8,355	8,635	26,030
Iron and steel:						
Iron ore, mine output:						
Gross weight	thousand tons	12,578 r/	9,193 r/	9,375 r/	10,182 r/	10,467
Fe content	do.	7,547	5,516	5,625	6,109	6,280
Metal:						
Pig iron	do.	3,423 r/	3,501 r/	4,142	4,230 r/	4,450
Direct-reduced iron	do.	2,737 r/	3,216 r/	3,700 r/	3,795 r/	4,440
Total	do.	6,160 r/	6,717 r/	7,842 r/	8,025 r/	8,890
Ferroalloys: 7/						
Ferromanganese	do.	119 r/	117	109	126 r/	132
Silicomanganese	do.	63 r/	72	77	105 r/	117
Ferrosilicon	do.	(8/)	--	--	--	--
Other	do.	(8/)	--	--	--	--
Total	do.	182 r/	189	186	231 r/	249
Crude steel	do.	9,199 r/	10,260	12,147	13,172 r/	14,254
Rolled products 9/	do.	6,716 r/	7,598 r/	8,738 r/	10,341 r/	10,522
Lead:						
Mine output, Pb content		153,563 r/	170,322	164,348	173,831	174,661
Metal:						
Smelter:						
Primary 10/		182,468 r/	161,695 r/	166,862 r/	150,971 r/	169,510
Secondary (refined) e/		10,000	10,000	10,000	10,000	10,000
Total e/		192,468 r/	171,695 r/	176,862 r/	160,971 r/	179,510
Refined:						
Primary 11/		178,419 r/	160,734 r/	165,868 r/	150,395 r/	168,164
Secondary e/		10,000	10,000	10,000	10,000	10,000
Total e/		188,419 r/	170,734 r/	175,868 r/	160,395 r/	178,164
Manganese ore: 12/						
Gross weight		363,000	307,000	472,200	485,000	534,000
Mn content e/		135,000	112,300 r/	174,200	173,380	192,825
Mercury, mine output, Hg content e/		12	12	15	15	15
Molybdenum, mine output, Mo content		1,710	2,610	3,883	4,210 r/	4,841

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity 3/		1993	1994	1995	1996	1997
METALS--Continued						
Silver:						
Mine output, Ag content	kilograms	2,135,719 r/	2,214,638	2,324,348 r/	2,527,875	2,679,090
Metallurgical products, Ag content:						
In copper bars	do.	409,000	469,712 r/	389,620 r/	375,325	378,557
Mixed gold and silver bars	do.	109,000	123,648 r/	169,744	240,677	243,188
Metal, refined, primary	do.	1,769,985 r/	1,696,283 r/	1,781,111	1,744,464	1,928,812
Other	do.	78,100	122,500 r/	108,762	175,998	149,828
Tin:						
Mine output, Sn content		3	3	1	2	5
Metal, smelter, primary		1,640	1,640	414	1,232 r/	1,183
Tungsten, mine output, W content		--	--	287	188	179
Zinc:						
Mine output, Zn content		369,697 r/	381,689 r/	363,658	377,599	379,252
Metal, refined, primary		209,931 r/	209,200	222,748	221,736	231,444
INDUSTRIAL MINERALS						
Abrasives, natural 13/		25,000 e/	25,000 e/	8,234	9,922 r/	10,457
Barite		135,891 r/	86,605	248,367	470,028	236,606
Cement, hydraulic	thousand tons	27,141 r/	29,674 r/	24,042 r/	25,366	27,548
Clays:						
Bentonite		94,584 r/	92,476	72,599	69,810 r/	111,503
Common		4,236,345 r/	4,553,635	3,697,053	4,048,458 r/	5,078,048
Fuller's earth		36,068 r/	21,377	15,755	41,800 r/	51,430
Kaolin		215,510 r/	193,034	221,685	253,602 r/	135,278
Diatomite		46,077 r/	52,100	50,200	52,494	59,463
Feldspar		123,512 r/	133,441	121,779	139,972 r/	155,760
Fluorspar:						
Acid-grade	thousand tons	187	129	270	279	291
Metallurgical-grade	do.	93	103	252	245	262
Submetallurgical-grade e/	do.	3	3	--	--	--
Total	do.	283	235	522	524	553
Graphite, natural:						
Amorphous		47,000 r/ e/	29,903	32,938	38,967	46,707
Crystalline		1,500 r/ e/	960 e/	1,450	1,445	1,275
Total		48,500 r/	30,863	34,388	40,412	47,982
Gypsum and anhydrite, crude (yeso)		5,339,746 r/	5,040,400 r/	4,854,339	6,064,682 r/	5,869,175
Lime, hydrated and quicklime e/	thousand tons	6,500	6,500	6,580	6,600	6,600
Magnesium compounds:						
Magnesite		1,530	1,120	250	200 r/	231
Magnesia e/ 14/		89,104 r/	82,286 r/	80,514 r/	83,526 r/	73,657
Mica, all grades		6,437 r/	5,753	5,028	4,273 r/	975
Nitrogen, N content of ammonia		1,760,000	2,030,000	1,992,000	2,053,900	1,448,300
Perlite		34,568 r/	31,918	33,529	37,417 r/	51,758
Phosphate rock 15/		501,254 r/	546,857	622,354	682,079	713,662
Salt, all types	thousand tons	7,491 r/	7,458 r/	7,670	8,508	7,933
Sodium compounds, n.e.s.: e/						
Carbonate (soda ash), synthetic		290,000 r/	290,000 r/	290,000 r/	290,000 r/	290,000
Sulfate, natural (bloedite) 16/		562,000 r/	565,000 r/	588,000 r/	603,000 r/	616,000
Stone, sand and gravel:						
Calcite, common		422,871 r/	389,749	362,715	325,199 r/	490,531
Dolomite		545,494 r/	588,000	931,770	929,933	902,710
Limestone	thousand tons	33,985 r/	36,020 r/	32,873 r/	37,641 r/	43,706
Marble		987,488 r/	1,086,237 r/	898,990	659,192 r/	516,805
Quartz, quartzite, glass sand (silica)		1,310,134 r/	1,360,549 r/	1,292,265	1,424,825 r/	1,564,348
Sand	thousand cubic meters	47,611 r/	50,982	45,086	55,344	60,104
Gravel	do.	43,700	44,899	37,970	40,179	43,636
Strontium minerals, celestite		71,903 r/	111,485 r/	138,342	141,142 r/	134,707
Sulfur, elemental:						
Frasch process	thousand tons	102	--	--	--	--
Byproduct:						
Of metallurgy e/	do.	311 r/	300 r/	359 r/	359 r/	417
Of petroleum and natural gas	do.	906 r/	877	882	921	923
Total e/	do.	1,319 r/	1,177 r/	1,241 r/	1,280 r/	1,340

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity 3/		1993	1994	1995	1996	1997
INDUSTRIAL MINERALS--Continued						
Talc		14,376 r/	14,900	11,134	10,100 r/	13,586
Vermiculite		300 r/	300	225	350 r/	295
Wollastonite		35,800	29,000	20,194	28,365	20,655
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Run-of-mine:						
Metallurgical	thousand tons	4,500	4,632	4,036	4,273	3,736
Steam	do.	5,720	6,800 r/	7,197	7,935 r/	7,487
Total	do.	10,220	11,432 r/	11,233	12,208 r/	11,223
Washed metallurgical coal e/	do.	1,710	1,800	1,800	1,800	1,800
Coke: 17/						
Metallurgical	do.	1,890	1,933	2,097	2,141	2,100
Imperial	do.	3	3	--	--	--
Breeze	do.	49	49	51	43	37
Total	do.	1,942	1,985	2,148	2,184	2,137
Gas, natural:						
Gross	million cubic meters	37,000	37,492	38,879	43,507	46,169
Marketed e/	do.	35,700 18/	36,000	36,000	41,000	42,000
Petroleum:						
Crude	thousand 42-gallon barrels	976,000	980,025	955,205	1,043,170 r/	1,103,030
Condensate e/	do.	1,500	1,500	1,500	1,560	1,500 e/
Total	do.	977,500	981,525	956,705	1,044,730 r/	1,104,530
Refinery products:						
Liquefied petroleum gas	do.	21,500	24,100	22,265	22,630	13,870
Motor gasoline	do.	152,000	157,000	154,395	152,205	141,620
Jet fuel	do.	26,300	27,000	25,550	22,630 r/	20,440
Kerosene	do.	3,650	3,290	2,190 r/	2,555 r/	1,095
Distillate fuel oil (diesel)	do.	97,500	104,000	93,075 r/	98,550 r/	100,375
Lubricants	do.	2,560	2,560	2,555	2,555 r/	2,190
Residual fuel oil	do.	162,000	156,000	152,205 r/	152,570 r/	155,490
Asphalt	do.	8,760	11,700	10,950	8,395 r/	9,490
Other, refinery fuel, and losses	do.	20,700	24,400	24,090	21,170 r/	21,170
Total	do.	494,970	510,050	487,275 r/	483,260 r/	465,740

e/ Estimated. r/ Revised.

1/ Data previously published for 1993 and 1994 were rounded by the U.S. Bureau of Mines to three significant digits. With very few exceptions, data in the present table have been unrounded to their original state.

2/ Table includes data available through October 28, 1998.

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 by Cámara Nacional del Hierro y del Acero. Cía. Minera Autlán reported salable production of ferromanganese, in tons: 1995--58,000; 1996--69,000; and 1997--68,000. For ferrosilicion, Autlán reported, in metric tons, the following: 1995--67,700; 1996--93,000; and 1997--105,000.

8/ Less than 1/2 unit.

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

10/ Lead content of impure bar, antimonial lead, plus refined metal.

11/ Includes lead content of antimonial lead.

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

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

14/ Reported by Industrias Peñoles S.A. de C.V. as the only major producer.

15/ Includes only output used to manufacture fertilizers.

16/ Series reflects output reported by Industrias Peñoles plus an additional 40,000 tons estimated output by other producers.

17/ Includes coke made from imported metallurgical coal.

18/ Reported figure.

TABLE 2
MEXICO: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(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		Cía. Minera y Refinadora Mexicana S.A. (private Mexican, 51%; Cookson Ltd., 49%)	San José mine, Catorce, S.L.P.	365.
Barite		Barita de Sonora S.A. (Grupo Acerero del Norte S.A. de C.V., 100%)	Mazatán, Son.	219.
Do.		Cía. Minera Capela S.A. de C.V. (Peñoles, 100%)	La Minita mine, Chinicuila, Mich.	NA.
Do.		Minerales y Arcillas S.A. de C.V. (private Mexican, 100%)	the San Francisco del Huerto mine in San Pedro, Coah., La Escondida and Angelita mines and plant in Galeana	55.
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.; Torreón, Coah.; Huichiapan, Hgo.; Valles, S.L.P.	8,970 (Monterrey group).
Do.		Cementos Anahuac S.A. (Cementos Mexicanos, 100%)	León, 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.	9,000.
Do.		Cooperativa Manufacturera de Cemento Portland La Cruz Azul S.C.L. (private Mexican, 100%)	Jasso, Hgo.; La Cruz Azul, Oax.	5,600.
Do.		Cementos de Chihuahua S.A. de C.V. (private Mexican, 100%)	Chihuahua and Cuidad Juarez, Chih.	1,900.
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.		Carbonífera de San Patricio S.A. de C.V. (private Mexican, 100%)	Progreso, Coah.	1,314.
Do.		Industrial Minera México S.A. de C.V. C.V. (Grupo Minero México S.A. de C.V., 100%)	Nueva Rosita, Coah.	1,500.
Do.		Minera Carbonífera Río Escondido S.A. (MICARE) (Grupo Acerero del Norte, 51%; Mission Energy, 49%)	Mina I, Mina II, and Tajo I at Nava and Piedras Negras, Coah.	4,000.
Copper		Mexicana de Cobre S.A. de C.V. (Grupo Minero México S.A. de C. V.,96.4%)	La Caridad mine and smelter at Nacozari de García, Son.	300 smelter, 22 SX-EW. 180 refinery
Do.		Mexicana de Cananea S.A. de C.V. (Grupo Minero México S.A. de C.V., 98.5%)	Mine and smelter at Cananea, Son.	60 smelter, 33 SX-EW.
Ferroalloys		Cía. Minera Autlán S.A. de C.V. (Grupo Ferrominero, 54%; Minas de Basis S.A. de C.V. , 32%, Broken Hill Property Co. Ltd. , 14%)	Plant in Tamós, Ver. Plant in Teziutlan, Pue. Plant in Gómez Palacio, Dgo.	140 . 38. 35.
Fluorspar		Cía. Minera Las Cuevas S.A. de C.V. (Grupo Industrial Camesa S.A. de C.V.) 2/	Salitera (Zaragoza), S.L.P.	520.
Do.		Fluorita de México S.A. de C.V. (Corp. Alfil, 51%; Applied Industrial Minerals Corp., 49%)	Mines at La Encantada district and plant at Muzquiz, Coah.	150
Gold	kilograms	Cía. Fresnillo S.A. de C.V. (Industrias Peñoles S.A. de C.V., 60%; AMAX, 40%)	Fresnillo mine, Zac.	1,866.
Do.	do.	Minas de San Luis S.A. (Industriales Luismín, 100%)	Tayoltita and Santa Rita, Dgo; San Antonio, Sin.; San Martín, Qro.,; La Guitarra, Mex.	2,700.
Do.	do.	Cía. Minera de Santa Gertrudis (Grupo Ariztegui, 51%; Phelps Dodge, 49%)	Santa Gertrudis mine, Son.	1,600.
Do.	do.	Exploraciones El Dorado S.A. de C.V. (70%), Minerales Sotula (30%)	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.	Cía. Minera las Torres S.A. de C.V. (Industrias Peñoles S.A. de C.V., 100%)	Guanajuato, Gto.	730.

See footnotes at end of table.

TABLE 2--Continued
MEXICO: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities 1/	Annual capacity
Gold--Continued: kilograms	Cía. Minera El Cubo S.A. de C.V. (private Mexican, 100%)	Guanajuato, Gto.	128.
Do. do.	Sociedad Cooperativa Minero Metalúrgica Santa Fe de Guanajuato (private Mexican, 100%)	do.	438.
Graphite	Grafitos Mexicanos S.A. (Cummings Moore Graphite Co. of U.S., 25%; private Mexican, 75%)	Lourdes and San Francisco mines, Son.	60.
Gypsum	Cía. Occidental Mexicana S.A. (private Mexican, 51%, Domtar, Ltd. of Canada, 49%)	Santa Rosalía on San Marcos Island, B.C.S.	2,500
Iron ore	Consorcio Minero Benito Juárez Peña Colorada S.A. de C.V. (Grupo Acerero del Norte, 29%; ISPAT Inernational, 29%; Hylsa de México S.A. de C.V., 42%)	Peña Colorada mine and pellet plant near Manzanillo, Col.	3,000.
Do.	Siderúrgica Lázaro Cárdenas-Las Truchas, S.A. (SICARTSA) (Grupo Villacero, 80%; Government, 20%)	Ferrotepec, Volcán, and Mango deposits in Las Truchas project area and pellet plant, Mich.	1,900.
Lead and zinc	Industrial Minera México S.A. de C.V. (Grupo Minero México S.A. de C.V., 100%)	Charcas, S.L.P.; San Martín, 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), 113 refined zinc.
Do.	Industrias Peñoles S.A. de C.V. (private Mexican, 97%; private U.S., 3%)	Mines at La Encantada, Coah.; Fresnillo, Zac.; Naica, Chih.; Bismark, Son; Rey de Plata, Gro. (Peñoles, 60%; Outokumpu, 40%); metallurgical complex at Torreón, Coah., with silver, lead, and zinc smelter and/or refineries operated by Met-MexPeñoles (Peñoles, 100%)	50 (lead), 130 refined zinc.
Do.	Minera San Francisco del Oro S.A. de C.V. (Empresas Frisco, S.A. de C.V., 100%)	San Francisco del Oro, near Hidalgo del Parral, Chih.	15 (lead). 21 (zinc).
Do.	Minera Real de Angeles S.A. de C.V. (Empreses Frisco, S.A. de C.V., 100%)	Noria de Angeles, Zac.	45 (lead). 47 (zinc).
Manganese	Cía. Minera Autlán S.A. de C.V. (Grupo Ferrominero, 54%; Minas de Basis, S.A. de C.V., 32%,; Broken Hill Property Co. Ltd. , 14%)	Molango mine and Nonoalco mine, Hgo.	586 ore and concentrate
Molybdenum	Mexicana de Cobre S.A. (Grupo Minero México S.A. de C.V., 100%)	La Caridad mine, Molybdenum plant, Son.	6.
Petroleum thousand 42-gallon barrels per day	Petróleos Mexicanos S.A. de C.V. (PEMEX) (Government, 100%)	Comalcalco, Poza Rica, Ver., and Gulf of Campeche, Cam. districts	3,500. 3/
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 Peñoles S.A. de C.V. (private Mexican, 97%; private U.S., 3%) 4/	Naica, Chih.; Fresnillo, Zac.; Las Torres, Gto.; Cuale, Jal.; La Negra, Qro.; La Encantada, Coah.; La Minita, Mich.	654,000.
Do. do.	Industrial Minera México S.A. de C.V. (IMMSA) (Grupo Minero Mexico, 100%)	San Martín 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. (Empresas Frisco S.A. de C.V., 100%)	Open pit mine and concentrator at Noria de Angeles, Zac.	924,000.
Sodium sulfate	Química del Rey, S.A. de C.V. (Industrias Peñoles S.A. de C.V., 100%)	Plant at Laguna del Rey, Coah.	620.
Steel	Altos Hornos de México S.A. (AHMSA), S.A. de C.V. [Grupo Acerero del Norte (GAN), 100%]	Steelworks at Monclova, Coah. (iron ore from Peña Colorada mine in Col.)	3,900.
Do.	Hylsa de México S.A. de C.V. (Grupo Industrial ALFA, 100%)	Direct-reduction units at Monterrey, N.L., and Puebla, Pue., (Iron ore from Cerro Nahuatl mine in Col.)	3,100.
Do.	Siderúrgica Lázaro Cárdenas-Las Truchas S.A. de C.V. (SICARTSA) (Grupo Villacero, 80%; Government, 20.	Port of Lázaro Cárdenas, Mich.	1,300.
Do.	ISPAT Mexicana S.A. de C.V. (IMEXSA) (ISPAT International, 100%)	SICARTSA II Plant Facilities at Lázaro Cárdenas, Mich.. plus 29% share in the Peña Colorada mine, Col.	2,000 .

See footnotes at end of table.

TABLE 2--Continued
MEXICO: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities 1/	Annual capacity
Steel--Continued:.	Tubos de Acero de México S.A. (TAMSA) (private Mexican, 100%)	Veracruz, Ver.	1,000.
	100%)		
Sulfur	Petróleos Mexicanos S.A. de C.V. (PEMEX)	Nationwide petroleum operations	890,000.
Tin 5/	Metales Potosí S.A. de C.V. (private Mexican, 100%)	San Luis Potosí, S.L.P.	15.
Do.	Mexiestaño S.A. de C.V.	do.	4.

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/ Grupo Industrial Camesa S.A. de C.V. is owned by Banco Internacional (34%), Banco del Atlántico (34%), Banamex (17%), Noranda Inc. of Canada (4%), Free Float (12%).
3/ PEMEX operates nine refineries with an installed capacity of 1.68 million barrels per day.
4 Includes capacity from Cía. Fresnillo S.A. de C.V.
5/ Smelter output from mostly imported concentrates.

TABLE 3
MEXICO: RESERVES OF SELECTED MINERAL COMMODITIES IN 1996

(Thousand metric tons unless otherwise specified)

Commodity 1/		Reserves
Antimony		180
Barite		7,000
Bismuth	metric tons	10,000
Cadmium	do.	35,000
Copper		14,000
Fluorspar 2/		19,000
Gold	metric tons	450
Gas, natural 3/	billion cubic meters	10,160
Graphite, natural		3,100
Iron ore	million metric tons	690
Lead		1,000
Manganese		4,000
Mercury	metric tons	5,000
Molybdenum	do.	90
Petroleum, crude 3/	million 42-gallon barrels	48,475
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 1996. Source: Petroleos Mexicanos 1997.
4/ Sulfur in all forms.