

MEXICO

By Victor Flores

Despite the slowdown in global economic growth and its impact on the Mexican economy, Mexico's mining sector posted some notable gains relative to 2000, and the production of key mineral products actually rose in the year 2001. Gold output rebounded despite the weak gold price and the depletion of several deposits, while silver production also posted a healthy increase of almost 14%, reversing a three-year downtrend.

The base metals sector turned in a much-improved performance, with a 20% increase in lead production and a slight gain in zinc output (+3%), although copper production did decline (-9%). Other base metals were also mixed, with a decline in arsenic, gains in bismuth and cadmium, but decreasing production of molybdenum.

The production of non-metallic minerals was also mixed, with increased output of feldspar (+36%) and phosphates (+5%). Barite production, which has been in a downtrend since 1997, declined by 14%, while graphite production declined by 17%. Fluorspar and sulphur production both posted a rebound, with gains of 16% and 3%, respectively.

The country's economy suffered during 2001 as a result of the slowdown in the US and Europe, and to a certain extent as a result of the problems in other Latin American countries. The country's GDP is estimated to have shrunk by 1.0% in 2001, a sharp decline from the 6.9% growth achieved in 2000. A small improvement is expected for 2002, with GDP growth estimates of the order of 0.5%. Inflation, fortunately, fell in tandem with the economic slowdown, at 4.4%, compared to 9.0% in 2000, and the lowest level achieved in recent memory. The government's plan to maintain a small budget deficit in order to help the economy along was affected by the

slowdown, but the government managed with a modest budget deficit (as a percentage of GDP) of 1.5% in 2001. The rise in oil prices has certainly helped the country's financial situation, and the deficit is expected to narrow to 1.0% in 2002.

The peso/dollar exchange rate, which averaged MP9.5 to the dollar in 2000, strengthened to MP9.3 to the dollar in 2001, and by year-end was trading at approximately MP9.2. The return from portfolio investments and strong exports have helped arrest the slide in the currency.

For the first time, the ruling PRI has lost a presidential election since its formation in the late 1920s, and Ernesto Zedillo was replaced by Vicente Fox who represents the National Action Party (Partido Acción Nacional). With the election of the country's first president from an opposition party, the industry has made a series of proposals with respect to mining taxation aimed at improving the country's competitive position vis-à-vis other mining countries. The proposals touch on areas such as accelerated depreciation, fiscal stability agreements, and tax credits for exploration.

Mexico's mining regulations have completely opened the mining sector to foreign and domestic investment. Exploration concessions are now granted for a period of six years, but may not be extended. Exploitation concessions are now good for 50 years and can be extended for a like period. In addition, the exploitation concession also confers the right to process and beneficiate any minerals recovered. Mining and exploration leases are now granted in less than six months, and leases are freely tradable. The previous restriction on the exploration for, and development of, sulphur, phosphates, potash, iron ore and coal have been lifted, as have been the previous

restrictions on exploration along the country's coastline and continental shelf, international borders, islands, and reefs.

The Dirección de Minas, responsible for regulating the mining industry, is now part of the recently renamed Secretaría de Economía (formerly Secretaría de Comercio y Fomento Industrial, SECOFI). The Dirección General de Promoción Minera promotes the development of the mining industry by providing investors with general information about the country's mining industry, guidance for investors and studies on the Mexican and international mining industry.

The Consejo de Recursos Minerales, or Mineral Resources Council (CRM), continues the process of transferring its leases to the private sector, as part of its goal of becoming purely a geological survey. The CRM has even set up a computer database that allows parties interested in mineral exploration to obtain information on potentially attractive properties. This database is managed by the Centro de Documentación Sobre los Recursos Minerales, CEDOREM. The country's register of mining leases is also on a computerised database. The CRM continues to pursue an aggressive mapping programme designed to provide geological and geochemical information of the country's most prospective ground on a 1:50,000 scale. The Fideicomiso de Fomento Minero provides financing for the small and medium-size mining companies.

The government continues to reduce the number of hectares of prospective exploration ground held within the National Mining Reserve system, aided by a new set of bidding procedures established by SECOFI.

The Cámara Minera de México, Mexico's Chamber of Mines, represents the interests of Mexico's private mining sector. At present, one of the chamber's principal priorities is to work with the regulatory agencies to establish clear, fair environmental laws. The Chamber now sponsors symposia every two years on

ecology and mining, and has concluded agreements with the National Environmental Institute (Instituto Nacional de Ecología) to implement measures to reduce lead emissions in accordance with guidelines issued by the OECD.

The Chamber also participated in the discussions that led to the amendments to the country's environmental protection laws (Ley General del Equilibrio Ecológico y Protección al Ambiente-LGEEPA). The amendments require an environmental risk assessment and a programme to mitigate accidents, as well as increased penalties for violations of the LGEEPA. The Chamber also contributed to the development of regulations concerning effluent standards and emissions of diesel-powered vehicles. The chamber continues to work with the authorities to develop standards for the siting, design, construction, and operation of tailings dams, and the creation of specific environmental regulations for exploration projects. The proposal by SEMARNAP for the creation of the 800,000 ha Maravi biosphere in Sonora is being condemned by the sector, as it would affect ongoing minerals exploration and development in several important mining districts, including Cananea and Nacozari.

With respect to taxation, the Chamber continues to lobby for the elimination of the asset tax during the pre-production period. On the transportation and infrastructure front, the mining industry originally applauded the much awaited privatisation of Ferrocarriles Nacionales, the government railroad monopoly, but is now lobbying against what it claims are indiscriminate rate hikes. The Chamber continues to fight against proposed changes to the rules governing the classification of roadways and the allowable weight of freight trucks. The Chamber continues to work with the governmental entity responsible for regulating explosives in order to reduce the restrictions on the use of explosives in mining. The Chamber recently successfully lobbied the government to renew the diesel tax credit for the mining sector

(Impuesto Especial sobre Producción y Servicios). The industry also obtained a renewal of the favourable water use fees for the mining sector.

The Chamber has also initiated a programme to work more closely with agrarian communities located in those areas where exploration and mining take place. The strong increase in exploration activity has led to instances of friction between owners of surface rights and the mining companies. Some of these conflicts are due to ambiguous interpretations between the Agrarian Law (Ley Agraria) and the country's mining law. This remains a priority issue for the mining sector.

Mexico's mining industry can be broadly divided into three categories, large domestic producers, small domestic producers, and foreign firms. A fourth category, state-owned mining companies, disappeared with the last of the privatisations in 1993.

There are four large domestic producers operating in Mexico - Industrias Peñoles, a diversified producer of precious and base metals and the world's largest producer of refined silver; Grupo México, also a diversified producer, responsible for over 90% of the country's copper production; Empresas Frisco, also a diversified producer of precious and base metals; and Luismin, the smallest of the four and devoted exclusively to precious metals.

Mexico is an important producer of a number of mineral products. It is ranked number one for the production of silver, bismuth, and celestite, and is one of the world's top five producers of fluorspar, arsenic, cadmium, graphite and molybdenum. Mexico ranks among the world's top ten in the production of barite, manganese, salt, lead, and zinc. Mexico's exports of mineral products (including value-added beneficiation) reached US\$1.97 billion in 2001, whilst imports totalled US\$1.58 billion, providing the country with a positive balance on mineral products of US\$389 million.

Copper

After posting significant growth in previous years, Mexico's copper production declined in 2001, totalling 343,446 t, a decrease of 9%. The country's two largest producers, Cananea and La Caridad are located in the north of the state of Sonora. Both operations are part of Grupo México, which in 2001 struggled with low commodity prices in the aftermath of its hostile take-over of US-based Asarco in 1999. Funded partially with debt, the company was unable to meet scheduled interest and principal repayments due to the low price of copper. Despite this setback, production was largely unaffected. With the completion of the smelter and refinery complex at the nearby La Caridad mine, production at Cananea remained steady at 137,274 t during 2001. The orebody has a reserve estimated at 1,600 Mt grading 0.61% Cu, plus an additional 1,550 Mt of leach material grading 0.26% Cu. The project's SX-EW capacity is currently 35,000 t/y, but this is expected to increase to 85,000 t/y with the construction of additional capacity. Schedule for completion by the end of the year 2000, delays pushed back the start up to August 2001.

A strike at Cananea in late 1998 prompted the closure of the smelter, which was due to be closed as part of the environmental protocols that accompanied the signing of the North American Free Trade Agreement (NAFTA). Production at La Caridad improved by 2%, to 167,306 t, in 2001. This deposit has a reserve of 426 Mt at an average grade of 0.52% Cu and leach ore totalling 187 Mt averaging 0.24% Cu. The concentrator has a capacity of about 170,000 t/y and the new SX-EW facility has the capacity to produce 22,000 t/y of copper cathode.

The smelter at La Caridad began to produce at its expanded capacity of 300,000 t/y at the beginning of 1997. The expansion includes the construction of new sulphuric acid and oxygen plants. In addition to the expansion of La Caridad smelter, Grupo México completed work on the copper refinery, with annual capacity of 300,000 t, which reached full

capacity in early 1999. The facility is adjacent to the smelting facilities at La Caridad and will also include a gold and silver refinery, and a copper rod plant. Grupo México, through its IMMSA subsidiary, also operates a copper smelter in the city of San Luis Potosí.

The state of Zacatecas is also an important copper producer, boasting production from Industrial Minera México's polymetallic operation at Sombrerete, where copper production increased to 22,620 t in 2001. In Chihuahua, production is centred at Santa Bárbara (8,513 t in 2001, an increase of 10%), the polymetallic San Francisco del Oro deposit (94 t, compared with 1,350 t the previous year) operated by Empresas Frisco, and Fresnillo's Naica operation in Saucillo (virtually unchanged at 2,484 t). Output at Industrial Minera México's polymetallic operation at Charcas in San Luis Potosí rebounded strongly, to 16,042 t, after a period of declining production. Minor copper production was reported by the states of Durango, Hidalgo, Michoacán, the state of Mexico, and Sinaloa.

Grupo México owns El Arco, a deposit located in Baja California. The deposit has a reserve of 1,000 Mt averaging 0.50% Cu and 0.2 g/t Au, containing both sulphide and oxide ores. The original development plans envisioned an operation treating 2.1 Mt/y to produce a sulphide concentrate. A development decision continues to be deferred as a result of low metals prices. Peñoles continues to advanced the Milpillas project in Sonora, which now has an indicated resource of 30 Mt averaging 0.25% Cu. The company expects to complete a prefeasibility by the end of 2001.

Gold and Silver

A favourable investment climate, coupled with a favourable financing environment, led to a boom in gold exploration in Mexico in 2000. However, a number of emerging producers have now shut down and there is a dearth of new development projects.

Despite continuing weakness in the gold price, production in 2001 rose to 24.9 t (800,599 oz),

although production from the state of Sonora, which had firmly held on to first place among Mexico's gold-producing regions, has fallen off dramatically. The Penmont joint venture, owned 56% by Peñoles and 44% by Newmont Mining, manages the state's largest producer, La Herradura near Puerto Peñasco on the Gulf of Cortez. This large, low-grade deposit has a proven and probable reserve of 47.3 Mt of ore at an average grade of 0.93 g/t Au. Production in 2000 totalled 124,000 oz at a cash cost of US\$160/oz.

At Peñoles' La Ciénega project, located in the state of Durango, production declined by about 13%, to 3.2 t in 2001. This project has a total reserve of 4.2 Mt at a grade of 5.85 g/t Au, 120 g/t Ag, 1% Pb and 0.8% Zn.

Empresas Frisco's San Felipe underground mine, located at the northern end of Baja California, produced 1.3 t of gold in 2001 (1.2 t in 2000), although by year-end the project's reserves were finally exhausted.

Luismin's San Martín mine in the state of Querétaro, which came on stream in 1993, produced approximately 1.0 t last year, while the company's La Guitarra mine in the state of Mexico produced 621 t.

Production from the state of Guanajuato is still centred around the Torres Mine, operated by Minera Las Torres, a subsidiary of Peñoles. Despite a declining reserve profile, production increased by 6% in 2001, to 3.1 t.

Gold is also produced as a by-product or co-product at many mines throughout the country, including Fresnillo's operations in Zacatecas, which produced 662 kg in 2001, Santa Bárbara in Chihuahua (239 kg), and Real del Monte near Pachuca in the state of Hidalgo (179 kg). Other gold production is derived from smaller operations in Durango and San Luis Potosí, usually as a by-product of silver production.

Minas de Bacis, operator of mines at El Herrero in the Otáez district of Durango

reported lower production of 1,045 kg. The Panuco de Colorado and Guanaceví districts (Durango) reported 2001 production of 168 kg and 50 kg, respectively. Gold by-product from the copper porphyry at Cananea fell again, to 302 kg, while by-product gold from La Caridad improved significantly, to 170 kg. The Villa de la Paz district (SLP) reported production of 1,173 kg in 2001, an improvement of 17% on the previous year.

A number of projects that led to Mexico's gold boom are now at the end of their lives. Geomaque Explorations, a Toronto-based company, completed mining at the San Francisco property north of Hermosillo, and is currently de-commissioning the operation. The project produced 17,092 oz in 2001. Residual leaching is expected to continue into 2002, but production will be nominal.

The recent improvement in the price of gold has turned the fortunes of a number of gold projects that had been on hold. Francisco Gold agreed to merge with Glamis Gold, which will conduct a new feasibility study for El Sauzal project in southwestern Chihuahua, one of Mexico's largest undeveloped gold deposits. An updated resource calculation completed at the end of 2001 indicates a proven and probable reserve of 1.65 Moz, based on an average grade of 3.47 g/t. Glamis will focus on a smaller scale open-pit project with annual production of 170,000 oz.

Metallica Resources and Glamis have continued working on the Cerro San Pedro project, near the city of San Luis Potosí, and in December 2000 the joint venture announced the results of an updated feasibility study. The project is based on a reserve of 49.2 Mt averaging 0.57 g/t Au and 23 g/t Ag. The feasibility study envisages a run-of-mine heap leach operation with production of 118,800 oz of gold equivalent, with cash costs of US\$129/oz gold equivalent and capital costs of US\$45 million. During 2001, the joint venture completed the construction and re-location of the village of La Zapatilla, although for the time being

further work has been largely suspended pending an improvement in metals prices.

Teck Corp. and Miranda Mining of Mexico City have identified geological resources in excess of 2.2 Moz on their joint venture ground in the state of Guerrero. Feasibility work is ongoing to confirm the extent of the reserve and to establish conceptual project economics for Los Filos, a project which contains an indicated resource totalling 55.0 Mt averaging 1.25 g/t Au. Miranda's adjacent Nukay project produced 16,500 oz in 2001 from the Nukay and La Agüita open pits. At the end of 2001 Teck announced the results of a drilling campaign to the north of Nukay on the Morelos Reserve, including significant near-surface and deeper intercepts.

Minefinders Corp. continued the economic evaluation of the Dolores project in southwestern Chihuahua during 2001. The gold and silver mineralisation at Dolores is associated with a series of brecciated and stockwork veined felsic dykes, and recent work has identified a number of higher-grade feeder structures. Drilling has better defined the resource into measured, indicated and inferred categories, and now includes economic parameters as well. The resource now totals 115.6 Mt averaging 1.42 g/t Au equivalent, and the mineralisation remains open along strike. Recent work has provided the company with a better geological model of the region, leading to the development of new targets.

Queenstake Resources has begun construction on the Magistral project in Sinaloa, which was acquired when the company merged with Santa Cruz Gold in 1999. The four open pits have a total reserve of 6.15 Mt averaging 1.86 g/t Au, with additional material contained in tailings. Moreover, recent drilling has extended the mineralisation. The project would produce 40,000 oz over seven years at a cash cost of US\$180/oz. The capital cost is estimated at US\$13.7 million. Queenstake has also exercised an option to acquire the Santa Gertrudis gold project in the state of Sonora

from Campbell Resources. The project has been on care and maintenance since late 2000 as a result of the low gold price, and Queenstake plans to use the equipment at Santa Gertrudis to develop Magistral.

The Mulatos project, located in the southeast corner of Sinaloa state, was sold by joint venture partners Placer Dome (70%) and Kennecott (30%) at the end of 2000. The project, renamed Salamandra, has a geological resource of 1.99 Moz (51.2 Mt at 1.2 g/t Au).

Cambior has written off its US\$14 million investment in the Metates property, where it is earning a 50% interest from Luismin. This large, low-grade deposit, located in the northwest corner of the state of Durango, hosts a resource of some 434 Mt averaging 0.75 g/t Au and 18.6 g/t Ag. The mineralisation is hosted by sediments, believed to be of Cretaceous age, and by quartz-feldspar porphyry.

Meanwhile, work has been suspended at the Paredones Amarillos project at the southern end of the Baja California peninsula. Echo Bay Mines sold its 60% interest in the project in October 1999 to partner Viceroy Resources for a 2% royalty and the joint venture's interest in the mill. The partners had outlined a reserve of 44.5 Mt at a grade of 1.1 g/t Au in La Paz crystalline complex.

Having completed a prefeasibility study on its Guadalupe de los Reyes gold property in Sinaloa, Northern Crown has sold the property to Meridian Gold. Northern Crown had reported a resource of 5.8 Mt averaging 1.35 g/t Au, but Meridian will now pursue the project as a low-tonnage, high-grade target.

The Penmont joint venture between Peñoles and Newmont Mining has suspended work on the Bermejil deposit at its Mezcala project in the state of Guerrero. Located less than 500 m from the Nukay/Teck deposit at Los Filos, reserves at Bermejil total 62.5 Mt averaging 0.8 g/t Au.

Despite the ongoing weakness in silver prices, Mexico's silver production in 2001 increased

by almost 14% to 2,824 t (90.8 Moz), primarily as a result of the expansion at Sabinas and the start-up of Rey de Plata. Peñoles' operations in Torreón account for some 1,500 t/y of refined silver.

Peñoles remains the country's largest silver producer, and production at its Proaño operation near Fresnillo in the state of Zacatecas totalled 695 t as a result of the project's expansion. Three vein systems - Santo Niño, San Ricardo, and San Mateo - are exploited by cut-and-fill methods, and during 2001 the expansion from 0.9 Mt/y to 1.2 Mt was completed.

Of Peñoles' other silver operations, the US\$40 million Rey de Plata mine in the Taxco region, a joint venture with Dowa Mining of Japan, boasts reserves of 2.9 Mt averaging 239 g/t Ag and 8% Zn. Commercial production commenced in the final quarter of 2000 for the production of 130 t of silver. Annual capacity is rated at 330,000 t of ore, but the project was put on care and maintenance in December 2001 as a result of low commodity prices.

Las Torres, in the state of Guanajuato reported production of 165 t, a decline of almost 10%, while output at Naica, in the state of Chihuahua, fell by 6%, to 148 t. In Hidalgo, the Zimapán mine contributed 39 t to Peñoles' silver output in 2001, although production at this operation declined by 19%. Production from Peñoles' gold-silver mine at La Negra near Cadereyta, Queretaro, was marginal. Reopened in 1995 at an annual rate of 300,000 t/y the project has exhausted its reserves.

Industrial Minera México is also an important producer of silver, although most of it is recovered as a by-product or co-product at its polymetallic operations. Production at the Charcas operation in the state of San Luis Potosí increased to 64 t in 2001 (50 t in 2000), while at Taxco in Guerrero, production also increased, to 59 t (50 t in 2000). Production at the operations in Chihuahua fell with respect to the previous year. Production at Santa Bárbara improved to 172 t, but production at San Francisco del Oro fell again to 2 t.

IMMSA's San Martín operation, also in Zacatecas near Sombrerete, reported an increase in production of almost 35%, to 212 t.

Production at the historic Real del Monte mine in the state of Pachuca continued to decline, falling to 42 t in the year 2001. Project operator Real del Monte Mining, part of the GAN Group, has suffered from a lack of working capital and is unlikely to proceed with previously announced expansion plans.

Real de Angeles, part of Grupo Frisco, remained closed during 2000 whilst Minas de Bacis, located in the state of Durango, produced 98 t, a 20% decline in production with respect to 2000.

Small mining operations produced a significant amount of silver, with the largely artisanal districts of Cuencamé, Guanaceví, Panuco de Coronado, and San Dimas in the state of Durango reporting slightly lower year-on-year combined output of 143 t.

Pan American Silver of Vancouver has announced ongoing work to develop La Colorada mine, in the state of Zacatecas. The company reported an updated measured and indicated resource of 4.1 Mt at 323 g/t Ag, hosted by veins, containing a proven and probable reserve of 2.8 Mt at 451 g/t Ag. Additional drilling has extended the deeper, replacement-style mineralisation, now totalling 5.0 Mt averaging 108 g/t Ag. The company is in discussions with the IFC to secure financing for the project. The total capital is estimated at US\$12 million. The company hopes to expand the mine to 800 t/d, with annual production of 3.8 Moz of silver.

Lead and Zinc

Mexico is one of the world's most important producers of lead and zinc. Year-on-year, zinc production in 2001 rose by 3% to 402,328 t as higher production at Charcas and Tizapa was offset by lower production at Zimapán, San Martín and other operations. Although a number of mines curtailed their operations as a result of low zinc prices, the start-up of

Peñoles' new Francisco I. Madero helped make up for these losses. The country's largest zinc producer is Charcas, in the state of San Luis Potosí, which produced 63,860 t last year, up from 59,180 t/y earlier. The San Martín mine in Zacatecas reported higher lower in 2001 of 52,178 t.

The Tizapa operation in the state of Mexico, a joint venture between Peñoles (51%) and Dowa Mining (49%), came on stream at the end of 1994 and has reserves of 3.2 Mt averaging 250 g/t Ag, 8.5% Zn and 1.3% Pb, plus minor amounts of gold. This underground operation produced 30,493 t of zinc in 2001, an improvement of almost 20% with respect to 2000.

Chihuahua remains the country's largest zinc-producing state. Peñoles' Bismark underground mine is the state's largest producer, and reported improved production of 51,293 t in 2001 (compared with production in 2000 of 45,880 t). This polymetallic skarn deposit has reserves of 3.75 Mt at an average grade of 6.7% Zn, 0.42% Pb, 0.39% Cu and 40 g/t Ag. A cut-and-fill mining method is employed to feed a 2,400 t/d concentrator. Elsewhere in Chihuahua, production at San Francisco del Oro fell to 1,608 t (21,785 t in 1999), as this operation was also closed pending a recovery in zinc prices. In contrast, the Santa Bárbara mine delivered improved production, reaching 44,551 t in 2001 (41,970 t in 2000). At Naica, in the Saucillo district of Chihuahua, zinc production in 2001 was largely unchanged at 31,901 t, while Grupo México's Santa Eulalia mine was placed on care and maintenance as a result of low prices, despite the benefits of a previously announced expansion.

The country's newest zinc producer, the Francisco I. Madero mine in the state of Zacatecas, started up on schedule in July of 2001. The orebody has reserves of 30 Mt averaging 5.2% Zn and 1.10% Pb, and at full capacity the mine will process some 3 Mt/y of ore for the production of 110,000 t/y of zinc. During 2002 the mine produced approximately

17,000 t, but by year-end was rapidly building up towards its rated production. The project was brought on stream at a total capital cost of US\$125.8 million, slightly below budget.

Mexico's lead production is estimated at 146,832 t in 2001, a year-on-year increase of 20.8%. The bulk of the country's lead is produced in the northern state of Chihuahua.

Production at Fresnillo's Naica unit in Saucillo declined somewhat in 2001, to 44,268 t (2000: 46,710 t), while output at Santa Bárbara improved to 20,809 t (2000: 20,245 t). In contrast, lead production at San Francisco del Oro fell to 856 t (1999: 10,930 t), as operations at the mine were curtailed. The same occurred at Santa Eulalia, which was closed. Production at this mine totalled 3,825 t in 2000. As previously mentioned, the Real de Angeles mine in Zacatecas also remained closed during 2001, having last been in operation in 1998.

Two other important lead producers are Zimapán in the state of Hidalgo and San Martín in the state of Zacatecas. Zimapán recovered from its 1999 slump, producing 22,364 t, while production at San Martín fell slightly to 8,765 t. The new Francisco I. Madero mine also contributed a small amount as the operation started up in mid-2001. The Charcas project in San Luis Potosí contributed an additional 4,891 t in 2001.

Peñoles is also Mexico's largest producer of refined lead and zinc. The company operates a refinery in Torreón, state of Coahuila, which includes a silver-lead refinery with annual capacity of 150,000 t and an electrolytic zinc refinery that can produce 220,000 t/y of zinc. This facility also recovers cadmium, bismuth, antimony, ammonium sulphate, sulphur dioxide and sulphuric acid. The company completed a US\$130 million expansion of the refinery at the end of 2000, which has lifted annual capacity to 220,000 t. The facility has been under scrutiny by the environmental authorities as a result of elevated levels of lead in the surrounding communities.

Industrial Minera México operates a zinc refinery in San Luis Potosí with the capacity to produce 100,000 t/y of high-grade zinc, as well as sulphuric acid and refined cadmium. The company's 85,000 t/y capacity lead refinery at Monterrey, in the state of Nuevo León, has been converted into a facility to recover gold and silver from anode slimes.

Teck Corp. and Western Copper Holdings continued to advance the development of the San Nicolás project in the state of Zacatecas. During 2001, the company completed a feasibility for the project but decided to defer a production decision as a result of low commodity prices. Teck has produced separate resource estimates for the upper (mineable by open-pit methods) and lower (requiring underground mining) massive sulphide orebodies. The open-pit resource to a depth of 500 m totals 73 Mt averaging 1.3% Cu and 1.9% Zn, plus precious metals credits, with a strip ratio of 4.3:1.

At the Campo Morado project in the state of Guerrero, Farallon Resources has suspended work on the precious metals-rich massive sulphide deposits pending the resolution of an ownership dispute.

Iron and Steel

As a result of the financial problems experienced by the country's principal producer, Mineral del Norte (Minosa), and the reduced global demand for steel, Mexico's iron-ore production declined to 5.54 Mt in 2001, compared with 6.79 Mt in 2000. Mexico's largest reserves of iron ore are found at Hércules (168 Mt) and Peña Colorada (131 Mt) and Peña Colorada, which has become the subject of a border dispute between the states of Colima and Jalisco (the state of Jalisco claims that the deposit falls within its state boundary).

The Hércules mine in the state of Coahuila produced 2.1 Mt in 2001. The development of a tailings retreatment project will allow the mine to expand its capacity, while the discovery of the Ulises deposit will extend the life of the project by over 20 years.

The Peña Colorada mine in the state of Colima has an annual capacity of 3.0 Mt of concentrates that are pelletised at the company's facilities at the nearby port of Manzanillo. Output at the pelletising plant totalled 2.06 Mt in 2001, virtually unchanged from the previous year. Las Truchas in the state of Michoacán, operated by a subsidiary of Villacero, reported unchanged production of 1.30 Mt.

Minosa, which had resumed operations at the Cerro de Mercado mine in the state of Durango during 2000, reported no production in 2000. The project has an annual capacity of 3.0 Mt and delivered production of 400,000 t during 2000. La Perla mine in the state of Chihuahua, which is also owned by Minosa, did not resume production in 2001. Las Encinas, in the state of Jalisco, was closed at the end of September 2000 and did not reopen during 2001. Reserves at Las Encinas have been increased to 157 Mt following the discovery of 24.3 Mt of additional mineralisation at Cerro Nahuatl.

Steel production fell slightly in 2001 to 13.29 Mt due to the slump in world-wide steel prices as a result of a slowing global economy, high natural gas prices, as well as a strengthening peso. Moreover, Mexican steel producers continue to claim that Asian and Eastern European steel producers are 'dumping' steel onto the Mexican market and have filed a request with SECOFI alleging that producers in 10 countries continue to sell steel products (primarily hot-rolled and cold-rolled sheet) at prices below fair market value. SECOFI did impose a 30.52% tariff on steel products from Ukraine last year.

The privatisation of the steel industry has resulted in the formation of five large steel producers and a handful of mini mill producers. Grupo Acerero del Norte (GAN) controls Altos Hornos de México (AHMSA) and Fundidora de Monterrey. The company's principal product is sheet steel, production of which fell to 2.80 Mt in 2001, whilst production of raw steel was slightly greater than 3 Mt and

accounted for 23% of national raw steel output. The start-up of a third blast furnace should see production increase during 2002.

In 1995, GAN purchased Aceros Nacionales (ANSA), the largest and most modern producer of steel wire in the Mexico City area, but this facility was sold to Grupo DeAcero for US\$68 million during 1998. In May 1999, GAN and AHMSA declared bankruptcy and were awarded protection from creditors whilst a financial rescue package was implemented. Spanish steel producer Aceralia was interested in entering a deal with AHMSA, but backed off upon closer examination of the company's financial status.

Ispat Mexicana was established when Indian interests purchased Siderúrgica del Balsas, part of the facilities that comprised the Siderúrgica Lázaro Cárdenas (Sicartsa II) complex. Ispat's main facilities include a 4 Mt/y pelletiser plant and two DRI plants with annual capacities of 2.3 Mt 1.5 Mt, respectively. The company's furnaces have the capacity to produce 5.3 Mt/y of liquid steel.

Ispat, which produces hot and cold-rolled sheet and steel slab, primarily for the export market, has signed a deal to supply 1 Mt of slab to galvanised steel producer Industrias Monterrey (IMSA). For its part, Industrias Monterrey (IMSA) plans to increase its production of hot-rolled steel to 2.2 Mt/y, and in the year 2000 announced the acquisition of BHP Steel's operations in the US.

Grupo Villacero purchased the Sicartsa I unit, and produced 1.75 Mt of steel products in 2001, primarily rebar, which is then processed further by the company's plants in Monterrey (Simisa), Guanajuato (Sibasa), Mexico City (Camsa), Veracruz (Metaver), and El Paso, Texas (Border Steel). The company's other production subsidiaries include Tubería Nacional (steel tubing), Cintacero (steel belts), and Zincacero (galvanised steel). Speciality products, primarily steel mesh, are produced by two subsidiaries, Viga Trefilados in Michoacán and Temple in Veracruz.

Hylsa, the steel-making subsidiary of Grupo Alfa, produces hot and cold-rolled sheet, galvanised steel, steel rod and rebar. The company's new direct reduction plant in Monterrey, completed during 1998 at a cost of US\$400 million, has an annual capacity of 700,000 t. The company also completed the expansion of its mini mill that will have an annual capacity of 1.5 Mt. Shipments of Hylsa's finished products fell slightly in 2001 to 2.34 Mt, down from 2.72 Mt in the year 2000.

Tubos de Acero de México (Tamsa) is Mexico's only producer of seamless steel pipe, used primarily in the petroleum industry. During 1995, Argentine seamless pipe producer Siderca acquired a 37% interest in Tamsa and took over management control, creating the world's second largest producer of seamless drilling pipe. The company produced 616,017 t of steel pipe in 2001, up from 535,963 t in 2000, as higher international drilling activity led to an increase in demand.

In October 1998, Tamsa concluded a strategic association with Venezuela's CVG to create a seamless-tube producer named Tubos de Acero de Venezuela (TAVSA) that will supply that country's oil industry. Sales at TAVSA increased to 41,658 t in 2001 from 38,905 t in 2000.

Several mini-mill firms are also producing a variety of steel products. Industrias Campos Hermanos (ICH) is a producer of speciality steels, steel alloys and welded pipe. The company's 120,000 t/y capacity mini-mill has been operating below capacity, as has the acquired 185,000 t/y welded pipe facility at Monclova, Nuevo León.

ICH completed the acquisition of an 82% stake in Grupo Simec for US\$285 million during the first quarter of 2001. Grupo Simec, a division of Grupo Sidek, produces both steel and aluminium products. The company has a total capacity of 840,000 t/y at its plants in Guadalajara, state of Jalisco, and Mexicali, state of Baja California Norte. The company's principal products are steel bars and rebar. Following the acquisition, ICH announced that it intends to invest US\$190 million in the company.

Manganese

Minera Autlán is Mexico's primary manganese producer. Having been a state-owned enterprise, the company was privatised in 1993. The purchaser, Grupo Ferrominero, committed to invest US\$66 million in the operation over the next five years as part of the purchase package. Despite the positive results following the privatisation, production has suffered as a result of weaker demand from the steel sector and high natural gas prices. Production in 2001 fell by 34% to 104,298 t.

The company's principal operations are located in the state of Hidalgo. The Molango deposit is a manganiferous limestone grading approximately 27% Mn, but the processing facilities (which produce manganese nodules) were shut down in November 2000 as a result of high natural gas prices. Early in 2001 the company announced that it had defaulted on its debt.

Elsewhere, the deposits in the Tetzintla area occur as manganese oxides and average 38% Mn. The company's mine at Terrenates, in the state of Chihuahua, produces ore with a high Mn:Fe ratio. The company produces ferroalloys at three different plants. The Tamós plant in the state of Veracruz produces silicomanganese and ferromanganese, as does the Gómez Palacio plant in Durango. The former benefited from an US\$8 million investment to boost production by 18,000 t/y, but was also shut down as a result of high fuel prices. The Tezuitlán plant in the state of Puebla produces silicomanganese.

Molybdenum

The majority of Mexico's molybdenum is produced as a by-product of copper production at La Caridad copper porphyry mine in Sonora, and molybdenum concentrates are exported to the US, the UK, the Netherlands, and Germany.

Output in 2001 is estimated at 5,478 t, a 19% decrease with respect to 2000. The country's molybdenum production had been

growing since 1997 as a result of the expansion of the molybdenum plant at La Caridad, prompted by an increase in the molybdenum grades being mined. The country's second producer is Molymex, located in the Cumpas district of Sonora.

Antimony

Antimony production continued to drop in 2001, falling by 61% (having declined 61% in 2000 and by 79% the previous year) to 93 t, and is now a fraction of the 1,800 t produced in 1995. Mexico's primary producer is Minera y Refinadora Mexicana, which mines stibnite ores in the Real de Catorce district in the state of San Luis Potosí. Antimony is also produced in the Tejocotes region of Oaxaca, and resources of this metal are known to occur in the states of Puebla, Sonora, and Zacatecas. Antimony trioxide is produced at Peñoles' facility in Bermejillo, Durango, and at Industrial Minera México's refinery in Monterrey. Production is exported primarily to the US.

Other Metals

Mexico is an important producer of a number of other ferrous and base metals. Arsenic production decreased slightly to 2,381 t in 2000 from 2,468 t in 2000 although output remains depressed, having reached a peak of 4,450 t in 1993. Arsenic is recovered from the refining of base metals at the Met-Mex refinery of Peñoles in Torreón and at Industrial Minera México's refinery in San Luis Potosí.

Mexico remains the world's largest producer of bismuth, even though production has been erratic in recent years. Bismuth is recovered from the processing of base and precious metals at the Met-Mex refinery in Torreón and by Industrial Minera México. From an output level of over 1,600 t in 1997, production in 1999 plunged to 560 t, then recovered to 1,080 t in 2000, and grew further to 1,391 t in 2001. As Mexico's consumption of bismuth is only around 50 t/y, the rest is exported, primarily to the US and Belgium.

Cadmium production recovered somewhat in 2001 at 1,436 t, but is still well below the 1,891

t recorded in 1997. The Charcas mine in the state of San Luis Potosí, and the San Martín mine in the state of Zacatecas account for the bulk of Mexico's production. Refined metal, meanwhile, is recovered at the Met-Mex refinery in Torreón and at Electrolítica de Zinc's refinery in San Luis Potosí. Cadmium oxide, once produced at Industrial Minera México's now-idled Chihuahua base metal refinery, is now recovered at Peñoles' facility at Bermejillo, in the state of Durango. Mexico consumes about 180 t/y of cadmium and exports the remainder.

Mexican tin production, which has declined dramatically in the past decade, remains at depressed levels. Having once produced 600 t/y, production in 2001 was only 7 t. Tin is recovered as cassiterite from small alluvial operations.

Mexico's tungsten production has plummeted. Having produced 173 t in 1997, no production has been reported since 1999.

Barite and Celestite

Mexico's production of barite, which had bounced back in 2000, fell again in 2001, to 134,179 t. The largest consumer of Mexican barite has and continues to be the state-owned oil company, Petróleos Mexicanos, national capacity, at 400,000 t, was developed solely to satisfy Pemex's ambitious oil exploration and development plans. Declining oil prices and the government's drive to reduce public spending severely curtailed the level of exploration, which in turn has reduced the domestic demand for barite.

Baramín produced 100,900 t at its facilities in Galeana in the state of Nuevo León, a 9% increase with respect to 2000. The remaining producers are Barita de Santa Rosa and Barita de Parral, in Coahuila, which contributed 14,087 t during 2001. Barita de Sonora, one of the country's primary producers, has been suspended since 1998.

Celestite production declined slightly after experiencing several years of growth driven

by strong demand from the electronics sector and an improved competitive position due to the devaluation of the currency. Mexico is the world's largest producer of celestite, accounting for some 25% of global production, and output in 2001 totalled 138,121 t. Celestite is produced by Estroncio de México at its Cuatrociénegas facility and by Minas de Estroncio at its Coahuila unit, both in the state of Coahuila.

Production of strontium carbonate for export takes place at a facility in the city of Reynosa along the border with the US. This operation has a capacity of over 22,000 t/y. Minera La Valenciana, in the state of Coahuila, is the country's primary producer of this strontium mineral, which is refined to strontium carbonate at the company's facilities in Torreón.

Fluorspar

Mexico's production of fluorspar grew by 15.8% to 629,637 t in 2001. Although still well below the country's peak output of nearly 1.0 Mt during the 1980s, the strength in worldwide demand for acid-grade fluorspar for the production of the new generation of refrigerants has helped improve Mexico's competitive position. The two principal producers in San Luis Potosí are Minera Las Cuevas and Fluorita de Río Verde, and the companies' operations produced 463,635 t in 2001, an increase of 18% over 2000, although by the end of the year production was being curtailed.

Minera Las Cuevas, Mexico's largest producer of fluorspar, operates a high-grade operation with a capacity of 430,000 t/y. In response to demand for higher quality concentrates, the company has invested US\$25 million in a new calcine plant.

Fluorita de Río Verde, meanwhile, also located in San Luis Potosí, has an annual capacity of 160,000 t. Fluorita de México produces fluorite from its underground operations at Muzquiz, Coahuila, where mining is carried out by room-and-pillar methods. The project produced 102,178 t in 2001. The Acuña district contributed an additional 40,479 t.

Graphite

Graphite production in 2001 fell to 28,989 t, a 17% decrease with respect to the previous year. The country still ranks as one of the world's top five graphite producers, but its resource base of 3.1 Mt place it second in the world. Virtually all of the country's production is centred near the city of Hermosillo in the state of Sonora. Mexico's principal producer is Grafitos Mexicanos, which accounts for about 45% of the country's output. Another important producer in Sonora is Minera Internacional Midas. About 95% of the country's production is in the form of amorphous graphite. An additional 5,000 t of crystalline graphite is produced by Grafito de México in the San Francisco Telixtlahuaca region in the state of Oaxaca.

Salt

Mexico's production of salt is estimated at 8.95 Mt in 2001. Most of Mexico's salt production comes from the Guerrero Negro Complex, located on the Pacific coast in the state of Baja California Sur. Exportadora de Sal, operator of Guerrero Negro, is a joint venture between the Mexican Government (51%) and Mitsubishi (49%). The proposed Salitres de San Ignacio project remains on hold as a result of strong environmental opposition, although the government continues to study the potential environmental impact of the project. Production includes several grades of salt, including table salt, industrial salt, and salt for de-icing. Approximately 99% of the production is destined for the export market, primarily to Japan, South Korea, New Zealand, Canada and the US. The country's remaining production can be attributed to Salinera de Yucatán, Azufrera Panamericana, and a handful of small producers.

Other Non-Metallic Minerals

Mexico's gypsum production, which reached a high of 4.2 Mt in 1997 as a result of healthy growth due to healthy construction in the US, slipped by 21% in 2001, to 2.85 Mt. The country's principal producer is Yeso San Marcos, with annual capacity of 2.0 Mt.

Mexico's Mineral Production (t except where stated)

	2000	2001	% change
Precious Metals			
Gold (kg)	24,479	24,902	1.7
Silver (kg)	2,482,809	2,824,219	13.8
Gold (oz)	787,009	800,599	1.7
Silver ('000 oz)	79,822	90,799	13.8
Base Metals			
Antimony	108	93	-13.9
Arsenic	2,468	2,381	-3.5
Bismuth	1,080	1,391	28.8
Cadmium	1,310	1,436	9.6
Copper	376,504	343,446	-8.8
Lead	121,540	146,832	20.8
Molybdenum	6,725	5,478	-18.5
Tin	2	7	250.0
Tungsten	0	0	0.0
Zinc	391,025	402,328	2.9
Ferrous Metals and Coal			
Coal	7,369,465	7,194,223	-2.4
Coke	2,241,343	2,081,525	-7.1
Iron	6,794,777	5,539,944	-18.5
Manganese	157,547	104,298	-33.8
Industrial Minerals			
Barite	155,679	134,179	-13.8
Celestite	148,336	138,121	-6.9
Dolomite	386,110	231,050	-40.2
Feldspar	267,819	364,459	36.1
Fluorite	543,579	629,637	15.8
Graphite	34,915	28,989	-17.0
Gypsum	3,581,221	2,848,269	-20.5
Kaolin	21,069	6,871	-67.4
Phosphate	981,196	1,025,134	4.5
Salt	7,380,000	8,953,521	21.3
Silica	1,795,558	1,696,716	-5.5
Sulphur	851,427	878,177	3.1
Wollastonite	36,109	28,941	-19.9

Minera Caopas recovers gypsum from its facilities at Santa Rosalía in the state of Baja California Sur. The project has reserves of around 150 Mt and an annual capacity of 1.0 Mt. The completion of a 4 km conveyor and a 1,250 t/h loading facility will enable Caopas to increase its production to 2.0 Mt/y. Yeso Mexicano produces approximately 175,000 t/y, while the balance of the country's production comes from small producers.

The production of phosphates increased by 4.5% in 2001 to 1.03 Mt. Production has reached record levels as the country's largest producer, Roca Fosfórica Mexicana, successfully competes as a private enterprise. Roca Fosfórica has traditionally accounted for about 75% of the country's phosphate production. Minerales no Metálicos de Puebla produces about 150,000 t/y.

Mexico's sulphur production grew by 3% in 2001 to 878,177 t. The country's two producers, Azufrera Panamericana and Compañía Exportadora del Istmo, shut down their Frasch sulphur facilities at the end of 1993 and these operations, remain in government hands (technically, they are owned by state-owned oil monopoly, Pemex) after a failed privatisation effort in 1994. The country's primary source of production is the recovery of sulphur from oil and gas production. The majority of the country's production comes from the southern states of Tabasco and Chiapas, which contributed 339,548 t and 317,443 t, respectively, in 2001. Sulphur production was also reported from the states of Veracruz, Oaxaca, Guanajuato, Nuevo León, and Tamaulipas.

Mexico's remaining kaolin production is in the hands of a number of small producers scattered throughout the states of Guanajuato and Jalisco. Mexico's production declined sharply in 2001, to 6,871 t (from 21,069 t in 2000), yet the country still imports significant amounts, primarily high-grade kaolin from the US.

Mexico's production of feldspar increased by 36% to 364,469 t in 2001. The country's

principal producer is Materias Primas y Minería, a unit of Vitro, and accounts for about 65% of the country's production.

Coal

Mexico's total steam coal production fell by 2%, to 7.19 Mt, in 2001, partially due to the financial problems of some of the primary producers. The country's largest producers are Minera Carbonífera Río Escondido (Micare) and Minerales Monclova (Mimosa), both subsidiaries of Mexican steel producer Grupo Acerero del Norte. These two companies were formed when government-owned Micare was privatised in 1992. Micare produces the bulk of the country's steam coal from the Sabinas and Fuentes-Río Escondido basins in the state of Coahuila, and consists of two open-pit and three underground operations with reserves totalling 208.6 Mt. Mimosa produces coking coal and operates five underground mines in the Sabinas region. In early 2000 it opened its Mina V coal mine, also in Coahuila, in order to supply the Federal Electricity Commission. Development work has also commenced on Mina VI, which has a reserve of 27 Mt. As a result of GAN's financial troubles, Micare has been put on the auction block.

Mexico's production of coke declined by 7% in 2001, to 2.08 Mt. Production is centred around the coking coal facilities at Monclova in the state of Coahuila and at the Lázaro Cárdenas-Las Truchas metallurgical complex in Michoacán. Coking coal is produced primarily in the state of Coahuila. Industrial Minera México produces approximately 250,000 t/y of coking coal at its Nueva Rosita complex in Coahuila, and production is primarily destined for the company's smelters. Carbonífera de San Patricio, another important producer of coking coal, operates three underground mines and is developing a fourth, all located in the state of Coahuila. La Luz and El Gavilán mines are located in the Saltillito Basin and have a capacity of 360,000 t/y and 90,000 t/y, respectively. The company's '4-1/2' mine is located in the Esperanza Basin and has a capacity of 24,000 t/y. The development of La Caballada will increase the production from the Esperanza Basin to 96,000 t/y. The company's washing plant feeds a coking facility at Cloete, Coahuila, with an annual capacity of 96,000 t, and which produced 84,758 t in 2001.

Last year, Grupo Acerero del Norte produced 489,555 t of coke at Las Truchas steel complex in the state of Michoacán, a decline of 7% with respect to the prior year.