THE MINERAL INDUSTRY OF

ARGENTINA

By Pablo Velasco

The Republic of Argentina, which is located in southern South America, has an area of about 2.77 million square kilometers (km²). In 1999, the area supported a population of about 37 million. The gross domestic product (GDP) was estimated to be \$285 billion¹; the per capita GDP was \$8,000. The economy contracted from the second half of 1998 through late 1999 by 3.5% of the GDP. Some signs of recovery began to appear in the final quarter of 1999, and most experts expected a return to solid economic growth by the second half of 2000 (U.S. Bureau of Economic and Business Affairs, 2000).

Despite the high growth level of recent years, unemployment rates have persistently grown, largely because of rigidities in Argentina's labor laws (U.S. Central Intelligence Agency, 1999, Argentina—Economy—World factbook 1999, accessed February 29, 2000, at URL http://www.odci.gov/cia/publications/factbook/ar.html).

In 1991, Argentina, Brazil, Paraguay, and Uruguay established the Mercado Comúm del Cono Sur [Southern Cone Common Market (Mercosur)] and on January 1, 1995, formed a partial customs union with a common external tariff (CET) covering approximately 85% of trade. In 1998, Mercosur members hiked the CET by three points for most products. As a result, many non-Mercosur products that enter Argentina now face higher tariffs. Chile signed a free trade agreement with Mercosur, which was effective on October 1, 1996, but did not participate in the CET. Bolivia also entered into a similar pact on April 30, 1997. Mercosur was also discussing an agreement with the Andean Community.

In 1999, mining contributed 2.9% to Argentina's GDP. The annual value of mineral production was about \$970 million; mineral exports were valued at about \$740 million (Mining Journal, 2000).

A few junior mining exploration companies continued to explore in Argentina, but a number of companies withdrew (Mining Journal, 1999).

Government Policies and Programs

The Argentina-Chile cross-border mining treaty will be ratified by both countries Congresses by September 2000 at the latest, before the October and December presidential elections in Chile and Argentina, respectively. The treaty would lift restrictions on mining and related activities in border areas. These would include harmonizing customs, taxation, and labor regulations as well as modifying controls on property purchases close to the border. Although the treaty was signed by both presidents in December 1997, both Congresses have delayed

ratification while the two countries discussed a sensitive border agreement in the Patagonia area known in Chile as Campo de Hielo Sur and in Argentina as Hielos Continentales. Two projects close to the Chile-Argentina border, Barrick Gold Corp.'s Pascua- Lama gold properties and Cambior's Pachón copper deposit, were subject to special protocols to the mining treaty, thus allowing them to proceed before ratification (Metals & Minerals Latin America, 1999b). The dispute was sorted out in 1999, with the approval of an agreement drawing a definitive border in the disputed zone that was excluded from the mining treaty (Metals & Minerals Latin America, 2000a).

Argentina's Legal Framework for Mining covered an abstract of the Mining Code, the Legal Framework for Investment in Argentina, Mining Investment Law No. 24196, Regulating Law of Mining Investment (Decree No. 2686/93), Mining Reorganization Law No. 24224, Federal Mining Agreement Law No. 24228, VAT Funding Law No. 24402, Regulation of Law No. 24402 (Decree No. 779/95), Mining Updating Law No. 24498, and Environmental Protection for the Mining Industry Law No. 24585.

The Mining Code, which was approved by the Argentine Congress on November 25, 1986, regulated the rights, obligations, and procedures for the acquisition, exploitation, and use of mineral substances.

Environmental Issues

The Environmental Protection Mining Code Law No. 24585, which was enacted on November 21, 1995, provides investors with the appropriate legal framework and requires that each provincial government create an enforcement authority within its jurisdiction.

The environmental framework that relates to mining activities was completed with the establishment of provincial environmental management units, which were responsible for assisting the enforcement authority pursuant to Law No. 24585 in all aspects relating thereto, specifically in assessing the environmental impact reports presented and monitoring mining projects. At yearend 1999, more than 1,500 environmental impact reports had been filed nationwide.

Argentina's historically low rate of mining development became an advantage in environmental terms compared with other Latin American mining countries. This circumstance allowed it to learn from their experiences and, therefore, to include environmentally preventative measures in its own new legal framework. As a result, Argentina was able to develop mining activities with environmental guidelines included from the very start. With this success, the Government intended to take advantage of mining activity growth, particularly the construction of highway and energy infrastructure works, and to

¹Where necessary, values have been converted from Argentine pesos to U.S. dollars at the rate of 1.00 peso=US\$1.00, the average exchange rate in 1999.

spur the growth of potential regional productive activities that would survive the closing or completion of mining projects (Industry, Commerce, and Mining Secretariat, [undated], Legal and institutional framework activities, accessed November 25, 1998, at URL http://www.mecon.gov.ar/index/buding/hoja75i.htm).

Production

Argentina was self-sufficient in construction materials and some other nonmetallic minerals. In the industrial mining sector, the largest growth was in mining of construction materials, the production value of which increased by about 1.9%. Production of semiprecious stones rose by 0.3% to about \$1.5 million. Argentina also produced copper, gold, lead, silver, uranium, and zinc. About 900 small mining companies were in operation; of these, about 640 were involved exclusively in the production of construction materials. Most Argentine mining companies employed fewer than 50 people with the exception of El Aguilar Mine, which was owned by Cía. Minera Aguilar, S.A., in Jujuy Province; Minera Aguilar was a subsidiary of Compañia Minera del Sur (Comsur) of Bolivia. El Aguilar Mine mined approximately 15,000 metric tons per day (t/d) of combined 11% lead and zinc ore at a grade of 4% lead, 7.4% zinc, and 85 grams per metric ton (g/t) silver from two underground ore bodies. The mine has approximately 5 years of reserves, and the large amount of surrounding land controlled by Comsur is attractive for zinc exploration.

The Bajo de la Alumbrera Mine, which was owned by Minera Alumbrera Ltd. in Catamarca, was Argentina's flagship mining project. Production at Alumbrera began in September 1997, and the mine was one of the top 15 copper-gold mines in the world in 1998. The deposit contains 767 million metric tons (Mt) of ore at a grade of 0.51% copper and 0.64 g/t gold. Alumbrera was designed to produce 180,000 metric tons per year (t/yr) of copper and 19,900 kilograms per year (kg/yr) of gold. By 2000, the mine was expected to move 325,000 t/d of ore and 140,000 t/d waste and to recover 2,000 t/d of copper-gold concentrate (Mining Journal, 1998b).

Aluminios Argentinos, S.A.I.C. (ALUAR), which was the primary aluminum producer, produced about 206,400 t/yr of aluminum ingot, billet, and slab. Crude steel production decreased by 10% to about 3.8 Mt in 1999, and domestic consumption decreased to 3.3 Mt from 4.3 Mt in 1998. The largest producer of steel in the private sector was Empresa Siderúrgica de Argentina. Production of crude oil increased by nearly 0.2% in 1998, and refinery products remained at about the same level as that of 1997 (table 1).

Trade

According to the preliminary mining statistics released by the Dirección de Evaluación Minera de la Secretaría de Industria, Comercio, y Minería of Argentina, the value of exported metallic minerals, mineral-related products, and industrial minerals, which included construction materials, exported in 1999 amounted to \$967 million; this was a substantial increase compared with that of 1998.

In 1999, nonfuel minerals and mineral-related products were

exported to 51 countries, which included Brazil, 30.5%; the United States, 15.1%; Belgium, 12.7%; Japan, 8.6%; Chile, 6.1%; Uruguay, 5.1%; Morocco, 4.7%; and Bolivia, 1.1%. Exports of copper increased owing to the start-up of the Alumbrera copper mine. Exports of gold doré, which contained gold and silver, and lithium were expected to increase; the Salar del Hombre Muerto lithium mine in Catamarca and the Cerro Vanguardia gold mine in Santa Cruz Province were largely responsible for these increases. Borates and lead exports also increased. According to the Secretaría de Industria, Comercio, y Minería, mineral exports were expected to increase to \$1.7 billion per year by 2003 (Metals & Minerals Latin America, 1998b).

Structure of the Mineral Industry

The Subsecretaría de Minería, which is a unit of the Secretaría de Industria, Comercio, y Minería, defines and controls the tasks performed by the Direccion National de Minera and the Cervic Geologic Minero Argentino. It also promotes and coordinates mining technology policy, establishes the development and incorporation of new technologies, and monitors and preserves a single data bank of mining and geologic information.

The mineral industry in the private sector comprised several mining and manufacturing companies, such as ALUAR, Cementos Loma Negra C.I.A.S.A., Cía. Boroquímica S.A.M.I.C.A.F., Cía. Minera Aguilar, Cía. Minera Tea S.A.M.I.C.A.F., Sulfacid S.A.C.I.F., Minera Alumbrera, FORMICRUZ-Cerro Vanguardia S.A., FMC Minera del Altiplano S.A (FMC Lithium Corp.), and El Pachón S.A. (table 2).

At yearend, 10.9 million people were employed nationwide, 36,000 of whom worked in metallurgical plants; 21,000, in the oil and gas industry; 16,000, in the mining sector; and 7,000, in the cement industry.

Commodity Review

Metals

Aluminum.—Primary aluminum was produced by ALUAR in Puerto Madryn, Chubut Province, at an installed production capacity of 206,400 t/yr. In 1999, ALUAR's smelter expansion was going smoothly, according to officials. When the plant reaches full capacity after the expansion, it will produce 262,000 t/yr of aluminum (Metal Bulletin, 1999).

Copper and Gold.—The directors at Minera Bajo de la Alumbrera were expected to conclude the study for an expansion project at a copper-gold and silver mine located 1,100 kilometers (km) northeast of Buenos Aires in the region of Catamarca. The mine was designed as an open pit plus a conventional flotation plant with the capacity to treat 90,000 t/d of ore. The expansion project at Bajo la Alumbrera will involve adding a third South American Gold and Copper (SAG) milling and flotation line to the existing ones, which would bring capacity up to 135,000 t/d. The expansion would cost \$100 million and would come into operation at the beginning of

2000.

Costs would be contained through the use of Isamill Ultralite flotation cells and Jamieson technology, which is pressureoperated instead of mechanical, as is usually the case in conventional flotation cells, is cheaper and more energyefficient, and takes up less space. In the first 3 months of 1999, Alumbrera treated 7.5 Mt of ore at a grade of 0.80% copper and 0.95 g/t gold and yielding 183,600 metric tons (t) of concentrates, which contained 53,146 t of copper. Goldequivalent production in the first quarter of 1999 was 5,270,830 kilograms (kg) (169,461 ounces) of contained metal in concentrates and 1,045 kg (33,588 ounces) of gold metal doré, up from 1,105 kg (35,525 ounces) and 167 kg (5,385 ounces), respectively, in the same 1999 quarter. At this rate of production, by the end of 1999 the company planned to reach approximately 200,000 t of copper in concentrate and about 24,883 kg (800,000 ounces) of gold equivalent (Metals & Minerals Latin America, 1999a).

Broken Hill Proprietary Company Ltd. (BHP) of Australia reduced activities at the Agua Rica copper project in Argentina. Weak copper market conditions and the reshaping of BHP's global asset portfolio have led to the reduction of Argentine copper activities from active field program status to care and maintenance with low-cost district exploration. Although staff reductions were initiated at yearend 1998, work continued. Agua Rica was a large porphyry copper-gold-silvermolybdenum deposit in Catamarca not far from Alumbrera. BHP, which had a 70% interest in the joint venture, and Northern Orion Exploration Ltd. of Canada, which had a 30% interest, undertook a final feasibility study of the project and agreed to an \$8.4 million budget for the year starting in June 1998. (Metals & Minerals Latin America, 1998e). The Agua Rica deposit has been on BHP's back burner for some time now. The estimated resource at Agua Rica at a 0.4% copper cutoff is 802 Mt, at a grade of 0.61% copper, 0.24 g/t gold, and 0.04% molybdenum. The deposit has been accessed by two bulk-sampling adits, and preliminary metallurgical test results were positive.

Gold and Silver.—The Cerro Vanguardia open pit silvergold mine in southern Patagonia had been producing 2,000 t/d of ore for more than 18 months, and reserves, as of December 1999, were 9.1 Mt at a grade of 9.6 g/t gold and 125 g/t silver at a cutoff grade of 4.0 g/t gold. Production was expected to be 7,776 kg/yr (250,000 ounces per year) of gold and 87,090 kg/yr (2.8 million ounces per year) of silver. Recent improvements to the cyanide recovery plant have significantly reduced operating costs. The mine draws ore from six different pits from different epithermal, low-sulfidation quartz veins that host bonanza-type silver-gold mineralization. Cerro Vanguardia was owned by Anglo Gold Corp. (46.25%), Pérez Companc of Argentina (46.25%) and Formicruz, which was a Santa Cruz provincial company (7.5%). The mine paid an after-cost royalty of 1% of the value of mine production to Santa Cruz Province, as per Federal guidelines. (Mining Journal, 1999).

Barrick Gold Corp. of Canada will develop the Pascua-Lama project, which will become South America's next world-class gold mining district. Exploration of this high-sulfidation ephithermal system began in Chile in the 1980's, and gold-

silver mineralization was followed eastward right up to the Argentine border. As part of Argentina's opening up to world mining that began in 1989 and continued throughout the following decade, technical studies and political negotiations were undertaken between Argentina and Chile to facilitate exploration and development along the Andean border. The Pascua-Lama protocol, which was signed in 1998, was an important step in this process. It formed an operations area within which Barrick could freely move people and equipment without having to undergo immigration or customs proceedings. This protocol also enabled Barrick to explore the area underground via a 1-km tunnel from the Pascua project on the Chilean side to the Lama project on the Argentine side. The protocol agreement will enable the Pascua-Lama project to operate as a single unit regardless of the international border. According to Barrick, the development of proven and probable reserves in the past 3 years has been phenomenal. At the end of 1999, the Pascua-Lama deposit had 262 Mt at a grade of 2.03 g/t gold and 66.3 g/t silver, with the reserves divided into two types of ore—a nonrefractory type of ore processed by conventional cyanide leaching to produce gold-silver doré and a refractory type undergoing conventional flotation concentration to produce a copper-silver-gold concentrate. Based on these reserves, Barrick announced that full production will start in 2003 with a phase I project of 33,000 t/d that will produce 24,883 kg/yr (800,000 ounces per year) of gold. Phase II, which was due to come on-stream in 2005, will increase mill throughput by 11,000 t/d and increase production to 31,104 kg/yr (1 million ounces per year) of gold (Mining Journal, 2000).

The Veladero project, which was owned by Homestake Gold (60%) and Barrick (40%) and lies entirely within Argentina, is immediately adjacent to the Lama portion of Barrick's Pascua-Lama project and constitutes the eastern end of the Pascua trend of high-sulfidation epithermal gold-silver mineralization. Since purchasing the outstanding shares of Argentina Gold in April 1999, Homestake has aggressively explored the property and significantly increased resources. Results to date show a highgrade portion that contains 18.5 Mt at a grade of 4.97 g/t gold and 47.9 g/t silver, and yearend proven and probable reserves stood at 92.5 Mt at a grade 1.7 g/t gold and 24.3 g/t silver. The most recent drilling at Veladero has suggested a resource of 220.6 Mt at a grade of 1.2 g/t gold and 22.9 g/t silver at a 0.34 g/t cutoff; mineralization has been intercepted between the two main mineralized zones that should add significantly to reserves. Homestake was conducting economic studies on the deposit that were expected to be ready by midyear. Veladero is a provincial reserve area with mining rights held by Instituto Provincial de Exploración y Explotación Minera, which is a San Juan provincial mining company; it will receive a future royalty on production (Mining Journal, 2000).

Corriente Resources Inc. of Canada completed the first phase of its 2,000-meter (m) diamond drilling program to test the company's Famatina gold-silver-copper prospect in La Rioja Province. The program was designed to provide confirmation of the project's Mexicana Ridge resource interpretation, which was previously estimated to contain 1.7 Mt of ore at a grade of 32.1 g/t gold, 40 g/t silver, and 1.3% copper. An underground sampling program also produced a number of high-grade gold

and silver samples in areas of workings south of the main Mexicana Ridge veins.

Corriente held the Famatina gold-silver-copper project in a joint venture with current [1999] owners Yamiri S.A., which was a consortium of private Argentinian investors, and the provincial government of La Rioja. Corriente will be required to make payments of \$4.2 million and to complete work programs that total \$4.7 million within a 5-year period following the completion of an initial 2-year feasibility study period in order for it to earn an 80% interest in the project; the percentage will depend on the total level of exploration expenditures made (Metals & Minerals Latin America, 2000c).

Barrick increased its interests in western Argentina's Andean gold belt through an earn-in agreement with Canadian Junior TNR Resources. According to TNR, Barrick has optioned up to 75% of TNR interest via a letter of agreement in La Brea, Cateo 23, Las Carachas, Ranchillos, Rio Blanco, Peña Negra, and Valle del Cura properties. Agreement terms included Barrick's purchase of 2 million of TNR's shares for \$540,000, 90% of which must be used in Argentinian exploration. The focus will be on 54 km² at the La Ortiga gold-silver property in which Orko Gold of Canada has a stake (Metals & Minerals Latin America, 2000b).

Silver Standard Resources obtained high-grade assays from drilling completed in December 1999 at its 225- km² Manantial Espejo silver-gold project in Santa Cruz province. Seventeen diamond drill holes that totaled 1,416 m were completed on six veins; most holes successfully tested new targets. The company expected that these results together with further drilling would add to the property's previously reported 2.8-million-kilogram (89.3-million-ounce) equivalent silver resource. The 1999 drilling program targeted extensions to the previously drilled Veta Karina vein system and five other new vein systems (Metals & Minerals Latin America, 2000d).

Reverse circulation drilling began on Rio Tinto Zinc Corp. Plc.'s and Corriente Resources' Cerro Cobre target at the Taca Taca project in Salta Province. The program was being operated by Rio Tinto and was targeted at a near-surface high-grade leachable copper oxide ore body. The area to be drilled showed a strong copper surface anomaly in rock chip sampling. The Cerro Cobre anomaly is to the east and south of a deep copper mineralization outlined by the previous operator of the Taca Taca project. This deep copper mineralization has been calculated to be 440 Mt at a grade of 0.58% copper and 0.18 g/t gold and contains 2.6 Mt of copper and 79.2 t of gold (Metals & Minerals Latin America, 1999c).

Corriente Resources has acquired a second gold exploration target to add to its Taca Taca project. A joint-venture agreement with Yamiri was signed on June 17.

Argentina Gold, which was the subject of a hostile takeover bid by Barrick, released results from three drill holes that extended the mineralization at the Veladero project in San Juan Province (Metals & Minerals Latin America, 1998a, c). At the Amable target, mineralization has been extended to the east. Hole 92 returned 105 of mineralization grading 7.67 g/t gold and 52.5 g/t silver. Hole 93 returned 119 m at a grade of 1.4 g/t gold and 20.6 g/t silver. The overall mineralized area at the Amable target has a north-south extent of 440 m and an east-west extent of 250 m. At the Filo Federico target, hole 91,

which was drilled on the eastern side of the target, returned 64 m at a grade of 0.84 g/t gold and 2 g/t silver (Metals & Minerals Latin America, 1998b).

Iron and Steel.—Compared with that of 1998, crude steel production decreased by 9.9% to about 3.8 Mt; output of semimanufactured products also decreased by about 9.5% to 3.8 Mt. Apparent domestic consumption of rolled steel products was estimated by the Instituto Argentino de Siderúrgia to have decreased by about 18% to about 1.3 Mt, and per capita apparent consumption of steel decreased by 20.0% to 114 ingots (Instituto Latinoamericanico del Fierro y el Acero, 2000).

Lead and Zinc.—A \$1.5 million exploration program at Mina Aguilar in northwestern Argenitna was cut by 30% in the face of the metal's falling price. Since July 1997, zinc prices have fallen to between \$940 and \$950 per metric ton from \$1,050 per ton. To compensate, only \$1.05 million will be spent to explore for zinc to extend the mine life (Metals & Minerals Latin America, 1999d).

Mina Aguilar was mining 15,000 t/d of combined 11% lead-zinc ore at a grade of approximately 4% lead, 7.4% zinc, and 85 g/t silver from two underground ore bodies. Jujuy Province allowed the mine to deduct 1% from the 3% after-cost royalty if it will be spent on exploration (Mining Journal, 2000).

Pacific Rim Mining Corp. of Canada received assay results from its La Colorada project in northwestern Argentina. Lead, silver, and zinc show a strong correlation, copper is ubiquitous throughout the system, and gold appears to halo zinc-rich intervals although it occurs in anomalous concentrations throughout the system. Pacific Rim Mining reported a few significant intersections as a result of the drilling. One hole intersected 6.65 m of ore at a grade of 3.72% zinc, 0.73% lead, 0.03% copper, 12.9 g/t silver, and 0.04 g/t gold. Another intersected 10.8 m of ore at a grade of 4.13% zinc, 1.95% lead, 0.14% copper, 10.1 g/t silver, and 0.07 g/t gold. Geologic mapping of the property indicated the presence of two or three massive sulfide horizons on the surface, and geophysical surveys suggested that these persist at depth (Metals & Minerals Latin America, 1998d).

Tin.—Sunshine Mining and Refining Co. has finalized a revision to the economic feasibility study for the Pirquitas silver, zinc, and tin project in Jujuy Province. The company had been contemplating a 9,000-t/d operation, up from the 6,000 t/d outlined in the Jacobs Engineering feasibility study completed earlier in the year. That study recommended a 6,000-t/d concentrator that would yield an average 286,152 kg/yr (9.2 million ounces per year) of silver plus 4,100 t of tin during its 10-year lifetime. The costs of the future operation were set at \$1.50 per ounce of silver, assuming a silver price of \$5.50 per ounce; \$2.54 per pound for tin; and \$0.47 per pound for zinc. The project was based on reserves of 23 Mt of ore and a total production of 3.6 Mt (116 million ounces) of silver, 58,225 t (156 million pounds) of tin, and 101,521 t (272 million pounds) of zinc, with construction costs set at \$124 million. The revised version of the Pirquitas, which was aimed at reducing operating costs, however, would see a further \$7.8 million investment to enlarge the concentrator to the 9,000-t/d

level. Barclays Capital and Warrior, which is the financial branch of the Standard Bank of London Ltd., are coordinating the securing of funding for Pirquitas (Mining Journal, 1998d; Metals & Minerals Latin America, 1999e).

Industrial Minerals

According to statistics released by the Portland Cement Manufacturers' Association, Argentina's production of cement increased by 1.4% to 7.2 Mt compared with that of 1998. The Argentine production base had an effective clinker production capacity of 8.44 Mt in 17 cement works, which included 3 grinding units. Nearly 51% of this capacity was owned by Loma Negra C.I.A.S.A., which was Argentina's premier cement company and part of the country's Fortabat Group. It operated integrated cement works at Barker, Catamarca, Olavarria, San Juan, and Zapata as well as two grinding units at Pipinas and Yacyretá. Loma Negra had a 40% market share in the crucial Buenos Aires market. Juan Minetti, S.A., operated three works in the central and northwestern regions of the country that brought its total production capacity to 1.66 Mt (International Cement Review, 1999).

Mineral Fuels

Natural Gas.—In 1999, gross production of natural gas decreased by 2.4% to about 40 billion cubic meters (Gm³). Proven reserves of natural gas were reported by the privatized Yacimientos Petrolíferos Fiscales (YPF) to be about 684 Gm³. About 53% of the natural gas used in Argentina was produced by Repsol-Yacimientos Petrolíferos Fiscales S.A., and the rest, either imported from Bolivia or produced under service contracts with private production companies. Natural gas imports from Bolivia amounted to less than 2.0 Gm³. Natural gas represented an important and growing market for YPF in Argentina and neighboring countries. YPF was in a strong competitive marketing position because of its extensive reserves and dominant position in basins close to major population centers.

"Argentina has the second largest proven reserves of natural gas in South America after Venezuela. Because most of these reserves were discovered as a result of oil exploration, gas production is concentrated in the same five basins as oil production. Argentina largest gasfield is Repsol-YPF's Loma de la Lata. Repsol-YPF is the largest producer of domestic natural gas, with about 53% of the total, followed by Total Austral (a unit of France Total), Pérez Companc, Bridas Corp. and Pluspetrol (itself controlled by Repsol-YPF).

"A Total-led consortium planned to start up a \$70 million plant in 1999 to extract liquids from natural gas produced from Cañadon Alfa and Ara fields off Tierra del Fuego. Capacities were to be 250,000 t/yr of Liquid Petroleum Gas (LPG) and 60,000 t/yr of natural gasoline.

"LPG would be exported through a pipeline owned by Chilean state firm Empresa National del Petroleo to a separation plant at Cabo Negro, Chile. The natural gasoline would be blended with crude from Total-operated Hidra offshore field. Enron's Transportadora del Gas Sur affiliate was to expand its General Cerri plant and bring on-stream 300,00 t of LPG during

the year. YPF, Dow Chemical Co., and Petroleo Brasileiro S.A. (Petrobrás) formed a joint venture to build the 650,000 t/yr MEGA project gas plant, which was likely to come on-stream by 2002 with production designated for Brazil. Plans were announced to build five other smaller gas plants due on-stream in 1998-2001 to add 386,000 t/yr of LPG to export.

"Pipeline projects were under way to transport Argentine gas to Chile, Brazil via Bolivia, and Uruguay. Uruguay's government picked BG PLC, formally British Gas, and the Amoco-Bridas Corp. joint venture Pan American Energy to build and operate a gas pipeline from Buenos Aires to industrial and power users in Montevideo. Plans were advancing for a \$400 million integrated natural gas project in Chile's Bio Bio region fueled by Argentina gas. NOVA Gas International S.A. and its partners were to proceed with Gasoducto del Pacifico, a \$342 million pipeline from the Neuquén basin to Chile. Another project was a 163 km, 20 inch pipeline from Loma de la Lata, Argentina, to Concepción, Chile. Soc. Gasoducto del Pacifico let a \$47 million contract to Dragados Internacional de Pipelines SA for the construction of Spread 3 of the system" (International Petroleum Encyclopedia, 1999).

Petroleum.—Argentina had around 2.6 billion barrels of proven oil reserves that are, distributed among 19 sedimentary basins. Most of Argentina's oil is produced in two onshore basins—Neuquén in the southwest and Golfo San Jorge in the southeast. Other producing basins were Austral, Guyana, and Norwest (Northwest). To date, there has been little activity offshore. Puerto Hernandez, which is in the Neuquén basin, serves as the starting point for three major pipeline routes transporting crude oil north to the Luián de Cuvo refinery near Mendoza; over the Andes to Concepcion, Chile; and east to Puerto Rosales on the Atlantic. The pipeline terminus at the port of Concepcion provides an outlet for shipments to the U.S. Gulf Coast or the Pacific Rim, but so far, only small volumes have been shipped to these distant customers. Argentina's oil production increased by about 1.5% to 309 million barrels per year compared with that of 1998. About one-third of Argentina's oil was exported mainly to Brazil, Chile, and Uruguay.

"YPF is Argentina's largest producer of crude oil, followed by Pérez Companc and Petrolera San Jorge. Pérez Companc had about 11% of oil production in 1998 with about 109,000 barrels per day, and a market capitalization of about \$4.8 billion. Both Pérez Companc and YPF and others are actively seeking deals with Petrobrás, the Brazilian state-run oil company. Pan American Energy is joint venture between U.S. Amoco and local firm Bridas" (U.S. Energy Information Administration, August 1999, Argentina—Oil, accessed September 23, 1999, at URL http://www.eia.doe.gov/emeu/cabs/argentina.html).

"Three companies control the downstream oil sector in Argentina: Repsol-YPF, Esso Petroleum Co., and Shell Oil Co. These three companies are investing in upgrading capacity to produce lighter products as the country completes the switch to unleaded gasoline and complies with more stringent environmental requirements. Argentina's 12 oil refineries produce petroleum products primarily for the domestic market. In addition to these largest refiners, the much smaller Eg3

consortium (Astra, Isaura, and Puma)—itself controlled by Repsol-YPF—controls 14% of the retail fuel market. Pérez Companc also has stakes in two Argentine refineries at San Lorenzo and El Norte, as well as a substantial retail network. Repsol-YPF accounts for around 48% of the country's total refining capacity, mainly from its ownership in La Plata and Lujan de Cuyo refineries in the Greater Buenos Aires region, among the largest in the country. The remaining capacity is split among Shell's one refinery (18%), Esso's two refineries (16%), and the six refineries of five small companies (18%)" (U.S. Energy Information Administration, August 1999, Argentina—Downstream—Refining and petrochemicals, accessed on September 23, 1999, at URL http://www.eia.doe.gov/emeu/cabs/argentina.html).

Outlook

Based on the scale of exploration and development interest in recent years, Argentina's mining officials predicted that within 10 years the value of mineral production could reach \$2.3 billion, and mineral exports could increase to as much as \$1.4 billion per year. The exploration boom of the early 1990's has ended, and Argentina will not see the return of speculative junior mining company activity to previous levels. Nonetheless, metal exploration by a smaller number of companies with long-term commitments to Argentina will continue, and these exploration ventures will have an excellent chance of success in one of Latin America's most advanced and stable countries (Mining Journal, 1998a).

Although behind agroindustrial production and beef, mine products will soon be among Argentina's top five exports but will have stiff competition from automobile exports and also natural gas exports via five new pipeline projects to Chile. The increase of mining's contribution has been projected to be just under 1% of Argentina's GDP by 2000 (Mining Journal, 1998b).

After completion of the 6-month feasibility study of a proposed copper smelting and refining project by Fluor Daniel, paid for by a loan from the U.S. Trade and Development Agency, Argentina will invite mining companies to consider investing in the \$400-million to \$440-million project that would be located in either Bahia Blanca or Rosario. The initial production capacity would be 175,000 t/yr of refined copper and 525,000 t/yr of sulfuric acid (Mining Journal, 1998c).

Mining projects to be completed in the near future are the Agua Rica, the Alumbrera expansion, El Carmen, the Cerro Vanguardia, the Fenix-Salar del Hombre Muerto, Las Flechas, El Pachón, the Rio Colorado, the San Jorge, and the Sunshine Pirquitas.

Argentina's energy resources, which are abundant and diverse, include crude oil, natural gas, hydropower, and uranium; the potential has not been fully determined. New investments in Argentina are directed toward several promising projects, including copper, gold, crude oil, gas pipelines, natural gas, and petrochemicals. Significant copper, gold, silver, lithium carbonate, and potassium chloride projects being evaluated include Cerro Amarillo, which consists of seven properties that lie in the southern extension of Chile's El Teniente copper belt.

Argentina welcomes foreign direct investment, which has become an essential element of the country's economic growth. Argentina's climate for foreign investment is among the most favorable in Latin America (U.S. Embassy, Buenos Aires, July 1999, FY 2000 Country commercial guides—Argentina— Investment climate—Openness to foreign investment, accessed at http://www.state.gov/www/about_state/business/com_guides/2000/wha/argentina_CCG2000.pdf). National and provincial laws encourage the development of mining by private enterprises, which include foreign companies. Several major mining companies and more than 60 junior companies are exploring the whole range of the Argentine Andean chain. Argentina's mineral resources will be important in the future of worldwide investment, development, and mineral-resource analyses.

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${\bf TABLE~1}$ ARGENTINA: PRODUCTION OF MINERAL COMMODITIES 1/2/

(Metric tons unless otherwise specified)

Commodity		1995	1996	1997	1998 e/	1999 e/
METALS						
Aluminum:						
Primary		185,500	183,900	187,200	186,700 3/	206,400 3/
Secondary		10,000	15,800	15,800	16,000	16,000 3/
Cadmium concentrate:		0.0		40.5		440.04
Gross weight		82	127	136	145	140 3/
Cd content		43	40	45	34	15 3/
Copper:				20.421	170 272 2/	210 126 27
Mine output, Cu content		16,000		30,421	170,273 3/	210,126 3/
Refined e/	1.11	16,000	16,000	16,000 3/	16,000	16,000
Gold, mine output, Au content Iron and steel:	kilograms	837	723	2,289	20,400 r/ 3/	38,515 3/
Metal:						
	housand tons	1,568	1,966	2,080 r/	2,122 r/3/	2,100
Sponge iron (direct reduction)	do.	1,328	1,422		· ·	1,538
Total	do	2,896	3,388	1,496 r/ 3,576 r/	1,512 r/ 3/ 3,634 r/ 3/	3,638
Ferroalloys, electric furnace:	<u>uo.</u>	2,890	3,300	3,370 1/	3,034 1/ 3/	3,038
		5 926	7 274	0 201	5.016 =/2/	5 000
Ferromanganese		5,836	7,374	8,381	5,016 r/3/	5,000
Ferrosilicomanganese Ferrosilicon		27,344	24,654 22,452	26,134 17,835	25,388 r/ 3/	25,000 11,200
Total		<u>14,017</u> 47,197	54,480	52,350	11,245 r/ 3/ 41.649 r/ 3/	41,200
	housend tons	3,581	54,480 4,075	52,350 4,169 r/	41,049 f/ 3/ 4,216 r/ 3/	3,797 3/
Semimanufactures 4/	housand tons		4,075 4,026 r/	*	*	3,730
Lead:	do.	3,684 r/	4,020 1/	4,258 r/	4,131 r/3/	3,730
Mine output, Pb content		10.521	11,272	13,760	15,004 3/	15,256 3/
		10,521		14,200	<i>'</i>	
Smelter, primary e/		14,000	14,100	14,200	14,150 3/	14,200 3/
Refined:		2,430	396	3,282	300 3/	500 3/
Primary		,				
Secondary		26,298	27,705	28,834	30,057 r/3/	25,195 3/
Total Silver:		28,728	28,101	32,116	30,357 r/ 3/	25,695 3/
	1-11	47 707	50.200	52.550	25.769 -/2/	72 700 2/
Mine output, Ag content	kilograms	47,787	50,399	52,550	35,768 r/ 3/	73,788 3/
Metal, smelter e/	do.	110,000	140,000	145,000 3/	100,000	150,000
Tin, metal, smelter e/	1-11	100	100	100	100	100
Uranium, mine output,U3O8 content Zinc:	kilograms	68,000	27,000	41,000	40,000	35,000
Mine output, Zn content		32,104	31,093	33,357 r/	35,560 r/3/	34,192 3/
Metal, smelter:		32,104	31,093	33,337 1/	33,300 1/ 3/	34,192 3/
Primary		35,767	36,392	38,672	38,677 3/	40,224 3/
Secondary e/		2,800	2,900	3.100 3/	3,100	3,220 3/
Total		38,567	39,292	41,772	41,777 3/	43,444 3/
INDUSTRIAL MINERALS		36,307	39,292	41,772	41,777 3/	45,444 3/
Asbestos e/		300	446 3/	400	380	350
Barite				9,532 r/		
Boron materials, crude		28,907 244,933	14,038 342,210	422,556	1,833 r/ 3/ 350,000	1,300 360,000
	housand tons	5,447	5,117	6,858	7,091 r/3/	7,187 3/
Clays:	nousanu tons	5,447	3,117	0,030	7,091 1/ 3/	7,107 3/
Ball clay (plastic clay) e/	do.	90	90	90		
Bentonite	uo.	111,011	134,588	104,880 r/	115,000	110,000
Foundry earth e/		120,000	100,000	100,000	100,000	100,000
Fuller's earth (decolorizing clay) e/		1,600	1,600	1,500	1,500	1,500
Kaolin		39,860	64,241	47,365	46,832 r/ 3/	45,000
Diatomite		4,938	8,647	9,449	9,500	9,000
Feldspar		37,095	72,539	105,320	80,000	80,000
Fluorspar		5,105	5,666	7,168	7,200	7,000
Gypsum, crude		590,055	633,121	7,108	650,356 r/ 3/	650,000
Lithium, spodumene, amblygonite, gross weight e/		400	400	729,493 697	700	700
Mica:		400	400	07/	700	700
Sheet e/		700	297	300	300	300
				1,053 r/		1,900
Waste and scrap Nitrogen, N content of ammonia e/		4,341 r/	1,840	1,053 f/ 107,000	1,837 r/ 3/	
		78,700	80,000		86,300 r/	87,700 3/
Phosphates, Thomas slag e/ 5/ Pumice and related volcanic materials (perlite, pozzolan, tob	un ota)	50 74.041	50 91 292	50 147 235	50	50
See footnotes at end of table	a, etc.)	74,941	81,283	147,235	140,000	120,000

See footnotes at end of table.

$\label{thm:continued} \textbf{ARGENTINA: PRODUCTION OF MINERAL COMMODITIES 1/2/}$

(Metric tons unless otherwise specified)

Commodity	1995	1996	1997	1998 e/	1999 e/
INDUSTRIAL MINERALSContinued					
Salt:					
Rock e/ thousand tons	1		1	1	1
Solar do.	1,009	1,096	841	850	850
Total do.	1,010	1,096	842	851	851
Sand and gravel:					
Sand:					
Construction do.	15,726	16,628	18,743	18,000	8,500
Silica sand (glass sand) do.	286	244	257	260	250
Gravel do.	5,819	5,550	6,062	6,000	6,100
Soda ash e/	200	200	200	200	200
Stone:					
Basalt thousand tons	1,975	1,133	1,774	1,800	1,600
Calcareous:					
Calcite, nonoptical	40,099	40,011	73,415	75,000	70,000
Calcium carbonate (chalk) e/	20,000	20,000	20,000	20,000	25,000
Dolomite	1,107,906	1,239,467	1,241,844	1,240,000	1,250,000
Limestone thousand tons	11,540	12,315	13,439	13,500	13,000
Marble:					
Onyx, in blocks and broken	122		100	100	80
Travertine, in blocks and broken	16,718	22,800	14,782	15,000	15,500
Unspecified, in blocks and broken	8,440	11,655	29,775	29,800	29,000
Flagstone	87,576	102,510	55,340	55,500	55,000
Granite:	,	,	,-	,	,
In blocks	125,547	113,456	95,013	95,000	95,000
Crushed thousand tons	7,030	7,809	11,974	12,000	12,500
Quartz, crushed	95,121	130,951	117,976	118,000	119,000
Quartzite, crushed thousand tons	1,841	899	900 e/	900	1,000
Rhodochrosite	69	73	14	15	18
Gemstones (agate, amethyst, apolo, tourmaline, etc.) kilograms	3,134	3,100	13,420	13,500	13,600
Sandstone e/	200	200	200	200	200
Serpentine, crushed	78,107	71,989	141,410	140,000	140,000
Shell, marl	869,650	883,990	287,670	290,000	280,000
Tuff, (tosca) thousand tons	7,002	8,268	6,183	6,300	6,300
Strontium minerals, celestite	9,325	3,775	3,049	3,100	3,000
Sulfates, natural:	7,323	3,773	3,047	3,100	3,000
Aluminum (alum)	352	306	300 e/	300	300
Magnesium (epsomite)	720	1,440	7,200	7,000	7,000
Sodium (mirabilite)	10,604	21,726	9,133	9,500	9,400
Falc and related materials:	10,004	21,720	7,133	7,300	2,400
Pyrophyllite	4,189	2,180	4,242	4,000	4,000
Steatite e/	300	300	300	300	300
Talc	12,474	11,777	13,380	13,500	13,000
Total					17,300
Vermiculite	16,963 44	14,257 40	17,922 822	17,800 100	17,300
Water, mineral-containing e/	135,000	135,000	130,000	130,000	130,000
Zeolite e/	90	90	90	90	90
MINERAL FUELS AND RELATED MATERIALS	662	2.476	2.500 /	2.000	2 400
Asphalt and bitumen, natural (asphaltite)	662	3,476	3,500 e/	3,000	3,400
Coal, bituminous thousand tons	305	310	250	300	300
Coke, all types, including breeze e/ do.	300	200	200	200	200
Gas, natural:	20.452	24	25.004	44.000	40.000
Gross million cubic meters	30,472	34,651	37,081	41,000	40,000
Marketed 6/ do.	26,972	29,121	30,670	32,000	31,000
Natural gas liquids:		_	_		
Butane thousand 42-gallon barrels	6,935	7,265	7,300	7,300	7,400
Propane do.	8,395	8,795	8,800	8,800	8,900
Total do.	15,330	16,060	16,100	16,100	16,300
Peat, agricultural (turba)	4,000	2,692	9,256	5,000	4,900
Petroleum:					
Crude thousand 42-gallon barrels	260,975	275,933	304,447	304,775 r/ 3/	309,484 3
Refinery products:					
Refinery products: Gasoline do.	44,718	44,895	45,000 e/	45,000	46,000

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

(Metric tons unless otherwise specified)

MINERAL FUELS AND RELATED MATERIALSContinued		1995	1996	1997	1998 e/	1999 e/
PetroleumContinued:						
Refinery productsContinued:						
Kerosene	thousand 42-gallon barrels	2,480	2,555	2,600 e/	2,600	2,700
Jet fuel	do.	7,499	7,665	7,700 e/	7,700	7,800
Distillate fuel oil	do.	62,914	62,780	63,000 e/	63,000	63,500
Lubricants e/	do.	1,825	1,825	1,800	1,800	1,800
Residual fuel oil	do.	18,025	17,885	18,000 e/	18,000	18,500
Other	do.	10,515	10,525	10,600 e/	10,600	10,700
Refinery fuel and losses	do.	28,473	28,470	28,300 e/	28,300	29,000
Total	do.	131,731	131,705	132,000 e/	132,000	134,000

e/ Estimated. r/ Revised. -- Zero.

${\it TABLE~2}$ ARGENTINA: STRUCTURE OF THE MINERAL INDUSTRY IN 1999

(Thousand metric tons unless otherwise specified)

_		Major operating companies		Annual
	Commodity and major equity owners		Location of main facilities	capacity
Aluminum		Aluminios Argentinos S.A.I.C. (Government, 52.1%; private, 47.9%)	Puerto Madryn, Chubút Province	190.
Boron		Cía. Boroquímica S.A.M.I.C.A.F. (owned by Rio Tinto Zinc Corp. Ltd.)	El Porvenir Mine, Jujuy Province; Tincalayu and Campo Quijano, Salta Province	345.
Cement		Loma Negra C.I.A.S.A., #1; Juan Minetti, S.A., Corporación Cementera Argentina, S.A. (private, 100%)	Buenos Aires, Córdoba, Corrientes, Salta, San Juan, Mendoza, and Jujuy Provinces	6,000.
Coal		Yacimientos Carbóniferos Fiscales (Government, 100%)	Río Turbio, Santa Cruz Province	210.
Copper and gold	kilograms	Minera Alumbrera Ltd. (Mount Isa Holding Ltd. of Australia, 50%; North Limited of Australia, 25%; Rio Algom Ltd. of Canada, 25%)	Bajo de La Alumbrera Mine, Belén Depart- ment, Catamarca Province	180 Cu, 20,000 Au
Gold and silver.	do.	Yacimientos Mineros de Agua de Dionisio (Government, 100%)	Farallón Negro, Hualfín, and Belén, Catamarca Province	
Do.	do.	Small mines (private, 100%)	Various in Jujuy Province	50,000 Ag 5,000 Ag
Iron ore		Hierro Patagónico de Sierra Grade, S.A. (Government, 100%), shut down in 1998.	Sierra Grande, Río Negro Province	1,000.
Lead, silver, and z	inc kilograms	Cía. Minera Aguilar, S.A., owned by Cia. Mineral del Sul (private, 100%)	Estación Tres Cruces, El Aguilar, Jujuy Province	49,800 Ag 24,000 Pb 30,000 Zn
Natural gas	million cubic meters	Transportadora de Gas del Sur, S.A., and Transportadora de Gas del Norte (private, 100%)	Neuquén, Santa Cruz, Tierra del Fuego, Salta, and Río Negro Provinces	41,000.
Petroleum	million barrels	Repsol 97.5%, Yacimientos Petrolíferos Fiscales S.A. (2.5%.) (private, 97.5%)	Chubút, Santa Cruz, Neuquén, Río Negro, Mendoza, Salta, Tierra del Fuego, Jujuy, La Pampa, and Formosa Provinces	366.
Steel		Aceros Paraná, S.A. (private, 79.9%; Government, 20.1%)	7 kilometers from San Nicolás de los Arroyos, Buenos Aires Province	3,300.
Do.		ACINDAR-Industria Argentina de ACEROS, S.A. (private, 100%)	Plant Nos.1, and 3, Buenos Aires Province; Plant No. 2, near Río Paraná, Santa Fe Province	1,500.
Uranium (ore)		Empresa Nucleár Mendoza, subsidiary of Nucleoélectrica Argentina S.A. (NASA)	Sierra Pintada, San Rafaél, Mendoza Province	160.
Zinc, refinery		Cía. Sulfacid S.A.C.I. y F and Cia. Minera Aguilar S.A. (50%, and private, 50%)	Near Rosario on the Paraná River, Santa Fe Province	35.

^{1/} Table includes data available through December 2000.

^{2/} Estimated data are rounded to three significant digits; may not add to totals shown.

^{3/} Reported figure.

^{4/} Hot-rolled semimanufactures only; excludes castings and cold-rolled semimanufactures produced from imported hot-rolled semimanufactures.

^{5/} Thomas slag production was estimated from the Thomas crude steel reported in La Siderurgia Argentina annual, published by the Instituto Argentino de Siderurgia.

^{6/} Natural gas imported from Bolivia.