

THE MINERAL INDUSTRY OF BRAZIL

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Brazil, a country of continental dimensions with about 170 million people, had a gross domestic product (GDP) of \$755.1 billion¹ in 1996 (Fidler, 1997). GDP growth decreased to 3.2% compared with 4.2% in 1995. Foreign exchange reserves were about \$52 billion. Brazil's total debt burden amounted to \$187.6 billion at yearend. The Brazilian Congress supported the Government's economic plan for stabilization Plano Real (Real Plan), which was based on strict control of the domestic deficit, issuance of a new currency, stable foreign exchange rates, renegotiation of its foreign debt on favorable terms, and reduction of tariffs.

The Real Plan has succeeded in restraining Brazil's chronically high inflation (5,000% for 1993). In 1996, inflation was held at 10%. The Government continued to use a tight monetary policy and high short-term interest rates (24.2% for 1996) with the objective of curbing inflation to about 8% in 1997 and preventing a price explosion (Ferraz, 1997, p. 1). Lower inflation has encouraged foreign direct investment (FDI) in Brazil, particularly in the minerals sector. According to the Central Bank of Brazil, the country received \$9.4 billion of FDI compared with \$3.9 billion in 1995 and \$2.2 billion in 1994 (Dyer, 1997).

Brazil produced bauxite, columbium, gemstones, gold, iron ore, kaolin, manganese, tantalum, and tin from world-class deposits and exported them to the global marketplace. In Latin America, particularly within the Southern Cone Common Market (Mercosur), Brazil continued to be the leading producer of aluminum, cement, ferroalloys, gold, iron ore, manganese, steel, and tin. The country continued with its ambitious petroleum exploration program to expand reserves and to reduce dependence on oil imports, which satisfied about 60% of its crude oil requirements. Brazil's reportedly large identified and undiscovered resources helped make it one of the most dynamic markets in the world, ranking ninth in the global economy and constituting one-third of the Latin American economy (Brito, 1997, p. 1).

Government Policies and Programs

In August 1995, the Brazilian Congress approved constitutional amendments allowing the participation of the private sector via privatization, joint ventures, and deregulating investment in the sectors of mining, petroleum exploration, natural gas distribution, coastal and river shipping, and

telecommunications. The lower House has approved a bill ending the 40-year Government monopoly of the oil and gas industries and fuel price subsidies after 3 years and allowing *Petróleo Brasileiro S.A.* (Petrobrás) to enter into joint ventures with foreign investors. Other significant actions were undertaken by the Brazilian Government—the Brazilian import tariff was lowered; an Industrial Products Tax, a Federal tax levied on most domestic and imported manufactured products, was set between 0% and 15%; 100% of equity ownership was allowed via privatization or by direct acquisition; and profits were allowed to be expatriated. In the mining sector, restrictions on foreign investments were removed in August 1995. The Concessions Law, also passed in 1995, should create additional opportunities for the private sector in public utilities previously reserved for the Government. These actions were undertaken by the Government to create a favorable and positive environment to attract domestic and foreign investments equally. The establishment of joint ventures, such as in construction and management of railroads, ports, and hydroelectric powerplants, is now a common practice in Brazil.

Privatization of Government-owned firms led to lower employment levels and more efficiency. Since yearend 1991, the Government has sold 55 companies worth \$17.9 billion. With the yearend privatization of *Companhia Vale do Rio Doce* [(CVRD)—51% Government and 49% private], the huge mining conglomerate, and with the public concessions in the transportation, electricity, telecommunications, and port and water sectors, the National Development Bank (BNDES) estimates that privatization receipts alone will surpass \$12 billion in 1997 (Alvares and Tombini, 1997, p. 6). Other major privatizations by the end of the decade could bring additional \$56 billion according to expert estimates (Mining Journal, 1997c, and Welch and Bacha, 1997a).

According to BNDES' Director of Privatization, 29% of CVRD will be auctioned on April 29, 1997; 5% will be offered to CVRD's employees by May 5, 1997; and the remaining 17% will be offered by yearend, if the first 29% is fully sold (José Pio Borges, Privatization Director of BNDES, oral commun., 1997). BNDES confirmed that minority shareholders can sell their stock on April 29. The Government has set a minimum price for CVRD at \$9.96 billion, or \$27.74 per share (Mining Journal, 1997b). If this privatization is completed, then CVRD will be able to expand investments and production in several mine projects in the near term.

The country's mining industry appeared to be on the verge of an investment boom in exploration and mine development, particularly in gold, that will take place when lower inflation,

¹Where necessary, values have been converted from Brazilian Real R\$ to U.S. dollars at the rate of R\$1.01=US\$1.00.

higher or improved productivity, and high mineral inventory levels are no longer used as a financial hedge. The Government's economic policies, Brazil's diversified minerals endowment, and a skilled labor base stimulated a return of the major international mining companies to Brazil. Several of them, which fled Brazil after the promulgation of the 1988 Constitution, began acquiring exploration properties and mining prospects, particularly for gold. The more than 50 active foreign companies in Brazil included Barrick Gold and Newmont (United States), Placer Dome, INCO Limited, and TVX Gold Inc. (Canada), Anglo-American and General Mining Union Corp. Ltd. (South Africa), Rio Tinto Zinc Mineração Ltd. (RTZ) (United Kingdom), and BHP Minerals and Western Mining Company (Australia).

Brazil is the largest open market and geographic center of Mercosur, the trade bloc that also includes Argentina, Paraguay, and Uruguay. It is expected that Bolivia and Chile might join Mercosur in 1997, and Peru, in 1998. According to the United States International Trade Commission, Mercosur has more than 200 million people and a combined economic output of more than \$1 trillion (U.S. International Trade Commission, 1997). Many U.S. companies were interested in Mercosur because of the positive changes that are taking place in the region (Thurston, 1997). Most multinational companies think that the next most important trade bloc in the world is Mercosur after the North America Free Trade Agreement (NAFTA) and the European Union (EU) because of its size and the amount of trade taking place in the region (Thurston, 1997). Mercosur's success and Brazil's growing global importance have increased South America's geopolitical power (Riordan Roett, Professor of the School of Advanced International Studies at The Johns Hopkins University, written commun., 1997). This success depends on the continuation of economic reforms and stability. The growing importance of the region, and of Brazil in particular, should give Mercosur a greater range of strategic options in its dealings with NAFTA and the Free Trade Agreement of the Americas' process (The Woodrow Wilson Center, 1997, p. 5).

Environmental Issues

According to the National Environmental Council (Conseho Nacional de Meio Ambiente), an environmental license was required for all mining activities in Brazil. In 1986, law No. 88351 established the National System for the Environment, composed of representatives of the Federal, State, and local governments and private foundations involved in environmental protection and improvement. Article 225 of the 1988 Constitution stipulated that mining operators must reclaim areas they have environmentally degraded. Later, detailed legislation, which was passed with a goal of harmonizing mining activities with the environment, included the Plan for Recovery of Degraded Areas and the Environmental Control Plan (Departamento Nacional de Produção Mineral, 1996a).

In February 1989, the President of Brazil signed a decree prohibiting the use of mercury and cyanide in the mining of gold unless approved by Brazilian local environmental agencies. The

States most affected were those in the Pantanal and the Amazon regions. Currently, however, the Ministério de Minas e Energia enforces the 1989 decree and offers technical assistance to *garimpeiros* (small-scale independent miners), in particular, to produce gold without affecting the environment. It is expected that environmental impacts will be minimized in both regions and the country in the near future.

Resolution 010 of December 6, 1990, required that all mining operations obtain environmental licenses prior to the granting of mineral rights by the Departamento Nacional de Produção Mineral (DNPM). As environmental problems increased, antipollution measures were enacted to eliminate the sources of pollutants and to mitigate their effects on the environment.

Production

According to the DNPM, the total value of minerals produced in 1996 was about \$15 billion, or almost 2% of the GDP. Crude oil and natural gas amounted to almost \$6 billion. Brazilian minerals production increased about 3.1% over that of 1995, caused mostly by an iron ore output increase of about 10.7%. Increases also were recorded in production of chromium, 17.4%; manganese, 13.8%; bauxite, 10%; copper, 8%; kaolin, 4.9%; and, to a lesser extent, asbestos, phosphate, and zinc. Gold production decreased by about 2%; depletion of shallow gold deposits and environmental constraints on *garimpeiros* would affect future output (Departamento Nacional de Produção Mineral, 1996b, p. 76).

The five major integrated steelworks [Aço Minas Gerais, S.A. (AÇOMINAS), a structure and rail producer; Cia. Siderúrgica Nacional (CSN), Brazil's largest mill; Cia. Siderúrgica Paulista (COSIPA), a carbon steel sheet and plate producer; Cia. Siderúrgica de Tubarao (CST), a slab producer; and Usinas Siderúrgicas de Minas Gerais, S.A. (USIMINAS), Brazil's second largest steel mill] produced about 17.5 million metric tons (Mt) of the total Brazilian steel production of 25.2 Mt. Six firms accounted for 90% of iron ore production. CVRD produced about 56.7% of the iron ore. Mineração Rio do Norte, S.A. (MRN), the majority of which is privately owned and the world's third largest bauxite producer and exporter, produced about 77% of the total bauxite production, which amounted to about 12.4 Mt. The five major aluminum smelters, all predominantly private Brazilian or foreign owned, produced about 87% of the primary aluminum production of 1.2 Mt. (See table 1.)

Trade

Mercosur's common external tariff ranges between 0% and 20% for minerals. When fully implemented, the treaty would allow unrestricted movement of labor, goods, and services among the four countries. Mercosur has had its impact on the Latin intraregional trade, which increased from \$7 billion in 1983 to about \$30 billion this year. Intra-Mercosur trade amounted to \$17 billion, and mineral trade amounted to \$4 billion.

Brazil's balance of trade decreased from a surplus of \$10.5 billion in 1994 to a deficit of \$5.6 billion in 1996. The total value of exports was about \$47.7 billion, and the total value of imports, \$53.3 billion. During 1996, Brazil sold 13% of its exports to the other Mercosur members and 8% to the other countries in South America. Brazilian mineral imports were valued at \$9.5 billion, and its total exports were \$11 billion, or about 1.2%, below those of 1995 (Brazilian Foreign Trade Association, 1996). The positive balance of trade in the minerals sector was heavily influenced by the value of steel and nonferrous metals exports (\$6.8 billion). In addition to petroleum and derivatives (\$7 billion), other major mineral imports (\$600 million) were coal, copper, lead, natural gas, potash, sulfur, and zinc.

During 1996, Brazilian exports of steel, mostly semifinished products, were more than 13 Mt valued at about \$4.1 billion (Ferraz, 1997, p. 4), an increase of about \$200 million in value, and a 5.7% increase in volume from that of 1995 (12.3 Mt).

Brazilian imports from the United States increased to \$11.8 billion from \$4.4 billion in 1990, or more than 160%. During the same period, Brazilian exports to the United States increased to \$9.3 billion from \$7.7 billion, or 20.8% (Alvares and Tombini, 1997, p. 7).

Structure of the Mineral Industry

The mineral industry of Brazil is large by world standards. The major portion of the industry was partially or wholly owned by private Brazilian investors, Brazilian corporations, and foreign companies. The exceptions were the natural gas and petroleum industries, which were 100% Government owned through Petrobrás, which comprised four subsidiaries—Petrobrás Distribuidora, S.A., the petroleum products distribution company; Petrobrás Química, S.A., the petrochemical company; Petrobrás Internacional, S.A., the foreign operating company; and Petrobrás Fertilizantes, S.A., the agricultural fertilizer company.

Beginning in 1991, the Government privatized the steel industry when it sold 75% of the common stock in USIMINAS to a variety of stockholders for \$1.2 billion. The share auction for Cia. Siderúrgica do Nordeste took place in 1991, and Aços Finos Piratini, S.A., a specialty steelmaker, was auctioned in 1992. Additional mills were privatized—CST in March 1992, AÇOMINAS in mid-1992, and CSN in the second half of 1992; COSIPA was sold in the first half of 1993. Several smaller companies that are partially or wholly Government owned were engaged in the mineral industry.

In 1996, 40 cement companies operated 51 cement plants and 7 grinding plants with a clinker capacity of 36.6 Mt and an utilization rate of 70%, and 40 iron ore mining companies operated 90 mines (Departamento Nacional de Produção Mineral, 1996b, p. 34, 50).

Brazil's total labor force was nearly 60 million. Of this total, services represented 42%; agriculture, 31%; and industry, 27%. The minerals sector composed about 4% (650,000) of the industry total (16 million). This did not include the 500,000 to 1 million garimpeiros active in Brazil. Employment in the

mining sector continued its downward trend as Brazil's economy was affected by joint ventures and privatization, particularly of the steel sector. (See table 2.)

Commodity Review

Metals

Alumina, Aluminum, and Bauxite.—Primary aluminum production amounted to 1.2 Mt of metal, which remained at nearly the same level as that of 1995, and bauxite production increased to 12.4 Mt from 11.3 Mt in 1995, or almost 10%. Alumina production remained at the same level of 1995, or 1.9 Mt (Ferraz, 1997, p. 1).

A consortium led by CVRD constructed a \$875 million, 1.1-million-metric-ton-per-year (Mt/yr) alumina refinery, known as the Jabuti Project, near Paragominas, Pará, to process the bauxite from the 850-Mt deposit there. The refinery produced 215,000 metric tons (t) of alumina after its startup in October 1995 and 826,000 t in 1996; full capacity will be attained in 1997 (Ferraz, 1997, p. 1).

In Brazil, producers of primary aluminum were Albras-Alumínio Brasileiro S.A. with about 340,000 t, followed by Alcoa Alumínio S.A. (Alcoa) with 284,000 t. Other producers included Compahnia Brasileira de Alumínio with 220,000 t, Billiton Metais S.A. with 210,000 t, and Vale do Rio Doce Alumínio S.A. with 48,000 t. Vale do Sul Alumínio S.A., produced 93,000 t. MRN increased its production to 9.6 Mt from 8.6 Mt in 1995, or about 11.6%. According to the DNPM, MRN was planning to invest \$65 million to open a new mine with bauxite reserves of 800 Mt in Trombetas, Pará, in 1997, with a capacity of 2 Mt/yr; thus, MRN's total bauxite production capacity will increase from about 10 to 12 Mt/yr. Reynolds Internacional do Brasil is building its third plant, which will produce an additional 1.5 million aluminum cans; total capacity will reach to 5.4 million cans per year (Departamento Nacional de Produção Mineral, 1996b, p. 19).

Alto Brazil Mineração is a joint venture of Alcoa (60%) and Billiton Metais S.A. (40%) set up to mine their Oriximina bauxite deposit near the Trombetas River and MRN's bauxite mine in Pará. When in operation, they will supply the feed to the Alcoa's refinery at São Luís, Maranhão. Exports of bauxite were 4.4 Mt, valued at \$115 million; primary aluminum was 632,000 t, valued at about \$1.1 billion (Departamento Nacional de Produção Mineral, 1996b, p. 19).

Columbium (Niobium) and Tantalum.—Brazil was the world's most significant producer and main supplier of columbium to global markets. Brazil produced about 90% of the world's total with about 22,000 t of pyrochlore in concentrate, 16,800 t of columbium in alloys, and 1,605 t of columbium in oxides. Brazil's most important columbium plant [23,000-metric-ton-per-year (t/yr) capacity] was in Araxá, Minas Gerais, operated by Companhia Brasileira de Metalurgia e Mineração (CBMM). CBMM accounted for about 80% of Brazil's production capacity and supplied about 65% of the world demand for ferrocolumbium. Columbium also was

produced at the Chapadão plant (3,000-t/yr capacity) in Ouidor, Goiás, owned by Mineração Catalao de Goiás Ltda.

Araxá and Catalão columbium ore deposits contained 4.5 Mt of pyrochlore reserves at yearend. Early in the year, the Mining Resources and Research Co. of Amazonas had announced the discovery of what may be the largest columbium-bearing deposit in the world. It was found in the São Gabriel da Coxoeira (Rio Negro), Amazonas, and contained about 2,900 Mt of columbium ore (Mining Journal, 1997a).

Tantalum production totaled 55 t. The Araxá deposit, considered to be the world's largest and the most economically viable ore body, contains columbite and tantalite. Over the long run, the upward trend in tantalum supply will continue in response to increased world demand. Brazil, however, will continue to import tantalum oxide and metal products until Araxá enters into production by the end of the decade (Departamento Nacional de Produção Mineral, 1996b, p. 73).

Copper.—Production of copper concentrate amounted to 46,200 t of metal, a decrease of 5.6% compared with that of 1995. Total primary copper metal production amounted to 172,000 t produced by Carafba Metais from the Carafba deposit in Jaguari, Bahia (154,600 t), and the Brazilian Copper Co.'s (BCC) operations in Camaquã, Rio Grande do Sul (17,400 t); BCC closed its operations by yearend 1996. The largest copper project under way is CVRD's Salobo Metais. Feasibility studies for the Salobo deposit in Carajás, Pará, proved 784 Mt of ore reserves containing 0.96% copper and 0.52 gram per ton of gold with associated molybdenum and silver. Mine startup is expected by 2002, and production is planned at the rate of 200,000 t/yr of refined copper over a 33-year life. The expected production of gold and silver is about 8 and 37 t/yr, respectively. CVRD announced plans to build a \$345 million, 225,000-t/yr copper refinery near its Salobo Mine. The estimated investment for the entire Salobo project will be \$1.5 billion (Departamento Nacional de Produção Mineral, 1996b, p. 37).

Fortaleza de Minas' nickel mine was expected to go online in the first quarter of 1998 and produce 7,000 t/yr of copper sulfate as a byproduct of nickel (Ferraz, 1997, p. 2). Salobo and Fortaleza mines would make Brazil self-sufficient in copper production.

Copper-consuming companies in Brazil imported 152,589 t of copper, in all forms. Total copper exports was 62,256 t. Brazil's metallic copper production was used primarily in construction and in automobile manufacturing. There also was a copper balance of trade deficit of \$233 million, the largest among the nonferrous metals in Brazil (Departamento Nacional de Produção Mineral, 1996b, p. 36-37).

Gold.—Gold production was reported by the DNPM as 60 t, which represented 42 t from mining companies and 18 t from garimpos (cooperatives of garimpeiros.) The increase in gold production from the private sector was due to the favorable operations at CVRD's gold mines in the States of Minas Gerais, Bahia, and Pará, which produced 18 t. The second largest producer of gold in Brazil was Mineração Morro Vehlo S.A., (MMVSA) with almost 6.5 t. Rio Paracatu Mineração S.A., a

British concern (RTZ) associated with TVX Gold Inc., produced 5.6 t from its Paracatu Mine in Minas Gerais.

São Bento Mineração, S.A., produced 3.1 t of gold at its Santa Barbara Mine in the east-central part of the State of Minas Gerais. Gold was extracted by a combination of pressure oxidation and bioleaching using the South African General Mining Union Corp. Ltd.'s technology. Mineração Santa Elina operated its São Vicenete Mine in Mato Grosso, producing 1.3 t of gold. This mine will be expanded to produce about 10 t of gold by the end of this decade.

Brazilian gold production could increase significantly in the near future because of increased interest by domestic and foreign investors in large unexplored areas having gold mineralization. According to DNPM, more than 2,000 gold deposits are known, mostly Precambrian vein deposits and alluvial placers (Departamento Nacional de Produção Mineral, 1996b, p. 77).

Iron and Steel.—Ferroalloys.—Ferroalloy production increased to 982,209 t from 864,033 t in 1995. For the year, exports decreased from those of 1995 but reached 335,509 t, valued at \$504 million. Brazil was the third largest ferroalloy producer in the world and the third largest exporter. Apparent domestic consumption was about 742,000 t (Ferraz, 1997, p. 4).

Norway's Elkem A/S (Elkem), one of the world's largest manganese alloy producers, formed a joint venture with Brazil's Prometal Produtos Metalúrgicos, S.A., that will produce 500,000 t of ferromanganese alloy in 1997. The project, in which Elkem will hold a 40% share, is in Marabá, Pará. The manganese will come from the nearby Prometal Mine, and the iron ore will come from the Carajás District (Departamento Nacional de Produção Mineral, 1996b, p. 65).

Nova Era Silicon S.A., in which CVRD (49%) is associated with Japanese capital [Mitsubishi (25.5%) and Kawasaki Steel (25.5%)], is building a silicon ferroalloy plant in Nova Era, Minas Gerais, with an installed capacity of 48,000 t/yr. About two-thirds of output will be exported, mainly to Japan, during the decade (Departamento Nacional de Produção Mineral, 1996b, p. 77).

Iron Ore.—Brazil produced 182.7 Mt of iron ore, a decrease of 0.6% compared with 183.8 Mt in 1995. About 90% of that production was from one Government-owned mining conglomerate and four major iron ore companies, in order of descending output—CVRD with 100.3 Mt; Minerações Brasileiras Reunidas S/A (MBR), 24.5 Mt; Ferteco Mineração S.A., 10.7 Mt; Samarco Mineração S.A. (SAMARCO), 9.4 Mt. S.A. Mineração da Trindade (SAMITRI), 9.3 Mt; and others, 28.5 Mt (Departamento Nacional de Produção Mineral, 1996b, p. 50-51).

The total iron ore exports were about 129.7 Mt, which represented an increase of almost 12% compared with those of 1995, and shipped to 35 countries. Total export revenues increased to \$2.7 billion at yearend from \$2.5 billion in 1995. The major importers of Brazilian iron ore were Japan, 17.5%; Germany, 17.3%; Italy, 6.7%; and China, 6.2%. In 1996, the United States imported 4.1% of Brazil's total iron ore exports.

The customized commercial products (varied chemical characteristics) sold were sinter-feed and pellet-feed, 70.3%; pellets, 21.4%; and lump ore, 8.3% (Departamento Nacional de Produção Mineral, 1996b, p. 51).

CVRD started the construction of the Kobrasco pellet plant, its seventh, which is a joint venture with Pohang Iron and Steel Co. (POSCO) of the Republic of Korea. The facility is in the port of Tubarão, Espírito Santo; CVRD-POSCO plan to invest \$230 million by yearend 1996 to produce 4 Mt/yr of pellets. MBR, Brazil's second largest iron ore producer, continued its long-range plan to invest \$1 billion during the 10-year period beginning in 1991. The investment program is aimed at increasing reserves and production. The target is to increase output to 32 Mt/yr from the present 23 Mt/yr by the end of the decade (Ferraz, 1997, p. 3).

SAMARCO, controlled by SAMITRI (51%) and BHP-Utah (49%), is planning to build its second pellet plant at Ponta do Ubo in Espírito Santo. The expansion will increase the production to 13 Mt/yr (12 Mt/yr of pellets for blast furnace and 1 Mt/yr of pellet-feed for direct reduction) from 5.5 Mt/yr of pellets at a cost of \$250 million (Breña, 1996, p. 1).

Pig Iron.—Brazil produced 25.2 Mt of pig iron, which remained at the same level as that of 1995. Exports were 2.5 Mt valued at \$287 million, approximately one-third of the pig iron traded in the world (Ferraz, 1997, p. 2).

Steel.—Brazil's 1996 steel production totaled 25.1 Mt, which was a decrease of 680,000 t in comparison with that of 1995, placing the country eighth in world ranking. The major recipients of Brazil's exports were Asia, 5 Mt; Latin America, 2 Mt; and the United States, 1.4 Mt (Instituto Brasileiro de Siderurgia, 1996, p. 32). The Instituto Brasileiro de Siderurgia (IBS) stressed that the Brazilian steel industry no longer received subsidies or enjoyed tariff protection and that the industry became more efficient because of the major changes it had made via privatization. Brazil has begun to auction Government-owned assets in amounts never before seen in Latin America, and privatization can be expected to generate \$15.9 billion in 1997, \$20 billion in 1998, and \$19.8 billion in 1999 (Welch and Bacha, 1997b).

Privatization has fundamentally changed the in efficiency and reduced employment levels of the Brazilian steel industry. Vertical integration was evident as suppliers and customers of the steel companies participated in the auctions. For instance, CVRD acquired significant minority holdings in CST, CSN, and USIMINAS and supplied iron ore to these companies and continued providing them with railroad, port, and shipping facilities.

After the Government's privatization program identified Brazil's steel industry as one of the first sectors for auction, via the stock exchanges of Rio de Janeiro and São Paulo, the Government-owned steel companies were largely privatized in 1991. The last steel companies sold were COSIPA in 1992 and AÇOMINAS in 1993. The decline in employment in the steel industry from 174,000 in 1989 to 102,300 in 1996 reflected, in part, the effects of privatization and associated downsizing.

Government-owned companies, expecting to be privatized, reduced employment levels in anticipation of the process. Other major privatizations, in the near term, are expected to collect an additional \$56 billion (Welch and Bacha, 1997).

Manganese.—Brazil produced 2.2 Mt of manganese ore in 1996, which was 8.3% lower than that of 1995. CVRD continued operating its high-grade manganese mine, Igarapé Azul, in the Carajás complex, which produced 1.1 Mt of metallurgical manganese, no increase from that of 1995.

Indústria e Comércio de Minérios S.A., controlled by the Caemi Mineração e Metalurgia group, was the second largest Brazilian producer with 332,000 t. Other manganese ore producers were Mineração Buritirama, a subsidiary of Prometal Produtos Metalurgicos S.A., 280,000 t; Sociedade Mineira de Mineração Ltda., controlled by CVRD, 242,000 t; Urucum Mineração S.A., 198,000 t; and SAMITRI, 10,000 t (Departamento Nacional de Produção Mineral, 1996b, p. 64-65).

Tin.—Brazil was the world's third largest tin producer following China and Indonesia. Tin production has decreased from the peak of 50,200 t in 1989 to 23,178 t. (Departamento Nacional de Produção Mineral, 1996b, p. 46-47). The reduction in Brazilian output was attributed to the closing of some high-cost operations, the decrease in the ore grades, and the decline in tin prices. Production cuts were made at the Pitinga Mine in Amazonas, operated by the world's largest tin firm, Paranapanema S.A. Mineração, Indústria e Construção, and at the garimpeiros' Bom Futuro operations in Rondônia. Exports increased to 12,268 t from 10,190 t in 1995. Although much below the 20,185-t quota based on Brazil's commitment to the Association of Tin Producing Countries.

Paranapanema produced 13,670 t of tin from its high-grade Pitinga Mine, with byproducts of, in order of importance, columbium, tantalum, zirconium, hafnium, thorium, and cryolite. Garimpeiros produced 6,500 t, and Paranapanema's Bom Futuro tin mine produced 10,500 t.

Industrial Minerals

Asbestos.—Economically significant asbestos deposits were in Minaçu, Goiás. Sociedade Anônima Mineração de Amianto (SAMA) produced 3.95 Mt of chrysotile ore and 213,200 t of asbestos fiber, which was 1.4% higher than the 210,352 t of 1995 (Departamento Nacional de Produção Mineral, 1996b, p. 20). About 80% of Brazil's asbestos output was consumed in the manufacture of specialized cement products, such as ceiling tiles, protective screens, water and sewer pipes, water tanks, and molded electrical insulators. Other uses were in thermal insulators, paper and cardboard, decorations, slabs, insecticide, asphalt for highways and airport runways, and the automobile industry.

Brazil exported about 78,294 t, worth \$35 million. Exports went mainly to, in order of importance, India, Thailand, Japan, Nigeria, Angola, Mexico, Chile, Colombia, Uruguay, Argentina, and Saudi Arabia (Departamento Nacional de Produção

Mineral, 1996b, p. 21). Domestic consumption has increased steadily in recent years. The State of São Paulo was the country's largest consumer followed by the States of Paraná and Rio Grande do Sul. Asbestos mining and consumption have been highly regulated in most industrialized nations, forcing them to reduce production and consumption. Industry experts expected asbestos use in the industrial nations to continue to decline beyond the turn of the century. In contrast, the world's developing nations were expected to increase their collective asbestos consumption by large margins (Departamento Nacional de Produção Mineral, 1996b, p. 21).

Brazilian asbestos reserves have been considered to be adequate to meet demand in the short to medium term, while SAMA was investing in an exploration program to assure a long term supply (Departamento Nacional de Produção Mineral, 1996b, p. 20). The average grade of ore from the Cana Brava Mine in Minaçu was 5.235%, and its reserves, considering its fiber content only, were 3.01 Mt, which, at a production rate of 200,000 t/yr, represented a 15-year mine life.

Cement.—The country produced 34.6 Mt, which was almost 22.4% higher than that of 1995. Minas Gerais contributed 25%; São Paulo, 20.1%; Paraná, 9.7%; Rio de Janeiro, 8.8%; and other States, 36.4% (Departamento Nacional de Produção Mineral, 1996b, p. 34). Most of the exported cement (176,500 t) went to Bolivia, 59.5%; Paraguay, 24.8%; and Peru, 8.1%. Brazil imported about 448,900 t of cement from Greece, 43.3%; Cuba, 14.3%; Romania, 13.2%; Venezuela, 12.4%; Panama, 11%; and other countries, 5.8% (Departamento Nacional de Produção Mineral, 1996b, p. 35).

Gemstones.—For many years, Brazil has been an important world producer and exporter of gemstones in terms of volume and variety. The largest proportion of gemstones produced was mined by garimpeiros. For this reason, gemstone reserves are unknown, but Brazil probably has a remarkable potential.

The total value of gemstone (including diamond) production was \$107.6 million, the same level as that of 1995. Exports of uncut gemstones have declined from \$20.2 million in 1993 to \$3.3 million despite the removal of some export barriers (Departamento Nacional de Produção Mineral, 1996b, p. 40-41).

Graphite.—Historically, Brazil's beneficiated natural graphite output had been centered in Minas Gerais. Nacional de Grafite Ltda. (NGL) mined natural graphite in the municipalities of Pedra Azul, Itapecerica, and São Francisco de Paula, together amounting to about 36,000 t grading 14% of carbon. This mine output was concentrated by NGL in products ranging in grade from 61% to 99.5% carbon. Also in Minas Gerais, Empresa de Mineração J. Mendes produced 3,368 t of graphite grading 14% that was sold, domestically, after simple grinding (Departamento Nacional de Produção Mineral, 1996b, p. 58).

Three types of beneficiated products were processed by NGL in Itapecerica and Pedra Azul—lump graphite, medium grained graphite, and graphite fines. Brazil's demand for natural flake-

type crystalline graphite was met by the Pedra Azul and the Itapecerica beneficiation plants, which had installed capacities of 30,000 and 4,500 t/yr, respectively. Imports totaled 2,188 t, valued at \$1.9 million, and exports amounted to 12,000 t, valued at about \$11.9 million (Departamento Nacional de Produção Mineral, 1996b, p. 59).

Growth of the domestic consumption of natural graphite during the 1980's and 1990's was correlated with the stability of the iron and steel industries, which absorbed about 80% of the natural graphite consumed in Brazil, or 18,307 t in 1996. Other consumers included battery manufacturing, 6.5%; refractories, 6%; paint and varnishes, 2%; and other miscellaneous uses, 5.5% (Departamento Nacional de Produção Mineral, 1996b, p. 59). Assuming a healthy Brazilian steel industry, these trends are expected to continue into the next decade.

Kaolin.—Production of kaolin was about 1.1 Mt, which was almost 10.9% higher than that of 1995. Caulim da Amazônia S.A. (CADAM) continued operating its Adam Mine in Rio Jarf, Amazonas, and accounted for about 60% of the country's total output. Brazilian kaolin exports amounted to 601,822 t, valued at about \$65.5 million; of this total, CADAM exported 98%, or about 589,800 t. Two quarries came onstream—Pará Pigmentos S.A., a CVRD \$180 million joint venture, at a capacity of 300,000 t/yr in August and Rio Capim Caulim S.A. at a capacity of 250,000 t/yr in November. By the turn of the century, depending on market conditions, Pará Pigmentos and Rio Campim Caulim are considering expansions that will increase their capacities by 100% and 124%, respectively (Ferraz, 1997, p. 3).

In Brazil, kaolin was mainly used in the paper and ceramics industries. To a lesser degree, it was utilized in the manufacture of rubber, plastics, pesticides, animal feed, food supplements and pharmaceuticals, fertilizers, and paint, as well as many other applications. Brazil had 1.7 billion metric tons of kaolin reserves, or about 14.2% of the world's total (Departamento Nacional de Produção Mineral, 1996b, p. 30).

Magnesite.—The most important magnesite mine in Brazil was Pedra Preta Mine owned and operated by Magnesita S.A. (MSA) in the Éguas Mountain region of Brumado, Bahia, about 610 kilometers (km) from Salvador. Brazil produced 302,700 t of magnesite, of which MSA produced 98%, or 296,646 t. Exports were 166,792 t, valued at \$37.8 million (Departamento Nacional de Produção Mineral, 1996b, p. 62).

In Brazil, there were about 630 Mt of identified resources with 180 Mt of magnesium content by yearend. According to the DNPM, in the next decade, MSA's beneficiation plant in Brumado, Bahia, and its industrial complex in Contagem, Minas Gerais, where a range of refractory materials are produced, should continue operating (Departamento Nacional de Produção Mineral, 1996b, p. 63).

Phosphate Rock.—Production of phosphate rock concentrate amounted to about 3.8 Mt, a decrease of 1.7% from that of 1995. Production was highly concentrated in four mining

companies—Fertilizantes Fosfatados S.A. (FOSFERTIL), 37%; Arafertil S.A. (ARAFERTIL), 16%; Ultrafertil S.A. (ULTRAFERTIL), 18%; and Copebras, controlled by MMVSA, a subsidiary of the Anglo American Group, 13.5%—representing almost 84% of the total domestic output. The reported domestic consumption was 4.4 Mt/yr. FOSFERTIL announced a \$55 million investment to build a phosphoric acid plant in Uberaba, Minas Gerais (Ferraz, 1997, p. 3).

Of the total phosphoric acid, 73% was used in the fertilizer industry, 25% in the chemical industry, and the rest for other uses (Departamento Nacional de Produção Mineral, 1996b, p. 53). The industry has changed because of the privatization process (the Government has privatized ARAFERTIL, FOSFERTIL, and ULTRAFERTIL) and the elimination of trade barriers.

Quartz.—Brazil produced 5,586 t, valued at about \$7.4 million, and continued to be the largest producer of quartz in the world. Quartz exports were 5,549 t, valued at about \$10.7 million, and were shipped mostly to Japan, 45.9%; the United Kingdom, 21.9%; Germany, 20.9%; Hong Kong, 7.8%; and others, 3.5%. Telequartzo Exportação S.A., and others produced quartz powder, which is an important constituent in the production of optic fibers, crucibles, oscillators, solar cells, wafers and integrated circuit packing, and ceramic materials of exceptional purity. Brazil is estimated to have 53 Mt of reserves (Departamento Nacional de Produção Mineral, 1996b, p. 83).

Salt.—The reported domestic production of marine salt was 4.5 Mt, which represented a 4.5% decrease from that of 1995's output. Rio Grande do Norte S.A., continued to be the major source of salt with 91%, followed by Rio de Janeiro, 5%; Ceará, 3%; and Piauí, 1% (Departamento Nacional de Produção Mineral, 1996b, p. 86). The domestic consumption of marine salt was 4.4 Mt, which represented almost 98% of the country's output. Also, Brazil produced 1.34 Mt of rock salt. The total salt consumption was for chemical industry, 40.4% (2.346 Mt); feedstock, 40% (2.32 Mt); chlorine and caustic soda, 34.4% (rock salt, 1.34 Mt and marine salt, 0.657 Mt); deicing salt, 6% (0.349 Mt); and other uses, 19.6% (1.134Mt) (Departamento Nacional de Produção Mineral, 1996b, p. 87).

Serrana de Mineração S.A. and Álcalis do Rio Grande do Norte S.A. were acquired by Frota Oceânica Brasileira S.A., (FOBSA). FOBSA is the major nacional producer of marine salt, representing 37% (1.65Mt) of the total output (Departamento Nacional de Produção Mineral, 1996b, p. 86-87).

Other Industrial Minerals.—Potassium production increased by 8.9%, to 404,500 t, compared with that of 1995. Brazil imported 1.5 Mt of potash, mainly from Canada, 34.5%; Germany, 19.4%; Russia, 11.7%; Israel, 9.5%; and other countries, 24.9% (Departamento Nacional de Produção Mineral, 1996b, p. 78-79).

Mineral Fuels

Brazil produced 296.1 million barrels (Mbb) of petroleum and 9.2 billion cubic meters (m³) of natural gas. The total amount of energy produced was 163.9 Mt of oil equivalent. The primary sources were, in order of importance, hydraulic energy, firewood, petroleum, sugarcane bagasse, natural gas, steam coal, metallurgical coal, and uranium. Crude oil imports were 494,000 barrels per day (bbl/d), and oil products amounted to 353,000 bbl/d. Exports were gasoline, 10,000 bbl/d; fuel oil, 20,000 bbl/d; and others, 45,000 bbl/d. Total energy consumption was 178.2 Mt of oil equivalent. The transportation sector consumed 36.1 Mt of oil equivalent, and the industrial sector, 78.4 Mt of oil equivalent. In the mineral industry, consumption was, by category and in order of importance, pig iron and steel, 19.9 Mt of oil equivalent; nonferrous and other metals, 10.2 Mt of oil equivalent; cement, 3.2 Mt of oil equivalent; mining and pelletization, 3 Mt of oil equivalent; and ferroalloys, 3.1 Mt of oil equivalent (Petrobrás Magazine, 1997).

Coal.—The Brazilian coal industry is not a large component of the minerals industry. Coal production is concentrated in the southern States of Rio Grande do Sul, 64%; Santa Catarina, 33%; Paraná, 3%; and with Minas Gerais, minor production (Departamento Nacional de Produção Mineral, 1996b, p. 28). Brazil's total production of coal (run-of-mine) was about 4.65 Mt, which was transformed into 1.82 Mt of marketable product, and remained at about the same level as that of 1995. Imports of metallurgical coal amounted to about 12.4 Mt and came from the United States, 49%; Australia, 26%; Canada, 10%; Poland, 7%; South Africa, 6%; Colombia, Germany, and Venezuela, 2%. Coal consumption at yearend reached 15.8 Mt. Metallurgical coal represented 71% of this total consumption, and the remainder was for power generation.

Most Brazilian coals have lower content of carbon and higher content of ashes compared with that of Colombian coals. Total Brazilian coal reserves were estimated to be 32.3 billion metric tons (Departamento Nacional de Produção Mineral, 1996b, p. 28-29).

Natural Gas and Petroleum.—The gas pipeline linking the Enchova platform in the offshore Campos Basin to Macaé, Rio de Janeiro, has added 5 million cubic meters per day (Mm³/d) of gas flow to the Rio de Janeiro and the São Paulo markets. The State of Rio de Janeiro is planning to sell its gas companies in mid-1997, which would be the first Government-owned gas firm to be privatized in Brazil (Dyer, 1997).

Braspetro, the international operating subsidiary of Petrobrás, continued producing natural gas in the Gulf of Mexico. The gas was recovered from the Frederick Field, 27 km off the Louisiana coast by Petrobrás América Inc., a subsidiary of Braspetro.

Petroleum production averaged 888,500 bbl/d, or 324.3 Mbb, while natural gas production amounted to 26.8 Mm³, or 9.8 billion cubic meters (Petrobrás Magazine, 1997, p. 33). Brazil's imports of petroleum and derivative products were 309.2 Mbb at a cost of \$7 billion; of this total, Saudi Arabia

supplied 75%, and the remainder was supplied by Algeria, Argentina, Kuwait, Nigeria, and Venezuela.

Uranium.—Brazil owns the fifth largest uranium reserves in the world. Reserves amounted to about 163,000 t of U_3O_8 and 92,000 t of inferred reserves. Private interests are permitted to participate in uranium exploration and production in Brazil through state-owned joint ventures; there is, however, a restriction that no more than 20% of the country's uranium reserves may be exported (Rapouso dos Santos, 1997).

Reserves

Brazil was among the world leaders in reserves of the following mineral commodities, by rank: columbium (niobium), first; talc and pyrophyllite, third; bauxite, fourth; iron ore, fifth; manganese, fifth; and tin, sixth. (See table 3.)

Infrastructure

Brazil's railroads comprised 25,268 km of 1.000-meter (m) gauge, 4,339 km of 1.600-m gauge, 74 km of 1.600- to 1.000-m gauge, 13 km of 0.760-m gauge, and 2,308 km electrified for a total of 32,002 km. The country contained a total of almost 1.5 million kilometers (Mkm) of roads—48,000 km paved and 1.4 Mkm gravel and dirt. There was 50,000 km of navigable inland waterways. The major shipping ports were Belém, Manaus, Porto Alegre, Recife, Río de Janeiro, Río Grande, Salvador, and Santos. Among the 271 ships, 56 were tankers; 15, chemical tankers; 10, liquefied natural gas; 14, combination ore and oil vessels; 82, bulk vessels; and 2 combination bulk vessels. There were 2,000 km of crude petroleum pipelines, 3,804 km of refined petroleum product pipelines, and 1,095 km of natural gas pipelines (Vale, 1996, p. 1-17). In 1996, Brazil's installed electrical generating capacity was 52,865 megawatts (MW). Total production of electric power for the year was 227,800 gigawatt hours, which translated into 1,340 kilowatt hours per capita. Brazil's primary domestic energy supply encompassed the following: hydroelectric, 39%; petroleum and natural gas, 32%; firewood and charcoal, 12.5%; sugarcane derivatives, 9.8%; coal 5.3%; nuclear energy, 0.10%; and others, 1.3% (Vale, 1996, p. 18-23).

Power investment negotiations were underway between the Brazilian Government and five companies, four of which were foreign subsidiaries. The companies involved were Alcan Alumínio do Brasil S.A. (Canada), Alcoa (United States), Billiton Metais S.A. (Netherlands), Dow Química S.A. (United States), and Camargo Corrêa Industrial S.A. (Brazil). The proposal submitted by the five companies was to build a 1,200-MW dam on the Tocantins River on the border between the States of Maranhão and Tocantins. The dam construction would cost about \$1 billion; Billiton Metais S.A. has pledged \$350 million (Vale, 1996, p. 23). The companies have been receiving electricity from the Tucuruí Dam on the Tocantins River, but the demand has been increasing at such a rapid rate that it could exceed the supply in a very few years. Another factor was the 10% subsidy on electricity prices that expires in

2004.

During the last several years, the lack of funding has led to a significant deterioration in the quality of Brazilian highways. Thus, the lack of proper maintenance of Brazilian roads added between 10% and 15% to the total transportation costs in the country. This high cost of the country's inadequate infrastructure was called as the Brazilian cost (Thurston, 1997). During the 1990's, the Inter-American Development Bank has made loans totaling almost \$47.5 billion to Brazil. Of this total, \$29.5 billion (62.1%) was dedicated to the mining, energy, and tourism industries, and only \$6.2 billion (13.1%) was allotted for transportation and communications (Inter-American Development Bank, 1995, p. 61).

A study by the IBS found that the loading of 1 t of steel at the Port of Santos cost \$32.50. In comparison, the average cost of loading 1 t of steel in Asian, European, and U.S. ports was \$4.50. At the Ports of Rio de Janeiro and Vitória, the costs exceeded \$10.00 per ton of steel (Instituto Brasileiro de Siderurgia, 1996, p. 6-8).

The ports of Brazil were found to require heavy investments in modernization and expansion. The bottlenecks resulting from the lack of capacity were so great that Brazilian importers paid almost \$300 million in penalties charged by ships that had to wait in line to be unloaded (Instituto Brasileiro de Siderurgia, 1996, p. 7).

Constran, S.A. Construção e Comércio of the Itamaraty Group, a private sector company, plans to construct an additional 1,718 km of railroads linked to the existing railroad system. The cost of the new system was projected to be \$2.5 billion. This addition will connect to the existing system, which runs through Vitória, Espírito Santo; Belo Horizonte, Minas Gerais; Santos, São Paulo; and Chapadao do Sul, Mato Grosso do Sul. The new railroad system will run from Chapadao do Sul, Mato Grosso do Sul, to Cuiabá, Mato Grosso, and Santarem, Pará, branching from Cuiabá, Mato Grosso, to Porto Velho, Rondônia (Vale, 1996, p. 22).

Outlook

Brazil established a favorable climate for potential foreign investors by keeping inflation under control, reducing public deficit along with improvements in its external debt, providing stable rules for capital repatriation and profit remittances, and reducing the tax burden, tariffs, and nontariff barriers. These and the recent review of its 1988 Constitution should position Brazil well for the future. Clearly, the flow of foreign capital into the Brazilian economy would support continued economic growth and investments in technology may well continue. In September 1996, 42 high-priority development projects in the infrastructure, environment, and service sectors were identified under the title "Brazil in Action." The private sector is expected to invest \$12.8 billion of the \$54.4 billion cost of these projects (Branco, 1997).

In comparison to past plans, Real Plan is based on constitutional reviews, privatization of Government-owned companies, and joint ventures to increase capital flow into the country. There were no price freezes, and the Real Plan relied

solely on macroeconomics to achieve its goals.

Most sectors of the Brazilian economy recorded positive growth during 1996. For instance, the mineral sector increased 3.1%. If that positive rate of economic growth is sustained into 1997 and beyond, then the minerals sector should continue its recovery as the demand for mineral exports and steel intensive goods increase.

FDI into the Brazilian mining industry appears to be enhancing exploration and mine development activities, particularly in gold. This trend should continue as several corporations are acquiring exploration properties and mining prospects, particularly for gold, diamond, and base metals. U.S. private sector investors are increasing investments in Latin America, and especially Brazil, through joint ventures and project finance mechanisms minimizing the investors' risks. The Export-Import Bank is providing a political risk guarantee for the 3-year period of infrastructure and environmental project constructions and will follow with a comprehensive guarantee, covering political and commercial risks, for the 10-year term loan that will be in place once the projects are up and running (Barovick, 1997). These programs could provide the needed comfort level to commercial lenders.

In the mineral industries, the steel industry was privatized, and the gas and mining industries will be part of the privatization process. New projects in the petroleum sector, however, will be opened up to joint ventures. After privatization, scheduled for 1997, CVRD will be able to expand investments and production in several mine projects in the near term.

Privatization of Government-owned firms has led to lower employment levels and greater efficiencies; as a result, the Brazilian economy became more competitive in the global economy. Privatization of Government monopolies, dismantling all trade barriers, and increased exports to the world markets will continue to be important, allowing continued flow of fresh capital into the Brazilian economy.

The existing Brazilian infrastructure is of particular interest to the minerals and related industries. Within the Mercosur bloc, Brazil is a leading producer of competitive hydroelectricity, has a good industrial base capable of supplying most of the required mining equipment, has a modern and reliable transportation and communication systems, and can provide skilled labor, adequate mining technology, and an efficient network of supporting services. Improvements and additional infrastructure would, however, have a direct bearing on Brazil's ability to increase industrial and minerals production competitively.

The sectors most likely to be affected are those that depend most heavily on electricity and transportation facilities. The aluminum, automobile, steel, petrochemical, and pulp and paper industries, which depend heavily on energy and on exports, would benefit most from a new and improved infrastructure. Foreign majority participation in mining operations and investment in new infrastructure were barred by the Brazilian Constitution of 1988. The constitutional amendment to eliminate the distinction between domestic and foreign capital should, however, eliminate these restrictions once fully

implemented.

As the barriers to foreign investments continue to fall, foreign interests will probably be attracted by Brazil's mineral potential. The Amazon region alone is considered to have possibilities for major undiscovered mineral deposits beyond the large reserves of iron ore, manganese, bauxite, gold, and tin in Carajás, Pará, being produced by CVRD. A factor that may have a negative effect over the longer term is the environment, especially in the Amazon rain forest. Much depends on what approaches are used to protect the environment and to continue on the path of sustainable development.

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TABLE 1
BRAZIL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1992	1993	1994	1995	1996 e/
METALS					
Aluminum:					
Bauxite, dry basis, gross weight	9,366,000	10,001,031 r/	9,041,471 r/	10,866,042 r/	10,760,000 3/
Alumina	1,833,000	1,853,000	1,868,000	1,883,000 r/	1,870,000
Metal:					
Primary	1,193,000	1,172,000 r/	1,185,000 r/	1,188,000 r/	1,180,000 3/
Secondary	66,000	62,000	90,000 r/	92,000 r/	90,000 3/
Beryllium, beryl concentrate, gross weight	850	850	900 e/	900	900
Cadmium, metal, primary	200	200	300 e/	300	300
Chromium:					
Crude ore	198,000	126,107 r/	153,359 r/	175,667 r/	216,600 3/
Concentrate	98,588	86,759 r/	85,879 r/	100,969 r/	101,000
Marketable product 4/	64,000	63,000 r/	62,500 r/	64,200 3/	64,500
Cobalt: e/					
Mine output, Co content by hydroxide	400	400	400	400	400
Metal, electrolytic	240	240	240	180	180
Columbium-tantalum ores and concentrates, gross weight:					
Columbite and tantalite	200	180	180 e/	180	180
Djalmaite concentrate e/	10	10	10	10	10
Pyrochlore concentrate, Cb ₂ O ₅ content	17,807 r/	13,640 r/	18,485 r/	21,731 r/	22,000 3/
Copper:					
Mine output, Cu content	39,845	43,396 r/	39,690 r/	48,933 r/	46,200 3/
Metal:					
Primary	157,950	161,102 r/	170,033 r/	164,966 r/	172,000 3/
Secondary	52,244	54,000 r/	54,290 r/	54,400 r/	54,000
Gold:					
Mine output kilograms	39,044	39,894 r/	40,188 r/	40,951 r/	42,000 3/
Garimpeiros (independent miners) do.	37,000 r/	36,412 r/	32,208 r/	22,348 r/	18,000 3/
Total do.	76,044 r/	76,306 r/	72,396 r/	63,299 r/	60,000 3/
Iron and steel:					
Ore and concentrate (marketable product): 5/					
Gross weight thousand tons	146,447	153,999 r/	177,331 r/	183,839 r/	182,700 3/
Fe content	95,200	104,000	108,800 r/	112,793 r/	112,000 3/
Metal:					
Pig iron thousand tons	23,200	24,000	25,200	25,200	25,200
Ferroalloys, electric-furnace:					
Chromium metal e/	37	37	37	37	37
Ferrocilcium silicon	22,800	22,000 e/	25,000 e/	25,000	25,000
Ferromanganese	91,100	83,892	77,105 r/	77,100 3/	77,100
Ferrosilicon	6,760	4,500	5,000 e/	5,000	5,000
Ferrocolumbium	16,300	19,000	19,000 e/	19,000	19,000
Ferromanganese	178,937	201,500 r/	200,000 r/	130,000 3/	160,000
Ferromolybdenum	--	47	47 e/	47	47
Ferronickel	34,968 r/	34,732 r/	35,260 r/	34,000 e/	34,000
Ferrophosphorus	800	800 e/	2,000 e/	2,000	2,000
Ferrosilicon	243,838	284,147	198,505 r/	243,824 r/	240,000
Ferrosilicon magnesium	10,600	10,000 e/	15,000 e/	15,000	15,000
Ferrosilicon zirconium	104	102	1,500 e/	1,500	1,500
Ferrotitanium	4	126	500 e/	500	500
Ferrotungsten	--	1	25 e/	25	25
Ferrovandium	--	--	3,000 e/	3,000	3,000
Inoculant	20,900	24,500	25,000 e/	25,000	25,000
Silicomanganese	299,995	284,147 r/	248,000 r/	167,000 3/	210,000
Silicon metal	93,734	106,000	110,000	116,000 3/	165,000
Total	1,020,877 r/	1,075,531 r/	964,979 r/	864,033 r/	982,209
Steel, crude, excluding castings	23,934	25,207	25,747	25,076 3/	25,076 3/
Semimanufactures, flat and nonflat e/	25,000	25,000	25,000	25,000	25,000
Lead:					
Mine output, Pb content	2,517 r/	2,062 r/	1,329 r/	11,611 r/	13,200 3/
Metal:					
Primary	24,500	27,500 r/	14,602 r/	13,958 r/	14,000
Secondary	38,267	47,027 r/	34,530 r/	28,000 e/	28,000

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1992	1993	1994	1995	1996 e/
METALS--Continued					
Manganese metal: e/					
Primary	6,500	6,500	6,500	6,500	6,500
Secondary	1,600	1,600	1,600	1,600	1,600
Manganese ore and concentrate, marketable, gross weight 4/	1,992,545 r/	1,838,414 r/	2,199,079 r/	2,398,025 r/	2,200,000 3/
Nickel:					
Mine output, Ni content	29,372 r/	32,154 r/	32,663 r/	25,469 r/	25,600
Ferronickel, Ni content	8,742	8,683 r/	8,815 r/	8,497 r/	8,500
Rare-earth metals, monazite concentrate, gross weight	396 r/	270 r/	256 r/	103 r/	200
Silver 6/ kilograms	162,000	108,000 r/	50,400 r/	49,775 r/	55,000
Tin:					
Mine output, Sn content	27,500	26,500 r/	16,900 r/	19,950 r/	20,400 3/
Metal:					
Primary	27,000 r/	26,900 r/	20,400 r/	19,500 r/	20,500
Secondary e/	250	250	250	250	250
Titanium concentrates, gross weight:					
Ilmenite	76,558	90,567 r/	97,439 r/	97,500	97,500
Rutile	1,798	1,744 r/	1,911 r/	2,000	2,000
Tungsten, mine output, W content	205	245 r/	155 r/	115 r/	100 3/
Zinc:					
Mine output, Zn content	149,000 r/	171,800 r/	145,900 r/	150,000	150,000
Metal, smelter:					
Primary	180,414 r/	190,400 r/	209,200 r/	188,472 r/	80,400 3/
Secondary	7,000	7,200 r/	7,000	7,000	7,000
Zirconium, zircon concentrate, gross weight 7/	16,874	13,252 r/	17,064 r/	17,100	17,100
INDUSTRIAL MINERALS					
Asbestos:					
Crude ore e/	2,900,000	3,950,000	3,950,000	3,950,000	3,950,000
Fiber	170,000	186,662 r/	183,079 r/	210,352 r/	213,200 3/
Barite:					
Crude	72,172	75,835 r/	48,287 r/	43,737 r/	45,000
Beneficiated	54,490	32,068 r/	31,499 r/	30,750 r/	32,000
Marketable product e/ 4/	65,000	65,000	65,000	65,000	65,000
Calcite	31,074 r/	32,296 r/	32,798 r/	36,733 r/	35,000
Cement, hydraulic thousand tons	23,903 r/	24,843 r/	25,230 r/	28,256 3/	34,597 3/
Clays:					
Bentonite (beneficiated)	131,180 r/	113,180 r/	113,215 r/	130,000 3/	130,000
Kaolin:					
Crude	1,632,538 r/	1,560,000 r/	1,800,000 r/	2,020,000 r/	2,100,000 3/
Beneficiated	810,976	916,048 r/	1,037,570 r/	1,067,109 r/	1,105,000 3/
Marketable product e/ 4/	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000
Diamond: e/					
Gem thousand carats	650	700	700	700	700
Industrial do.	665	600	600	600	600
Total 8/ do.	1,315	1,300	1,300	1,300	1,300
Diatomite:					
Crude	35,000	25,570 r/	20,349 r/	15,059 r/	11,300 3/
Beneficiated	14,669 r/	15,669 r/	17,018 r/	14,049 r/	17,000
Marketable product e/ 4/	13,100	13,100	13,100	13,100	13,100
Feldspar:					
Crude	202,632 r/	205,000 r/	205,000 r/	198,894 r/	200,000
Feldspar, marketable product e/ 4/	122,000 3/	122,000	122,000	122,000	122,000
Leucite, marketable product e/ 4/	5,000	5,000	5,000	5,000	5,000
Sodalite, crude, marketable product e/ 4/	500	500	500	500	500
Total e/ 4/	127,500	127,500	127,500	127,500	127,500
Fluorspar:					
Crude e/	250,000	250,000	250,000	250,000	250,000
Concentrates, marketable product:					
Acid-grade	61,432	68,325 r/	68,890 r/	72,498 r/	63,700
Metallurgical-grade	22,264	24,566 r/	21,041 r/	16,760 r/	14,000
Total	83,696 r/	92,891 r/	89,931 r/	89,258 r/	77,700 3/

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1992	1993	1994	1995	1996 e/
INDUSTRIAL MINERALS--Continued					
Graphite:					
Crude e/	650,000	650,000	650,000	650,000	650,000
Marketable product:					
Direct-shipping crude ore	8,957 r/	9,960	9,670 r/	12,000 r/	10,000
Concentrate	29,414	29,472	35,965 r/	28,028 r/	36,000
Total	38,371 r/	39,432 r/	45,635 r/	40,028 r/	46,000
Gypsum and anhydrite, crude	896,925 r/	906,135 r/	834,187 r/	953,116 r/	1,197,400 3/
Kyanite: e/					
Crude	750	750	750	750	750
Marketable product 4/	600	600	600	600	600
Lime, hydrated and quicklime	5,240	5,634 r/	6,000 r/	6,144 r/	5,700
Lithium, concentrates	3,100 r/	5,000 r/	7,031 r/	7,190 r/	7,000
Magnesite:					
Crude	1,001,724	974,161 r/	1,019,688 r/	1,230,955 r/	1,200,000 3/
Beneficiated	273,014	232,683 r/	279,489 r/	315,978 r/	302,700 3/
Mica, all grades	7,000	7,000	6,700 r/	5,200 r/	7,000
Nitrogen, N content of ammonia e/	940,000	940,000	940,000	940,000	940,000
Phosphate rock including apatite:					
Crude:					
Mine product e/	27,000	27,000	27,000	27,000	27,000
Of which, sold directly e/	35	35	35	35	35
Concentrate:					
Gross weight	2,825 r/	3,461 r/	3,937 r/	3,888 r/	3,823 3/
P ₂ O ₅ content	350 r/	882 r/	984 r/	986 r/	1,000
Pigments, mineral, other, crude e/	2,500	2,000	2,000	2,000	2,000
Potash, marketable (K ₂ O)	85,035 r/	167,589 r/	234,265 r/	215,411 r/	220,000
Precious and semiprecious stones except diamond, crude and worked: e/					
Agate	3,000	3,000	3,000	3,000	3,000
Amethyst	1,000	1,000	1,000	1,000	1,000
Aquamarine	20	20	20	20	20
Citrine	100	100	100	100	100
Emerald	90	90	90	90	90
Opal	500	500	500	500	500
Ruby	value	\$10,000	\$10,000	\$10,000	\$10,000
Sapphire	do.	\$15,000	\$15,000	\$15,000	\$15,000
Topaz	50	50	50	50	50
Tourmaline	80	80	80	80	80
Other	500	500	500	500	500
Quartz crystal, all grades	1,604 r/	4,224 r/	3,963 r/	5,586 r/	6,600
Salt:					
Marine	4,030	4,780 r/	4,670 r/	4,460 r/	4,500
Rock	1,231	1,400 r/	1,373 r/	1,340 r/	1,514 3/
Silica (silica) e/	1,600	1,600	1,600	1,600	1,600
Sodium compounds: e/					
Caustic soda	1,050,000	1,050,000	1,050,000	1,050,000	1,050,000
Soda ash, manufactured (barilla)	200,000	200,000	200,000	200,000	200,000
Stone, sand and gravel: e/					
Dimension stone:					
Marble, rough-cut	200,000	200,000	200,000	200,000	200,000
Slate	50,000	50,000	50,000	50,000	50,000
Crushed and broken stone:					
Basalt	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Calcareous shells	450,000	450,000	450,000	450,000	450,000
Dolomite	3,500	3,500	3,500	3,500	3,500
Gneiss	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000
Granite	60,000	60,000	60,000	60,000	60,000
Limestone	60,000	60,000	60,000	60,000	60,000
Quartz 9/	250,000	250,000	250,000	250,000	250,000

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1992	1993	1994	1995	1996 e/	
INDUSTRIAL MINERALS--Continued						
Stone, sand and gravel e/--Continued:						
Crushed and broken stone--Continued:						
Quartzite:						
Crude	400,000	400,000	400,000	400,000	400,000	
Processed	200,000	200,000	200,000	200,000	200,000	
Sand, industrial	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	
Sulfur:						
Frasch	18,182	21,924 r/	20,708 r/	22,472 r/	21,000	
Pyrites	24,684	1,700 r/	153 r/	67 r/	100	
Byproduct:						
Metallurgy	184,057	183,529 r/	182,638 r/	170,942 r/	183,000	
Petroleum	58,513	58,582 r/	53,256 r/	41,951 r/	50,000	
Total	285,436	265,735 r/	256,755 r/	235,432 r/	254,100	
Talc and related materials:						
Talc:						
Crude	286,000 r/	320,000 r/	360,000 r/	250,000 r/	280,000	
Marketable product e/ 4/	1,500	2,000	2,000	2,000	2,000	
Pyrophyllite, crude	144,000 r/	160,000 r/	148,000 r/	150,000 r/	150,000	
Vermiculite						
Concentrate	11,615 r/	14,541 r/	16,000 r/	17,000 r/	16,000	
Marketable product 4/	3,393 r/	3,514 r/	4,000 r/	4,000	4,000	
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous, marketable 4/	thousand tons	4,605 r/	4,854 r/	5,352 r/	5,525 r/	4,648 3/
Coke, metallurgical, all types	do.	143	227 r/	118 r/	25 r/	150
Gas, natural, gross	million cubic meters	6,970	7,712 r/	7,352 r/	8,043 r/	9,182 3/
Natural gas liquids e/	thousand 42-gallon barrels	13,000	13,000	13,000	13,000	13,000
Petroleum:						
Crude	do.	238,345 r/	233,764 r/	242,723 r/	251,716 r/	296,121 3/
Refinery products: 10/						
Gasoline	do.	146,000 e/	134,000	126,000 e/	126,000	126,000
Jet fuel	do.	20,500 e/	19,000	17,800 e/	17,800	17,800
Kerosene	do.	1,540 e/	1,450	1,370 e/	1,370	1,370
Distillate fuel oil	do.	171,000 e/	157,000	149,000 e/	149,000	149,000
Lubricants	do.	4,900 e/	4,350	4,120 e/	4,120	4,120
Residual fuel oil	do.	90,900 e/	83,000	79,000 e/	79,000	79,000
Other	do.	69,000 e/	63,400	60,000 e/	60,000	60,000
Refinery fuel and losses	do.	23,700 e/	21,800	20,600 e/	20,600	20,600
Total		527,540 r/e/	484,000	457,890	457,890	457,890

e/ Estimated. r/ Revised.

1/ Table includes data available through June 1997.

2/ In addition to the commodities listed, bismuth, molybdenite, and uranium oxide are produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

4/ Direct sales and/or beneficiated (marketable product).

5/ Includes sponge iron as follows, in thousand metric tons: 1991-94--260; and 1995-96--270 (estimated).

6/ Officially reported output; of total production, the following quantities are identified as secondary silver (the balance being silver content of other ores and concentrates), in kilograms: 1992--42,000 (revised); 1993--42,500 (revised); 1994--30,000 (revised); 1995--35,000 (revised); and 1996--30,000 (estimated).

7/ Includes baddeleyite-caldasite.

8/ Figures represent officially reported output plus official Brazilian estimates of output by nonreporting miners.

9/ Apparently includes crude quartz used to produce quartz crystal (listed separately in this table) as well as additional quantities of common quartz.

10/ Figures represent officially reported production to the United Nations (Energy Statistics Yearbook) by the Ministry of Mines and Energy of Brazil.

TABLE 2
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
METALS			
Aluminum	Albras-Alumínio Brasileiro S.A. (ALBRAS) [CVRD; 51% and Nippon Amazon Alumínio Co. (NAAC), 49%]	Belém, Pará State (smelter)	160 (metal).
Do.	Alcan Alumínio do Brasil S.A. (Alcan Aluminum Ltd., 100%)	Saramenha, Minas Gerais State (refinery)	150 (alumina).
Do.	Alcan Alumínio Poços de Caldas (ALUCALDAS) (Alcan Alumínio do Brasil S.A., 100%)	Poços de Caldas, Minas Gerais State (mine)	1,000 (bauxite).
Do.	Alcoa Alumínio S.A. (Alcoa) (Aluminum Co. of America, 60%; Billiton International Metals B.V., 40%)	Poços de Caldas, Minas Gerais State (mine) São Luis, Maranhão State (refinery) (smelter)	400 (bauxite). 550 (alumina). 174 (metal).
Do.	Alumínio do Brasil Nordeste S.A. (Alcan Aluminum Ltd., 100%)	Aratu, Bahia State (smelter)	58 (metal).
Do.	Billiton Metais S.A. (Billiton International Metals B.V., 100%)	São Luis, Maranhão State (refinery)	375 (metal).
Do.	Compahnia Brasileira de Alumínio (CBA) (private, 100%)	Poços de Caldas, Minas Gerais State (mine) Sorocaba, São Paulo State (refinery) (smelter)	1,000 (bauxite). 170 (alumina). 170 (metal).
Do.	Compahnia Geral do Minas (private, 21%; Aluminum Co. of America, 79%)	Poços de Caldas, Minas Gerais State (refinery) (smelter)	275 (alumina). 90 (metal).
Do.	Mineração Rio do Norte S.A. (MRN) (Government, 24%; private, 32%; Alcan Empreendimentos Ltda., Billiton International Metals B.V., 10%; Norsk Hydro Comercio e Industria, 5%; Reynolds Alumínio do Brasil, 5%)	Oriximina, Pará State (mine)	8,000 (bauxite).
Do.	Vale do Sul Alumínio S.A. (Government, 27%; private, 25%; Shell do Brasil S.A., 44%)	Santa Cruz, Rio de Janeiro State (smelter)	86 (metal).
Do.	Vale do Sul Alumínio S.A. (ALUVALE, 49.7%; Billiton Metais S.A., 41.5%; Cia. Cataguazes, 8.8%)	Santa Cruz, Rio de Janeiro State (smelter)	93 (metal).
Do.	Reynolds Internacional do Brasil (Reynolds, 42.5%; Bradesco Bank, 42.5%; J.P. Morgan, 15%)	Sorocaba, São Paulo State (smelter)	5.4 million (cans).
Do.	Consortium Paragominas S.A., (CVRD, 48.7%; MRN, 24.6%; Nipon Amazon Aluminum Co., 12.2%; CBA, 5.7%; and others, 8.8%)	Jabuti, Pará State (mine)	1,000 (bauxite).
Chromite	Coitezeiro Mineração S.A. (COMISA) (private, 75.4%; Bayer do Brasil S.A., 24.6%)	Campo Formosa, Bahia State (mine)	50 (ore).
Do.	Companhia de Ferro Ligas da Bahia (FERBASA) (private, 100%)	Campo Formoso, Bahia State (mine) (beneficiation plant)	370 (ore). 292 (concentrate).
Copper	Companhia Brasileira do Cobre (CBC) (private, 100%)	Cacapava do Sul, Rio Grande do Sul State (mine) (beneficiation plant)	1,000 (ore). 1,800 (concentrate).
Do.	Mineração Caraiba Ltda. (private, 100%)	Jaquarari, Bahia State (mine) (beneficiation plant)	3,000 (ore). 5,700 (concentrate).
Columbium	Companhia Brasileira de Metalurgia e Mineração (CBMM) (private, 55%; Molycorp, Inc., 45%)	Araxá, Minas Gerais State (mine) (beneficiation plant)	1,200 (ore). 44.
Do.	Mineração Catalão de Goiás Ltda. (private, 68.5%; Anglo American Corp. do Brasil, 31.5%)	Ouvidor, Goiás State (mine)	500 (ore).
Ferroalloys	Companhia Brasileira Carbureto de Calcio (CBCC) (private, 100%)	Santos Dumont, Minas Gerais State (plant)	54.
Do.	Companhia Ferro-Ligas de Bahia S.A. (FERBASA) (private, 100%)	Pojuca, Bahia State (plant)	194.
Do.	Companhia Ferro-Ligas Minas Gerais (MINASLIGAS) (private, 100%)	Pirapora, Minas Gerais State (plant)	58.
Do.	Companhia Paulista de Ferro-Ligas (private, 100%)	Barbacena, Caxambu, Jeceaba, Passa Quatro and Passa Vinte, Minas Gerais State; Corumba, Matto Grosso do Sul State; and Xanxere, Santa Catarina State (seven plants)	326.

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Ferroalloys--Continued		Italmagnesio S.A. Indústria e Comercio (private, 100%)	Braganca Paulista, São Paulo State; and Varzeada Palma, Minas Gerais State (two plants)	63.
Gold	kilograms	Companhia de Mineração e Participações (CMP) (private, 100%)	Lourenco, Amapá State (mine) Currais Novos, Rio Grande do Norte State (mine)	1,080 (ore). 300.
Do.	do.	Mineração Morro Velho S.A. (private, 50%; Anglo American Corp. do Brasil, 50%)	Novo Lima, Raposos, and Sabara, Minas Gerais State; and Jacobina, Bahia State (four mines)	2,000.
Do.	do.	São Bento Mineração S.A. (Gencor Indústria e Comercio Ltda., 49%; Amcor S.A., 29.4%; Amcor Metals Ltda., 21.6%)	Santa Barbara, Minas Gerais State (mine)	500.
Do.	do.	Rio Paracatu Mineração S.A. (RTZ, 50%; TVX Gold Inc., 50%)	Paracatu Mine, Minas Gerais State (mine)	5,600.
Iron ore		Companhia Vale do Rio Doce (CVRD) (Government, 51%; private, 49%)	Serra dos Carajás, Pará State; and Itabira, Ouro Preto, and Santa Barbara, Minas Gerais State (four mines)	91,000
Do.		Ferteco Mineração S.A. (FERTECO) (Exploration Bergbau GmbH, 100%)	Ouro Preto and Brumadinho, Minas Gerais State (two mines)	12,800.
Do.		S.A. Mineração da Trindade (SAMITRI) (private, 100%)	Mariana, Rio Piracicaba, Itabira, Ouro Preto and Sabara; Minas Gerais State (five mines)	9,300.
Do.		Minerações Brasileiras Reunidas S/A (MBR) (private, 85.3%; Mitsui e Co. Ltd. 14.7%)	Novo Lima and Itabira, Minas Gerais State (two mines)	31,500.
Do.		Samarco Mineração S.A. (SAMARCO) (SAMITRI, 51%; Broken Hill Properties Ltd., 49%)	Alegria, Minas Gerais State (mine)	13,500.
Lead		Mineração Boquira S.A. (private, 100%)	Boquira, Bahia State (mine) (beneficiation plant)	300 (ore). 310 (concentrate).
Manganese		Companhia Vale do Rio Doce (CVRD) (private 49%; Government 51%)	Corumba, Minas Gerais State (mine) Serra dos Carajás, Pará State (beneficiation plant)	2,500 (ore). 1,000 (concentrate).
Do.		Indústria e Comercio de Minerios S.A. (ICOMI) (private, 100%)	Macapa and Mazagao, Amapá State (two mines) (beneficiation plant)	1,500 (ore). 800 (concentrate).
Nickel		Companhia Niquel Tocantins (private, 100%)	Niquelandia, Goiás State (mine)	150 (ore).
Steel		Aço Minas Gerais S.A. (AÇOMINAS) (private, 100%)	Rodovia, Minas Gerais State	2,000.
Do.		Companhia Aços Especiais Itabira (ACESITA) (Government, 90.9%; private, 9.1%)	Timoteo, Minas Gerais State (stainless steel plant)	600.
Do.		Companhia Siderúrgica Belgo - Mineira (private, 100%)	João Monlevade, Minas Gerais State	1,000.
Do.		Companhia Siderúrgica de Tubarão (CST) (private, 100%)	Serra, Espírito Santo State	3,000.
Do.		Companhia Siderúrgica Nacional (CSN) (private, 100%)	Volta Redonda, Rio de Janeiro State	4,600.
Do.		Companhia Siderúrgica Paulista (COSIPA) (private, 100%)	Cubatão, São Paulo State	3,900.
Do.		Usinas Siderúrgicas de Minas Gerais S.A. (USIMINAS) (private, 100%)	Ipatinga, Minas Gerais State	4,400.
Tin		Mineração Jacunda Ltda. (private, 100%)	Santa Barbara, Novo Mundo, and Potosi; Rondônia State (six mines) (three beneficiation plants)	108 (ore). 450 (concentrate).
Do.		Parapanema S.A. Mineração, Industria e Construção (private, 100%)	Aripuana, Mato Grosso State; Ariquemes, Rondônia State; Novo Aripuana and Presidente Figueiredo, Amazonas State; and São Felix do Xingu, Pará State (five mines) (two beneficiation plants)	5,420 (ore). 1,400 (concentrate).
			Piraporada Bom Jesus, São Paulo State (refinery)	25 (metal).

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Titanium	Rutilo e Ilmenita do Brasil S.A. (RIB) (private, 100%)	Mataraca, Paraíba State (mine) (two beneficiation plants)	4,200 (ore). 120 (concentrate).
Zinc	Companhia Mineradora de Metais (CMM) (private, 100%)	Vazante, Minas Gerais State (mine) (beneficiation plant)	800 (ore). 48 (concentrate).
Do.	do.	Tres Marias, Minas Gerais State (refinery)	72 (metal).
Do.	Mineração Areense S.A.-MASA (MASA) (private, 100%)	Vazante, Minas Gerais State (mine)	400 (ore).
Zirconium	Nuclemon Mineradora Química Ltda. (Government, 100%)	São João da Barra, Rio de Janeiro State (mine)	660 (ore).
Do.	do.	Itapemirim, Espírito Santo State (Mine)	90 (ore).
Do.	do.	Prado, Bahia State (mine) (three beneficiation plants) (three separation plants)	90 (ore). 123 (concentrate). 90 (concentrate).
INDUSTRIAL MINERALS			
Asbestos	SAMA-Sociedade Anonima Mineração de Amianto (SAMA) (private, 100%)	Minacú, Goiás State (mine) (beneficiation plant)	9,000 (ore). 230 (concentrate).
Cement	Cimento Santa Rita S.A. (private, 100%)	Itapevi, São Paulo State (plant) Salto de Pirapora, São Paulo State (plant)	1,000. 1,200.
Do.	Companhia Cimento Portland Itau (private, 100%)	Itau de Minas, Minas Gerais State (three plants)	2,400.
Do.	Companhia de Cimento Portland Paraiso (private, 100%)	States of Espírito Santo, Goiás, Minas Gerais, and Rio de Janeiro (five plants)	4,000.
Do.	Companhia de Cimento Portland Rio Branco (private, 100%)	Rio Branco do Sul, Paraná State (two plants)	5,000.
Diamond	Mineração Tejuicana S.A. (private, 100%)	Diamantina, Minas Gerais State (mine)	100.
Fluorspar	Mineração Nossa Senhora do Carmo Ltda. (private, 100%)	Morro da Fumaca and Pedras Grandes, Santa Catarina State (four mines) (two beneficiation plants)	180 (ore). 220 (concentrate).
Do.	Mineração Santa Catarina Ltda. (private, 100%)	Morro da Fumaca and Pedras Grandes, Santa Catarina State (four mines) (beneficiation plant)	100 (ore). 120 (concentrate).
Do.	Nacional de Grafite Ltda. (private, 100%)	Itapecerica and Pedra Azul, Minas Gerais State (three mines) (two beneficiation plants)	840 (ore). 720 (concentrate).
Gypsum	CBE-Companhia Brasileira de Equipamento (CBE) (private, 100%)	Codo, Maranhão State, and Ipubi, Pernambuco State (two mines)	100.
Do.	Companhia de Cimento Portland Paraiso (private, 100%)	Ipubi, Pernambuco State (mine)	50.
Kaolin	Caulim da Amazônia S.A. (CADAM) (private, 100%)	Mazagão, Amapá State (mine) (beneficiation plant)	720 (ore). 360 (concentrate).
Do.	Empresa de Mineração Horii Ltda. (Horii) (private, 100%)	Biritiba and Mogi das Cruzes, São Paulo State (two mines) (two beneficiation plants)	200 (ore). 180 (concentrate).
Limestone	Companhia de Cimento Portland Paraiso (private, 100%)	States of Goiás, Minas Gerais, and Rio de Janeiro (five mines)	2,000.
Do.	Companhia de Cimento Portland Rio Branco (private, 100%)	Rio Branco do Sul, Paraná State (three mines)	5,500.
Do.	S.A. Industrias Votorantim (private, 100%)	States of Rio de Janeiro and São Paulo (four mines)	1,000.
Magnesite	Magnesita S.A. (private, 100%)	Brumado, Bahia State (one major mine and numerous small mines) (two beneficiation plants)	770 (ore). 820 (concentrate).
Phosphate rock	Arafertil S.A. (ARAFERTIL) (private, 100%)	Araxá, Minas Gerais State (mine)	5,000.
Do.	Copebras S.A.(Copebras) (private, 90.55%; Anglo American Corp. do Brasil, 9.45%)	Ouvidor, Goiás State (mine)	4,400.
Do.	Fertilizantes Fosfatados S.A.-Fosfertil (FOSFERTIL) (private, 100%)	Tapira, Minas Gerais State (two mines)	10,500.
Do.	Ultrafertil S.A. (ULTRAFERTIL) (private, 100%)	Araxá, Minas Gerais State (mine)	5,000.
Quartz	Telequartz Exportação S.A. (private, 100%)	Cristal, Minas Gerais State (mine)	6.0.

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity	
Salt (rock)	Frota Oceânica Brasileira S.A., (private, 100%)	Jacupiranga, São Paulo State (mine)	6,000.	
Do.	Mineração e Química do Nordeste S.A. (Dow Produtos Químicos Ltda., 100%)	Vera Cruz, Bahia State (mine)	1,000.	
MINERAL FUELS				
Coal	Carbonífera Criciúma S.A. (private, 100%)	Criciúma and Siderópolis, Santa Catarina State (two mines)	4,000.	
Do.	Companhia Carbonífera de Urussanga (CCU) (private, 100%)	Criciúma, Siderópolis, and Urussanga Santa Catarina State (three mines)	7,200.	
Do.	Companhia de Pesquisas e Lavras Minerais-Copelmi (COPELMI) (private, 100%)	Arroio dos Ratos, Butiá, and Charqueadas; Rio Grande do Sul State (four mines)	5,700.	
Petroleum	thousand 42-gallon barrels	Petróleo Brasileiro S.A. (Petrobrás) (Government, 81.4%, private, 11.8%; public, 6.8%)	Fields in the States of Alagoas, Amazonas, Bahia, Ceará, Espírito Santo, Rio de Janeiro, Rio Grande do Norte, Pará, Maranhão, and Sergipe (99)	220,000.
Petroleum products	do. do.	Refineries in the States of Amazonas, Bahia, Ceará, Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, and São Paulo	503,000.	
Do.	Refinaria de Petróleo Ipiranga S.A. (private, 100%)	Ipiranga, Rio Grande do Sul	3,400.	
Do.	Refinaria de Petróleos de Manguinhos S.A. (private, 100%)	Manquinhos, Rio de Janeiro State	3,650.	

TABLE 3
BRAZIL: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1996 1/

(Thousand metric tons unless otherwise specified)

Commodity	Reserves	Ranking	World percent	
Asbestos, fiber	3,000		NA	
Bauxite, ore	3,910,000	(4)	13.6	
Chromite, Cr ₂ O ₃	6,300		0.2	
Coal, all types	32,279,000		0.3	
Columbium, pyrochlore, and columbite ore	4,500	(1)	88.3	
Copper, metal content	11,640		1.9	
Fluorspar, ore	8,000		2.5	
Gold, metal	metric tons	800	1.8	
Graphite, ore	56,000		12.8	
Gypsum	654,000		NA	
Iron ore, 60% to 65% Fe content	20,000,000	(5)	8.7	
Kaolin	1,700,000		14.2	
Lead, metal content	365		0.3	
Magnesite	180,000		5.2	
Manganese, metal content	69,000	(5)	1.4	
Natural gas 2/	million cubic meters	398,400	NA	
Nickel, metal content	6,000		5.2	
Petroleum 2/	thousand 42-gallon barrels	11,600,000	NA	
Phosphate rock	370,000		1.1	
Talc and pyrophyllite	178,000	(3)	19.1	
Tin, metal content	metric tons	590,300	(6)	7.2
Titanium, TiO ₂	5,900		1.6	
Uranium, U ₃ O ₈	metric tons	163,000	NA	
Zinc, metal content	5,000		1.5	
Zirconium, ore	1,910		3.1	

NA Not available.

1/ Summário Mineral 1996.

2/ Petróleo Brasileiro, S.A. (Petrobrás), 1997 Annual Report.