

# BRAZIL

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Brazil, which had the largest economy in Latin America and was the eighth largest economy worldwide with a population of more than 174 million inhabitants, had a gross domestic product (GDP) of \$596 billion<sup>1</sup>, or \$1.13 trillion in terms of purchasing power parity in 2000. Brazil's GDP growth rate was 4.46% compared with 0.82% in 1999. Foreign exchange reserves decreased to about \$33 billion from \$36.3 billion in 1999 and the peak level of \$51.4 billion in 1997. Brazil's total debt burden amounted to \$232 billion. The trade deficit decreased substantially to \$700 million from the peak level of \$6.6 billion in 1998; exports were valued at \$55.1 billion, and imports were valued at \$55.8 billion.

Brazil's economy continued to recover in 2000, with inflation remaining in the single digits—6%, which was lower than the 9% of 1999. Brazil's currency (real) was no longer pegged to the U.S. dollar, but devaluation helped to moderate the downturn in economic growth that started in the second half of 1999 (Departamento Nacional de Produção Mineral, 2001a, p. 10; Ferraz, 2001, p. 1; U.S. Central Intelligence Agency, 2001, Brazil—Economy, World factbook, accessed September 20, 2001, at URL <http://www.odci.gov/cia/publications/factbook/geos/br.html>).

In 2000, foreign direct investment (FDI) inflows to the Latin American and Caribbean region amounted to about \$74.2 billion, which was 20.2% lower than that of 1999 (\$93 billion). Brazil, however, set a record of more than \$30.6 billion of FDI in 2000 followed by Mexico with about \$13 billion. Brazil's share of the region's net FDI inflows (\$30.6 billion) increased by about 2% compared with that of 1999 (\$30 billion) and was up from the \$1.5 billion at the beginning of the past decade (Yolen, 2000, p. 2). Within the Mercado Común del Cono Sur (Mercosur), which included Argentina, Brazil, Paraguay, and Uruguay plus Bolivia and Chile as associated members, Brazil was followed at a considerable distance by Argentina (\$12 billion), Chile (\$3.7 billion), Uruguay (\$180 million), and Paraguay (\$100 million). Brazil was the largest recipient of FDI in the region for the fifth consecutive year largely because of the sale of previously state-owned assets, primarily in energy, finance, the service sector, and telecommunications, by the Government (Yolen, 2000, p. 2; Departamento Nacional de Produção Mineral, 2001d, p. 26; Economic Commission for Latin America and the Caribbean, April 18, 2001, Foreign investment in Latin America and the Caribbean—2000 report, accessed October 22, 2001, via URL <http://www.eclac.cl>).

In 2000, the Economic Commission for Latin America and the Caribbean (June 14, 2001) reported that Brazil received \$546 million FDI inflows in the oil and gas sector, \$22 billion in nonprivatization investments (joint ventures on coal, iron ore,

steel, oil and gas, and other sectors), which reflected the “new” modality of investment and the noticeable slowdown in the privatization process, \$2 billion in telecommunications and \$1.5 billion in electricity.

The International Monetary Fund endorsed Brazil's move to a system of inflation targets and currency devaluation to guide its monetary policy into 2000. This action indicated that the country could reduce its current (2000) account deficit of \$33.4 billion down to an equivalent of 6% of GDP, thus helping restore confidence in the Government's economic management and creating conditions for lower interest rates and economic recovery (Dyer, 2000, p. 1).

The Brazilian strategic plan Plano Real continued to be based on macroeconomics, constitutional reviews, and direct acquisitions of assets via mergers and joint ventures with the private sector to achieve its goals and to encourage new capital flows into the Brazilian economy. Given that the economy was in recovery, however, the currency devaluation and a tough fiscal austerity plan helped restore confidence in the Government's economic management and create favorable conditions for lower interest rates and Brazil's economic recovery that began in the second half of 1999 and continued into 2000. Brazil turned a fiscal deficit of 3% of the GDP in 1997 to a surplus of 3% in 1999 and 4% in 2000 (Dyer, 2000, p. 1; Yolen, 2000, p. 2; Departamento Nacional de Produção Mineral, 2001a, p. 11).

In 2000, Brazil's trade balance was affected by a reduction in demand and depressed prices for mineral exports and higher prices for crude oil imports. The mineral sector had a deficit of \$1.316 billion; if petroleum and its derivatives and natural gas were excluded, however, then the surplus would have been \$5.281 billion (Departamento Nacional de Produção Mineral, 2001a, p. 11).

Brazil produced 70 mineral commodities (21 metals, 45 industrial minerals, and 4 fuel minerals), such as bauxite, coal, columbium (niobium), chromite, gemstones, gold, iron ore, kaolin, manganese, tantalum, and tin from large deposits and exported them to the global marketplace in 2000. In Latin America, particularly within Mercosur, Brazil continued to be the leading producer of aluminum, cement, ferroalloys, gold, iron ore, manganese, steel, and tin. Brazil's reportedly large mineral reserves and other identified resources helped make it one of the most dynamic markets in the world and constituted one-third of the Latin American economy (Departamento Nacional de Produção Mineral, 2001a, p. 11). The country continued with its petroleum exploration program to expand reserves as well and to reduce dependence on oil imports, which satisfied about 25% of its crude oil requirements (Petrobrás Magazine, 2001, p. 4).

Brazil's petroleum and mining industries and utilities attracted investors' interest because of the Government's

<sup>1</sup>Where necessary, values have been converted from Brazilian real (R\$) to U.S. dollars at the rate of R\$1.830=US\$1.00.

macroeconomic policies, the country's diversified minerals endowment, and a skilled labor force. Major international petroleum, mining, and steel companies were notably interested or very active in the country acquiring exploration properties and mining prospects and steel firms. They were particularly interested in, in order of importance, oil and gas, iron ore, steel, coal, gold, copper, and diamond. Exxon Mobil Corp. and ChevronTexaco Corp. of the United States, British Petroleum Ltd. of the United Kingdom, and others entered in joint-venture oil-gas projects with *Petróleo Brasileiro S.A. (Petrobrás)*. Petrobrás viewed such megamergers of British Petroleum and Amoco Corp., Exxon Corporation and Mobil Oil Corp., and Chevron Corp. and Texaco Corp. as significant by improving and strengthening economy of scales, competitiveness, operational synergy, and regional strategies, which will affect future oil/gas joint ventures between Petrobrás and the private sector. Equally important to Brazil will be the Minas Gerais iron ore joint venture between *Companhia Vale do Rio Doce (CVRD)* and China's Shanghai Baosteel Group Corp. beginning in 2002 and the Sossego copper-gold joint venture between CVRD and Phelps Dodge Corp. of the United States beginning in 2002 (Ferraz, 2001, p. 3; *Metal Bulletin*, 2001). Since 1991, nearly 500 transnational corporations that have established operations in Brazil have brought in a total of \$217 billion in registered investment with the Central Bank of Brazil; of that total, \$57.1 billion was received by the minerals sector (Yolen, 2000, p. 3). The Banco do Brazil also reported that since 1996, the accumulated net FDI amounted to \$112.4 billion as equity capital, of which \$29.8 billion was used for acquisitions of state-owned assets and \$82.6 billion (excluded privatizations) was for direct acquisitions and joint ventures with the private sector (Banco Central do Brasil, November 2001, Recent developments—May 2001, accessed November 28, 2001, at URL <http://www4.bcb.gov.br/gci-i/RS200105/sld011.htm>).

The list of active international mining and oil companies in Brazil included *Yacimientos Petroleros Fiscales* of Argentina; BHP Minerals International Exploration Inc. and Western Mining Corp. Holdings Ltd. of Australia; Barrick Gold Corp., INCO Limited, and TVX Gold Inc. of Canada; Shanghai Baosteel Group Corp. of China; EDP of Portugal; Anglo American plc, Billiton plc, and Rio Tinto plc of the United Kingdom; Iberdrola S.A. of Spain; and Enron Energy Corp., ExxonMobil (Esso Brasileira de Petróleo Ltda.), Newmont Mining Corp., Placer Dome U.S. Inc., Royal Dutch/Shell Group, and Chevron Texaco (ChevronTexaco Brasil S.A.) of the United States (Hawrylyshyn, 2000; Ferraz, 2001, p. 4).

### **Government Policies and Programs**

The present legal framework for the development and use of mineral resources in Brazil was established by the Federal Constitution that was enacted on October 5, 1988. On August 15, 1995, the Brazilian Congress approved Constitutional Amendments Nos. 6 and 9, which allow the participation of the private sector via deregulated investment, joint ventures, and privatization in the sectors of coastal and river shipping, mining, natural gas, petroleum, telecommunications, and transportation. The 45-year Government monopolies of the oil and gas industries and fuel price subsidies were ended in 1999, thus

allowing Petrobrás to enter into joint ventures with foreign investors. The *Agencia Nacional do Petróleo*, however, regulates the petroleum industry (Pimentel, 2000a, p. 3-5; Ferraz, 2001, p. 6). In 2000, other significant actions were undertaken by the Brazilian Government. The Brazilian import tax for minerals, in general, was reduced; the rates, however, vary from 3% to 9%—ores and concentrates are 5%, and other products, 7%. The export tax does not apply to exported mineral products. The tax on industrialized products does not apply to mining activities, although there is a “value-added tax.” In most cases, the basis for assessment for corporate income taxes is the net profit for the fiscal year; the tax rate ranges between 10% and 15% and is levied on gross profit. Profits can be expatriated. Equity ownership, which is allowed via privatization or by direct acquisition, can be as high as 100% (Pimentel, 2000b, p. 10-15; *Departamento Nacional de Produção Mineral*, 2001b, p. 5-8). In 2000, Concessions Law created additional opportunities for the private sector in public utilities previously reserved for the Government.

All the above actions, which were undertaken by the Government to open the Brazilian economy to international competition, have continued to create an environment that attracts domestic and foreign investments equally. The establishment of joint ventures, such as construction and management of railroads, ports, telecommunications, and hydroelectric powerplants, oil and gas, and metals, has become a common practice in Brazil. The Brazilian Constitution and the Mining Code, law No. 9314 of January 1997, provide greater flexibility for investment in the Brazilian mining sector. Article 7 of this law stipulates that the exploitation of mineral deposits will depend upon an Exploration Authorization Permit granted by the General Director of the *Departamento Nacional de Produção Mineral (DNPM)* and a Development Concession issued by the Minister of Mines and Energy. Licensing is a restricted system applicable exclusively to the exploitation of industrial minerals. The DNPM is responsible for enforcing this mining code and its complementary legal provisions. In 2000, the DNPM issued 21,200 exploration licenses compared with 7,600 in 1999 and reported an investment of \$104 million in mineral exploration compared with \$44 million in 1999. The *Companhia de Pesquisa de Recursos Minerais (CPRM)* (Brazilian Geological Survey) is developing programs for basic geologic mapping, metallogenetic and hydrogeologic mapping, and prospecting in areas of potential development, in addition to creating and maintaining geologic and economic data bases, particularly for coal, copper, diamond, gold, kaolin, nickel, peat, and zinc, to assist potential investors in the minerals sector. In 2000, there was a reorganization proposal whereby the DNPM will be called the National Agency of Mining, and the CPRM will be called the National Geological Service (*Departamento Nacional de Produção Mineral*, 2001d, p. 25, 30-31; Ferraz, 2001, p. 1-2).

### **Environmental Issues**

The Brazilian Environmental Policy (BEP) is executed at three levels—Federal, State, and municipal. The coordination and formulation of the BEP is the responsibility of the *Ministério de Meio Ambiente (MMA)*. Linked to MMA is the

Conseho Nacional de Meio Ambiente (CONAMA), which grants the environmental licenses that are required for all mining activities in Brazil. Law No. 88351 of 1986 established the National System for the Environment, which comprises representatives of the Federal, State, and local governments and private foundations involved in environmental protection and improvement. Article 225 of the 1988 Brazilian Constitution stipulates that mining operators must reclaim areas that they have environmentally degraded. In Brazil, the environmental legislation applied to mining is basically consolidated in the following environmental requirements: Environmental Impact Study (EIA), Environmental Licensing (LA), and Plan for Recovery of Degraded Areas (PRAD). An EIA applies to mining projects of any mineral substance; an LA is mandatory for installing, expanding, and operating any mining activity under the systems of mining concession or licensing; and a PRAD requires suitable technical solutions to rehabilitate the soil and other aspects of the environment that might be degraded by mining operations (Departamento Nacional de Produção Mineral, 2001d, p. 35-38). The Ministério de Minas e Energia enforces the 1989 decree, which prohibits the use of mercury and cyanide in the mining of gold unless approved by Brazilian local environmental agencies, and offers technical assistance to garimpeiros (small-scale independent miners), in particular, on producing gold without affecting the environment. Environmental impacts are expected to be lessened in the future.

Resolution 010 of December 6, 1990, requires that all mining operations obtain LAs prior to the granting of mineral rights by the DNPM. As environmental problems have increased, antipollution measures have been enacted to eliminate the sources of pollutants and to mitigate their effects on the environment.

## Production

In 2000, the total value of minerals produced, gas and crude oil included, was about \$9.3 billion, or about 1.6% of the GDP. The mineral-based industries amounted to \$50.5 billion, or about 8.5% of the GDP. Crude oil and natural gas amounted to almost \$6.4 billion. The 9.1% increase in Brazilian minerals production from that of 1999 was related mostly to the crude oil output, which increased by 12%. Increases in production also were recorded—chromium (content) and mica (moscovite), 33.3% each; manganese (content), 32.4%; graphite (content), 33.1%; titanium (content), 25.8%; iron ore, 20%; coal (energy), 15%; natural gas, 12.4%; and diamond (carat), 11.1%. Lesser amounts of bauxite, crude oil, gold, potash, and salt were produced. Depletion of shallow gold and tin deposits and environmental constraints on garimpeiros were expected to affect future outputs of gold and tin (Departamento Nacional de Produção Mineral, 2001c, p. 21).

The five major integrated steelworks were the structure and rail producer Aço Minas Gerais, S.A.; Latin America's largest integrated steelmaker Companhia Siderúrgica Nacional (CSN); the carbon steel sheet and plate producer Companhia Siderúrgica Paulista; the slab producer Companhia Siderúrgica de Tubarão; and Brazil's second largest steel mill Usinas Siderúrgicas de Minas Gerais, S.A. CSN has earmarked \$350 million for new facilities, production expansion, and

environmental improvements (Yolen, 2000, p. 2). These companies produced about 17.5 million metric tons (Mt) of the total Brazilian steel production of 27.3 Mt (Departamento Nacional de Produção Mineral, 2001c, p. 64). Eight firms accounted for 96% of iron ore production. CVRD produced about 48% of the iron ore. Mineração Rio do Norte, S.A. (MRN), the majority of which was privately owned, was the world's third largest bauxite producer and exporter; it produced about 79.1% of the total bauxite production, which amounted to about 13.8 Mt. The four major aluminum smelters, all of which were predominantly privately or foreign owned, produced 87.9% of the primary aluminum production of 1.3 Mt (table 1).

## Trade

Brazil was the largest open market and the economic center of Mercosur. In 2000, the member countries of Mercosur had almost 230 million people, which was 33.1% of America's population, and a combined GDP of \$1.35 trillion, which represented about 65% of South America's total GDP (Cowley, 2000, p. 2). Brazil accounted for about 74% of Mercosur's population and almost 43% of its GDP. Most multinational companies considered this growing trade bloc to be extremely important, after the North America Free Trade Agreement (NAFTA) and the European Union, because of its size and the amount of trade taking place in the region. When Mercosur is fully integrated, unrestricted movement of goods, labor, and services is expected to take place among the four principal and two associate members. Mercosur has had its impact on Latin intraregional trade, which increased to about \$25 billion from \$7 billion in 1983. Intra-Mercosur trade amounted to \$15 billion, and mineral trade amounted to \$6.1 billion (Departamento Nacional de Produção Mineral, 2001a, p. 16).

In 2000, Brazil sold 17.4% of its exports to the other Mercosur members and 26.1% to the other countries in Latin America. Total minerals trade between the major players of Mercosur, Brazil (\$1.743 billion) and Argentina (\$779 million), amounted to about \$2.5 billion. Brazilian mineral imports were valued at \$13.328 billion, or 39.4% higher than those of 1999 (\$9.560 billion), and its total mineral exports were \$12.012 billion, or about 20% higher than those of 1999 (\$10.005 billion). The values of the principal exports were \$3.048 billion, iron ore; \$2.752 billion for steel products; and \$1.489 billion, aluminum. In addition to petroleum and derivatives (\$4.3 billion), other major mineral imports (\$1.874 billion), in order of importance, were copper, phosphate rock, potash, sulfur, and zinc (Departamento Nacional de Produção Mineral, 2001c, p. 16; Ferraz, 2001, p. 6).

Brazil-U.S. trade relations during the past decade grew at an unprecedented rate. The U.S. imports were primarily manufactured and semimanufactured Brazilian goods of high aggregate value, such as chemical products and steel, as well as other commodity exports. Brazilian exports to Europe and Japan consisted mostly of raw materials, in order of importance, iron ore, manganese, marble, and granite and agricultural commodities.

In 2000, total trade between Brazil and the United States was \$4.355 billion. Exports increased by 27.6% to \$3.145 billion, and imports decreased by 3.1% to \$1.210 billion. Brazil's

mineral trade balance with the United States increased to a surplus of \$1.935 billion from a surplus of \$1.2 billion in 1999 (Departamento Nacional de Produção Mineral, 2001a, p. 16).

### Structure of the Mineral Industry

The mineral industry of Brazil was large by world standards. The major portion of the industry was partially or wholly owned by private Brazilian investors, Brazilian corporations, and/or foreign companies. The exceptions were the natural gas and petroleum industries, which were 100% Government owned through Petrobrás, which comprised five subsidiaries—the petroleum products distribution company Petrobrás Distribuidora S.A.; the foreign operating company Petrobrás Internacional, S.A.; the constructing and operating pipelines, terminals, vessels, and facilities needed for the transportation and storage of oil and derivatives, natural gas, and bulk products company Petrobrás Transporte S.A.; the integrated refining-petrochemical operations company Petrobrás Química, S.A.; and the producing, trading, and distributing of natural and liquefied natural gas, and fertilizers company Petrobrás Gás S.A. (Petrobrás Magazine, 2001, p. 10-29).

The structure of the Brazilian mineral industry continued to change to a privately owned/Government-regulated regime from one that was Government owned/Government operated. Between 1991 and 2000, the Government privatized the electrical energy and the telecommunication sectors, the steel industry, and CVRD. Additionally, 40 cement companies were operating 64 cement plants and 7 grinding plants with a clinker capacity of 45 Mt, and 30 iron ore mining companies were operating 80 mines and 43 processing plants (Departamento Nacional de Produção Mineral, 2000, p. 159; 2001c, p. 45-46).

Brazil's total labor force was nearly 79 million. Of this total, services represented 53.2%; industry, 23.7%; and agriculture, 23.1%. The unemployment rate was 7.1% (U.S. Central Intelligence Agency, 2001, Brazil—Economy, World factbook, accessed September 20, 2001, at URL <http://www.odci.gov/cia/publications/factbook/geos/br.html>). The minerals sector employed about 5% (940,000) of the industry total (19 million); this did not include the nearly 700,000 *garimpeiros* active in Brazil (Vale, 2000, p. 1). Employment in the mining sector continued its downward trend as Brazil's economy was affected by its recent slow economic recovery, electricity crisis, and the increases of efficiencies and productivities in the private sector that resulted from the joint ventures, mergers, and privatizations, particularly in the steel and mining sectors (table 2).

### Commodity Review

#### Metals

**Alumina, Aluminum, and Bauxite.**—Primary aluminum production amounted to about 1.3 Mt of metal, or 2.6% higher than that of 1999 (1.25 Mt). Primary aluminum producers were Albras-Alumínio Brasileiro S.A. (28.9%), Alcoa Alumínio S.A. (23%), Companhia Brasileira de Alumínio (CBA) (18.8%), Billiton (17%), Alcan Alumínio do Brasil S.A. (Canada) (8.4%), and Vale do Sul Alumínio S.A. (Aluvale) (3.9%) (Departamento Nacional de Produção Mineral, 2001c, p. 25).

Bauxite production was 13.8 Mt, which remained about the same level as that of the previous year. The MRN joint venture owned by CVRD (40%), Billiton (14.8%), Alcoa (13.2%), Alcan (12%), CBA (10%), Norsk Hydro Group (5%), and Reynolds Alumínio do Brasil (5%) accounted for almost 81.2% of the total bauxite production (10.6 Mt) for 2000. Alumina production was 3.7 Mt, or 5.7% higher than that of 1999 (3.5 Mt), of which a consortium led by Alcoa (54%), Billiton (36%), and Alcan (10%) produced 43.7%; Alumínio do Norte do Brasil S.A. (Alunorte), 43.4%; and the remainder was produced by CBA, 12.9%. Exports amounted to 4.2 Mt of bauxite valued at \$113 million, 1.12 Mt of alumina valued at \$215 million, and 1.04 Mt of primary aluminum valued at \$1.7 billion (Departamento Nacional de Produção Mineral, 2001c, p. 25-26).

MRN planned to open its new mine, which has bauxite reserves of 800 Mt and a capacity of 2 million metric tons per year (Mt/yr), in the Papagalo plateau, Trombetas, Pará. The Papagalo Mine will maintain MRN's total bauxite ore production capacity at about 12 Mt/yr. CVRD was planning to invest \$400 million in the bauxite-alumina-aluminum sector. The Albras facility at Vila do Conde, Pará [CVRD (51%) and Nippon Amazon Alumínio Co. (49%)], produced 369,200 metric tons (t) of primary metal and was to be expanded to a capacity of 400,000 metric tons per year (t/yr) at a cost of about \$100 million in the near future. Alcan invested \$370 million in expansions of its complex facility at Laminação de Pindamonhangaba in São Paulo to increase its production capacity to 280,000 t/yr from 120,000 t/yr by early 2002. The Alcoa aluminum smelter owned by Alcoa (53.66%) and Billiton (46.34%) at São Luiz, Maranhão, was expanded to 239,000 t/yr from 194,000 t/yr at a cost of \$550 million. Alcan expanded its aluminum sheet production capacity to 120,000 t/yr from 100,000 t/yr as a part of a \$380 million investment program and was planning to increase its primary capacity to 150,000 t/yr. Investments in the aluminum sector could reach up to \$1.6 billion within the next few years. Latapack-Ball S.A., which produced aluminum cans, invested \$5 million to increase its plant capacity in Jacareí, State of São Paulo, to 2 billion aluminum cans from 1.7 billion. Brazil's goal to recycle 80% of its aluminum cans was not achieved, but it came very close (77%) to its goal (Departamento Nacional de Produção Mineral, 2001c, p. 26; Ferraz, 2001, p. 2).

MRN was set up to mine the Oriximina bauxite deposit near the Trombetas River in junction with the Papagalo bauxite mine in Pará. MRN will supply the feed to Alcoa's refinery at São Luís, Maranhão. CBA planned to invest \$700 million to produce 500,000 t/yr of alumina and to expand its aluminum capacity to 360,000 t/yr from 220,000 t/yr. Alunorte began an expansion program to increase its alumina production capacity by about 40% to 2.3 Mt/yr from 1.6 Mt/yr by 2005 (Departamento Nacional de Produção Mineral, 2001c, p. 26; Ferraz, 2001, p. 2, 6).

**Columbium (Niobium) and Tantalum.**—Brazil continued to be the world's most significant producer and main supplier of columbium to the global markets. Brazil produced about 92.4% of the world's total output, or 31,190 t of pyrochlore (Nb<sub>2</sub>O<sub>5</sub>) in concentrates, 18,218 t of columbium in alloys, and 1,274 t of

columbium in oxides from two open pits located in Araxá, State of Minas Gerais, and Catalão, State of Goiás. In 2000, Mineração Catalão de Goiás Ltda. (MCGL) [a joint venture of Bozzano Simonsen S.A. of Brazil (68.5%) and Anglo American (31.5%)] and Companhia Brasileira de Metalurgia e Mineração (CBMM) [a joint venture of Grupo Moreira Sales S.A. of Brazil (55%) and Molycorp Inc. of the United States (45%)] accounted for 61.5% and 38.5%, respectively, of Brazil's 65,000-t/yr pyrochlore production capacity. The columbium plants of MCGL in Ovidor and CBMM in Araxá accounted for about 88% of Brazil's pyrochlore production and supplied about 79% of the world demand for ferrocolumbium. The Araxá, the Catalão, and the Ovidor columbium ore deposits contain 90% (5 Mt) of the world's pyrochlore reserves. Tantalum production totaled 50 t. The Araxá deposit, which was considered to be one of the world's largest and most economically viable ore bodies, contains columbite and tantalite and produced 330 t/yr. The upward trend in tantalum supply will continue in response to increased world demand (Departamento Nacional de Produção Mineral, 2001c, p. 83-84).

**Copper.**—Copper concentrate production amounted to 31,786 t, which was a small increase of 1.3% compared with that of 1999. The concentrate was produced by Mineração Caraíba S/A's (Grupo PARANAPANEMA) deposit in Jaguari, State of Bahia, which was Brazil's only underground copper mine (Departamento Nacional de Produção Mineral, 2001c, p. 41).

In 2000, Caraiba Metais S/A (CMSA) of Camaçari, Bahia, produced 185,345 t of primary copper metal, which was a decrease of 4% compared with that of 1999; this also included 486,703 t of copper concentrates imported from Chile (65%), Peru (14%), and others (21%). CMSA, which was the only electrolytic copper producer to meet Brazil's metal copper demand of 335,203 t/yr, imported 147,915 t of copper cathode, mostly from Chile (85%) and Peru (13%), in 2000 (Departamento Nacional de Produção Mineral, 2001c, p. 41-42).

In 2000, the reserves at Cobre Salobo, which was Brazil's largest copper project, were estimated to be 1,900 Mt at a grade of 0.65% copper and contained 0.96% copper-equivalent associated with, in order of importance, gold, silver, and molybdenum. These reserves could support a 250,000-t/yr production capacity of refined copper with byproducts of, in order of added value, gold, silver, and molybdenum. The project, which is in Marabá, Pará, was a joint venture of CVRD, Anglo American, and the Brazilian Banco Nacional de Desenvolvimento Econômico e Social (BNDES); each member held a one-third interest. The Salobo copper project was going through a reassessment process owing to the depressed prices for copper in 2000 (Departamento Nacional de Produção Mineral, 2001c p. 42). CMSA's Camaçari refinery in the State of Bahia expanded its cathode capacity to produce 220,000 t/yr of refined copper with an investment of \$14 million in 2001. A feasibility study on the Chapada copper project in Alto Horizonte, Goiás (owned by Mineração Maracá S.A.), estimated its ore reserves to be 434.5 Mt and to contain 1.3 Mt of copper and 9.6 t of gold. The Cobre Sossego project, Cristalino, and Corpo Alemão in Carajás, Pará, were being explored by

Mineração Serra do Sossego S.A. (a joint venture between CVRD and Phelps Dodge Corp.); resources of copper have been estimated to be 400 Mt at a grade of 1.14% copper and 0.34 gram per metric ton (g/t) gold (Departamento Nacional de Produção Mineral, 2001c, p. 42).

Brazil's refined copper production was used primarily in the construction and the auto industries. Exports amounted to 55,712 t of copper metal valued at \$100 million, which went to Chile, 39%; Argentina, 33%; and the United States, 28% (Departamento Nacional de Produção Mineral, 2001c, p. 41-42).

**Gold.**—Gold production was reported by the DNPM to be 50.4 t, which represented 42 t from mining companies and 8.4 t from garimpeiros; this output was 9.6 t lower than that of 1996, which had the highest levels of output during the past 5 years (table 1). Gold production from the garimpeiros and the private sector decreased because of higher production costs, depletion of shallower deposits, lower prices in the international market, and much higher environmental standards. CVRD, which was the largest gold producer, reported 17.4 t; AngloGold Ltd., which was the second largest gold producer, reported 12.6 t, of which Mineração Morro Velho S.A. (owned by AngloGold) produced 6.6 t and Mineração Serra Grande S.A. (owned by AngloGold) produced 6 t. Rio Paracatu Mineração S.A. [owned by Rio Tinto (51%) and Autram S/A (49%)] continued to be the third largest gold producer with 7.1 t. São Bento Mineração S.A. (owned by Eldorado Gold Corp.) was the fourth largest producer with an output of 4 t. Refined gold from São Bento Mine was extracted by a combination of pressure oxidation and bioleaching (biox process) developed by Gold Fields Ltd. and Mintek Ltd. of South Africa. Mineração Maracá S.A.'s São Vicente Mine in Mato Grosso produced 1.5 t of gold. São Vicente Mine will be expanded to produce about 10 t of gold in the near term (Departamento Nacional de Produção Mineral, 2001c, p. 55-56).

Brazilian gold production could increase significantly in the foreseeable future with the growth of the Brazilian copper production and because of increased interest by domestic and foreign investors in largely unexplored areas in spite of the depressed gold market prices in 2000. More than 2,000 gold occurrences, mostly Precambrian vein deposits and alluvial placers, were known (Departamento Nacional de Produção Mineral, 2000, p. 192; Ferraz, p. 4).

AngloGold Ltd. of South Africa was planning to spend \$50 million to implement the Amapari gold project in the State of Amapá, which will begin operating next year, and \$6 million to explore for gold near to the Pedra Branca do Amapari in the Amazon region (Mining Journal, 1999; Departamento Nacional de Produção Mineral, 2001c, p. 56).

**Iron and Steel.**—Ferroalloy production increased to 819,000 t from 743,000 t in 1999. For the year, steel production amounted to 27.3 Mt, which represented an increase of 10% with respect to 1999. Brazil was the third largest ferroalloy producer in the world (Departamento Nacional de Produção Mineral, 2001c, p. 62). Apparent domestic consumption was about 742,000 t. Brazil's Prometal Produtos Metalúrgicos S.A. took Norway's Elkem A/S, which was one of the world's

largest manganese alloy producers, as a partner to produce a projected 500,000 t of ferromanganese; 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. Nova Era Silicon S.A. [a joint venture between CVRD (49%), Mitsubishi Corp. (25.5%), and Kawasaki Steel Corp. (25.5%)] was building a silicon ferroalloy plant in Nova Era, Minas Gerais, with an installed capacity of 48,000 t/yr. About two-thirds of its output will be exported, mainly to Japan, between 2000 and 2010 (Departamento Nacional de Produção Mineral, 2001c, p. 62).

**Iron Ore.**—Brazil produced 210 Mt of beneficiated iron ore compared with 194 Mt in 1999. About 96% of that production was from the major iron ore companies—CVRD, Minerações Brasileiras Reunidas S/A (MBR), Ferteco Mineração S.A., S.A. Mineração da Trindade (SAMITRI), Samarco Mineração S.A. (SAMARCO), CSN, SOCOIMEX S.A., and Itaminas Comércio de Minérios S.A. In 2000, Brazil exported 156.9 Mt of iron ore and pellets valued at \$3.05 billion (Departamento Nacional de Produção Mineral, 2001c, p. 61-62).

The total iron ore exports were 12.3% higher than those of 1999 and were shipped to 40 countries worldwide. Total export revenues increased to \$3.05 billion by yearend from \$2.75 billion in 1999. The major importers of Brazilian iron ore were Japan (18%), Germany (14%), China (9%), the Republic of Korea (7.6%), Italy (6%), the United States (5.2%), Belgium (4.8%), France (4.1%), Spain (3.8%), and Argentina (3.3%). The customized commercial products (varied chemical characteristics) sold were sinter feed and pellet feed (70.3%), pellets (21.4%), and lump ore (8.3%).

CVRD inaugurated its seventh pellet plant at Kobrasco (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 invested \$220 million to produce 4 Mt/yr of pellets. CVRD was planning a new \$400 million pelletizing plant with railroad and port facilities in São Luiz, Maranhão. MBR opened three new mines—Capão Xavier, Tamandúa, and Capitão do Mato—in Minas Gerais to increase capacity to 32 Mt/yr in 2004 and to offset the iron ore depletion at the Aguas Claras and the Matuca Mines. Mineração Corumbaense S.A. (a subsidiary of Rio Tinto plc) was planning a \$200 million plant at Corumba in the State of Matto Grosso to produce 1 Mt/yr of hot-briquetted iron to supply steel plants in Argentina. This facility will use natural gas from the 3,150-kilometer (km) pipeline between Brazil and Bolivia that connects the Bolivian city of Santa Cruz de la Sierra to the city of Campinas, State of São Paulo (Departamento Nacional de Produção Mineral, 2001c, p. 62).

In 2000, CVRD acquired the following Brazilian enterprises: SOCOIMEX S.A. (100%) with a capacity to produce 7 Mt/yr of iron ore, for \$48 million; Gulf Industrial Company (50%), owner of a pellet plant in Bahrain with a 4-Mt/yr capacity, \$92 million; and SAMITRI (51%), for \$711 million. The auction of Caemi Mineração e Metalurgia S.A. (CAEMI), which controls MBR (CAEMI, 85.3%; Mitsui e Co. Ltd., 14.7%), was won by Broken Hill Properties Ltd. (BHP) with the offer of \$332 million. BHP was, however, awaiting Mitsui's reaction; Mitsui has preference rights. CVRD was planning to invest about \$1.8

billion to focus in the mining sector (Ferraz, 2001, p. 4).

**Manganese.**—In 2000, Brazil produced 2.192 Mt of manganese ore, which was 32.4% higher than that of 1999. CVRD's high-grade manganese mine Igarapé Azul in the Carajás complex accounted for 70% of metallurgical manganese production; production increased to 1.4 Mt from 960,000 t in 1999 owing to mine expansions in 2000. Construtora Polares Ltda. was a medium producer (176,000 t, or 72% higher than that of 1999) followed by small producers, in order of importance, in the States of Minas Gerais, Goiás, and Bahia. Exports of manganese ore accounted for 1.17 Mt valued at \$138 million; this export increase of almost 96% was due to higher demand for steel. Manganese ferroalloys exports also increased by 62.7%, which amounted to 133,400 t valued at \$58 million (Departamento Nacional de Produção Mineral, 2001c, p. 73-74; Ferraz, 2001, p. 6).

**Nickel.**—Brazil produced about 2.8 Mt of nickel ore with a nickel content of 38,739 t, which was about 6.7% lower than the 3 Mt nickel ore and 41,522 t of nickel content produced in 1999. The Mineração Serra da Fortaleza in Fortaleza de Minas, Minas Gerais (owned by Rio Tinto), produced 8,475 t of nickel contained in matte, which was 8.9% lower than that of the previous year; Companhia Niquel Tocantins of Grupo Votarantin (GV) in Niquelândia, Goiás, produced 17,223 t of nickel contained in carbonates obtained by the hydrometallurgical process of ammoniacal leaching, which was maintained at about the same level as of 1999 (17,153 t); and also in the same district, CODEMIN S.A. of Anglo American produced 6,347 t of nickel contained in ferronickel alloy, which was 2.4% lower than that of 1999 (6,502 t) (Departamento Nacional de Produção Mineral, 2001c, p. 81-82; Ferraz, p. 4).

In Brazil, owing to the increase in world demand for stainless steel and better nickel prices, investments of \$1.4 billion in the nickel industry have been planned to increase the production capacity to 107,000 t/yr from 34,000 t/yr starting in 2003. CVRD intends to invest \$600 million to produce 30,000 t/yr of nickel from its Vermehlo project in Carajás, Pará, which contains reserves of 100 Mt at a grade of 1.5% Ni; to develop the Barro Alto nickel project in Goiás, Anglo American will invest \$750 million to produce 40,000 t/yr of Ni from a deposit with 117 Mt at a grade of 1.5% Ni; Companhia Niquel Tocantins will increase production capacity to 20,000 t/yr from 17,000 t/yr at a cost of \$50 million in Niquelândia, Goiás; and Falconbridge Limited of Canada, which was third in the world as a producer of refined nickel, entered into exploration of sulfide and lateritic nickel in the country in 2000 (Departamento Nacional de Produção Mineral, 2001c, p. 81-82; Ferraz, 2001, p. 4).

**Pig Iron.**—Brazil produced 27.7 Mt of pig iron, which was 10.8% higher than that of 1999. The 2.5 Mt of exports were valued at \$288 million, which was approximately one-third of the pig iron traded in the world (Departamento Nacional de Produção Mineral, 2001c, p. 62).

**Steel.**—Brazil's 2000 steel production totaled 27.3 Mt, which was a 8.4% increase from that of 1999; this places the country

eighth in the world (Fenton, 2001). 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, 2000, p. 32). The Instituto Brasileiro de Siderurgia (IBS) stresses that the Brazilian steel industry become more efficient because privatization has fundamentally improved inefficiency and reduced employment levels of the Brazilian steel industry. IBS believes that vertical integration was evident as suppliers and customers of the steel companies participated in the auctions. The Government's privatization program identified the Brazilian steel industry as one of the first sectors for auction via the stock exchanges of Rio de Janeiro and São Paulo. The state-owned steel companies were largely privatized between 1991 and 1993 (Ferraz, 2001, p. 6).

**Tin.**—Brazil was the world's fourth largest tin producer after China, Indonesia, and Perú. Tin production was 14,200 t of tin contained in concentrate and 13,773 t of metal, which were increases of about 7.6% and 7.7%, respectively, compared with those of 1999. During the past 5 years, production cuts were made at the Pitinga Mine in the State of Amazonas operated by Marmoré S.A. (Grupo PARANAPANEMA) and at the garimpeiros' Bom Futuro operations in the State of Rondônia. Marmoré's mine produced 8,827 t with byproducts of, in order of importance, columbium (niobium), tantalum, zirconium, hafnium, thorium, and cryolite. Exports increased to 7,161 t valued at \$35.3 million from 6,048 t valued at \$30.2 million in 1999. During the past 5 years, the highest exports were registered in 1997 (11,957 t valued at \$62.5 million). These exports were far below the quota of 20,185 t/yr assigned to Brazil by the Association of Tin Producing Countries. Shipments were made to the United States, 73%; Argentina, 14%; and Belgium, Spain, and others, 13%. Amazonas (72%) and Rondônia (25%) remained the major producers in the country (Departamento Nacional de Produção Mineral, 2001c, p. 83-84; Ferraz, 2001, p. 4-5).

**Zinc.**—Brazil produced 100,254 t of zinc in concentrates, which was about 1.7% higher than the 98,590 t produced in 1999. The only producer of zinc ore in Brazil Grupo Votarantin's Companhia Mineira de Metais S.A. (CMM) produced 27,772 t of zinc sulfide concentrates in Paracatu, which was about 7% higher than that of 1999, and 72,482 t of zinc silicate in Vazante, which remained about the same level of 1999 (Departamento Nacional de Produção Mineral, 2001c, p. 119-120).

The concentrates were processed in CMM's plant in Três Marias and Grupo PARANAPANEMA's Juiz de Fora complex in Minas Gerais. These zinc refineries produced 191,777 t of primary metal, which was 2.5% higher than that of 1999. CMM produced 110,684 t (57.7% of the total), which was an increase of 1.2% from that of 1999, and GP's Companhia Paraibuna de Metais S.A. produced 81,100 t, which was an increase of 4.5% compared with that of 1999 (Ferraz, 2001, p. 5).

To meet Brazil's demand for zinc, which was about 190,000 t/yr of metal, the country imported 186,945 t of zinc concentrates (valued at \$64.4 million), which was 13.5% lower than that of 1999 (216,287 t valued at \$72.9 million), and 26,575 t of metal, which was 23.6% higher than that of 1999.

Peru supplied 95% of concentrates and 13.5% of metal zinc; additional needed metal zinc was supplied by Argentina (72.2%) and the United States (3.6%) (Departamento Nacional de Produção Mineral, 2001c, p. 119-120; Ferraz, 2001, p. 5).

To identify additional zinc reserves in Paracatu and to expand the Três Marias zinc refinery to 165,000 t/yr from 110,000 t/yr by early 2002, CMM was planning to invest \$8 million and \$160 million, respectively (Departamento Nacional de Produção Mineral, 2001c, p. 120).

### *Industrial Minerals*

**Asbestos.**—Brazil's significant asbestos deposits were in Minaçu, Goiás, which was the only producing State in the country. Sociedade Anônima Mineração de Amianto produced 209,332 t of asbestos fiber, which was 11.1% higher than that of 1999. Almost 80% of Brazil's asbestos production was consumed in the manufacture of specialized cement products, such as ceiling tiles, molded electrical insulators, protective screens, sewer and water pipes, and water tanks. Other uses were asphalt for highways and airport runways, the automobile industry, decorations, insecticide, paper and cardboard, slabs, and in thermal insulators (Departamento Nacional de Produção Mineral, 2001c, p. 43-44; Ferraz, 2001, p. 5).

Brazil exported about 34.7% of its production mainly to India, 37%; Thailand, 11%; Japan, 10%; Mexico, 9%; and Indonesia, 6%; these exports were 27.8% higher than those of 1999. The State of São Paulo was the country's largest consumer followed by Paraná and Rio Grande do Sul. Asbestos mining and consumption have been highly regulated in most industrialized nations, thus forcing them to reduce production and consumption. Industry experts expected asbestos use in the industrial nations to continue to decline into the century. In contrast, the world's developing nations were expected to increase their collective asbestos consumption by large margins. Brazilian asbestos reserves (16.3 Mt) were considered to be adequate to meet demand in the short to medium term; 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 Mt, which, at a production rate of about 200,000 t/yr, represented a 15-year mine life (Departamento Nacional de Produção Mineral, 2001c, p. 43-44).

**Cement.**—The country produced 39.2 Mt of cement, which was about 2.7% lower than that of 1999. Among the 21 State producers, Minas Gerais was the major one with 22.8% of the total, followed by São Paulo (19.7%), Paraná (9.7%), Rio de Janeiro (7.4%), Sergipe (4.8%), Rio Grande do Sul (4.5%), and other States, 31.1%. The main producers were GV's Companhia Cimento Portland Itau (21.5%) and Companhia Cimento Portland Rio Branco (20.3%), Grupo Swiss Holderbank's Holder Cimento S.A. (9%), Grupo Lafarge's Companhia Cimento Portland Paraiso (8.3%), Camargo Correia Cimentos S.A. (8.1%), and others (32.8%). Most of the exported cement (185,754 t) went to Argentina (43.3%), Paraguay (40.2%), Bolivia (6%), Peru (2.4%), and Colombia (1.3%). Brazil imported 157,296 t of cement mainly from Mexico (43.9%), Colombia (21%), France (15.3%), and Belgium (10.4%). Camargo Correia Cimentos S.A. was

investing \$200 million to build a new 1.6-Mt/yr cement plant in Ijaci, Minas Gerais, that will begin operations in late 2002. Grupo Cimentos Portland S/A (CIMPOR) will invest \$180 million to build two cement plants in the State of Paraíba. CIMPOR will produce 1.7 Mt/yr of cement in 2003 (Departamento Nacional de Produção Mineral, 2001c, p. 33-34).

**Clays.**—Production of beneficiated kaolin was about 1.7 Mt, which was about 13.3% higher than that of 1999. The beneficiated kaolin was either coating or filler kaolin. In 2000, Caulim da Amazônia S.A. (CADAM) accounted for 43.5% (756,000 t) of the country's total output, the State of Pará contributed 704,500 t of beneficiated kaolin via Ymerys Rio Campin Caulim S.A. (RCCSA) and Pará Pigmentos S.A. (PPSA), and the remainder (274,500 t) was produced by small producers in the States of Minas Gerais, Rio Grande do Sul, and São Paulo. Brazilian kaolin exports were 20% higher than that of 1999, or about 1.4 Mt valued at \$155 million. Shipments were made to Belgium (40%), Japan (18%), Italy (16%), the Netherlands (10%), the United States (9%), and others (7%). Depending on market conditions, RCCSA was planning to produce 500,000 t in 2001 and expand its capacity to 600,000 t/yr by 2002, PPSA was considering expansions that would increase its capacity to 460,000 t in 2001 and 550,000 t/yr of kaolin by 2002, and CADAM in Amapá was expected to increase production of coating kaolin to 1 Mt in 2002. In Brazil, kaolin consumption decreased by about 4.3% to 349,533 t from 365,183 t in 1999. Kaolin was used mainly in the paper and ceramics industries and, to a lesser degree, in the manufacture of rubber, plastics, pesticides, animal feed, food supplements and pharmaceuticals, fertilizers, and paint. Brazil had 4,000 Mt of kaolin reserves, or about 28.2% of the world's total (Departamento Nacional de Produção Mineral, 2001c, p. 63-64).

**Fluorspar.**—Production of beneficiated fluorspar totaled 42,962 t, which was 4.4% lower than that of 1999 (44,926 t). The beneficiated fluorspar were either acid or metallurgical grades. Crude ore [(run-of-mine (ROM)) production was 130,976 t, which was about 33.6% higher than that of 1999. The decline of ROM production during the past 3 years was due to the shutdown of Mineração Nossa Senhora do Carmo Ltd.'s (MNSCL) Fumaça and Pedras Grandes fluorspar mines. ROM production per mine in Santa Catarina State was 34.7% in Morro de Fumaça; 26.3%, Rio Fortuna; and 22.3%, Santa Rosa de Lima; and in Rio de Janeiro State was 16.7% in Tanguá. MNSCL was planning to acquire Mineração Del Rey Ltda.'s Cerro Azul Mine in the State of Paraná to start production and to increase domestic production in the near term (Departamento Nacional de Produção Mineral, 2001c, p. 51-52).

**Gemstones.**—Brazil continued to be one of the world's largest gemstones producer and exporter. Many different varieties of gemstones include, in order of importance, emerald, aquamarine, diamond, amethyst, citrine, chrysoberyl, opal, topaz, agate, and tourmaline, which are found throughout the country. Brazil is the world's only source of such quality gemstones as imperial topaz and Paraíba tourmaline (Oliveira,

2001).

In 2000, mining of gemstones continued to be dominated by the garimpeiros. Brazilian production of gems (including diamond) was mainly derived from digging activities (garimpos), which amounted to 820,000 carats, or 82% of the total; the private sector produced 80,000 carats, or 8% of the total of 1,000,000 carats (table 1). Garimpeiros' production continued in decline, however, because of fewer garimpos and increased environmental restrictions. By the end of 2000, some high-content gem placers in indigenous reserves were closed by the Government to exploration, the jewelry industry's gemstone consumption was unknown, taxation on domestic sales of jewelry was high, and the private sector faced severe competition from their black-market counterparts. Taking into consideration these factors, Brazil's gemstone reserves were almost impossible to be quantified. Brazil, however, may have great potential because the country has 600 million cubic meters of sedimentary rocks that contain diamond, which grade between 0.01 and 0.1 carat per cubic meter, or 15 million carats, which represented about 1.2% of the world's diamond reserve base (Departamento Nacional de Produção Mineral, 2001c, p. 45-46; Olsen, 2001, p. 54-55). Diamond production was about 11.1% higher than that of 1999. The total value of gemstone (including diamond) production was \$45 million. Total exports of uncut gemstones were about \$13.2 million, which remained about the same level of that of 1999 but lower than the \$15.8 million in 1998 and \$34.6 million in 1997. The major market for uncut stones was Belgium (95%). The major markets for cut stones were the United States (55%), Argentina (15%), Japan (12%), Paraguay (9%), Germany (6%), and Bolivia (3%). Imports increased to \$21.2 million from \$20.6 million in 1999 and from \$17 million in 1998. The main sources for uncut stones were Ireland (48%), the United States (36%), and the United Kingdom and Germany (8%) each. The main sources for cut stones were Italy (31%), China (25%), the United States and Spain (15%) each, and Japan (14%). Brazil had lapidarian centers, many of them closed over time owing to the preference of foreign buyers for uncut stones (Departamento Nacional de Produção Mineral, 2001c, p. 45).

**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, which has a production capacity of 30,000 t/yr; Itapecerica, 10,800 t/yr; and Salto da Divisa, 6,000 t/yr. Production amounted to 71,208 t with 14% of carbon content; this was an increase of 33.1% compared with that of 1999. This production was mainly of products that ranged in grade from 65.5% to 99.9% carbon at NGL's three plants—Pedra Azul (31,050 t), Itapecerica (13,374 t), and Salto da Divisa (6,050 t). Also in Minas Gerais, Grafita MG Ltda. produced about 16,570 t of natural graphite, which was 10.5% higher than that of 1999 and which was consumed domestically after simple grinding, and GP's Mamoré Mineração e Metalurgia Ltd. at Maiquinique, Bahia, produced 4,163 t of natural graphite (Departamento Nacional de Produção Mineral, 2001c, p. 57-58).

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, the Itapeçerica, and the Salto da Divisa beneficiation plants. Exports amounted to 17,994 t valued at \$19 million in 2000 compared with 11,307 t valued at about \$18 million in 1999. Growth of the domestic consumption of natural graphite during the 1990s was correlated with that of the iron and steel industries, which absorbed about 80% of the natural graphite consumed in Brazil; current demand, however, increased by about 42.6% (51,000 t) compared with that of 1999 (35,771 t). Other consumers included battery manufacturing (6.5%), refractories (6%), paint and varnishes (2%), and other miscellaneous uses (5.5%) (Departamento Nacional de Produção Mineral, 2001c, p. 57-58).

**Magnesite.**—The most important magnesite mine in Brazil was Pedra Preta Mine, which was owned and operated by Magnesita S.A. (MSA) and is in the Éguas Mountain region of Brumado, Bahia, about 610 km from Salvador. Brazil produced 279,876 t of beneficiated magnesite, which was 7.9% higher than that of 1999; MSA produced 98% (274,278 t). Exports of processed magnesite totaled 79,930 t valued at \$11 million and were shipped to Paraguay (25%), Poland (20%), the United States (16%), Argentina (15%), and Chile (11%). Imports totaled 7,580 t valued at \$4.9 million and were imported from Norway (69%), Canada (21%), Mexico (3%), and others (7%) (Departamento Nacional de Produção Mineral, 2001c, p. 71-72). In Brazil, about 630 Mt of resources with 180 Mt of magnesium content had been identified by yearend. Indústria Química Xilolite S.A. was involved in an ongoing expansion of its calcined magnesia plant in Brumado, Bahia, to 28,000 t/yr from 4,000 t/yr (Departamento Nacional de Produção Mineral, 2000c, p. 71-72).

**Phosphate Rock.**—Production of phosphate rock concentrate amounted to about 4.7 Mt, which was an increase of 8.8% from that of 1999. Production was highly concentrated (95.4%, or 4.5 Mt) in the following mining companies: Fosfertil S.A. (Grupo Fertifós), 34%; Fertilizantes Serrana S.A. (Bunge International Group), 30%; Ultrafertil S.A. (Grupo Fertifós), 15%; and Copebras S.A. (Anglo American), 15%. Fosfertil and Ultrafertil were reorganized by yearend and were controlled by Grupo Fertifós (79%) and CVRD (11%). Bunge Group controlled Fertifós (100%), Serrana (52%), Cargill S.A. (33%), and Fertibrás S.A. (13%) (Ferraz, 2001, p. 5-6). The reported domestic consumption of concentrates was about 5.7 Mt/yr; this was an increase of 14% compared with that of 1999. Of the total phosphoric acid, 73% was used in the fertilizer industry; 25%, in the chemical industry, and 2%, in other uses. These usages remained about the same levels as those of 1999. Imports of concentrates, phosphoric acid, and intermediate products amounted to \$573.8 million compared with those of 1999 (\$466.6 million) (Departamento Nacional de Produção Mineral, 2001c, p. 87-88).

**Quartz.**—Brazil produced 3,651 t of quartz valued at \$1.6 million. Quartz was exported mostly to Japan (31%), Hong Kong (25%), the United Kingdom (21%), Canada (8%), and Germany (4%). Quartz powder was shipped to the United Kingdom (48%), Germany (46%), and the United States (6%).

Telequartzo Exportação S.A. and others produced quartz powder, which is an important constituent in the production of ceramic materials of exceptional purity, crucibles, optic fibers, oscillators, solar cells, and wafers and integrated circuit packing. Brazil's reserves were estimated to be 53 Mt (Departamento Nacional de Produção Mineral, 2001c, p. 93-94).

**Salt.**—The reported domestic production of marine salt was 4.6 Mt, which represented a 2.2% increase from that of 1999. The State of Rio Grande do Norte continued to be the major producer of marine salt with 95.9% followed by the States of Rio de Janeiro (2.4%) and Ceará (1.7%). The domestic consumption of marine salt was 5.5 Mt. Brazil also produced 1.4 Mt of rock salt. Salgema Mineração e Química S.A. in Maceió, State of Alagoas, produced 751,000 t (51.8%) of rock salt, and Dow Química do Nordeste Ltd. (a subsidiary of Dow Chemical Co. of the United States) produced 697,000 t (48.2%) from the Vera Cruz Mine in the State of Bahia.

In 2000, salt imports decreased to 190,000 t from 215,000 t, or 11.6%. Imports were sea salt (23,000t) and bulk without aggregates—table salt, sodium chloride, and pure sodium (167,000 t). Imports came from Chile (98%) and the Netherlands (2%). Salt exports amounted to 765,000 t, which was an increase of 48.3% from that of 1999. Exports were sea salt (756,000 t), bulk without aggregates (4,000 t), table salt (3,000 t), and pure sodium chloride (2,000 t). Exports were shipped to Nigeria (63%), the United States (30%), Belgium and Uruguay (3%) each, and Venezuela (1%). Salt was consumed by the chemical industry (chlorine and sodium manufacture; 85.4%) and others (caustic soda; 14.6%) (Departamento Nacional de Produção Mineral, 2001c, p. 99-100).

**Other Industrial Minerals.**—Potassium production increased almost by 1% to 586,140 t compared with that of 1999. Brazil imported 2.6 Mt of potash mainly from Canada (29%), Russia (20%), Germany (20%), and Israel (15%) (Departamento Nacional de Produção Mineral, 2001c, p. 91-92).

Production of gypsum was more than 1.5 Mt, which was about the same level as that of 1999. In Brazil, the renewed housing and infrastructure construction activities improved the consumption of cement and plasters (Departamento Nacional de Produção Mineral, 2001c, p. 59-60). Production of talc was 300,000 t, which was an increase of 2% compared with that of 1999 (294,000 t). Paraná was Brazil's major talc producer with 58% of the national output followed by Bahia (29%), São Paulo (12%), and Minas Gerais (1%); these represented lower volumes as a result of some talc ore depletions that had taken place since mid-1997 (Departamento Nacional de Produção Mineral, 2001c, p. 105-106).

### **Mineral Fuels**

Brazil produced 464.3 million barrels (Mbbbl) of petroleum and 13.3 billion cubic meters of natural gas, which were 12.4% and 11.7% higher, respectively, than those of 1999. The country produced, in order of importance, crude oil, natural gas liquid, natural gas, and shale oil; production totaled 606.9

million barrels of oil equivalent (Departamento Nacional de Produção Mineral, 2001c, p. 85-86; Ferraz, 2001, p. 6). In 2000, Petrobrás's average production of crude oil, which included condensate and natural gas liquid, was about 1.271 million barrels per day (Mbb/d), which was 12% higher than that of 1999. In December, Petrobrás attained a new production record of 1.531 Mbb/d and was planning to reach a target of 1.9 Mbb/d in 2002-03 (Ferraz, 2001, p. 6; Petrobrás Magazine, 2001, p. 4).

**Coal.**—The Brazilian coal industry's mine operations were concentrated in three southernmost States of Santa Catarina, 50%; Rio Grande do Sul, 49%; and Paraná, 1%. In 2000, Brazilian ROM coal production increased by 50% to 13.8 Mt, and production of energy generation type coal (marketable output) increased to 6.9 Mt from 6 Mt in 1999 and 5 Mt in 1998, which were increases of about 15% and 38%, respectively (table 1).

The main producers of ROM coal were Copelmi Mineração Ltda. with 4.61 Mt followed by Companhia Riograndense de Mineração S.A. (CRM) (2.19 Mt), Carbonífera Ciriúma S.A. (1.60 Mt), and Companhia Carbonífera Metropolitana S.A. (1.16 Mt). Coal demand increased mainly because the existent thermoelectric plants were operating at full capacity in these three States. Domestic coal (6.3 Mt) was used by Santa Catarina (56.5%), Rio Grande do Sul (42.1%), and Paraná (1.4%). To meet Brazil's metallurgical coal demand, 14.9 Mt valued at \$521 million was imported, which was an increase of 11.2% compared with that of 1999. Imports came from the United States (33%), Australia (27%), South Africa (10%), and Canada (8%). Brazil imported 1.6 Mt of mineral coal coke as well, which was an increase of 77% compared with that of 1999; and China was the main supplier. Total coal consumption had reached 17 Mt, which was an increase of 4.3% compared with that of 1999. The steel industry consumed 62% of metallurgical coal, and the remainder was used for power generation. The higher consumption of electricity in the country was reaching the limits of the hydroelectric-generating capacity, which could lead to rationing during periods of drought. Brazil was planning a priority thermoelectric generating program that would be based mostly on natural gas and coal and would involve 49 new power stations that would be based mainly on natural gas. Three of them to be built in Rio Grande do Sul will be coal fired. These new powerplants were part of the Government's 17-gigawatt emergency plan to cope with the increased demand of electricity. CRM was planning to invest \$3 million to produce 2.5 Mt/yr in early 2002. Metropolitana and Ciriúma were negotiating with Usina Termoelectrica do Sul Catarinense to supply coal to produce 400 megawatts (MW). In July 2000, Chinese investors signed a letter of intent with the State of Rio Grande do Sul to perform technical and economic feasibility studies on a thermoelectric plant in the Candiota region. Most Brazilian coals have a lower content of carbon and a higher content of ash compared with the Colombian coals in the Guajira area. Total Brazilian coal reserves were estimated to be 7,400 Mt (Departamento Nacional de Produção Mineral, 2001c, p. 37-38; Ferraz, 2001, p. 2-3).

**Natural Gas and Petroleum.**—Brazil produced 36.4 million

cubic meters per day of gas, which was 11.7% higher than that of 1999. The gas pipeline that links the Enchova platform in the offshore Campos Basin to Macaé, Rio de Janeiro, had 5 million cubic meters per day of gas flow added to the Rio de Janeiro and the São Paulo markets; offshore gas production accounted for 65% of the total. The two agreements signed between Petrobrás and Yacimientos Petroleros Fiscales of Argentina and Yacimientos Petroleros Fiscales of Bolivia supplied natural gas to Brazil. The Argentina-Brazil gas pipeline linked Aldeia Brasileira in Argentina to Porto Alegre in Rio Grande do Sul. The \$2 billion 3,150-km Bolivia-Brazil gas pipeline started operation and will increase the supply of natural gas along the 1,970-km pipeline between Santa Cruz de la Sierra, Bolivia, and Guararema, Brazil, to supply Mato Grosso do Sul, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul to 8 million cubic meters per day into 2005, to 16 million cubic meters per day from 2005, and to 30 million cubic meters per day from 2010. The natural gas share of the country's energy mix was 2.6% in 2000 and will be 12% in 2010. Petrobrás continued producing natural gas in the Gulf of Mexico and recovered gas from the Frederick Field, which was 27 km off the Louisiana coast (Departamento Nacional de Produção Mineral, 2001c, p. 54, 86; Ferraz, 2001, p. 6; Petrobrás Magazine, 2001, p. 51).

Brazil produced 1.3 Mbb/d of petroleum, which was 12.6% higher than that of 1999. Imports of crude oil and derivatives were valued at \$3.826 billion compared with exports valued at \$896.5 million. Brazil's imports of petroleum were 145 Mbb/d at a value of \$4.3 billion. The main sources were Argentina (23.6%), Algeria (22.9%), Saudi Arabia (14.2%), Nigeria (12.9%), and Venezuela (11.2%) (Departamento Nacional de Produção Mineral, 2001c, p. 86).

**Uranium.**—Brazil owned the fifth largest uranium reserves in the world (Rapouso dos Santos, 1999, p. 204). The country's indicated reserves amounted to 21.9 Mt of uranium oxide ( $U_3O_8$ ) and 60 Mt of inferred reserves; minable reserves contained 103,197 t at a grade of 0.104%  $U_3O_8$ . Private interests were permitted to participate in uranium exploration and production in Brazil through state-owned joint ventures; there was, however, a restriction that no more than 20% of the country's uranium reserves may be exported (Departamento Nacional de Produção Mineral, 2000, p. 386-387).

## Reserves

Brazil was among the world leaders in reserves of some mineral commodities. According to the Departamento Nacional de Produção Mineral (2001a, p. 17), they were ranked as follows: columbium (niobium), first; graphite and kaolin, second; aluminum, talc, and vermiculite, third; magnesite and tin, fourth; and iron ore and manganese, sixth (table 3).

## Infrastructure

Brazil's railroads totaled 30,539 km of which 2,129 km electrified. Of that total, broad (1.600-m) gauge totaled 5,679 km of which 1,190 km was electrified; standard (1.440-m) gauge, 194 km; and narrow (1.000-m) gauge, 24,666 km of 930 km was electrified. In addition, three rails had dual gauge—336 km of 1.000-m and 1.600-m gauge. The country contained a

total of almost 2 million kilometers of roads—184,140 km paved and 1.8 million kilometers gravel and dirt. There was 50,000 km of navigable inland waterways. Pipelines for crude oil totaled 2,980 km; petroleum products, 4,762; and natural gas, 4,246 km. The major shipping ports were Belém, Fortaleza, Ilheus, Manaus, Paranagua, Porto Alegre, Recife, Rio de Janeiro, Rio Grande, Salvador, Santos, and Vitoria. Among the merchant marine's 271 ships, 56 were tankers; 15, chemical tankers; 10, liquefied gas tankers; 14, combination ore and oil vessels; 82, bulk vessels; and 2, combination bulk vessels (Vale, 2000, p. 18-23; U.S. Central Intelligence Agency, 2001, Brazil—Transportation, World factbook, accessed September 20, 2001, at URL <http://www.odci.gov/cia/publications/factbook/geos/br.html>).

In 2000, Brazil's installed electrical generating capacity was 52,865 MW. Total production of electric power for the year was 291,630 gigawatthours, which translated into 1,370 kilowatthours per capita. Brazil's primary domestic energy supply encompassed the following: hydroelectric, 95%; petroleum and natural gas, 2.6%; nuclear energy, 0.8%; and others, 1.6% (Vale, 2000, p. 18-23; U.S. Central Intelligence Agency, 2001, Brazil—Electricity, World factbook, accessed September 20, 2001, at URL <http://www.odci.gov/cia/publications/factbook/geos/br.html>).

The Brazil-Bolivia pipeline (owned by a consortium or joint venture of the Royal Dutch-Shell Group, Enron, Inc., and Petrobrás) was the largest of various cross-border energy projects. Argentina supplied gas to Rio Grande do Sul's new thermoelectric plant. Two additional pipelines were to take Argentine gas to Brazil's southern market. Another project was to supply energy to Brazil from a powerplant in Uruguay. In northern Brazil, a transmission line supplied energy to Roraima from Venezuela. The majority of these projects were being developed by the private sector as a result of liberalization and privatization. State-owned corporations entered into partnerships with the private domestic and foreign investors (Chodorowski and Carnecir, 2001).

Negotiations were also completed between the Brazilian Government and five companies, four of which were foreign subsidiaries. The companies involved were Alcan Alumínio, Alcoa Alumínio, Billiton, Dow Química, and Camargo Corrêa Industrial S.A. (Brazil). Brazil and the five companies will build a 1,200-MW dam on the Tocantins River on the border between the States of Maranhão and Tocantins. Construction of the dam was estimated to cost about \$1 billion; Billiton pledged \$350 million (Vale, 2000, p. 23). This new dam appeared to be necessary because demand for hydroelectricity was growing at a rate faster than that of supply. This increased demand could exceed the current (2000) supply in a very few years. The supply of subsidized electricity from the Tucuruí Dam on the Tocantins River had been exceeded by the current (2000) mining and industrial activities in the Tocantins area. The 10% electrical subsidy was expected to be phased out by 2004 (Vale, 2000, p. 20).

Constran S.A. and Construção e Comércio of the Grupo Itamaraty planned to construct an additional 1,718 km of railroad to be 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 to Cuiabá, Mato Grosso, and Santarem, Pará, branching from Cuiabá to Porto Velho, Rondônia (Vale, 2000, p. 22).

## Outlook

Brazil has established a favorable climate for domestic and foreign investors by keeping inflation under control, coming to grips with its fiscal deficit, providing stable rules for capital repatriation and profit remittances, and reducing the tax burden, tariffs, and nontariff barriers. These factors, along with the 1988 Constitution review in 2000, will probably position Brazil well for the first decade of the 21st century. The increasing trend of FDI (\$30.6 billion) into the Brazilian economy reflects foreign investor confidence in the country, which will support continued economic growth and investments in technology well into the new millennium. The Brazilian economy was affected by the volatility of the international financing market, depressed prices for mineral exports, and the country's dramatic electricity crisis owing to its worst drought in decades, which affected the country's power-generating capacity, 95% of which is dependent on hydropower (Prates, 2001).

The various sectors of the Brazilian economy recorded diverse rates of growth—minerals, 11.48%; industrial, 5.01%; services, 3.85%; and agriculture, 3.02% (Departamento Nacional de Produção Mineral, 2001a, p. 1). If that positive rate of economic growth in the minerals sector is sustained into 2001 and beyond, then it should continue its expansion as the demand for mineral exports and fabricated steel goods increase. Mercosur has undergone dramatic changes in natural gas and power markets owing to the increase in domestic gas consumption, privatization of the energy sector, and cross-border energy investment opportunities. Brazil has become the center of an increasingly rapid process of energy integration in South America owing to the country's gas market, which is in full evolutionary mode with an unsatisfied energy demand and great potential for growth.

The FDI into the Brazilian mining industry should continue enhancing exploration and mine development activities, particularly in, in order of importance, iron ore, gold, and emeralds. This trend should continue because several corporations were forming joint ventures and acquiring exploration properties, mining prospects, and permits, particularly for, in order of importance, iron ore, gold, diamond, base metals, and oil and gas.

After the steel industry and CVRD were privatized, other sectors of the Brazilian economy, such as energy, mining, services, telecommunications, and transportation, will probably be part of the privatization process and joint ventures. In addition, new projects in the oil and gas sectors will continue to be opened up to mergers and joint-venture projects with domestic and foreign investors. Privatization of Government-owned firms and joint ventures has led to lower employment levels and greater efficiencies owing to the use of modern technology. The Brazilian economy should be sustainable and competitive within the global economy into the new century.

Privatization of Government monopolies, the dismantling of

all trade barriers, increased exports to the world markets, and the constitutional amendment that eliminates the distinction between domestic and foreign capital will continue to be important, thus allowing the continued flow of foreign investment into the Brazilian economy.

The existing Brazilian infrastructure is of particular interest to the minerals (metals, industrial minerals, and fuel minerals) and related industries. Brazil 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, modern 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 were those that depend most heavily on electricity and transportation facilities.

Brazil's dramatic electricity crisis will create short- to medium-term slowdowns, in order of importance, in the aluminum, automobile, steel, petrochemical, and pulp and paper industries, which depend heavily on energy and exports; they will likely benefit most from a new and improved power-generating infrastructure. The 46 expected thermal generation plants to be built in the near term would be the major driver for growth in gas and/or coal demand. Brazil, however, would need to have in place the necessary regulatory resolutions, including gas and coal prices, to motivate private investment.

Brazil's dynamic and diverse economy, coupled with its sizeable consuming market and its membership in Mercosur, will continue to attract the interest of investors of all types and origins. The Amazon region alone was considered to have possibilities for major undiscovered mineral deposits in addition to the large reserves of, in order of importance, iron ore, manganese, bauxite, gold, and tin. A factor that may have a negative effect over the longer term was the environment, especially in the Amazon rain forest. Much will depend on the approaches to be used for economic and social development while protecting the environment in a sustainable way.

Finally, the Government's new initiative the \$550 billion "Advance Brazil" development program may encourage Federal, State, and municipal entities to review their tax and mineral policies and welfare reforms with fiscal responsibility and austerity to open up Brazil to new investment opportunities in, in order of importance, the telecommunications, transportation, energy, and mineral industries in the foreseeable future (Yolen, 2000, p. 2).

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90 Botafogo-ZC-02  
22290-Rio de Janeiro-RJ-Brasil
- Companhia de Pesquisa de Recursos Minerais  
Avenida Pasteur 404-Anexo, 2º Andar, Praia Vermelha  
22290-Rio de Janeiro-RJ-Brasil
- Conselho de Não-Ferrosos e de Siderurgia  
Esplanados dos Ministerios-Bloco 6-5º Andar  
70053-Brasília-DF-Brasil
- Conselho Nacional do Petróleo  
SGAN-Q.603 Modulos J, I e H  
70830-Brasília-DF-Brasil
- Instituto Brasileiro de Mineração  
Avenida Afonso Pena, 3880 3º, 4º e 5º Andares  
30000-Belo Horizonte-MG-Brasil
- Instituto Brasileiro de Siderurgia  
Rua Araújo Porto Alegre, 36 - 7º Andar  
20030-010-Rio de Janeiro-RJ-Brasil
- Departamento Nacional de Produção Mineral  
Ministério da Minas e Energia  
SAN-Quadra 01-Bloco "B"  
70040-Brasília-DF-Brasil
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Avenida República do Chile, 65  
20035-Rio de Janeiro-RJ-Brasil

Rio Doce Geológica e Mineração, S.A.  
Avenida President Wilson 11º Andar  
22030-Rio de Janeiro-RJ-Brasil

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weekly.

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

(Metric tons unless otherwise specified)

Commodity 3/ METALS	1996	1997	1998	1999	2000
<b>Aluminum:</b>					
Bauxite, dry basis, gross weight	10,998,000	11,671,000	11,961,000	13,839,000 r/	13,846,000
Alumina	2,759,000	3,088,000	3,322,000	3,515,000 r/	3,743,000
<b>Metal:</b>					
Primary	1,197,000	1,189,000	1,208,000	1,245,000	1,277,000
Secondary	143,000	148,000	170,000	190,000	210,000
Beryllium, beryl concentrate, gross weight	6	7	5	11	13
Cadmium, metal, primary e/	300	300	300	300	300
<b>Chromium:</b>					
Crude ore	408,495	285,500	440,450	420,000	600,000
Concentrate and lump, Cr <sub>2</sub> O <sub>3</sub> content	174,150	112,274	209,596 r/	207,123 r/	276,105
Marketable product 4/	51,632 r/	46,115 r/	81,886 r/	103,015 r/	69,271
<b>Cobalt:</b>					
Mine output, Co content by hydroxide e/	400	400	400	400	900
Metal, electrolytic 5/	193	266	364	630 e/	900
<b>Columbium-tantalum ores and concentrates, gross weight:</b>					
Columbite and tantalite e/	190	190	330	330	330
Djalmaite concentrate e/	10	10	10	10	10
Pyrochlore concentrate, Nb <sub>2</sub> O <sub>5</sub> content	19,621	25,688	33,795	31,352 r/	31,190
<b>Copper:</b>					
Mine output, Cu content	46,203	39,952	34,446	31,371	31,786
<b>Metal:</b>					
Primary	172,075	177,060	167,205	193,014	185,345
Secondary	54,000	54,100	54,150	54,220	54,300
<b>Gold:</b>					
Mine output kilograms	41,142	41,062	37,787	42,367 r/	42,025
Garimpeiros (independent miners) do.	18,869	17,426	11,780	10,267	8,368
Total do.	60,011	58,488	49,567	52,634 r/	50,393
<b>Iron and steel:</b>					
<b>Ore and concentrate (marketable product): 6/</b>					
Gross weight thousand tons	174,200	184,970	197,500	194,000	210,000
Fe content do.	106,879	121,355	131,670	128,040	138,600
<b>Metal:</b>					
Pig iron thousand tons	23,978	25,013	25,111	25,060	27,723
<b>Ferroalloys, electric-furnace: e/</b>					
Chromium metal	37	37	40	40	40
Ferrocilicon	25,000	25,000	25,000	25,000	25,000
Ferrosilicon	77,231 7/	74,485 r/ 7/	72,507 r/ 7/	90,784 r/ 7/	142,522 7/
Ferrosilicon silicon	5,000	5,000	5,000	5,000	5,000
Ferrosilicon columbium	12,651 r/ 7/	16,681 r/ 7/	20,516 r/ 7/	18,866 r/ 7/	18,218 7/
Ferromanganese	215,260 7/	153,000 7/	122,000	110,000 7/	88,900 7/
Ferromolybdenum	47	47	50	50	50
Ferrosilicon nickel	9,091 r/ 7/	9,350 r/ 7/	8,077 r/ 7/	6,502 r/ 7/	6,347 7/
Ferrosilicon phosphorus	2,000	2,000	2,000	2,000	2,000
Ferrosilicon silicon	236,838 7/	212,183 7/	210,000 7/	210,000 7/	210,000
Ferrosilicon magnesium	15,000	15,000	15,000	15,000	15,000
Ferrosilicon zirconium	1,500	1,500	1,500	1,500	1,500
Ferrosilicon titanium	500	500	500	500	500
Ferrosilicon tungsten	25	25	25	25	25
Ferrosilicon vanadium	3,000	3,000	3,000	3,000	3,000
Inoculant	25,000	25,000	25,000	25,000	25,000
Silicomanganese	232,218 7/	175,000 7/	124,000	110,000 7/	156,100 7/
Silicon metal	150,054 7/	136,884 7/	120,000	120,000	120,000
Total	1,010,000 r/	855,000 r/	754,000 r/	743,000 r/	819,000
Steel, crude, excluding castings thousand tons	25,076	25,100	25,800	24,600 r/	27,300
Semimanufactures, flat and nonflat e/ do.	25,000	25,000	25,000	25,000	25,000
<b>Lead:</b>					
Mine output, Pb content in concentrate	7,894	8,729	7,567	10,281	8,832
Metal, secondary	45,000	44,500	--	--	--

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity 3/ METALS--Continued	1996	1997	1998	1999	2000
Manganese, metal:					
Primary e/	6,500	6,500	6,500	6,500	6,500
Secondary e/	1,600	1,600	1,600	1,600	1,600
Manganese ore and concentrate, marketable, gross weight 4/	2,506,000	2,124,000	1,940,000 r/	1,656,000 r/	2,192,000
Nickel:					
Mine output (ore)	2,078,291	2,760,787	2,603,757	2,990,657	2,790,184
Ni content in ore	25,245	31,936	36,764	41,522 r/	45,317
Ferronickel, Ni content	9,091	9,350	8,077	6,502	6,347
Rare-earth metals, monazite concentrate, gross weight	200	200	200 e/	200 e/	200 e/
Silver 8/ kilograms	29,560	26,598	34,000	42,000	41,000
Tin:					
Mine output, Sn content	19,617	18,078	14,237	13,202	14,200
Metal:					
Primary	18,361	17,525	14,600	12,787	13,773
Secondary e/	250	250	250	250	250
Titanium concentrates, gross weight:					
Ilmenite	97,955	97,174	103,000	96,000	123,000
Rutile	2,018	1,742	1,800	4,300	3,162
Tungsten, mine output, W content	171	70	--	22 r/	22
Zinc:					
Mine output, Zn content	117,341	152,634	87,485 r/	98,590	100,254
Metal:					
Primary	186,338	185,701	176,806	187,010	191,777
Secondary e/	7,000	7,000	7,000	7,000	7,000
Zirconium, zircon concentrate, gross weight 9/	15,560	19,252	20,132	27,160 r/	29,805
INDUSTRIAL MINERALS					
Asbestos:					
Crude ore e/	3,950,000	3,950,000	3,950,000	3,950,000	3,950,000
Fiber	213,212	208,447	198,332	188,386	209,332
Barite:					
Crude	49,662	44,755	55,977	48,789	55,462
Beneficiated	39,662	51,961	46,632	44,906	53,741
Marketable product e/ 4/	65,000	65,000	65,000	65,000	65,000
Calcite e/	35,000	35,000	35,000	35,000	35,000
Cement, hydraulic thousand tons	34,597	38,096	39,942	40,270	39,208
Clays:					
Bentonite (beneficiated)	186,000	230,000	220,000	274,623	273,975
Kaolin:					
Crude	2,196,708	2,764,040	3,259,518	3,598,326	4,100,000
Beneficiated	1,057,671	1,165,047	1,373,892	1,516,700	1,734,787
Marketable product e/ 4/	1,100,000	1,150,000	1,150,000	1,150,000	1,200,000
Diamond: e/					
Gem thousand carats	200	100	100	900 7/	1,000 7/
Industrial do.	600	600	600	600	600
Total 10/ do.	800	700	700	1,500 7/	1,600 7/
Diatomite:					
Crude	15,236	15,448	14,303	14,601	10,164
Beneficiated	11,236	11,228	10,162	7,867	7,201
Marketable product e/ 4/	13,100	13,100	13,100	13,100	13,100
Feldspar:					
Crude	276,621	89,708	200,000	220,000	115,000
Marketable product: e/ 4/					
Feldspar	122,000	122,000	122,000	122,000	122,000
Leucite	5,000	5,000	5,000	5,000	5,000
Sodalite, crude	500	500	500	500	500
Total	128,000	128,000	128,000	128,000	128,000
Fluorspar:					
Crude ore, run-of-mine (ROM)	117,418	247,109	220,911	98,000	130,976
Concentrates, marketable product:					
Acid-grade	46,706	66,858	61,024	38,209	30,131
Metallurgical-grade	12,334	11,174	11,058	6,717	12,831
Total	59,040	78,032	72,082	44,926	42,962

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity 3/	1996	1997	1998	1999	2000
INDUSTRIAL MINERALS--Continued					
Graphite:					
Crude e/	650,000	650,000	650,000	650,000	650,000
Marketable product:					
Direct-shipping crude ore	4,134	9,397	10,747	NA	NA
Concentrate	27,190	31,190	50,622	53,503 r/	71,208
Total	31,324	40,587	61,369	53,503 r/	71,208
Gypsum and anhydrite, crude	1,126,106	1,507,114	1,631,957	1,456,309	1,541,109
Kyanite: e/					
Crude	750	750	750	750	750
Marketable product 4/	600	600	600	600	600
Lime, hydrated and quicklime	6,210	6,469	6,229	6,137	6,273
thousand tons					
Lithium, concentrates	6,571	6,948	9,485	11,122	10,875
Magnesite:					
Crude	1,268,265	1,030,171	1,109,351	868,604	1,006,654
Beneficiated	305,737	294,629	308,300	259,834	279,876
Mica, all grades	7,000	4,000	4,000	3,000 r/	4,000
Nitrogen, N content of ammonia	976,800	1,018,600	948,600	948,000 e/	950,000 e/
Phosphate rock including apatite:					
Crude: e/					
Mine product	27,000	27,000	27,000	27,000	26,300 7/
Of which, sold directly	35	35	35	35	35
do.					
Concentrate:					
Gross weight	3,823	4,276	4,421	4,344 r/	4,725
do.					
P <sub>2</sub> O <sub>5</sub> content	1,353	1,510	1,561	1,543 r/	1,687
do.					
Pigments, mineral, other, crude e/	2,000	2,000	2,000	2,000	2,000
Potassium (KCl)	404,538	466,984	544,200	580,380	586,140
Potash, marketable (K <sub>2</sub> O)	242,723	280,164	326,489	348,231	351,681
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	10,000	10,000	10,000	10,000	10,000
Sapphire	15,000	15,000	15,000	15,000	15,000
do.					
Topaz	50	50	50	50	50
Tourmaline	80	80	80	80	80
Other	500	500	500	500	500
value					
do.					
Quartz crystal, all grades	2,355	2,169	1,594	1,470	3,651
Salt:					
Marine	3,870	5,064	5,353	4,528	4,626
thousand tons					
Rock	1,514	1,452	1,484	1,430	1,448
do.					
Silica (silex) e/	1,600	1,600	1,600	1,600	1,600
do.					
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
cubic meters					
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
cubic meters					
Calcareous shells	450,000	450,000	450,000	450,000	450,000
Dolomite	3,500	3,500	3,500	3,500	3,500
thousand tons					
Gneiss	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000
cubic meters					
Granite	60,000	60,000	60,000	60,000	60,000
thousand cubic meters					
Limestone	60,000	60,000	60,000	60,000	60,000
thousand tons					
Quartz 11/	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/ 2/

(Metric tons unless otherwise specified)

Commodity 3/	1996	1997	1998	1999	2000	
INDUSTRIAL MINERALS--Continued						
Stone, sand and gravel--Continued: e/						
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	25,319	20,476	24,582	23,232	23,720	
Pyrites	4,158	2,307	1,137	--	--	
Byproduct:						
Metallurgy	175,121	175,511	186,806	217,119	217,238	
Petroleum	33,424	33,823	36,973	57,962	81,762	
Total	238,022	232,117	249,498	298,313	322,720	
Talc and related materials:						
Talc:						
Crude	296,810	285,614	289,000	294,000 r/	300,000	
Marketable product e/ 4/	2,000	2,000	2,000	2,000	2,000	
Pyrophyllite, crude	155,370	158,675	161,000	160,000	150,000	
Vermiculite:						
Concentrate	21,999	23,000	24,300	23,400	23,400	
Marketable product 4/	4,000	5,000	4,200	3,100	3,100	
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous:						
Run-of-mine	thousand tons	5,000	6,500	5,500	6,900	13,800
Marketable 4/	do.	4,788	5,542	5,040 r/	6,013 r/	6,924
Coke, metallurgical, all types	do.	70	90	43 r/	50 r/	50
Gas, natural, gross	million cubic meters	9,156	9,461	10,412	11,898	13,291
Natural gas liquids	million 42-gallon barrels	1,300 e/	2,541	2,654	3,345 r/	3,694
Petroleum:						
Crude	thousand 42-gallon barrels	286,843	318,290	365,365	413,121	464,280
Refinery products: 12/ 13/						
Liquefied petroleum gas	do.	38,778	40,055	58,288	10,950 r/	13,140
Gasoline	do.	102,389	115,409	167,943	128,854 r/	134,722
Jet fuel	do.	535	478	695	533 r/	557
Kerosene	do.	22,896	22,449	32,668	25,064 r/	26,175
Distillate fuel oil	do.	169,994	177,435	258,203	198,106 r/	206,885
Lubricants	do.	4,906	5,001	7,277	5,584 r/	5,831
Residual fuel oil	do.	81,198	103,364	150,415	115,406 r/	118,698
Other	do.	63,856	84,871	123,502	94,758 r/	100,893
Refinery fuel and losses	do.	--	--	--	NA	NA
Total	do.	484,552	549,062	798,991	579,255 r/	606,901

e/ Estimated. r/ Revised. NA Not available. -- Zero.

1/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

2/ Table includes data available through October 2001.

3/ 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.

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

5/ Source: Cobalt Development Institute.

6/ Includes sponge iron as follows, in thousand metric tons: 1996-2000--270 (estimated).

7/ Reported figure.

8/ 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: 1996--38,000; 1997--32,000; 1998--40,000; 1999--50,000; 2000--50,000.

9/ Includes baddeleyite-caldasite.

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

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

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

13/ Minerals Questionnaire, 1997-2001, and Petrobrás Magazine, 1998-2001.

TABLE 2  
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2000

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
<b>METALS</b>				
Aluminum		Albras-Alumínio Brasileiro S.A. (Albras) [Companhia Vale do Rio Doce (CVRD); 51% and Nippon Amazon Alumínio Co. (NAAC), 49%]	Belém and Vila do Conde, Pará State (two smelters)	400 (metal).
Do.		Alcan Alumínio do Brasil S.A. (Alcan Aluminum Ltd., 100%)	Saramenha, Minas Gerais State (smelters and refinery)	100 (metal), 150 (alumina).
Do.		Alcan Empreendimentos Ltda. (Alcan Alumínio do Brasil S.A., 100%)	Laminação de Pindamonhangaba, São Paulo State (smelter)	280 (metal).
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, 53.66%; Billiton plc, 46.34%)	Poços de Caldas, Minas Gerais State (mine) São Luiz, Maranhão State (refinery) (smelter)	400 (bauxite), 550 (alumina), 239 (metal).
Do.		Alumínio do Brasil Nordeste S.A. (Alcan Aluminum Ltd., 100%)	Aratu, Bahia State (smelter)	120 (metal).
Do.		Billiton Metais S.A. (Billiton plc, 100%)	São Luis, Maranhão State (refinery)	375 (metal), 450 (alumina).
Do.		Alumínio do Norte do Brasil S.A. (Alunorte) (private, 100%)	Barcarena, Pará State (refinery)	1,550 (alumina).
Do.		Companhia Brasileira de Alumínio (CBA) (private, 100%)	Poços de Caldas, Minas Gerais State (mine) Sorocaba, São Paulo State (refinery) (smelter)	1,000 (bauxite), 500 (alumina), 220 (metal).
Do.		Companhia 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) (CVRD, 40%; CBA, 10%; Alcan Empreendimentos Ltda., 12%; Billiton plc, 14.8%; Norsk Hydro Comercio e Industria, 5%; Reynolds Alumínio do Brasil, 5%; and Alcoa, 13.2%)	Oriximina, Pará State (mine) Papagalo, Pará State (mine) Trombetas, Pará State (mine)	11,000 (bauxite), 2,000 (bauxite), 2,000 (bauxite).
Do.		Vale do Sul Alumínio S.A. (Aluvale) (Government, 27%; private, 25%; Shell do Brasil S.A., 44%)	Santa Cruz, Rio de Janeiro State (smelter)	86 (metal).
Do.		Aluvale (CVRD, 49.7%; Billiton Metais S.A., 41.5%, Cia. Cataguazes, 8.8%)	do.	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%; Nippon Amazon Alumínio Co., 12.2%; CBA, 5.7%; and others, 8.8%)	Jabuti, Pará State (mine) Jabuti, Pará State (alumina)	1,500 (bauxite), 1,200 (alumina).
Chromite		Coitezeirio 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		Mineração Caraíba S.A. (Grupo PARANAPANEMA, 100%)	Jaguari, Bahia State (mine) (beneficiation plant)	130 (ore), 90 (concentrate).
Do.		Caraíba Metais S.A. (CMSA) (private, 100%).	Camaçari, Bahia State (refinery)	220 (metal).
Columbium		Companhia Brasileira de Metalurgia e Mineração (CBMM) (Grupo Moreira Sales S.A., 55%; Molycorp, Inc., 45%)	Araxá, Minas Gerais State (mine) (beneficiation plant)	1,200 (ore), 50 (pyrochlore).
Do.		Mineração Catalão de Goiás Ltda. (MCGL) (Bozzano Simosen S.A., 68.5% and Anglo American plc, 31.5%)	Ouvidor and Catalão I, Goiás State (mines) Ouvidor, Goiás State (plants)	700 (ore), 13 (pyrochlore).
Ferroalloys		Companhia Brasileira Carbureto de Calcio (CBCC) (private, 100%)	Santos Dumont, Minas Gerais State (plant)	54.
Do.		Prometal Produtos Metalúrgicos S.A., 60% and Elken A.S., 40%	Marabá, Pará State (plant)	500.
Do.		Nova Era Silicon S.A. (CVRD, 49%; Mitsubishi Corp., 25.5%; and Kawasaki Steel Corp., 25.5%)	Nova Era, Minas Gerais State	48.
Do.		Companhia Ferro-Ligas de Bahia S.A. (FERBASA, 100%)	Pojuca, Bahia State (plant)	194.
Do.		Companhia Ferro-Ligas Minas Gerais (MINASLOGAS, 100%)	Pirapora, Minas Gerais State (plant)	58.
Do.		Companhia Paulista de Ferro-Ligas (CPF) (private, 100%)	Barbacena, Caxambu, Jeceaba, Passa Quatro and Passa Vinte, Minas Gerais State; Corumba, Matto Grosso do Sul State; and Xanxere, Santa Catarina State	326.
Do.		Italmagnesio S.A. Indústria e Comercio (ISAIC) (private, 100%)	Bragança Paulista, São Paulo State; and Varzeada Palma, Minas Gerais State (two plants)	63.
Gold	kilograms	Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Gold mines in the States of Minas Gerais, Bahia, and Pará	18,000.
Do.	do.	Mineração Morro Velho S.A. (AngloGold Ltd., 100%)	Novo Lima, Raposos, and Sabara, Minas Gerais State; and Jacobina, Bahia State (four mines)	7,000.
Do.	do.	Mineração Serra Grande S.A. (AngloGold Ltd., 50%; and TVX Gold Inc., 50%)	Serra Grande, Minas Gerais State (mine)	6,000.
Do.	do.	São Bento Mineração S.A. (Eldorado Gold Corp., 100%)	Santa Barbara, Minas Gerais State (mine)	4,000.
Do.	do.	Rio Paracatu Mineração S.A. (Rio Tinto plc, 51% and Autram S/A, 49%)	Paracatu Mine, Minas Gerais State (mine)	7,500.
Do.	do.	Mineração Maracá S.A. (MMSA) (private, 100%)	São Vicente Mine, Mato Grosso State (mine)	1,500.
Iron ore		Companhia Siderúrgica Nacional (CSN) (private, 100%)	Volta Mine, Minas Gerais State	12,000.
Do.		Itaminas Comércio de Minérios S.A. (ICMSA) (private, 100%)	Itaminas, Minas Gerais State	5,000.
Do.		Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Serra dos Carajás Pará State; and Itabira, Ouro Preto, and Santa Xavier, Tamandua, Capao, and Mato, Minas Gerais (four mines)	55,000. 105,000

TABLE 2--Continued  
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2000

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
<b>METALS--Continued:</b>			
Iron ore--Continued	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) (Broken Hill Properties Ltd., 85.3% and Mitsui e Co. Ltd., 14.7%)	Capão Xavier, Tamandua, and Capitão do Mato, Minas Gerais State (three mines)	32,000.
Do.	Samarco Mineração S.A. (SAMITRI), 51% and Broken Hill Properties Ltd., 49%)	Alegria, Minas Gerais State (mine)	13,500.
Do.	SOCOIMEX S.A. (CVRD, 100%)	Mato, Minas Gerais State (mine)	7,000
Lead	Mineração Boquira S.A. (MBSA) (private, 100%)	Boquira, Bahia State (mine) (beneficiation plant)	300 (ore), 310 (concentrate).
Manganese	Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Corumba, Minas Gerais State (mine) Igarapé Azul, Carajás, Pará State (beneficiation plant)	2,500 (ore). 1,400 (concentrate).
Do.	Urucum Mineração S.A. (CVRD, 100%)	Corumba and Ladario, Mato Grosso do Sul State (two mines and plant)	1,500 (ore), 800 (concentrate).
Do.	Construtora Polares Ltda. (CPL) (private, 100%)	Corumba Minas Gerais State (mine)	200 (ore).
Nickel	Companhia Niquel Tocantins (CNT) (Grupo Votarantin, 100%)	Niquelândia, Goiás State (mine) (refinery plant)	20 (ore), 10 (electrolytic Ni).
Do.	Mineração Serra da Fortaleza (Rio Tinto plc, 100%)	Fortaleza, Minas Gerais State (mine)	19 (nickel matte).
Do.	CODEMIN S.A. (Anglo American plc, 100%)	Niquelândia, Goiás State (refinery)	20 (metal).
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 (CSBM) (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)	Ipatinga, Minas Gerais State	4,400.
Tin	Mineração Jacunda Ltda. (MJL) (private, 100%)	Santa Barbara, Novo Mundo, and Potosi; Rondônia State (six mines) (three beneficiation plants)	108 (ore), 450 (concentrate).
Do.	Grupo PARANAPANEMA (private, 100%)	Aripuana, Mato Grosso State; Ariqueemes, Rondônia State; Novo Aripuana, Pitinga, and Presidente Figueiredo, Amazonas State; and São Felix do Xingu, Pará State (five mines) (two plants) Piraporada Bom Jesus, São Paulo State (refinery)	5,420 (ore), 1,400 (concentrate), 25 (metal).
Do.	MARMORÉ.A. (MSA) (Grupo PARANAPANEMA, 100%)	Juiz de Fora, Minas Gerais State (mine)	20 (ore).
Titanium	Rutilo e Ilmenita do Brasil S.A. (RIBSA, 100%)	Mataraca, Paraíba State (mine) (two beneficiation plants)	4,200 (ore), 120 (concentrate).
Zinc	Companhia Mineira de Metais S.A. (CMM) (Grupo Votarantin, 100%)	Vazante, Minas Gerais State (mine) (beneficiation plant)	800 (ore), 48 (concentrate).
Do.	do.	Três Marias, Minas Gerais State (refinery)	165 (metal).
Do.	Companhia Paraibuna de Metais S.A. (CPM) (Grupo PARANAPANEMA, 100%)	Juiz de Fora, Minas Gerais State (mine)	100 (ore).
Zirconium	Nuclemon Minerio-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).
<b>INDUSTRIAL MINERALS</b>			
Asbestos	Sociedade Anônima Mineração de Amianto (SAMA) (private, 100%)	Cana Brava and Minaçu, Goiás State (mines) (beneficiation plant)	9,000 (ore). 230 (concentrate).
Cement	Cimento Santa Rita S.A. (CSSA) (CSSA, 50%; Holder Cimento S.A., 50%)	Itapevi and Salto de Pirapora, São Paulo State (two plants)	2,200.
Do.	Companhia Cimento Portland Itau (CCPI) (Grupo Votarantin, 100%)	Itau de Minas, Minas Gerais State (three plants)	2,400.
Do.	Companhia de Cimento Portland Paraíso (CCPP) (CCPP, 50%; Lafarge Group, 50%)	States of Espírito Santo, Goiás, Minas Gerais, and Rio de Janeiro (five plants)	4,000.
Do.	Companhia de Cimento Portland Rio Branco (Votarantin Group, 100%)	Rio Branco do Sul, Paraná State (two plants)	5,000.
Do.	Camargo Correia Cimentos S.A. (CCSA) (private, 100%)	Ijaci, Minas Gerais State (plant)	1,600.
Diamond	Mineração Tejucana S.A. (MTSA, 100%)	Diamantina, Minas Gerais State (mine)	100.
Fluorspar	Mineração Nossa Senhora do Carmo Ltda. (MNSCL) (private, 100%)	Cerro Azul, Paraná State (two mines)	180 (ore).
Do.	Mineração Santa Catarina Ltda. (MSCL) (private, 100%)	Morro da Fumaça, Santa Rosa de Lima, Rio Fortuna, Santa Catarina State Tangúá, Rio de Janeiro State (three mines) (beneficiation plant)	100 (ore), 120 (concentrate).
Graphite	Nacional de Grafite Ltda. (NGL) (private, 100%)	Itapeçerica, Pedra Azul, Salto da Divisa, Minas Gerais State (three mines) (two beneficiation plants)	84 (ore), 72 (concentrate).

TABLE 2--Continued  
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2000

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
<b>INDUSTRIAL MINERALS--Continued</b>			
Graphite--Continued:	Grafita MG Ltda. (GML) (private, 100%)	Pedra Azul, Minas Gerais State (mine)	20 (ore).
Do.	Marmoré Mineração e Metalurgia Ltda. (MML) (Grupo PARANAPANEMA, 100%)	Maiquinique, Bahia State (mine)	10 (ore).
Gypsum	Companhia Brasileira de Equipamento (CBE) (private, 100%)	Codo, Maranhão State, and Ipubi, Pernambuco State (two mines)	100.
Do.	Companhia de Cimento Portland Paraiso (CCPP) (private, 100%)	Ipubi, Pernambuco State (mine)	50.
Kaolin	Caulim da Amazônia S.A. (CADAM) (private, 100%)	Mazagão, Amapá State (mine) (beneficiation plant) Adam Mine, Rio Jari, Amazonas State	720 (ore), 360 (concentrate), 660 (concentrate).
Do.	Pará Pigmentos S.A. (PPSA) (private, 100%)	Pará Mine, Pará State	500 (concentrate).
Do.	Ymerys Rio Capim Caulim S.A. (RCCSA) (private, 100%)	Rio Capim Mine, Pará State	460 (concentrate).
Do.	Empresa de Mineração Horii Ltda. (EMHL) (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 (CCPP) (private, 100%)	States of Goiás, Minas Gerais, and Rio de Janeiro (five mines)	2,000.
Do.	Companhia de Cimento Portland Rio Branco (CCPRB, 100%)	Rio Branco do Sul, Paraná State (three mines)	5,500.
Do.	S.A. Industrias Votorantim (SAIV) (private, 100%)	States of Rio de Janeiro and São Paulo (four mines)	1,000.
Magnesite	Magnesita S.A. (MSA) (private, 100%)	Brumado, Bahia State (one major mine and numerous small mines) (two beneficiation plants)	1,000 (ore), 280 (concentrate).
Phosphate rock	Fertilizantes Serrana S.A. (Bunge International Group, 100%)	Araxá, Minas Gerais State (mine)	5,000.
Do.	Copebras S.A. (Copebras) (Anglo American plc, 100%)	Ouvidor, Goiás State (mine)	4,400.
Do.	Fosfertil S.A. (Grupo Fertifós, 79%; CVRD, 11%; public, 10%)	Tapira, Minas Gerais State (two mines)	10,500.
Do.	Ultrafertil S.A. (Grupo Fertifós, 79%; CVRD, 11%; public, 10%)	Araxá, Minas Gerais State (mine)	5,000.
Quartz	Telequartz Exportação S.A. (TESA) (private, 100%)	Cristal, Minas Gerais State (mine)	6.0.
Salt, rock	Frota Oceânica Brasileira S.A. (FOBSA) (private, 100%)	Jacupiranga, São Paulo State (mine)	6,000.
Do.	Dow Química do Nordeste Ltd. (DQNL) (Dow Chemical Co., 100%)	Vera Cruz, Bahia State (mine)	1,000.
Do.	Cia. Nacional de Alcalis S.A. (CNA) (private, 100%)	Alcalis Grupo, Rio Grande do Norte State	1,500.
Do.	Salgema Mineração e Química S.A. (SMQ) (private, 100%)	Salgema, Maceió, Alagoas State (mine)	1,000.
<b>MINERAL FUELS</b>			
Coal	Carbonifera Circiúma S.A. (CCSA) (private, 100%)	Circiúma and Sideropolis, Santa Catarina State (two mines)	1,600.
Do.	Companhia Carbonifera Metropolitana S.A. (CCM) (private, 100%)	Circiúma, Sideropolis, and Urussanga Santa Catarina State (three mines)	1,200.
Do.	Copelmi Mineração Ltda. (COPELMI) (private, 100%)	Arroio dos Ratos, Butia, and Charqueadas; Rio Grande do Sul State (four mines)	4,600.
Do.	Companhia Riograndense de Mineração S.A. (CRM) (private, 100%)	Circiúma and Urussanga, Santa Catarina State (two mines)	2,200.
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)
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
Do.	Refinaria de Petróleo Ipiranga S.A. (RPISA) (private, 100%)	Ipiranga, Rio Grande do Sul	3,400.
Do.	Refinaria de Petróleos de Manguihos S.A. (RPMSA) (private, 100%)	Manquinhos, Rio de Janeiro State	3,650.

TABLE 3  
BRAZIL: RESERVES OF MAJOR MINERAL COMMODITIES IN 2000 1/

(Thousand metric tons unless otherwise specified)

Commodity	Reserves	World ranking	World percentage
Asbestos, fiber	16,325		NA
Bauxite, ore	2,500,000	3	7.8
Chromite, Cr <sub>2</sub> O <sub>3</sub>	6,606		0.1
Coal, all types	7,372,000		0.6
Columbium, pyrochlore, and columbite ore	5,000	1	90.0
Copper, metal content	11,833		1.8
Fluorspar, ore	7,000		2.1
Gold, metal	1,800		3.8
Graphite, ore	95,000	2	21.0
Gypsum	1,248,720		NA
Iron ore, 60% to 65% Fe content	19,500,000	6	6.5
Kaolin	4,000,000	2	28.2
Lead, metal content	950		0.7
Magnesite	180,000	4	5.2
Manganese, metal content	51,000	6	1.0
Natural gas 2/	231,000		NA
Nickel, metal content	6,000		4.0
Petroleum 2/	9,000,000		0.8
Phosphate rock	298,211		0.8
Talc and pyrophyllite	178,000	3	19.0
Tin, metal content	540,000	4	6.8
Titanium, TiO <sub>2</sub>	3,534		0.7
Uranium, U <sub>3</sub> O <sub>8</sub>	163,000		NA
Zinc, metal content	5,200		1.2
Zirconium, ore	1,888		2.8

NA Not available.

1/ Summário Mineral 2001.

2/ Petróleo Brasileiro, S.A. (Petrobrás) Magazine, 2001; 2000 annual report.